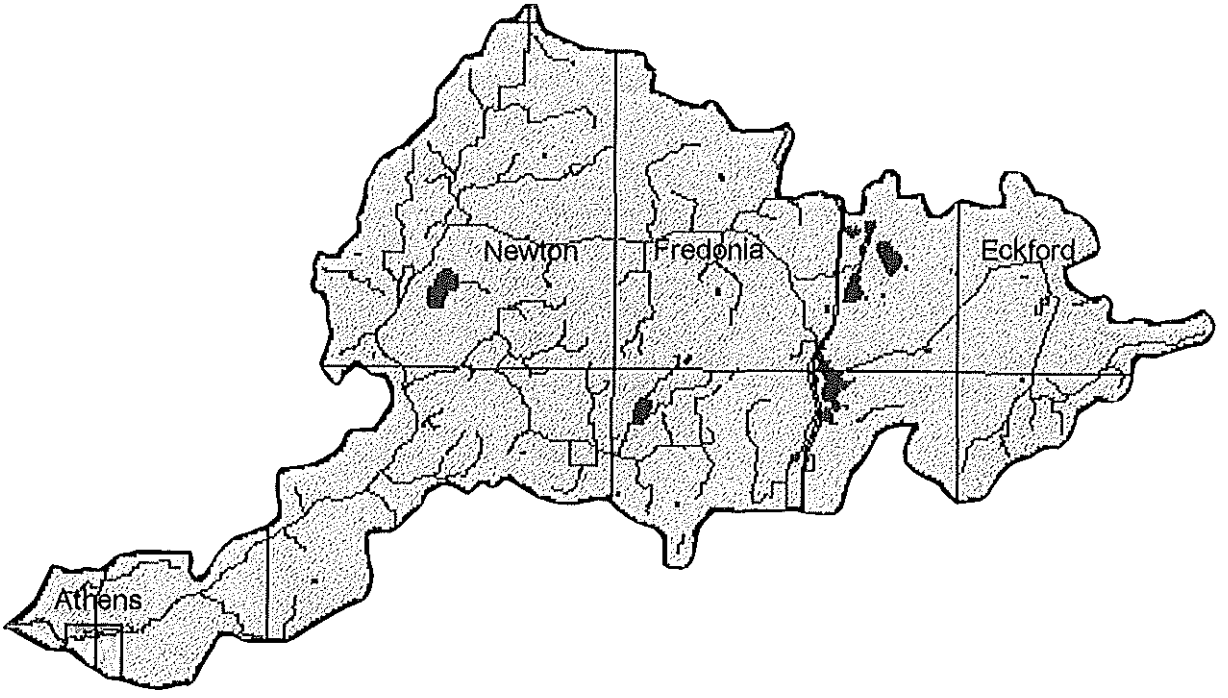
Nottawa Creek Watershed Water Quality Planning Project

Watershed Plan



February 1, 1998

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In Cooperation Witll:
WMU's Groundwater Education in Michigan Center
MDEQ Surface Water Quality Division
Call1oun County Drain Cornrnission
USDA Natural Resources Conservation Service

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Water Quality Statement

The Nottawa Creek Watershed covers 59,196 acres across the southern portion of Calhoun County. Calhoun County is located in south-central Michigan (Figure I). The Nottawa Creek is a sub-watershed of the St. Joseph River watershed, which flows directly into Lake Michigan. The designated uses for water in the Nottawa Creek Watershed are agriculture, partial or total body contact recreation, drinking water, and warm-water fishery/habitat for indigenous aquatic life and wildlife. Within the watershed boundaries, groundwater is generally 20 to 40 feet below the land surface and its associated activities. Numerous wetlands, shallow aquifers and nearly level topography indicate shallow, local flow systems, and demonstrate the interdependent relationship between surface water and groundwater within this watershed. In the lower half of the watershed, thin drift overlying Coldwater Shale suggests a drift aquifer that is highly vulnerable to contamination with no alternative water source available.

A watershed planning project was developed to assess how the intensive land use practices affect the quality of the surface water and groundwater. Two independent studies were conducted, one focusing on surface water and the other on groundwater. The surface water component involved a comprehensive watershed inventory, identif'ying critical areas and land management practices within these areas. A major component of the groundwater study involved creating a database in the watershed to determine critical areas posing the greatest pollution potential to water quality. Field verified well log data were used to characterize subsurface geology within the watershed. Information gathered from both studies was then combined and developed into a comprehensive watershed management plan.

The primary known non-point source pollutants are sediments in surface water and nitrates in groundwater. The Nottawa Creek is designated as a warm-water fishery. However, according to a 1994 MDEQ Biological Survey, the creek fails to support its use as a warm-water fishery because the fish communities, macroinvertebrates, and habitat are adversely impacted due to excessive sedimentation (Table 1). Water quality is threatened due to the combination of highly permeable soils, intensive agriculture, and shallow water tables in the watershed. Nitrates above the national drinking water standards of 10 mgIL have been detected in several shallow drift wells located in the Village of Athens. Projected sources of nutrients and pesticides in surface water and pesticides in groundwater have the potential to impact all other designated uses in the Nottawa Creek Watershed if not managed properly.

There are 5 known sources of sediments in surface water, each ranked from highest to lowest impact:

1) Unrestricted livestock access to waterways. 17 sites were found along the Nottawa Creek and its tributaries. Small beef cattle herds (averaging 15 head) were the primary source of livestock access. Trampling of vegetation and destabilization of the banks caused by cattle has resulted in severe erosion and sedimentation.

2) *Streambank erosion and soil erosion from drain maintenance activities.* 26 sites averaging

Nottawa Creek Watershed, Calhoun County, Michigan

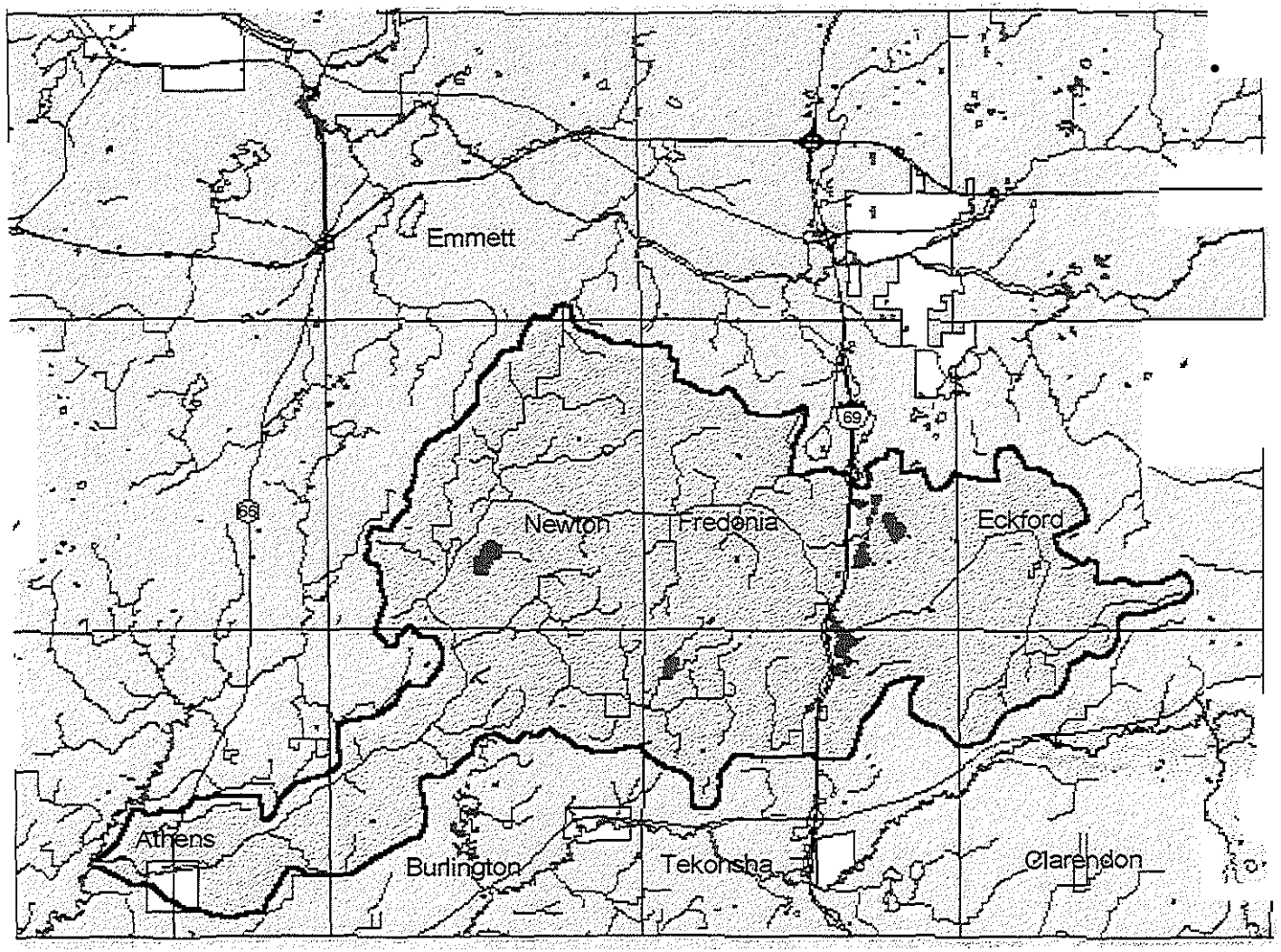

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Figure 1: Boundary Map of the Nottawa Creek Watershed

Basemap: MIRIS
GEM Regional Center
Institute for Water Sciences
College of Arts and Sciences

Nottawa Creek Watershed Study
Calhoun Conservation District
1/26/98

Table 1: Fish Populations

Data on fish populations was available on four lakes in the watershed. Surveys, conducted by the Michigan DNR Fisheries Division, show major types of game fish and how each lake compares to others for fishing.

Fish Populations

Lake Name	Bluegill	Large Mouth Bass	Black Crappie	Northern Pike	Pumpkinseed Sunfish	Yellow Perch	Bullhead	Walleye	Rainbow Trout	Redear Sunfish	Date of Survey
Lee Lake	Good	Fair	Fair	Fair	Fair	Good	Good	Poor	Good	Good	1994
WamerLake	Good	Fair	Fair	Poor	Fair	Fair	Good	No	No	No	1986
NottawaLk.	Fair	Good	Fair	Fair	Fair	Fair	Good	No	No	No	1983
Nott. Little Lk.	Fair	Good	Fair	Fair	Fair	Fair	Good	No	No	No	1983

approximately 100 feet in length showed considerable undercutting and erosion, resulting in excessive sedimentation in the Lower Nottawa Creek and its tributaries. Drainage records demonstrate that these areas have been dredged and maintained on a regular basis. These sites have steep banks containing little or no vegetation in combination with poorly structured soils.

3) Soil erosion from agricultural land Sheet and rill erosion are the most common forms of erosion from agricultural land in the Nottawa Creek Watershed. An average of 6 ½ tons of soil are lost per acre per year. The extent of sedimentation occurring in surface water from this source, however, is very difficult to measure due to the nature of this type of activity. Soil loss is widespread and location of deposits are dependent upon topography, buffer zones, type of tillage used, weather, etc. Much of the soil lost may never make it to surface water. Wind erosion from agricultural land is occurring on nearly 300 acres in the headwaters region of the Nottawa Creek Watershed. These fields are flat, open, and contain high organic matter soils which are failed plowed, making them very prone to soil loss.

4) Soil erosion from road/stream crossings. Soil erosion at 5 of 41 road crossings in the watershed are considered high priority. Steep slopes, unarmored bank toes and short culverts are responsible for contributing sediment to the Nottawa Creek.

5) Soil erosion from drainage o/wetlands. Two new drains were located directly adjacent to the Nottawa Creek. The process of ditch construction in combination with no application of soil erosion control practices has resulted in sediment transport to the creek.

Vulnerability of Groundwater Resources

Residents of southwest Michigan are almost 100% dependent on groundwater for their drinking water supply. For most of the region, groundwater is located primarily in layers of loose, unconsolidated geologic material called glacial drift, which is composed of gravel, sand, silt, and clay. In neighboring counties such as Kalamazoo County, glacial drift can be hundreds of feet thick. In Calhoun County, groundwater is found in both glacial drift aquifers and in bedrock aquifers. Preliminary examination of the residential well logs for the Nottawa Creek Watershed confirm that the layer of glacial drift which overlies the bedrock is generally less than 80 feet thick. For the eastern two thirds of the watershed, the drift is underlain by the Marshall Sandstone aquifer, an ample source for potable groundwater. However, the western most third of the watershed is underlain by the Coldwater Shale which is a poor source for potable water. This region of the watershed is the most vulnerable to surface and subsurface contamination because the glacial drift aquifer is significantly thinner than the rest of the watershed, less than 40 feet thick.

Relationship Between Groundwater and Surface Water

The relationship of the groundwater aquifers to surface water bodies in the watershed cannot be demonstrated from residential water well records. It is a known fact that the glacial geology of this region provides a continual supply of groundwater to rivers and streams. This supply is called base flow. It is not uncommon for lakes and wetlands to also be supported by groundwater discharge, although this is not always the case. Further study of the water chemistry within the watershed will help to demonstrate the relationship between groundwater and surface water.

Goals and Objectives

The Nottawa Creek Watershed's overall goal is to protect and improve the water quality for drinking water, recreation, aquatic and wildlife habitat, and agricultural resources. To meet this goal, demonstration best management practices (bmp's) will be developed and implemented along with an intensive I & E program to build strong partnerships among stakeholders and increase awareness and knowledge about groundwater and surface water quality. Future efforts to protect/restore water quality make it necessary to conduct further water quality testing. In order to protect the watershed from increasing development pressures, it is essential to provide local decision-makers with proper education and tools for application in their watershed. This will create a better understanding of where and how certain land use activities can negatively impact surface water and groundwater quality.

Recommended Actions

In order to create a postitive impact on the watershed, residents must have a complete understanding of groundwater and its relationship to surface water. With the use of both demonstration sites and information and education programs, watershed stakeholders will be more capable of making infonned decisions regarding proper use and care of their groundwater and surface water resources. This Comprehensive Watershed Management Plan will be applicable to watersheds with similar circumstances, for developing land use activities based on the potential of the land and water resources.

To protect the watershed from increasing development pressures, it is essential to provide local decision-makers with proper education and tools for application in their watershed. The Nottawa Creek Watershed Steering Team will work extensively in developing a land use planning strategy over the next several years, to be adopted by local townships beyond the scope of this project. Activities will include land use planning workshops designed to share model ordinances and land management tools with local governments. A major goal of this project is to develop a local network of individuals in the watershed and surrounding communities, who will provide townships with the needed resources to keep them up to date on land use ordinances and issues (well beyond the time frame of this project). By having a greater understanding of how current land use trends may impact water quality and the environunent as a whole, local governments will be more capable of protecting these resources in the future.

Cost Effectiveness

Best Management Practices will be used based on the areas which are posing the greatest threat to groundwater and surface water resources as well as their potential to result in the greatest improvement to water quality. Best Management Practices will be implemented using only NRCS standards and specifications and will be monitored for effectiveness. Information and Education strategies will address those target audiences and methods that are the most effective in restoring and protecting groundwater and surface water quality.

Cost of Actions

Total costs needed to meet the goals and objectives for this project are estimated to be $ 921.822. Details for the next 5 years of implementation are as follows:

Staffing	
Project Coordinator	
Clerical Support	
Total Staffing Costs	***$165,400***
Fringe Benefits	
Project Coordinator	
Clerical Support	
Total Fringe Benejits	*$ 38,850*
Supplies	***$ 5,500***
Travel	***$ 10,850***
Ofller ***Direct Expenses*** *(Includes I & E Program. training)*	**$ 54,775**
[I,direct Expenses	***$ 19,500***
Implementation ofBMP's	*$572,455*
Contractual (WMU GEM Center)	*$ 54,492*
Total Blldget	***$921,822***

CHAPTER I: Description of the Watershed

Location and Size

The Nottawa Creek Watershed covers 92.5 square miles in South Central Lower Michigan. It consists of 59,196 acres located in the townships of Athens, Burlington, Clarendon, Eckford, Emmett, Fredonia, Newton, and Tekonsha, in Calhoun County. The main drainage system is the Nottawa Creek, which flows directly into the St. Joseph River, and ultimately into Lake Michigan.

Land Uses

Nearly 68% of the land in the Nottawa Creek Watershed is agricultural. Of this farmland, 50% is used for intensive row crops and livestock production (Appendix C). The remaining is in pasture, hay, and conservation reserve (CRP). Approximately 13% of the watershed is forested and 10% is wetlands, while 9% is urban and rural, non-farm (Figure 2). For recreation, there exists one golf course, one park, and two campgrounds, all of which are adjacent to lakes and streams.

Population

Based on a 1990 census, provided by the Calhoun County Planning Commission, the population of the watershed is estimated to be 4,761. Of this number, 21% reside in the village of Athens, which is the only village located within the watershed boundaries. Using 1996 population growth estimates (see Table 3), Newton Township, Eckford Township, and Athens Village may be experiencing the highest growth rates in the watershed.

Topography

Topography in the Nottawa Creek Watershed is level to gently rolling. The watershed consists mostly of coarse-textured glacial outwash and is located primarily in the Tekonsha Moraine. The eastern end is underlain by Marshall Sandstone, while the western (lower end of the watershed) is over Coldwater Shale. Soil types vary from well-drained sandy soils located predominantly along the outer ranges of the watershed boundary, with medium-textured poorly drained soils located primarily inland around lakes and streams (Figure 3). Occasionally, high water does occur in poorly drained areas during the spring.

Description of Water Bodies

The length of the Nottawa Creek that is being studied is 26.6 miles. The headwaters begin approximately 2 miles northwest of Homer Village and end at Pine Creek, just west of Athens. The drainage systems begins with the Goose Pond Drain which flows into the Nottawa Drain (also known as the Upper Nottawa Creek). This drain empties into Nottawa Lake just east of I-69. The Nottawa Creek continues on out of Nottawa Lake and runs for 19 miles to Athens and beyond where it meets the Pine Creek. There are 8 lakes in the watershed. They are the Nottawa, Nottawa Little, Warner, Lee, Lyon, Long, Pine, and Fish Lakes. A description of lake characteristics for these lakes is given in Table 2.

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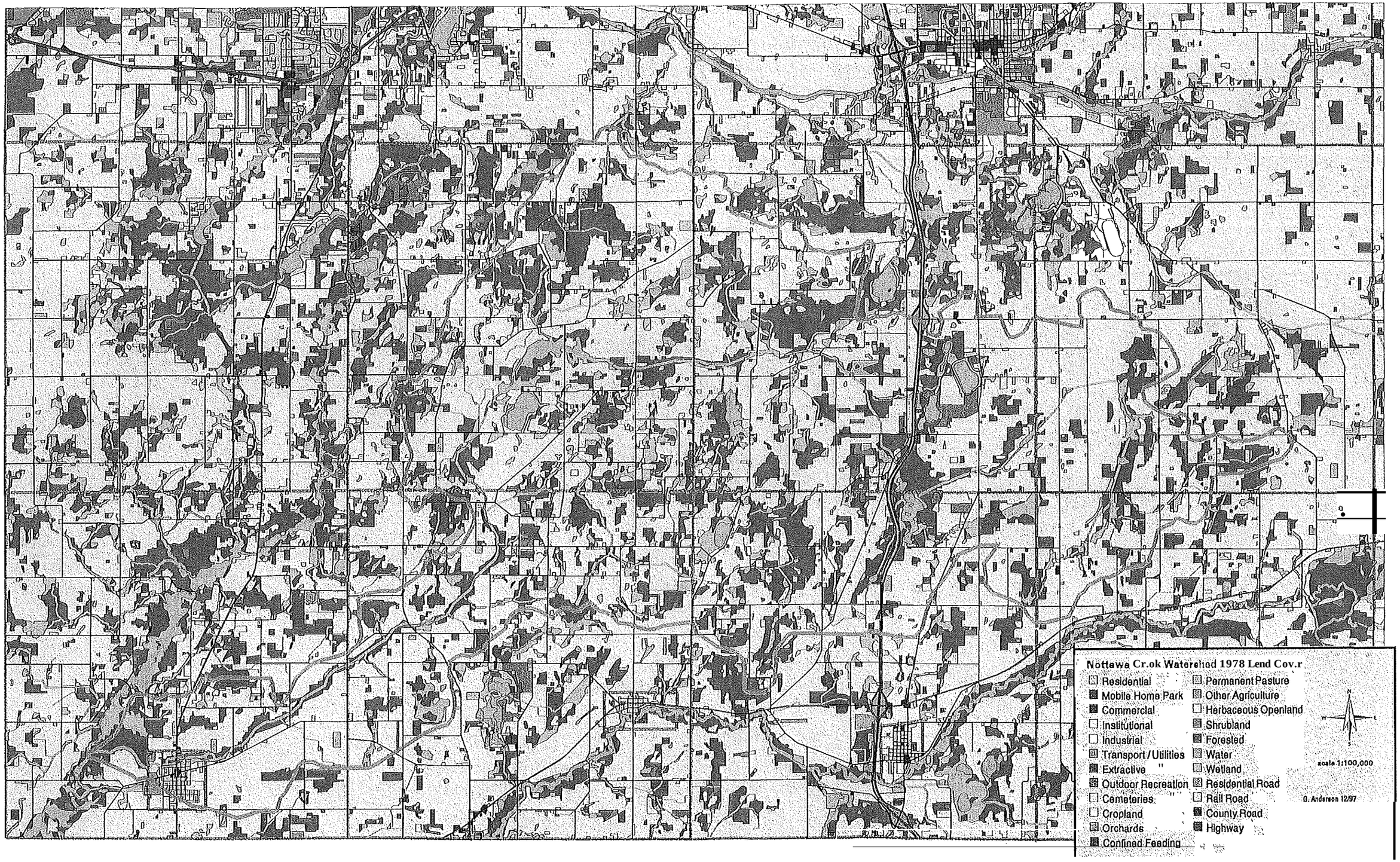
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Residential
Mobile Home Park
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Institutional
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Transport / Utilities
Extractive
Outdoor Recreation
Cemeteries
Cropland
Orchards
Confined Feeding
Permanent Pasture
Other Agriculture
Herbaceous Openland
Shrubland
Forested
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Rail Road
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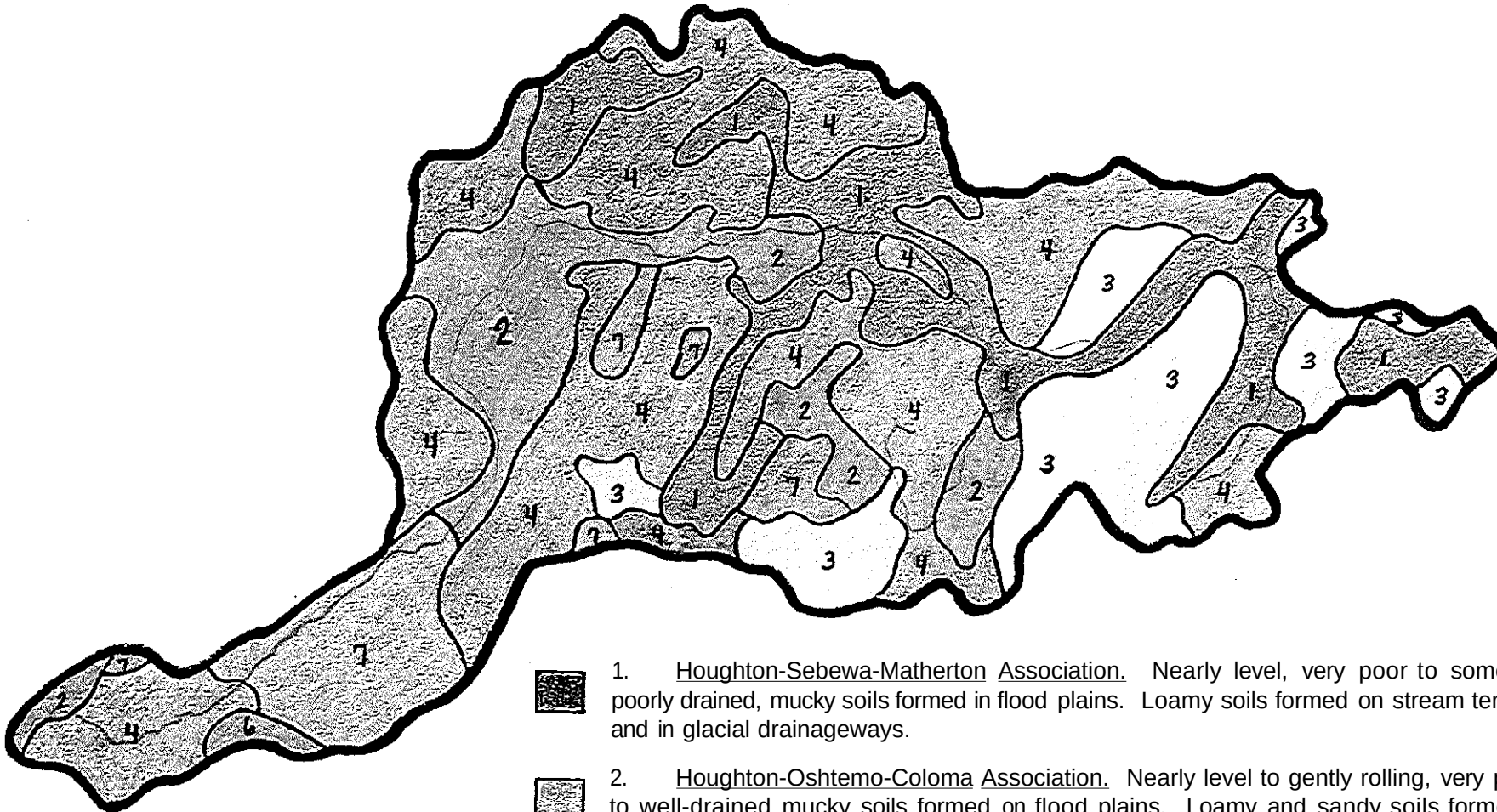

1. Houghton-Sebewa-Matherton Association. Nearly level, very poor to somewhat poorly drained, mucky soils formed in flood plains. Loamy soils formed on stream terraces and in glacial drainageways.

2. Houghton-Oshtemo-Coloma Association. Nearly level to gently rolling, very poorly to well-drained mucky soils formed on flood plains. Loamy and sandy soils formed on stream terraces and in glacial drainageways.

3. Hillsdale-Kalamazoo-Oshtemo Association. Nearly level to gently rolling, well-drained, loamy soils formed on moraines and outwash plains.

4. Oshtemo-Kalamazoo Association. Nearly level to gently rolling, well-drained, loamy soils formed on outwash plains.

5. Oshtemo-Spinks Association. Gently rolling to very sleep, well-drained, loamy and sandy soils formed on outwash plains and moraines.

6. Matherton-Sebewa-Hillsdale Association. Nearly level to gently rolling, poorly drained to well-drained, loamy soils formed on outwash plains and moraines.

7. Bronson-Sebewa-Houghton Association. Nearly level to gently rolling, moderately well to very poorly drained loamy and mucky soils, formed on lake plains and *glacial* drainaaewavs

Figure 3: Nottawa Creek Watershed General Soils Map

Table 2: Lake Characteristics within the Nottawa Creek Watershed

Lake	Area (acres)	Maximum Dellth (ft.)	Public Access	Inlet	Outlet	Shore Type Mineral	Ol'ganic
Fish	43	18	**no**	yes	yes		100%
Lee	116	47	yes	**no**	yes	10%	90%
Long	31	na	no	yes	yes		100%
Lyon	125	27	yes	no	yes	97%	3%
Nottawa	116	20	yes	yes	yes	30%	70%
Nottawa Little	22.8	20	yes	yes	yes	30%	70%
Pine	21	**na**	no	**no**	yes		100%
Warner	58.5	30	yes	yes	yes	40%	60%

Description of Water Bodies cont'd.

Lake levels on Nottawa, Nottawa Little, Lyon, and Lee Lakes are maintained. Lyon Lake is regulated by drain which empties into a neighboring wetland when the level exceeds the designated height. A pumping station is maintained at Nottawa Creek which serves as both an inlet and an outlet to Lee Lake, regulating the lake level. According to Lee Lake residents, approximately 20 years ago Lee Lake "lost its seal", resulting in a dramatic drop in water level.· Due to the overwhelming pressure from the moderately.high population of lake residents, the pumping station was installed. This station can have a negative impact on both the quantity and quality of water in the Nottawa Creek. Two dams are also located in the Nottawa Creek. One, approximately 18" high, is located beyond the Nottawa Lakes to regulate these lake levels. Another, about 12 feet tall, was constructed over 100 years ago to provide water for a mill within the village of Athens. The mill no longer exists, but the dam still remains. Presently, a park is located at the mill pond in Athens.

,Channelization

The Nottawa Creek, from the Nottawa Lakes to Pine Creek, was a natural stream until the entire length was cleaned, deepened, widened, and straightened for purposes of agricultural drainage between 1890 and 1910. The Nottawa Drain, 7.6 miles long, was constructed from 1879 to 1906. Prior to this period, it is believed that the drainage area consisted mostly of wetlands. Much of the Nottawa Creek was deepened, widened, and straightened even further in the late 1960's, making it twice the width it was previously. Since then, the majority of work has been brush removal and cleaning in small, localized areas. The Nottawa Drain was cleaned almost entirely in the last 5 to 10 years. No major dredging is expected to take place in the near future, except for occasional brush removal and maintenance of the sediment basins.

The main tributaries in the Nottawa Creek Watershed include: Alder Creek/Acker Extension, Mud CreekIYost·Francisco Drain, Goose Pond Drain, Rowe and Wallace Drain, French Drain (2.1 miles), and the Gleason Drain (1.9 miles). All are considered county drains. Alder Creek/Acker Extension is the largest tributary to the Nottawa Creek, covering 8 miles. This has not been dredged since 1977. It is the greatest contributor of sediment to the Nottawa Creek. Much of the Alder Creek is making its way back to a natural stream, with meanders, pools, and rimes throughout. The Yost-Francisco Drain, 2.7 miles long, feeds into Mud Creek, which is 2.8 miles long. This creek's name matches the characteristics of its muddy, seemingly bottomless streambeds. The Yost-FranciscolMud Creek tributaries drain much of the northern part of the watershed. The RowelWallace Drain is an intermittent stream, 2.4 miles long. This flows into the lower portion of the Nottawa Creek. The Goose Pond Drain, (3 miles in length), is responsible for drainage of the headwaters of the Nottawa Creek watershed.

Two sediment basins are located in the Nottawa Creek. One lies just east of 10 Mile Road and runs for approximately 1/4 mile. At least 50% of this basin has filled in with sediment since its development, leaving it only 1-2 feet deeper than the rest of Nottawa Creek. The other, a smaller one designed to take sediment out prior to reaching Nottawa Lake, is located west of Old U.S. 27 and east of Nottawa Lake.

Special Resources Within the Watershed

The Nottawa Creek Watershed has a unique history and valuable resources that are well worth protecting. The Nottawa Creek, also referred to as the Nottawaseppee (various spellings), was thought of by local Native Americans as the "Land of Open Spaces." It is also believed that the creek was named after a Potawatomi Indian Chief (known as Chief Nottawa), with the term "seppee" meaning river. Long ago, areas of the Nottawa Creek (especially the lower reaches) were used by Native Americans for running trap lines used for fur trading, transportation, water supply, and food sources. Many of the areas surrounding the Nottawa Creek remain as open spaces. There are also many woodlands, which provide special appeal to the creek.

The Nottawa Creek is designated as a warm-water fishery. However, the lower reaches have the potential to be a cold-water fishery, with the presence of trout not uncommon. Much of this may be due to an extensive network of springs providing cool, clean groundwater to the stream. Also, the woodlands adjacent to the stream, more commonly found along the lower reaches, provide shade to cool the creek. They, in addition to the numerous wetlands, provide a place for precipitation to fall, gradually moving across and through the earth's surface, to help filter water, provide a place for groundwater recharge and slow water flow.

For several years, the Department of Natural Resources (DNR) has been stocking the lower Nottawa Creek with trout. However, this practice may be terminated due to water temperatures being too high to sustain healthy trout populations. Efforts to reduce sediment and improve habitat for trout should be made in order to improve this valuable resource.

Currently, population pressures are relatively low adjacent to lakes and streams, with the exception of Lyon Lake, Lee Lake, and Athens Village. However, increasing development is beginning to impact northern portions of the Nottawa Creek Watershed in Newton Township. Battle Creek is expanding rapidly and the Nottawa Creek Watershed is an area prime for development. Two townships in the watershed, Burlington and Newton, have moved forward in protecting water resources by designating open space and water body conservation areas. Local ordinances were adopted by these townships requiring a 200 foot buffer zone near waterways and other valuable resource areas.

The Nottawa Creek is considered legally navigable, meaning that any individual desiring to travel the creek may do so as long as he/she does not step out of the watercraft and onto private property. Nearly 100% of the land adjacent to the creek is private land. Although the creek is navigable, this does not mean that it is simple to travel. Except for a few minor stretches, much of the Nottawa Creek is obstructed by snags, downed trees, and barbed wire, making it necessary to portage and trespass.

The Nottawa Creek, the longest county drain in Michigan, contains abundant wildlife, old iron bridges, and scenic natural areas. Deer, hawks, ducks, great blue herons, muskrats, and other wildlife are often seen along the creek. Also, it is common to see local residents fishing for trout

in the lower reaches of the Nottawa Creek. The iron bridges were used many years ago - some still in use today - to allow farmers to cross from one side of the creek to the other to farm their fields. There are mixed emotions among riparian owners of what activities should take place along the Nottawa Creek. There is a great deal of admiration for the creek and many would prefer to see it left alone rather than being dredged. Some like to use the water for canoeing and put effort into removing trees and brush so they, as well as others, can enjoy its use. Still, farmers depend on the creek for agricultural drainage and would like to see dredging and maintenance continue. Although necessary to some, this is very costly to all residents in the drainage district and may result in having a negative impact on habitat in the creek. In recent years, the number of farmers in the watershed has diminished, while the population of residents moving into rural areas has increased. This results in conflicts on how waterways should be managed, a situation which requires very careful handling on the part of the drain commissioner.

CHAPTER 1/: WATERSHED PROJECT BACKGROUND/DEVELOPMENT

Highlights of Project Development

The Nottawa Creek Watershed is unique in Michigan. There are few areas within the state where the combination of light soils, intensive agricultural use, expanding non-agricultural development and shallow depth to groundwater pose as high a risk for non-point source contamination to both groundwater and surface water. Within the watershed, groundwater is generally 20 to 40 feet below the land surface and its associated land use activities. The numerous wetlands, shallow aquifers, and hummocky topography indicate shallow, local groundwater flow systems and underscores the interdependent relationship between surface water and groundwater in the watershed.

Concern for both groundwater and surface water quality in the Nottawa Creek Watershed has been present for some time. A well survey, which focused primarily on the availability and quality of well water, was conducted in Athens and Burlington Townships in 1974. In 1984, high nitrate levels resulted in the shutdown in one of three wells in the Village of Athens. "Geology and Aquifers of Calhoun County, Michigan", published in 1990 and containing the results of an extensive study by Western Michigan University, pointed out the vulnerability of the shallow groundwater aquifers in the Nottawa Creek Watershed.

Efforts to bring about the current watershed planning project started in 1991. Proposals for funding the "Nottawa Creek Watershed Water Quality Planning Project" were submitted annually from 1991 through 1996 with the project finally being approved for funding in 1996. Each proposal was submitted by the Calhoun Conservation District with assistance from the USDA Natural Resources Conservation Service and the Potawatomi Resource Conservation and Development Council. Additional support came from the Calhoun County Drain Commission, Calhoun County Dept. of Enviromnental Health, Calhoun County Dept. of Planning, Calhoun County MSU Extension, Michigan DNR, the USDA ASCS, and the WMU Groundwater Education in Michigan Center.

Project Time Frame

The development phase for the Nottawa Creek Watershed Management Plan extended from October 1, 1996 to January 31, 1998. Two individual studies, one evaluating groundwater and the other examining surface water, were initiated at different times during the planning phase. The groundwater study, conducted by WMU's GEM Center, extended from October 1, 1996 to September 30, 1997, while the surface water evaluation, based at the Calhoun Conservation District, began on January 1, 1997 and ended with the development of the watershed plan. During the development phase, watershed boundaries were determined and other watershed information (ie, land use, soil types, well data, drainage history) was obtained. A physical inventory of the watershed included locating and logging every existing known well in the watershed through the use of global positioning devices, plus a detailed evaluation of surface water critical areas by walking and canoeing. Information collected from the inventories was gathered and mapped. Examples of the types of pollutant sources found in the physical inventory are illustrated in Appendix F. Systems of best management practices were also developed, with assistance from the Natural Resources Conservation Service.

Committee's were developed in 1997 to provide input to the project in determining critical areas and needs of the watershed. Details of each committee are listed in the next section.

Development of plans for implementation will take place during the transition phase from February I, 1998 to January 3I, 1999. Plans will include systems of best management practices as well as information and education activities for the following years. Actual implementation of these practices and activities wiII occur between February 1,1999 and December 31, 2003.

Steering Team

In January of 1997, a group of individuals with varying expertise was organized as the Steering Team to provide leadership for this project. Following is a list of Steering Team members and their roles in the development of the watershed plan:

Name/Agency	Role
Ronda Wuycheck, MDEQ-Surface Water Quality Division	Administrator of project. Provided valuable oversight and guidance in development of Information and Education Program and entire watershed plan.
Dan Kesselring, Natural Resources Conservation Service	Provided technical assistance on inventory procedures, Resource Management Systems, and other activities associated with development of watershed plan.
Lauren Hughes, WMU Groundwater Education in Michigan Center	Took lead role in conducting groundwater study. Provided valuable assistance in development of Information and Education Plan and watershed goals.
Jim Coury, Potawatomi RC & D	Provided planning/technical assistance and overall direction for project. Was instrwnental in developing final watershed plan details.
Sharon Williams, Calhoun Conservation District	Served as watershed coordinator, responsible for identification of critical areas and development of final watershed management plan.

The Steering Team was instrumental in guiding this project. The team provided a combination of backgrounds, ranging from experience in developing other successful watershed projects to knowledge of watershed community needs, local geologic and groundwater features, conservation practices, and land use issues.

Advisory Committee

With assistance from the Steering Team, a Nottawa Creek Advisory Committee was developed. The committee was established in March of 1997 to discuss the progress of the Nottawa Creek Watershed Project as well as provide input regarding water quality issues and concerns in the watershed. The committee, scheduled to meet quarterly, is made up of residents, businesses, educators, community organizations, and local agencies. Members of the committee represent the following:

Calhoun Conservation District
Western Michigan University's Groundwater Education in Michigan Center
Natural Resources Conservation Service
Michigan Department of Environmental Quality - Surface Water Quality Division
Farm and Non-Farm Residents
Calhoun County Drain Commission
Potawatomi RC & D Council
Friends of the St. Joe River Association, Inc.
Eckford Township
Fredonia Township
Tekonsha Township
Burlington Township
Clarendon Township
Marshall FFA
National Farmer's Union
Calhoun County Farm Bureau
Calhoun County Road C01llmission
Calhoun County Planning & Development
Calhoun County Board o/Commissioners
Calhoun County Environmental Health
Calhoun County MSU Extension
Nottawa Lake Association
Marshall Countly Club

The Calhoun County Drain Commission has been extremely helpful and supportive of this project. The Drain Office provided maps, drainage history of the watershed, technical assistance on drain maintenance, and other information. Several agencies have been generous in offering their services as well. Attendance at the quarterly Advisory Committee meetings has been high, averaging around 18 people per meeting, with many positive interactions between the members.

Information and Education Team

An 1nfonnation and Education (I & E) Team was developed based on the need to increase awareness of water quality issues in the Nottawa Creek Watershed. The team met quarterly to develop a communications plan for the watershed. This document is given in Chapter X.

Members of the I & E Team consist of the Steering Team, two area residents, representatives of Michigan State University Extension and the Calhoun County Department of Environmental Health. The residents on the I & E Team provided the other team members with a non-agency perspective of concerns and needs in the watershed. They possess a well-rounded background in education, agriculture, business, and conservation issues. The MSU Extension agent has been very involved in conducting workshops, seminars, and in-field demonstrations of environmentally sustainable practices. She is very aware of the level ofknowledge and needs regarding water quality education in the agricultural community. The Environmental Health Dept. has worked extensively with businesses and residents in the watershed. It has brought insight into groundwater concern areas, land use issues, and the needs of the community regarding watershed education.

I & E Activities

During the planning phase, approaches were taken to begin increasing awareness of how individuals can protect water quality in their watershed. A watershed model, displaying land use activities which may impact water quality both above and below ground, was developed for use as an educational tool. The model was available for observation at the Calhoun County Fair and local Groundwater Stewardship Tour. It will also be used in future classroom activities and meetings. The model offered individuals a unique perspective of the relationship between groundwater and surface water as well as how everyday activities can affect the watershed.

The Project Coordinator worked with the Marshall Future Farmers of America (FFA) in developing a fair display titled "Protecting our Watersheds". The display defined what a watershed is and offered simple steps residents can take to protect their water resources. Maps of local and large-scale Michigan watersheds were used to show observers where they fit into the overall picture. The display was entered into a contest and received 2nd place.

A canoe trip on the Nottawa Creek provided an opportunity for several Boy Scouts, their fathers, and volunteers to vacation together as well as learn about their environment. Twenty stations located along a three mile stretch of the creek were used to educate the 18 canoeists about stream characteristics, plant uses and identification, impacts of land use on water quality, and the value of these resources not only to humans, but to all living things. The trip was very successful. The group had a great time, learned a lot from this experience, and would like to do it again.

Visits to Township, County Planning, and local organizational meetings, plus extensive newspaper coverage were additional tools used in promoting the Nottawa Creek Watershed Project. Overall,

watershed residents were very interested in the project and are concerned about water quality.

In summary, based on the planning phase activities and responses from each, it was determined that hands-on activities are more effective methods of increasing awareness. Fair displays attracted attention, however, few individuals took sufficient time to read the captions. New, innovative ways of capturing and maintaining attention will be pursued during transition and implementation stages. News articles resulting from our I & E efforts are given in Appendix F. An infonnation brochure about the watershed project is in Appendix G.

A survey, developed by the I & E Team, was randomly distributed to 190 watershed residents in November of 1997. There were 41 respondents. Survey results are included in Appendix H.

Local GoveTl/l1lental Agencies in Watershed

Athens TownshilJ
Stephen Irons, Supervisor
4881 M-66
Athens, MI 49011

Athens Village
Douglas D. Denney, President
129 E. Burr Oak
Athens, MI 49011

Burlington Township
Brian AcMoody, Supervisor
16808 Mile Road
Union City, MI 49094

Calhoun Conservation District
June Adams, Administrator
13464 15 Mile Road
Marshall, MI 49068

Calhoun County Board of Commissioners
George Perrett, Chairperson
315 W. Green Street
Marshall, MI 49068

Calhoun County Drain Commission
Don Eishen, Drain Commissioner
315 W. Green Street
Marshall, MI 49068

Calhoun County Env. Health
Sue Hauxwell
190 E. Michigan Ave.
Battle Creek, MI 49014

Calhoun County MSU Extension
Natalie Rector, Agricultural Agent
315 W. Green Street
Marshall, MI 49068

Calhoun County Planning/Development
Richard Smith, Director
13300 15 Mile Road
Marshall, MI 49068

Calhoun County Road Commission
Joyce Foondle
13300 15 Mile Road
Marshall, MI 49068

Clarendon Township
Bruce Mittelstadt, Supervisor
470021 ½ Mile Road
Homer, MI 49245

Eckford Township
Athol Hazen, Supervisor
989022 Mile Road
Marshall, MI 49068

Emmett Township
James Demarest, Supervisor
620 Cliff Street
Battle Creek, MI 49014

Farm Services Agency
Elizabeth Lake, Director
13464 15 Mile Road
Marshall, MI 49068

Fredonia Township
David Sebring, Sr., Supervisor
14595 G Drive South
Marshall, MI 49068

Lee Lake Association
Janie Swarthout, President
861 Clark Road
Ceresco, MI 49033

Lyon Lake Association
Diane Hazen, President
296 Perrett Road
Marshall, MI 49068

Natural Resources Conservation Service
Dan Kesselring, District Conservationist
13464 15 Mile Road
Marshall, MI 49068

Newton Township
Sue Ann Jessup, Supervisor
7173 J Drive South
Burlington, MI 49029

Nottawa Lake Association
LaVerne Hill, President
5021 N Drive South
Marshall, MI 49068

Potawatomi RC & D
Jim Coury
500 Country Pine Lane, Suite 6
Battle Creek, MI 49017

Tekonsha Townshi!l
Nelson Shedd, Supervisor
16998 T Drive South
Tekonsha, Ml 49092

CHAPTER III - Water Quality StatementlDesignated Uses

The designated uses for water in the Nottawa Creek Watershed are agriculture, partial or total body contact recreation, drinking water, and warm-water fisherylhabitat for indigenous aquatic life and wildlife. Water quality in general is good. The watershed, however, has highly permeable soils, intensive agriculture, and shallow water tables, which make it very sensitive to human activities. The main drainage channel in the Nottawa Creek Watershed is the Nottawa Creek (totalling 26.6 miles in length). The watershed also contains over 30 miles of streams and county drains plus 8 lakes totalling 533 acres in size. The primary known non-point source pollutants are sediments in surface water and nitrates in groundwater. Nutrient and pesticide entry into both surface water and groundwater may greatly impact water quality if they are not managed carefully.

Wate.' Qnality Problems

The known sources ofsedirnents **in** surface water, ranked from highest to lowest impact, include:

1) 17 sites of livestock access to waterways
2) 26 streambank erosion sites
3) Soil erosion from approximately 300 acres of agricultnralland
4) Runofffrom road/stream crossings (5 high priority sites)
5) Two sites containing soil erosion from drainage of wetlands
6) Village storm water runoff
7) Runofffrom I driveway through creek
8) Historical drainage (maintenance) practices

Sources of nutrients and/or pesticides in surface water result from:

1) Livestock access to waterways
2) Erosion from agricultural land
3) Failing 01' deficient septic systems adjacent to lakes and streams
4) Overapplication of lawn fertilizer/pesticides adjacent to lakes
5) Storm water runoff from golf course and village of Athens
6) Waterfowl along lakes and streams
7) Increasing development in the watershed (urban sprawl)

The potential sources of nitrates and/or pesticides in groundwater, ranked from highest to lowest impact, are:

1) Leaching of nitrogen/pesticides from agricultural land
   a. Overapplication of fertilizer and chemicals
   b. Overapplication of irrigation water
   c. Overapplication of livestock wastes
   d. Feedlot runoff and subsequent percolation into groundwater
2) Large livestock facilities located in vulnerable groundwater areas
3) Leaching from septic systems, lawns/gardens in village and surrounding communities
4) Leaching from septic systems, lawns/gardens in watershed
5) Leaching from farmsteads

a. Fuel Storage
b. Pesticide mixing/loading
c. Silo leaching

6) Excessive irrigation from agricultural lands
7) Leaching from salts and other contaminants from roads

Final Water Quality Statement

All of the known and potential sources of pollution are capable of degrading the designated uses within the Nottawa Creek Watershed. Based on a Nottawa Creek Biosurvey conducted in August of 1995, by the Michigan Department of Environmental Quality, it was concluded that habitat degradation within the Nottawa Creek was caused partly by dredging and partly by sediment transport to the stream. Five sites were sampled at various locations along the Nottawa Creek. Overall, fish communities ranged from slightly impaired to severely impaired, with generally good diversity of species, but low densities throughout. The macroinvertebrate cOlfununities were rated fair (moderately impaired). It was recommended that restoration and protection effOils be used to address the issues of sedimentation to improve habitat.

The groundwater study confinns moderate to shallow drift thickness throughout the watershed and suggests that drift and bedrock aquifers function more or less as one system. This indicates less protection from surface and near subsurface contamination for the bedrock aquifer than would otherwise be available. There are two known sites of groundwater contamination based on information gathered from the MDEQ Environmental Response Division. Ongoing problems exist with nitrate concentrations exceeding 10 mgIL in municipal wells located in the Village of Athens. Shallow depth to water and a lack of a productive bedrock aquifer in combination with drift thickness of 40 feet or less in Athens Township suggests that this area is highly vulnerable to contamination. Areas of similar geology outside but adjacent to the watershed are demonstrating nitrate levels above the 10 mg/L MeL. Currently, lack of water quality data inside the watershed prohibits assessment of groundwater quality in that region.

The focus of the Nottawa Creek Watershed Project is to protect and improve the water quality for drinking water, recreation, aquatic and wildlife habitat, and agricultural resources. To meet this goal, demonstration best management practices (bmp's) will be developed and implemented along with an intensive I & E program to build strong partnerships among stakeholders and increase awareness and knowledge about groundwater and surface water quality. Future efforts to protect/restore water quality make it necessary to conduct further water quality testing. In order to protect the watershed from increasing development pressures, it is essential to provide local decision-makers with proper education and tools for application in their watershed. This will create a better understanding of how certain land use activities can negatively impact surface water and groundwater quality.

CHAPTER IV - Existing or Potential Water Quality Problems in the Watershed

Impaired uses in the Nottawa Creek Watershed include: 1) Warm-water fishery/aquatic and wildlife habitat; 2) Drinking water; 3) Agriculture (drinking water for livestock); and 4) Partial or total body contact recreation. Various pollutants and their sources in the watershed have affected or may affect these uses in the future.

Impaired Use #1: Warm-water Fishery/Aquatic and Wildlife Habitat

Pollutants:
- Sediment
- Nutrients
- Pathogens
- Pesticides

Sources:
- Livestock Access to Lakes/Streams
- Waterfowl along Lakes/Streams
- Dredging of Streams
- Soil Erosion from Agricultural Land
- Leaking Septic Systems along Lakes/Streams
- Fertilizer/Pesticide Runoff from Non-Ag Areas
- Erosion/Runoff from Roadsides

Livestock Access to lakes and streams is having tremendous impact on aquatic and wildlife habitat in the watershed. Small beef cattle herds (each herd averaging 15-20 head) make up many of the critical sites. These large animals can quickly destroy streambanks from trampling the banks in an effort to cross to other pastures or seek water. Livestock cause erosion and release of sediments into the water supply, clogging up stream bottoms. This increased sedimentation results in greater need for dredging as well as a decline in fish and macroinvertebrate habitat in the creek. Animals also contribute nutrients, organic matter, and pathogens, through manure, into the water. Restricting the use of or removing these animals from the creek can greatly improve both streambank and water quality.

Waterfowl, typically geese in large numbers, along lakes and streams have been observed in several locations in the watershed. These animals also impact aquatic and wildlife habitat by contributing nutrients and pathogens through waste.

Dredging, or drain maintenance, can disturb stream bottoms by loosening up soil particles and redistributing them throughout the stream channel. Also, spoils are often dumped along the edge of streambanks rather than spread out and sodded. This creates even steeper banks. In many cases, after dredging, the banks are not re-seeded or mulched to protect them from runoff events. Seeding and mulching can be expensive at the time of application, but may be cost effective in the long run compared to re-dredging. To avoid the need for drain maintenance, sediment must be kept out of waterways initially and banks properly managed. Several practices will be installed to demonstrate alternatives/options

of reducing streambank erosion from drain maintenance.

Areas most heavily impacted by streambank erosion are Alder Creek and the Lower Nottawa Creek, west of 10 Mile Road. These areas contain very steep, poorly structured banks, probably created by dredging, resulting in erosion and sedimentation. East of 10 Mile Road, the Upper Nottawa Creek and Nottawa Drain are better protected. They contain shallower banks, well-established vegetation, and fewer obstructions in the creek.

Sheet and rill erosion from cropland has contributed sediments to surface water. However, the extent of this type of erosion was very difficult to measure at the time of inventory. Much of the inventory process occurred in early spring, before tillage of fields began. Wind erosion is more common in the headwaters region of the watershed. Here, farm fields are larger and open to high wind gusts. Fall tillage with little or no residue left to protect soils from erosion is the greatest contributor to this nonpoint source problem. Significant amounts of sediment were deposited in the Nottawa Drain directly adjacent to some fields. Also, considerable algal growth was observed in the same locations, most likely due to nutrients remaining attached to soil particles during transport. Soil particles also have the potential to carry pesticide residues during transport to waterways.

Leaking septic systems along lakes and streams are a potential source of nutrients and pathogens affecting water quality. Areas especially along highly populated lakes with no pUblic sewer may have the greatest impact on aquatic and wildlife habitat. Aggressive Information and Education efforts will be initiated to encourage proper management of septic systems.

Nutrients and pesticides from non-agricultural runoff, such as golf courses, villages, campgrounds, residential areas, and property near lakes and streams can impair water quality. These sources have the potential to negatively impact aquatic and wildlife habitat, if not managed properly.

Erosion and runoff from roadsides has contributed sediments, salts, and other contaminants to surface waters, thereby affecting the health of aquatic and wildlife habitat. Demonstration practices will be used to reduce impacts from these pollutants.

Impaired Use #2: Drinking Water

Pollutants:
- Nitrates
- Pesticides
- Pathogens

Sources: Leaching from:
- Excessive Fertilizer/Pesticide Use on Ag. Land
- Farmsteads

Large Livestock Facilities
Excessive Fertilizer/Pesticide Use on Non-Ag. Land
Septic Systems
Salts and Other Contaminants along Roadsides

Excessive fertilizer and pesticide use on agricultural lands may have the greatest impact on drinking water quality. Agriculture is the most common form of land use in the Nottawa Creek Watershed, accounting for over 70%. This, in combination with sandy soils and shallow water tables, has the potential to deliver nutrients and pesticides directly to groundwater supplies.

Leaching from farmsteads can come from improper fuel storage, pesticide mixinglloading areas, fertilizer/pesticide storage areas, silos, maintenance shops, and septic systems. These may contribute nutrients, pesticides, and other contaminants which may reach drinking water wells.

Several large livestock facilities in lower portions of the Nottawa Creek Watershed have the potential to contribute nutrients and pathogens (through manure) to groundwater. Groundwater in this area is threatened due to shallow wells and very permeable soils. Careful management of livestock manure will be addressed to reduce the potential for high nitrate levels and pathogens entering drinking water supplies.

Leaching from excessive fertilizer and pesticide use on non-agricultural lands is also a concern throughout the watershed, especially in the lower portions around Athens. A greater potential for nutrients and pesticides. to reach drinking water exists, due to the higher population rates in this area.

Leaching from improperly managed septic systems in both agricultural and non-agricultural residences can impair drinking water quality by contributing nutrients and pathogens.

A pollutant which may impact drinking water quality is the leaching of salts and other contaminants from roadsides. Although this was not identified during inventory, the potential still exists. Salts are showing up in groundwater supplies in various areas throughout the county and state.

Impaired Use #3: Agriculture (Drinking Water for Livestock)

Pollutant: Pathogens

Sources: Livestock Access to Lakes and Streams
Leaking Septic Systems along Lakes/Streams
Waterfowl along Lakes and Streams

Several farms in the watershed rely on drinking water for their livestock from the Nottawa Creek. However, the health of these animals may be threatened due to areas of unlimited livestock access, where nutrients and pathogens are released into the water from manure. Efforts to limit or ban access to waterways would greatly improve the quality of drinking water.

Leaking septic systems along lakes and streams may also contribute nutrients and pathogens, thereby affecting the health of livestock who use the water for drinking. Regular maintenance activities will reduce this threat.

Waterfowl in and along lakes and streams contribute nutrients and pathogens through release of manure both in water and along shorelines. Waterfowl tend to gather in large groups, resulting in greater concentrations of these pollutants. This is becoming an increasing problem in many areas of the watershed.

Impaired Use #4: Partial or Total Body Contact Recreation

Pollutant: Pathogens

Sources: Livestock Access
Septic Systems along Lakes and Streams
Waterfowl along Lakes and Streams

Pathogens released from livestock manure, septic systems, and waterfowl can impact the health of humans through partial or total body contact recreation, such as swimming, skiing and other water sports. See impaired use #4 for details on the above sources.

CHAPTER V: WATERSHED GOALS AND OBJECTIVES

Goal #1

The overall goal for the Nottawa Creek Watershed is to protect and improve surface water and groundwater quality for its most important identified designated uses: drinking water, aquatic and wildlife habitat, agriculture, and recreation. This will be done through watershed management. The first step was to develop this document, a comprehensive Watershed Management Plan, which details the resource problems, needs, and solutions for the Nottawa Creek Watershed in both groundwater and surface water. This plan indicates the distinctive and, in some cases, threatened surface and groundwater resources in the watershed. The plan then details the essential protection and restoration efforts necessary to improve and enhance both surface water and groundwater quality. Based on broad public participation and input, the plan has a varied, yet targeted information and education program to increase awareness and understanding of watershed resource problems and solutions, leading to strong partnerships that will implement effective protection and restoration measures.

Specific Objectives

1. Develop for the watershed an accurate and detailed watershed description, land use analysis, hydrologic profile, and vulnerable aquifer areas.

2. Identify and prioritize designated water uses, impairing pollutants, and non-point sources of water quality degradation for groundwater and surface water.

3. Identify current or potential water quality problems in the watershed.

4. Locate and map watershed critical areas of concern as they relate to non-point source pollution for both groundwater and surface water.

5. Quantify non-point sources of pollution in the critical areas.

6. Choose and assemble Resource Management Systems (RMS') composed of one or more best management practices (bmp's) which best address the identified pollutants and their sources.

7. Select and expand public participation and infonnationJeducation programs to raise awareness, expand knowledge, and stimulate planning and implementation regarding watershed resource problems, needs, and solutions.

8. Detennine and evolve the roles of cooperating resource agencies, governmental units, essential and/or interested organizations and citizens in watershed plan evaluation and implementation.

Goal #2

Drawing from the Watershed Management Plan, an implementation plan will be developed which will direct and expand both the plarming and implementation of needed Resource Management Systems (RMS') and the Information and Education Program. This will lead directly to the protection of sound, existing water quality areas and to the improvement of critical water quality areas (groundwater and surface water) needing remediation.

Specific Objectives

I. Develop the Watershed Implementation Plan based on the Watershed Management Plan.

2. Regularly monitor and evaluate the Watershed Management Plan implementation according to accepted proven criteria (see Chapter XII for evaluation criteria and specifics).

3. Apply and expand information and education activities from the plan.

4. Create sample Water Quality Resource Management Plans (WQRMP's) to serve as guides from transition year planning at critical remediation sites.

5. Since groundwater concerns are an integral element of this plan, continue the focus on the expansion ofknowledge about groundwater for this watershed.

Goal Modification During Planning Phase

Once into the planning phase of this project, it became apparent that not only was identification of critical sources of impairing pollutants and their remediation a primary concern, but that other important goals would have to be included in order for real water quality restoration and protection to occur. Since the water quality problems and non-point source pollutants are diverse and complex in this multi-use watershed, long-term conservation stewardship necessitated an enlarged Information and Education Program. This would establish and solidify public awareness, understanding, and knowledge on how to bring about effective watershed management. This, in turn, provides a long tenn basis for sound natural resources stewardship and public acceptance of that stewardship. Also expanded were goals for land use planning and balanced land use. One of the sources of non-point pollutants in this watershed is poor land use and haphazard development. Objectives need to be developed on open space, farmland, floodplain, and wetland protection. Finally, there are many governmental entities and juridsdictions in this large watershed. An expanded goal of intergovernmental cooperation and coordination was necessary for effective stewardship to occur. This was developed and realized especially through the watershed Advisory Committee. Another significant detail is streambank erosion and destabilization which was identified along portions of the Nottawa Creek and its tributaries. Specific bmp's were developed to address this problem.

Community Expectations for the Project

During the year of developing the Watershed Management Plan there were numerous public

meetings, workshops, and field tours. There was also extensive Advisory Committee input from associated goverrunental agencies, community organizations, and interested citizens. Also, a watershed-wide survey was conducted. Based on these public input forums, community expectations for this Watershed Management Plan are high for:

- A practical, achievable Watershed Management Plan, which identifies the watershed resource problems (groundwater and surface water), and points to feasible protection and remediation solutions.
- The Watershed Management Plan leading to an attainable implementation plan.
- Protected groundwater and surface water areas where water quality is good and action to implement improvement measures where water quality is threatened or impacted.
- Significant reductions in non-point source pollution.
- Improved recreation based on improved water quality. Tourism can be an important economic factor here, especially in the future.
- Public health protected, based on protected and/or improved water quality.
- Balanced growth and sustainable economic development, which includes natural resource conservation and essential open space, farmland, wetland, and floodplain protection.
- Application of effective land use and water conservation practices which reduce non-point source pollutants and their sources.
- More awareness, understanding, and knowledge of groundwater and its essential role in the watershed.

Primary Benefits

This watershed has been identified as one of the priority watersheds of concern in the St. Joseph River Basin because of its size, numerous tributaries, associated lakes, and critical groundwater interaction. The watershed here demonstrates a diverse multiple use of water resources, especially recreational uses (fishing, swimming, etc.) and agricultural uses (irrigation, livestock watering). Improvements in water quality through implementation of this watershed plan will show that urban, residential, and agricultural impacts can be mitigated and controlled. This leads directly to an improving quality of life and environment.

Due to its large size (59,196 acres), land use impacts on groundwater and surface water affect water quality both in the local area and for the St. Joseph River, which flows into Lake Michigan. This drainage basin brings pesticides, nutrients, sediment, and other pollutants originating in the watershed to Lake Michigan. Thus, it is critical to the entire Great Lakes Region to take an active watershed approach to controlling non-point source pollution. This watershed, with its unique groundwater component, can serve as a prime model for future watershed management in the state and nation. The primary benefits of this project involve the restoration and protection of groundwater and surface water quality and the improvements to designated uses of water in this watershed. Specifically, the primary benefits are:

- Restoration and protection of the highest priority designated uses of groundwater and surface water in the Nottawa Creek Watershed. These primary uses are drinking water, total body contact recreation, agriculture, and habitat for aquatic life and wildlife.
- Increasing awareness, understanding, knowledge base, improvement and protection of the

whole array of water resources in the basin. This will be especially true for groundwater, which plays an integral role and interaction in this watershed.

• Enhance water-based recreation and tourism with consistent reduction in sedimentation, algal blooms, aquatic weed growth, and turbidity throught the planning and application ofRMS' in the identified priority critical watershed areas.

• The Comprehensive Watershed Management Plan is also a primary benefit as it provides the guide for effective watershed management to achieve watershed goals. The plan furnishes the method, direction, priorities, and schedule to achieve improved water quality.

The approach will be to use a "worst is first" approach to reduce pesticides, sediment, and nutrients. We are going to target the highest priority sites for immediate mitigation. This would be a reduction approach aimed at water quality restoration. Simultaneously, an aggressive I & E Program will be implemented to bring about positive attitude and behavioral change to insure watershed stewardship and protection.

Secondary Benefits

A wide array of secondary benefits will grow from the development and implementation of a Comprehensive Watershed Management Plan. These will include, but not be limited to, environmental, agricultural, education, social, economic, and quality of life benefits. The Nottawa Creek Watershed is now, and can be even more so in the future, a significant watershed for our southern Michigan region in terms of a protected and improved water quality for public health, agriculture, recreation, wildlife, and sustainable economic development. Virtually every form of water-based recreation can be found in this watershed. In contrast to rising expectations for clean groundwater and surface water, there has been a degradation of water quality, especially since the mid 1950's. This is marked by increased lakeside/streamside development, and changes in farm operations toward more soil tillage, row crops, and pesticide use. The result has been more leaching to groundwater, increased runoff, and more non-point source pollution. The development of the watershed plan and its implementation provide a new direction for this watershed, one in which people can understand their effects on resources and properly manage them. The secondary benefits of the project emphasize this. Specifically, these secondary benefits are:

- Soil erosion reduction and improvements of the soil resource base. Technical and financial assistance will be available for the planning and installation ofRMS' that will reduce soil loss on agricultural and residential lands, streambanks, and other areas. This assistance will be available to watershed land operators and owners. Improved conservation practice installation has a multiplier effect, acting as demonstration sites, increasing people's knowledge and capacity while improving and protecting the resource base.

- Sediment Delivery Reduction. Application ofbmp's greatly reduces runoff of soil from the land. Less maintenance and cost will be required to keep county drains and main stream channels free flowing. Road ditches and culverts will convey water efficiently over longer periods oftime before drain cleanouts are necessary. Turbidity and deposition of sediment should be greatly

reduced.

- Groundwater. Increasing awareness and understanding of groundwater and hydrology as well as application of groundwater stewardship practices will provide essential knowledge and impetus to protect and improve this critical resource.

- Economic benefits. Developing a Watershed Management Plan which leads to protecting and enhancing water quality in the watershed stimulated multiple economic advantages. These include increased property values of lakeside, riparian, and other watershed lands as well as increased tourism to the area, enhanced economic development within the region, and cost savings to lake and riparian residents. Also, costly restorative measures for local, state, and federal agencies are avoided. Perhaps foremost in the consideration to improve water quality restoration or protection is the incentive to promote environmental quality, and therefore, the quality of life in general.

- Social benefits. No minority groups or persons residing in the watershed will be adversely affected by proposed project measures. All watershed residents, especially fanners, will benefit from a host of improving resources (land and water). Also, expanded I & E activities and demonstration practices will provide watershed residents with a broad knowledge base and focus to select positive resource renewing practices and behaviors. Public health can only improve with the application of conservation measures which reduce non-point source pollution.

- Recreation and tourism. With improved water quality, eutrophic indicators such as turbidity, algal blooms, undesirable weed species, odors, and fish kills will decline. This makes all forms of water sports and aesthetics attractive again, leading to increased use of the lakes and streams. Increased use translates directly into improved tourism and related businesses (i.e. campgrounds, boat liveries, etc.). This leads directly to an expanded economy, improved standard of living, increased property values, and an enhanced quality of life for area residents.

- Rare, threatened, and endangered species. The project will not adversely affect rare, threatened, or endangered species of plants or animals. In fact, a more diverse habitat will be created for both plants and animals, as some erodible or sensitive lands are removed from crop production and converted to grassland or forest. The DNR will be consulted during planning and application ofbmp's to insure no adverse impacts occur to these species. The DNR maintains the Rare, Threatened, and Endangered Species List for the region.

- Wildlife enhancement. The quality of wildlife habitat improves with accelerated land and water conservation treatment and protection. No wildlife mitigation will be needed, since the impacts of all conservation measures show benefit to most wildlife species. The protection of critical cropland and livestock areas with vegetative practices and crop residues also improve wildlife cover, nesting, and shelter. Practices which maintain and improve the existing diversity of wildlife habitat will be encouraged. The increased use offilter strips and open space protection will provide more undisturbed nesting cover for pheasants, quail, and songbirds, if left in a natural state through the nesting/brooding cycle. Once this process is complete, mowing ofthe filter strips will

also be a practice to improve water quality. Clump planting of conifers and conservation tillage will increase the amount of winter cover available. Wetland restorations will be pursued as a bmp to reduce sedimentation and improve wildlife habitat.

- Fisheries and macro-invertebrate habitat. The application of practices which reduce nutrient inflow and sediments to tributaries and lakes directly improves the quality and quantity of desirable aquatic species and their habitats. With the installation of recommended conservation practices and ordinances, water quality will improve, as will the number of desirable macro-invertebrates and game fish, such as Northern Pike, Walleye, Yellow Perch, Sunfish, Bluegill, and Bass species. Improved water quality and fisheries lead directly to increased tourism and recreational use.

- Wetland and floodplain protection and enhancement. The types of RMS' being developed for the project will have positive impacts on existing floodplains and wetlands. Reduced sediment deposition to wetlands will prolong life of open water habitat for waterfowl brooding areas, prolong vegetative cover for nesting and winter cover, reduce detrimental effects of herbicide and pesticide runoff, and potential reduction of macro-invertebrates. Natural features inventories have identified valuable wetlands. They will be protected and enhanced through land use planning, protection ordinances, and active restoration.

- Flood frequency, speed, and duration will be reduced. Through land use planning and ordinance development, floodplains and wetlands will be protected and enhanced, resulting in more land area available for water infiltration.

- Important and prime farmland will be recognized. Open space protection will be pursued so that sustainable balanced growth and valuable open space can occur mutually. On cropland, some cover types will change to more protective permanent vegetative cover.

- Archaeological and historical resources. Review of the State Historic Preservation Record (Michigan Bureau of History) shows that planned conservation practices will not affect any known cultural resources. Installation of the project is not expected to adversely affect archaeological and historic resources. If resources are unexpectedly discovered, state and federal laws regarding protection of these resources will be followed and the State Historic Preservation Officer (SHPO) will be notified.

CHAPTER VI - Identification of Critical Areas

In order to effectively implement Resource Management Systems, it is necessary to determine critical areas in the watershed. Critical areas are those areas which have the greatest potential to deliver the greatest quantity of pollutants to groundwater and surface water. Since this project takes into account both groundwater and surface water quality, each water source has its own set of standards for determining critical areas.

Critical Area/or Surface Water Protection ill *the Nottawa Creek Watershed*

A quarter mile corridor on each side of the Nottawa Creek and its main tributaries (see Figure 4) was determined to be the area most likely to impact surface water quality. Factors used in determining these areas include highly erodible lands, concentrations of unlimited livestock access to surface water, streambank erosion sites, areas with wetland/woodland/wildlife habitat restoration potential, irrigation sites, and areas of residential development.

Soil maps, aerial photos (defining highly erodible land, wetland determination's, and land uses), topographic maps, drainage activity records, and general knowledge of the watershed were used in identifying critical areas.

Data was also gathered from an in-depth physical inventory of the critical area. This consisted mostly of walking and canoeing, with some visual observation by vehicle. Notes were written on aerial photos and and later recorded in greater detail on topo maps. Surface water quality data on the Nottawa Creek was also collected from a 1994 MDEQ Biosurvey. Additional information was collected from an Athens High School water quality sampling project and a USGS Stream Flow Gaging Station, both on the Nottawa Creek. Lee Lake water quality data is also available. Input on land use activities from the Watershed Project Advisory Committee and local citizens has provided guidance for the project as well.

Critical Area/or Groulldwater Protectioll in the Nottawa Creek Watershed

Determining critical area for the Nottawa Creek Watershed involved assessing the physical characteristics of the subsurface in the watershed, combined with known sites of contamination, and potential for increased development within the watershed. Evaluation of the water well data gave preliminary indications that the drift aquifer and the bedrock aquifer are hydraulically connected, operating more or less as one system rather than two separate systems. This suggests less protection from surface and near subsurface contamination for the bedrock aquifer than would otherwise be available. Coupled with shallow depth to water for most wells in the water well database, moderate to shallow drift thickness, and the lack of a productive bedrock aquifer for nearly half of the watershed, it is suggested that the watershed aquifer(s) should be viewed as vulnerable. This assessment is supported by the lack of access to public sewer in most of the watershed and increasing numbers of new water wells with greater than 10 mg./L of nitrate located just outside the watershed boundary. This detennination is also supported by two separate aquifer vulnerability

assessments derived from clay layers, well depth, soil type, slope, and depth to water for the watershed. Therefore, critical area for the watershed is determined to be a range of high, higher, and highest vulnerability, beginning with Athens Township and portions of Burlington Township at the highest vulnerability status and decreasing to higher vulnerability in the remaining portion of Burlington Township and all of Newton Township within the watershed boundary, and including Fredonia, Tekonsha, Eckford and Clarendon Townships listed as high vulnerability (Figure 5). This differentiation of high to highest allows a prioritization of implementation activities to provide information and education on the groundwater resources within the Nottawa Creek Watershed to local policy makers and the population in general.

Nottawa Creek Watershed, Calhoun County, Michigan

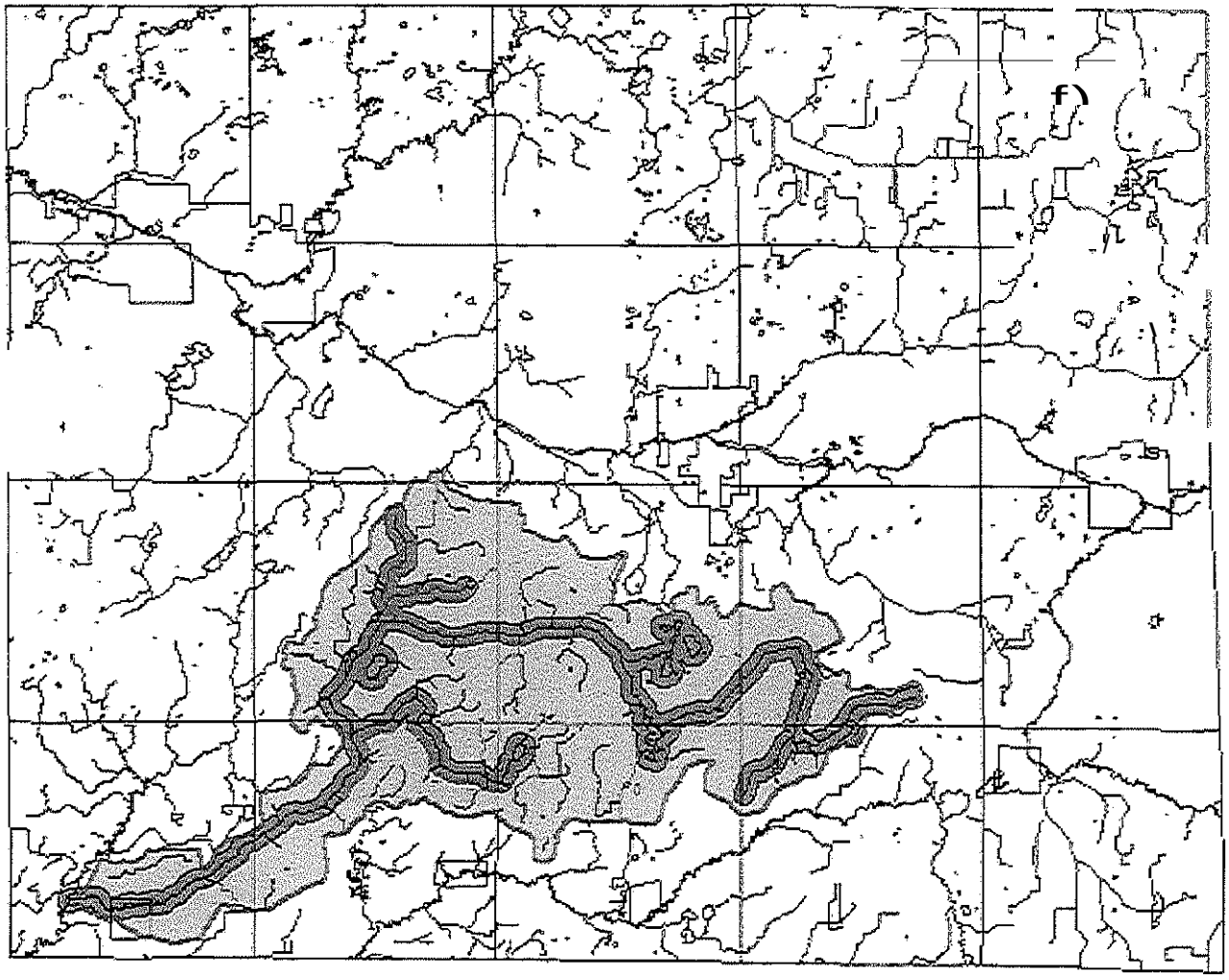

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Figure 4: Critical Area for Surface Water Along the Drainage System for the Nottawa Creek Watershed.
One Quarter Mile Corridor on Each Side of Streams

Basemap: MIRIS
GEM Regional Center
Institute for Water Sciences
College of Arts and Sciences
Western Michigan University

Nottawa Creek Watershed Study
Calhoun Conservation District
1/15/97

Nottawa Creek Watershed, Calhoun County, Michigan

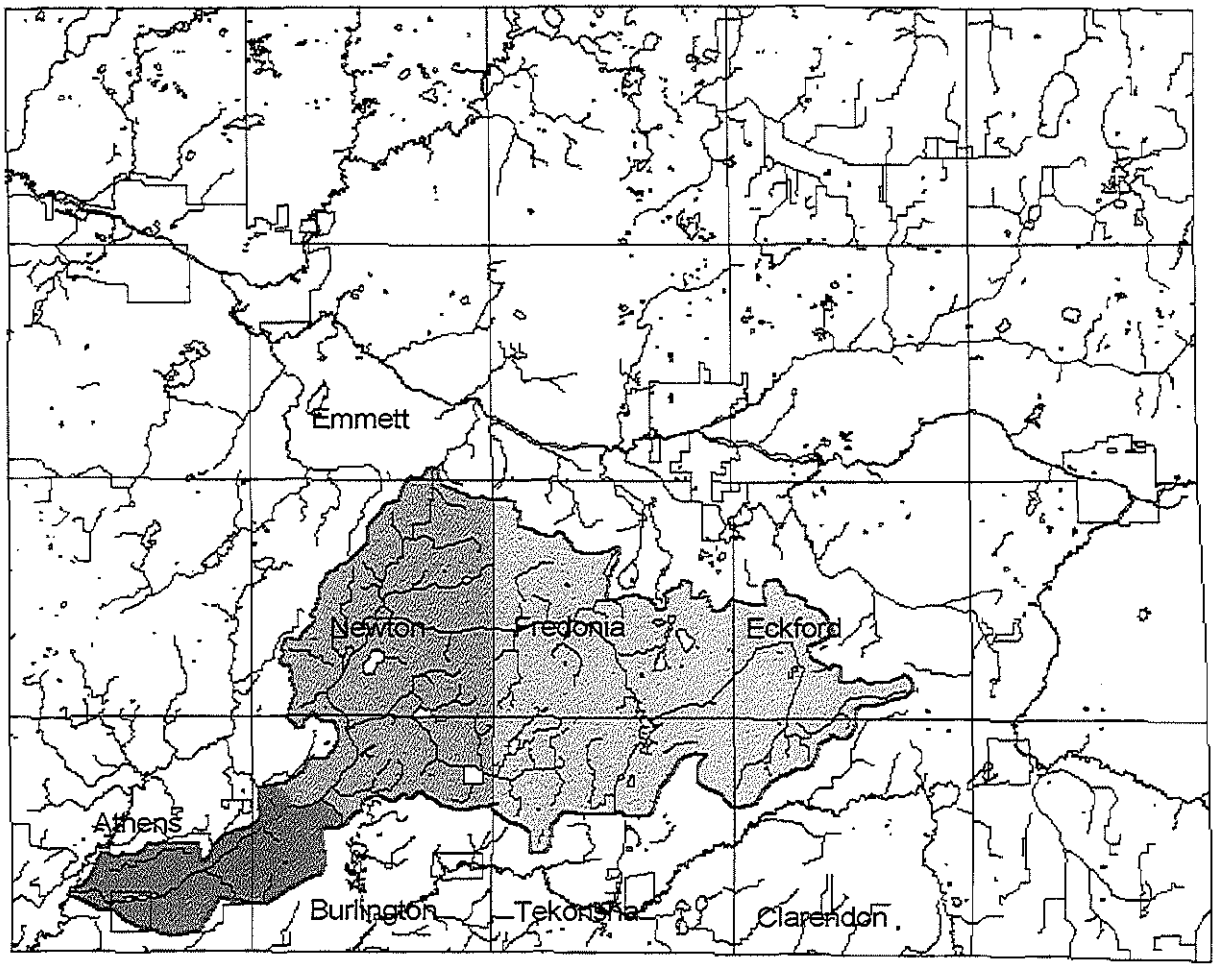

Figure 5: Critical Area for Groundwater Contamination Potential

Basemap: MIRIS
GEM Regional Center
Institute for Water Sciences
College of Arts and Sciences
Western Michigan University

12/97

CHAPTER VII - Inventory of Sources in Critical Areas

Description and Inventory Process of Surface Water Pollutioll Sources

Livestock Access to waterways contributes sediment, nutrients, and pathogens to surface water. Excess traffic near waterways can damage streambanks, resulting in erosion and sediment transport to surface water. This empedes water flow over time and may impact habitat for fish and macroinvertebrates by clogging up stream bottoms. Excess nutrients from manure can result in eutrophication of lakes especially, impacting both fishing and recreational uses of the water. Pathogens may contribute to a decline in health of fish and other organisms who depend on that surface water for survival.

Critical sites for livestock access were determined based on the level of streambank erosion, length of waterway impacted, number of livestock with direct access, amount of sedimentation in surface water, level of fish and wildlife habitat observed, site location relative to critical area, and impact on stream flow. Livestock access sites were documented by using visual observation. Information from all sources impacting surface water was recorded on aerial photos and then transferred to a topographic map.

Streambank erosion was observed as the second greatest contributor of sediment to surface water. Sediment from this source may impact fish and macroinvertebrate healthlhabitat and impede drainage. Factors observed in determining streambank erosion include: length of stream channel eroded, bank steepness, percent of vegetation on banks, amount of sedimentation in stream, wildlife habitat, relation of site to critical area, and impact of erosion on stream flow. Visual observation by canoeing and walking, soil maps, dredging history, and aerial photos were all used in determining this pollution source.

Soil erosion fi'Oln cropland contributes sediment to waterways and with it the potential to carry nutrients and pesticides. Soil erosion by wind and water are both sources of soil loss. The inventory process included observation of both streambanks and surrounding agricultural practices (ie. tillage, residue, crop type, topography, soil type, etc.). Levels of sediment and algae in surface water, buffer areas between fields and streams, stream flow, fish habitat, length of stream impacted, and relation to critical area were all considered during the inventory. Soil maps, aerial photos, and topo maps were reviewed in determining critical areas prior to visual observation.

Runofffi'om road/stream crossings has the potential to contribute sediment, salts, and emission pollutants to streams. Poorly constructed bridges and improper roadways through the creek can increase the risk of these sources getting into the water supply, thereby impacting the health of fish and other organisms as well as impeding stream flow for drainage and recreation. Data on the road/stream crossing inventory is enclosed in Appendix B.

Soil erosion from drainage a/wetlands is a concern in the critical area. Draining wetlands requires digging channels which, in itself, results in loss of sediment to surface water. This not only impairs

the health of fish and other wildlife with sediment contribution, but also increases the volume and velocity of water entering the Nottawa Creek. Draining wetlands disturbs wildlife habitat present in that wetland and reduces surface area for groundwater recharge and filtering of pollutants. The use of wetland determination maps, aerial photos, soil maps, and drainage history provided information prior to physical inventory. Amount of vegetation in the channel, sediment, and size of wetland being drained were all considered in measuring the impact from this activity on surface water.

Garbage has the potential to obstruct flow of surface water, contribute sources of unknown contaminants which may affect the health of wildlife, and detract from area scenery. Visual observation by canoe and foot were the only methods used in the inventory process. All sites were recorded on maps.

Other pollution sources also having the potential to impact surface water quality include:
1) Runofffi'Olnlocal GolfCourse. This may contribute nutrients and/or pesticides to surface water, thereby increasing the risk of eutrophication in an adjacent lake and causing other unknown effects to living organisms. A surface water outlet directly from the golf course into the lake plays an important role on the impact of water quality. This was observed as well as slope, soil type, and runoff area adjacent to surface water.
2) Runofffrom lake/stream residents contributing nutrients, pesticides, organic matter, and/or pathogens from septic systems.
3) Storm water runofffi'om Athens Village contributing nutrients, pesticides, sediment, salts, and other contaminants.
4) Waterfowl in and along lakes contributing nutrients and pathogens to surface water.
Obvious effects from these activities were difficult to determine and, therefore, could not be quantified. However, they are still a concern due to their presence in the critical area. Implementation will mostly consist of information and education about lawn/garden care, composting, septic system maintenance, proper uselhandling of hazardous wastes, etc.

Description of Grollndwater Pollution Sources

There are 7 potential sources of nitrates and/or pesticides in groundwater. They are as follows:
I) Leaching of nitrogen/pesticides /i'OIII agricultural land. Sources of leaching include: overapplication of fertilizer and chemicals, irrigation water, and livestock wastes to land; feedlot runoff and subsequent percolation into groundwater.
2) Large livestockfacilities located in vulnerable groundwater areas. Several large hog facilities and a few dairy farms are located in Athens Township, which is the most critical groundwater area in the watershed (containing sandy soils and shallow wells).
3) Leaching from septic systems and lawns/gardens in Athens Village and the surrounding communities. Nearly 1,000 people reside in the Village of Athens. However, there is no municipal sewer system in the village. All residences are on private septic. Concerns about high nitrate levels in the village municipal wells have been an ongoing issue in Athens.
4) Leaching from septic systems and lawns/gardens in the entire watershed. Since the whole

watershed is considered a critical area for groundwater (some areas being higher priority), use and care of the land throughout the watershed is a concern with regard to water quality.

5) Leaching from farmsteads. Many activities, which have the potential to impact groundwater, take place on farmsteads. Concerns include: leaking of fuel from underground storage tanks; leaching of fertilizers/pesticides from storage and mixing/loading areas; leaching of nutrients from grain storage (silo's in particular).

6) Excessive irrigation from agricultural lands. Irrigation water has the potential to move nitrogen down through the soil profile and into groundwater resources. Producers who depend on irrigation water typically increase fertilizer rates to meet higher yield goals.

7) Leaching from salts and other contaminants from roads. Several sites in the county are already detecting salts in groundwater supplies. Certain areas of the watershed are very vulnerable to this type of activity.

Process and Identification of Groundwater Critical Areas

Criteria chosen to identify critical areas for groundwater protection included assessing both the physical environment and what is known to date about existing contamination sites and anticipated growth and development for the region.

Specific criteria used to identify critical areas includes:

- Availability of a multiple aquifer system
- Static water levels
- Connectivity of upper and lower aquifers
- Identification of recharge areas
- Drift thickness
- Assessment of aquifer vulnerability
- Potential for urban sprawl
- Known sites of contamination

Availability of a Multiple Aquifer System

Evaluation of the water well records for the Nottawa Creek Watershed confinns the existence of a multiple aquifer system. Lithologic descriptions that identify the geologic materials and the thickness of the individual geologic layers the well driller must drill through to install the well, are recorded on the well record by the well driller. This allows identification of wells installed in glacial drift and wells that are installed in bedrock. Studies previously conducted in Calhoun County identify the bedrock aquifer underlying the glacial drift in the upper half of the Nottawa Creek Watershed as the Marshall Sandstone Formation. The Marshall Sandstone is generally an excellent source for potable groundwater. However, the Marshall Sandstone begins to pinch out in the lower half of the watershed. The Coldwater Shale now underlies the glacial drift for a significant portion

of Tekonsha and Fredonia Townships and all of Burlington and Athens Townships. The Coldwater Shale when sufficiently fractured may provide sufficient potable water to supply individual residential water wells. Unfortunately, the Coldwater Shale is generally not a reliable source for drinking water. The watershed data base shows an increase in the number of drift wells over the lower half of the watershed. However, bedrock wells are also located in the lower half of the watershed.. (A map of residential water wells in the Nottawa Creek Watershed is shown in Appendix D 1).

Static Water Levels: Depth to Water

Depth to water is a measurement of the level to which water will rise inside a well. Hydraulic gradient serves as the force behind the level to which the water will rise. Drift wells that are drawing water from a lower drift aquifer that is separated from upper aquiferes) by a layer(s) of impermeable material such as clay (these aquifers are known as confined or semi) may exhibit shallower depth to water than the same well would iflocated in an upper unconfined aquifer. Water wells located in bedrock may also exhibit shallower depth to water than they would if located in an upper unconfined aquifer if the bedrock aquifer is not hydraulically connected to the upper aquiferes). Using the static water levels available from the well drillers records for the Nottawa Creek Watershed, vulnerability was assessed by examining both proximity ofthe static water levels to surface and near subsurface contamination and potential hydraulic connectivity between the drift aquifer and the bedrock aquifers in the watershed. At least 85 % ofthe water wells in the watershed have a depth to water no greater than 30 feet. The mean depth to water is 19 feet. Land use practices surrounding these wells place them at moderate to high risk to contamination from the surface and near subsurface. (See Appendix D2 for Static Water Levels in the watershed).

Connectivity of Upper and Lower Aquifers

Individual maps of depth to water for both drift and bedrock wells were generated and then compared. The depth to water map for bedrock wells was subtracted from the depth to water map for drift wells to better define the relationship between the two aquifers. This differencing of the depth to water values for both aquifers produced a new map with values that are either positive (which may indicate that the drift aquifer may be recharging to the bedrock aquifer in that area), zero (suggesting a hydraulic connectivity between the two aquifers), or negative (suggesting some level of separation between the two aquifers). This requires sufficient drift and bedrock wells to be present in the same area. Using the above methodology for the Nottawa Creek Watershed produced results in an area that includes about half of Newton Township and the upper tier of Burlington Township, and an area including a small portion of Tekonsha and Fredonia Townships. The NewtonlBurlington area shows a narrow band that may suggest the possibility of a hydraulic separation between the upper and lower aquifers. It may also reflect the presence of Nottawa Creek and Lee Lake and groundwater discharging to these surface water bodies, or a combination of both. This is also the area in which the Marshall Sandstone aquifer begins to pinch out. Another small,

narrow band of values suggesting bedrock wells are exhibiting a shallower depth to water than the drift wells is located in Tekonsha and Fredonia Townships. However, as there are few wells available in that narrow region, it is not reasonable to attempt to interpret the flow regime for that area. Because of the narrow focus of both of these areas, it is strongly suggested that the data needs to be more closely examined in order to determine if there are data quality errors behind these interpretations.

The predominance of shallow depths to water for the majority of both drift and bedrock wells within the watershed suggest in this preliminary evaluation that groundwater moves between the upper and lower aquifers at least to some degree. Establishment of the water chemistry in these wells would produce a more definitive determination of hydraulic connectivity between drift and bedrock aquifers.

Idelltiflcatioll of Recharge Areas

Using a methodology developed by Dr. Richard N. Passero, emeritus, Western Michigan University, and assuming both drift and bedrock aquifers were in communication with each other, the water wells in the watershed were used to identify and map those areas of the watershed that recharge to groundwater. Unfortunately, the distribution of these wells was not sufficiently uniform to permit this process to take place. From previous hydrogeologic studies in areas outside the watershed it is generally assumed that at least 85% of the watershed recharges to the aquifer(s). This percentage is often higher.

Drift *Thickness*

Thickness of glacial drift overlying bedrock is an important criteria when determining critical area. Glacial drift is composed of sand, gravel, silt and clay. Sand and gravel make excellent aquifer material. Silt and clay in sufficient thickness and extent can provide valuable protection to groundwater aquifers found beneath these layers. Drift thickness is used to assess available options for locating drinking water wells if the upper region of the drift aquifer becomes contaminated. Out of 264 wells in the Nottawa Creek Watershed used to estimate drift thickness, 86% showed less than 80 feet of drift thickness. This suggests a fairly thin glacial drift aquifer, particularly in Athens Township where drift thickness is known to be 40 feet and less. In the lower half of the watershed, where the Marshall Sandstone is not available as an alternative source for potable ground water, thin drift overlying the Coldwater Shale suggests a drift aquifer that is highly vulnerable to contamination without an alternative water source. (For more details on drift thickness in the watershed, see map in Appendix D3).

Assessment of Aquifer Vulnerability

The computer software program AQUIPRO, developed by Dr. Richard N. Passero, Institute for Water Sciences, Western Michigan University, was applied to the water well data in the groundwater database for determining aquifer vulnerability. The system for determining aquifer vulnerability in the AQUIPRO program is based on the assumption that clays and clayey glacial sediments and certain low permeability rocks such as shale, provide natural protection for glacial and bedrock aquifers. The program multiplies the weighted depth of the wells times the weighted thickness of the protective clay, clayey glacial sediments and confining and semi-confining bedrock types. An aquifer vulnerability score is determined for each water well location from the water well record for that well. An assumption was made for the Nottawa Creek Watershed wells that both the drift and bedrock wells were hydraulicly connected. This is a very preliminary assumption and needs to be tested. With that assumption, all wells were run through AQUIPRO and the vulnerability scores mapped as point data on the watershed. Individual scores were then evaluated against the actual clay and partial clay thickness and grouped into categories of high, medium, and low vulnerability. The data were again mapped as point data on the watershed. High vulnerability wells are located thoughout the watershed. However, it is not uncommon to find highly vulnerable wells near low and medium vulnerability wells given the frequency of clay, partial clay and till found in the watershed. Those areas with multiple levels of vulnerability make them particulary unpredictable. Ultimately, it suggests that they should still be viewed as vulnerable in order to protect the most vulnerable wells. (For details on aquifer vulnerability using AQUIPRO, see map in Appendix D4).

An initial groundwater pollution potential map of the Nottawa Creek Watershed has been developed for this project as part of the research on aquifer vulnerability currently being conducted as a dissertation research project by a student in the hydrogeology Ph.D program in the Geology Department at Western Michigan University (see Appendix D5). The dissertation research is to focus on development of an improved method for assessing aquifer vulnerability at the watershed level. The Nottawa Creek Watershed has been chosen as the research site. Although research in this project is in the beginning phase, an initial groundwater pollution potential map has been generated. The map shows relative vulnerability of groundwater to contamination from surface sources. It is based on soil characteristics, slope and depth to the water table. Soil permeability and slope data were overlaid on depth to water that was derived from the watershed groundwater data base. As such, this initial map assesses aquifer vulnerability in the unsaturated zone above the water table. The aquifer vulnerability map derived from the input data shows moderate to high vulnerability over most of the watershed. The largest concentration of high vulnerability area occurs in southwest Burlington Township and Athens Township.

Potential for Urban Sprawl

At the present time, the Nottawa Creek Watershed remains primarily rural in character. The following table represents a summary of estimated growth for townships and villages in the watershed for 1991-1996.

Table 3 Population and growth trends for townships with the Nottawa Creek Watershed.

Government Unit	1990 Census	1996 Estimate	Number Chauge 1990-1996	Percent Chauge 1990-1996
Athens Twp.	1,525	1,530	5	0.3%
Athens Village	990	1,064	74	7.5%
Burlington Twp.	1.472	1,477	5	0.3%
Burlington Village	294	315	21	7.1%
Clarendon Twp.	1,100	1,103	3	0.3%
Eckford Twp.	1,217	1,308	91	7.5%
Fredonia Twp.	1,741	1,833	92	5.3%
Newton Twp.	2,025	2,218	193	9.5%
Tekonsha Twp.	1,016	1,019	3	0.3%
Tekonsha Village	733	746	13	1.8%

Source; U.S. Bureau of the Census, November, 1997

Although these numbers represent estimated growth indicators, they predict that growth levels should have remained relatively low in the watershed until at least 1996. The total increase for the population in the entire region is only 500. This covers all the jurisdictions in the watershed and not just the watershed area. Eckford, Newton and Fredonia Townships show the highest estimated growth rates, as do the Villages of Athens and Burlington. It is not surprising that these three townships show the highest estimated growth, given their proximity to the Cities of Battle Creek and Marshall and two limited access highways, 1-94 and 1-69. It should be anticipated that urban sprawl will move south and west of these highways. 1-94 in particular should continue to develop as a growth corridor between the City of Kalamazoo and the City of Battle Creek. This will not only increase the opportunity for commercial development along the corridor, it will also bring increased job opportunities. As a logical consequence, the quiet, rural environment of the Nottawa Creek Watershed with its abundance of surface water bodies will look very appealing to new development. With that new development will come an increased area of impermeable surfaces, storm water runoff, increased numbers of residential water wells and in-ground septic systems. Aquifers can become contaminated as pollutants such as gasoline, oil, and road salt deposited on streets and highways eventually infiltrate to groundwater through storm water runoff. Storm water retention basins can serve to concentrate the contaminants at a single point of recharge. As the area of impermeable surfaces increases, the recharge to the aquifers decreases. Storm water runoff that is discharged to surface water bodies (Le. rivers and streams) removes water from the watershed that would otherwise have recharged the aquifers in the watershed. Every new water well is in direct contact with the aquifer and therefore has the potential to serve as a conduit for contamination if not properly managed. Finally, the proximity of the water table to the surface, in areas where the concentration of private water wells and in-ground septic systems are higher, may increase the risk of contaminating the drinking water source.

CHAPTER YIn: Identified Pollutant Sites and Sources

Below, are the number of sites of each pollutant of concern affecting surface water. Each source was quantified based on the individual site where impact or potential impact to water quality was observed. The location of these sites is given in Figure 6.

Table 4. Inventory of known or suspected surface water pollutant sources.

Sources Impacting Surface Water	*# of Sites*
I) Unlimited livestock access to waterways	17
2) Streambank erosion	26
3) Soil erosion from agricultural land (sheet & rill)	*
4) Soil erosion from agricultural land (wind erosion)	2
5) Runoff from road/stream crossings	5 (high priority)
6) Soil erosion from drainage of wetlands	2
7) Garbage	12
8) Golf course runoff	I
9) Runofffrom lake/stream residents	*
10) Village storm water runoff	*
11) Waterfowl in and along lakes	3

*Generally known to be a source, but not quantified

Known Sites and Sources of Groundwater Contamination within the Watershed

There is presently one Part 201 site and one Leaking Underground Storage Tank (LUST) site in the Nottawa Creek Watershed. Both sites are located in the Village of Athens. The Part 20I site is the shallow municipal well for the Village of Athens. There has been an ongoing problem with nitrate concentrations exceeding the Maximum Contaminant Level (MCL) of 10 mg/L for nitrate as listed in the National Primary Drinking Water Standards. Calhoun County Environmental Health conducted a survey of nearby community wells in an effort to locate the source for the contamination. Ofthe 19 private wells surveyed, three were found to exceed the MCL. The majority of these wells were located in shallow glacial drift. The Village has located their deeper wells at 125 and 129 feet in a buried bedrock valley. These wells remain free of nitrate contamination. In general, drift thickness is very shallow in the Athens area. At present, the Village is mixing the waters from its shallow and deep wells to reduce the nitrate concentrations below 10 mg/L. The LUST site is McLeieer Oil.

Recent conversations with the staff of the Environmental Health Department in the Calhoun County Department of Public Health have confinned increasing numbers of water wells with nitrate concentrations exceeding the MCL in Leroy and Burlington Townships. Although these identified sites are outside the boundary of the Nottawa Creek Watershed, it is important to recognize that the identification of these high nitrate concentrations are in response to new development which initiates a sampling of new wells. As these growth pressures are largely not being experienced by the watershed, our knowledge of the current status of nitrate contamination in that region is very limited. It should also be recognized that groundwater does not necessarily follow the same boundaries as does surface water. Lack of clear understanding of the water quality within the watershed leaves local planners without some of the critical infonnation needed to make appropriate land management decisions.

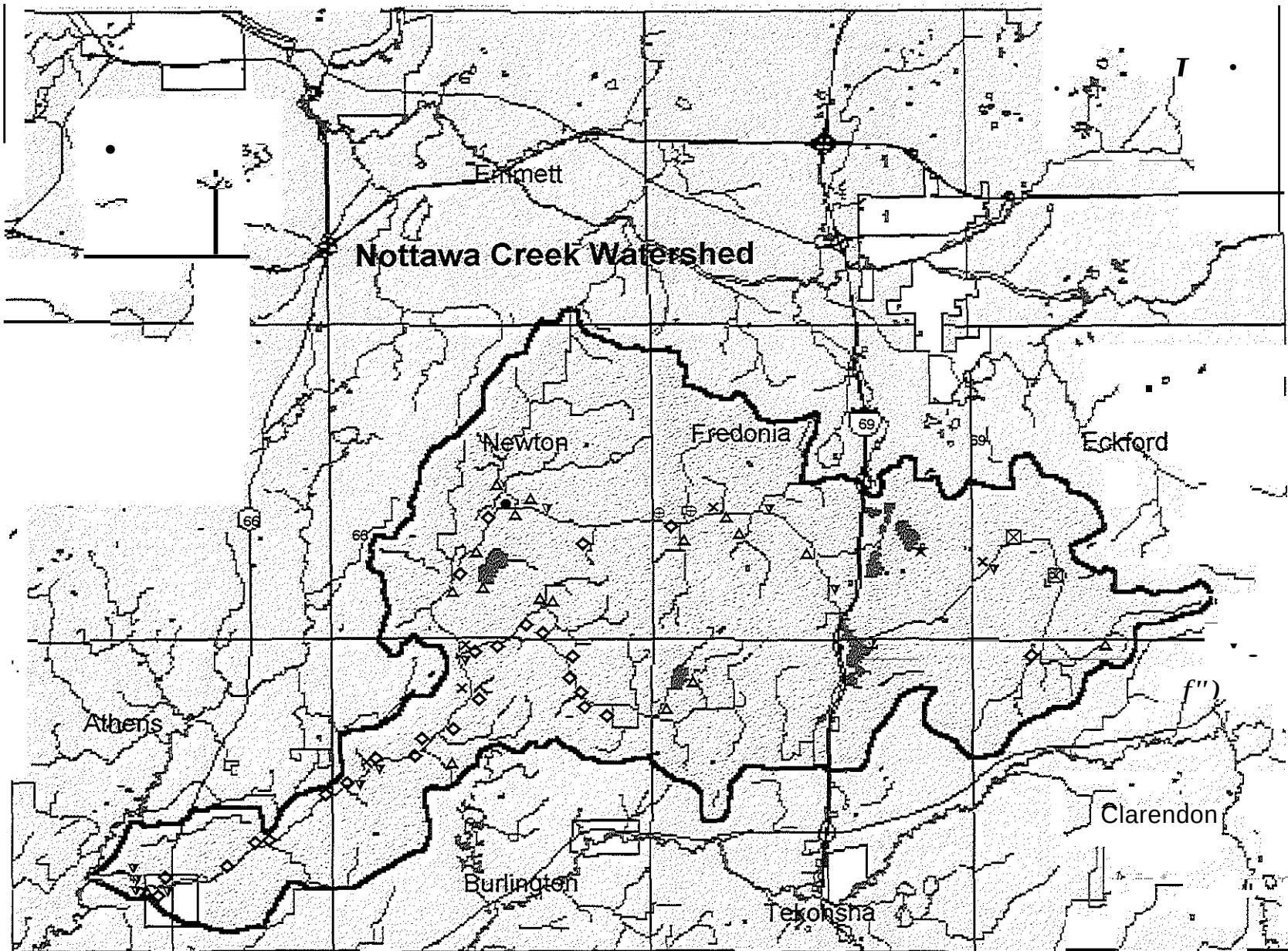

Figure 6: Identified Surface Water Pollutant Sources Along the Drainage System for the Nottawa Creek Watershed.

Basemap: MIRIS
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Calhoun Conservation District
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CHAPTER IX - Proposed Implementation Activities

Implementation Strategy

The implementation strategy suggested for the Nottawa Creek Watershed is based on identified designated uses of water resources in the watershed as well as the impairing pollutants and their inventoried nonpoint sources. Tools believed to have the greatest impact on improving and/or protecting water quality include increased technical assistance to priority landowners and land users, resource management systems planning and installation, land use planning, creative information/education programs, and selected available financial cost-share programs such as the Clean Water Act, USDA's EQIP, and MDA's Groundwater Stewardship Program. The recommendations are also based on review and suggestions from key agencies and technical experts associated with the Advisory Committee. The objective of these programs is the reduction or elimination of sources of non-point pollution within the priority areas of the watershed for both surface water and groundwater.

The Calhoun Conservation District (CCD) will be the implementation agency with continued public input and advisory direction provided by the Nottawa Creek Watershed Advisory Committee. Significant program direction on groundwater will be provided by Western Michigan University. Project oversight will be provided by the Michigan Department of Environmental Quality (MDEQ) Surface Water Quality Division. A full time Project Coordinator will be employed by the District. The coordinator will insure that all recommended programs are being implemented according to schedule. This individual will specifically provide the technical assistance necessary to install and maintain the Resource Management Systems used to reduce or eliminate critical non-point source pollution in the watershed. The implementation project will further benefit from assistance and programs currently available to landowners in the watershed through the USDA Natural Resources Conservation Service (NRCS) and Fann Services Agency (FSA) as well as Michigan Department of Natural Resources (MDNR), Michigan Department of Environmental Quality (MDEQ), Michigan Department of Agriculture (MDA), Western Michigan University, Michigan State University Extension, and the County Drain and Road Commissions. There are also private organizations and foundations which may provide additional technical and financial services. The Project Coordinator will identify and help to focus and expand these programs in the watershed. The coordinator's emphasis will be on problems and needs for improving and protecting water quality within identified priority areas in the watershed.

Assistance for Infonnation and Education (I & E) program activities will be available from Section 319 funding and otherlocal sources. Cost-share for best management practices (BMP's) will come, in part, from 319 implementation funding. However, the majority will come from USDA, through the Environmental Quality Incentives Program (EQIP), Wetland Reserve Program (WRP), Wildlife Habitat Incentives Program (WHIP), Forestry Incentives Program (FIP), Stewardship Incentives Program (SIP), and the Michigan Groundwater Stewardship Program (GSP). Additional funding may exist through lake board incentives, and other governmental and private organization funding measures as researched and available. One main focus ofthe Project Coordinator's work will be to establish needed BMP's in the priority areas. BMP usage in the non-priority areas of the watershed will be encouraged with technical assistance and cost-share from other sources as available. Nationwide, within Michigan, and in Calhoun County, demonstration programs instituted by Conservation Districts and cooperating conservation agencies have demonstrated, again and again, that accelerated application of Resource Management Systems (with BMP's) effectively reduces non-point source pollution. This will be the case in this watershed. Support for this

conclusion comes from the fact that currently 75-80% of producers in the watershed already participate in federal government farm programs.

Specific practices to reduce or eliminate non-point source pollutants of concern (sediments, pesticides and nutrients primarily) in the watershed priority areas would be targeted at the key sources of the pollution. These would include agriculture (especially farmstead and cropland pesticide leaching, cropland erosion and runoff, and livestock impacts), streambank and roadside erosion, and erosion from lakeside residential and urban areas. Specific Resource Management Systems (RMS') with individual BMP's are listed in Table 5. Definitions and objectives of each BMP are given after Table 5. Table 6 lists all recommended practices, amounts, and costs in the priority area. A suggested implementation schedule is given in Table 7.

Broad Initiatives and Specific Programs

To reach project goals and objectives as well as address impairing non-point source pollutants and identified sources, broad project intiatives and specific conservation practices will be recommended by this watershed plan. These will entail the application ofRMS' composed of specific BMP's and, long-term, the establishment of sound land use planning. The broad initiatives include:

1. Identifying, prioritizing, recommending, planning, and implementing BMP's to substantially reduce or eliminate non-point source pollutants of concem. This is primarily a restoration activity involving soil erosion, sediment delivery reduction, and pesticide and nutrient reduction. Water Quality Resource Management Plans (WQRMP's) will be planned and implemented with landowners and operators at identified priority problem sites.
2. Protection of areas having sound water quality and effective land use and conservation will be pursued. Also, preservation of critical environments that protect and enhance water quality will be sought including wetlands, floodplains, forests, prime and important farmlands, and other identified valuable open space. This can be done through proper land use planning procedures. The most effective method for promoting and maintaining water quality within the watershed will be through improved land management decisions. This is a long-term goal. However, it is the only reasonable method for creating a sustainable water resource protection effort that can be supported and maintained at the local level. It will include work by land conselvancies, township and county planning departments, and other public and private conservation agencies and groups. The approaches used will generally be non-regulatOlY to protect natural resources and water quality. This initiative will also pursue some local governmental adoption of model ordinances to protect essential natural features where feasible. This initiative is primarily preventative and protective in nature.
3. InformationJEducation/Public Participation. The 1&E Team developed model programs based on past project successes in this and other watersheds for broad information and education outreach efforts. These involve watershed newsletters, field days, workshops on key issues, news media presentations, community meetings, and school presentations and school involvement in watershed management. These outreach efforts combine to increase cooperation and partnerships in watershed management. They will also increase awareness, understanding and knowledge about surface water and groundwater improvement. The I & E Plan is fully explained in Chapter X.
4. Intergovernmental and agency coordination will be accomplished by expanding the role of the Watershed Advisory Committee to help coordinate watershed plan implementation. All of the key governmental units, agencies, and organizations are represented on the committee. The body will assure broad public input and promote cooperation across watershed jurisdictions.

This will stimulate coordinated policies and shared practices which then become models for further progress. Moreover, this inter-jurisdictional cooperation advances and dissemination of innovative practices and effective evaluation of plan implementation is improved. (Agencies involved in project implementation are listed in Chapter XI).

Specific Programs and Practices

To accomplish these broad initiatives, specific recommended programs will be pursued. These programs have the dual goals of (1) Water quality improvement and restoration, and (2) Water quality protection for areas restored or already high in water quality. This will be accomplished through the reduction, or elimination of, non-point source pollutants, especially within identified priority areas. Specific programs will include technical assistance, cost-share ofBMP's, land use planning, and key open space protection efforts, and detailed infonnation/education programs. The recommendations in this section are also derived from Advisory Committee, key agency and technical expert review of the water quality problems, non-point source pollutants/sources, and solutions available in this watershed.

The implementation ofRMS' within the watershed priority area will be accelerated through the attention and expertise ofthe Project Coordinator and the partnering agencies. Their knowledge of BMP solutions and sources of funding will increase the rate and scope of practices applied. Only BMP's located within the priority area will receive cost-share assistance from the Clean Water Act funds. BMP's needed in the non-priority areas will be encouraged with technical assistance and other cost-share funding sources, if available. The key focus will be applied conservation in the priority area. Key problem areas and specific BMP's are examined:

1. Agricultural Erosion Control and Nutrient/Pesticide Runoff and Leaching Reduction.

As pointed out in early sections, agriculture is the primary land use within the watershed, at 68% of the watershed land area. The most erosive category of agricultural land is cropland, with the primary crops being com and soybeans. Cropland is the primary use of the watershed's agricultural land. There is highly erodible land (hel) in the watershed that is eroding at 10 tons or more per acre, per year (Universal Soil Loss Equation Figures fi'om USDA-NRCS). Most of the cropland soils are sandy loams subject to water erosion and leaching. With spring plowing common in the watershed, the average erosion rate on cropland is 6.5 tons/acre/year (Natural Resource Inventory Figures). This is well above the tolerable soil loss rate of 4-5 tons/acre/year for these soils. There are also substantial applications offertilizers and pesticides to fann fields. Over-application can result in leaching of nutrients and pesticides to shallow, vulnerable aquifers.

Resource Management Systems (RMS') using coordinated combinations ofBMP's will be applied first to identified critical cropland in the priority areas. For surface water, these would be agricultural lands within a quarter mile (approx. 1,320 feet) of the lakes, major tributaries, and principal county drains in the watershed. For groundwater, these critical areas are indicated by WMU as vulnerable aquifer areas. The application of RMS' will significantly reduce direct sedimentation, nutrient loading, and leaching from cropland. Specific BMP's for agricultural land erosion and leaching are listed and explained later in this section. The RMS' applied for each site will be based on the needs ofthe site and the landowner/user, effectiveness ofthe BMP, and the cost efficiency. The RMS selected will often be a combination of vegetative, structural, and managerial applications. Typical successful demonstration conservation measures have already been applied to some sites in the watershed. These will serve as a basis for widespread application ofBMP's, such as: no-till, conservation tillage, cover crops, critical area treatment, buffer strips, grade

stabilization structures, integrated crop management, well closures, and pesticide containment facilities, just to name a few. All of these practices will serve to protect agricultural fields and farmsteads during high erosion and leaching events, by safely controlling water flow from fields and/or increasing water infiltration and reducing runoff.

2. Streambank Erosion Control

Next to agriculture, streambank erosion is one of the prime contributors to sediment and nutrient loading of the waters. This is due to the fact that there is a large network of streams and drains in the watershed. Also, the water levels in the drains are rarely constant. The fluctuating nature of stream flow, especially after heavy rains, places severe water flow stress on streambank areas. In turn, water velocities reach critical erosive stages and streambank cutting occurs sporadically throughout these water courses. Based on actual physical inventory, 26 significant streambank cutting sites have been noted along the main watercourse. Many of the eroded bank areas occur where there are obstructions in the stream channel or where there are bends in the tributary.

The Nottawa Creek and most main tributaries in the watershed are also county drains. The Project Coordinator and Advisory Committee will work closely with the County Drain Commissioner (who also sits on the Advisory Committee) to plan, design, and implement streambank stabilization measures. County drains are allowed about $2,500 per drain mile for maintenance. This maintenance budget, combined with Clean Water funds, allows for the substantial remediation of the critical streambank erosion areas. The Calhoun Conservation District will also work closely with the Drain Office on dam release and lake level control to properly manage water flow and erosive water velocities.

Streambank stabilization BMP's would include bank shaping and seeding, riparian buffer strips, rock rip rap placement, bio-engineering practices (log and live cut tree diversions, wood revetments, tree cutting plugs, etc.), critical area treatment and culvert repair/replacement. The Conservation District will work closely with the Road and Drain Commissions to make sure that proper shaping, seeding, and stabilization techniques and standards are in place and utilized for any drain construction projects.

3. Livestock Waste Utilization, Storage, and Access

While agricultural, this non-point source pollutant is treated as a separate category because it is a major source by itself and has solutions (BMP's) specific to it. The primary pollutants here are nutrients (nitrogen and phosphorus), fecal coliform bacteria, and some sediment. There are significant levels of animal waste runoff occurring during rainfall events from livestock pastures and feedlots. There are 17 livestock operations in the watershed near streams and drains for water supply and waste elimination purposes. The key problems here are: indiscriminate livestock access to streams causing erosion, fecal pollution, and poor watering management; improper animal waste storage (leading to nutrient runoff and leaching); and poor waste spreading practices. Many livestock operations are run in concentrated bam areas or feedlots with no storage facilities for excess manure or with inadequate storage. Excess manure percolates to groundwater or flows in runoff to surface water. Where there is adequate storage, often the problem is a poor spreading plan where manure is applied too near streams, especially in winter or in excessive amounts so that the crop and soil cannot handle the high nutrient load. Where livestock have open space access (grazing), the problem then becomes indiscriminate access to fragile streambanks causing erosion and direct waste input into the stream.

Resource Management System solutions here are very effective and well known. BMP's included would be proper storage facilities, effective waste utilization (spreading) plans, livestock exclusion practices (fencing) and access management, livestock stream crossings and livestock watering facilities. Nutrient management, including soil and manure testing, can be cost-shared. The goal will be to know the capacity of the soils for manure application based on nutrient levels in the manure, nutrient levels in the soils, and crop needs. This will lead to spreading plans that properly utilize the fertilizer value of the manure based on crop needs and soil capacity. There will be both strong BMP implementation and education efforts in this area. These efforts will significantly reduce non-point pollutants from this source.

4. Roadside Erosion and Runoff

Though less critical than the first three sources mentioned, there are areas in the watershed where roads come near, cross or deliver water to watershed tributaries. Problems here concern bare roadside areas, road construction, gravel roads and roadsides, and road ditches and culverts. These sources all contribute sediment and nutrient pollutants to watershed streams. There are significant sites of roadside erosion in the watershed and at least 5 are considered high priority. These will be addressed in the implementation phase. Working with the County Road Commission, BMP's will be planned and installed, which address these problem sites. These BMP's would include: critical area treatment, streambank stabilization, roadside shaping and seeding, buffer strips, culvert repair/replacement and road grading management. There is a long history of cooperation to date between the Road Commission and the Conservation District at placing demonstration conservation treatments in problem road areas. This will continue in the implementation phase.

5. Lakeside and Residential Areas

With the development of residential areas around and along watershed lakes and streams, vegetative cover was lost or reduced and replaced by homes, roads and other impermeable surfaces. As a result, increased amounts of nutrients and sediments are transported to the surface waters in surface runoff or leached to groundwater. In terms of impacting water quality, phosphorus and nitrogen are the nutrient pollutants of primary concern. These are the nutrients which most often stimulate aquatic plant growth in lakes and streams, and accelerate the process of cultural eutrophication. Nitrogen is a real concern for impact on drinking water. Fecal coliform bacteria, sedimentation, and pesticide leaching are also concerns here.

The primary sources of nutrient loading from lake and streamside areas and residential areas near surface drains are excessive lawn fertilization and pesticide use, improper disposal of organic debris (grasses and leaves), and improperly operating septic tanks. Other sources of sediments and nutrients here would be eroding channel and shoreline banks, construction areas, bare soil areas, and excessive goose populations.

Resource Management Systems proposed would be composed of a mix of BMP's necessary to remediate each site. BMP's such as fertilizer management, soil testing, lawn maintenance/organic debris disposal, septic tank upgrading/maintenance, critical area treatment, and shoreline/channel stabilization will be utilized. Because of high cost, there will not be cost-share for septic tank repair and/or replacement. Rather, this will be encouraged with educational efforts and several demonstration projects. Where needed and identified, public sewer can be encouraged around area lakes and streams. Replacing septic tanks with sewers substantially reduces pollutant problems. Educational outreach programs will also be a critical tool to use in reaching this residential segment of the watershed.

6. Urban Areas and Construction Sites

Non-point source pollutants from urbanizing and developing areas within the watershed originate from surface runoff from stonn sewers, lawn fertilization, grass and leaf disposal, household waste disposal and construction sites. The main problem here is the slowly expanding, developing urban areas with new construction, bare soils, and increasingly impenneable surfaces. The Village of Athens and M-66 lie in the western portions ofthe watershed while 1-69 runs north and south in the eastern area. Athens stonnwater drains to the Nottawa Creek. Water runoff from these areas is not the most significant contribution to non-point source pollution in the watershed but should be studied more closely and tested to more clearly define its contribution.

New construction sites that expose soils and expanding impenneable surfaces (new homes, businesses, roadways, etc.) are the chief concerns for potential new sources of non-point pollution. Excavating for foundations and bulldozing of driveways and parking lots expose large areas of soil. New construction often takes many months. This problem is critical if construction is located near lakes and streams, and the sites do not have proper erosion control measures. MDNR estimates that soil loss from bare construction sites can be as high as 135 cubic yards from each acre per year. This is equivalent to about a 1 inch layer of soil lost per acre/year.

Resource Management Systems to be encouraged in developing areas will involve such BMP's as fertilizer management, organic debris disposal, road cleaning scheduling, critical area treatment, buffer strips, wetland protection/restoration and placements of filtering sediment basins. Over the term of this project, key local agency partners will be encouraged to more stringently review new construction sites in the planning and implementation phases for proper staging of work, erosion control, and the use of temporary seeding, filter fencing, buffer strips and other erosion mitigation measures. Land use planning and zoning will be critical here with protection of critical open space, wetland, and floodplains a priority.

Comprehensive stormwater management will also be a focus. As an example, detention basins can be emphasized as a necessity for new businesses and larger multi-home developments to temporarily store stonn runoff on site. Innovative artificial wetland filtration will be sought in conjunction with existing or new sediment basins. Educational outreach will also be done to reach urban populations on soil testing, fertilizer management, organic debris disposal, stonn drain stenciling, garbage clean-up, and soil erosion reduction.

Critical Long Term Program: Land JJse Planning

The most effective method for promoting and maintaining water quality within the watershed will be through improved land management decisions. This is a long tenn goal. However, it is the only reasonable method for creating a sustainable water resource protection effort that can be supported and maintained at the local level.

Currently, there is no clear picture of the present state ofland use planning within the watershed. Given the rural nature ofthe watershed and the primarily part-time status oflocal government, land management is a result of decisions made on an issue by issue basis and made totally within the context of the jurisdiction of the detennining local unit of government. Coordination of these decisions with neighboring jurisdictions is a desirable goal that lies well within the future.

In order to begin the journey toward regional cooperation, it will be necessary to assess the present level of land use plans and existing zoning ordinances within the watershed and their potential for protecting water quality. This can be facilitated by acquiring and assessing existing land use plans and zoning ordinances by township and beginning the process of developing an overview of the present level of land use planning on a watershed basis. This assessment will be supported through creation of a 1996 land cover map for this area. Such a map serves as a valuable tool for local decision-makers to actually visualize the entire watershed as it relates to land use and to promote a watershed perspective. In order to promote a better understanding of the zoning that is directing the watershed today, a buildout analysis can be conducted. This analysis can be coupled with a growth assessment study for the watershed. These tools will aid greatly in supporting a future vision of the watershed in the context of existing land use planning and to identify where change needs to take place.

Given the increasingly complex nature of land use issues today, there is need for greater access to training opportunities for local elected and appointed officials, improved access to the ongoing dialogue within the state on land use and growth management issues, and opportunities for sharing experiences and tools with other units of local government throughout Michigan. Workshops can be held that provide both initial and advanced training in skills needed by planning commissions and zoning boards. Speakers can be brought to the watershed to discuss critical issues that address not only land management tools that are available now, but also how they fit within a multiple jurisdictional entity such as a watershed. Through the watershed newsletter and the hands-on relationships that will be promoted with local governments, the Nottawa Creek Watershed Project can serve as a conduit for dissemination of model ordinances, experiences and new initiatives undertaken by other communities, legislative news, etc. As leaders within the watershed are identified, it would benefit the process by sending these individuals to some of the numerous conferences being offered around the state that promote our understanding of land use and its relationship to water resource protection.

It should not be forgotten that land use decisions made with insufficient understanding of the nature and vulnerability of the resources that need protecting, will ultimately fail to provide that protection. Land use decisions must be made within the context of the physical environment and the hydrology of the area being impacted by those decisions. The water quality and physical assessment of the watershed, for both surface water and groundwater, should be continued in order to promote a more complete understanding of the aquifers within the watershed, their vulnerability to surface and subsurface contamination, their relationship to surface water and the impact of present land use practices on the overall water quality of the watershed. Ideally, development of well defined risk assessment maps would provide a valuable tool for local decision-makers both today and in the future.

Proposed Activities to be Conducted by WMU and the Conservation District

✔Conduct water quality sampling and gamma ray logging, (gamma ray logging provides a detailed analysis of subsurface geology at the well site), for assessment of groundwater contribution to surface water, hydraulic connectedness between upper and lower aquifers, and overall water quality. This will provide watershed characterization for improved land management decision-making.

✔Develop a watershed symposium: Include a state or nationally known expert on watershed management plus local speakers to focus specifically on the Nottawa Creek Watershed.

✔Conduct a land use planning workshop for local townships to establish zoning ordinances which promote land use decisions focused on resource protection. This will be initiated by both WMU and the Conservation District.

✔Develop a Citizen Network to expand knowledge and provide tools that can be applied to local governments related to land use planning. Individuals will be sent to conferences, workshops, and meetings to learn about current ordinances, issues related to the impacts of growth pressure and other land uses on water quality, and how other communities are dealing with these topics. This will be done in cooperation with Calhoun County Community Development and other local agencies/individuals. The Citizen Network will, by project end, be prepared to conduct meetings and activities for local planning commissions to provide them with tools for better land use management.

✔Provide groundwater study data on CD-ROM or diskettes for local acces to data.

✔Train interested townships in the use of digital data created for the Nottawa Creek Watershed Project.

✔Produce a summary of the environmental and land use analysis for distribution to the public. This will include all findings from gamma ray logging, water quality sampling, well log data, etc. All findings from WMU's GEM Center will be compiled in a brief document and made availabe to any interested parties.

✔Develop risk assessment maps by township. These maps will be developed to assist local decision-makers in making appropriate resource protection/management decisions and will be used in concert with the land management, decision-making hierarchy developed in the previous years.

Table 5: Methods of Implementation

Source	*Concern*	*Affected Resource* GW	SW	*Priority* H	M	L
Unlimited Livestock Access to Streams	Sediment, Nutrients, Animal Waste		✔	✔		

Approach

Resource Management System and BMP's

Pastureland

Fencing	Livestock Stream Crossing
Pond	Planned Grazing System
Trough or Tank	Streambank Protection
Well	PasturelHayland Planting
Filter Strip	Critical Area Planting
Use Exclusion	

Riparian Corridor

Filter Strip	Grade Stabilization Structure
Fencing	Riparian Buffer Strip
Use Exclusion	Crit. Area Planting

Wetlands

Fencing	Wetland Devel. & Restoration
Wildlife Hab. Mgmt.	

Information & Education

Activities

Land Use Planning Workshops

NewslettерslFact Sheets on Impacts of Livestock Access on Water Quality

Target Audiences

Agricnltural Producers
Township Government
Youth Clubs
Educators/Students

Partners

Drain Commissioner
NRCS/SCD
MDEQ
MDA
Road Commission
MSU-E
TwpNillage/County Planning
Calhoun Env. Health
EPA
Potawatomi RC & D
FSA

Resources

Farm Organizations
Env.lSportsman's Clubs
Information Networks
South Central Michigan Regional Planning

Table 5: Methods of Implementation cont'd.

Source	*Concern*	*Affected Resource* GW	SW	*Priority* H	M	L
Streambank Erosion	Sediment		✔	✔		

Arrroach

Resource Management System & BMP's

Rirarian Corridor

Crit. Area Planting	Streambank Protection
Sediment Basin	Fish Stream Improvement
Diversion	Grade Stabilization Structure
Spoil Spreading	Recreation TraillWalkway
Rip. Buffer Strip	Tree/Shrub Establishment

Information & Education

Activities

Promotion of Buffer Strip Program
Student Water Quality Monitoring
Student Insect Sampling
Develop Streambank Demonstration Projects with Drain Commissioner
Distribution of Newsletter on Watershed Activities and Water Quality Issues

Target Audiences

Agricultural Producers
Watershed Residents
Twp.Nillage Govt.
Educators/Students
Youth Clubs
Ag-Cheru Dealers

Partners

Drain Commissioner
Calhoun Env. Health
County PlanninglDev.
MDEQ
NRCS/SCD
Road Commission
EPA
Potawatomi RC& D
FSA

Resources

Farm Organizations
Sportsman's Clubs
Local Newspapers
Schools

Table 5: Methods of Implementation cont'd.

Source	Concern	Affected Resource GW	Affected Resource SW	Priority H	Priority M	Priority L
Cropland Erosion! Runoff	Sediments, Nutrients, Pesticides		✔	✔		

Approach

Resource Management System & BMP's

Cronland

Filter Strip	Conserv. Cropping Sequence
Nutrient Mgmt	Residue Mgmt (No-till)
PestMgmt.	Residue Mgmt. (Mulch till)
Diversion	Sediment Control Basin
Waste Utiliz.	Grassed Waterway
Conserv. Cover	Riparian Buffer Strip

Information and Education

Activities

Nutrient Mgmt Yardstick
Innovative Fanner Plots
Student Water Quality Monitoring
Field*A*Syst
Land Use Planning Workshop
Promotion of Buffer Strip Program
Adopt-A-Stream Program
Plot Tour
Distribution of Newsletter on Watershed Activities and Water Quality Issues

Target Audiences

Agricultural Producers
Township Govt.
Educators/Students
Youth Clubs

Partners

NRCS/SCD
Calhoun Env. Health
Drain Commissioner
MDEQ
County PlanningIDev.
County Bd. of Comm.
MDA
Potawatorni RC & D
MSU-E
FSA
Innovative Fanners

Resources

Farm Organizations
Sportsman's Clubs
Information Networks
South Central Mich. Regional Planning
Ag-Chem Dealers
Schools

Table 5: Methods of Implementation cont'd.

Source	*Concern*	*Affected Resource* GW	SW	*Priority* H	M	L
Over-application offertilizers/ pesticides on cropland	Nutrients, Pesticides leaching into groundwater	✔		✔		

Anproach

Resource Management System and BMP's

Cropland

PestMgrnt.	Conserv. Cropping Seq.
Nutrient Mgrnt.	Conservation Cover
Waste Uti1iz.	Well Decommissioning
Irrig. Mgrnt.	Irrigation System, Trickle

Information and Education

Activities

Innovative Farmer Plots
Well Water Monitoring
Groundwater Stewardship Tour
Nutrient Management Yardstick
Field*A*Syst
Distribution of Newsletter on Watershed Activities and Water Quality Issues

Target Audiences

Agricultural Producers
Businesses
Township Govt.
Educators/Students
Youth Clubs

Partners

Calhoun Env. Health
NRCS/SCD
MSU-E
WMU
EPA
MDA
Innovative Farmers
Potawatomi RC & D
County Bd. of Comm.
FSA
MDEQ

Resources

Farm Organizations
Information Networks
Businesses

Table 5: Methods of Implementation cont'd.

Source	Concern	Affected Resource GW	Affected Resource SW	Priority H	Priority M	Priority L
Concentrated Livestock Facilities	Nutrients, Pathogens	✔		✔		

Approach

Resource Management System and BMP's

Feedlot

Filter Strip	Waste Storage Facility
Diversion	Roof Runoff Mgmt
Waste Utiliz.	Heavy Use Protection Area
Well Decomm.	Planned Grazing Systems

Information and Education

Activities

Fann*A*Syst
Water Well Monitoring
Groundwater Stewardship Tour
Nutrient Mgmt Yardstick
Land Use Plauning Workshop
Distribution of Newsletter on Watershed Activities and Water Quality Issues

Target Audience

AgriculturaI Producers
Township Govt.
Educators/Students
Youth Clubs

Partners

Calhoun Env. Health
NRCS/SCD
FSA
MDA
County PlauninglDev.
MDEQ
EPA
County Bd. of Comm.
Potawatomi RC & D
MSU-E
WMU

Resources

Fann Organizations
South Central Mich. Regional Plauning
Infonnation Network
Businesses

Table 5: Methods ofImplementation cont'd.

Source	Concern	Affected Resource GW	Affected Resource SW	Priority H	Priority M	Priority L	Anproach	Target Audiences
Urban Runoff/ Leaching from Improper Management of Nutrients, Pesticides, and Septic Tauks	Nutrients, Pesticides, Household Hazardous Waste, and Septic System Waste	✔	✔			✔	*Resource Management System & BMP's* *Residential* Pest Mgmt. Nutrient Mgmt. Well Decommissioning *Commercial* PestMgmt. Nutrient Mgmt. Well Decomm. Fuel Containment Facility Chemical Containment Facility *Information and Education* *Activities* Laud Use Planning Workshop Hold Local Watershed Events/Tours Water Well Monitoring Home*A*Syst Promotion of Hazardous Waste Collection Day Promotion of Tire Collection Day Hazardous Waste Mgmt. Educational Materials Septic System Maintenance Storm Water Management Adopt-A-Stream Program Distribution of Newsletter on Watershed Activities and Water Quality Issues	Watershed Residents Businesses Village Gove=ent Educators/Students Youth Clubs Garden Clubs *Partners* Calhoun Env. Health MDEQ WMU County PlanninglDev. NRCS/SCD EPA County Bd. of Comm. Potawatomi RC & D MSU-E *Resources* Churches/Service Clubs, etc. Sportsman's Clubs South Central Mich. Regional Planning Information Networks Businesses

Table 5: Methods of Implementation cont'd.

Source	Concern	Affected Resource GW	Affected Resource SW	Priority H	Priority M	Priority L
Lake/Stream Residential & Recreational Runoff and Leaching (Includes Golf Course, Campgrounds)	Sediment, Nutrients, Pesticides, Household Haz. Waste and Septic System Waste	✓	✓	✓		

Approach		Target Audiences
Resource Management System & BMF's		Watershed Residents
Riparian Corridor		Ag. Producers
Diversion	Critical Area Planting	Businesses
Access Road	Grade Stabilization Strncture	Township Govt.
Sediment Basin	Grassed Waterway	Educators/Students
Tree/Shrub Est.	Streambank Protection	Lake Associations
Pond	Riparian Buffer Strip	Youth Clubs
Filter Strip	Fish Stream Improvement	Recreation
		Garden Clubs
Residential		
Pest Mgmt.	Well Deconnnissioning	*Partners*
Nutrient Mgmt.		Calhoun Env. Health
		Drain Connnissioner
Information and Education		NRCS/SCD
Activities		WMU GEM Center
Septic System Maintenance		County PlanninglDev.
Lake*A*Syst		MDEQ
Student Water Quality Monitoring		EPA
Promotion of Hazardous Waste Collection Day		MDA
Promotion of Tire Collection Day		County Bd. of Comm.
Adopt-A-Stream Program		Potawatomi RC & D
Distribute Newsletters on Watershed Activities and Water Quality Issues		FSA
Hold Local Watershed Events/Tours		MSU-E
Land Use Planning Workshop		
Hazardous Waste Mgmt. Educational Materials		***Resources***
		Businesses
		Sportsman's Clubs
		South Central Mich. Regional Planning
		Farm Organizations
		Info. Networks
		Schools

Table 5: Methods of Implementation cont'd.

Source	*Concern*	*Affected Resource* GW	SW	*Priority* H	M	L
Farmstead Leaching from Improper Management and Storage of Farm and Household Products	Nutrients, Pesticides, Fuel, Household Hazardous Waste	✔			✔	

Approach

Resource Management System and BMP's

Farmstead

Well Decomm.
Nutrient Mgmt.
Pest. Management
Well
Tree/Shrub Estab.
Agri-Chem. Cont. Facility
Fuel Containment Facility
In-field MixlLoad System
Roof Runoff Management

Information and Education

ActiVities

Farm*A*Syst
Water Well Monitoring
Promotion of Pesticide Container Recycling
Groundwater Stewardship Tour
Groundwater Education Materials
Nutrient Management Yardstick
Hold Local Watershed EventslTours
Distribute Newsletter on Watershed ActivitiesIWater Quality Issues
Promotion of Hazardous Waste Collection Day
Promotion of Tire Collection Day

Target Audiences

Ag. Producers
Businesses
Township Govt.
Educators/Students
Youth Clubs

Partners

NRCS/SCD
WMU GEM Center
FSA
MDA
MDEQ
Calhoun Env. Health
EPA
County Bd. of Comm.
MSU-E
Potawatomi RC & D
Innovative Farmers of South Central Mich.

Resources

Farm Organizations
Businesses
Sportsman's Clubs
Info. Networks

Table 5: Methods of Implementation cont'd.

Source	Concern	Affected Resource GW	Affected Resource SW	Priority H	Priority M	Priority L
Erosion from Drainage of Wetlands	Sediment, Nutrients		✓		✓	

Approach

Resource Management System and BMP's

Riparian Corridor

Grassed Waterway	Grade Stabilization Structure
Sediment Basin	Critical Area Planting
Diversion	Riparian Buffer Strip
Filter Strip	Streambank Protection
Tree/Shrub Estab.	

Wetlands

Fencing	Wetland DevellRestoration

Information and Education

Activities

Land Use Planning Workshops
Make Available Educational Materials on Values of Wetlands
Adopt-A-Stream Program
Student Water Quality Monitoring
Promotion of Buffer Strip Program
Hold Local Watershed Events/Tours
Distribute Newsletter on Watershed ActivitieslWater Quality Issues

Target Audiences

Watershed Residents
Ag. Producers
Businesses
Township Govt.
Educators/Students
Youth Clubs

Partners

Drain Commissioner
Calhoun Env. Health
NRCS/SCD
MDEQ
County PlanninglDev.
County Bd. of Comm.
MDA
Potawatomi RC & D
FSA
MSU-E

Resources

Sportsman's Clubs
Farm Organizations
Businesses
South Central Mich. Regional Planning
Info. Networks
Schools

Table 5: Methods of Implementation cont'd.

Source	Concern	Affected Resource GW	Affected Resource SW	Priority H	Priority M	Priority L
RoadIBridge Runoff	Sediment, Salts		✔	✔		

Apnroach

Resource Management System and BMP's

Transportation

Diversion	Critical Area Planting
Access Road	Grade Stabilization Structure
Tree/Shrub Est.	Streambank Protection
Filter Strip	Grassed Waterway

Information and Education

Activities

Develop Demonstration Projects with Road Commission
Hold Local Watershed TourslEvents
Distribution of Newsletter on Watershed Activities and Water Quality Issues
Adopt-A-Stream Program

Target Audiences

TownshipNillage Government
YouthClnbs
Watershed Residents

Panners

Road Commission
MOOT
Drain Commissioner
NRCS/SCD
EPA
County Bd. of Comm.
Potawatomi RC & D
FSA

Resources

Sportsman's Clubs
Info. Networks
Businesses

Table 5: Methods of Implementation cont'd.

Source	*Concern*	*Affected Resource* GW	SW	*Priority* H	M	L
Debris, Garbage in Lakes and Streams	Household Hazardous Waste and materials such as appliances, tires, etc.		✔		✔	

Annroach

Information and Education

Activities

Adopt-A-Stream Program
Student Water Quality Monitoring
Promotion of Hazardous Waste Collection Day
Promotion of Tire Collection Day
Promotion of Pesticide Container Recycling
Distribute Newsletter and Seek Participation in Watershed ActivitieslEvents
Hazardous Waste Management Educational Materials

Target Audiences

Watershed Residents
Ag. Producers
Businesses
TownshipNillage Government
Educators/Students
Lake Assocations
Youth Clubs
Recreation
Garden Clubs

Partners

Calhoun Env. Health
Drain Commissioner
Road Commission
NRCS/SCD
MDEQ
EPA
Friends of the St. Joe
Potawatomi RC & D

Resources

Farm Organizations
Churches, Service Clubs, etc.
Sportsman's Clubs
Info. Networks
Businesses
Schools

Table 5: Methods of Implementation cont'd.

Source	*Concern*	*Affected Resource* GW	SW	*Priority* H	M	L
Improper Management of Nutrients, Pesticides, and Septic Systems on Rural, Non-farm Residences	Nutrients, Pesticides, Household Hazardous Waste, and Septic System Waste	✔				✔

Annroach

Resource Management System and BMP's

Residential

Pest Management	Ctit. Area Planting
Nutrient Management	Filter Strip
Well Decommissioning	

Information and Education

Activities

Distribute Newsletter and Seek Participation in Local Watershed Events/Activities
Water Well Monitoring
Home*A*Syst
Promotion of Tire Collection Day
Promotion of Hazardous Waste Collection Day
Septic System Maintenance
Hazardous Waste Management

Target Audiences

Watershed Residents
Businesses
Township Govt.
Educators/Students
Youth Clubs
Garden Clubs

Partners

WMU GEM Center
Calhoun Env. Health
MDEQ
MSU-E
EPA
Potawatomi RC & D

Resources

Businesses
Information Networks
Churches/Service Clubs, etc.

Table 5: Methods ofImplementation cont'd.

Source	***Concern***	*Affected Resource* GW	SW	*Priority* H	M	L
Excessive Irrigation Use	Increased Sedimentation, Nutrients, Pesticides, Salts, and Reduction of Groundwater and Surface Water Supplies	✔	✔			✔

Anproach

Resource Management System and BMP's

Cropland

Well	Irrigation System, Trickle
Filter Strip	Residue Mgmt. (No-till)
Nutrient Mgmt.	Irrig. Water Management
Pest Management	Cover/Green Manure Crop
Waste Utilization	

Information and Education

Activities

Innovative Fanner Plots
Well Water Monitoring
Groundwater Stewardship Tour
Distribution of Newsletter on Watershed Activities and Water Quality Issues
Nutrient Management Yardstick
Field*A*Syst

Target Audiences

Agricultural Producers
Businesses
Watershed Residents
Twp.Nillage Govt.
Educators/Students
Youth Clubs
Lake Assocations

Partners

WMU GEM Center
NRCS/SCD
Env. Health Dept.
MSU-E
Innovative Farmers
County Bd.. of Corom.
EPA
MDA
Potawatomi RC & D
FSA
MDEQ

Resources

Farm Organizations
Information Networks
Businesses

DESCRIPTION OF BEST MANAGEMENT PRACTICES (BMP'S)

BMP's are conservation practices determined to be the most effective, practical means of preventing or reducing pollution /i'Gln nonpoint sources. The following is a list of BMP's for eXisting or potential nonpoint source pollutants in the Nottawa Creek Watershed.

Best Management Practices (BMP's)

Access Road
Objective: A travelway constructed to provide a fixed route for moving livestock, equipment, etc. This controls runoff to prevent erosion and maintain or improve water quality.

Agrichemical Containment Facility
Objective: To contain/store pesticides or fertilizer in an enclosed area to prevent groundwater contamination from a potential spill.

Conservation Cover
Objective: The temporary use of grasses, legumes, or small grain to control erosion, improve soil structure and infiltration. May also be used in nutrient management to provide a nitrogen source for future crops or to utilize excess nutrients from previous crops.

Conservation Cropping Seqllence
Objective: Provides extended periods of live vegetative cover by growing row crops and/or small grains in combination with hay. This improves soil structure and reduces soil erosion and runoff potential.

Critical Area Planting
Objective: Planting of trees, grasses, or legumes on highly erodible areas to stabilize soil and reduce erosion and sedimentation in and along waterways.

Diversion
Objective: A channel with a supporting ridge on the lower side constructed across the slope, to divert water from areas where it is in excess to sites where it can be used or diposed of safely. This reduces effects of erosion, pathogens, nutrients, and pesticides on water quality. This can influence volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation and groundwater recharge.

Fencing for Livestock Exclusion
Objective: Restricts access to surface water, resulting in streambank protection; reduction of organic matter, fecal colifonn, and nutrient loadings; and prevents shallowing and widening of streams to keep water cooler.

Filter or Buffer Strip
Objective: Areas of vegetation, usually perennial grasses or legumes, adjoining a stream, ditch, lake, wetland, or flood plain. These aid in removal of sediment, organic matter, and other pollutants from entering the water supply.

Fish Stream Improyement
Objective: Improving a stream channel to create or enhance fish habitat. This is done by improving food, cover, and or spawning conditions, as well as reducing erosion and sedimentation.

Fuel Containment
Objective: Above ground storage or containment of fuel in an enclosed area to prevent groundwater contamination from a potential spill.

Grade Stabilization Structure
Objective: This is used to control the grade and cutting in natural or artificial channels. This aids in the prevention of gullies, enhances environmental quality and reduces pollution hazards.

Grassed Waterway
Objective: To shape, grade, and establish vegetation on a natural watercourse to reduce erosion and sedimentation.

Heavy Use Protection Area
Objective: The use of vegetative cover or other materials to protect and restore areas where extensive damage has been done (ie., an area heavily used by livestock at a stream channel). This can result in reduction of nutrients from animal waste, soil, and other pollutants entering groundwater and/or surface water.

Irrigation System, Trickle
Objective: A system designed for efficient application of water directly to the root zone of plants. This minimized water use, reduces risk of erosion to surface water and accumulation of nutrients, pesticides, and salts in groundwater.

Irrigation Water Management
Objective: Determines and controls rate, amount, and timing of irrigation water in a planned and efficient manner. This minimizes soil erosion, loss of plant nutrients, and salt accumulation. Irrigation water management also controls undesirable water loss and protects water quality.

Livestock Stream Crossing
Objective: A structure enabling livestock to cross from one side of the stream to another, minimizing streambank erosion.

Nutrient Management
Objective: Used to maximize nutrient potential in soil to reduce threat to groundwater and surface water quality. Practices may include nitrate soil sampling (to measure nitrogen levels); soil testing for N, P, and K; use of cover crops; reduced starter fertilizer, etc.

Pasture and Hayland Planting
Objective: Provides long-term establishment of perennial and biennial forage plants, improving soil structure and infiltration capacity as well as reducing soil erosion and surface water runoff.

Pest Management
Objective: A tool using alternative measures aimed at reducing pesticide use. Practices may include: sprayer calibration, field scouting for insects or disease, crop rotation, conservation tillage, etc. This protects both groundwater and surface water from excess pesticides.

Planned Grazing Systems
Objective: A practice designed to maximize pasture productivity by alternating units and allowing for total plant recovery. This provides sufficient soil cover, reducing opportunity for erosion and surface water runoff It also reduces threat to water quality and maximizes full nutrient potential of manure by uniformly spreading it throughout the pasture(s).

Pond
Objective: May be used or developed as an alternative source of drinking water for livestock, to reduce impact livestock may have on streams.

Recreation TraillWalkway
Objective: A pathway prepared for pedestrian travel for recreation and erosion control purposes.

Residue Management (Mulch-till)
Objective: Growing crops where field is tilled prior to planting, leaving some residue. This practice will help to reduce sheet, rill, and wind erosion; improve surface water quality by reducing pesticide/sediment movement; conserve soil moisture; and provide food and escape cover for wildlife.

Residue Management (No-till)
Objective: Growing crops in previously untilled soil and residue to: reduce sheet, rill, and wind erosion; improve surface water quality by reducing pesticide/sediment movement; conserve soil moisture; and provide food and escape cover for wildlife.

Riparian Buffer Strip
Objective: Trees, shrubs, and other vegetation located in areas adjacent to and upgradient from water bodies. The purpose is to remove or filter nutrients, pesticides, sediment, and organic matter prior to reaching both groundwater and surface water. These areas also provide wildlife habitat.

Roof Runoff Management
Objective: A facility for collecting, controlling, and disposing of runoff water from roofs. The goal is to prevent runoff water from flowing across concentrated waste areas and barnyards to reduce erosion and improve water quality.

Sediment Basin
Objective: A barrier is constructed to for a basin designed to capture sediments. This structure can reduce costs to watershed residents by preserving the capacity of streams, ditches, etc., resulting in less cleaning and maintenance. This can also reduce pollution and improve stream habitat by providing a place for deposition of sand, silt, and other waterborne materials.

Spoil Spreading
Objective: Disposing of surplus materials from dredging by spreading them over surfaces of adjacent lands. This aids in establishment and control of vegetation along banks and results in less streambank erosion by reducing bank steepness.

Streambank Protection
Objective: To stabilize and protect banks of waterways, by reducing erosion and sedimentation caused by livestock access, surface water runoff, pedestrian, wildlife, and vehicle traffic.

Tree/Shrub Establishment
Objective: Planting trees and shrubs provides erosion control, reduces air pollution (by taking in soil and waterborne chemicals and nutrients), conserves energy, protects groundwater and surface water quality, provides, wildlife habitat, reduces noise pollution, and enhances the beauty of the watershed.

Trough or Tank
Objective: Provides alternative water source to livestock (besides surface water) and serves as a portable watering system designed to move from one pasture to another. This reduces impact to surface water quality from livestock access.

Use Exclusion
Objective: Excluding animals, people, or vehicles from an area in order to protect, maintain, or improve water quality in that area.

Waste Storage Facility
Objective: A waste impoundment made by constructing an embankment and/or excavating a pit or structure. The purpose of this is to temporarily store wastes such as manure, wastewater and contaminated runoff to protect water quality.

Waste Utilization
Objective: Proper application of animal wastes on fields to aid in maximizing nutrient potential and reducing threat of pollution to groundwater from leaching or direct runoff into surface water.

Well
Objective: To provide an alternative water source for livestock, irrigation, wildlife or recreation if no other source is available (ie., pond). This reduces heavy use impact on surface water supply and keeps livestock out of waterways.

Well Decommissioning
Objective: Consists of plugging and permanent closure of a well no longer in use. This prevents the entry of contaminated surface water and debris. It also eliminated the physical hazard of an open hole to people, animals, and farm machinery.

Wetland Development or Restoration
Objective: To restore, create, or enlarge wetlands to filter runoff from surrounding areas, reduce flood potential, improve wildlife habitat, and recharge groundwater.

Table 6. Best Management Practices (EMP's) Recommended for Critical Sites.

BMP	Quantityl Acres	*Cost!* Unit	Total Cost	Cost-share Rate	319 Funds	Other Funds	Local Match
Fencing for livestock Exclusion	24,000 ft.	*$1.60/ft.*	$38,400	75%	$14,400	$14,400	$ 9,600
Livestock Stream Crossing	7 each	$1,100 ea.	7,700	75%	2,887	2,888	1,925
Streambank Protection	2,500 ft.	*$20/ft.*	50,000	75%	11,250	18,750	20,000
Trough or Tank	3,000 gal.	$700/1,000 gallon tank	2,100	75%	787	788	525
Well	2 each	$1,500 ea.	3,000	50%	750	750	1,500
Pond	3 each	$1,200 ea.	3,600	50%	900	900	1,800
Pasture/Hayland Planting	255 acres	*$100/acre*	25,500	$30/acre	----	7,650	17,850
Planned Grazing Systems	255 acres	$35/acre	8,925	$30/acre	-----	7,650	1,275
Conservation Cropping Sequence	500 acres	$10/acre	5,000	50%	— —	2,500	2,500
Filter Strip	10 acres	$150/acre	1,500	75%	675	450	375
Critical Area Planting	3 acres	*$2,000/acre*	6,000	75%	2,250	2,250	1,500
Wetland Development! Restoration	50 acres	$500/acre	25,000	75%	5,624	9,375	10,000
Grassed Waterway	½ acre	$2,000/acre	1,000	75%	------	750	250

Table 6: Best Management Practices (EMP's) Recommended for Critical Sites Cont'd.

BMP's	Quantityl Acres	Cost! Unit	Total Cost	Cost-share Rate	319 Funds	Other Funds	Local Match
Conservation Cover	300 acres	$60/acre	$18,000	$45/acre	$ 2,250	$13,500	$ 2,250
Fish Stream Improvement	2 each	$1,000 ea	2,000	75%	750	750	500
Grade Stabilization Struct	9 each	$1,000 ea	9,000	75%	2,250	4,500	2,250
Irrigation System, Trickle	2 each	*$1,9001* 1,000 tips	3,800	50	950	950	1,900
Nutrient Management	3,000 ac.	$20/acre	60,000	75%	13,500	22,500	24,000
Pest Management	3,000 ac.	$20/acre	60,000	75%	13,500	22,500	24,000
Waste UtiIization	2,500 ac.	$25/acre	62,500	75%	— —	46,875	15,625
Heavy Use Protect Area	300 sq. ft.	$60/100 sq. ft.	180	50%	45	45	90
Agri-Chemical Containment Facility	3 sites	$15,000 ea.	45,000	75%	---	33,750	11,250
Fuel Containment Facility	4 sites	$5,000 ea.	20,000	75%	------	15,000	5,000
Diversion	3,000 ft.	$1.25/ft.	3,750	75%	937	1,876	937
Riparian Buffer Strip	6 acres	$150/acre	900	75%	----	675	225
Tree/Shrub Establishment	20 acres	$140/acre	2,800	50%	----	1,400	1,400
Well Decommissioning	20 wells	$500 each	10,000	75%	— —	7,500	2,500

Table 6: Best Management Practices (BMP's) Recommended for Critical Sites Cont'd.

BMP's	Quantity/ Acres	Cost! Unit	Total Cost	Cost-share Rate	319 Funds	Other Funds	Local Match
Irrigation Water Mgmt.	10 farms	*$350/farm*	$ 3,500	50%	---	$1,750	$1,750
Use Exclusion	1,000 acres	*$1.60/ft.*	1,600	75%	$ 600	600	400
Recreation Trail! Walkway	1	$500	500	50%	250	---	250
Spoil Spreading	10,000 cu. yds.	$550 per 1,000 cu. yds.	5,500	50%	825	2,750	1,925
Access Road	30 ft.	$*101ft.*	300	50%	150	------	150
Residue Mgmt. (No till)	200 acres	$30/ac.	6,000	$7.50/acre	1,500	1,500	3,000
Residue Mgmt. (Mulch till)	150 acres	$lO/ac.	1,500	$3.00/acre	450	450	600
In-field MixlLoad System	8 units	$2,000 ea.	16,000	50%	----	8,000	8,000
Water & Sediment Control Basin	2	$800 each	1,600	75%	----	1,200	400
Waste Storage Facility	3	$20,000 ea.	$60,000	50%	--	30,000	30,000
Roof Runoff Management	20 ac.	$15/ac.	300	50%	150	----	150
Total			$572,455		$ 77,627	$287,172	$207,656

Table 7: Implementation Schedule for Best Management Practices (BMP's)

BMP's	$ Implemented Year 1	year 2	Year 3	Year 4	YearS	Total Cost
Fencing for Livestock Exclusion	$11,520	$15,360	$11,520	$ -----	$ ----	$38,400.00
Livestock Stream Crossings	2,200	**3,300**	2,200	------	-----	7,700.00
Streambank Protection	10,000	10,000	10,000	10,000	10,000	50,000.00
Trough or Tank	700	700	700	------	----	2,100.00
Well	---	1,500	1,500	- ..--	----	3,000.00
Pond	1,200	1,200	1,200	------	----	3,600.00
Pasture/Hayland Planting	8,000	9,500	8,000	--	-----	25,500.00
Planned Grazing Systems	2,100	2,275	2,275	2,275	---	8,925.00
Conservation Cropping Sequence	1,000	2,000	2,000	-----	----	5,000.00
Filter Strip	300	600	600	----	---	1,500.00
Critical Area Planting	2,000	2,000	2,000	----	--	6,000.00
Wetland Development & Restoration	-----	7,500	7,500	10,000	------	25,000.00
Grassed Waterway	---	500	500	-----	---	1,000.00
Conservation Cover	6,000	6,000	6,000	-----	---	18,000.00
Fish Stream Improvement	---	1,000	1,000	----	--	2,000.00
Grade Stabilization Structure	2,000	3,000	4,000	-----	-----	9,000.00
Irrigation System, Trickle	---	1,900	1,900	---	-----	3,800.00
Nutrient Management	12,000	12,000	12,000	12,000	12,000	60,000.00
Pest Management	12,000	12,000	12,000	12,000	12,000	60,000.00
Waste Utilization	12,500	12,500	12,500	12,500	12,500	62,500.00
Heavy Use Protection Area	60	60	60	-----	---	180.00
Agri-Chemical Containment Facility	-----	15,000	15,000	15,000	--	45,000.00
Fuel Containment Facility	-----	5,000	5,000	5,000	5,000	20,000.00
Diversion	---	1,875	1,875	---	-----	3,750.00
Riparian Buffer Strip	300	300	300	------	-----	900.00
Tree/Shrub Establishment	--	1,400	1,400	---	---	2,800.00
Well Decommissioning	5,000	5,000	--	---	--	10,000.00
Irrigation Water Management	700	700	700	700	700	3,500.00
Use Exclusion	500	500	600	-----	------	1,600.00
Recreation Trail/Walkway	-----	500	-----	----	-----	500.00

Table 7: Implementation Schedule for Best Management Practices (BMP's) Cont'd.

BMP's	$ Implemented Yearl	Year 2	Year 3	Year 4	YearS	Total Cost
Spoil Spreading	$ I,IOO	$ 1,100	$ 1,100	$1,100	$1,100	$ 5,500.00
Access Road	-----	300	---	-----	-----	300.00
Residue Mgmt. (No till)	2,000	2,000	2,000	----	-----	6,000.00
Residue Mgmt. (Mulch till)	500	500	500	-----	-----	1,500.00
In-Field MixlLoad System	8,000	8,000	----	----	-----	16,000.00
Water & Sediment Control Basin	----	800	800	----	-----	1,600.00
Waste Storage Facility	--	20,000	20,000	20,000	-----	60,000.00
Roof Runoff Management	-	150	150	-----	-----	300.00
Total	101,680	168,020	148,880	100,575	53,300	$572,455.00

Innovative Techniques in the Watershed

Global Positioning System (GPS) technologies, using satellites to determine exact locations, will reduce groundwater and surface water nutrient loading by coupling nutrient application to soil fertility and crop uptake. Current fertility management *involves* broadcasting entire fields with a single rate of N, P, and K, resulting in great overapplication in some areas of the field. The resulting high *levels* lead to increased phosphorus in surface runoff and nitrate contamination of groundwater. Site specific application techniques apply nutrients at *varying* rates in the same field depending on soil *levels* and yield potential based upon yield maps from previous harvests. The same principals apply to manure management and application *varying* rates using the same information.

New techniques in agriculture are being analyzed at a local *level* by the Innovative Farmers of South Central Michigan. The newly organized Innovative Farmer's are investigating sustainable agricultural practices that minimize impacts of agriculture on the environment, while still maintaining profitable levels. The group serves as a mechanism to acquire experimental equipment for use on demonstration plots. Some of the techniques being examined include:

Banding of Pesticides to Reduce Pesticide Use
Corn Borer Resistant (Bt) Corn
Roundup Ready Soybeans
Reduced Tillage
Site Specific Farming using GPS
Interseeding Legumes into Corn
On-the-Go Nitrogen Application Technologies
Manure Composting

Current Watershed Nonpoint Source Initiatives

Following is a list **of** ongoing programs available in the Nottawa Creek Watershed, offering opportunities for the development of conservation practices. These initiatives will aid in protecting water quality for all designated uses in the watershed.

Environmental Quality Incentives Program· Focuses assistance to locally identified conservation priority areas or areas where agricultural improvements will help meet water quality goals. Funds will be available to pay for technical assistance and cost-sharing on conservation practices. Fifty percent of the funds are dedicated to conservation associated with livestock operations. Implementation of practices such as livestock exclusion and manure storage will greatly benefit water quality in the Nottawa Creek Watershed.

Wetlands Reserve Program . Provides landowners options for protecting wetlands. Landowners may choose either permanent or 3D-year easements, or restoration only cost-share agreements. This will contribute to the project's goals of protecting and restoring wetlands in the watershed.

Conservation Reserve Program· Offers financial opportunity for landowners who are willing to take highly erodible lands out of production. This is an option available for agricultural fields with erosion problems and farmland in the vulnerable groundwater portions of the watershed.

Wildlife Habitat Incentives Program· Will be providing $50 million through the year 2002 to help landowners improve wildlife habitat on private lands. This project is funded by the Michigan **DNR** and is matched by local sponsors. Increasing development and urban expansion have reduced the amount and quality of wildlife habitat in Calhoun County. Assistance from this program will help the Nottawa Creek Watershed Project improve wildlife in riparian areas.

Forestry Incentives Program. Offers assistance in writing forestry management plans for landowners who are interested in maximizing the potential of their woodlots. This includes planting woodlots, managing woodlots for lumber production, etc. Woodlots are valuable to the protection of water quality, and this program will help to sustain this land use. The Calhoun Conservation District also holds annual tree sales in an effort to improve air and water quality, wildlife habitat, scenery, and other valuable resources.

Groundwater Stewardship Program· Educates and offers cost-share opportunities to farm producers who are interested in protecting water quality at the farmstead. The Farm*A*Syst Program is a series of worksheets which enables the farmer to evaluate his/her own practices on the farmstead and how they may be impacting water quality. Cost-share money is available to producers interested in: decommissioning abandoned wells, manure and nitrogen management, mixinglloading pesticides in the field rather than on the farmstead, fertilizer containment, pesticide storage, and other practices. This program will

help the watershed project protect groundwater resources in those vulnerable areas.

Water Quality Monitoring Project - Athens High School students, led by their science teacher, have been actively monitoring water quality in the Nottawa Creek near Athens for the past 7 years. This project teaches young people in the watershed about the importance of protecting and maintaining their water resources. It is the only regular water quality monitoring program going on in the Nottawa Creek. The data is useful in measuring changes occurring in the Nottawa Creek. This program will continue as long as there is funding available.

Friends of the St. Joseph River Project· Encourages all watersheds around the 5t. Joseph River to protect and maintain water quality for health and recreation purposes. The Nottawa Creek Watershed is a subwatershed of the 5t. Joseph River. Efforts to remove garbage and brush for recreation and improve habitat for fisheries in area streams are the main goals of this project. New efforts encouraging schools in every watershed to participate in water quality monitoring activities are taking place.

Other funding or in-kind services may come from the following:

Calhoun County Drain Commission
Calhoun County Community Development
Calhoun County Dept. of *Environmental Health*
Calhoun County MSU Extension
Calhoun Conservation District
319 Clean Waters Act
Potawatomi RC &D
Watershed Residents
Local Businesses
Pheasants Forever
Trout Unlimited
Ducks Unlimited
Local Service Clubs
Village of *Athens*

CHAPTER X: Information and Education Plan

An Information and Education (I &E) Task Team was formed to assist the Nottawa Creek Watershed Project in developing an Information and Education Plan to be implemented in the next several years. The team consisted of individuals with varying backgrounds and expertise, providing the project with guidelines on how to effectively increase awareness among watershed residents to protect water quality. Several meetings resulted in the development of a mission statement; a survey to be distributed to watershed residents; a listing of target audiences, partners, and resources; and objectives and strategies for the information and education process.

Members of the I & E Team consisted of:

Carl Moquist, Farmer, Lake Association Member
Dorothea Moquist, Homer Elementary Science Teacher
Lauren Hughes, WMU's G.E.M. Center
Ronda Wuycheck, Grant Administrator (MDEQ)
Sue Hauxwell, Calhoun County Environmental Health
Natalie Rector, MSU-E Agricultural Agent
Dan Kesselring, NRCS District Conservationist
Sharon Williams, Watershed Technician

Mission Statement:

To promote stewardship and shared community values within the Nottawa Creek Watershed, through raising awareness of ground and surface water quality and their relationship to land use and management decisions.

I & E Objectives:

1) Increase public knowledge and awareness of watersheds, including the relationship between groundwater and surface water.
2) Educate stakeholders about the environmental impacts of land use activities on the watershed.
3) Develop partnerships among stakeholders by sharing ideas, resources, and facilitating cooperative activities that increase public awareness of watershed management and impact land use policies.
4) Create a sense of individual responsibility for the proper use and care of groundwater and surface water resources.

The I & E Team developed lists of Target Audiences, Partners, and Resources to more effectively determine how and where to focus the information and education program.

Target Audience➜ *Agricultural Producers (Farmers)*

Concerns➜ Sediment and nutrients from cropland erosion, livestock access, wetland drainage, septic systems, and pesticides from ago land use

Activities➜ ① Partner with the Conservation District, NRCS, MSU Extension, Innovative Farmers of South Central Michigan, Farm Bureau, etc. in developing educational sessions and demonstration plots to show best management practices, such as nitrogen management, conservation tillage, cover crops, manure management, etc.

② Develop Nutrient Management Yardstick Program, in cooperation with Extension Agent, to measure on-farm nutrient inputs vs. outputs

③ Work with Conservation District in encouraging ago residents to participate in Farm*A*Syst evaluation, which includes septic system maintenance, pesticide/fertilizer storage and handling, and management of drinking water well

④ Work with Conservation District, Farm Bureau and MSU-E in developing land use planning workshops to encourage watershed protection efforts

⑤ Seek participation in the Adopt-A-Stream Program

⑥ In cooperation with the Conservation District's Groundwater Stewardship Program, hold Groundwater Stewardship Tour to educate residents about watersheds as well as methods to protect water quality

⑦ Initiate Buffer Strip Program

⑧ Develop water quality monitoring program

® Promote Pesticide Container Recycling Program, Tire Collection Days, Hazardous Waste Drop-off events and other activities, through newsletters

⑩ Hold watershed tours to teach producers about watershed management

⑪ Submit articles to Farm Journal Magazine

⑫ Highlight farmers doing a good job (through awards program)

⑬ Hold public meetings, advisory committee meetings, and provide fact sheets to inform producers about watershed project activities/practices to protect groundwater and surface water

Target Audience➜ *Rural, Non-farmNillage Residents*

Concerns➜ Fertilizer and pesticides from lawns and gardens, household hazardous waste, and nutrients from septic systems

Activities ➜ ① Distribute newsletter informing residents about watershed activities, events, and water quality issues
② Make available educational packets and Home*A*Syst assessment on how to protect groundwater and surface water, by following proper septic system maintenance, lawn and garden care, and use of household hazardous chemicals
③ Provide opportunity for residents to attend local tour to learn about watersheds and watershed management
④ Promote annual household hazardous waste drop-off event, tire collection day
⑤ Adopt-A-Stream
⑥ Conduct water well monitoring program
⑦ Distribute flyers, newsletters, etc. on what individuals do to pollute and how they can improve

Target Audience ➜ *Lake Residents*

Concerns ➜ Fertilizer and pesticides from lawns and gardens, nutrients from leaf burning and septic systems, household hazardous waste, and watercraft activity

Activities ➜ ① Develop and distribute educational packets on septic system maintenance, composting, and proper lawn and garden care
② Adopt Lake*A*Syst program to help lake residents assess the impact of their activities on water quality
③ Attend Lake Association meetings to update residents on watershed project activities and water quality issues
④ Provide information on water quality monitoring programs for lakes.
⑤ Develop Adopt-A-Lake program
⑥ Target newsletter articles regarding lake activities, water quality issues, etc.
⑦ Promote annual household hazardous waste drop-off, tire collection days

Target Audience ➜ *Businesses (Industrial and Non-Industrial) in the Watershed*

Concern ➜ Lack of awareness of impacts from land use activities on watershed

Activities ➜ ① Target newsletter articles concerning business-related issues about watershed activities &events, water quality issues, and methods they can use to protect groundwater and surface water
② Seek participation in the Adopt-A-Stream program
③ Seek sponsorship of local events to increase level of watershed awareness.

Target
Audience➜ Township Government

Concerns➜ Lack of awareness among decision-makers about impacts of land use activities on water quality

Activities➜ ① Develop network of individuals to influence loeallevel about impacts of land use activities on water resources in the watershed. Include education about trend futures of Michigan
②Conduct workshops and meetings to update local decision-makers about new land use planning issues and land use management tools
③ Distribute educational packets about water quality issues to township offices
④ Visit township meetings to update local officials about Nottawa Creek Watershed Project activities
⑤ Produce slide show about project

Target
Audience➜ Schools

Concern➜ ①Low level of awareness among students of groundwater and surface water quality issues
② Lack of educational materials on watershed management

Activities➜ ① Provide school presentations using enviroscape
② Provide educational materials to students and teachers about proper use and eare of their groundwater and surface water resources
③ Sponsor local Envirothon Team to educate high school students about watershed management
④ Work with Athens High School Science class in conducting water quality monitoring project
⑤ Include area schools in local Adopt-A-Stream program
@Work with local elementary students to develop logo for watershed project, to be used for newsletters, t-shirts, hats, etc.
⑦ Offer scholarships to teachers/students for environmental education and training

Target
Audience➜ Village Government

Concern➜ Lack of awareness among citizens and village officials about impacts of land use activities on water quality

Activities ➜ ① Provide educational meetings/workshops to inform village officials about groundwater and the vulnerability of their local aquifer
② Provide village with educational materials on proper septic system maintenance, lawn & garden care, and effects of household hazardous waste and storm water runoff on water quality
@Present village officials with regular updates on watershed project activities
④ Develop network of individuals to inform village officials about impacts of land use activities on the watershed. Indude education about trend futures of Michigan
⑤ Hold Land Use Planning Workshops

Target Audience ➜ *Youth Clubs (FFA, Boy/Girl Scouts, etc.)*

Concerns ➜ ① Lack of educational materials on watershed management
② Low level of awareness among youth of groundwater and surface water quality issues

Activities ➜ ① Work with local FFA in conducting land use discussion meet to educate individuals about current trends of development in Calhoun County, and its impact on water quality as well as agriculture
② Hold annual canoe trip for Boy/Girl Scouts to educate them about watersheds as well as methods to protect water quality
③ Encourage participation from FFA in establishment of buffer strips along waterways
④ Distribute educational materials to youth on proper lawn/garden care and septic system maintenance
⑤ Provide tour at local campground educating youth about watersheds and watershed management
⑥ Offer scholarships for environmental education/training
⑦ Adopt-A-Stream

Target Audience ➜ *Garden Clubs*

Concern ➜ Lack of awareness of watersheds and watershed management

Activities ➜ ① Work with MSU Extension in providing educational materials to garden clubs on proper lawn and garden care
② Provide newsletters informing gardeners about watershed activities, events, and water quality issues

Target
Audience → *All Watershed Residents*

Concern → Lack of awareness of watersheds and water quality issues

Activities →
① Distribute newsletters informing residents about watershed activities, events, and water quality issues
② Make available educational packets, fact sheets, brochures, etc. on how to protect groundwater and surface water
③ Adopt-A-Stream program
④ Sponsor programs to clean up entire watershed (ie., tire collection day, household hazardous waste collection, etc.)
⑤ Work with local groundwater technician in encouraging residents to participate in Home*A*Syst evaluation
® Organizelhold field day for general public to promote watershed awareness
⑦ Make available hats, t-shirts, etc. to promote watershed project
⑧ Highlight residents doing a good job, through articles in local newspapers, awards program, etc.
® Hold public meetings to inform residents about project activities

Partners are those cooperating agencies that will work with the watershed project in enabling it to achieve its objectives. Most of *these organizations are active on the Nottawa Creek Advisory Committee. Following, is* a *list* of *those pariners and their roles (past, present, and future):*

Calhoun County Environmental Health
→Has provided data on contamination sites and nitrates in the area.
Will assist in water quality samplinglanalysis, household hazardous waste and tire collection days, as well as education of proper septic system maintenance.

Drain Commissioner
→Has been very helpful in providing information on drainage in watershed.
Will assist in implementing best management practices along waterways.
Will continue to provide drainage information and work closely with watershed project to protect water quality.

Michigan Depariment of *Environmental Quality (MDEQ)*
→Has been very valuable in guiding the project during its planning phase.
Will continue to administer project, and support technical assistance as well as information and education activities.
Is also active on the Nottawa Creek Steering Team, which keeps the project focused and on target.

Deparlment of *Planning and Development*

➔Has provided local census data and zoning maps of townships in the watershed.

Will assist in developing local network of individuals to provide training and education to townships regarding up to date land use planning techniques.

Natural Resource ConseNation Service

➔The District Conservationist has provided several days of training on inventory procedures and Best Management Practices. He will be responsible for training watershed technician on Resource Management Systems and Field Office Computing Systems (FOCS), to be utilized during transition and implementation stages.

NRCS has provided resource information on soils and other relevent data.

The District Conservationist is an active member of the Nottawa Creek Steering Team and Advisory Team.

Calhoun ConseNation District

➔Responsible for local administration of project.

Provides office space, resources, and matching funds for duration of granting period.

Calhoun County Road Commission/Public Works

➔Has provided data and plans on sewer systems in the watershed.

Will cooperate with watershed project in implementing Best Management Practices to improve road crossings.

Environmental Protection Agency (EPA)

➔Provides funding and guidelines for planning, transition, and implementation phases of the project.

Friends of *the St. Joe River*

➔Is actively working with the Nottawa Creek Watershed Project in developing a water quality monitoring program with local schools.

The organization's founder has been an active participant in the Advisory Committee Meetings.

Michigan Deparlment of *Transporlation (MOOT)*

➔Will assist the project to reduce inputs of road salts and sediments along the I-69 and Old U.S. 27 corridors. These go directly through the Nottawa Creek Watershed and both intersect the Nottawa Creek.

Calhoun County Board of *Commissioners*

➔Is the governing board and policy-making body of the county government.

The Board has been informed about the watershed project and has supported activities pertaining to water quality protection.

Michigan Deparlment of Agriculture (MDA)

→Is working with the Conservation District, through the Groundwater Stewardship Program, to improve groundwater quality.

This program will be utilized by the Nottawa Creek Watershed Project to encourage land use practices which protect groundwater in the Nottawa Creek Watershed.

Potawatomi RC &0

→Has provided resource information on inventory procedures and is contributing to the development of a watershed plan.

Has also provided assistance in searching for grant funds for the Nottawa Creek Watershed Project and is an active member of the Steering Team and Advisory Team.

WMU GEM Center

→Western Michigan University's Groundwater Education in Michigan Center is partnering with the Conservation District in studying the Nottawa Creek Watershed. Lauren Hughes has been instrumental in leading the groundwater study for this project, looking at critical groundwater areas in the watershed. Future involvement of the GEM Center will be essential in the success of this project. The development of tools for education on land use issues and groundwater educational materials for watershed residents will be just part of GEM's contribution.

MSU Extension

→The Calhoun County Agricultural Agent will be working with the watershed project to promote sustainable agriculture by initiating demonstration plots on nitrogenlmanure management, cover crops, rotational grazing, conservation tillage, etc. MSU-E will also assist in developing a land use planning network and local workshop on planning by watersheds. MSU-E will work cooperatively with producers in the watershed in establishing a tool to measure nutrient inputs vs. outputs on the farm, which will result in better utilization of nutrients to protect water quality.

Innovative Farmers of South Central Michigan

→Is a group of producers working as a community in developing demonstration projects to learn about new sustainable practices and techniques. This provides farmer-based research that can be utilized by local farmers and applied to their own individual situations. The information compiled from the demonstration plots is shared with other Innovative Farmers. Producers within the watershed will work with the project to implement demonstration plots looking at nitrogenlmanure management, cover crops, etc. This will be done in cooperation with MSU Extension.

Farm Services Agency

→Provides cost-share opportunities and assistance to residents for demonstration practices in the watershed.

Calhoun County Board of Commissioners
➔Is the governing board and policy-making body of Calhoun County, and has remained informed of the project, supporting its objectives.

***Resources** are those agencies, organizations, etc. which will provide assistance to the project in enabling it to achieve its objectives. Following, is a list of those resources:*

A. *Farm Organizations*
   1. *National Farmer's Union*
   2. *Calhoun County Farm Bureau*
   3. *National Farmer's Organization*
   4. *Grange*
B. *Churches/Service Clubs, etc.*
C. *Environmental/Sportsman's Clubs*
   1. *Pheasants Forever*
   2. *Nature Conservancy*
D. *South Central Michigan Regional Planning*
E. *Information Networks*
   1. *Community Ad-Visor*
   2. *Battle Creek Enquirer*
   3. *District Newsletter*
   4. *Nottawa Creek Newsletter*
F. *Businesses*

I & E Activities

Adopt-A-Stream

This program will be developed for use by watershed residents, students, businesses, agricultural producers, organizations, etc. to clean up and maintain the Nottawa Creek. Adopt-A-Stream signs will be posted at road intersections along the creek showing who is responsible for each section. To keep the program running efficiently, dates and activities will be scheduled twice annually.

Tire Collection Day

Tires are a major source of garbage found in streams and along uninhabited roadsides. An annual event will be co-sponsored by the watershed project (in cooperation with the Calhoun County Road Commission) to encourage all watershed residents to bring in scrap tires for recycling. This has been done in Calhoun County in the past and has proven to be a very successful program.

Household Hazardous Waste Collection Event

In cooperation with the Calhoun County Environmental Health Department, the Nottawa Creek Watershed Project will co-sponsor an opportunity for all watershed residents to bring in unused, unwanted hazardous wastes. These may include: banned pesticides, lead paints, cleaners, batteries, etc. This event will be held twice a year at the Health Department and/or Road Commission.

Canoe Trips for Watershed Education

Scheduled trips will be held to provide basic watershed education to watershed residents. Canoe trips will be planned twice annually and will address different audiences each time. Audiences will include: Boy/Girl Scouts, students, organizations, agricultural producers and other interested individuals.

Watershed Tours

Tours will be provided to educate various audiences about watershed management. These will take place throughout the time frame of the project.

Brochure

Brochures promoting the Nottawa Creek Watershed Project will be distributed to townships, villages, businesses, organizations, etc. The brochure will be used to promote the project, provide basic watershed education, and offer tips on how to protect the Nottawa Creek watershed.

Nottawa Creek Watershed Poster

The poster will show a boundary map of the Nottawa Creek watershed. It will provide a perspective of water flow patterns and characteristics both above and below ground in the watershed, to demonstrate the unique relationship between groundwater and surface water.

Public Meetings

Meetings to inform townships, lake associations, organizations, watershed residents and others will be held to inform individuals about project activities. Some meetings will focus on a particular aspect of watershed education. Topics will include: land use planning; groundwater stewardship; pest and nutrient management; forestry, wetland, and wildlife planning, etc.

Groundwater Stewardship Tour

The tour will be sponsored by the Calhoun/Branch Groundwater Stewardship Program to raise awareness of groundwater protection. It will demonstrate how to close abandoned wells and discuss cost-share opportunities for practices to protect groundwater. The tour will be offered to anyone who is interested.

Nutrient Management Yardstick

The yardstick is a tool designed to measure on-farm nutrient inputs vs. outputs. By tracking all nutrients entering and leaving the farm, the producer can then determine if there's a surplus. The program will be developed in cooperation with the MSU Extension ago agent and the Nottawa Creek Watershed Project and administered by both.

Buffer Strip Program

This program will be developed in association with the local FFA to establish buffer/filler strips in fields adjacent to waterways.

Nottawa Creek News/etters

These will be distributed quarterly to all watershed residents. Watershed project activities, events, and educational material will be included in the newsletters.

Advisory Committee Meetings

Meetings will take place quarterly to inform members on project activities and progress. The committee will also provide feedback on which direction the project should take.

Pesticide Container Recvcling Program

The Nottawa Creek Watershed Project will work with the Calhoun County Recycling Coordinator to provide information on drop-off locations for pesticide containers. This program has been available to watershed residents, but there is a lack of information regarding dates and locations for drop-off.

Innovative Farmer Demonstration Plots

The Innovative Farmers of South Central Michigan are a group of producers working to develop sustainable agricultural practices for their area of the state, by using demonstration plots. Some of these on-farm studies look at interseeding legumes into standing corn, using row-crop tillage to reduce pesticide applications, growing organic vegetables, rotational grazing, and reduced nitrogen applications based on nitrate soil sampling.

Fact Sheets/Brochures

These will provide educational material on groundwater and surface water and their interaction as well as useful tips on protecting watershed resources.

Classroom Presentations and Curriculum

Through the use of enviroscape and other educational materials, students will learn about proper use and care of their water resources. Teachers will be provided with tools for educating students about water quality issues.

Scholarships for Environmental Education and Training

Scholarships will be awarded, through the Nottawa Creek Watershed Project, to *studentslteachers* for various environmental education and training programs available throughout the state.

Water Qualitv Monitoring Program

With assistance from the Michigan Department of Environmental Quality (MDEQ), a workshoplfield day will be held to train high school students on proper water quality monitoring techniques.

Citizen Network (for Land Use Planning)

A network of individuals will be organized to influence local government about the impacts of land use activities on groundwater and surface water resources. Land use planning workshopslmeetings will be held to educate township planning officials about current land use trends and ordinances.

T-shirts. hats, and other promotional materials

A logo will be developed and used on t-shirts, hats, newsletters, etc. to promote the Nottawa Creek Watershed Project. These items will be available at the Calhoun Conservation District.

Table 8: I & E Implementation Schedule

Activity	Quantity	Cost	Total Cost	Implementation Dates
Adopt-A-Stream	1 program	$3,000	$3,000	Mar, 1999 - *
Promotion of Tire and Appliance Collection Day	2,000 flyers! 3 events	$.25 ea	1,500	Apr, 1999-Jul, 2001
Promotion of Hazardous Waste Collection Day	2,000 flyers! 3 events	$.25 ea	1,500	Jun,1999-Aug,2001
Canoe Trips (1 per yr.)	5 trips	$250 ea	1,250	Apr, 1999-Sep, 2003
Watershed Tours	5 tours	$200 ea	1,000	Apr, 1999-Apr, 2003
Brochures	2,000	$.75 ea	1,500	Jan, 1999-Dec, 2001
Posters	100	$8.00 ea	800	Jan, 2000
Public MeetingslWorkshops	10	$250 ea	2,500	Feb, 1999-0ct,2003
Groundwater Stewardship Tour (1 per year)	2	$25 ea	50	Aug, 1999-Aug,2000
Nutrient Mgmt. Yardstick	25 farms	$30 ea	750	Mar, 1999-Dec, 2003
NewsletterslFact Sheets	20 mailings (2000 copies)	$.30 ea	12,000	Jan, 1999-Dec,2003
Advisory Committee Mtgs.	20	$25 ea	500	Feb,1999-Nov,2003
Promotion of Pesticide Container Recycling	3 mailings (2000 copies)	$.30 ea	1,800	Mar,1999-Nov,2001
Innov. Farmer Demo. Plots	25 plots (5 plotsfyr)	$1,250!yr	6,250	Mar, 1999 - *
Plot PromotionfDevelop.	2000 newsI.!yr @5yrs	$.30 ea	3,000	Dec, 1999-Dec,2003

Table 8: 1& E Implementation Schedule Cont'd.

Activity	Quantity	Cost	Total Cost	Implementation Dates
School Water Quality Monitoring Program	5 programs	$500 ea	$2,500	Jul, 1999 - *
Nottawa Creek Watershed Signs	6 signs	$500 ea	3,000	Aug, 1999-Dec, 2000
T-shirtsIHats	150	$12.50 ea	$1,875	May, 1999
Land Use Planning! Ordinance Develop.	5 workshops	$2,000 ea	$10,000	Nov, 1999 - *
		Total Cost	**$54,775.00**	

CHAPTER XI: Agencies Involved in Project Implementation

The following agencies will potentially be available for project implementation:

"Athens Township, Stephen Irons, SupeNisor

"Athens Village, Douglas D. Denney, President

"Burlington Township, Brian AcMoody, SupeNisor

"Calhoun ConseNation District, Tracy Bronson, Administrator. The ConseNation District will be the lead agency for this project. Ms. Bronson will be responsible for local administration of the project. The District will also provide office space, resources, and matching funds for the duration of the granting period.

"Calhoun County Board of Commissioners, George Perrett, Chairperson. The Board of Commissioners is the governing board and policy-making body of the county government. The Board has been informed about the watershed project and will continue to support activities pertaining to water quality protection.

"Calhoun County Drain Commission, Don Eishen, Drain Commissioner. Mr. Eishen will assist in implementing best management practices along waterways. He will also continue to provide drainage information and work closely with the watershed project to protect water quality.

"Calhoun County Env. Health, Sue Hauxwell. Ms. Hauxwell will assist in water quality sampling/analysis, household hazardous waste and tire collection days, as well as education of proper septic system maintenance.

"Calhoun County MSU Extension, Natalie Rector, Agricultural Agent. Ms. Rector will be working with the watershed project to promote sustainable agriculture by initiating demonstration plots on nitrogen/manure management, cover crops, rotational grazing, conservation tillage, etc. MSU-E will also assist in developing a land use planning network and local workshop on planning by watersheds. MSU-E will work cooperatively with producers in the watershed in establishing a tool to measure nutrient inputs vs. outputs on the farm, which will result in better utilization of nutrients to protect water quality.

"Calhoun County Community Development, Richard Smith and Joyce Foondle. (This agency includes both County Planning and the Road Commission). Community Development will assist in developing a local network of individuals to provide tools and education to townships regarding up to date land use planning techniques and will cooperate with the watershed project in implementing systems of best management practices to improve road crossings.

"Clarendon Township, Bruce Mittelstadt, Supervisor

"Eckford Township, Athol Hazen, Supervisor

"Emmett Township, James Demarest, Supervisor

"Farm Services Agency (FSA), Elizabeth Lake, Director. The Farm Services Agency will provide assistance on cost-share for demonstration practices in the watershed.

"Fredonia Township, David Sebring, Sr., Supervisor

Friends of the St. Joe River, Al Smith. Mr. Smith will be actively working with the Nottawa Creek Watershed Project in developing a water quality monitoring program with local schools. He will also remain an active participant of the Advisory Committee Meetings.

Lee Lake Association, Janie Swarthout, President

Lyon Lake Association, Diane Hazen, President

"Michigan Department of AgricUlture (MDA). Through the Groundwater Stewardship Program, MDA will work with the Conservation District to improve groundwater quality. This program will be utilized by the Nottawa Creek Watershed Project to encourage land use practices which protect groundwater in the Nottawa Creek Watershed.

"Michigan Department of Environmental Quality (MDEQ), Jenny Molloy. Ms. Molloy will administer the project and provide technical assistance on implementation activities. She will provide leadership on the Nottawa Creek Steering Team and Advisory Committee in an effort to keep the project focused and on target.

"Michigan Department of Transportation (MDOT). MDOT will assist the project to reduce inputs of road salts and sediments along the 1-69 and Old U.S. 27 corridors in the watershed.

"Natural Resources Conservation Service, Dan Kesselring, District Conservationist. He will be responsible for training the watershed coordinator on Resource Management Systems and Field Office Computing Systems (FOCS), to be utilized during transition and implementation stages. Mr. Kesselring will also approve implementation plans as needed and will remain an active member of the Nottawa Creek Steering Team and Advisory Committee.

"Newton Township, Sue Ann Jessup, Supervisor

Nottawa Lake Association, LaVerne Hill, President

Potawatomi RC & 0, Jim Coury, Coordinator. Mr. Coury will continue to offer assistance in searching for grant funds for the Nottawa Creek Watershed Project and plays an active role in providing leadership and direction through the Steering Team and Advisory Committee.

'Tekonsha Township, Nelson Shedd, Supervisor

'Western Michigan University's Groundwater Education in Michigan Center, Lauren Hughes. The GEM Center will continue to partner with the Conservation District in providing education to the Nottawa Creek Watershed. The development of tools for education on land use issues and groundwater educational materials for watershed residents will be part of GEM's contribution.

'Has legal authority to assist in implementation

CHAPTER XII: Project SchedulelEvaluation

Project Implementation Schedule

Activity	*Date*
Submit Implementation Proposal	Feb, 1998
Begin Transition Phase - Begin identifying demonstration projects for critical sites and begin application ofInformation and Education (I & E) Program	Feb, 1998
Notify Watershed Residents (in critical areas) and Agencies Involved in Project Implementation of Program OpportunitieslEligibility (December of each implementation year)	1998-2002
Begin Sign-up for Resource Management System (RMS)	1999-2003
Implementation Plans and Cost-Share Assistance (Sign-up will be in February of each implementation year)	1999-2003
Select Priority Requests from Sign-up List for Development and Implementation of RMS' (January of each implementation year)	1999-2003
Plan and Design Systems of Best Management Practices for Final Implementation	Feb, 1999 - Dec, 2002
Install Resource Management Systems	Feb, 1999 - Dec, 2003
Continue Application of I & E Program Activities	Feb, 1999 - Dec, 2003
Hold Advisory Committee and Steering Team Meetings (quarterly)	Feb, 1999 - Dec, 2003
Review Progress of Project and Make any Needed Changes (Final Quarter)	1999 - 2002
Conduct MDEQ Biosurvey on the Nottawa Creek to Measure Changes in Water Quality	Apr, 2001
Distribute Survey to Determine Changes in Watershed Awareness Among Watershed Residents	Aug, 2003
Prepare Final Report on the Nottawa Creek Watershed Management Plan	Oct - Dec, 2003
Hold Public Meeting to Present Final Project Outcomes	Dec, 2003
Insure Continuance of Sound Management Practices Beyond Scope of Watershed Project	Dec, 2003

Project Evaluation

The success of the Nottawa Creek Watershed Management Plan and subsequent implementation activities recommended by the plan will be effectively evaluated by a variety of procedures. These procedures, while gauging plan implementation, will also provide timely feedback to correct, change, or expand project activities. This will guarantee project responsiveness to publicly developed goals and objectives.

One of the primary evaluation tools will be the oversight by both the Steering Team (a small group of watershed partners meeting monthly) and the Advisory Committee (a broader representation of watershed organizations meeting quarterly). The Watershed Coordinator will prepare reports for each group, highlighting expected goals/objectives for the period, project progress and measures instituted, and upcoming expectations. This review will allow regular judgement and adjustments to occur for the program. MDEQ representatives sit on both committee's and will provide direct oversight for the project.

Another key evaluation tool will be the regular progress reports (monthly) mandated by the MDEQ. These will provide a regular check and the possibility for project adjustments. These checks will be made by the MDEQ and the Steering Team. A further useful tool for evaluation will be the Watershed Coordinator's weekly schedule which will provide a delineation of needed activities undertaken for project success. These schedules will be saved and annotated for each day's actual activities, providing a check of activities undertaken.

Other useful eyaluation tools will be utilized. Reporting forms which show the number, type, and effectiveness of best management practices (bmp's) applied will be created. In regards to infonnation and education programs, the number, diversity, level of understanding (before and after event), and subsequent conservation actions of key watershed citizens and organizations will be tracked and recorded. The Calhoun Conservation District, Western Michigan University (WMU), and USDA Natural Resources Conservation Service (NRCS) all have computers that will be consistently utilized to store recorded resource data, applied conservation measures, and information/education programs. All of these above tools will serve as an excellent evaluation system.

More evaluation techniques will be employed. Since the primary non-point source pollutants of concern are sediments and nutrients, further evaluation of the project's effectiveness will include erosion reduction and stream loading changes occurring from installation ofbmp's. These changes will be recorded using USDA's Revised Universal Soil Loss Equation (RUSLE) and sediment delivery ratios (for surface water). The WMU Groundwater Education in Michigan (GEM) program will deliver results on groundwater quality trends and hydrogeology. Some surface water and groundwater quality nutrient/chemical testing and analysis will be done at selected sites periodically to investigate water quality trends as the project evolves and bmp's are implemented.

Biological surveys of watershed stream ecosystems have been made in the past at selected sites along the Nottawa Creek. These were done by the Michigan Department of Environmental Quality (MDEQ). Follow-up biological surveys at the selected sites will be requested during the implementation phase to provide more comparative data on surface water quality trends. Use of these biotic diversity indices provides another evaluation tool for water quality improvement and project effectiveness.

The extensive Information and Education Program Plan will have its own specific evaluation procedures as it is implemented. The evaluation measures used in this area would consist of follow-up surveys completed after the first several years of implementation. An initial survey was done during the planning year regarding awareness and knowledge of watershed water quality problems, issues, and solutions. Follow-up surveys done near project completion would reveal the levels of growth in water quality awareness and the effectiveness of the lIE program. Information and education activities and events, numbers of participants, and the sectors they represent will be documented as another evaluation measure of project success.

CHAPTER XIII- 319 PROJECT COST ESTIMATES (YEARS 1,2, &3)

Budget Categories	Grant Funds	Local Match	Total
Staffing Cost:			
Project Coordinator (6240 hours at $13.00Ihr.)	$81,120		$81,120
Clerical (1200 hours at $12.00Ihr.)	14,400		14,400
Conservation District Assistance (300 hours at $12.00Ihr.)		$3.600	3.600
SUbtotal:	$95,520	3.600	$99.120
Fringe Benefits:			
Project Coordinator (25% of salary)	$20.280		$20.280
Clertcal (15% of salary)	2,160		2.160
SUbtotal:	$22.440		$22,440
Supplies and Equipment:			
Project Matertals ($1.100/yr.)	$ 3.300		$ 3.300
Office Supplies ($1.000/yr.)		$ 3.000	3.000
Computer Software and Use *($4,0001yr.)*		12.000	12.000
SUbtotal:	$ 3.300	$15.000	$18.300
Travel:			
21.000 miles @ $.31/mile (7.000 mileslyr.)	$ 6.510		$ 6.510
Subtotal:	$ 6.510		$ 6.510
Other Direct Expenses:			
Land Use Planning	$ 4.000		$ 4.000
Local Involvement in Water Quality Protection (Includes Adopt.A·Stream Program, plots. promotional material. meetings. tours. water quality testing)	24.879		24.879
Training		$ 500	$ 500
Groundwater Stewardship Program Assistance (Farm*A'Syst. Well Closures. Groundwater Education)		1.250	1.250
Grant Administration Assistance		$4.500	4,500
Subtotal:	$28.879	$6.250	$35.129
Indirect Costs: (Rate: 10% of salary. frtnge. *travel)* Includes office space. phones. etc.	$11,232		$11,232
Subtotal:	$11.232		$11.232
BMP Costs:	$77,627	$136,198	$213.825
Subtotal:	$77.627	$136.198	$213,825
Contractual:			
WMU GEM Center	$54.492		$ 54,492
Groundwater Study (Services inclUde gamma ray logging. water quality sampling. land use planning. land *cover/* risk assessment maps, etc.>			
Subtotal:	$54,492		$ 54,492
TOTAL	$300,000	$161,048	$461,048

Appendix A

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

April 4, 1996

To: Mary Ellen Cromwell, Supervisor
Jackson District Office
Surface Water Quality Division

From: Sandra Kosek
Great Lakes and Environmental Assessment Section
Surface Water Quality Division

Subject: . Nottawa Creek Biosurvey Report

Attached are two copies of our staff report no. MIlDNR/SWQ-96/014 for the biosurvey conducted on Nottawa Creek during August 24-25, 1995. This survey was conducted in support of a local 604(b) planning project regarding the effects ofland use practices on surface and ground water quality in the Nottawa Creek watershed.

Overall biological stream quality of Nottawa Creek was fair at Stations 1 and 3 and good at Station 2. The overall biological quality of Stations 4 and 5 was poor. With a substantial groundwater component, flow conditions are probably stable most of the year with good water quality. Biological community impainnents were primarily due to habitat degradation caused partly by dredging and partly by transport of sediment to the stream. Restoration/protection efforts should address both of these factors.

Please provide a copy of this report to the appropriate local government staff.

Attachments

cc: Mr. William CreallLake and Stream file

SKosek

MI/DEQ/SWQ-96/014

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION
APRIL,I996

STAFF REPORT

A BIOLOGICAL SURVEY OF NOTTAWA CREEK
CALHOUN COUNTY
AUGUST 24-25, 1995

As part of a nonpoint source inspection, staff of the Great Lakes and Environmental Assessment Section (GLEAS) conducted a biological survey of Nottawa Creek in Calhoun County. The survey was performed according to GLEAS Procedure #51 (available on request). Water samples were collected and preserved according to MDEQ protocol (MDNR, 1994).

Nottawa Creek is located in the Southern Michigan / Northern Indiana Till Plains ecoregion and is part of the St. Joseph River watershed. This survey was conducted In support of a local 604(b) planning project regarding the effects of land use practices on surface and ground water quality in the Nottawa Creek watershed.

SUMMARY

1) Sampling station locations are shown in Figure I. Fish community ratings are given in Tables 1-2 and macroinvenebrate community ratings are given in Tables 3-4. Habitat evaluations are given in Tables 5-6. Water chemistry results are given in Table 7. Length-frequency data was recorded for game species of fish and is provided in Appendix I.

2) Fish communities rated good (slightly impaired) at Stations I and 2. Station 3 also rated good, but had a low. density of fish. Stations 4 and 5 did not have sufficient numbers of fish collected to generate a rating, and therefore the fish communities were considered poor (severely impaired). The few fish that were collected at Station four were from taxa such as mudminnows, green sunfish, and Johnny darters, which are tolerant of a wide range of environmental disturbance. Station 5 had a more diverse fish community, including rock bass and three taxa of darters, but at very low densities.

3) The macroinvenebrate community was rated good at Station 2. This station had the most diversity, although it did not have a high number of total taxa or of mayfly and caddisfly taxa Macroinvertebrate communities were rated fair (moderately impaired) at Stations 1, 3, 4, and 5. Stations 1 and 4 had high percentages of surface breathers and taxa such as scuds, corixids (water boatmen), and baetid mayflies. A diversity of mayflies and caddisflies were found at Station 4, but

in very low munbers. Station 3 had a very high density of native freshwater mussels over the entire station. on the order of two individuals per square foot in places.

4) All stations visited in this survey had been dredged at some point in the past, some more recently than others. This was reflected in the habitat ratings. Habitat was rated excellent at Stations 2 and 3. Station 2 was located downstream of a wooded area and had a wide riparian buffer in that area and at the site, and apparently had not been dredged for quite some time. The channel was beginning to form meanders, and the gradient was such that fme sediments were not being deposited. Station 3 was located downstream of Nottawa Lake, which has served to reduce sediment transport downstream. The charme1 was straight and uniform, but there was very little fme sediment covering the sand and gravel substrate. Charmel uniformity and lack of large gravel/cobble substrate was probably the reason why the biological community rated fair instead of good at this station. Stations I, 4, and 5 had poor habitat. Station I had 2-3 feet of fme organic sediments overlaying the sand and gravel bottom, which was uncovered somewhat in the riffle zones. Stations 4 and 5 were dominated by shifting sand bottoms, with very little available habitat for fish or macroinvertebrates. This was probably the reason for the very low densities of both types of organisms. Some streambank erosion was occurring at Station 5, but otherwise the banks were stable. Several stretches, such as at Stations I, 2, and 4, were located in agricultural areas that had little or no natural riparian areas for shading or erosion control. There appeared to be significant groundwater inputs to the stream at all stations, with water temperatures of 64-70°F at Stations 1, 2, **4,** and 5 despite air temperatures of around 80°F. Due to the wanning effect of Nottawa Lake, the water temperature at Station 3 was 76°F, but the sediments at this station were 6°F colder than the water temoerature. Because of the groundwater inputs, cool/coldwater taxa such as blacknose dace and glossosomatid caddisflies were found at some of the sites.

5) Water chemistry data were collected at Stations I and 5. These two stations were meeting water quality standards at the time of the survey. No heavy metals were detected in the water column at Station 5. There was a slight increase in the amount of nutrients in the water from Station 1 to Station 5, but all values were within the range expected for streams in this ecoregion (Lundgren, 1994).

6) Station 5 was surveyed using Procedure #51 in 1989 (Oernke, 1991). The fish communities were similar in both surveys, except that in this survey fewer fish were collected and there were fewer darter taxa. The macroinvertebrate community did not score as well in this survey as in 1990. There were four fewer taxa overall, and those lost were mayflies, caddisflies, and stoneflies. Habitat was not rated in 1990, but the stream was described as sand dominated, which was also true in this survey. Stream biotic quality at this station appeared to have deteriorated slightly between 1990 and 1995.

7) Overall biological stream quality of Nottawa Creek was fair at Stations 1 and 3 and good at Station 2. The overall biological quality of Stations 4 and 5 was poor. **With** a substantial groundwater component, flow conditions are probably stable most of the year with good water quality. Biological community impairments were primarily due to habitat degradation caused partly

by dredging and partly by transpon of sediment to the stream. Restoration/protection effons should address both of these factors.

REFERENCES

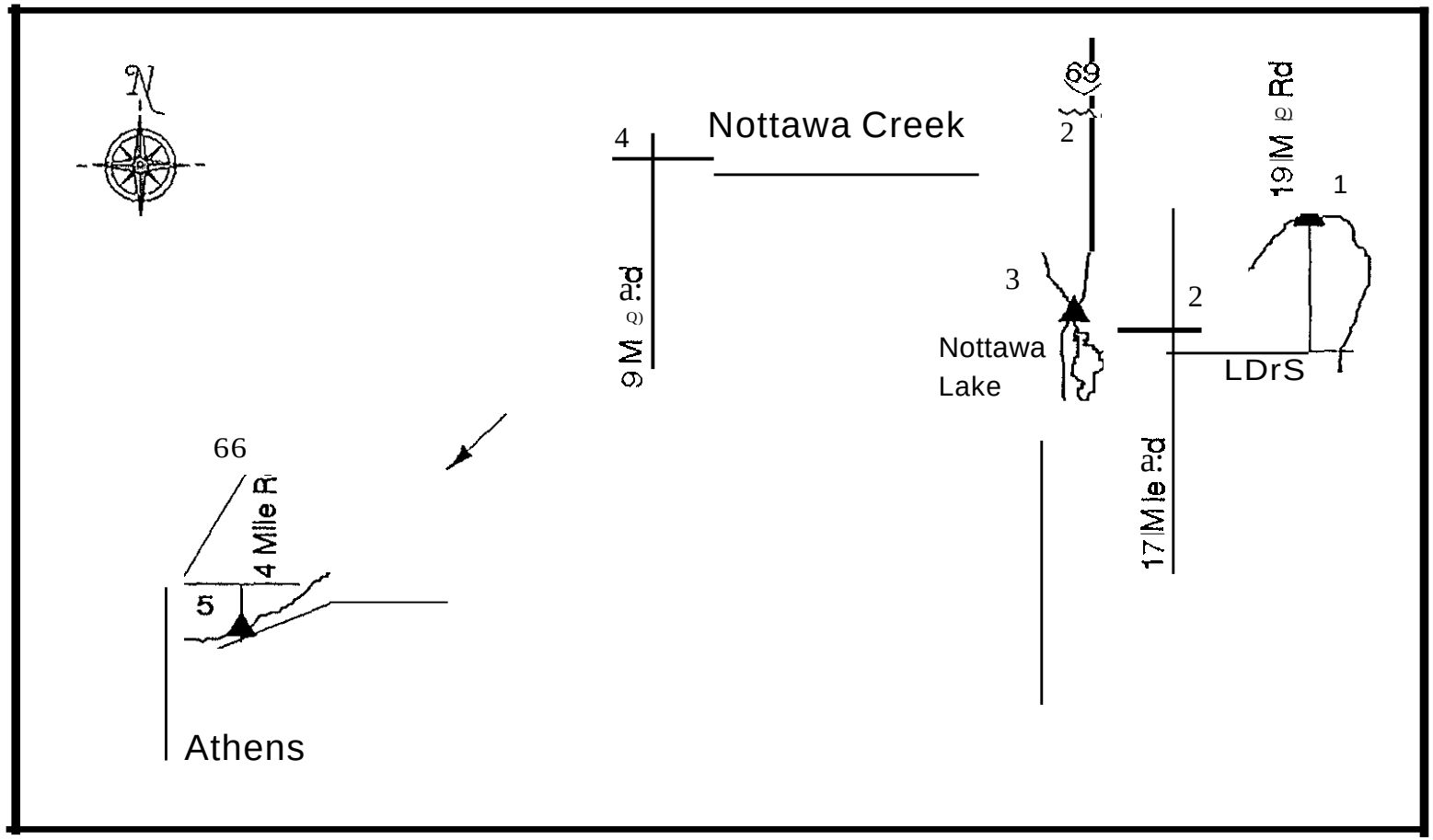
Lundgren, R. 1994. Reference Site Monitoring Report, 1992-1993. MDNR, Surface Water Quality Division, Report #MIIDNR/SWQ-94/048.

MDNR. 1994. Quality Assurance Manual for Water, Sediment, and Biological Sampling. MDNR, Surface Water Quality Division.

Oemke, M. 1991. A Biological Survey of Nottawa Creek, St. Joseph and Calhoun Counties, Michigan, May 17, 1989. MDNR, Surface Water Quality Division, Repon *iiMllDNRlSWQ*-91/081.

Field Work By: Sandra Kosek, Aquatic Biologist
Sylvia Heaton, Aquatic Biologist
John Wuycheck, Aquatic Biologist
Ronda Wuycheck, Environmental Quality Analyst
Ben limont, Environmental Quality Analyst

Report By: Sandra Kosek, Aquatic Biologist
Great Lakes and Environmental Assessment Section



Rgure 1: Sampling Stations on Nottawa Creek, Calhoun County, August 24-25 1995.

▲ = Sampling Station.

Table tA. Qualitative fish sampling results *for* Nottawa Creek, Calhoun County, August 24-25. 1995.

TAXA	STATION 1 19 Mile Rd	STATION 2 17 Mile Rd	STATION 3 15 1/2 Mile Rd
Amlidae (bowrins)			
Amia calva (Bowfin)			
Umbridae (mudminnows)			
Umbra limi (Central mud minnow)			6
Esocidae (pikes)			
Esox amerlcanus ver. (Grass Pike)			2
Cyprinidae (minnows and carps)			
Nocomis bi9uttatus (Horneyhead)	7	2	13
Semolilus atromaculatus (Creek)	16	42	5
luxHus cornutus (Common shiner)	1	4	
Rhinichlhys atratulus (Blacknose)	51	16	
Catostomidae (suckers)			
Catostomus commersoni (W. sucker)	6	15	4
Hypentellum ni9ricans (N. h09SU.)			2
Moxostoma erythrurum (Golden rh.)			
Ictaluridae (Bullhead. Catfish)			
Ameiurus natalis (Yellow bullh.)			5
Centrarchidae (sunfish)			
Ambloplites rupestris (Rock bass)			1
Lepomis cyanellus (Green sUnfish)			6
Lepom;s gibbosus (Pumpkinseed)			1
Lepomis macrochirus (Bluegill)			11
Micropterus salmoides (Lm. bass)			
Percidae (perch)			
E!heostoma caeruleum (Rainbow d.)	8	6	
E!heostoma nigrum (Johnny darter)	21	10	
Perca flavescans (Yellow perch)	6	1	
TOTAL INDIVIDUALS	118	99	58
NUMBER OF ANOMALIES	0	0	0
SQUARE FOOT SAMPLED	7200	4000	4800
DENSITY OF INDIVIDUALS (#/SF)	0.016	0.025	0.012

Table IB. Fish metric evaluation of Nottawa Creek. Calhoun County, August 24·25.1995,

METRIC	STATION 1 Value	Score	STATION 2 Value	Score	STATION 3 Value	Score
TOTAL NUMBER OF TAXA	10	3	11	3	13	5
NUMBER OF DARTER SPECIES	2	5	2	5	0	1
NUMBER OF SUNFISH SPECIES	0	1	1	3	4	5
NUMBER OF SUCKER SPECIES	1	3	2	5	2	5
PERCENT CARP. G.SUNFISH. W,SUCKE	5,1	5	16	3	17	3
PERCENT OMNIVORES	5.1	5	15	5	6,9	5
PERCENT INSECTIVO. CYPRINIDS	6.8	1	6,1	1	22	3
PERCENT PISCIVORES	5,9	5	2,0	3	8,6	5
DENSITY OF INDIVIDUALS	0.016	3	0,025	3	0.012	3
PERCENT ANOMALIES	0	5	0	5	0	5
TOTAL SCORe		36		36		40
FISH COMMUNITY CATEGORY		GOOD (SLIGHTLY IMPAIRED)		GOOD (SLIGHTLY IMPAIRED)		GOOD (SLIGHTLY IMPAIRED)

Table 2A. Qualitative fish sampling results for Nottawa Creek. Calhoun County, August 24-25. 1995.

TAXA	STATION 4 91/2 Mile Rd	STATIONS 4 Mile Rd
Petromyzontidae (lampreys)		
lampreyammocoele		
Umbndae (mudminnows)		
Umbra limi (Central mudminnow)	17	8
Esocidae (pikes)		
Esox amencanus ver. (Grass Pike)		6
Cyprinidae (minnows and carps)		
Semotllus alfomaculatus (Creek)	8	
luxilus comulus (Common shiner)	7	
Catostomldae (suckers)		
Calostomus commersoni (W. sucker)	2	1
Hypentelium nigricans (N. hogsu.)		2
Aphredoderidae (pirate perch)		
Aphredoderus sayanus (Pir. perch)		5
Centrarchidae (sunfish)		
Ambfoplites rupestris (Rock bass)		4
Lepomis c/anel!us (Green sunfish)	15	7
Lepomis macrochirus (Bluegil)	1	
Percidae (perch)		
Etheosloma caerufeum (Rainbow d.)		3
Elheostoma nigrum (Johnny darter)	3	8
Percina maculata (Blackside d.)		6
TOTAL INDIVIDUALS	55	50
NUMBER OF ANOMALIES	O	O
SQUARE FOOT SAMPLED	3300	16800
DENSITY OF INDIVIDUALS (#ISF)	0.017	0.003

Table 28. Fish metric evaluation of Nottawa Creek. Calhoun County, August 24-25, 1995.

METRIC	STATION 4 Value	Score	STATIONS Varue	Score
TOTAL NUMBER OF TAXA	9		12	
NUMBER OF DARTER SPECIES	1		3	
NUMBER OF SUNFISH SPECIES	2		2	
NUMBER OF SUCKER SPECIES	1		2	
PERCENT CARP, G,SUNFISH. W.SUCKE	31		16	
PERCENT OMNIVORES	3,6		2	
PERCENT INSECTIVO. CYPRINIDS	13		2	
PERCENT PISCIVORES	1,6		20	
DENSITY OF INDIVIDUALS	0.017		6.003	
PERCENT ANOMALIES	O		O	
TOTAL SCORE				
FISH COMMUNITY CATEGORY		Not rated		Not rated

Table 3A. Qualitative macrainvertebrate sampling results (ar Nottawa Creek. Calhoun County, August 24-25. 1995.

TAXA	STATION 1 19 Mile Rd	STATION 2 17 Mile Rd	STATION 3 15 1/2 Mile Rd
PLATYHELMINTHES (flatworms)			
Turbellaria	4	3	4
ARTHROPODA			
Crustacea			
Amphipoda (scudS)	8	13	5
Decapoda (crayfish)	3	4	5
Insecta			
Ephemeroptera (mayfiles)			
Baetidae	28	28	
Caenidae			
Ephemerellidae			
Heplagenildae			
Odanata			
Anisoptera (dragonflies)			
Aeshnidae	2		6
Gomphidae			3
Zygoplera (damselflies)			
Calopterygidae			8
Lestidae			12
Hemiplera (lrue bugs)			
8elostomatidae	1		
Corixidae	26	12	
Gerridae	2	4	3
Mesaveliidae	10	8	5
Nepidae			1
Megaloplera			
Sialidae (aider flies)			
Trichoptera (caddisflies)			
Brachycentridae		3	
Glossosomatidae		2	
Helicopsychidae	2		
Hydropsychidae	5	10	28
Hydroptllidae	4		
Limnephilidae	2	4	2
Mo/annidae		1	
Coieoplera (beetles)			
Dytiscidae (Iolal)			2
Gyrinidae (aduits)	3		3
Elmidae	2	2	4
Diplera (flies)			
Chironomidae	18	6	6
Simuiiidae	2	'7	
Slratlomyidae	2	1	
Tabanidae			
Tlpulidae			
MOLLUSCA			
Gastropoda (snails)			
Campa/oma			
Ferrissia (limpel)			3
Elimia (=Goniobasis)			2
Physa	3		1
Pelecypoda (bivalves)			
Union/dae (mussels)			
Anodonta			8
Lampsilis			12
TOTAL INDIVIDUALS	128	111	128

Table 38. Macroinvertebrate metric evaluation of Nottawa Creek, Calhoun County, Augusl24·25. 1995.

METRIC	STATION 1 Value	Score	STATION 2 Value	Score	STATION 3 Value	Score
TOTAL NUMBER OF TAXA	20	4	19	4	26	6
NUMBER OF MAYFLY TAXA	1	2	2	4	2	4
NUMBER OF CADDISFLY TAXA	4	4	5	6	2	2
NUMBER OF STONEFLY TAXA	0	0	0	0	0	0
PERCENT MAYFLY COMPo	22	6	26	6	1.6	0
PERCENT CADDIS FLY COMPo	10	0	18	2	23	4
PERCENT CONTR. DOM. TAXON	22	4	25	4	22	4
PERCENT ISOPOD. SNAIL. LEECH	2.3	4	0.90	6	4.7	2
PERCENT SURFACE AIR BREATH	34	2	23	2	11	4
TOTAL SCORE		. 26		34		26
MACROINVERTEBRATE COMMUNITY CATEG		FAIR (MODERATELY IMPAIRED)		GOOD (SLIGHTLY IMPAIRED)		FAIR (MODERATELY IMPAIRED)

Table 4A. Qualilative macroinvertebrate sampling results for Nottawa Creek, Calhoun County, August 24·25. 1995.

TAXA	STATION 4	STATION 5
ANNEIIOA (segmented worms)		
Hirudinea (leeches)		
Oligochaeta (worms)		
ARTHROPODA		
Crustacea		
Amphipoda (scuds)	15	20
Decapoda (crayfish)	4	20
Insecta		
Ephemeroptera (mayflies)		
Baetidae	32	5
Ephemereilidae	3	
Heptageniidae	2	10
Ollgoneurildae	2	
Odonala		
Anlsoptera (dragonflies)		
Aeshnidae		5
Gomphidae		1
Zygoptera (damselflies)		
Caloplerygldae	4	
Coenagrionidae	1	
Plecoptera (stoneflies)		
PerJidae		5
Hemiptera (true bugs)		
Corixidae	42	
Gerridae	3	10
Mesovelllidae	4	
Pleidae	2	
Trichoplera (cadd/sflies)		
Brachycentridae	1	
He!icopsychidae	1	
Hydropsychldae	5	5
Limnephliidae	2	5
Philopotamidae	1	
Phryganeidae	1	
Coleoptera (beetles)		
Dytlscidae (tolal)		
Gyrinldae (adulls)		5
Haliplidae (adulls)	1	
Hydrophilidae (total)	1	
E/mldae	2	5
Gyrinidae (larvae)	1	
Dlplera (flies)		
Chironomidae	3	5
Dixidae	1	
SimuJiidae	4	5
TIpulidae	1	
MOLLUSCA		
Gastropoda (snails)		
Campeloma	4	
HeJisoma	1	
Stagnicola	2	
Pelecypoda (bivalves)		
Sphaeriidae (clams)		
Sphaerium	2	
TOTAL iNDIVIDUALS	151	106

Taole 48. Macroinvertebrate metric evaluation of Nottawa Creek. Calhoun County, August 24-25. 1995.

METRIC	STATION 4 Value	STATION 4 Score	STATION 5 Value	STATION 5 Score
TOTAL NUMBER OF TAXA	32	6	14	2
NUMBER OF MAYFLY TAXA	4	4	2	2
NUMBER OF CADDISFLY TAXA	6	6	2	2
NUMBER OF STONEFLY TAXA	O	O	1	2
PERCENT MAYFLY COMPo	26	2	14	O
PERCENT CADDISFLY COMPo	7.3	O	9.4	O
PERCENT CONTR. DOM. TAXON	28	4	19	6
PERCENT ISOPOD. SNAIL. LEECH	5.3	O	O	6
PERCENT SURFACE AIR BREATH	36	2	14	4
TOTAL SCORE		24		24
MACROINVERTEBMTE COMMUNITY CATEG		FAIR (MODERATELY IMPAIRED)		FAIR (MODERATELY IMPAIRED)

Table 5. Habital evaluation for Nottawa Creek, Calhoun County, August 24-25, 1995.

HABITAT METRIC (MAX)	STATION 1 19 Mile Rd	STATION 2 17 Mile Rd	STATION 3 15 1/2 Mile Rd
Bottom Substrale Avail. Cover (20):	5	8	12
Embeddedness (20):	0	7	16
Velocily:Depth (20):	6	11	4
Flow Stability (15):	8	9	4
Bottom Depos. (15):	2	7	14
Poels-Riffles- Runs-Bends (15):	2	7	3
Bank Stabilily (10):	6	9	5
Bank Vegetative Siability (10):	6	9	8
Stream Cover (10):	5	7	8
TOTAL SCORE (135)	40	74	74
HABtTAT CONDITION CATEGORY	POOR (SEVERELY IMPAIRED)	EXCELLENT (NON. IMPAIRED)	EXCELLENT (NON· IMPAIRED)
Dale:	8/24/95	8/24/95	8/24/95
Stream Type:	Warmwaler	Warmwater	Warmwater
Weather:	Partly Cloudy	Partly Cloudy	Partly Cloudy
Stream Order:	first	first	first
Ecoregton:	SMNITP	SMNITP	SMNITP
Air Temperalure:	82 Deg. F.	85 Deg, F.	75 Deg. F.
Water Temperature:	64 Deg, F.	64 Deg, F.	76 Deg, F.
Ave. Stream Widlh:	18 Feet	16 Feet	16 Feel
Ave. Stream Depth:	1,5 Feel	1 Feel	1 Feet
Surface Velocity:	0.5 FUSee.	1 FUSee,	1 FUSee.
Estimated FloW:	13.5 CFS	16 CFS	16 CFS

Table 6. Habitat evalualion for Nottawa Creek. Calhoun County. August 24-25. 1995.

HABITAT METRIC (MAX)	STATION 4	STATION 5
Bottom Substrate Avail. Cover (20):		2
Embeddedness (20):	O	5
Ve!ocity:Depth (20):		5
Flow Siability (15):	4	15
Bottom Depos. (15):	O	3
Pools-Riffles-Runs-Bends (15):		3
Bank Siability (10):	6	2
Bank Vegetalive Siability (10):	6	9
Siream Cover (10):	3	6
TOTAL SCORE (135)	22	60
HABITAT CONDITION CATEGORY'	POOR (SEVERELY IMPAIRED)	POOR (SEVERELY IMPAIRED)
Date:	*8/24/95*	*8/26/95*
Stream Type:	**Warmwater**	**Warmwater**
Weather:	Partly Cloudy	Sunny
Stream Order:	**second**	**second**
Ecoregion:	SMNITP	SMNITP
Air Temperature:	75 Deg. F.	73 Deg. F.
Water Temperature:	69 Deg. F.	70 Deg. F.
Ave. Siream Width:	22 Feet	40 Feet
Ave. Siream Depth:	4 Feet	2 Feet
Suriaee Velocity:	0.5 FUSee.	0.75 FUSee.
Estimated Flow:	44 CFS	60 CFS

Table 7: Water Chemistry Results for Nottawa Creek, August 24-25, 1995, Values in µg/L except as noted. Not all parameters were sampled at each station.

Parameter	Station I	Station 5
Silver		<0.5
Arsenic		2.7
Cadmiwn		<0.2
Chromiwn		<1
Copper		<1
Hardness (mg/L)	255	275
Mercury		<0.2
Nickel		<2
Nitrite	7	17
Nitrate + Nitrite	103	
Ammonia	44	
Kjeldahl Nitrogen	560	490
Lead		<1
Total Phosphorus	18	83
Zinc		<4

ATTACHMENT I

FISH COLLECTION

Water Nottawa Creek

County BRANCH

(1) T 3S R 5W Sec. 29

(2) T 3S R [illegible] $ 36

10 STATIONS 1+2

Date 8/24/95

Sta.. 1 o 3

Summary 0 | All sit-- (1) ( ) Coll site No ( ) Index site No. All gear ( ) Gear

Species	CREEK CHUB	COMMON SHINER	WHITE SUCKER	HORNEY HEAD CHUB	YELLOW PERCH	LARGE MOUTH BASS	CREEK CHUB (2)	COMMON SHINER	WHITE SUCKER	HORNEY HEAD CHUB	YELLOW PERCH	LARGE MOUTH BASS	GREEN SUNFI
Gear													
Lengths													
Total No.													
CPE													
1 inches	2			1									
2	7						8		12			1	
3	4	1			1		17					1	
4	7		1	12	6 1		7		2				
5			1	3			5						
6							3						
7	1	1							1				
8												1	
9									4				
10			1		1				14				
11				1					2				
12												1	
13				1									
14											1	1	
15													
16													
17													
18		1			1								
19													
20													
21					1								
22													
23		1											
24													
25													
26													
27													
28													
29													
30													
31													
32													
33													
34													
35					1								
36													
37									\				
38			1										
Sample total	21	1	6	1	6	1	42	4	15	2	\	1	1

LENGTH FREQUENCY = LENGTH BIOMASS SAMPLE

...URAL RESOURCES

FISH COLLECTION

Water NOTTAWA CREEK · T. 3S R. 6W Sec. 34 Dat. 8/24/95

County BRANCH I.D STATION 3 She.. 2 of 3

Summary of ( ) All sites ( ) Coll. site No. .f) Index site No. (I All gear { I Gear

Species	BOWFIN	WHITE SUCKER	CREEK CHUB	HORNEY HEAD CHUB	GREEN SUNFISH	ROCK BASS	PYMPKW SEED	BLUE GILL	N. HOG SUCKER	YELLOW BULLHEAD	YELLOW PERCH		
Gear													
Lengths													
Total	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
CPE													
Inches 1													
2								2					
3					3			5					
4				ID	2			4					
5			4	3						1			
6		3											
7						J							
8													
9													
10		1											
11													
12													
13		1											
14													
15													
16													
17													
18													
19													
20													
21													
22					1								
23					1								
24													
25													
26													
27													
28													
29													
30												1	
31													
32													
33													
34													
35													
36					1								
37													
38													
SamOt. total	1	4	5	13	6	1	1	11	2	5	1		

LENGTH-FREQUENCY = LENGTH BIOMASS SAMPLE

Water NOTTAWA CREEK (4) T 3S R 1W S 22 (5) T. 4S R. 8W S.C. 22

County ~~BRANCH~~ CALHOUN

10 STATIONS 4 + 5

FISH **COLLECTION**

oi,. 8/24-25/96

Sh·· 3 of 3

Summary 0'· ( ) All life. (4) ( ) Coll. sit. No ( ) Index site No. ( ) All gear (5) ( ) Gear

Species	CREEK CHUB	COMMON SHINER	WHITE SUCKER	GREEN SUNFISH	BLUE GILL		COMMON SHINER	WHITE SUCKER	GREEN SUNFISH	N. HOG SUCKER	ROCK BASS		
Gear													
Langing													
Total	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
CPE													
Inches 1	1	6		12									
2				3	1				3				
3									7				
4	4										2		
5	3				1					1			
6										1			
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22					1								
23													
24													
25													J
26													
27													
28													
29													
30													
31													
32													
33													
34													
35													
36													
37													
38													
Sample total	8	7	2	15	1		1	1	7	2	4		

LENGTH-FREQUENCY = LENGTH BIOMASS SAMPLE

Athens High School Water Quality Data
on the Nottawa Creek
Athens, Michigan - 1991 through 1997

Year	DO (mg/L)	CO2 (mg/L)	ph	NO3 (mg/L)	PO4 (mg/L)	Temp. (C)	Hardness (mg/L as CaCO3)
1991	11	NA	8.4	6	NA	15	NA
1992	10	42	8.3	2	0.4	14	322
1993	11	39	8.1	3	0.2	14	254
1994	12	53	8.2	14	0.1	13	290
1996	11	43	8.0	NA	0	15	425
1997	10	59	8.5	0	0	15	288

STREAM FLOW DATA ON THE NOTTAWA CREEK

STREAMS TRIBUTARY TO LAKE MICHIGAN

04096900 NOTTAWA CREEK NEAR ATHENS. MI

LOCATION.-Lat 42'03'20", long 85'18'30", in NW1I4 sec.12, T.5 S., R.9 W" St. Joseph County, Hydrologic Unit 04050001, on right bank at downstream side of bridge on Shorts Road, 4,2 mi southwest of Athens. and 5.0 mi downstream from Pine Creek.

DRAINAGE AREA..• 162 m.i^2.

PERIOD OF RECORD.-October 1966 to current year.

GAGE...Water-stage recorder. Elevation ofgege is 850 ft above sea level, from topographic map.

REMARKS...Records fair. Several measurements of water **temperature were made during the year.**

DISCHARGE. CUBIC FEET PER SECGND. WATER YEAR OCTOBER 1995 TO SEPTEMBER 1996
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	77	125	184	.91	e115	215	115	213	117	147	78	65
2	74	145	175	.88	e110	229	111	205	"3	140	77	63
3	75	164	157	e86	e105	206	114	188	13.	138	74	63
4	78	168	160	";	e105	181	111	170	130	129	71	62
5	80	156 .	153	.81	ellO	161	111	159	126	126	57	59
8	83	141	147	.79	e115	151	108	15'	140	122	61	58
7	58	131	135	.77	123	0145	10'	147	15'	120	61	58
8	92	125	129	.75	137	0145	95	143	19.	116	6.	5'
9	93	121	e125	.74	164	e140	9'	14'	19'	111	82	53
10	59	128	108	e74	159	el30	95	150	235	107	60	'9
11	8'	218	133	,75	162	121	97	248	287	104	57	'9
12	80	329	144	.76	149	128	102	258	259	101	57	50
13	78	383	147	,77	133	147	131	247	239	98	55	'0
I.	76	369	148	.79	122	162	163	211	201	95	54	50
16	77	330	163	..2	11•	173	161	189	174	97	65	52
15	77	287	160	.88	107	175	165	188	157	9'	74	51
17	74	245	157	102	105	165	175	188	162	88	76	'0
18	72	'14	146	165	8104	154	18'	179	264	88	73	47
19	73	200	135	235	103	149	151	157	340	86	75	45
20	81	196	0125	274	103	142	161	164	339	8'	86	44
21	99	200	121	267	116	134	210	161	311	81	95	50
22	114	199	117	260	129	130	'51	179	275	7.	98	6.
23	118	'192	115	192	129	124	311	172	244	75	113	65
24	lOB	181	11'	178	140	121	333	158	222	72	108	8'
25	98	188	114	e165	149	126	305	152	211	72	103	56
26	90	159	111	e150	159	129	265	145	194	73	97	63
27	104	158	e105	e140	214	118	231	141	182	59	88	62
28	128	176	.100	e135	289	117	200	140	170	68	81	70
29	139	199	.98	e130	302	117	18.	136	160	69	78	68
30	132	194	,96	e125		116	194	128	154	78	72	60
31	126		.94	e120		115		121		78	88	
TOTAL	2855	5999	4115	3904	4062	4625	'997	5369	6100	2996	2344	1680
MEAN	92.1	200	133	126	140	149	167	173	203	96,6	75.6	66.0
MAX	139	383	184	274	30.	275	333	288	340	147	113	70
MIN	72	121	94	74	103	115	94	121	117	68	54	44
CFSM	.57	1.23	.82	.78	.86	.92	1.03	1,07	1.26	.60	.47	.35
IN.	.66	1,38	.94	.90	.93	1.06	1.15	1.23	1.40	.69	.54	.39

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1967 • 1996, BY WATER YEAR (WY)

MEAN	101	135	158	163	169	.46	240	179	164	110	92.0	84,1
MAX	344	'90	273	366	30.	475	385	33'	525	279	239	163
IWY)	1987	1989	1991	1993	1985	1982	1985	1983	1989	1986	1995	1980
MIN	41.9	43.9	56.7	49.3	71.3	135	119	91.1	55,9	41.7	37,5	35.0
IWY)	1967	1972	1977	1977	1977	1970	1971	1971	1977	1977	1977	1976

SUMMARY STATISTICS	FOR 1995 CALENDAR YEAR		FOR 1996 WATER YEAR		WATER YEARS 1967 ·1996	
ANNUAL TOTAL	55826		49046			
ANNUAL MEAN	163		134		15'	
HIGHEST ANNUAL MEAN					211	1989
LOWEST ANNUAL MEAN					80,0	1977
HIGHEST DAILY MEAN	589	Aug 20	383	Nov 13	2170	Jun 21989
LOWEST DAILY MEAN	65	Jul 14	44	Sep20	21	Jul291977
ANNUAL SEVEN·DAY MINIMUM	71	JulIO	'8	Sep 14	'3	Jul291977
INSTANTANEOUS PEAK FLOW			387	Nov 13	2190	Jun 21989
INSTANTANEOUS PEAK STAGE			3.42	Nov 13	7,85	Jun 21989
INSTANTANEOUS LOW FLOW					21	(8)
ANNUAL RUNOFF (CFSM)	.94		.83		.9'	
ANNUAL RUNOFF (INCHES)	12,82		11.'6		12.78	
10 PERCENT EXCEEDS	225		214		279	
50 PERCENT EXCEEDS	135		124		I"	
90 PERCENT EXCEEDS	88		85		59	

(a) July 28, 29, 30. Aug. 4, 6, 1977, Aug, 4, 1988.
(e) Estimated.

Appendix B

Road/Stream Crossing Data

Below is a summary of road/stream crossings inventoried in the Nottawa Creek Watershed. Of a total of 87 road crossings in the watershed, 41 were located in the sUllace water critical area. Those in the critical area were evaluated and rated based on the level of effort needed to improve water quality at the crossings.

Road/Stream Crossings in Critical Area	# of Crossings
Nottawa Creek	*20*
Nottawa Drain	*5*
Goose Pond	3
Alder/Acker Ext.	*7*
Mud Creek	3
Yost-Francisco Drain	*3*
**Number in Critical Area*	*41*

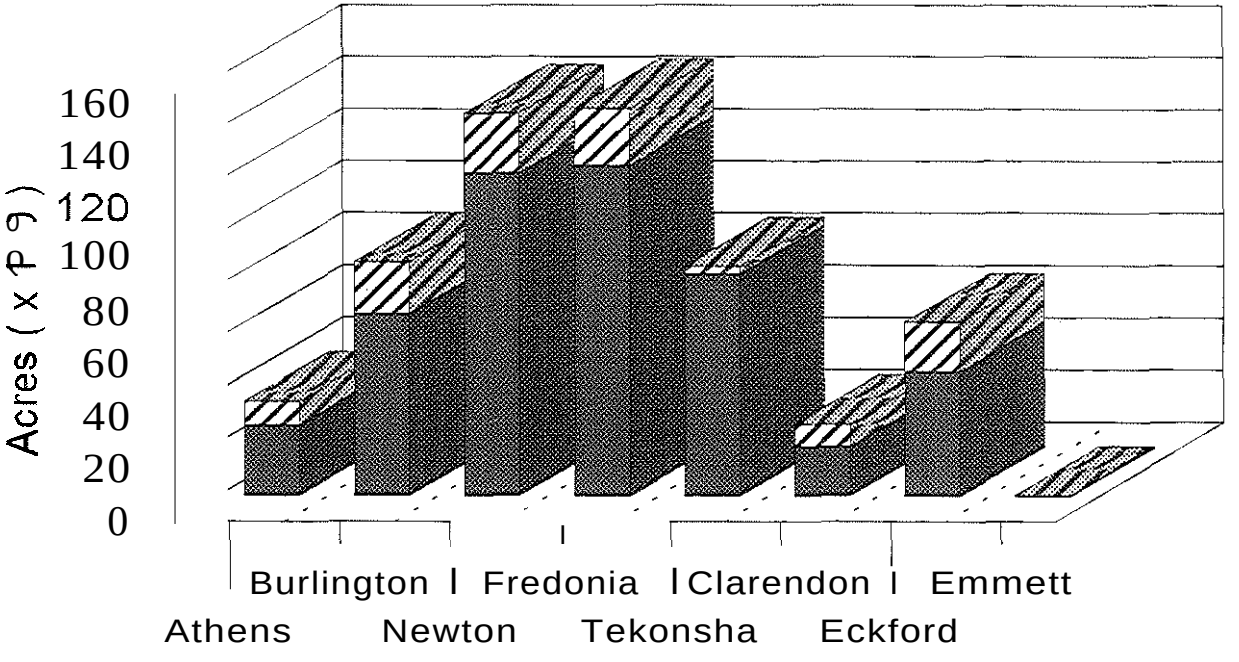
**Critical area includes Nottawa Creek, Nottawa Drain, Mud Creek/Yost-Francisco Drain, Goose Pond Drain, Alder Creek/Acker Extension Drain, 8 lakes, + all areas extending out 1/4 mile on each side of drains and lakes.*

Following is the number of road/stream crossings requiring high, medium, low, or no effort with regard to water quality improvement.

High	Medium	Low	No
5	9	17	*10*

Appendix C

Nottawa Creek Watershed



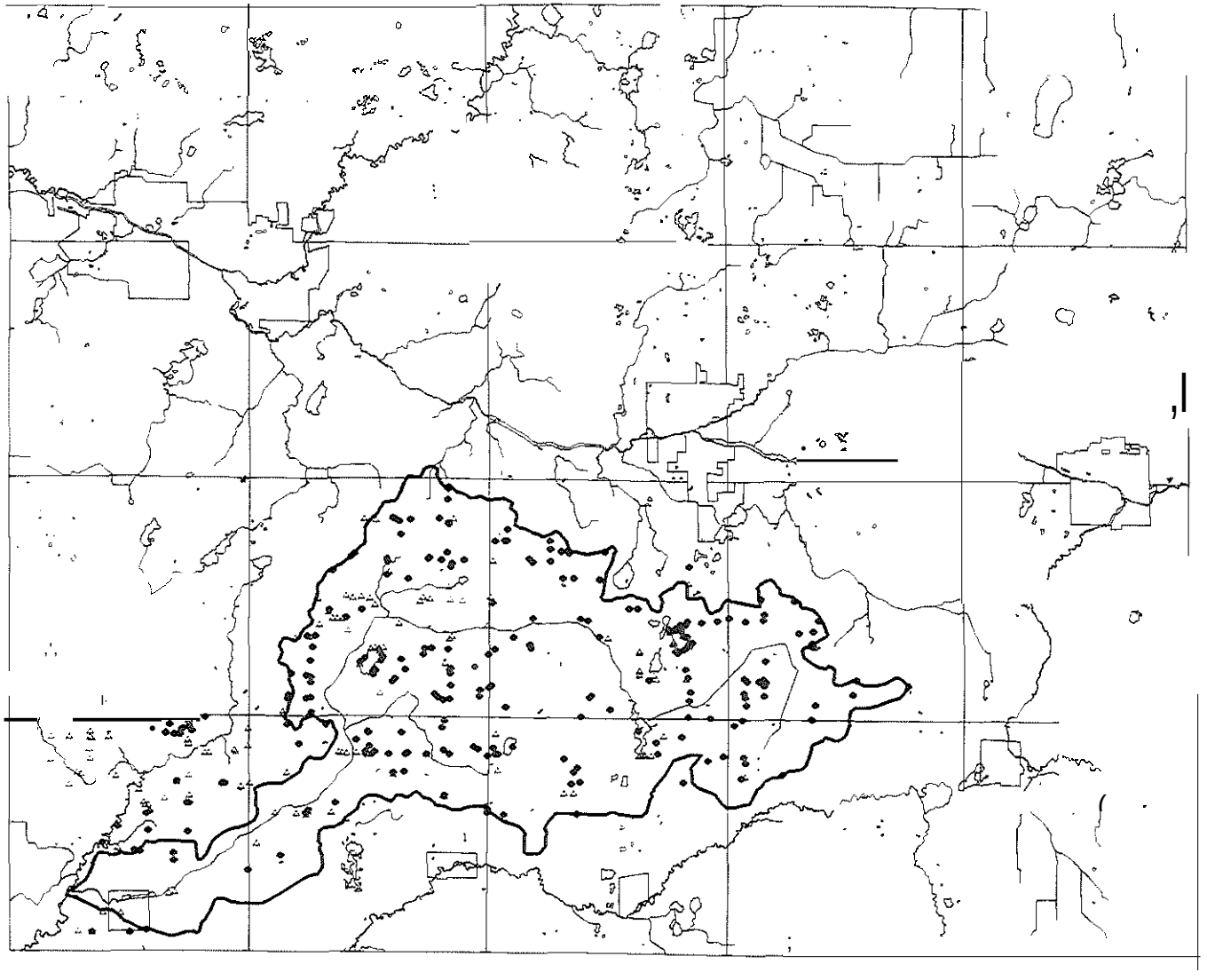
Intensive Agriculture Acres

- Total Watershed Acres

Appendix D

Appendix D1 - Residential Water Wells
Appendix D2 - Static Water Levels
Appendix D3 - Drift Thickness
Appendix D4 - Aquifer Vulnerability Using AQUIPRO
Appendix D5 - Aquifer Vulnerability Map of the Nottawa Creek Watershed

Nottawa Creek Watershed, Calhoun County, Michigan



Residential Water Wells

Bedrock Wells

Drift Wells

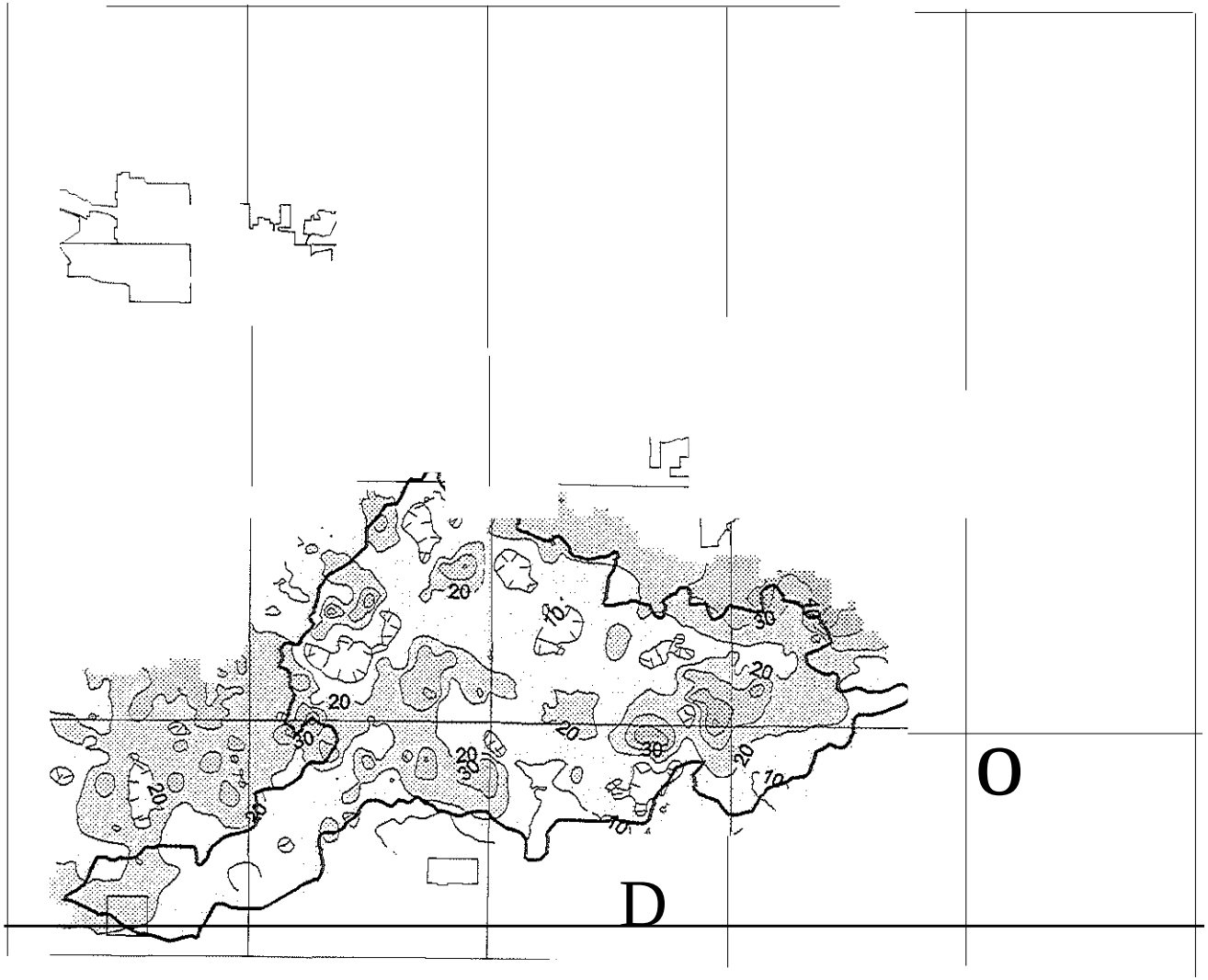
n=431

N

Appendix 01: Residential VVaterWells

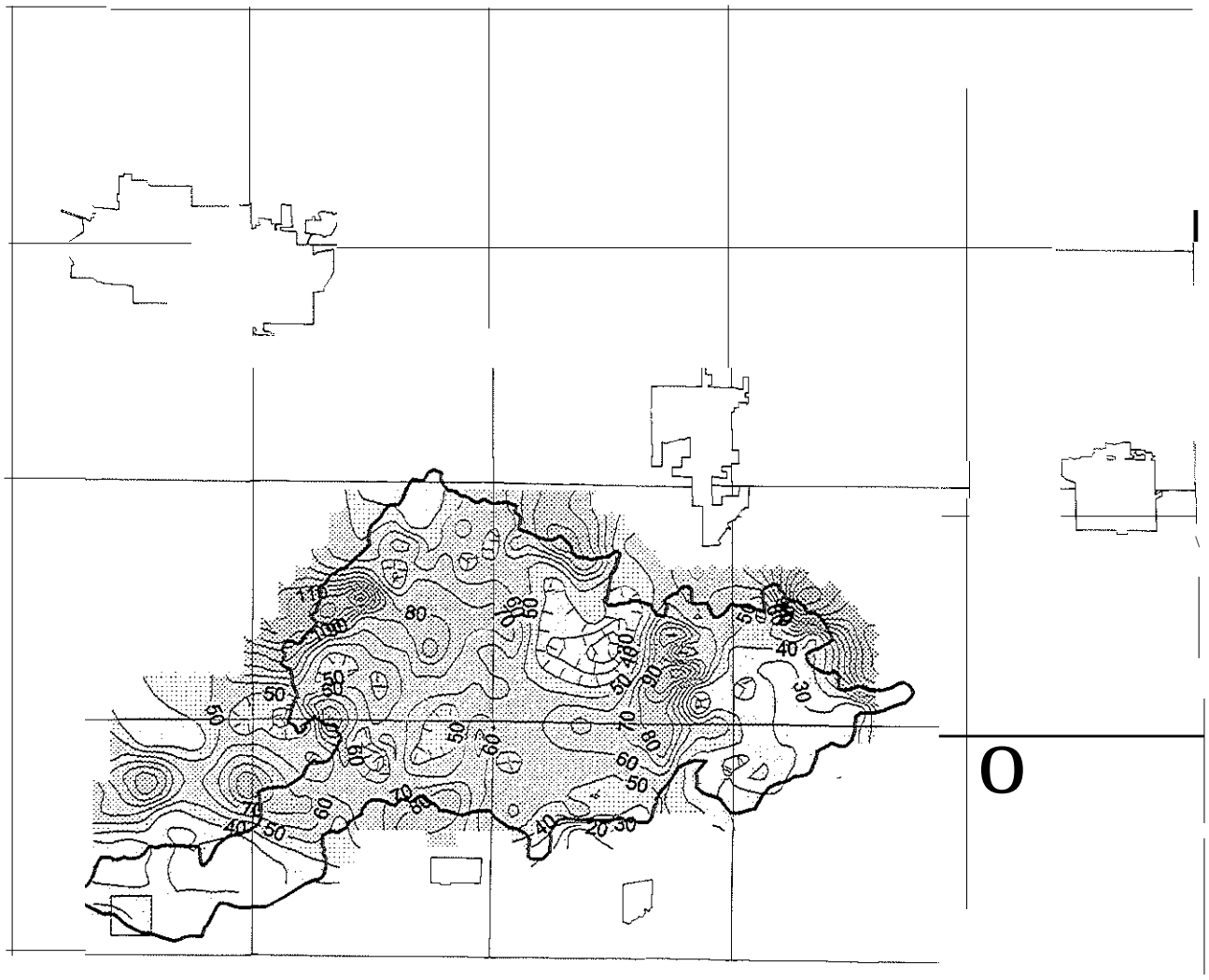
Basemap: MIRIS
GEM Regional Center
Institute for Water Sciences
Coilege of Arts and Sciences
Western Michigan University
12/97

Nottawa Creek Watershed, Calhoun County, Michigan



Appendix D2: Static Water Level Map

Nottawa Creek Watershed, Calhoun County, Michigan

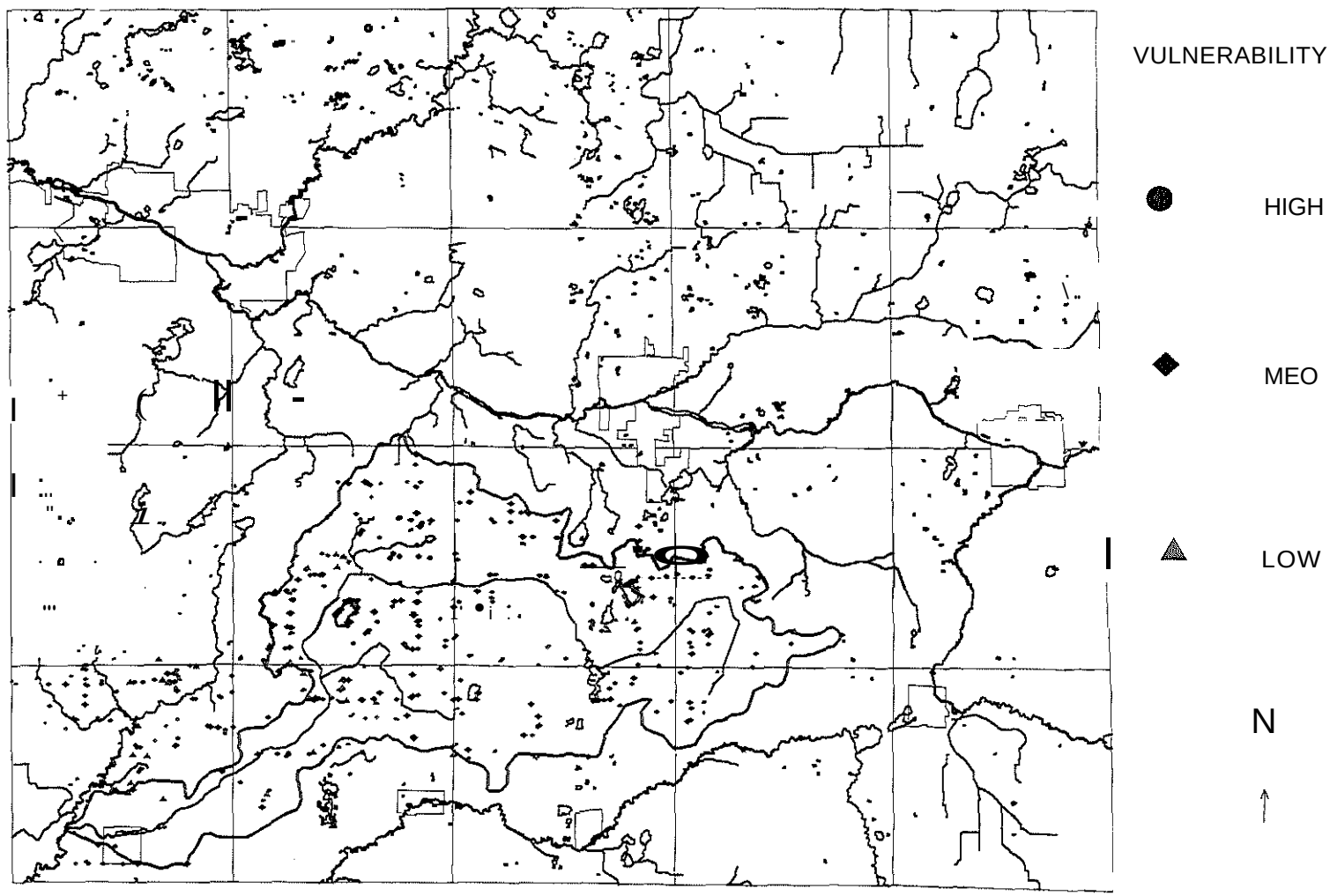


Contour Interval: 10 feet

Appendix D3: Drift Thickness Map

Basemap: MIRIS
GEM Regional Center
Inslitute for Water Sciences
College of Arts and Sciences
Western Michigan University

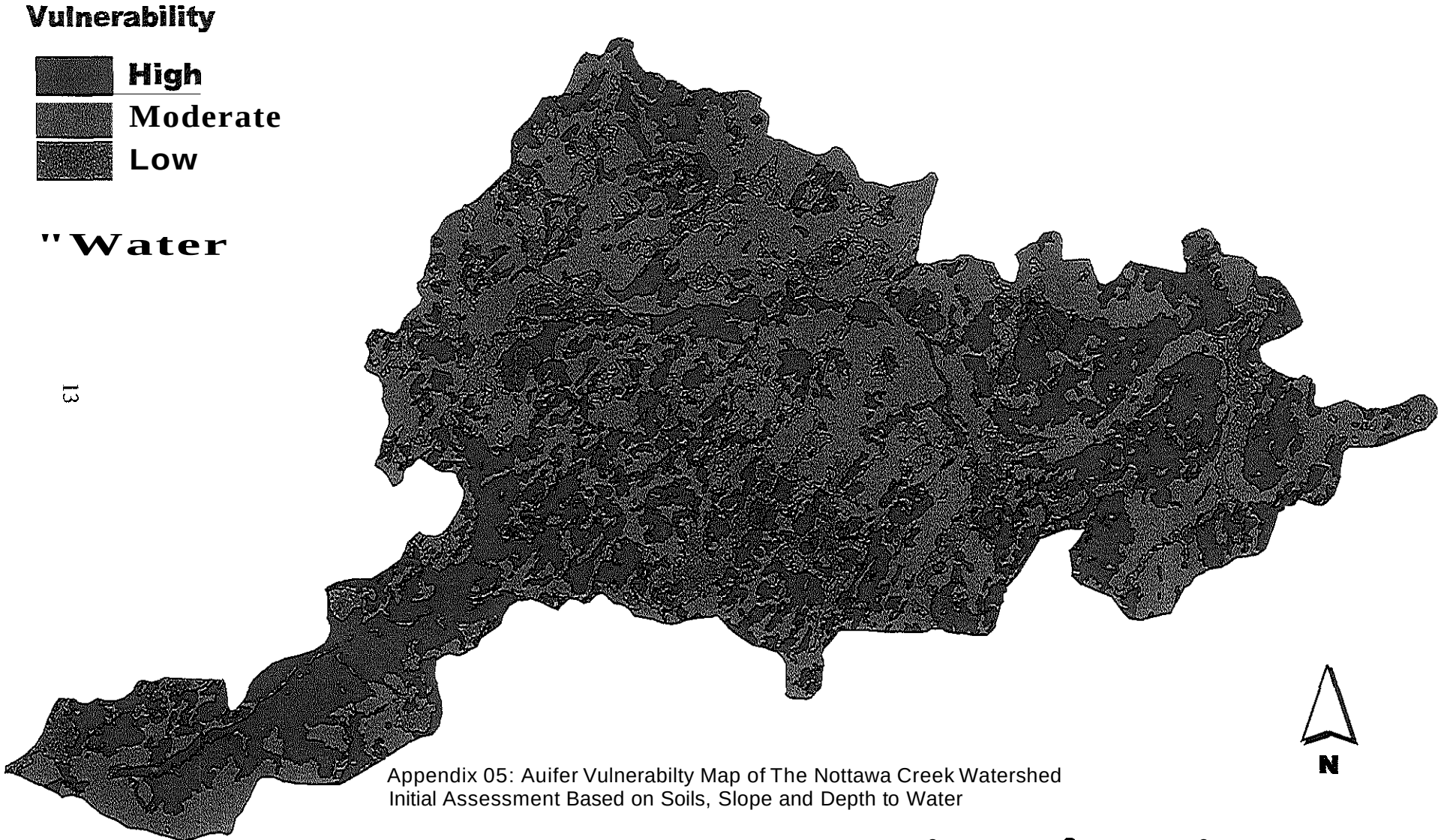
Nottawa Creek Watershed, Calhoun County, Michigan



Appendix 04: Aqiuifer Vulnerability Assessment Using Residential Water Wells and AQUI PRO, an Aquifer Vulnerability Assessment Model

Basemap: MIRIS
GEM Regional Center
Institute for Water Sciences
College of Arts and Sciences
Western Michigan University
11/07

Aquifer Vulnerabilty Map of Nottawa Creek Watershed



Appendix 05: Auifer Vulnerabilty Map of The Nottawa Creek Watershed
Initial Assessment Based on Soils, Slope and Depth to Water

2 0 2

GEM Regional Center
Institute for Water Sciences
Coiiege of Arts and Sciences
Western Michigan University
11/97

Appendix E

streambank erosion \'las a common site along lower portions of the Nottawa Creek and its tributaries.

Above left: Small beef cattle herds make up the largest source of unlimited livestock access to waterways; Lower left: Livestock can cause severe erosion and sedimentation along streambanks, even with limited access; Above: Deer trails, such as this one, were commonly found along the Nottawa Creek.

AppendixF

Canoe trip teaches Scouts ABCs of watershed conservation

MARSHALL ADVISOR Oct 8 '97

by Tom Isham

Marshall area Boy Scouts enjoyed a combination of recreation and environmental education – while paddling canoes -- on Saturday morning.

The eight Scouts and four adult leaders, from Troop 373 of the Marshall United Methodist Church, canoed down Nottawa Creek from N Drive South near 9 Mile Road to Wilson Park on M-66, north of Athens. Scoutmaster is Cliff Conklin.

The trip was sponsored by the Calhoun County Farm Bureau Young Farmers, in cooperation with the Calhoun Conservation District (CCD). The purpose was to educate Boy Scouts about watersheds and the environment.

"The Young Farmers are concerned about water quality and are doing their best to protect our natural resources," according to Sharon Williams, watershed coordinator for the CCD. "It's important that today's youth understand the concept of the value of watersheds and how they may be impacted by land use activities of everyone in the watershed."

Williams is heading up the Nottawa Creek Watershed Project, which aims to identify problem areas and work to improve and protect water quality. Part of her effort involves increasing awareness among the public. Hosting the Scouts was an aspect of this endeavor.

There was another motivation behind Saturday's trip.

"The Young Farmers just want to get the kids outside and away from computer games to experience nature," Williams said. "We want them to develop a curiousity about their surroundings."

To that end, the boys were encouraged to identify plants, learn about stream bank erosion, identify the characteristics of a healthy stream, and learn what effects land use activities have on groundwater and surface water.

"Another item the Young Farmers want to emphasize is respect for private property rights," Williams said. "Nearly all of the land adjacent to the Nottawa Creek is privately owned. Technically, if a canoeist were to step out of his or her canoe... this would be considered trespassing. Landowners can find it very frustrating when they see litter and destruction of their property from careless people who use the river for fishing and recreation."

Boy Scouts from Troop 373 and their adult leaders got underway at 10 a.m. Saturday.

The Nottawa Creek Watershed (a watershed is an area from which runoff water from rain and snow gathers to feed a stream or stream system) is 59,000 acres in size and extends from west of Athens to west of Homer. It includes six lakes and eight townships. The communities surrounding the watershed, largely agricultural, use the watershed as a drainage system. Ninety-nine percent of persons living in the watershed also depend upon it for their drinking water.

According to Williams, the watershed project hopes to generate awareness of the need for stewardship of the land and water.

The five-year project is funded by a $68,000 grant from the Environmental Protection Agency.

The Conservation District is working with the County Drain Commission to study surface water, looking for such pollutants as nutrients in fertilizers, pesticides, hazardous wastes and debris. Williams noted that access of livestock to the creek is probably the principal problem. Fixing that problem might be as simple as repairing a fence, she said.

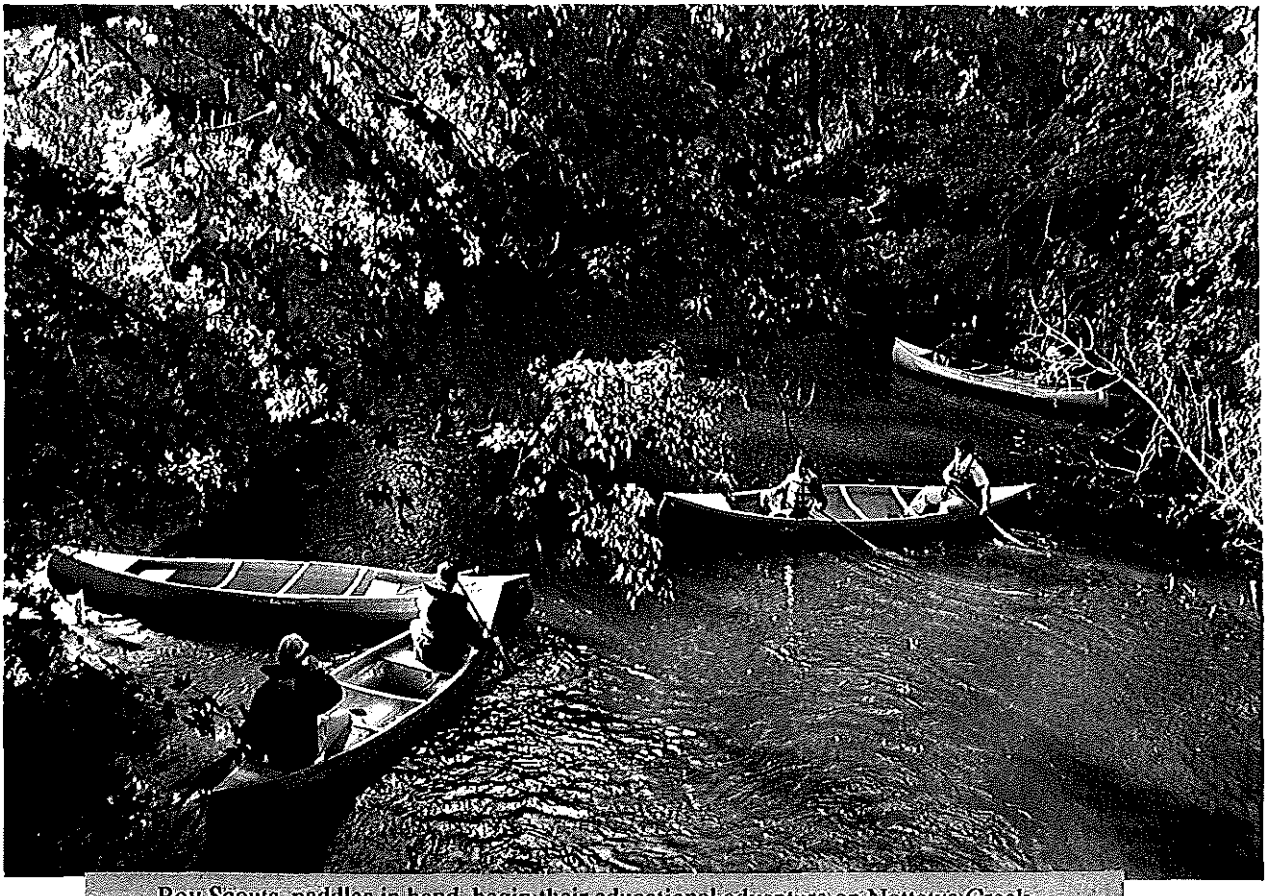
There is no enforcement provision in the project, so it will be up to landowners to volunteer their compliance in cleaning up trouble spots.

Saturday's canoe trip received donations and prizes from Sam's Club, Felpausch, Rollo's-Mancino's of Marshall.

136

Family Video, Drake's Office Supply, McDonald's, Meijer of Battle Creek, and Riverview Recreation.

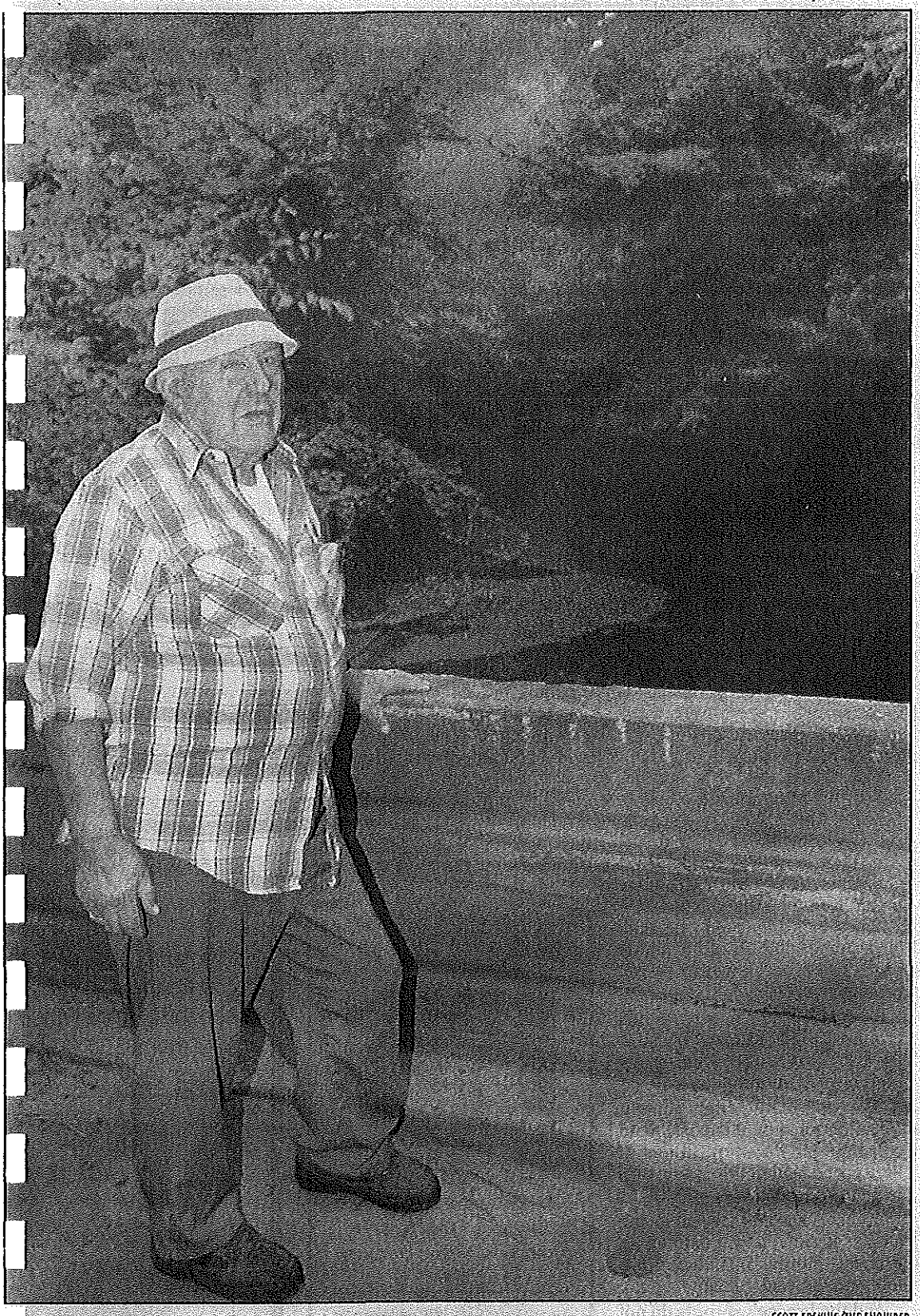
Right: Canoeists brave the rainy weather during their h'ip down the Nottawa Creek.



Boy Scouts, paddles in hand, begin their educational adventure on Nottawa Creek.

BATTLE CREEK ENQUIRER 9/17/97

Project working to keep water safe



SCOTT ERSKINE/THE ENQUIRER

ymond Korn stands on the 5 Mile Road bridge that crosses Nottawa Creek near Athens.

Watershed plan is trying to protect area drinking sUPPly

PATRICIA MAIIER
The Enquirer

The Nottawa Creek Watershed Project is a good example of how Groundwater Education in Michigan helps protect Calhoun County's water supply.

For 10 years, Groundwater 'Educatiou in Michigan (GEM), a c09perative effort of six of Michigan's public nniversities, has worked to develop au exten· sive. framewollk of resources around the state thai conuuuili' ties, individuals, business people and farmers can tlli'n 10 for infOl" **mation and assistance in protect-** ing drinking water.

The resources developed by GEM have helped grant writers secure federal and state funding for innovative projects like the one on Nottawa Creek, which be· gaiI in January.

The.project is the first study in MlChigan that examines surface and.gl:oundwater·on a watershed, In the past, studies have exam· ined'surface or.ground water, bul not on a watershed.

"We know that .ground. water **and** surface water was **.intel'con,** nected; but nobody had al· tempted to study the watershed both above ground and below," 'District Conservation·j· Dan .Kesselring said,

STUDY BEGINS

Since late spI,ing, Sharoll Williams, watershed coordinator for the·Calhoun County Conserv, ation 'District, has canoed Nottawa Creek several times. evaluating the eondition of the creek banks ,and making note oi any pollutants ·that pose a threal ..to the water quality.

For .the most part, the creek is .in.good condition, Williams sairl But sO far she has found 15 sites that 'al1e either polluting the creek right now Ole,pose 'a future threat.

Please see WATER, Page 2

Watershed project protects drinking supply

"Probably livestock access is the No. 1 problem," Williams said. "There's been areas where cattle have actually been standing in the creek."

Cows can mat down the creek banks with their hooves and cause the soil to erode and enter the creek. Erosion and sedimentation could destroy fish habitat, Williams said.

"There used to be trout 1 do hear that people used to catch trout in the creek,. but they're not (catching trout) nearly as much as they used to," she said. "Sc it could be impacting the trout population,"

Fixing some of the problems might be as simple as repairing a fence.

RESIDENTS JUMP IN

Raymond Korn, who lives on 6 Mile Road in Athens, said he's not sure the trout in the creek are on the decline. But he has attended some of the meetings Williams has led, and he thinks the Nottawa Creek project is a good idea.

He sees the big picture. He gets the connection.

"1 think it's all right," Korn said. "You know, we're running out of water now. We keep using up the same water over and over, and we're polluting it. What we've done, we've done away with our wetlands. Now it goes right to the ditch and the ditch goes to the crick and the crick goes to the Nottawa and the Nottawa goes to the St. Joe River and the river goes right out to Lake Michigan,"

Korn said he has found Williams' meetings to be informative.

Williams said she hopes other landowners along the creek, like Korn, will see the benefit of the project and pitch in to help keep the creek healthy.

She said this year she will continue to evaluate threats to the creek. Next year, she'll work on creating a report about the threats and when she's finished with the report she'll notify land owners of her findings, in hopes that they'll pitch in to help protect the water.

There is no enforcement portion of the Nottawa Creek project, so it will be up to landowners to volunteer compliance in order to get troubled spots cleaned up.

Williams hopes landowners will be able to see the benefit of protecting the creek. Some cost-sharing will be available to those who choose to clean up problems on their land, she said.

"We want to emphasize that the creek is clean and we want to keep it clean," Williams said. "There's some problems, but they are not major, they can be corrected."

THE BIG PICTURE

The Nottawa Creek Watershed Project also takes a look at wells and groundwater in the area of the creek. The idea is to make sure that the entire watershed is healthy and viable as a drinking, recreation and watering source.

"We want to emphasize that everything that you do will affect groundwater as well as surface water. They're interconnected," Williams said. "If you get rain water or water from snow melt, that seeps through the soil into rocks and crevices below the surface and eventually that water will probably come out onto the surface.

"It may take a long time, but it can come out to the surface through springs or through your well At the top of a watershed you have water that's seeping into the ground and back through the springs," she said.

TEN STEPS TO PROTECT DRINKING WATER

1. Know your drinking water: Understand where your water supply comes from, talk to your water supplier and schedule water quality tests required by the Environmental Protection Agency.

2. Test your well: In Michigan, 1,212,066 households get their drinking water from wells. If you have a well, have it regularly tested for contamination.

3. Plug abandoned wells: Identify the abandoned water wells in your area or on your property and have them plugged.

4. Septic system maintenance: If you have a septic system, pump it out every one to three years. Do not flush grease, caustics and non-biodegradable materials into the system.

5. Yank that tank: If you have an underground tank on your property, have it checked for leaks. Federal law requires that abandoned underground storage tanks be removed from the ground, and that leaking tanks be replaced.

6. Healthy farming and gardening: If you farm or garden, test the soil to avoid over-application of fertilizers, and practice the best livestock manure management practices available. Follow label recommendations for proper pesticide application.

7. Reduce, reuse and recycle: Remember what goes into garbage goes into our ground, and what goes into the ground goes into groundwater.

8. Buy recycled products: Paper made from recycled fibers reduces air pollution, saves trees and creates five times as many jobs as paper made from virgin wood. Look for stores that carry recycled products.

9. Don't dump toxins: Never dump, spill or permit contaminants or toxins to leak on the ground. Take used motor oil, paint cans and other materials to a collection center.

10. Become a **green consumer:** A green product is one which has environmentally sound contents or is wrapped in environmentally sound packaging. Say "no" to products that are over-packaged"

From Groundwater Education in Michigan, *financed by the W.K. Kellogg Foundation.*

FOCUS: OUR ENVIRONMENT

Plan targets water quality

$68,000 project lets county pool resources to protect watershed

XOCHITL PENA
The Enquirer

The Nottawa Creek Watershed – a source of drinking water and recreation for thousands of Calhoun County residents – may be fine for now.

But give the watershed, also an important agricultural drainage system, several years of exposure to pollutants, and the county could wind up with undrinkable water, dirty lakes and an expensive cleaning bill.

Years of contamination of the watershed's surface and groundwater could harm fish and pollute the drinking water, said Sharon Williams, watershed coordinator with the Calhoun Conservation District.

To avoid such a worst-case scenario, Williams is heading up the Nottawa Creek Watershed Project. It's purpose: to look at problem areas within the watershed and work to improve and protect the water quality.

"It's cheaper to prevent problems than to fix them," Williams said.

The watershed, an area from which runoff water (from rain and snow) gathers to feed a stream or stream system, is approximately 69,000 acres in size and extends west of Athens and east of Homer.

It includes six lakes and eight townships.

The communities surrounding the watershed, largely agriculture, use the watershed as a drainage system. But 99 percent of people living within the watershed also depend on it for their drinking water and for recreational activities, Williams said.

Those uses are threatened if awareness isn't heightened and preventive measures aren't implemented, Williams said.

"Our goal is to generate increased awareness of the need for stewardship of land and water resources."

SCOTT ERSKINE/THE ENQUIRER

Sharon Williams is the watershed coordinator for the Calhoun Conservation District and will help with the project

$68,000 GRANT

Williams gave several reasons why the project is needed: more than 40 percent of cropland erosion ends up in the water; the watershed has a shallow water table and sandy soils; and non-agricultural pollutants such as

Please see WATER, 4A

BATTLE CREEK ENQUIRER 2/20/97

4A

County focuses on water quality

WATER, from 1A

runoff from roads, septic systems and lawns threaten the watershed's future.

A $68,000 grant from the Environmental Protection Agency will pay for the project Helping to complete it will be the Calhoun County Conservation District, the Calhoun County Drain Commission and Western Michigan University.

The Conservation District will work with the Drain Commission to study the surface water, looking for pollutants such as nutrients in fertilizers, pesticides, hazardous wastes and other debris.

Western . Michigan University's Groundwater Education in Michigan Center will study the 'groundwater portion of the watershed.

Williams said the project could take up to five years. The first year will be devoted to research, the second year to developing a management plan, and the remaining years. to implementing the plan.

FARMERS LEERY

While the project is intended to educate the community - and not to impose regulations and penalties - local farmers are concerned.

"Farmers are leery of people coming in and telling them what to do," Calhoun Drain Commissioner Don Eishen said.

He said almost a dozen farmers have voiced concerns to him. They wonder if the project will end up costing them money by requiring new farming methods.

ABOUT THE WATERSHED

Awatershed, also known as a drainage basin, is the area froin which runoff water, from rain and snow, gathers to feed a stream or. stream system.

The Nottawa Watershed: .

- Extends west of Athens 10 eost of Homer.'
- Is 69,000 acres in size.
- Includes the lakes: Nonawo, Lee, Warner, Lyon, Long and Fish.
- Includes the townships: Athens, Leroy, Burlington, Tekonsha, Newton, Eckford, fredonia and darendon. .

.Is used for agricultural drainage, recreation and drinking water.

. ABOUT THE PROJECT

- will cost 56B,000, to be paid for with a grant from the U.S. Environmental Protection Agency.
- Will involve the Calhoun Conservation District, the Calhoun County Drain Commission and Western Michigan University's Groundwater Education in Michigan Center.
- Will anempt to find problem areas within the watershed and improve and protect the quality of the water.
- Ameeting to discuss the projectWi11 be from 3 to 4:30 p.m March 12 at the fredonia Township Hall.

But, Eishen said, he's also heard a lot of good comments coming from residents who are concerned about the watershed's future.

Bill Densham, a crop farmer in Newton Township, lives west of Lee Lake and has the Nottawa Creek running through his property.

"We do the best we can to not pollute it," Densham said, "but I'm interested to see how the project works **out"**

Williams of the Conservation District also looks forward to the implementation of the project.

"We want individuals to take responsibility for what happens to the quality of their water resource. We need to make an extra effort to care for our environment now, to protect what we have for the future."

Appendix

They're draining our budgets

4-25-83

Editor, Battle Creek Enquirer:

This concerns more taxes for Calhoun County rural residents. Last year we had a considerable rise in taxes. We haven't seen anything yet. Walt until we see what our drain commissioner does to our taxes unless we stop him.

We have all had notices for the meetlng of the Board of Determination for the proposition lorthe Nottawa Drainage Dlstrlct:We are asked to express our opinions as to whether we want to pay "to clean out, relocate;....widen; deepen, straighten, tile, extend or relocate along a hlghWaY)! No estimate is given as to how much all 01 this will cost. We are asked to slgn a blank check with no Idea how many hundreds 01 dollars it will cost, iis lndividually

In Tekonsha Townshlp, we are so poor that ourdusty roads can only have one application 01 calclum chlorIde, which is hardly any good at all. Last year It ralned right alter the application and washed it 011. 011, Which keeps the dust down better; they tell us is too expensive. And paving is out of the question.

Several years ago we paid for an Athens drain proposltlon.1 have never seen the final figures on that, I know it Increased our taxes individually by hundreds of dollars and we are 20 mUes Irom Athens, They tell us that thIs presentl'roject "Is necessary, and conducll'e to the 1lubllc.,healthrconvenlence and welfare ol,propertles and residents of Athens, Burllngton:.Fredonla;, Newlon, Eckford, Tekonsha and, Clarendon Xownshlps." Think about that,

I understand that the Nottawa Creek adds to the value of the land that actually borders .!t. It doesn't add one penny to mine. Some land owners bordering the 'creek keep their own stretches clean. Now, to determine if we think this is necessary and want to pay for it, we are asked to meet "Friday, Aprl129, 1983, at9 a.m :West of Oak DrIve where the draIn goes under M Drive South In the N.W, quarter 01 Section 4, Burlington Township" to hear all Interested persons; I hope I can find the place.

How many Interested persons do you suppose there are — rural taxpayers of Calhoun County? Providing all olthem can get off lwork, etc: Just bow are.Russell., Clutter;nlchard Wentworth and Dal'ld Veramay, or'.altnernate Bess Jordan, going to manage .thls hearing at a crossroads? Have cars parked for mUesln all direc tions? .Then how do they give each one a chance to express.hls opln lon? Suppose It rains or a cold wind is blowing? Thlslawis wrongl

Taxpayers should be glve.n'll chance to vote at voting booths on a proposllion this size, or at the very least;have a meeting In a building large enough 10'contain a large crowd and at a time when most taxpayers:Could get there to express their .0pln,lons;-When. a mill age question Is proposed for the schools,it Is done.lri astratrorward way wJth plentyof discussion and publlcIty. This seems to be a sneaky way 01 going about it.

Estelle Heraper
Tekonsha

Appendix G

Be Part of the ‚Solution

☞ Adopt-A-Stream
☞ Plant Filter Strips
☞ Use ProperFertilizer and Pesticide Rates
☞ Develop or Restore Wetlands
☞ Encourage Wildlife Habitat
☞ Exclude Livestock from Waterways
☞ Use Conservation Tillage

Ask About Cost-Share Funds

Conservation Districts

For More Information, Contact:

Calhoun Soil Conservation District
13464 15 *Mile Road*
Marshall, Ml 49068
(616) 781-4867

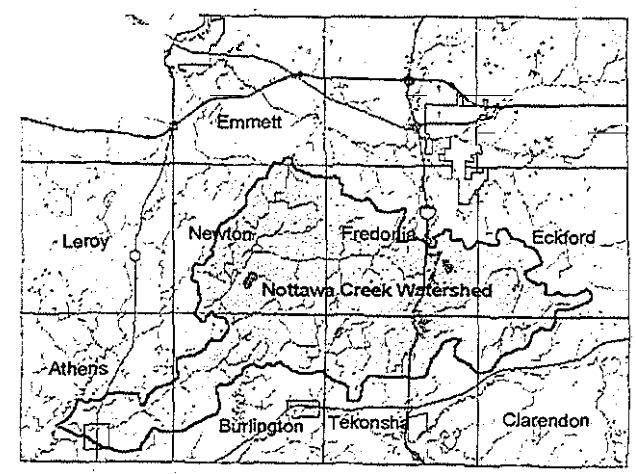
Western Michigan University
Groundwater Education inMichigan
Kalamazoo, Ml 49008
(616) 387-4936

Michigan Dept. ofEnvironmental Quality
301 E. Louis Glick Highway
Jackson, Ml 49000
(517) 780-7834

Calhoun County Dept. of Environmental Health
161 E. MichiganAvenue
Battle Creek, Ml 49014
(616) 966-1241

Natural Resources Conservation Service
13464 15 *Mile Road*
Marshall, Ml 49068
(616) 781-4264

Nottawa Creek Watershed Project



Protecting Your Water Resources

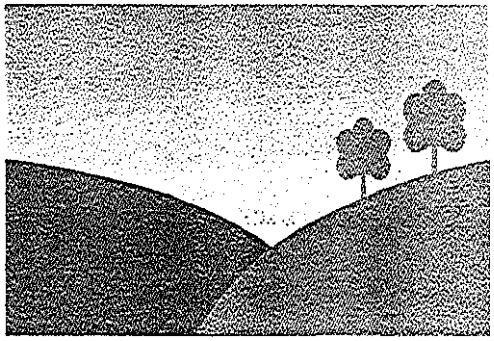
What is a Watershed?

We all live in a watershed. A watershed is an area where all waters flow to a comm:ondestination such as a wetland, river, pond, or lake.

Take a look around you, whether you live in town or on a farm, and observe where water flows. Follow the water as it meanders across the landscape and think about where it is going and where it's been. Water is constantly moving in a continuous cycle, being used and reused over and over again.

A watershed consists .of water both above and belowthe earth's surface. .99% of Calhoun County residents get their drinking· water from .groundwater.

Groundwater and surface water are interconnected Some water from rain or snow melt will seep through soil into the sands, gravels, and bedrock below. This water may eventually become the water that supplies your well, or may return to the earth's surface to feed lakes and streams.



About the Project

The Nottawa Creek Watershed Project is a cooperative effort by landowners, residents, and local, state, and federal agencies to protect the quality of water for drinking, recreation, and agriculture.

Watershed Area

The Nottawa Cre.ek Watershed project area covers 69,200 acres across Newton, Fredonia, Eckford, Burlington, Tekonsha, Athens, and Clarendon Townships. The main drainage channel is the Nottawa Creek, also known as the Nottawaseppee. The term "Nottawaseppee" comes from the Potawatomi Indian tribe, who named the river after their Indian Chief, Chief Nottawa. Seppee means river.

Why Should *You* be Concerned?

We all depend on safe drinking water. Human activity can contaminate water and impair watersheds making them unsuitable for wildlife, recreation, irrigation, drinking water, and other uses. An investment in watershed improvement will reap many benefits.

What Can You Do?

Cousider your activities and how they may impact the quality of the water around you. The use of household chemicals, fertilizer, road salt, septic systems, herbicides & insecticides, and soil erosion from construction' sites and bare fields may all impact water quality.

✔Read Labels Carefully
✔Follow Directions
✔Apply Only What You Need
✔Maintain Your Septic System

By using caution in our daily lives, we can be sure that these valuable water resources will be available for future generations.

AppendixH

Nottawa Creek Watershed Survey Results

190 surveys were randomly distributed to watershed residents by vehicle on November 3, 1997. There were 41 respondents. Below are the results from those surveys.

1. Are you familiar with the land area that drains into the Nottawa Creek?
   31 yes 10 no

2. What are your current activities with regard to the Nottawa Creek Watershed? Please check all that apply.

a. 14 Fishing
b. - Irrigating crop fields
c. 1 1 Swimming
d. 12 Drainage
e. **11** Watering lawn/garden
f 4 Canoeing
g. 6 Drinking water for livestock, pets
h. 27 Drinking water from well
1. **20** Household water supply
J. **28** Viewing wildlife/nature
k. 10 Hunting
1. **1** Mushrooming

3. Compared to 10 years ago, how much *better* or *worse* is the Nottawa Creek Watershed in the following categories? Circle the number or letter that best applies to each.

		Much Worse	Worse	Same	Belter	Much Belter	No Opinion
a.	Fishing		5	12	I	1	15
b.	Hunting		1	10	2	4	16
c.	Swimming		2	10	1		23
d.	Canoeing		3	7			19
e.	Observing wildlife		2	16	6	2	9
f	Water clarity		2	11	6	1	12
g.	Streambank erosion	2	4	8	5	1	14
h.	Littering	2	7	10	4	1	10
i.	Drinking water! household water supply		2	18			14

4. Rank the following sources, according to their degree of importance, where you think that most of the problems originate in the watershed.
(h = high, m = medium, I = low)

a.)	faulty septic systems	h= 5	m= **10**	1= **17**
b.)	household chemicals	h= 2	m= **10**	1= 20
c.)	storm water runoff	h= 7	m= **13**	1= 12
d.)	soil erosion from farmlands	h= 7	m= **12**	1= 14
e.)	livestock access to streams	h= **8**	m= **11**	1= 14
f)	construction site erosion and runoff	h= 3	m= 7	1= 21
g.)	fertilizer, pesticides, and other chemicals from agriculture	h= 21	m= 7	1= 6
h.)	fertilizer, pesticides, and other chemicals from lawns and gardens	h= **11**	m= 12	1= 10
i.)	nitrates in drinking water	h= 7	m= **14**	1= **9**
j.)	abandoned underground fuel storage tanks	h= 3	m= **5**	1= 25
k.)	soil erosion from road crossings	h= **2**	m= **11**	1= 18
l.)	urban sprawl	h= **6**	m= **9**	1= **16**
m.)	factories	h= **1**		
n.)	pond development along streams	h= 1		
0.)	excavation/clear cutting along drains	h= **1**		

5. Rate your level of concern for the water quality of the Nottawa Creek and its major tributaries. Please circle one option.

very concerned	somewhat concerned	not at all concerned	concerned
10	22	2	6

6. Please indicate your priorities on each of the following issues:

		High Priority	Moderate **Priority**	Low Priority	Nota Priority
a.	Planning development	7	13	10	5
b.	Environmental education	12	17	6	2
c.	Farmland preservation	24	9	3	I
d.	Hunting and fishing	9	15	8	5
e.	Land owners' rights	19	15	3	2
f.	Parks and outdoor recreation	7	17	9	3
g.	Preserving woodlands	20	9	5	2
h.	Preserving wetlands	20	12	4	3
i.	Recycling	17	11	4	3
j.	Water quality	29	4	2	2
k.	Wildlife preserves	18	9	6	3

7. Who do you think is responsible for protecting the Nottawa Creek Watershed? Please..[all that apply.

a. 34 citizens
b. 35 local government (twp., village, etc.)
c. 26 state government
d. 14 federal government

8. If cost were not a factor, of the following management practices, which ones would you like to learn more about for your property?

a. 6 Conservation tillage, crop residue management
b. 7 Grassed waterway
c. _6_ Managing riparian area (streamside)
d. _6_ Animal waste management
e. _5_ Pasture management (excluding livestock from streams)
f. 17 Wildlife habitat management/wetland restoration
g. _3_ Integrated crop management (crop scouting, pest. and fert. mgmt.)
h. _5_ Structures for erosion or water control
i. 10 Septic system maintenance
J. 7 Composting
k. 11 Lawn care

9. Please provide your opinion of the overall water quality of the Nottawa Creek Watershed.

_1_ = excellent 24 = good 12 = fair 4 = poor

10. Is there a specific problem affecting the watershed that is of greatest concern to you?

12 Yes 25 No

Concerns include:
brush/trees in creek
erosion
tree cutting/pond develop. along streams
contaminated drinking water supply
landfill

11. Would you volunteer your services to help this project?

16 Yes 19 No 2 Depends

12. Where do you typically look to find reliable infonnation about water quality and protection practices?

16 Local Newspapers
_1_1_ TV/Radio
11 University or Extension Sources
8 Magazines
10 Local Organizations
4 Workshops/Seminars
14 FSA/NRCS/Soil Conservation District

Questions 13 - 17 seek information that will help us to better interpret your responses to the survey. All of your answers will be kept confidential.

13. Where do you live?
12 On a farm
24 Rural, non-farm
3 Within village limits

14. How many acres do you own?
26 20 or less, 8 21 - *100,* 5 > 100

15. How many people live in your household?
a. 25 (I - 2)
b. 12 (3 - 4)
c. **2** (5 or more)

16. What is your age?
a. **I** (under 25)
b. 3 (26 - 35)
c. 9 (36 - 45)
d. 11 (46 - 55)
e. **15** (over 55)

17. What is your occupation?
12 retired
4 teacher
_5_ farmer
7 business
12 other

Appendix I

CALHOUN COUNTY COMMUNITY DEVELOPMENT

ROAD COMMISSION ✦ PLANNING COMMISSION
BOARD OF PUBLIC WORKS ✦ PARKS TRUSTEES

13300 Fifteen Mile Road .:. Marshall, Michigan 49068

December 8, 1997

Phone Numbers
(616) 781-9841
(800) 781-5512
(616) 781-6101 FAX

Calhoun Conservation District
13464 15 Mile Rd., Suite 110
Marshall, M1 49068

To Whom It May Concern,

The Calhoun County Community Development (CCCD) office fully supports the "Nottawa Creek Watershed Project". This project provides the opportunity to demonstrate important linkages in the greater community's efforts to improve environmental stewardship and the human quality of life.

There are linkages between surface water & ground water, between land use & water quality, between local governmental planning & land use regulation & land use practices, between farm and community awareness & educational initiatives, between all of the above and a well developed data base.

I have participated in the Advisory Committee for this Project. It is clear that while this Project is still in its formative stages, good efforts have been made to look at the Nottawa Creek as comprehensively as possible. In this process, efforts have been made to establish and strengthen vital linkages. The data base being developed for this project is equally impressive (esp. the GIS portion).

The CCCD office takes great interest in this Project as it touches various areas of our work including the following. We are also building our own first priority of GIS layers. This office also issues soil erosion control permits county wide. We work with and advise local units of government on planning & zoning matters on a regular basis. We also promote appropriate recreational use of the County's water resources.

The depth and breadth of the "Nottawa Creek Watershed Project" is remarkable. We fully support the further development of this initiative.

Sincerely.

Richard O. Smith
Community Planner

pc: Calhoun Co. Metropolitan Planning Commission
Dennis Randolph, Managing Director

USDA

UNITED STATES DEPARTMENT OF AGRICULTURE

FARM SERVICE AGENCY

CALHOUN COUNTY FARM SERVICE AGENCY
13464 15 MILE ROAD SUITE 100
MARSHALL, MICHIGAN 49068-9628
PHONE: (616) 781-4263
FAX: (616)781-3199

January 14, 1998

Calhoun Conservation District
13464 15 Mile Road, Suite 110
Marshall, Michigan 49068

To Whom It May Concern:

As the Director of the Calhoun County Farm Service Agency, I am writing this letter to express my enthusiastic support for the work being conducted by the Nottawa Creek Watershed Project.

During the past year the project has done a great deal of study on both groundwater and surface water quality in the watershed. The Nottawa Creek Watershed has areas of highly vulnerable groundwater. The potential impacts of intensive pesticide and fertilizer use on water quality in our area is a major concern facing today's agriculture. Livestock access to waterways may also be having a dramatic impact on the quality of water in the Nottawa Creek. Efforts on behalf of the Nottawa Creek Watershed Project to remediate critical sites and encourage better land use management are crucial to improving and protecting water quality.

The Calhoun County Farm Service Agency will support this project in whatever ways are appropriate. Most likely, this will be in the form of cost-share assistance for improved practices or disseminating information through the FSA newsletter.

Sincerely,

Elizabeth Lake
County ExecutiveDirector

Potawatomi
Resource, Conservation, and Development Area
500 Country Piue Lane, Suite 6
Battle Creek, MI 49015

Jan. 27, 1998

Michigan Dept. of Environmental Quality (MDEQ)
Surface Water Quality Division
P. O. Box 30273
Lansing, **MI** 48909

RE: Michigan's Non-Poiut Source Program RFP 1998
Implementation Project

Dear Sir:

After a thorough review, the Potawatomi Resource, Conservation, and Development (RC&D) Council, representing the counties of Barry, Branch, Calhoun, Kalamazoo, and St. Joseph, strongly supports the broad goals and speciflc objectives developed in the comprehensive Nottawa Creek Watershed Management Plan submitted by the Calhoun Conservation District (CD). Based on this Watershed Plan, the Calhoun CD and its conservation partners have submitted an Implementation Project Proposal under Michigan's Non-Point Source Program RFP (1998). This proposal addresses nonpoint source pollution problems in this critical watershed. The implementation project details the restoration and protection efforts necessary to improve and protect water quality in this area.

The Potawatomi RC&D Council feels the selection oflhis particular watershed is a high priority because it has been analyzed and reviewed for priority by the MDEQ, the Conservation District, Western Michigan University, the USDA Natural Resource Conservation Service, and other Watershed partners. These agencies all have long term, effective experience in solving local conservation problems and working together.

The Potawatomi RC&D Council has helped and will continue to help in any way its members and staff can to promote and sustain this worthwhile effort. We will offer technical advice and funding searches to the project, together with information/education efforts. Also, the RC&D office will assist in approval, planning, and implementation of some of the Best Management Practices. Through our work and cooperation with the USDA-NRCS and other conservation/funding organizations, the RC&D can help assure the success of this Implementation Project.

The Potawatomi RC&D Council looks forward to working with the Calhoun CD on this worthwhile project. The Council encourages the MDEQ and EPA to approve this essential and important implementation project.

Sincerely,

James Coury

James Coury
RC&D Coordinator

CALHOUN COUNTY COMMUNITY DEVELOPMENT

ROAD COMMISSION ✦ PLANNING COMMISSION
BOARD OF PUBLIC WORKS ✦ PARKS TRUSTEES

13300 Fifteen Mile Road .:. Marshall, Michigan 49068

Phone Numbers
(616) 781-9841
(800) 781-5512
(616) 781-6101 FAX

January 13,1998

Calhoun County Conservation District
13464 15 Mile Rd., Suite 110
Marshall, Mi. 49068
Atten: Sharon Williams

Dear Sharon,

I would like to take this opportunity to comment on the Nottawa Creek Watershed Project, now entering its second year. The Calhoun County Community Development Office has been actively involved in the Nottawa Creek Watershed Advisory Committee meetings.

This community, like many others in Southwest Michigan, is a growing one. With this growth comes stress on our natural resources. Lakes are becoming overcrowded with residential building without the benefit of municipal water or sewer. Sedimentation is a large concem in the Nottawa Creek and its tributaries. This office enforces Public Act 451 of 1994 under Sections 324.9101 thm 324.9123 which regulates activities of earth change over one acre or within 500 feet of a lake or stream, therefore we take a very active interest in the Nottawa Creek Watershed Project and support it.

I strongly encourage this project's efforts to improve the quality of life for the watershed's residents through education and demonstration of environmental responsibility.

Sincerely,

Dennis A. Randolph, Managing Director
copy: file

USDA

United States Department of Agriculture

Natural Resources Conservation Service

Marshall Field Office
13464 15 Mile Road
Marshall, MI 49068-9628
(616) 781-4264

December 8, 1997

Calhoun Conservation District
13464 15 Mile Road
Marshall, MI 49068

To Whom It May Concern:

As representative of the USDA Natural Resources Conservation Service (NRCS) in Calhoun county, I endorse and support the Nottawa Creek Watershed Water Quality Planning Project which is completing its planning phase.

The quality of surface waters in the Nottawa Creek Watershed is generally considered fair to good depending on location and use. Ground water resources, on the other hand, are considered threatened. The principal land and water use in the Watershed has been, and still is, agriculture. However, in recent years, development pressures from both Battle Creek and Marshall have started to change the character of the landscape.

In addition, the intensive survey conducted during the planning phase has revealed some critical problem areas that have already downgraded water quality, and threaten to continue this trend if not corrected. Therefore, the Watershed Plan deals both with corrective measures as well as protective measures. Both are essential to the health of the Watershed.

The Watershed Plan also emphasizes the need for cooperation between units of government. Watersheds do not follow political boundaries. Those who deal with political jurisdictions are becoming increasingly aware that dealing with natural resources in watersheds requires thinking outside their boxes. This trend should be supported to better manage our natural resources.

I support the partnership that provided the cooperative effort to make this project and the Nottawa Creek Watershed Water Quality Management Plan a possibility.

Sincerely,

Daniel F. Kesselring
Resource Conservationist

NEWTON TOWNSHIP
7988 G Drive South
Ceresco, Michigan 49033
Sue Ann Jessup, Supervisor

February 10, 1998

Calhoun Conservation District
13464 15 Mile Road Suite 110
Marshall, Michigan 49068

Re: Nottawa Creek Watershed Project

I am writing to add my support of the Nottawa Creek Watershed Project. As Newton Township Supervisor and a member of the Township Planning Commission I greatly appreciate information that will allow this township good choices in land use planning and protect the water quality for our farm and residential populations. A comprehensive study will give this COlUlty a data base to use to understmld water resources and aid in environmental decisions at all levels of govermnent.

We in Newton Township are working to retain our agricultural and wetland/open space land. The Nottawa Creek Watershed Project will give us infOlmation to do a "good job" of it.

Sincerely,

Sue AmI Jessup, Supervisor

CALHOUN COUNTY
FARM BUREAU

15151 C. Dr. North. P.O. Box 206, Marshall, Michigan 49068
Phone (616) 781·2849

December 15, 1997

Calhoun Conservation District
13464 15 Mile Road
Marshall, MI 49068

To whom it may concern:

There is an increasing concern amount rural and urban residents about non point source pollution of Michigan's surface and ground water. We support the concept of protecting our state surface and groundwater from contamination and recognize we share the responsibility with many other sources, The agricultural industry must also share in the solutions,

We have been a supporter of the Michigan Groundwater and Freshwater Protection Act which enacts a comprehensive statewide plan to protect groundwater and surface water from chemicals and fertilizers,

Programs to abate nitrate contamination in groundwater should address all possible sources of nitrates including all uses of nitrogen, fertilizers, animal manure, septic systems, urban runoff, nitrate occurring naturally, etc.

Calhoun County Farm Bureau encourages farmers to use soil testing as method of conserving resources and maintaining water quality, It is in agriculture's best interest to follow fertilizer recommendations made from soil test results, We also recommend additional research into making nitrogen fertilizer more stable and less able to leach below the crop root zone, MSU Extension offices and Soil Conservation District offices should develop specific management decisions based on soil test results,

We have been active participants on the Nottawa Creek Watershed Project Advisory committee and strongly support the efforts being made to protect water quality.

Sincerely,

Nancy Dietz

Nancy Dietz, President
Calhoun County Farm Bureau

MICHIGAN STATE UNIVERSITY EXTENSION

November 24, 1997

Michigan Dept of Environmental Quality
Surface Water Quality Division
P. O. Box 30273
Lansing, MI 48909

DearMDEQ,

I am very pleased to support the Nottawa Creek project **in** Calhoun County. As the Extension Field Crops agent for this area for over 13 years, I am well aware of the benefit such a project will bring to our area.

I have conducted many educational meetings on ground and surface waters, especially how agriculture impacts and can protect these resources. I have also worked with the Groundwater Stewardship program, administered by the Soil Conservation District. The value of technical support is enhanced by a strong informational educational component.

I am also working with a group of farmers **in** the area who are organized and interested **in** testing and demonstrating sustainable practices. This group is called the Innovative Farmers of South Central Michigan. With over 30 members, this group will be very valuable to many other farmers **in** our area as they watch and learn from the group's demonstration plots. These plots are critical to adopting practices that protect the environment, fit into a farmer's total farm system and in lending credibility to the data that is generated.

I look forward to working with Sharon Williams, assisting het where ever Extension can be of support in the educational outreach portions of her program. Sharon has a very strong sense of the needed outreach and will see this project to a successful completion.

Sincerely,

Natalie Rector

Natalie Bement Rector
Extension Field Crops Agent
Branch and Calhoun Couties

Calhoun County MSU Extension
315 W. Green Street
Marshall, Michigan
49068·1585
616·781·0784
Fax 616·781·0647
calhoun@msue.msu.edu

CALHOUN COUNTY
Drain Commission

"Building A Better County Through Responsive Leadership"

315 W. Green St.
Marshall, **MI** 49068
(616) 781·0790
(616) 781·0793

Office Day: Monday

DONALD J. EISHEN
Drain Commissioner

SHERRY TRADER
Deputy

December 3,1997

Calhoun Conservation District
13464 15 Mile Road, Suite 110
Marshall, MI 49068

RE: Nottawa Creek Water Shed

TO WHOM IT MAY CONCERN:

As County Drain Commissioner, I have enjoyed working with Sharon Williams and the Nottawa Creek Advisory Committee.

Nottawa Creek is the largest county drain in Calhoun County. The research and inspections Sharon has done have been very valuable to our office. I have to keep the drain in good working order to give the farmers a good outlet for drainage. This project informs the farmers and landowners in this water shed of the environmental problems that can arise and how to cut down on erosion and contamination of our water. Educating the landowners helps me explain why I spend their tax dollars for erosion and environmental concerns along with providing good drainage.

This has been a very good project and I give my support for it. I also would like to see more of them. The key to Cooperation is thru Education.

Sincerely,

Donald J. Eishen
Calhoun County Drain Commissioner

DJE:rmg

Tekonsha Township
P.O. Box 91
Tekonsha, MI 49092

February 10, 1998

Calhoun Conservation District
13464 15 Mile Road
Marshall, MI 49068

To Whom It May Concern,

As Tekonsha Township Supervisor I am very concerned about the Nottawa Creek Watershed and support the Nottawa Creek Watershed Water Quality Project whole heartily.

This pass year this project has raised the awareness of the linkage between surface runoff and the contamination of our water supplies. By continuing this awareness and education we can help Michigan's clean water supply.

The Tekonsha area is also concerned about the success of this project. The VIIlage of Tekonsha's water wells are located in the watershed. Nottawa Lake, also localed in the Tekonsha area, provides fishing, recreation and camping to residents in the area and the state. Groundwater contamination is always a concern, with over a quarter of the township's land area located In the watershed.

As Supervisor, I will continue to encourage our township's support in this vital watershed project.

Sincerely,

Nelson A. Shedd

Nelson A. Shedd
Tekonsha Township Supervisor