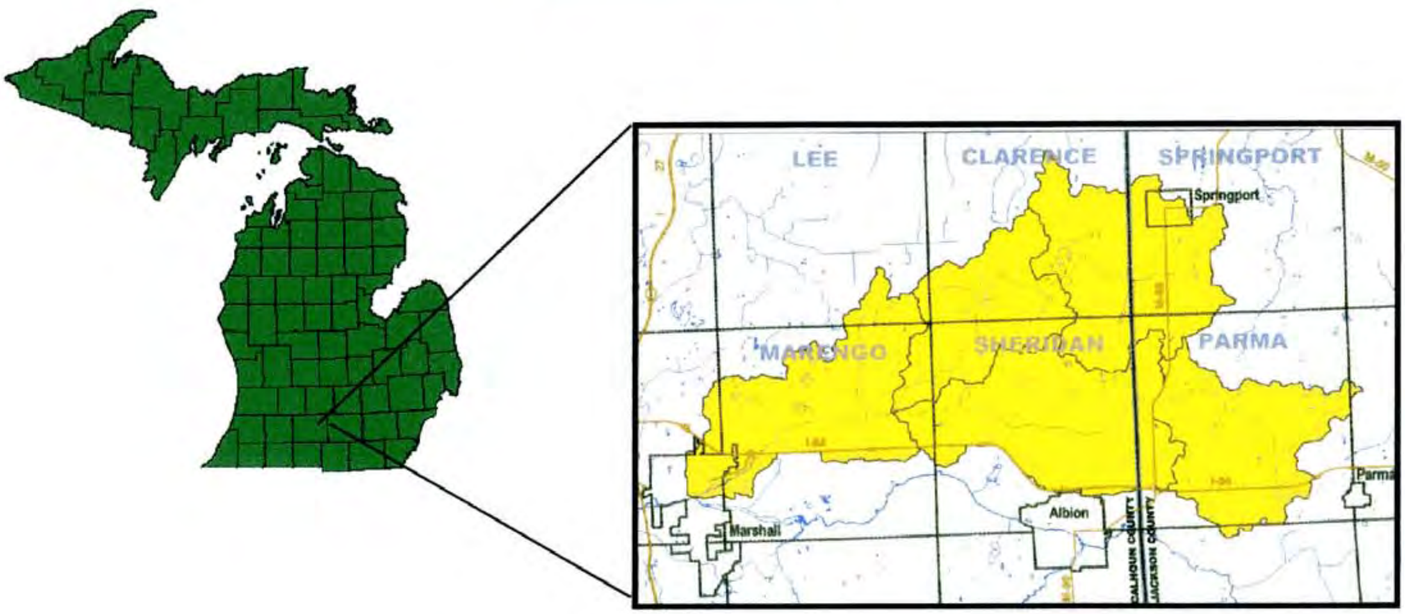
Rice Creek Watershed Project

Watershed Management Plan
July 1, 2003



Calhoun Conservation District
Calhoun County, Michigan

In Cooperation with:
Calhoun County Drain Commission, Calhoun County MSU Extension,
Jackson County MSU Extension, Albion College, MDEQ Water Division,
USDA Natural Resources Conservation Service

Introduction

The overall goal of this planning project was to develop a comprehensive watershed management plan that identifies and analyzes the resource and water quality needs, problems, and solutions for the Rice Creek Watershed. The plan integrates the valid concerns of all watershed stakeholders and outlines solutions that will improve conditions so that all designated uses in Rice Creek are restored and maintained.

The Rice Creek Watershed covers 58,200 acres (90.9 square miles) in western Jackson and eastern Calhoun County. Rice Creek is a tributary to the Kalamazoo River which flows into Lake Allegan and then Lake Michigan. Much of the creek was developed as an agricultural drain in the 1920's. The relevant designated uses for surface water in the Rice Creek Watershed are warm-water fishery, habitat for indigenous aquatic life and wildlife, agriculture, public water supply (groundwater) and partial or total body contact recreation. Portions of the south branch of the creek are considered a cold water trout stream. Interestingly this project discovered that the south branch most likely became a cold water stream because of the dredging many years ago. This dredging restricted surface waters, with their warm water influence from large wetlands in the floodplain, from entering the creek, and allowed significant new groundwater resources to enter directly into the stream.

The Rice Creek Watershed includes the following Townships in Calhoun County: Clarence Township sections 10, 11, 13, 14, 15, 21 – 36; Lee Township sections 25, 26, 34 – 36; Sheridan Township sections 1 – 28; Marengo Township sections 1 – 3, 7, 8 – 24, 30; and Marshall Township sections 12, 13, 24, 25. The following Townships in Jackson County are also included: Springport sections 17 – 21, 28 – 33; Parma Township sections 4 – 9, 13, - 35; and Concord Township section 4.

Also included are the Villages of Springport and Devereaux and the northeast corner of the City of Marshall, east of Brewer Street and Kalamazoo Avenue and north of Pearl, Walnut, and Washington Streets.

Local Agencies and Citizens

The Rice Creek Watershed Advisory Committee consists of a diverse group of resource professionals, farmers, landowners, agency staff, township officials, and concerned citizens. They are to be praised and saluted for their dedication and hard work over the past two years. Most of them remain committed to continue serving on the Committee into the implementation phase of the watershed plan. Their names are Richard Robilliard, farmer Sheridan Township; Wendy Chamberlain, Parma Township Supervisor; Tracy Bronson, Calhoun Conservation District Executive Director; Rachel Grades, Calhoun County Drain Commission Office; Greg Potter, Trout Unlimited and Business Owner; Linda Kubiak, Farmer, Calhoun Conservation District Board; Scott Hanshue, Michigan Department of Natural Resources, Fishery Division;

Doug White, Professor of Biology at Albion College and Manager of water quality monitoring for the project; James Coury, Potawatomi Resource Conservation & Development; Chris Bauer, Michigan Department of Environmental Quality-Water Division; Jennifer Bomba, Calhoun County Community Development, Planning Director; Daniel Kesselring, United States Department of Agriculture Natural Resources Conservation Service, District Conservationist; Charles Elzinga, Professor of Stream Ecology, Michigan State University and Manager of Lake studies for the project; Ben Lark, Chairman of the Calhoun Conservation District Board and Sportsman; Mike Metzger, Jackson County-Michigan State University Extension; Bob Battel, Calhoun County-Michigan State University Extension; Blaine VanSickle, Calhoun County Drain Commissioner, Farmer in Marengo Township; Ken Lauer, Sheridan Township Supervisor; James Tech, Landowner, Sportsman; Steve Hall, Jackson County Health Department; Sue Hauxwell, Calhoun County Health Department; Robert Brownell, Marengo Township Board, Farmer in Marengo Township; Mike Lehtonen, City of Marshall engineer; Jack Knorek, Lee Township Board; Cyndi Twichell, Manager of the Village of Springport; Robert Neumann, Consumers Energy; Sharon Parker, Jackson Conservation District, Executive Director; Don Franklin, Marshall Township Planning Commission and retired engineer; Craig Gill, Village of Springport Department of Public Works; Tara Egnatuk, Conservation Education Director, Calhoun Conservation District; and Rick Pierson, Coordinator for the Rice Creek Watershed Project, Calhoun Conservation District.

The Rice Creek Watershed Advisory Committee met quarterly, while the steering committee (made up of 12 of the above individuals) met most months. Many of the Advisory Committee Members also served on various sub-committee's during the planning process.

Public Involvement

The Rice Creek Watershed Project communicated directly with the 1200 residents in the watershed on many occasions and was blessed with a reasonable amount of interaction with folks across the watershed.

Newsletters were mailed in the Fall of 2001, Spring 2002, Winter 2002, and Spring 2003 with many educational articles on watersheds, land use, lakes, history, drinking water, stream ecology, water quality monitoring, project updates and results from meetings and questionnaires.There were many press releases announcing project details and events to the public.

A questionnaire was mailed to all watershed residents in the winter of 2001 and again in the spring of 2003 to gather concerns about the watershed. The results of the questionnaire are included in this plan (See Appendix A). Generally, folks in the watershed are concerned about the water quality of Rice Creek and value the creek and its corridor mostly for hunting, fishing, viewing wildlife, and for its ability to manage storm water.

As you think about these responses you can easily see, probably the biggest challenge for the future: How to balance the desire for wildlife, the fishery, and the natural aquatic resources with the ever increasing need for storm water run-off (drainage).

A two hour workshop was held for all watershed residents on April 18, 2002. An overview of the watershed planning project was given and the monitoring efforts were discussed. Soil sampling and lawn fertilization practices were taught. Septic system problems, maintenance and replacement options were shared A session on how to deal with household waste was taught along with an overview of the home*a*syst program, a program to help people reduce their risk of impact to groundwater contamination.

On July 25, 2002 a two and a half hour workshop specifically for farmers was held.
Topics included an overview of the watershed planning project, a discussion about County Drains, manure and nitrogen management, reduced tillage, filter strips, septic systems, and an overview of the farm*a*syst program, a program to help farmers reduce their risk of impact to groundwater contamination. A hardy question and answer period was held at the end of the workshop.

On February 27, 2003 a two and a half hour conference was held for all watershed residents. The workshop was held in cooperation with the Battle Creek River Watershed Project, adjacent to the Rice Creek Watershed Project. The conference agenda was established based on comments made by watershed residents who attended earlier workshops. They wanted a conference that focused on stream issues and desired an opportunity to ask questions and get answers on specific topics. The meeting site was the Clarence Township Hall in Calhoun County, only several miles away from the Jackson County line and on the very border of the Rice Creek and Battle Creek Watershed boundaries. As a result, the workshop was titled "On the Edge" Stream Issues and Answers Conference. Professional speakers were found for each of the desired topics: identifying the issues, striving towards solutions, lagoon wastewater management systems-system abilities and limitations, proposed regional sewer project update and alternatives, water quality monitoring-a summary of the findings,
and the state of our warm water and coldwater fisheries. The conference ended with a session titled "Ask the Speakers" a panel discussion.

All of the workshops and the conference were very well attended and many committee members felt that over the course of the planning project through the meetings, newsletters, town hall presentations, and one-on-one meetings we were very effective in bringing folks along a path of education related to watershed management, conservation of natural resources, application of best management practices and in piquing their interest in reducing and/or eliminating sources of non-point source pollution.

In March of 2003 working in cooperation with the Calhoun Conservation District and Jackson County MSU-E a “watershed management short course” was held for nearly 60 participants. The course was held every Monday night in March for five weeks and included a Saturday field trip, and resource expo on the last Monday night. One goal of this course was to train folks in watershed management who might get more involved with the Rice Creek Watershed Project in the future. Ten of the 60 folks who attended the course are on the Rice Creek Watershed Advisory Committee, so we are very excited about the future of the watershed and the hope of this management plan being implemented as some of these folks will be included on the “watershed action committee”. The watershed action committee will work to move forward the implementation of this management plan.

In February of 2002 and 2003 we met in Lansing with the State Legislators for the area that includes the Rice Creek Watershed. We shared with them the many goals and objectives of the project and expressed our need for funding to carry on the good work that has been done. They also asked us questions about the project which was an encouragement to us that they were aware of the project and were somewhat knowledgeable concerning the project.

In the fall of 2002 and the spring of 2003 Marshall high school teachers Angela Krueger and Tracy Haroff worked with us to develop a long-term stream ecology project on Rice Creek. They will use Rice Creek as an outdoor laboratory to teach their students about stream ecology and in the process collect valuable data on Rice Creek near the outlet into the Kalamazoo River. We hope to start two new groups and duplicate their efforts in other parts of Rice Creek by 2004. In addition Project Wet workshops will be held with teachers in the watershed, to promote water quality education. Project Wet is a nonprofit water education program for educators and young people, grades K-12.
The goal of Project Wet is to facilitate and promote awareness, appreciation, knowledge, and stewardship of water resources through development and dissemination of classroom-ready teaching aids and through the establishment of additional Project Wet programs.

Most of the City of Marshall’s Wellhead Protection Area is in the Rice Creek Watershed. Time was spent in the early part of the project serving on the wellhead committee developing a plan to protect the City’s drinking water supply. A detailed plan was printed in September of 2001 and is available for review either at the City of Marshall or at the Calhoun Conservation District.

Most of the data, maps, and reports that are a part of the files of the Rice Creek Watershed Project have been reproduced and are available for review by the public in a file in the historical room at the Albion Public Library. As a partner, the Albion Public Library has worked with the project to help us properly preserve the historical data gathered during this project and have allowed us to make that information available to the public for future reference.

Information related to this project is also available at the Calhoun Conservation District and the Michigan Department of Environmental Quality-Water Division.

Chapter I - Description of the Watershed

Inventory Methods

Various methods were used in the gathering of data concerning the watershed. A number of specific inventories were also conducted including the following: A thorough review of the historical data existing on Rice Creek and its watershed. Extensive files exist at the Calhoun County Drain Commission office, other significant files of historical data are available from Marengo Township, Calhoun & Jackson County Health Departments, and the Calhoun County USDA-NRCS office.

A comprehensive field study was conducted including inspections of the main tributaries, lakes, and potential groundwater contamination sites. This physical inventory provided an opportunity to identify significant water quality pollutants, sources, and causes. The inventory included photographic documentation of each of the 68 road/stream crossings and significant areas in between via kayak, and complete video documentation. The findings in this plan are a direct result of these inventory activities, which were conducted by the watershed project coordinator and Albion College.

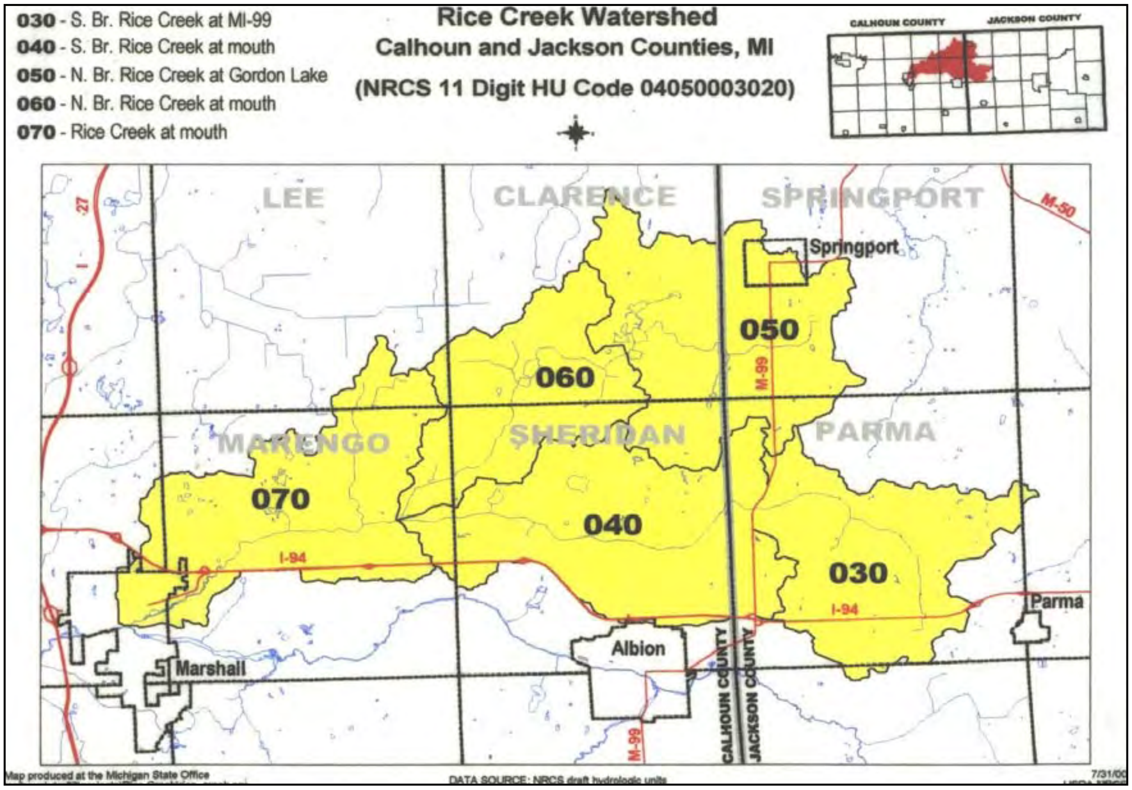
An aerial photographic catalog was developed of the entire stream corridor, including all major tributaries. A separate portion of this catalog contains all of the soil maps for the entire stream corridor. This catalog allows the investigator to always know what is around the next bend, when access or navigability is not possible. Maps were also developed for the watershed. The following maps were developed and used to complete the inventory: topographic maps, soils maps, corridor map, stream/road crossing map, stream & lake flow map, a township overlay map, and a land use/land cover map. Watershed project reports, data, and maps are available for review at the Calhoun Conservation District office.

Location and Size

The Rice Creek Watershed is a tributary to the Kalamazoo River Watershed, which is located in the Lake Michigan watershed. It is located in the south-central region of Michigan's Lower Peninsula. The Rice Creek Watershed covers 58,200 acres (90.9 square miles) in western Jackson and eastern Calhoun Counties. Rice Creek flows into the Kalamazoo River at Marshall, Michigan.

The watershed includes the following townships in Calhoun County: Clarence sections 10, 11, 13, 14, 15, 21-36; Lee sections 25, 26, 34-36; Sheridan sections 1-28; Marengo sections 1-3, 7, 8-24, 30; and Marshall sections 12, 13, 24, and 25. The following townships in Jackson County are also included in the watershed: Springport sections 17-21, 28-33; Parma sections 4-9, 13-35; and Concord section 4. Also included are the Villages of Springport and Devereaux and the northeast corner of the City of Marshall (east of Kalamazoo Ave. and north of Washington Street).

Map A



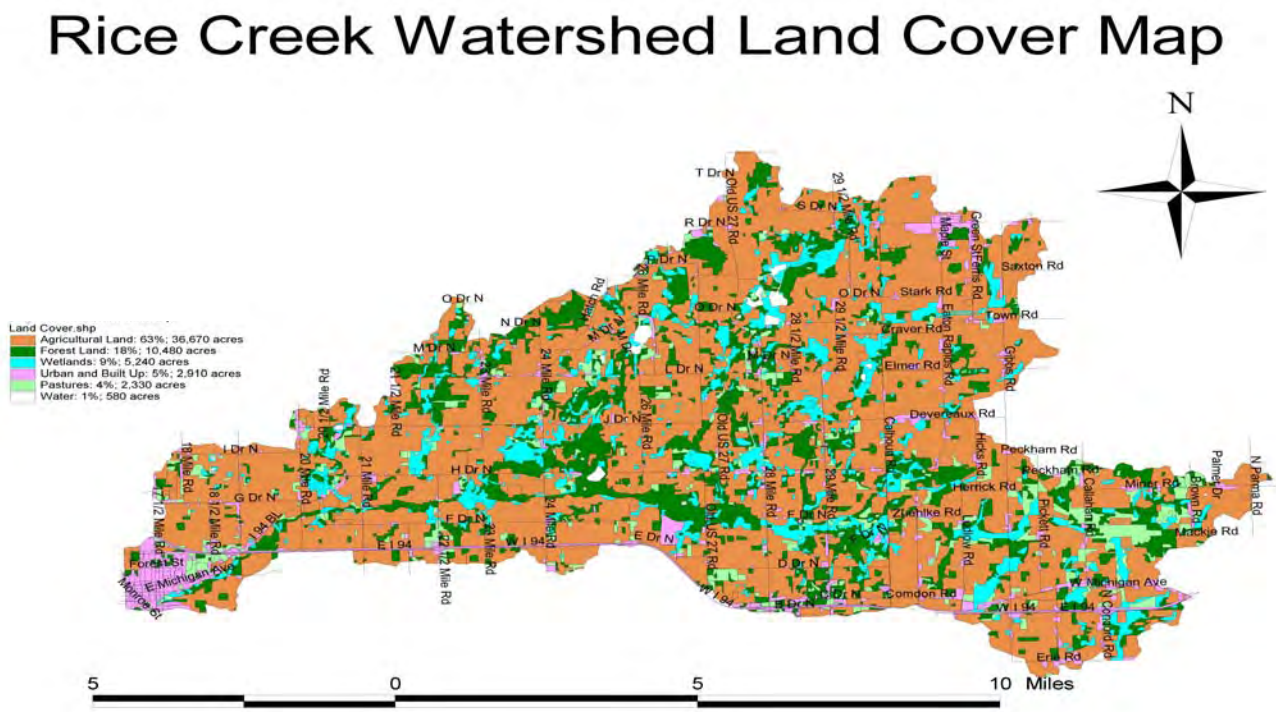
Land Uses

Agriculture is the dominant land use (63%) in the watershed. Forest land represents 18%, wetlands 9%, urban and built up land 5%, pasture lands 4%, and water surface area covers 1% of the watershed.

Many natural wetlands have been drained in the past and now lay idle. Large wetland areas along the stream corridor are disconnected from Rice Creek, due to past dredging activities. Forest cover dominates the Rice Creek stream corridor. As would be expected, a significant portion of the growth occurring in the watershed is occurring along the interstate corridor.

As with other communities in Michigan, the Rice Creek Watershed is experiencing the loss of prime farmland and open space to rural residential growth. The rural communities within the watershed have grown at a comparable rate, as people relocate from urban areas to rural areas within the Rice Creek watershed. In Calhoun County where the largest portion of the watershed lies, there was more than a 4% reduction in the number of land in farm acres from 1987 to 1997. Over the past twenty years the increase in rural residential homes is probably the most significant land use change.

Map B



Population

The intensity of land use in the Rice Creek watershed, at least during its history as a rural agricultural landscape, is largely reflected by human population trends.
Because census data are based on political boundaries not watersheds, it is not practical to construct an absolute population history for the watershed. However, a reasonable approximation of population trends can be made by compiling the U.S. census records for the rural sections of the four townships (Marengo, Sheridan, Clarence and Parma) that encompass the bulk of the watershed. From a relatively stable base during the first century of American settlement, the population more than doubled between 1920 and 1970. This growth spurt occurred after the major period of drain construction. Since 1970 population has been relatively stable, although it may be starting to grow again.

The evidence for population stability during recent decades may be surprising to anyone who has noted the many newer homes sprinkled across the watershed! A recent comprehensive study of patterns in land use in Michigan conducted by Public Sector Consultants, Michigan State University, the University of Michigan and others (available at www.publicsectorconsultants.com) found rates of land development exceed population growth by a factor of 2 to 27 times (average about 8 times).

Thus, recent population stability in the watershed is probably a falsely reassuring indicator of land use trends that can impact Rice Creek. In fact, The Consultants' report forecasts substantial increases in developed land use in the watershed in 2020 and 2040 based on sophisticated computer simulation models developed by Michigan State scientists. The watershed is exceptionally well situated to experience sprawl growth in coming decades. The average age of most property owners is high (59% of watershed residents responding to a 2001 questionnaire were over 55 years old; 48% were retired). The watershed is wedged between the cities of Marshall and Albion and the residential hubs of Duck Lake and Springport. The southern boundary of the watershed is nearly coterminous with a busy Interstate highway (I-94); there are six Interstate exits in, or nearly in, the watershed.

Topography

The present surface features of the Rice Creek Watershed are mostly a result of the Wisconsin Glaciation. This glacial deposition event began approximately 23,000 years ago. The Saginaw ice lobe, a sublobe of the larger Huron ice lobe, retreated across the watershed between 16,000 and 14,000 years ago. It was during this retreat that the sediments, which constitute the surficial geology of the watershed, were deposited. These glacial sediments (drift) range from 0 to 100 feet in thickness. Paleozoic age bedrock lies beneath the glacial sediments except where the bedrock is exposed at the surface.

The Paleozoic Era is represented by the Mississippian Period which began approximately 355 million years ago, and the Pennsylvanian Period which began approximately 310 million years ago. The Mississippian bedrock can be subdivided into five unique rock formations. four of which are represented in the Rice Creek Watershed.
They are: Saginaw Formation, Bayport Limestone, Michigan Formation, and Marshall Sandstone. Each of these represents a unique depositional event.

Predominant Soil Types

General Soil Map Units

Soil types within the watershed are represented in Map C.
In Jackson County there are three soil associations in the watershed.

- Hillsdale-Riddles association: approximately 7% of the watershed, deep well drained, loamy soils that formed in glacial till
- Hillsdale-Eleva-Riddles association: approximately 4% of the watershed, deep and moderately deep, well drained and somewhat excessively drained, loamy soils that formed in glacial till, in material that weathered from sandstone, or in glacial drift over sandstone
- Riddles-Teasdale-Palms association: approximately 15% of the watershed, deep, well drained, somewhat poorly drained, and very poorly drained, loamy and mucky soils that formed in glacial till or in organic material and the underlying loamy glaciofluvial deposits.

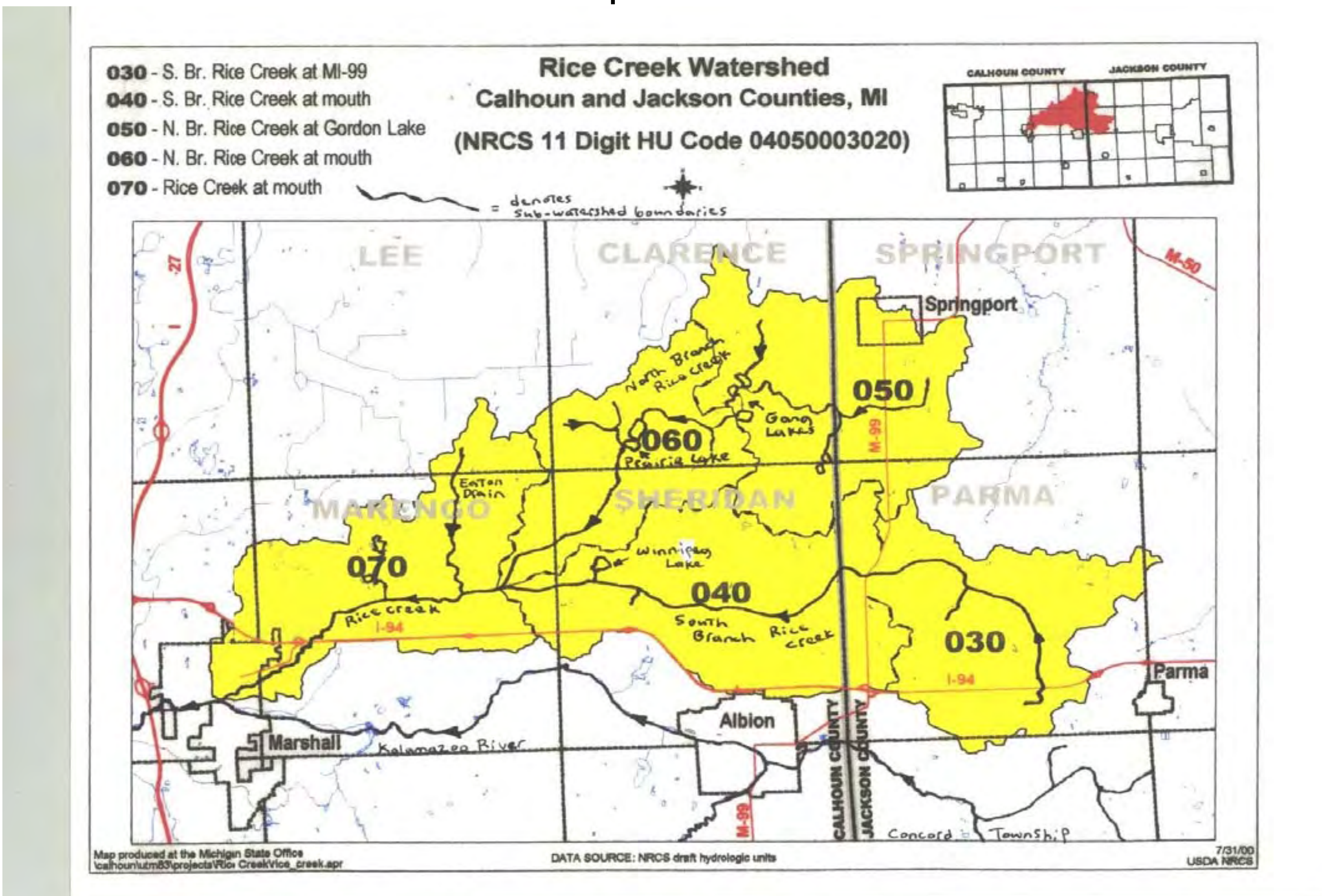
In Calhoun County there are six soil associations in the watershed.

- Hillsdale-Kalamazoo-Oshtemo association: approximately 30% of the watershed, nearly level to steep, well drained, loamy soils on moraines, till plains, outwash plains, and terraces
- Houghton-Oshtemo-Coloma association: approximately 25% of the watershed, nearly level to steep, very poorly drained to excessively drained, mucky soils on flood plains and loamy and sandy soils on outwash plains, moraines, and stream terraces and in glacial drainageways
- Oshtemo-Kalamazoo association: approximately 7% of the watershed, nearly level to steep, well drained, loamy soils on outwash plains and stream terraces
- Bronson-Sebewa-Houghton association: approximately 7% of the watershed, nearly level to gently rolling, moderately well drained, poorly drained, and very poorly drained, loamy soils on lake plains and mucky soils in glacial drainageways
- Morley-Blount association: approximately 3% of the watershed, nearly level to strongly sloping, well drained to somewhat poorly drained, loamy soils on till plains and moraines
- Houghton-Blount-Pewamo association: approximately 2% of the watershed, nearly level or gently undulating, very poorly drained to somewhat poorly drained, mucky and loamy soils on till plaines and moraines.

Hydrology

Rice Creek (which includes the North and South Branches) is the main drainage system in the watershed. Several popular lakes lie in Rice Creek's North Branch, including Prairie Lake and the Gang Lakes, some of which are impacted by seasonal nuisance algal and weed growth. The Gang Lakes includes White Lake, Bell Lake, Bass Lake and Pickerel Lake (both also known as Silver Lake), Bolt Lake, Clark Lake, and Wise Lake (also known as Gordon Lake). Two small lakes, the Cistern Lakes also are in the North Branch watershed. The Gang Lakes outlet into the North Branch of Rice Creek which flows in a westerly direction for approximately two miles before entering Prairie Lake. Prairie Lake outlets into the North branch of Rice Creek which then flows approximately four miles to the South Branch of Rice Creek. The North Branch of Rice Creek is approximately nineteen miles long.

Map F



Another popular lake exists in the sub-watershed of the South Branch of Rice Creek. Its name is Lake Winnipeg, located in Sheridan Township. Two other lakes in the watershed of the South Branch of Rice Creek are Hall's Lake and Wolcott Lake.

There are three additional lakes in the downstream portion of the Rice Creek watershed. They are Chapin Lake, Rothrick Lake and an unnamed lake.

They are located approximately three miles downstream from the point where the North and South Branches merge. The North and South Branches of Rice Creek merge near the center of the western boundary line of section thirteen in Marengo Township. The South Branch of Rice Creek is approximately seventeen miles long. From the main stem of Rice Creek, the point where the North and South Branches merge, to the outlet at the Kalamazoo River, the Creek is approximately another six miles long.

Public access facilities are available at Lake Winnipeg, Prairie Lake, and Gordon Lake, which provides access to most of the Gang Lakes. Most of the South Branch of Rice Creek is considered (by MDNR) as a quality cold-water trout stream, is stocked with trout by MDNR, and is actively used by local trout fishermen.

The Gang Lakes, Prairie Lake, Chapin Lake, and Lake Winnipeg are all excellent warm water fisheries and are favorite spots for anglers from several Counties.

Rice Creek and most of its tributaries have been classified, and regularly maintained, as county drains. Only the portion of Rice Creek from approximately 20-Mile Road down stream to the outlet at the Kalamazoo River, is not a part of a designated drain.

One of the biggest challenges in the future will be to establish the delicate balance between the desire for drainage and maintaining aquatic habitat, fish habitat, and the abundant wildlife along the stream corridor. Alternatives to further altering the hydrology of Rice Creek are outlined in this plan.

Albion College studied the hydrology of Rice Creek as part of the monitoring work they were contracted to complete for the watershed planning project. Below is a summary of their findings based on the data gathered.

An important step in understanding the fluvial geomorphology of a stream is to establish its long profile. A long profile is the elevation of the surface of the water of the creek, measured on one day, at all road crossings. A long profile may be useful in identifying areas where erosion or deposition of sediment may be problems. It may also be helpful in planning infrastructure improvements such as bridges and culverts, in planning remedial projects such as basins or engineered wetlands that could accommodate floodwaters, or in applying various hydrological models.

Because streams tend to increase in erosive force as they gain flow, the model stream profile is smoothly concave with steep slopes at the headwaters that level off gradually towards the mouth. Variations in landform geology naturally alter this pattern; milldams and drainage ditches are created specifically to alter it.
The steepest crossroad-to-crossroad intervals are above 20 Mile Rd (80 cm/km), 29 Mile Rd (75 cm/km), and M99 (71 cm/km). Stream gradients are less than half the maximum for the intervals above Pickett Rd (15 cm/km), Gibbs Rd (22 cm/km), 27 Mile Rd (24 cm/km), 28 Mile Rd (34 cm/km), and 22½ Mile Rd (39 cm/km). The flatness in the upper reaches is due in part to lowering of the stream channel by dredging. Thus, two “flat” sediment buffers occur in Rice Creek’s profile: one in the middle reaches of the South Branch, and the other at the confluence area of the North and South Branches. Although beyond the range of this data set, the reach below 20 Mile Rd and the Interstate is an obvious third “flat” spot. The North Branch was not included in this study, but other results suggest the Gang Lakes and Prairie Lake are key sediment traps.

The physical and biological character of a stream is a function of its water budget or hydrology. Hydrology encompasses the general patterns of water flows and variability in flow or flashiness in response to storms.

In a flashy stream, flow spikes abruptly following a storm as water runs off quickly instead of infiltrating the ground and contributing to a prolonged swell in base flow. Spikes in flow can cause erosion, turbidity and flooding and consequently damage stream life. In a sense, water itself can be a pollutant if it comes in quick excess. Documentation of discharge patterns is also a prerequisite for establishing patterns of mass flow of nutrients and suspended solids.

In relating precipitation and stream flow it is important to recognize that a large fraction of precipitation does not end up in streams but is instead returned to the atmosphere by evaporation and transpiration. Impervious surfaces increase stream flow not only by increasing immediate runoff, but also by reducing evaporation and transpiration losses, the main fate of precipitation.

Winter 2002 hydrographs were compiled for the lower Main Stem at 20 Mile Rd and for the upper South Branch at Gibbs Rd. Discharge on the Main Stem reached a peak of 6.3 cubic meters per second (cms) on February 22, about as much water as is carried on average by the entire Kalamazoo River at Marengo (the Marengo station is a long term data collection point that was used as a comparison site). The major precipitation and snowmelt events caused discharge at 20 Mile Rd to double and triple from a base of 2.5 cms to peaks of 5 and 6 cms. On the upper South Branch, stream flow was highly erratic with as many as 13 sharp peaks in discharge each lasting 1-2 days or less versus 6 rounded, multi-day peaks seen downstream. Overall, discharge at Gibbs Rd was about 13% that at 20 Mile Rd (0.43 vs. 3.21 cms, respectively). These strong winter flows likely constitute the chief erosive and sediment-moving events of the year.

Summer 2002 hydrographs were compiled for six stations on Rice Creek: on the Main Stem at 20 Mile Rd; on the North Branch below Prairie Lake at J Dr, below Gang Lake at 27 Mile Rd, and above the lakes at 29 ½ Mile Rd; and on the lower South Branch at 24 Mile Rd, and the upper South Branch at Gibbs Rd.

On the North Branch, discharge at 27 Mile Rd. above Prairie Lake accounted for 82% of the flow at J Drive below Prairie Lake (0.326 vs. 0.398 cms, respectively, between June 19 to July 10), indicating that tributaries and groundwater contributed relatively little new flow between these stations. In contrast, the upper North Branch at 29 ½ Mile Rd. varied in its contribution to downstream flow. In early June, discharge at 29 ½ Mile Rd. was about one third that at J Drive, but by mid July the fraction had climbed to about one half. The recession in base flow in the dredged upper North Branch was less rapid than that seen downstream.

On the South Branch, there was a repeat of the tendency for slower recession in base discharge in the dredged headwaters section. After the beginning of July, discharge at 24

Mile Rd. was only about 10% greater than at Gibbs Rd., 14 km upstream (0.282 vs. 0.258 cms, respectively). By late July, discharge at Gibbs Rd. was about 40% that at 20 Mile Rd. (compared to 13% in winter), indicating the increasing importance of dredged sections to overflow during dry periods. (The combined discharge at Gibbs Rd. and 29 ½ Mile Rd. on July 22nd was greater than half that at 20 Mile Rd.). Two striking features existed in the hydrograph for the South Branch at 24 Mile Rd. First, daily cycles in stage that were evident to some degree in all summer hydrographs were especially large here. Second, discharge dropped abruptly by 15-39% (mean=27%) on at least nine occasions.

The pattern is consistent with water withdrawals for irrigation, perhaps by the golf course upstream from this station. A diversion of one quarter of 0.25 cms would be roughly 1000 gallons per minute, a reasonable rate to expect from an irrigation pump. The golf course installed a new irrigation system two years ago.

Discharge at Callahan Rd, 22 ½ Mile Rd, and Eaton Drain at H Dr were also gauged. Discharge on the South Branch at Gibbs Rd averaged about 3 times that at Callahan Rd, 2.7 km upstream, indicating heavy groundwater input in the entrenched upper South Branch. Discharge on the Main Stem at 20 Mile Rd averaged about 1.5 times that at 22 ½ Mile Rd, 3.9 km upstream, indicating substantial groundwater input in this interval of rapidly dropping elevation. Discharge from Eaton Drain added to the Main Stem an amount equal to only about 3% of the flow at 22 ½ Mile Rd.

Dredging can make a channel more efficient, but it can also confine storm water between high banks, make a stream flows peak higher and faster, and trigger more erosion. To evaluate the "flashiness" of the entrenched upper reaches of Rice Creek, we compared variation in stream stage at Gibbs Rd. in late summer 2000 with that at Bangham Rd. on nearby Spring Brook, which has never been dredged. Rainfalls of 6mm on 7/28, 15mm on 7/30, 10mm on 8/2, and 28mm on 8/5 through 8/6 were recorded in Albion. As expected, Rice Creek rose and fell more quickly and reached higher peak flows than did Spring Brook. At both sites, however, long tails of elevated stage followed the storms, indicating that most non-evaporated rainfall infiltrated the ground and did not run off directly into the streams.

Significant Natural Resources

Wetlands

The most significant natural resources in the watershed are an abundant number of *wetlands* and the fifteen *lakes* located across the watershed. There are approximately 5,240 acres of undisturbed wetlands across the watershed, predominately within the quarter mile wide corridor along Rice Creek.

Wetlands are complex ecosystems that provide many ecological functions that are valued by society. In Michigan, these functions become increasingly significant as we continue to lose wetlands.

The valuable ecological functions of wetlands and the aesthetically pleasing open space they provide help to enhance the quality of life for all watershed residents and visitors to the area. The primary benefits of wetlands are storm water flood storage and conveyance ability, filtering of sediments, and habitat for fish, wildlife, and many migrating birds. The importance of the delicate balance of nature, provided by the aquatic life and botanical wetland resources in our wetlands is still being discovered. As is the delicate balance necessary for recharging our groundwater drinking water resource.

Marshes, swamps and bogs are all terms used for wetlands. Marsh is a term that represents a broad array of wetlands that are dominated by grass like vegetation. Typically marsh plants include rushes, reeds, sedges, cattails, and grasses. Swamps are simply wooded wetlands. Based on dominant vegetation, swamps can generally be divided into three different types: a conifer swamp with trees such as tamarack, cedar, or balsam fir; a hardwood swamp with trees such as red maple, black ash, American elm, or balsam poplar; or a shrub swamp with shrubs such as tag alder, willows, or red osier dogwood. Swamps are usually inundated or saturated periodically during the growing season. Bogs occur as thick peat deposits in old lake basins or as blankets of peat across a landscape. Bogs form in lake basins isolated from groundwater. Because normal rain water is slightly acidic, bog water tends to be slightly acidic. The acidic nature of bogs supports acid-loving vegetation, especially sphagnum mosses.

Without wetlands, we can expect an increase in flooding, decrease of animal, plant and species, increase in erosion, decrease in water quality, and lost revenue.

<u>Fishery</u>

Of the fifteen lakes in the watershed, eight are accessible to the public and seven have access by State maintained public access sites; with restrooms, docks, and boat launch areas. All of the lakes accessible to the public are an excellent warm water fishery resource.

The *Gang Lakes* located in Clarence Township, approximately 6 miles north of Albion in eastern Calhoun County is part of the Rice Creek and Kalamazoo River Watersheds. Among them are Gordon, Bolt, Silvers, Bell, Clark, and White Lakes.
All but White Lake are accessible for fishing from a public access located on Gordon Lake. These lakes have a reputation for good bass fishing and consistent catches of acceptable size panfish. Local MDNR conservation officers report steady angler pressure throughout summer months and light ice fishing pressure. Gamefish species sampled included bluegill, pumpkinseed, black crappie, largemouth bass and northern pike. The Gang of Lakes fishery was last evaluated in 1996.

Prairie Lake located in sections 32 and 33 of Clarence Township was also evaluated for its fishery in 1993. Reports revealed the following species: black crappie, bluegill, bowfin, bullhead (catfish family), carp and minnows, golden shiners, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, warmouth, white suckers, and yellow perch.

Lake Winnipeg located in sections 8 and 17 of Sheridan Township was also evaluated for its fishery in 1999. Reports revealed the following species: black bullhead, black crappie, bluegill, bowfin, brown bullhead, central mudminnow, common carp, golden shiners, grass pickerel, hybrid sunfish, largemouth bass, longear sunfish, northern pike, pumpkinseed, warmouth, white sucker, yellow bullhead, and yellow perch.

The mainstream and south branch of Rice Creek is designated as a type 1 trout stream by the MDNR. The mainstream and the lower section of both branches have fair populations of northern pike and suckers. The lakes connected by the north branch are a warm water fishery consisting primarily sunfish and bass.

Two sites were surveyed in 1999 and both are similar in morphology and have little gradient which results in relatively slow current velocities. Rice Creek averages 25 feet wide and has a depth range of ½ to 4 feet deep. Gravel is the predominant substrate type in the stream but sand, silt and rock are also present. Fish cover at both sample sites consisted of overhanging brush, in-stream debris, some undercut banks and pools. Vegetation in the stream is sparse and eelgrass is moderately abundant.

There are several cold water springs that seep into Rice Creek and are found at several locations along this waterway.
Dredging operations of the past as well as increased human development along the corridor of Rice Creek has significantly altered this stream's character over time.

Fish foods present during MDNR surveys included abundant crayfish, aquatic and terrestrial insects and small fish identified below. All of these aquatic organisms are good food sources for brown trout. Several inland lakes that are part of the headwaters of the north branch appear to be contributing to warm water marginal conditions. Surface water temperatures taken at the 20 Mile Road stream crossing site during the MDNR surveys on 7/17/2000 were 66 degrees Fahrenheit and in 1999 were 68 degrees Fahrenheit. Those temperatures are near the upper limit for temperatures that can support trout.
They require the colder waters for survival. The lack of both spawning areas and juvenile trout habitat limits natural reproduction of brown trout in Rice Creek. Dams in the lower section prevent migration of all fish to and from the Kalamazoo River and the impoundment limits the potential of Rice Creek.

Rice Creek has been stocked with various species of trout since 1935. In the early 1970's, MDNR Fishery Division changed its policy from stocking legal size brown trout (approx. 8 inches) to stocking only yearling browns that averaged between 5 and 6 inches. The stocking then was an attempt to create a stream trout fishery in southern Lower Michigan where trout fishing opportunities are limited. Limited survival of brown trout in Rice Creek prompted a request from the hatcheries for stocking larger, but fewer, brown trout. In 1998 and 1999, "accelerated growth brown trout" (wild rose strain) were stocked into Rice Creek. A survey in 1999 revealed brown trout ranging in size from 7.9 to 10.5 inches and over sixty-percent were larger than 8 inches. The trout appeared very healthy and robust and were found to have excellent growth rates, 3 inches above the state average.

Other species found in Rice Creek were: blackside darter, grass pickerel, mottled sculpin, northern pike, rock bass, central mudminnow, common shiners, green sunfish, johney darter, largemouth bass, white sucker, yellow bullhead, and yellow perch. The other lakes mentioned above are all interconnected to Rice Creek explaining the various species found.

<u>Forestry Resource</u>

An additional significant resource in the watershed that is often overlooked, because it is collectively owned by many different landowners and is often fragmented is our forestry resource. The Rice Creek Watershed has a decreasing forested area. Practices that impact forested areas are development, expansion of farm fields, and clear-cut timber harvests. The Calhoun Conservation District and USDA-NRCS continue to work with landowners to promote reforestation. On the land cover map of the Rice Creek Watershed it is very evident that the stream corridor is mostly forested.

This creates excellent habitat for wildlife. This forested corridor is therefore a unique resource worth protecting. This watershed management plan promotes the voluntary protection and enhancement of the area within the Rice Creek corridor (the area within ¼ mile of the stream and its tributaries). The primary tree species in the watershed are oak, hickory, ash, soft maple, elm, hard maple, beech, and some aspen. The primary problem for some wildlife species in the Rice Creek Watershed is the fragmentation of many of the forested areas

Many woodlots are also cut incorrectly on a diameter limit basis, usually being 16" to 18" on the stump. This means that all marketable trees are cut larger than this limit. Sometimes the limits are even less, which even more dramatically eliminates all potential sawlog and veneer trees that could be managed for the future.
Proper forest management recommendations combine the many goals and objectives of the landowner with sound silvicultural recommendations for each forest type.

Whether a landowner is interested in long or short term management of the woodlot, it is important to start out with a management plan. This plan should be written by a professional that is able to explain the present and future values of the forest crop along with available incentive programs to help meet the landowners goals and objectives.

Many landowners have sold their timber without seeking professional advice and only received half of the true value of their timber. And some also are left with a very big mess of their woodlot, because a proper harvest plan was not in place.

Chapter II – Watershed Resources,Activities, and Issues

History

Shared from the history of Clarence Township book "Then and Now" and other Township, County and District sources.

The area known as "Rice Creek" is located at the corners of Sheridan, Marengo, Clarence, and Lee Townships. Indian trails once crossed the creek there. The first settlers also used those trails as well as following the path of the creek. One of the first water well-drilling operations started in 1913 by Charles Sebastien Sr. and Charlie Wilson. Drainage ditches were dug to improve and increase tillable acres. Lee Township is said to have once been half swampland. Some of the drains in Clarence Township were started as early as 1880.

In 1958 it is reported that the City of Kalamazoo gave $5,000 to the "River Basin Corporation" to help finance a study on water conservation and that the City of Battle Creek was expected to match the donation. The River Basin Corporation was reported to make a complete study of potential water-retention facilities from Albion to Lake Michigan, one of which would have been a dam reservoir on Rice Creek near Marshall.

In simple terms, there was a need to flush significant pollutants from the Kalamazoo River during low summer flow periods. The above proposed solution would have used the flooded Rice Creek Basin to flush the pollutants from the Kalamazoo River.

A group of folks formed the Rice Creek Control Association and brought to the public's attention the facts concerning flooding of the basin. Among the many reasons listed were that it would have destroyed many acres of farmland and many other resources, destroyed fishing, polluted existing wells, and cut-off some roads to traffic.

With pollutants still a major concern in 1966, the idea of flooding the Rice Creek Basin was again explored at the request of Rep. Paul H. Todd of Kalamazoo. After yet another critical review, the proposed project was finally put to rest. Due to these historical actions in the past, the concerns of area landowners persist to this day; and any significant changes proposed to the Rice Creek Basin area are met with much speculation.

The Rice Creek Watershed Project began in 2001 and through education and communication has begun to work with area residents to promote the wise use of the rich natural resources within the watershed. Many of the residents of the watershed participated in the writing of this watershed management plan.

Resident cooperation will be expanded upon during implementation by using volunteers to investigate and interview watershed landowners and collect further historical data on the Rice Creek Watershed.

The data will enhance the file on the Rice Creek Watershed being developed at the Albion Public Library – Historical Room. The primary purpose of the interviews though is to create a "watershed-wide public awareness campaign". With the management plan and best management practices being promoted by "volunteer" watershed residents, it is anticipated that we will receive greater participation in the project.

Rice Creek (designated drain)

A portion of Rice Creek has been designated a County Drain by a legal process coordinated between the Michigan Department of Agriculture and the Calhoun County Drain Commission. This includes all of the headwaters of Rice Creek in both the north branch and the south branch and then downstream to section 17 of Marengo Township. From section 17 of Marengo Township down stream to the outlet at the Kalamazoo River in the City of Marshall Rice Creek is not a designated drain.

Rice Creek's glacial geology, ramp-and-flat topography, and reengineering as an agricultural drain have made it somewhat flashy and prone to turbidity and excess suspended solids. In places, the Creek bottom is buried under thick layers of fine sediments or the benthic macroinvertebrate community is impoverished. Repeated retrenching of drains in the headwaters regions has led to the transfer of sediments to downstream middle reaches where they raise the streambed and contribute to flooding.

The human-induced unsustainability of the system well exceeds the inherent erosion and deposition expected in a natural stream. We support buffer strips and other best management practices that will stabilize banks and freshly cleaned ditches. We encourage the Drain Commissioners responsible for Rice Creek to seek out and apply techniques that maintain serviceable flow rates while reducing erosion and degradation of aquatic habitat. As one example, George Palmiter's "river restoration" methods have been used successfully in St. Clair County, Michigan.

Dredging History

For nearly its entire span, Rice Creek has been developed and continues to function as an agricultural drain under the administration of the Calhoun and Jackson County Drain Commissioners. Draining cleared pestilent swamps, opened land to cultivation, and improved crop rooting by lowering spring water tables. Draining also altered the hydrology and vegetation of the watershed. Some idea of the impact of the dredging can be gleaned from old maps and comparisons with other watersheds. An historic Clarence Township property map from 1837 suggests that a single large lake named Prairie Lake originally covered today's interconnected Bell, Silvers, Clark, and Gordon Lakes, collectively known now as Gang Lake.

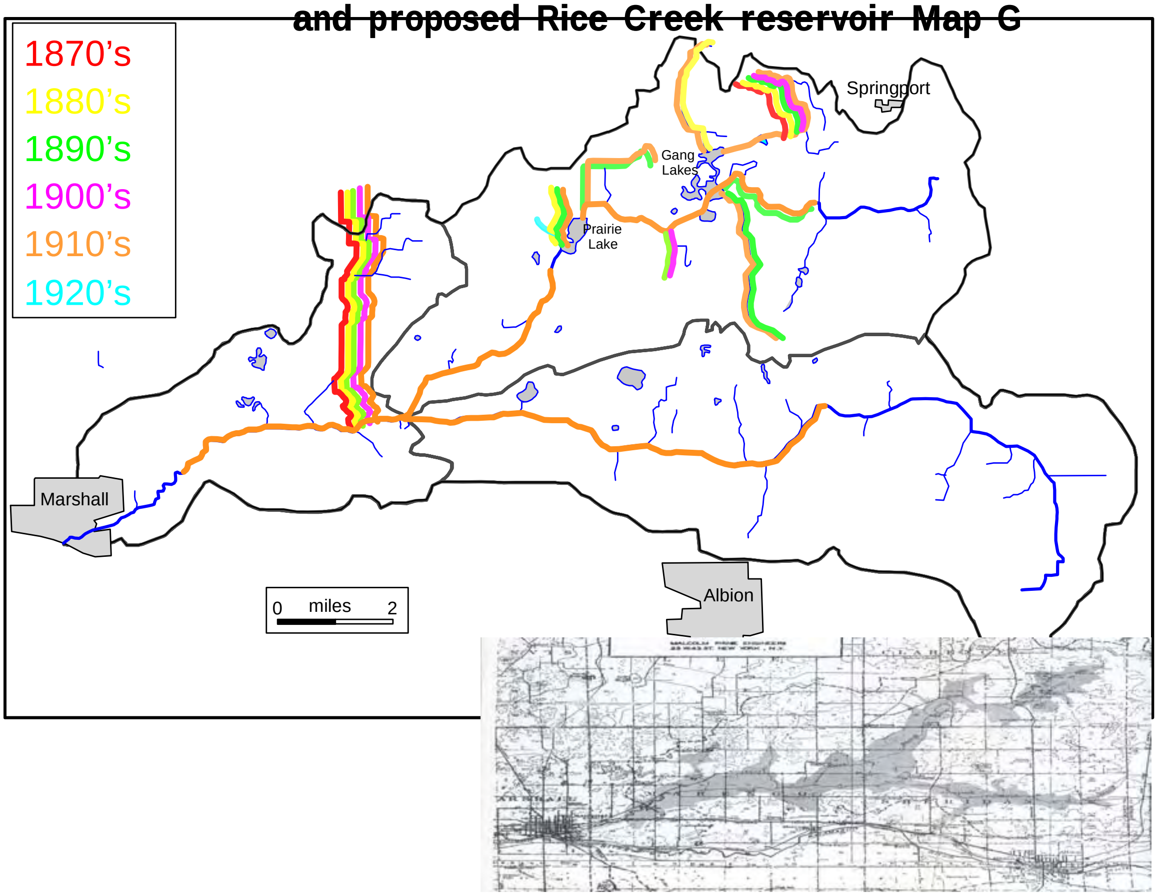
By 1858, waters had been lowered to expose today's Gang Lake array, and the Prairie Lake name had been moved downstream to its current location.

An 1858 map of Parma Township shows extensive wetlands and meandering along the upper South Branch of Rice Creek. Today, the stream in this area is straightened and well below grade following repeated dredging. Rice Creek must have resembled the situation seen today in the upper reaches of the adjacent Spring Brook, which retains some of its wooded wetlands and meandering course. A capsule history of draining efforts was assembled by examining records in the office of the Drain Commissioner for Calhoun County (Map G).

The first official records of specific drains date back to 1878 with the clearing and establishment of the Chappel; Deforest & Chittendon; and Poole, Bryant, Eaton & Baker Drains. In the 1880s, another series of drains were established. The pace of clearing new drains and cleaning old ones reached a peak in the 1890s, when 9 drains were either established or cleaned. The flurry of such activity did not subside until 1919.

Only nine drains were established or cleaned between 1920 and 1969, a fifty-year span. Essentially all the current drains in Calhoun County had been established by 1969. Dredging activity has been repeated most often in the smaller tributaries, which directly drain cropland. The dredging of the main branches of the Creek was done primarily in the 1910s.

Dredging history of Rice Creek in Calhoun County and proposed Rice Creek reservoir Map G



Agriculture

The farmers are the ones whose sweat and toil produced the food that has nourished people these thousands of years and whose tie to the good earth made the foundations for the cultures and civilizations of their own time and later times.

It is a fact that farmers are our countries first conservationists; providing stewardship over the land which is home to our soil, forests, and habitats for our wildlife. The farmers were the first to practice wise use and initiate conservation practices to prevent erosion and resultant offsite sedimentation. Farmers continue today to hold in trust most of the natural resources we all enjoy and care about. They continue to this day, to work hand in hand with conservation groups and agencies, to ensure that we pass along to the next generation, land and resources that are in even better shape than when they received them.

AGRICULTURE IN CALHOUN COUNTY, MICHIGAN

Based on 1997 Census of Agriculture, the most recent available

Out of the 459,776 acres (718 square miles) in Calhoun County, nearly 53%, or 243,151 acres is used for agriculture. According to the 1997 Census of Agriculture, the market value of all agricultural products sold in Calhoun County was $60,985,000. From 1987 to 1997 cropland in Calhoun County disappeared nearly twice as fast as the state average rate.

Number of Farms: 1085 (farm definition=$1000 or more in gross sales)
Average Size of Farms: 224 acres

In addition to agricultural crops, livestock are also raised on Calhoun County farms. In 1997 there were 10,575 beef cattle, 4,987 dairy cows, 41,965 hogs and 1,593 sheep and lambs.

Type of Farm Business Organization	**Farms**		**Acres**	
	1997	**1987**	**1997**	**1987**
Individual or family	942	1048	174,241	198,441
Partnership	98	88	48,844	42,649
Corporation (family held)	29	25	17,571	12,035
Corporation (other)	7	0	825	0
Cooperative, estate, trust, etc.	9	5	1,670	258
Total	1085	1166	243,151	253,383

Selected Harvest Crops	Farms	Acres	Bushels
Corn for grain or seed	533	71,687	6,883,919
Soybeans	459	48,722	1,837,575
Wheat for grain	256	13,675	638,998
Hay	474	17,979	44,728
Vegetables for sale	24	447	---

Value of Selected Products Sold	Farms	Value
Corn	389	$12,833,000
Soybeans	374	$10,716,000
Wheat	226	$1,894,000
Dairy Products	74	$10,781,000
Hogs	68	$8,944.000

Farms by Size		For Farms with $10,000 of Gross Sales or More
1-9 acres	40 farms	Number of Farms: 547 (50% of Total)
10-49 acres	225 farms	Total Acreages 202,976 acres(76%) of Total)
50-179 acres	462 farms	Average Size farm: 371 acres
180-499 acres	239 farms	Total Sales:$59,483,000 (97.5% of Total)
500-999 acres	85 farms	
1000 acres or more	34 farms	

Operators by Principal Occupation		Average Age	
Farming	493 (46%)	1997	54.4 years
Other	592 (54%)	1987	52.0 years

Agriculture is an important part of the Rice Creek Watershed. Approximately 12,957 acres of productive farm land lies within a one mile corridor of Rice Creek and its primary tributaries.

Artificial Stream Impoundments

At the time of this writing the City of Marshall Dam removal project is still in the evaluation stage. The Michigan Department of Environmental Quality, Michigan Department of Natural Resources Fisheries Division, and the Rice Creek Watershed Project are all involved with the City of Marshall to finalize a plan to remove the dams. A Rice Creek Dam removal feasibility study was completed in March 2002. The plan considers impacts, constraints, benefits, and design alternatives for the dam removal. A copy of the plan can be reviewed by contacting the City of Marshall.

Additional stream impoundments include 68 stream/road crossings. The stream and road crossing inventory evaluated each crossing and ranked it as a low, medium, or high priority for needing re-stabilization or other best management practices.
The inventory revealed that of the 68 crossings 53 ranked as a low priority, being fairly stable and vegetated; 9 crossings were ranked as medium priority, needing some work; and 6 crossings ranked as a high priority, needing immediate attention.

The high priority sites were usually sites where cattle are in the stream causing severe erosion and where peak flows are causing erosion on the downstream side of the crossing.

Farmland Preservation

On April 15, 2003 the Calhoun County Board of Commissioners unanimously supported the adoption of a "farmland preservation ordinance". The ordinance focuses on the Purchase of Development Rights (PDR). After researching land use trends, available planning tools, existing state and Federal laws, as well as the economic impact of the agricultural industry in Calhoun County, it was decided that local zoning efforts could be complimented by a PDR program. A workgroup, comprised of local farmers, township officials, realtors, citizens and county planning and conservation staff worked for 16 months to develop the ordinance. Their work included development of the selection criteria, easement provisions, appraisal and payment options, and program administration.

Taken from the ordinance: It is the purpose of the Calhoun County Farmland Preservation Program and this development rights ordinance to preserve productive farmland in order to maintain a long-term business environment for agriculture in the county, to preserve the rural character and scenic attributes of the county, to enhance important environmental benefits and to maintain the quality of life of county residents. Further it is recognized that this ordinance is but one of several farmland preservation strategies encouraged throughout the County. Other strategies include agricultural zoning, quarter-quarter zoning, sliding scale zoning, and various overlay techniques.

Land Use Planning

A municipality's authority with zoning and land use regulations can play a large part in how natural resources are impacted. Appropriate land use planning can provide the foundation for improved water quality; both surface water and ground water. A natural resource inventory is a process that determines, based on the natural resources, areas within a community that are best suited for development and those areas that may be best left in their natural state. The natural resource inventory is then compared to the municipality's zoning and land use documents for consistency. Because the local units of government have the authority over zoning and land use they really are the key people to have involved in this process. Land uses that are incompatible with natural resources cause degradation and require much more time, effort, and money to restore than if proactive measures are implemented up front.

Calhoun County Community Development (CCCD) is in the process of conducting a county-wide natural resource inventory. The Rice Creek Watershed Coordinator will be actively involved in facilitating the process within the townships in the Rice Creek Watershed.

In an effort to bring adjacent municipalities together for land use planning, the local units of government, including townships and villages, have been assembled into five "neighborhoods". The Rice Creek Watershed lies within two of the neighborhoods as defined by County Planning Department staff. Each local unit of government has been asked to select two planning commissioners and a board member to represent them in the process. The neighborhoods will meet within their vicinity to collectively analyze their neighborhood with respect to natural resources such as: soil conditions, land cover (forested, cropland, wetland, etc.), flood plain, etc. Draft maps and text will be presented to the participants and then finalized by CCCD. The process will end by bringing together all the participants for a county-wide presentation of the final product.

The information collected during the natural resource inventory process is intended to provide a guide for the townships to utilize when making decisions regarding specific planning and zoning issues. The neighborhood concept is intended to create awareness among local leaders that decisions made in one community can have direct effects on adjacent communities, especially land use issues. Creating a foundation for the decision makers in these local units of government that is natural resource based will help to address a variety of the environmental concerns within the watershed.

In addition to the natural resource inventory, the Watershed Coordinator will work closely with Calhoun County Community Development to ensure that the natural resource inventory data is implemented, and foster a new way of thinking for local leaders with respect to development of natural resources. The Cost of Community Services study conducted in Calhoun County by American Farmland Trust revealed the fiscal impact that development has on the local unit of government's budget. For every $1.00 generated by residential property, $1.47 must be spent to provide services to those lands (Marshall Township, 2000). Whereas, for every $1.00 generated from farm, forest, or open land uses only 27 cents are required to provide the necessary services to those lands (Marshall Township, 2000). While residential development contributes a large percentage of revenue to the tax base, it does not pay for all the public services it receives from the local unit of government/county. The Cost of Community Services study demonstrates that farm, forest, and open lands are of great fiscal value to the local community and should therefore be addressed with care during the planning process. Resource materials and workshop opportunities regarding low impact development designs, soil erosion and sedimentation control measures, and farmland preservation techniques will be offered to the local units of government in an effort to educate decision makers on the use of such tools. With the appropriate training local officials will be better equipped to make decisions where natural resources are of utmost concern.

Soil Erosion Control

1994 Public Act 451, Part 91, Soil Erosion and Sedimentation Control Law of Michigan. Michigan Law provides for the control of soil erosion and protects the waters of the state from sedimentation. A permit is generally required for any earth change activity which disturbs one or more acres of land or which is within 500" of a lake or stream. Once a permit is obtained it validates that a soil erosion control plan is in place to protect adjacent landowners and the waters of the state of Michigan from off-site sedimentation. A survey conducted by grading and excavation contractors found, that the costs of implementing planned soil erosion control measures was only 25% of the costs needed for cleanup at the end of a project without planned soil erosion control measures. For more information on proper soil erosion control practices contact your local county enforcing agency or MDEQ.

New Development

Many new rural homes are built in the watershed on an annual basis. Most have only a minimal impact on the overall watershed water quality. Collectively some of the newly developed areas can have a negative impact on water quality. One way they can have a negative impact is because of the lack of storm water management requirements on newly developed sites. New developments are not required to limit their off-site runoff to pre-developed run-off rates. This can allow an increase in the overall amount of run-off entering Rice Creek and increases the peak flows downstream.

Another problem that can occur on newly developed sites is erosion and resultant off-site sedimentation. Permits are required from the County for any earth changes within 500' of a lake or stream or an acre or larger in size, but many times these permits are not acquired.

A third way that collectively increasing development within the watershed can negatively impact water quality is simply the increased improper disposal of household products, garbage, yard waste, etc.

The finding of this project was that new residential developments biggest risk of negatively impacting water quality in the Rice Creek Watershed was because of soil erosion and the resultant off-site sedimentation.

A much larger concern related to new development is the risk of increased storm water run-off, erosion and off-site sedimentation from larger new commercial development sites. The risks are magnified greatly and impacts from even one site improperly managed can be devastating to water quality, the fishery, and greatly increase the potential for flooding. The Calhoun County Drain Commission has been working with Townships to require a storm water discharge permit. This program, if expanded could greatly reduce the risk from these sites. Like the residential projects, commercial projects within 500' of a lake or stream or an acre or larger in size also require a permit from the County, but are sometimes not obtained or if obtained, the soil erosion control plans are not properly followed.

Another new area within the watershed that is proposed for development is the 175 acres of land just east of the Calhoun County Fairgrounds. It will become an addition to the Fairgrounds and will allow them to expand and grow. Plans include four primary components: a new road and exit which would cross Rice Creek east of Marshall and provide a new entrance to the Fairgrounds along the east end of this new property; an approximately 400 site campground for fair and event camping, the camping area would be located on the portion of the land towards Rice Creek and proposes to include canoe launch sites into Rice Creek and walkout areas to the shoreline of Rice Creek; an all purpose/all season building with an educational wing for a regional science center; and a general evaluation of the entire Fairground facility for any general improvements, including updates to floral hall, the oldest fair building in Michigan.

We support regional land use planning efforts that will limit increases in runoff and flashiness. Monitoring results suggest that Rice Creek is especially vulnerable to mobilization of damaging suspended solids and turbidity.

Storm Water Management

Managing the amount, timing, and destination of storm water is called storm water management. Storm water management can take on many forms from controlling the amount of water, to delaying the transport time of the water flow, to diverting the flow to other destinations. Storm water detention basins may be used to control the amount of water that is allowed to enter a storm water drainage system at any one time.
This would also delay the transport time of the water flow and there are a number of practices and systems of practices for accomplishing this.

Another important storm water management practice is a "storm water management ordinance". This is an ordinance that requires a person performing a new development on a parcel of land to manage the storm water coming off of their parcel, so that no more water comes off of the parcel after the development has occurred, than the amount of storm water that came off of the parcel prior to the development. There is a simple engineering formula that allows the difference between pre development run-off and post development run-off to be figured.

A storm water ordinance also restricts a parcel of land from being over-developed. An example of this would be a new 10-screen movie theater being developed. Local zoning would require a certain number of parking spaces for a ten theatre business. The storm water ordinance would also require that a certain number of cubic feet per second of storm water storage be detained on-site (the difference between pre and post development run-off) and only released from the site at the pre-development rate. The amount of storm water storage needed would require a certain number of cubic feet of area, which depending on the size of the site may only allow room for enough parking spaces for a 6 screen movie theatre. Storm water is managed, over-development is controlled and downstream peak flow flooding impacts are eliminated.

Lake Allegan/Kalamazoo River Phosphorus - TMDL (Total Maximum Daily Load)

Like many other elements, phosphorus is necessary to sustain all living organisms. Problems are typically created only when phosphorus is present at elevated levels in our lakes and streams, as is the case for Lake Allegan, which the Kalamazoo River drains into after draining Rice Creek. High phosphorus levels in Lake Allegan have resulted in undesirable growths of algae. Undesirable algae blooms have caused high dissolved oxygen levels in the daytime when plants are releasing oxygen during photosynthesis, and likely low dissolved oxygen levels at night when no photosynthesis is occurring, but plant respiration is high. This has resulted in a significant negative impact to the invertebrate communities and to the fishery of Lake Allegan.

Historically, reductions of total phosphorus in the Kalamazoo River upstream of Lake Allegan have resulted in a shift of the aquatic community from a nuisance condition to a more diverse and desirable aquatic community. Therefore, controlling the amount of total phosphorus entering Lake Allegan should also result in the improvement of Lake Allegan water quality. Though Rice Creek is not known to be a significant contributor of phosphorus to the system, it does play a role in flushing phosphorus into the Kalamazoo River and likely into Lake Allegan.

Treated Wastewater Discharge

The primary source of treated wastewater discharge into Rice Creek is the discharge from the Village of Springport lagoons at Gibbs Road. Facultative lagoons are designed to hold wastewater long enough for much of the solids in the wastewater to settle and for many disease-causing bacteria, parasites, and viruses to either die off or settle out. Aerobic bacteria converts wastes into carbon dioxide, ammonia phosphates, which in turn, are used by the algae as food. Anaerobic bacteria convert substances in wastewater to gases, such as hydrogen sulfide, ammonia, and methane. Many of these byproducts are then used as food by both the aerobic bacteria and algae in the layers above.

A tour of the entire Springport lagoon and discharge system revealed that they have a mechanism in place to meet and/or exceed all limitations set forth by MDEQ. They take samples and submit them to an independent laboratory service to make sure they meet MDEQ requirements. Once the lab notifies them that they meet discharge requirements the results are sent to MDEQ for their review and approval to discharge. Upon receiving permission from MDEQ the discharge begins. Every other day during the discharge period they are required to collect samples at the discharge pipe at morning, mid-day, and evening. These three samples are refrigerated, mixed together and submitted to the lab for testing. If there are any negative changes in the lab results the discharge stops. This extensive testing occurs throughout the entire discharge period.

An additional concern related to treated wastewater discharge entering the stream system exists at Prairie Lake. Approximately 37 homes are around the Lake. An unknown number of the houses were built years ago with the septic system located between the home and the lake because of a lack of room to locate septic systems upland. During times of spring and fall flooding on Prairie Lake many of these systems are under water with an unknown impact to water quality.

Chapter III <u>Lake Water Quality Analysis</u>

Preliminary Observations and Background

Charles Elzinga, Ph.D. Michigan State University, with the help of his students and many volunteers worked on a study of the seasonal algal blooms on lakes. A summary of the study is provided here. The full study can be reviewed at the Calhoun Conservation District and the at the Albion Public Library Historical Room. Water quality of lakes in the Rice Creek Basin and identifying probable anthropogenic threats to these waters is one of the primary goals of this management plan. Initial work on Rice Creek Basin lakes was focused on the Gang Lakes, a chain of six lakes near Springport, Michigan, that are part of Rice Creek's North Branch headwaters. These lakes include White Lake, Bell Lake, Clark Lake, Bolt Lake, Silver Lake, and Gordon Lake. Water from the upper five lakes eventually empty into Gordon Lake before it flows out via the North Branch of Rice Creek.

Preliminary on-site observations of these lakes showed that several of them and their interconnecting channels exhibited heavy, early-summer blooms of nuisance algae and macrophytes. A survey of lake shorelines and channels revealed the following potential contributors to this phenomenon:

- Nutrient and sedimentation pollution from residential and agricultural runoff, tiled fields, and drains that empty directly into the lakes.
- Invasions of exotic species that clog the waterways and spread into the adjacent wetlands.
- Bank erosion along the shorelines and channels caused by boat wakes and the lack of effective erosion control.

Interestingly, these potential factors seem to be interrelated. Eurasian Milfoil (*Myriophyllum spicatum*) and Curly Pondweed (*Potamogeton crispus*), two invasive species that are choking the channels and margins of the Gang Lakes, are known to be dependent upon high levels of nitrogen and phosphorous. In the Gang Lakes, these submergent plants achieve their greatest abundance from early June to mid-July (Figure 1) but they die back over the rest of the summer (Figure 2). Although no direct connection between a particular land use and this pattern of weed growth has yet been made, the maximum aquatic vegetation biomass seems to occur a few weeks after the application of fertilizers on row crops adjacent to the lakes. Furthermore, it appears that the influx of sediments from the surrounding landscape, coupled with severe bank erosion, are causing certain parts of these lakes to rapidly fill-in and the channels to widen and become shallower. As shallow areas increase, they become more susceptible to weed encroachment.

Aquatic plant (including algal) growth in lakes is generally limited by the availability of nutrients, light, and heat. Plant growth in soft-water lakes is sometimes limited by inorganic carbon availability, but otherwise nitrogen- and phosphorous-limited systems are common.

Most Michigan lakes are phosphorous limited. Dissolved, suspended, and floating substances in the water influence the amount and quality of light reaching plants. These substances in turn affect how much heat reaches the plants, and therefore control how fast plants can grow.

Gang Lakes Studies

Over the last two years, more in-depth studies of five of the six lakes—White Lake was excluded due to unavailable access—were conducted in order to: 1) find out which species were involved in the nuisance algal and plant blooms of the Gang Lakes 2) record their growth pattern, and 3) evaluate the roles nutrients, light, and heat in their production. The goal was to use the above information for designing corrective measures to address the nuisance weed problem.

Large stagnant vegetation mats ringed Bell Lake (Figure 1) and portions of the other Gang Lakes by early June. These mats also extended into their connecting channels to the point where boat traffic between Bell and Clark Lakes was severely hampered. By late July these mats were beginning to die back (Figure 2) and they were almost completely gone by the end of August. Table 1 shows results of vegetation samples from the mats surrounding several of the Gang Lakes and their connecting channels. *Cladophora*, Eurasian Milfoil (*Myriophyllum spicatum)*, and Curly Pondweed (*Potamogeton crispus)* were the dominant macrophytes in these samples, and they are common indicators of nutrient enrichment.

The pattern of macrophyte growth, particularly in Bell Lake and its connecting channels, is consistent with what one might expect from nutrient enrichment occurring as the result of agricultural runoff from row crops. Row-crop agriculture is common on adjacent lands and much of the land is tiled for increased drainage. Sections of Bell, Silver, and Bolt Lakes have little or no buffer between them and the row crops, and tile drains empty directly into Silver and Bolt Lakes. In addition, tile drains empty into the county drains, which in turn, empty directly into Bell, Clark, and Gordon Lakes.

In summary, there is ample opportunity for agricultural activity on the surrounding landscape to have an immediate impact on the Gang Lake's nutrient levels, and the pattern of nuisance weed growth in consistent with row-crop runoff.

Nutrients

It must be noted, however, that agricultural activities on the adjacent landscape might not be the sole, or even a primary, cause of the nuisance weed growth in the lakes. Lawn fertilizers and leachates from household and campground septic systems might also make important contributions to the nutrient load of the lakes. Moreover, endogenous nutrient recycling might also account for the observed pattern of weed growth, where nutrients captured by macrophytes over the spring and summer are liberated by decomposition over the winter and made re-available to macrophytes after spring turnover.

Light Penetration

Previous studies have shown that Bell Lake consistently has the poorest light penetration whereas Bolt Lake consistently had the highest water clarity. Water clarity differences among the lakes can at least partially be explained by differences in the levels of dissolved organic compounds they contain. Bell Lake had significantly higher dissolved organic compound levels than any of the other lakes. Dissolved organic compound levels were also high in Clark, Gordon, and Silver Lakes, but it was significantly lower in Bolt Lake. High dissolved organic carbon is generally associated with waters that drain extensive areas of peaty soils, which is the case for Bell, Clark, and Gordon Lakes. Bolt and Silver Lake do not drain peaty soils. This explains why Bolt Lake should exhibit both high water clarity and lower dissolved organic compound levels, but it does not explain the higher dissolved organic compound levels that were indicated in Silver Lake.

Suspended solids also influence water clarity. Lakes that are wide and shallow often exhibit low water clarity during windy days. Suspended solids associated with brief periods of high winds are commonly non-living particles. High concentrations of living plankton which is often caused by waters having high nutrient inputs can also reduce water clarity. Low water clarity due to living plankton is usually a more chronic phenomenon. Silver Lake's water clarity is highly variable and wind-associated. It is also extremely shallow (maximum depth < 2 m). Bell Lake's low water clarity can be attributed to three factors: 1) high dissolved organic compound levels, 2) being wide and shallow, and 3) high concentrations of phytoplankton within the top 0.5-m layer of water.

Temperature and Dissolved Oxygen

Bell, Clark, and Gordon Lakes have similar temperature and dissolved oxygen profiles during the summer. All have shallow epilimnions and their dissolved oxygen levels decline abruptly after the upper 1-2 meters. Similarities in dissolved oxygen and temperature among these lakes can be attributed to their comparable light profiles. Bolt Lake has a much deeper epilimnion and corresponding gradual dissolved oxygen profile, which are associated with higher water clarity.

Groundwater and Runoff

Groundwater in the Jackson-Calhoun County area contains fairly high concentrations of calcium carbonate. Waters that are primarily derived from groundwater in this region therefore have a high Total Alkalinity, high Specific Conductivity signature; whereas, those waters primarily driven by runoff typically have low alkalinity and conductivity.

Bell, Clark, and Gordon Lakes have significantly higher alkalinity and conductivity than do Bolt and Silver Lakes. These data suggest that Bell, Clark, and Gordon Lakes have a greater groundwater inputs than do the other two lakes.

Table 1: Predominant taxa comprising the thick vegetative mats surrounding Bell Lake, Silver Lake, and Bolt Lake during the summer of 2001 and 2002. These taxa were also dominated the channel that connects Bell and Clark Lakes, as well as the channel that runs from Bell Lake towards the campground. Nuisance taxa are indicated with an asterisk (*).

Habit	Division- Common Name	Taxon
Phytoplankton	Blue-greens	*Anabaena*
		*Aphanizomenon**
		Gloeotrichia
		*Microcystis**
		Oscillatoria
	Diatoms	*Cyclotella*
		Fragilaria
		Tabellaria
		Nitzschia
Benthic Algae	Green Algae	*Cladophora**
		Mougeotia
		Spirogyra
		Zygnema
Submergent Macrophytes	Flowering Plants	*Ceratophyllum demersum*
		Elodea canadensis
		*Myriophyllum spicatum**
		*Potamogeton crispus**
		Potamogeton pectinatus
		Potamogeton zosteriformis
		Utricularia vulgaris

Figure 1. Photograph of Bell Lake taken on June 15, 2002, showing the extensive weed mat that rings the shoreline.

Figure 2. Photograph of Bell Lake taken on July 28, 2002, showing how the mat is dying back.

Chapter IV - Water Quality Monitoring

A water quality monitoring study was conducted by Albion College Watershed Research Group. Study findings are summarized here. The full report can be reviewed at the Calhoun Conservation District and at the Albion Public Library Historical Room. A summary of the water quality monitoring findings include the following observations:

A) The Rice Creek watershed and stream system have been substantially altered from pre-settlement conditions, largely by land clearance, draining, and stream dredging and straightening to support agriculture. This management plan identifies those pollutants impacting water quality in Rice Creek and impacting Rice Creek designated uses. Poor macroinvertebrate communities and excess suspended solids and turbidity levels can sometimes be problems in parts of the stream.

B) Because the North Branch of Rice Creek passes through Gang Lakes and Prairie Lake, the waters of the North Branch tend to be substantially warmer and cleaner than the waters of the South Branch.

C) Much of the Main Stem and South Branch of Rice Creek are sufficiently cool, well oxygenated, and biologically intact to justify a long-standing program of trout stocking by the Michigan Department of Natural Resources. Ironically, Rice Creek's status as a marginal cold-water fishery may depend in part on levels of cold groundwater intrusion and dissolved oxygen input that are promoted indirectly by dredging.

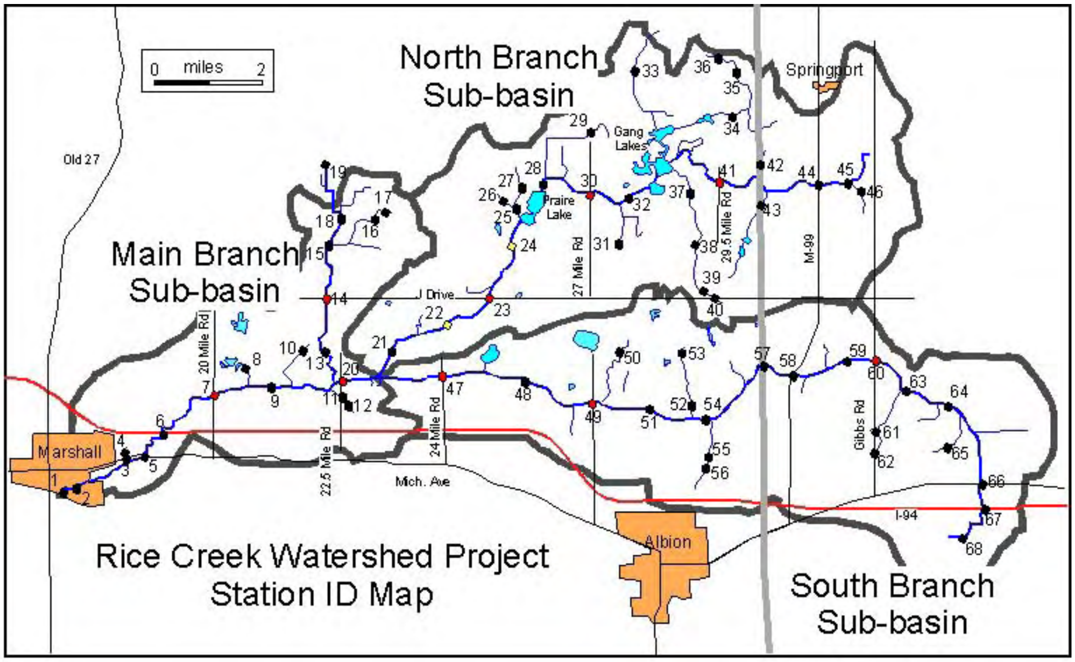
D) Maintaining cool water temperatures, reducing suspended solids and turbidity levels, and managing the flashiness of the Creek are major ongoing concerns for water quality.

Naming conventions

For the purpose of the water quality monitoring study, the watershed was divided into three sub-basins and associated stream sections: North Branch, South Branch, and Main Stem (or Main Branch) (Map E). Data were also collected in the Eaton Drain (or Eaton Branch), which empties into the Main Stem below 22 ½ Mile Rd. Following the protocol established by MDEQ/SWQD Stream Crossing Watershed Survey Procedure, each road crossing on the Creek was given a number in sequence beginning near the outlet into the Kalamazoo River, and then proceeding upstream with digressions for tributaries. The numbers run up the North Branch before returning to the base of the South Branch. And include 68 stream/road crossings. The stream and road crossing inventory evaluated each crossing and ranked it as a low, medium, or high priority for needing re-stabilization or other best management practices.

The inventory revealed that of the 68 crossings 53 ranked as a low priority, being fairly stable and vegetated; 9 crossings were ranked as medium priority, needing some work; and 6 crossings ranked as a high priority, needing immediate attention.

Map E



Rice Creek Watershed Project Station ID Map. The Rice Creek watershed and sub-basins were delineated on 1:24000 USGS topographic maps. Station ID numbers were assigned for each road crossing according to the MDEQ/SWQD Watershed Survey guidelines. Stations in red denote gauging/sampling stations that are part of the study array.

Main sites

Although sampling sites varied somewhat among our studies, most of our work centered around eight main sampling stations. There were three main stations each on the North and South Branches and two main stations on the Main Stem. Each of these sites is pictured in Figure 4 below, and it's location is identified on the site map by a red dot on Map E above.

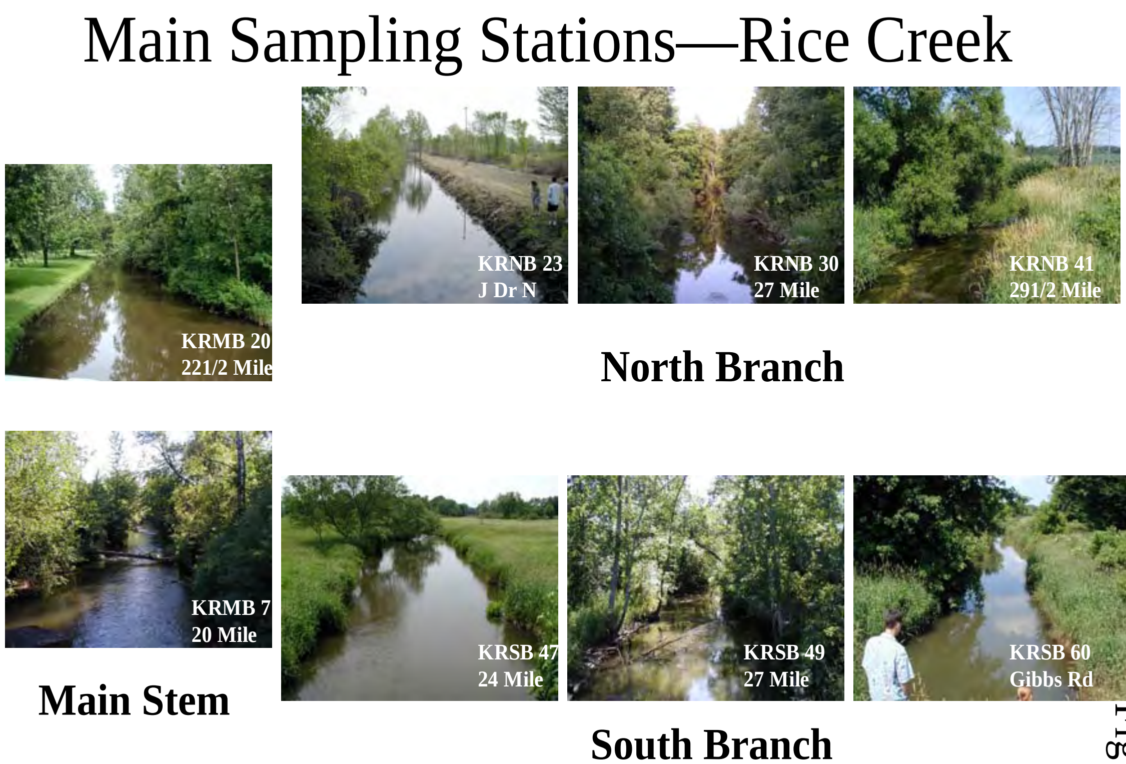


Figure 4

Physical properties

Water temperature

Temperature is a key water-quality parameter. Water temperature varies with air temperature, exposure to sunlight, and the mix of ground water and surface runoff contributing to the stream; hence, clearing vegetation, especially gallery forests, and land development can lead to stream warming. Elevations in water temperature are physiologically stressful to some fish because such warming increases metabolic rates while reducing the capacity of water to hold dissolved oxygen. Water temperature is particularly significant to Rice Creek because of the Creek's status as a marginal cold-water fishery in a largely rural landscape in the southern part of Michigan. Brown trout would like to see temperatures below 19^{o} C, and cannot long tolerate temperatures above 22^{o} C.

To reveal how the water temperature of the stream varied in space and time, we monitored temperature in several ways. First, we used a Quanta multi-parameter probe to assess spatial patterns in temperature.

In eight weekly sweeps between June 3, 2002 and July 16, 2002, we measured temperature (and other parameters, described later) at a total of 28 road crossings on the North Branch, South Branch, Main Stem, and Eaton Drain.

To emphasize spatial patterns in these sweeps, we minimized variation due to daily cycles by beginning at the headwater road crossing of one branch and visiting stations in order downstream until reaching the station below the conjunction of the two branches. We then moved to the head of the other branch and sampled downstream in order on that branch, continuing on through the main stem and Eaton drain. To balance time-of-day effects, we alternated starting branches between weeks.

Summer daytime temperatures in the lower South Branch and Main Stem were between 17-23^{o} C. Temperatures at the most upstream stations were 4-6^{o} C colder than those on the lower Main Stem, reflecting a high input of subsurface ground water in these entrenched sections. In-stream Gang Lake and Prairie Lake on the North Branch elevated temperatures in the North Branch by 4-6^{o} C over comparable stations on the South Branch. Thus, different parts of the stream regularly differed by 10^{o} C or more. The lowest stations on the North and South Branches differed by over 2.5^{o} C; the mixing of the two branches essentially elevated the temperature in the South Branch about 2^{o} C. Temperatures in the shallow Eaton Drain were especially variable. The impacts of variations in solar heating are evident along the South Branch. Temperature increases spiking at 30 Mile Road followed especially open reaches in Jackson County; a cooling trend in subsequent stations reflected the more wooded character of the stream in Calhoun County.

A second source of temperature data was the automatic logging devices deployed in stilling wells at gauging stations to assess stream depth. Six of these devices were equipped to log temperature at half-hour intervals and thus provided a rich picture of spatial differences in temperature and temperature variability throughout the watershed. Average mean temperatures in summer on Rice Creek was between 18.8-19.9 degrees Celsius except below Gang Lakes where it was substantially warmer at 25.1 degrees Celsius. In summer, the dredged headwaters sections of Rice Creek were about 3.5 degrees Celsius cooler on average than the Spring Brook reference stream. Rice Creek's headwaters also experienced a daily temperature range that was 4 degrees Celsius less than that in Spring Brook.

Overall, daily and day-to-day fluctuations in water temperature were contained within narrow bounds at the most downstream site on the Main Stem. Early-season records (Jan. 28-Mar. 7) from Gibbs Road and 20 Mile Road showed temperatures hovering about 4^{o} C above freezing (near the maximum density of water) despite prolonged freezing weather. This resistance to freezing demonstrates the dominance of ground water sources. Rice Creek did not begin major warming in 2002 until mid-April.

Dissolved Oxygen

An adequate supply of dissolved oxygen (DO) in stream water is necessary to support the metabolism of fish and other animal life. Species differ in their tolerance for low DO levels. The recommended minimum average DO is 5 mg/L for a warm-water fishery and 7 mg/L for a cold-water fishery; the minimums are 4 mg/L and 6 mg/L, respectively. Differences in DO tolerances are reflected also in the community composition of stream macroinvertebrates. Oxygen enters streams from the atmosphere by diffusion and especially physical agitation in moving water and as a by-product of photosynthesis by submerged aquatic plants. The oxygen holding capacity of water declines rapidly as water warms. We assessed spatial patterns in dissolved oxygen in the same sweeps with the Quanta meter used to assess temperate patterns.

Average summer daytime DO levels at different stations along the Creek were 6-12 mg/L. Rank stands of submerged aquatic vegetation in unshaded portions of the upper North and South Branches and in the in-stream lakes elevated DO to supersaturated levels. Oxygen content tended to decline downstream from the headwaters until reaching 20 Mile Rd and Michigan Ave where agitation in large riffles reversed the losses. A spike in DO along the South Branch peaking at 30 Mile Rd reflected the open exposure of that reach of the stream. The Michigan Department of Natural Resources Fisheries Division has yearly stocked thousands of brown trout in the Main Stem and South Branch of Rice Creek between Michigan Ave and 29 Mile Rd. Within this section, every station fell below the standard of 7 mg/L for a cold water fishery during at least one of the weekly sweeps. Oxygen levels appeared most marginal for trout at 21 Mile Rd and 22½ Mile Rd.

PH

Acidity can be damaging to stream life. As with oxygen, species differ in their tolerances to acid. A stream can be acidified by sulfates and nitrates in air pollution, by industrial or mine wastes, by sulfates in soil amendments, or by leaching from naturally acid soils or bogs. Acidity is measured on the pH scale where 7 is neutral, <7 is acid, and >7 is basic. Each unit step in the pH scale represents a 10-fold difference in the concentration of the acidic hydrogen ion, so pHs near 7 are only weakly reactive. For instance, carbon dioxide dissolves in water to form carbonic acid, a weak acid. Photosynthesis by submerged aquatic plants removes carbon from the water making it slightly less acid. Thus, pH can be a surrogate index for in-stream photosynthesis and weed density. We assessed spatial patterns in pH in the same sweeps with the Quanta meter. Michigan water quality standards call for a pH between 6.5 and 9.

There is no evidence of acid impairment in Rice Creek; all pH values observed in summer daytime sweeps were >7.2 and mildly basic. Observed patterns in pH did reveal several aspects of watershed function, however. First, the headwaters of the South Branch, and to a lesser extent the North Branch, tended towards lower pHs.

To see if these differences could be attributed to differences in dissolved oxygen content, we calculated regressions between DO and pH, and adjusted station mean pHs for a fixed DO of 8 mg/L. If anything, high DO in headwater reaches somewhat obscured underlying lower pH. Based on analyses of water chemistry, it appears that the pH trend is due to elevated levels of sulfates in the headwaters, which are diluted downstream. The source of the additional sulfates is uncertain, but it might represent leaching from drained peaty wetlands. Second, pHs in the North Branch were distinctly elevated by Gang Lake and Prairie Lake. This result is evidence for abundant photosynthesis in these shallow open lakes. Third, a spike in pH along the South Branch peaking at 30 Mile Rd again reflected the open exposure of that reach of the stream.

Specific Conductance

Spatial patterns in specific conductance were assessed in the same sweeps with the Quanta meter described above. The headwaters of the South Branch, and to a lesser extent the upper North Branch, had distinctly higher specific conductance values than the Main Stem. There was no evidence of a spike to suggest a previously unrecognized pollution source in the watershed. The declining conductance trace on the South Branch parallels differences in sulfate content found in chemical sampling.

Turbidity

Turbidity is an index of suspended solids and cloudiness. High turbidity can damage stream life by clogging gills, smothering bottom-dwelling organisms, obscuring vision, and reducing photosynthesis. Turbid water also absorbs more sunlight and heats more quickly.

The Quanta and YSI probes we used measured turbidity in NTU, normal turbidity units. There is no set turbidity standard, but studies comparing NTU values to indices of biological integrity have found impairment above 50 NTU, a level where water is distinctly cloudy. Turbidity, a classic nonpoint source pollutant, may be caused by bank erosion, surface runoff, and disturbances in the stream, such as wading cattle. A tendency for small disturbances to generate high turbidity reflects a high load of fine particles in the streambed. Spatial patterns in turbidity were assessed in the same sweeps with the Quanta meter. Occasional spikes in turbidity, often on the hottest days, occurred downstream from areas where livestock had access to the Creek. Turbidity levels were distinctly lower on the North Branch than the South Branch, evidence that the in-stream lakes acted as sediment traps to cleanse the Creek. A small rise in turbidity occurred at 22½ Mile Rd, the station just below the confluence of the two branches. The broad mudflats and wetlands in the region of the confluence have been described as the “bayou” of Rice Creek. Elevated turbidity at 22½ Mile Rd might reflect a high load of easily mobilized sediments in this confluence region.

Suspended Solids at main sampling stations

Another measure of turbidity is total suspended solids (TSS), the mass of particles suspended in water that can be removed by a filter. TSS and turbidity were listed as water quality impairments in the Creek in 1998. We collected water samples for TSS determinations at our main stations in conjunction with gauging. Thus, we can multiply TTS concentrations and stream discharge to calculate flux in suspended solids at the times of gauging. Differences in TSS fluxes between sequential gauging stations could potentially reveal regions of deposition or erosion of solids; however, most movement of sediments, especially larger particles, must occur irregularly during floods. The erosive force of the stream, and hence the concentration and flux of suspended solids, should be correlated with the amount of water flowing in the stream.

Concentrations of TSS in Rice Creek in daytime samples in summer 2002 and summer 2001 were mostly below 20 mg/L, in the "clear" range. Most stations showed the expected seasonal declines in TSS concentrations in both years. In 2002, however, TSS concentration increased unexpectedly with season on the upper South Branch at Gibbs Rd, and to a lesser extent at 27 Mile Rd. The evidence is consistent with some nonpoint source of sediment pollution on the upper reaches of the South Branch. Peaks in station records for TSS concentration correlated well with rainstorms in the watershed. For instance, the TSS peak on 7//26/01 at 24 Mile Rd on the South Branch occurred following a 25 mm storm the previous day. The stream was generally clearer in North Branch than the South Branch, again most likely because of the filtering effects of the in-stream lakes.

Fluxes in TSS showed clear seasonal declines in both 2002 and 2001. The North Branch transported only a small fraction of the TSS carried by the South Branch, even though the discharges of the two branches are similar. Flux in TSS at J Dr below Prairie Lake the lower North Branch was low at the earliest sampling dates and remained low. In comparison, at 24 Mile Rd on the lower South Branch, over a 1000 Kg/day of suspended solids were being transported at our earliest of sampling dates. These data suggest that the North Branch is adding many tons of sediment annually to Gang Lake and Prairie Lake. The TSS loads in the Main Stem in June 2002 were 1000-2000 Kg/day. Currently, a substantial portion of sediment carried in the Main Stem must end up at the bottom of the millpond behind the Ketchum Park dam in Marshall or in the braided, undredged portion of the Creek just north of I94. Beyond the obvious role of North-Branch lakes as sediment traps, the fluxes of TSS further suggest that the area of the confluence of the two branches, the so-call "Rice Creek bayou," may function as a sediment buffer. The big drop in TSS flux observed between our lowest station on the South Branch and the station immediately below the confluence on June 20, 2001, suggested sediment deposition in the bayou region. During the same period in 2002, the bayou reach apparently contributed sediment to the Main Stem.

Temporal variation and correlation of physical properties at four specific sites were specifically evaluated for all of the above described concerns and using all of the above described monitoring methods. The areas specifically evaluated were the South Branch of Rice Creek at the Gibbs Road stream crossing, the South Branch at the 27 mile road stream crossing, the North Branch at the 27 mile road stream crossing, and the South Branch at the Hicks Road stream crossing. All four of these evaluations completed by the Albion College Watershed Research Group for this project can be reviewed in their May 5, 2003 report at the Albion Public Library Historical Room or at the Calhoun County Conservation District.

Water Chemistry

Anions

Nitrate and nitrite are regulated water pollutants. Potential sources of these within the watershed include agricultural fertilizers and animal wastes, septic systems, and residential lawn and garden fertilizers. Water samples collected chiefly at the main gauging stations (Fig. 4) were analyzed for nitrate, nitrite, sulfate, and chloride using an ion chromatograph in the Dow Lab at Albion College. Sulfate and chloride are less reactive inorganic species that are useful to measure as tracers and indices of dilution. Nitrate concentrations in waters of Rice Creek were generally below the standard for drinking water, 10 ppm. Nitrate levels tended to be higher in April and May than in June and July. In June and July, levels above the lakes on the North Branch were higher than elsewhere in the watershed. Analyses for nitrite were uniformly <0.5 ppm, well below the standard for drinking water of 1 ppm.

Sulfate concentrations were uniformly between 42-54 ppm in the North Branch and Main Stem, but in the South Branch, concentrations began at 2-3 times typical watershed values and fell downstream. This pattern was also seen in 2001 and reflected in spatial patterns of specific conductance. Chloride concentrations were 12-31 ppm and showed no clear spatial or temporal trends.

Phosphorus

Inorganic phosphorus is the element most likely to limit primary productivity in freshwater streams and lakes. A substantial reduction in phosphorus loading for the Kalamazoo River is called for under the phosphorus TMDL plan for the Kalamazoo watershed. We used a sensitive colorimetric technique to measure total phosphorus in water samples collected at major gauging stations. As a point of reference, Michigan Water Quality Standards limits point source discharges to 1000 ppb total phosphorus. Long-term eutrophication may require total phosphorus levels above 500 ppb. Overall, phosphorus levels in Rice Creek were low with a grand mean of 66 ppb and a maximum of 209 ppb. In the North Branch, in-stream lakes did not consistently increase or decrease phosphorus concentrations in the stream. Nor was there a consistent pattern for phosphorus to be high in one part of the watershed versus another.

Effects of wastewater discharge on stream chemistry

We sampled the Creek in March 2002 to see the effects of the Springport sewage lagoon discharge at Gibbs Rd. Phosphate was our key concern, as previous work suggested that P levels in the creek during discharge events exceeded EPA recommended levels, which is 0.1 µg/l (=100 ppb) for surface waters not draining into a lake (*http://h2osparc.wq.ncsu.edu/info/phos.html*). Our primary goal was to see if high P levels occurred in the Creek, and if so, to determine the fate of the P in the Creek; was it deposited? Or did it remain in the water, and flush from the Creek?

Data were collected on the 30th, when we believe discharge had been continuous throughout the preceding day, at least. On this day, 13 stream samples were collected and *in situ* measurements were made from Callahan Road to 20 Mile Rd, a stream distance of approximately 23.5 km to the west. The wastewater outfall was also sampled, as was one location (J-Drive) on the North Branch. The Creek at the point of discharge was sampled on the east side of the bridge, about 10 m upstream from the point of discharge, and from the south bank, roughly 10 m downstream from the point of discharge.

Foam on the surface suggested that this water contained at least some admixed discharge; our analysis suggests that the stream was not thoroughly mixed at this point, as the samples slightly further downstream contain higher levels of components high in the discharge (Cl^-, and phosphorus).

In-stream measurements were made with the YSI sonde. Phosphorus was measured with the inductively coupled argon plasma spectrometer (ICP). This method gives total phosphate, here reported as mg/l HPO_4. The detection limits are near the background levels in the stream; background equivalent concentration was 0.012 mg/l, so practical limit of quantification with reasonable degree of certainty is estimated at about 0.03 mg/l. Other anions were analyzed with the ion chromatograph (IC).

The discharge contained high levels of phosphorus exceeding the levels in the Creek where the outfall occurred by roughly 200 fold. Elevated phosphate was detectable throughout the portion of the creek sampled, and was measured in levels near or in excess of the EPA standard for 13 km downstream. The highest chlorophyll values occurred downstream from the discharge, suggesting a fertilizing effect on algae. Chloride levels were also elevated in the outfall, and were about 10x those in the Creek at the point of discharge. This is not a serious environmental concern, but does provide us with an interesting tracer, as Cl^- is not expected to react to a significant degree with chemicals or organisms within the stream. The object is to compare the behavior of Cl^-, thought to be conservative, to P to see if it behaves in the same way. If P behaves the same, it also is subject only to dilution. If P suggests lower contributions of sewage to flow downstream, it suggests that actually P was being removed from the stream (thus appearing to be diluted more).

Using a mixing model, the calculated trends in phosphate and chloride dilution were strikingly similar. This result suggests that phosphorus, like salt (Cl^-), seems to stay dissolved and wash out of the Creek. If phosphorus was being deposited, its curve would have fallen below that for chloride. The observed divergence in the lines is thought to be due primarily to limitations in the two assumptions of the model. For example, the North Branch may have a slightly different chemistry from the South, and there may be additional sources of Cl or P along the course of the Creek.

It should be noted that it rained the day these samples were collected, and the Creek was relatively high. Thus these results represent if not a best-case situation, at least a good case situation, where the Creek had quite high flow with which to dilute and carry phosphate down stream. Also, stream assimilation of phosphorus may be greater for discharges made in May when temperatures are higher and growth of stream organisms is greater.

The discharge and stream were sampled again on two days during the discharge (October 15 and 16), and results were averaged. A dilution model was calculated in the same manner as for the spring discharge. Measured at Hicks Rd, wastewater constituted about one fifth of the stream volume, a 3-4 times larger percentage than seen in spring. This increase reflected the joint effects of a lower fall stream volume and a higher discharge rate of wastewater from the pipeline (because of intervening repairs to Springport's pumps). Unlike the spring discharge, phosphate fell more quickly downstream than did the marker chemical chloride. This pattern suggests that phosphorus was partly being taken up as it traveled downstream rather than being simply diluted and flushed from the Creek.

Biological properties

Bacteria

We sampled for fecal coliform bacteria as an index of possible fecal pollution of the Creek. Sampling targeted sites where there was an *a priori* suspicion of contamination by feces from livestock, humans, or fowl. On the South Branch we sampled below the hog farm and below the discharge pipe for wastewater from the sewage lagoons of the Village of Springport, both sites of concern to basin residents. On the North Branch we sampled the stream below Prairie Lake and Gang Lake to test for effects of leaking or flooded septic systems. We tested the lower South Branch and Main Stem, the best fishing and canoeing sections of Rice Creek, because these areas are among the most likely sites for human exposure to pathogenic microbes. Levels of fecal coliforms high enough to make full or partial body immersion dangerous would limit some recreational uses of the Creek.

Contrary to early concerns, in-stream lakes on the North Branch appeared to have a cleansing effect, so much so that water below the lakes was usually safe for full body contact. Elsewhere in the watershed, waters generally fell safely within the range for partial body contact but above the standard for full body contact. High readings at 29 Mile Rd and Eaton Drain may have been due to livestock in the stream and low flow, respectively.

Biological Oxygen Demand

We evaluated Biological Oxygen Demand (BOD) at major gauging stations on three dates to screen for high levels of biodegradable organic wastes such as aquatic plants, agricultural or livestock runoff, or septic system pollution that could deplete dissolved oxygen in the stream. Levels of 5-day, carbonaceous BOD in July 2002 were low, and presented no threats to stream dissolved oxygen levels given the large photosynthetic inputs from aquatic plants. There was a weak trend for BOD to decline downstream from headwaters areas.

Algal communities

Algal communities were investigated as a possible cause of turbidity and secondarily as a potential indicator of pollution. As short-lived primary producers that respond readily to phosphorus levels, algae may serve as good bio-indicators of nonpoint source pollution. We sampled and identified algae at two upstream sites on the South Branch where algal turbidity was suspected (Callahan Rd and Gibbs Rd) and at two control sites (Main Stem at 20 Mile Rd and Bangham Rd on Spring Brook, an adjacent but less disturbed headwaters stream). As the summer proceeded, the number of microscopic algal diatoms decreased drastically. Phosphorus levels appeared to reach especially low levels in the upper South Branch in mid-June to mid-July, so phosphorus limitation seems a more likely explanation than phosphorus pollution. Other possible causes of the collapse in diatom abundances include turbidity, high summer fluctuations in the physical and chemical water parameters, and competition for nutrients from dense stands of submerged aquatic plants.

Stream macroinvertebrates

Stream macroinvertebrate communities are an excellent indicator of overall stream health. Benthic macroinvertebrates such as mayflies, caddisflies, and stoneflies are key prey items for fish and other vertebrates and are particularly sensitive to environmental degradation. Poor macroinvertebrate communities have been an important non-attainment issue for Rice Creek.

Between May 20, 2002 and July 19, 2002, we sampled benthic macroinvertebrates near 15 sites, including each of the eight gauging stations plus three additional sites on the upper South Branch, three additional sites on the North Branch, and one site in the Eaton Drain (J Dr). We returned to take repeat samples at 22 ½ Mile Rd on the Main Stem and 24 Mile Rd on the South Branch. We used two similar protocols to sample macroinvertebrates at each site: a “qualitative” method and a “quantitative” method.

The qualitative method was the Great Lakes and Environmental Assessment Section rapid bio-assessment protocol for wadable streams (GLEAS Procedure #51), which is based on a mixed-habitat sample of 100 organisms. The qualitative protocol was chosen to give results that would be directly comparable to previous macroinvertebrate studies of the Creek by the MDEQ.

For the quantitative method, three separate sub-samples of macroinvertebrates were obtained at each site from the best habitats in the stream (as defined by GLEAS #51). For each sub-sample, the stream bottom within 1 foot by 1 foot quadrate was agitated for 60 seconds, and the dislodged organisms were collected in a 18" x 10" rectangular aquatic kick net with a 10" deep mesh nylon net. The GLEAS index of biological integrity allows the macroinvertebrate community observed in a qualitative sample to be compared to the community expected at an excellent site in our ecoregion (Southern Michigan Northern Indiana Till Plains) based on a set of nine metrics. For each metric, the score can be +1 (excellent), 0 (acceptable), or -1 (poor), with a negative score generally indicating a metric that differs by more than two standard deviations from the mean for an excellent site. Because there are 9 metrics, total scores can range from +9 to -9. Total scores above +4 are considered excellent, scores below -4 are considered poor, and intermediate totals are acceptable.

A total of 59 taxa of macroinvertebrates were collected in qualitative samples at 15 sites in summer 2002. Metric evaluation scores for the qualitative samples ranged from –7 to +5. Only 20 Mile Rd on the Main Stem was rated excellent. Three sites had macroinvertebrate communities rated poor: L Dr on the North Branch below Prairie Lake (-5), Hicks Rd on the South Branch below a pasture where cattle sometimes gained access to the stream (-6), and 22 ½ Mile Rd on the Main Stem downstream from the confluence of the two branches (-7).

Hicks Rd is the first site downstream from the wastewater discharge outlet at Gibbs Rd, so the discharge of wastewater at Gibbs Rd cannot be excluded logically as a contributor to the poor score at Hicks. Nevertheless, heavy sedimentation of the bottom appears to be the principle problem, and if nutrient pollution were a contributor, it would be difficult to distinguish between cattle and wastewater inputs. The community at 22 ½ Mile Rd was rated acceptable (-2) when it was resampled. The 22 ½ Mile Rd site was placed on the 2000 nonattainment list because the macroinvertebrate community rated poor.

Recent changes in the Creek help explain differences between our study and the Biological Survey Staff Report from MDEQ/SWQD in 1999. The decline in the macroinvertebrate community at J Dr from +2 to –2 may reflect the drain maintenance that occurred along this reach in spring 2002. In contrast, macroinvertebrate recovery at Callahan Rd (and perhaps Gibbs Rd downstream) may reflect bottom stabilization and colonization of submerged aquatic plants following drain maintenance along this reach in early 2000.

No macroinvertebrate evidence exists that the old commercial hog farm operation in Parma Township is damaging the Creek at Callahan Rd.
Our results agree with previous work in suggesting that the best macroinvertebrate community occurs at 20 Mile Rd on the Main Stem, and that the status of macroinvertebrates at 22 ½ Mile Rd is fair to poor.

A total of 59 taxa of macroinvertebrates were collected in quantitative samples at 15 sites in summer 2002. (Counting both qualitative and quantitative samples, 72 taxa were encountered overall.) Provisional metric evaluation scores for the quantitative samples ranged from –5 to +6. Again, only 20 Mile Rd on the Main Stem rated excellent. Only Hicks Rd (downstream from a pasture) rated poor, although negative scores at J Dr and 24 Mile Rd on the North Branch suggested a negative effect from drain maintenance in spring.

Despite our concern that calculation of metrics from the quantitative samples would spuriously inflate scores, quantitative scores were better than qualitative scores in matching results from the MDEQ report of 1999. At the two sites that were sampled twice, quantitative scores matched while qualitative scores jumped 4-5 spots. A moderate correlation existed between the scores from the two protocols (r = 0.46); the largest disparity existed at 29 ½ Mile Rd on the North Branch.

In addition to collecting macroinvertebrate samples in 2002, we also evaluated macroinvertebrate habitat characteristics at the sampling stations. The highest habitat score was recorded at 20 Mile Rd on the Main Stem, just where the best macroinvertebrate communities are typically found. Conversely, nearly the worst habitat was found at Hicks Rd, where the macroinvertebrate community was found to be poor.
Overall, however, habitat score was not significantly correlated with metric scores from either the qualitative or quantitative protocols (r = 0.26 and r = 0.21, respectively), suggesting that habitat factors alone cannot explain differences in Rice Creek's macroinvertebrate communities.

Watershed-wide, macroinvertebrate community quality assumed an unexpected pattern with higher metric scores in the headwaters and lower Main Stem reaches and lower scores in the midsections of the North and South Branches. The presence of abundant patches of submerged aquatic vegetation (especially *Chara* and *Potamogeton*) and cold groundwater inputs in the upper sections of both branches apparently provided suitable cover and dissolved oxygen to support an array of benthic insects despite generally poor abiotic substrates. The general depression of macroinvertebrates in the midsections may be due to sediment and turbidity.

Water quality summary discussion

The following discussion is taken from the final report prepared by Albion College: "Rice Creek suffers from few impairments to designated water uses. Generally, water quality is acceptable and much of the Creek retains an engaging rural charm.

Designated uses for the Creek's surface water are warm-water fishery and habitat for other indigenous aquatic life and wildlife, agriculture, and partial or total body contact recreation.

Portions of the Creek are also considered a second-quality cold-water trout stream. Those factors that did occasionally and locally rise above or near regulatory levels of concern are poor macroinvertebrate community, excess fecal coliforms, and suspended solids and turbidity. The probable root causes for these impairments include livestock in the stream and instability of sediments caused by a long history of drain work. The existence of daily cycles in turbidity vividly demonstrates the abundance of easily mobilized sediments in the Creek."

"Several factors that were perceived concerns at the outset of this study were not confirmed as problems in our monitoring efforts. In particular, no problems could be attributed to (1) residual effects of a large concentrated animal operation (hog farm) near Callahan Rd, (2) faulty residential septic systems, particularly near lakes, (3) waterfowl wastes, or (4) excess nitrates and phosphates running off specific cropland, residences, or golf courses." "Basin residents had also voiced concerns about wastewater from Springport's sewage treatment lagoons being discharged into the Creek at Gibbs Rd in spring and fall. Our studies raised two flags of concern. First, the water that is discharged from the pipe at the outset of the season may be excessively turbid and anoxic. We recommend that the management of the pipeline be improved to sweeten this first foul slug of water. "

"Second, we could not confirm that the large phosphorus loads introduced into the South Branch remained in solution to be flushed from the system. Phosphorus released in spring 2002 apparently cleared the South Branch, but phosphorus released in fall 2002, when the discharge flow was greater relative to stream flow, appeared to be taken up in the watershed. Our mixed results suggest that it may be advisable to reduce pumping rates when stream flow is low."

The North Branch of Rice Creek includes two in-stream lakes, Gang Lake and Prairie Lake, while the South Branch flows uninterrupted. For this reason, the down-lake sections of the North Branch were warmer, cleaner, and more uniform in flow than the South Branch. North and South Branches behaved differently in parameter after parameter including temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, fecal coliforms, sulfate concentrations, daily variability in flow, and variability in flow in response to storms. For the North Branch, the lakes acted as settling basins, filters, and buffers. We did not investigate how these stream inputs affected the lakes.

Note:
It is important to remember that monitoring provides a snap-shot picture of the water quality conditions at that moment and location. The above discussion was in relationship to *perceived concerns at specific locations* that were not confirmed as problems during monitoring. Yet, not to suggest that there are not known pollutants and impairments within the watershed. The known and suspected pollutants will be identified later in this plan.

Chapter V – Designated Uses and Desired Uses of the Watershed

Designated uses for surface water in the Rice Creek Watershed are warm-water fishery, habitat for other indigenous aquatic life and wildlife, agriculture, public water supply (groundwater), and partial or total body contact recreation. Industrial water supply, and navigation designated uses were not found to be pertinent to the watershed.

In addition to the designated uses, the residents of the watershed would add to the list the following **Desired Uses:**

- Enhancement of cold water fishery
- Improved access to warm water fishery
- Effective land use policies to maintain & improve water quality
- Healthy functioning wetlands
- Reconnection to wetland/floodplain
- Improve storm water management to provide storm water storage & limit the need for dredging needed for Agricultural Uses

Water Quality Threats and/or Impairments in the watershed

(k) = known pollutant (s) = suspected pollutant

Designated Uses	Impairing Pollutants	Threatening Pollutants
Warm water Fishery	Sediments (k) Nutrients (k) Salts (k) Hydrologic Flow (k)	Pesticides (s) Oils, grease, and metals (s)
Aquatic Life/Wildlife	Sediments (k) Nutrients (k) Salts (k) Hydrologic Flow (k) Temperature (k)	Pesticides (s) Oils, grease, and metals (s)
Partial/Total Body Contact Recreation	Nutrients (k) Bacteria (k)	Pesticides (s) Oils, grease, and metals (s)
Public Water Supply Groundwater (Cr*itical area only)*	Nutrients (k)	Nutrients (s) *(other areas)*

Water Quality Threats and/or Impairments in the watershed (continued)

(k) = known pollutant (s) = suspected pollutant

Desired Uses	**Pollutant**
Cold water fishery	Temperature (k) Hydrologic Flow (k) Sediment (k) Nutrients (k) Salts (k)
Warm water fishery access	* Lack of dock access (k)
Land Use Planning Policy	Sediment (s) Hydrologic Flow (s) Nutrients (s) Temperature (s)
Water Quality	Sediment (k) Salts (k) Hydrologic Flow (k) Pesticides (s) Nutrients (k) Oils, grease, metals (s) Temperature (k) Bacteria (k)
Wetlands/Floodplains reconnect to creek	** Lack of Hydrologic Flow (k)
Agriculture	Hydrologic Flow (k)
Wetlands	Sediment (k) ** Lack of Hydrologic Flow (k) Nutrients (k) Land Use Changes (k)
Healthy Functioning Wetlands	Sediment (k) Nutrients (k) Hydrologic Flow (k) Land Use Changes (k)

* Residents of the Rice Creek Watershed desire fishing access for all residents. Currently only those with boats can fish at the three lakes with public access and restrooms. L or T shapes docks at these three sites would provide access for all residents. The three lakes would include Winnipeg Lake in Sheridan Township and Prairie and Gordon Lakes in Clarence Township.

** Residents of the watershed would also like to promote healthy functioning wetlands in the watershed. The primary wetlands targeted would include those wetlands that lie in the floodplain of the creek. Where possible, it would be advantageous to reconnect the creek to wetland floodplains for two reasons. The first being the ability to store storm water peak flows that are destructive to the fishery and aquatic habitat and many times lead to downstream flooding and the need for dredging.

The second benefit being the restoration of the natural habitat and function of the wetlands; such as the plants, wildlife, and groundwater recharge.

Designated Uses Impaired and Threatened

This section describes designated and desired uses for the watershed. Sources of pollutants associated with threats and impairments are listed for each use. A general goal is identified for each use. In chapter 8 proposed methods for meeting the general goals are broken down into objectives and specific best management practices by the sources listed on the following pages.

Warm Water Fishery - Impaired Use

Sediments, nutrients, salt, and hydrologic flows all have a negative impact on the warm water fishery in Rice Creek. These pollutants are a result of the following sources:

- sediment from stream bank erosion
- construction erosion
- livestock in the waterways
- road/stream crossings
- residential and agricultural lands
- parking lots, roads, storm drains
- septic systems & treated wastewater
- loss of wetlands
- channelization
- increasing development
- deer/geese impacts
- flooding

The goal is to restore and improve the warm water fishery. The warm water fishery throughout the watershed are a very important resource to residents across the watershed and the region.

Warm Water Fishery – Threatened Use

Pesticides, oils, grease, and metals are all pollutants that threaten the warm water fishery designated use. These pollutants are not known to have impacted the designated use, though they threaten to impact the designated use, if not properly managed. These pollutants are suspected to come from the following sources:

- residential run-off
- agricultural run-off
- road-stream crossings
- parking lots/storm drains

The goal is to reduce and/or eliminate the pollutants threatening the warm water fishery designated use.

Aquatic Life/Wildlife - Impaired Use

Sediments, nutrients, salt, and hydrologic flows all have a negative impact on the aquatic life/wildlife in and along Rice Creek. These pollutants are a result of the following sources:

- parking lots, roads, storm drains
- sediment from stream bank erosion
- construction erosion
- septic systems & treated wastewater
- livestock in the waterways
- road/stream crossings
- residential and agricultural lands
- channelization
- deer/geese impacts
- loss of wetlands
- flooding
- increasing development

The goal is to restore the aquatic life/wildlife and their habitat. Twenty-two percent of watershed residents that responded to the questionnaire, expressed that viewing wildlife and nature was their number one activity and use of the watershed.

Aquatic Life/Wildlife – Threatened Use

Pesticides, oils, grease, and metals are all pollutants that threaten the aquatic life/wildlife designated use. These pollutants are not known to have impacted the designated use, though they threaten to impact the designated use, if not properly managed. These pollutants would likely come from the following sources:

- agricultural run-off
- residential run-off
- parking lots/storm drains
- road-stream crossings

The goal is to reduce and/or eliminate the pollutants that threaten to impact the aquatic life/wildlife designated use.

Partial/Total Body Contact Recreation - Impaired Use

Nutrients and bacteria both have a negative impact on the designated use partial/total body contact recreation. These pollutants are the result of the following sources:

- livestock in stream
- deer/geese impacts
- septic systems & treated wastewater
- agricultural & residential run-off

The goal is to reduce and/or eliminate the pollutants impacting the partial/total body contact recreation designated use.

Though only five percent of folks questioned in the watershed, expressed swimming as a personal use of the lake and stream resource, any impairment and/or threat to body contact recreation is a concern as directed by the State of Michigan's listing of body contact recreation as a designated use to be protected.

Partial/Total Body Contact Recreation – Threatened Use

Pesticides, oils, grease, and metals are all pollutants that threaten the partial/total body contact recreation designated use. These pollutants are not known to have impacted the designated use, though they threaten to impact the designated use if not properly managed. These pollutants would likely come from the following sources:

- residential run-off
- agricultural run-off
- parking lots/storm drains
- road-stream crossings

The goal is to restore the designated use by reducing and/or eliminating the pollutants threatening partial/total body contact recreation.

Drinking Water - Impaired Use

Nutrients are the only known pollutants having a negative impact on drinking water in the Rice Creek watershed and in a very limited area. (Marengo Township Sections 8, 9, 16, 17) High nitrates have been reported by the Calhoun County Health Department in this area. These pollutants are likely the result of the following sources:

- septic systems
- agricultural practices

The goal is to restore the designated use by reducing and/or eliminating the pollutants impacting the drinking water designated use. Only the critical area identified above is known to have a high nitrate level in some of the area wells sampled. A voluntary annual drinking well water monitoring program for the critical area is proposed.

Drinking Water – Threatened Use

Nutrients are the pollutant that threaten the drinking water designated use. Nutrients threaten drinking water in areas where proper agricultural management practices and septic system placement and maintenance practices are not followed. High nitrates in drinking water can be easily monitored with annual drinking water testing. This pollutant would likely come from the following sources:

- septic systems
- agricultural practices

The goal is to reduce and/or eliminate nutrients from threatening the risk to the drinking water designated use. This will be accomplished by implementing a series of educational as well as best management practices to address the threat of this pollutant.

Desired Uses Impaired

Desired Use – Agriculture Use Impaired

Hydrologic Flow is the only known pollutant having a negative flooding impact on agriculture in the Rice Creek watershed. This pollutant is the result of the following sources:

- loss of wetlands
- natural obstructions
- farming in the floodplain

The goal is to reach a balance between the need for drainage and the increase of peak flows and flashy conditions in the creek.

Desired Use – Cold Water Fishery Impaired

Temperature, hydrologic flow, sediment, nutrients, and salts are all pollutants that have a negative impact on the cold water fishery desired use. These pollutants are the result of the following sources:

- loss of wetlands
- loss of stream canopy
- Plentiful lakes
- treated wastewater
- artificial drainage
- channelization
- artificial impoundments

The goal is to reduce and/or eliminate the pollutants impacting the desired use of cold water fishery. This will be accomplished by implementing a series of best management practices to increase stream canopy, reconnect to floodplains, promote filter strips, route runoff through natural filter areas, and improve stream habitat. The South Branch of Rice Creek from 21 Mile Road to 26 Mile Road is portion of the creek most likely to respond to treatment.

Desired Use – Land Use Planning/Water Quality Use Impaired

Sediment, hydrologic flow, nutrients, and water temperature are all pollutants that impact water quality because of the lack of proper “land use planning for water quality”. These pollutants are the result of the following sources:

- construction
- residential runoff
- loss of wetlands
- increasing development
- septic systems

The goal is to reduce and/or eliminate the pollutants impacting the desired use of water quality by implementing best management land use planning practices.

Protection and enhancement of the wetlands, forestlands, wildlife/aquatic life habitat and water quality within the Rice Creek watershed stream corridor will be accomplished by implementing a "corridor preservation plan". The plan will be developed in cooperation with the six townships in the watershed. A ¼ mile wide area along the Rice Creek floodplain will be designated as a high priority for all applicable desired and designated uses and those BMP's identified to protect and enhance those uses. Additionally, the Rice Creek Watershed Management Plan has a goal of working with twenty-four landowners within the Rice Creek corridor to help them develop professional forest management plans.

<u>Desired Use – Warm Water Fishery Access Use Impaired</u>

No additional pollutants or sources affect this desired use. The desired use is for additional public access to the warm water fishery to address the lack of public access where possible.

<u>Desired Use - Healthy Functioning Wetlands Use Impaired</u>

Land use changes and diverted hydrologic flow and sediment and nutrient loads all impact the ability for wetlands in the watershed to be healthy functioning wetlands. The following sources contribute to the impacts by these pollutants.

- Septic Systems
- Channelization
- Livestock in wetlands
- Restricted flows
- Loss of wetlands (land use changes)

<u>Desired Use – Wetlands/Floodplains reconnect to creekUse Impaired</u>

Modified hydrologic flow is the problem that needs to be addressed in relationship to this desired use. The following sources contribute to the modification of hydrologic flow:

- artificial drainage
- channelization
- increasing development
- loss of wetlands

The goal to reconnect Rice Creek to the natural wetlands/floodplains would reduce and/or eliminate many of the pollutants negatively impacting the water quality of Rice Creek. This desired use would be implemented by using best management practices approved by USDA-NRCS and MDEQ.

Chapter VI – Inventory of Critical Areas

These areas are all located in the ¼ mile Rice Creek and main tributaries stream corridor, which has been designated as the critical area for the watershed. Lakes connected to Rice Creek are also included as part of the watersheds critical area.

Critical Areas	# of Sites
1) Unlimited livestock access to waterways Parma, Springport, Marengo & Sheridan Townships	7 locations
2) Stream Bank Erosion Sheridan, Clarence, Parma, & Marengo Townships	8 locations
3) Road/Stream Crossing Concerns Clarence, Parma, Sheridan & Marengo Townships	4 locations
4) Erosion and Runoff from Agricultural Lands All Townships within the watershed	10 locations
5) Golf Course Runoff Sheridan Township	1 location
6) Construction Site Erosion Marengo Township	1 location
7) Runoff from Lake & Stream Residents Marengo, Sheridan & Clarence Townships	8 locations
8) City Storm Water Runoff Marshall & Marengo Townships	1 location
9) Deer stream bank impacts Clarence Township	2 locations
10)Garbage Parma & Sheridan Townships	3 locations
11)Critical Land for Sale Parma Township	2 locations
12)Flooding Sheridan, Clarence & Marengo Townships	3 locations
13)Lawns to Lake & Stream Marengo, Sheridan, Clarence Townships	6 locations
14)Septic Systems Clarence, Marengo & Sheridan Townships	8 locations
15) Drinking water high nitrate area Marengo Township Sections 8, 9, 16, 17	1 location

Chapter VII – Prioritizing Pollutants, Sources, and Causes

The pollutants and sources identified by designated use in chapter V have been further analyzed to identify specific causes. A denotation of (k) indicates a known pollution source or cause and a denotation of (s) indicates a suspected pollution source or cause.

Pollutants	**Sources**	**Causes**
Nutrients	Septic Systems (k)	Improperly sited, designed, maintained (k)
	Livestock in stream (k)	Unrestricted access (k)
	Wildlife (deer)(geese) (k)	Crossing and watering of excessive populations (k) Improper manure management practices (s)
	Agricultural Run-off (k)	Lack of conservation tillage practices (k) Improper nutrient application & storage (k)
	Residential Run-off (k)	Inadequate buffer areas between fields/yards & streams (k) Improper fertilizer/application, storage (k)
Pesticides	Residential Run-off (s) Agricultural Run-off (s)	Improper pesticide application, storage, disposal (s) Lawns/fields to stream edge (s)
Sediments	Stream Banks (k)	Flow fluctuations (k) Stream bank erosion (k)
	Livestock in stream (k)	Unrestricted access (k)
	Construction (k)	Improper construction practices (k) Inadequate construction planning (k) Poor land use planning (k)
	Residential/Agricultural Runoff (k)	Lack of buffer strips (k) Lack of agricultural mgmt. practices (k) (tillage, etc.)
	Channelization (k)	Drainage directed to stream (k) Flooding relief requested by landowners(k)
	Parking lots, roads, storm drains (k)	Impervious surfaces (k)
Temperature	Storm drains (k)	Impervious surfaces (k)
	Loss of wetlands (k)	Artificial drainage or filling (k)
	Loss of stream canopy (k)	Stream banks converted to lawns and fields and removed due to dredging (k)
	Plentiful Lakes (k)	Natural Features (k)
	Artificial Impoundments (k)	Increased surface area, decreased flow (k) Large surface area that is part of the system
	Treated Wastewater (k)	Limitations of systems (k) (k)
Hydrologic Flow	Artificial Drainage (k)	Flood management (k)
	Loss of wetlands (k)	Wetland filling and/or drainage (k) Poor land use planning (k)
	Flashy flow conditions (k)	Channelization (k)
	Impervious Surfaces (k)	Increasing Development (k)
	Natural Obstructions (k)	Inadequate storm water management (k)
	Restricted flows (k)	Artificial Impoundments (k)
	Unnatural flows (k)	Treated Wastewater (k)

Pollutants	**Sources**	**Causes**
E. coli bacteria	Live stock in stream (k) Wildlife (deer)(geese) (k) Septic Systems (s) Agricultural Run-off (s)	Uncontrolled access (k) Crossing & watering of excessive populations (k) Improperly sited, designed, or maintained (k) Illicit discharge (s) Improper manure management practices (s)
Oils, grease, and metals	Road-stream crossings (s) Parking lots/Storm drains (s) Residential/Agricultural Lands (s)	Road drainage (s) Impervious Surfaces (s) Improper car maintenance (s) Improper disposal (s)
Salt	Roads and Parking Lots (k)	Improper application (s) Over application (k)

Pollutants, Sources, and Causes were prioritized by the Rice Creek Advisory Committee based on their impact to water quality, their likelihood of being corrected, the frequency of impact, the frequency of sources and causes and by being a known rather than a suspected pollutant. Most impacts by pollutants in the watershed, negatively effecting water quality, are related to sources and causes within the Rice Creek Corridor. The corridor is defined as the area within ¼ mile of the floodplain of Rice Creek or those lakes connected to Rice Creek. Those pollutants, sources and causes that represent the most significant impact to water quality are rated as a "high priority". Those that represent an impact but not a significant impact are rated as "medium priority". And those that are a minimum impact or only suspected but not known are rated as "low priority".

The following charts show the priority ranking of the pollutants, sources, and causes:

Pollutants	**Priority**
Nutrients	H
Pesticides	M
Sediments	H
Temperature	M
Hydrologic Flow	H
E.coli bacteria	M
Oils, grease, metals	L
Salt	M

Sources	**Priority**
Septic Systems	H
Livestock in stream	M
Wildlife in stream (deer, geese, etc)	L
Agricultural Runoff	H
Residential Runoff	M
Stream Banks	H
Construction	H
Channelization	H
Parking lots, roads, storm drains	M
Loss of wetlands	L
Loss of stream canopy	M
Plentiful Lakes	L
Artificial Impoundments	H
Artificial Drainage	M
Increasing Development	H
Natural Obstructions	M
Treated Wastewater	L
Road-stream crossings	H
Parking lots, roads, storm drains	M

Causes	Priority
Improperly sited, designed, maintained septics	H
Unrestricted livestock access	M
Crossing/watering excessive deer/geese	L
Improper manure mgmt. practices	L
Lack of conservation practices	H
Improper fertilizer storage	M
Improper fertilizer application	H
Inadequate buffer areas, agriculture	H
Inadequate buffer areas, residential	M
Improper pesticide storage	M
Improper pesticide application	M
Flow fluctuations	H
Stream bank erosion	H
Improper construction practices	H
Inadequate construction planning	H
Lack of buffer strips	H
Lack of agricultural management practices (tillage,etc.)	H
Drainage directed to stream	H
Flooding relief requested by landowners	H
Impervious surfaces	L
Artificial draining or filling of wetlands	M
Stream banks converted	H
Increased surface area due to dams	L
Poor land use planning	H
Inadequate storm water management	H
Restricted flows	L
Unnatural flows	L
Illicit disharge	L
Road drainage	L
Improper maintenance/disposal	M
Over application of road salt	M
Limitation of waste water systems	L

Chapter VIII – Objectives/BMP's

The following objectives will reduce and/or eliminate the causes of the pollutants identified in this report by implementing the designated tasks as "best management practices" (BMP's). Once implemented the BMP's will address the impaired or threaten designated and desired uses impacted in the Rice Creek watershed.

Objectives by source	***Task/BMP***
Reduce septic nutrient impacts to water	*Promote septic system maintenance
Reduce or eliminate livestock access to stream; reducing nutrient and sediment impacts to stream	*Fencing for livestock exclusion *Alternate watering systems *Stabilized livestock stream crossings
Reduce or eliminate livestock manure impacts to water	*Promote manure management practices *Waste storage facilities *Roof water runoff management *Buffer strips
Reduce nutrient, pesticide, and sediment runoff from agricultural lands	*Irrigation scheduling *Grassed waterways *Buffer strips *Tile inlet filter areas *Nutrient/Pesticide management *Agri-chemical containment facility *Diversions *Riparian Buffer *Critical area plantings *Residue Management – no till, mulch till *Cover crops *Incorporate land use planning tools *Soil testing *In-field mix/load systems
Reduce nutrient, pesticide, and sediment runoff from residential lands	*Buffer strips (native plantings) *Nutrient/Pesticide management *Tree/shrub establishment *Incorporate land use planning tools
Reduce sediments from stream bank Erosion by implementing stormwater management practices	*Storm water management ordinance *Reconnect wetlands/floodplains *Stream bank stabilization
Reduce excessive storm water flows from new development	*Storm water control basins *Storm water management ordinance *Promote land use planning tools

Objectives by source	*Task/BMP*
Reduce sediments from roads and lots	*Education and maintenance
Reduce offsite sedimentation from construction development sites by requiring onsite sediment control	*Strengthen County soil erosion control enforcement program *Hold soil erosion control workshops *Temporary sediment control basins *Require pre-construction planning *Require adequate erosion control practices on construction sites
Reduce storm water and sedimentation draining directly to stream	*Wetland/Floodplain restoration *Grade stabilization structure *Storm water conveyance channel *Stabilized outfalls *Diversions *Grassed waterways
Eliminate artificial drainage/filling of wetlands through implementation of new land use programs	*Wetlands ordinance *Promote Rice Creek Corridor Protection *Storm water management ordinance
Reduce loss of key natural resources by improving planning practices	*Conduct natural resources inventories *Conduct visioning sessions with township residents *Update master plans *Promote land use planning tools
Reduce over development of land parcels and future storm water management impacts	*Promote storm water management ordinance to limit parcels to pre-developed runoff flows
Restore stream canopy on Rice Creek	*Riparian buffer
Improve stream channel's by implementing restoration practices	*Dam removal *Stream Channel Improvement
Promote fishery/aquatic life habitat by implementing various bmp's and improving public access	*Fishery habitat improvement *Wetland development/restoration *Storm water management ordinance *T and L shaped docks at public access' *Soil Erosion Control enforcement *Reconnect to wetland/floodplain
Reduce soil erosion on pasture lands	*Pasture/hayland management
Promote wildlife habitat by protecting and enhancing wetlands, forest lands, and upland habitats	*Wetland development/restoration *Forest land management practices *Upland wildlife habitat/foodplots
Reduce downstream flooding and need for dredging via restoration practices	*Fluvial Geomorphic assessment *Reconnect wetlands/floodplain

Objectives by source	*Task/BMP*
Reduce over-application of road salts at stream/road crossings	*Information & Education targeted at road commissions *Sediment basins at critical sites
Reduce phosphorus levels entering Rice Creek	*Buffer strips *Grassed waterways *Tile inlet filter areas *Nutrient Management *Diversions, *Soil testing *Created wetlands *Cover crops, *Manure testing *Wastewater chemical treatment facility
Promote General Watershed Education: Reduce potential of pollutants such as oil, grease, metals, and fuel from entering stream & groundwater via education, promotion of cost/share practices and making drop-off sites more accessible	*Newsletters *Maintenance Practices such as home*a*syst program activities, street sweeping, parking lot maintenance, etc. *Workshops/Conferences *Demonstration Projects *Promote household hazardous waste drop-off sites *Fuel containment facilities *Well decommissioning *Automatic shut-off gas dispensing unit
Increase fishing access for all residents	*Build L or T shaped fishing docks

Chapter IX – BMP's/Systems/Lead Groups/Audience

The following chart lists the tasks and best management practices needed to reduce and/or eliminate the pollutants negatively impacting or threatening to negatively impact Rice Creek water quality. The chart also lists the system of best management practices that may be needed to address a particular source and cause of pollution, when applicable. Also included are the partners involved with the practice and the lead organization or group. Descriptions of individual BMP's are provided in Appendix C.

Note: The target group **audience** for each BMP is listed in the partner column (in parenthesis)

Physical BMP	System of BMP's	Lead Groups	Partners/Audience
Fencing for Livestock exclusion	~Alternate watering systems ~Stabilized livestock stream crossings	CCD/NRCS	~Watershed Action Committee (Agricultural Producers)
Irrigation Scheduling	N/A	NRCS/CCD	(Agricultural Producers)
Waste storage Facilities	~Engineering ~Site Preparation ~Roofwater runoff management ~Manure management plan	NRCS/CCD	~MSUE (Agricultural Producers)
Install Buffer Strip Practice	~Diversions ~Riparian Buffer ~Critical area plantings ~Grassed waterway	NRCS/CCD	~Drain Commission ~Pheasants Forever (Agricultural Producers) (Stream and Lake shore landowners)

Physical BMP	System of BMP's	Lead Groups	Partners/Audience
TemporarySediment Control Basins	~Soil erosion control practices	~Excavators ~Contractors	~CCCD (New Projects when needed)
Grassed Waterways	~Diversions ~Tile inlet filter areas ~Buffer strips	NRCS/CCD	(Agricultural Producers)
Install tile inlet filter areas	~Diversion ~Grassed waterway ~Buffer strips	NRCS/CCD	(Agricultural Producers)
Agri-chemical containment facility	~Engineering ~Site Preparation ~Emergency management plan	~NRCS/CCD ~GSP	~MSUE ~Fire Dept. (Agricultural Producer)
Install Diversions where needed	~Grassed waterway ~Tile inlet filter areas ~Buffer strips	~NRCS/CCD	(Agricultural Producers)
Install Riparian Buffer Practice	~Buffer strips ~Critical area plantings ~Awareness programs	~NRCS/CCD	(Watershed Lake and stream shore landowners)
Install critical area plantings	~Buffer strips ~Riparian buffers	~NRCS/CCD	(Watershed landowners)
Promote Residue Management practices	~no-till ~mulch-till ~Ridge-till	~NRCS/CCD	MSUE (Agricultural Producers)
Install Cover Crops Practice	Crop rotation	~NRCS/CCD ~GSP	(Agricultural Producers)
Install Soil Testing Practice	Nutrient Management	~MSUE ~GSP	(Agricultural Producers) (Watershed Residents)

Physical BMP	System of BMP's	Lead Groups	Partners/Audience
In-field mix/load systems	~Nutrient management ~Well water testing ~Soil testing	~GSP ~CCD	(Agricultural Producers)
Tree/shrub establishment	~Critical area planting ~Riparian buffers ~Soil erosion control ~Stream canopy restoration ~Wildlife habitat	~CCD/NRCS	~Pheasants Forever ~Trout Unlimited (Watershed Landowners)
Well Decommissioning	~Site evaluation	~GSP	(Landowners)
Stream Channel Improvement	~Fishery habitat ~Aquatic life habitat ~Stream bank restoration	~MDNR/MDEQ ~Drain Commission	~CCD ~Trout Unlimited ~Volunteers (Areas identified in assessments)
Stream bank Stabilization	~In-stream fisheries habitat ~Drainage district management ~Stream bank soil erosion control	~CCD ~Drain Commission	~Trout Unlimited ~Private Landowners (Riparian stream bank owners)
Storm water control basins	~Grassed waterway ~Buffer strips ~Diversions	~CCD/NRCS ~Drain Commission	~Calhoun County Community Development ~Townships (Landowners)
Automatic gas shut-off dispensing unit	~Farm*A*Syst ~Emergency Planning	~CCD ~GSP	(Agricultural Producers)
Dam Removal	~Engineering Plans	~City of Marshall	~MDEQ/MDNR
Grade stabilization Structure	~Grassed waterway ~Diversions ~Buffer strips ~Stabilized outlet	~NRCS/CCD	(Agricultural Producers)

Physical BMP	**System of BMP's**	**Lead Groups**	**Partners/Audience**
Storm water Conveyance channel	~Diversions ~Stabilized outlet	~NRCS/CCD ~County Road Commission	(Private landowners)
Stabilized outfalls	~Grade stabilization structures ~Grassed waterway ~Stormwater conveyance structures	~NRCS/CCD ~County Road Commission	(Agricultural Producers) (Private landowners)
Fishery Habitat Improvement	~Stream channel improvements ~Aquatic life habitat	~Tout Unlimited ~MDNR	~CCD ~Volunteers (Areas identified in assessments)
Manure testing	~Manure management practices ~Soil testing ~Spreader calibration	~MSUE	~CCD/NRCS (Agricultural Producers)

I & E = Information and Education

I & E BMP	System of BMP's	Lead Groups	Partners/Audience
Teach septic system maintenance	Home*A*Syst Program	~Americorp ~Health Department	~Volunteers ~CCD (Lake & stream shore landowners)
Assist landowners with manure management practices	~Manure testing ~Soil testing ~Spreader Calibration	CCD/NRCS MSUE	~Watershed Action Committee (Agricultural Producers)
Nutrient/Pesticide Management	~Conservation Planning ~Practices specified in plan	~NRCS/CCD ~MSUE ~GSP	~Americorp (Agricultural Producers) (Watershed Residents)
Establish Education related to the maintenance of impervious surfaces, to reduce sediment and other pollutant transport to stream	~Awareness education for residential and business residents ~Newsletter articles ~Drains to stream stencil program	~CCD ~Volunteer groups	~Volunteer groups ~(Area businesses) ~(City of Marshall)
Hold Soil Erosion Control Workshops	~Demonstration sites	~CCD ~CCCD	~NRCS ~Potawatomi RC&D (Excavators) (Contractors)
Help Establish Land Use Planning Tools	~Purchase of development rights ~Land Use planning workshops ~Articles	~CCCD ~Townships	~CCD ~Potawatomi RC&D (County Landowners)
Forest Lands Management	~Reforestation ~Timber stand improvement ~Wildlife habitat ~Timber harvests	~CCD ~Private Consultant	(Watershed Landowners)
Pasture/hayland management	~Stabilize highly erodible lands	~NRCS	~CCD (Agricultural Producers)

I & E BMP	System of BMP's	Lead Groups	Partners/Audience
Project WET	~Classroom water quality education	~CCD	(Watershed Schools) (Volunteers)
Historical Documentation Program	~ Data sources ~Residents ~Historical files	~Volunteers ~CCD	(Watershed Residents)
Groundwater Stewardship Program Assessments	~Residential/Farm Assessments ~Cost share BMP's	~GSP	~CCD (Residential Landowners) (Agricultural Producers)
Stream Ecology Program	~Data collecting equipment ~Data gathering ~Data Reporting	~Marshall High School ~CCD	(Mar Lee Schools) (Volunteer Group) (Springport Schools)
Newsletters, water sampling, landowner assessments, waste collection events, adopt*a*stream, presentations to townships, t-shirts, hats, "action committee", watershed tour, before & after slides	~Communication & feedback ~watershed clean-up and protection ~ongoing education ~watershed awareness ~project implementation ~BMP implementation	~CCD ~Volunteers ~Schools	~NRCS ~CCCD ~Townships (Watershed residents)
Update Township master plans	~Natural Resource Inventory ~Township visioning sessions ~Consultant assistance	~Townships ~CCCD	(Watershed Townships)

Contractual BMP	System of BMP's	Lead Groups	Partners/Audience
Reconnect wetlands and Floodplains	~Stormwater management ~Fisheries Habitat ~Aquatic life habitat ~Stream bank erosion control	~CCD ~MDNR Fisheries Division ~MDEQ	~Watershed residents (Floodplain/Rice Creek Riparian Landowners)
Fluvial Geomorphic assessment	~Hydrologic evaluation ~Source stabilization system ~Reconnection to wetlands/floodplain	~MDNR ~CCD	~Volunteers ~Trout Unlimited ~Riparian Landowners (Critical areas identified)
Wetland creation And restoration	~Stormwater management ~Wildlife/aquatic life habitat ~Groundwater recharge	~NRCS ~CCD	(Watershed Residents)
Forest Management Plans	~Wildlife Mgmt. ~Erosion Control	~CRM	(Watershed Landowners)

Land Use BMP	System of BMP's	Lead Groups	Partners/Audience
Stormwater management ordinance	~Flood management ~Stream restoration <continued below> ~Streambank erosion control	~Calhoun County Community Development(CCCD) ~Drain Commission ~Watershed	(County Townships) (Township residents)

	~Land-use planning	Townships	
Program to help Enforce County Soil Erosion Control Program	~Require approved plan prior to permit ~Require bond for soil erosion control measures ~Pursue violations	~Calhoun County Community Development (CCCD)	~CCD ~MDEQ ~Drain Commission (New earth changes within 500' lakes and streams or acre or larger in size)
Wetlands Ordinance <management of wetland resource>	~Stormwater management ~Groundwater recharge ~Wildlife habitat	~Townships ~CCCD	~CCD/NRCS (County Landowners)
Establish Rice Creek Corridor Protection <voluntary promotion of corridor enhancement>	~Stormwater management ~Wildlife/aquatic life & fishery habitat	~CCD ~Potawatomi RC&D ~Townships	~CCCD ~Pheasants Forever ~Trout Unlimited (Watershed corridor landowners)
Natural Resource Inventory	~Township visioning sessions ~Master plan revisions	~CCCD ~Townships	~Potawatomi RC&D ~NRCS/CCD (Watershed Townships)
Natural Resource Inventory Implementation Workshops	~Community visioning sessions ~Master plan revisions	~CCCD ~Townships	~CCD ~NRCS (Townships)
Pollutant Reduction Workshops	~Implementation of practices	~CCCD ~CCD	~NRCS (Contractors)
Low Impact Development Workshop	~Implementation of new development ideas	~CCCD ~Townships ~CCD	~MDEQ ~Key Developers (Developers)

Chapter X – BMP Quantity and Cost

The following chart lists the physical BMP's; the total quantity of acres, feet, etc. and the cost per unit. Also included is the cost share rate, local match expected and the total amount to be funded by grants or other sources.

Note: An asterisk (*) is used to show a BMP that will require engineering and evaluation to determine the size and cost.

Physical BMP	Quantity	Cost/Unit	Cost-Share	Local Match	Total Grant
Diversion	360 ft.	$6.25/ft.	75%	$563	$1,687
Fencing 8 farms	15,420 ft.	$1.60/ft.	75%	$6,168	$18,504
Waste Storage Facility	2 Units	$55,800/ea.	75%	$27,900	$83,700
Buffer Strips	14,820 ft. 21 acres	$345/acre	75%	$1,812	$5,433
Irrigation Scheduling	2 farms	$350/farm	50%	$700	----
Grassed Waterways	1400 ft. ½ acre	$3,000/acre	75%	$375	$1,125
Tile surface inlet Filter areas	7 Farms 13 inlets	$150/each	75%	$488	$1,462
Stream bank Shaping/Seeding	7,600/ft. 2.6 acres	$2,300/acre	75%	$1,495	$4,485
Agrichemical Containment Facility	1 Farm	$15,000/ea.	75%	$3,750	$11,250
Cover Crops	300 acre	$60/acre	$45/acre	$4,500	$13,500
Riparian Buffers	6 acres	$150/acre	75%	$225	$675
Critical area plantings	3 acres	$2,000/acre	75%	$1,500	$4,500
PSNT Soil Testing	400 acres	$3/acre	50%	$600	$600
In-field mix/load systems	2 Units	$3,200/ea.	50%	$3,200	$3,200
Stream bank stabilization	365 ft.	$87.50/ft.	75%	$7,985	$23,952
Storm water control basins	1 unit	$4,000 each	75%	$1,000	$3,000
Sediment Control basins	1 unit	$4,000 each	75%	$1,000	$3,000

Physical BMP	Quantity	Cost/Unit	Cost-Share	Local Match	Total Grant
Grade control structures	1 unit	$1,000 each	75%	$250	$750
Storm water conveyance channel	300 ft.	$27.50/ft.	75%	$2,063	$6,187
Stabilized outfalls	8 Units	$2,400 each	75%	$4,800	$14,400
Well decommissioning	20 wells	$390 each	90%	$780	$7,020
Stream channel improvement	2 Reaches	*	----	----	----
Fishery habitat improvement	2 areas	$1,500 each	75%	$750	$2,250
Pasture/hayland management	120 acres	$100/acre	$30/acre	$3,600	$8,400
Automatic gas shut-off dispensing units	20 units	$24/each	50%	$240	$240
Alternate Watering System	8 Systems	$1,500/each	75%	$3,000	$9,000
Stabilized Livestock Stream Crossing	4 Crossings	$750 each	75%	$750	$2,250
Residue Management	2,083 acres	$15/acre	50%	$15,622	$15,622
Nutrient/Pesticide Management	2,083 acres	$20/acre	75%	$20,830	$20,830
Crossflow culverts	4/24”dia. 120’ total	$27.10/ft.	50%	$1,626	$1,626

Land Use BMP	Quantity	Cost Each Or Total	Cost-Share	Local Match	Total Grant
Natural Resource Inventories	2	$3,500/ea.	75%	$1,750	$5,250
Natural Resource Inventory Implementation Workshops	6	$525/each	75%	$788	$2,362
Pollutant Reduction Workshop	1	$2,000	----	$500	$1,500
Low Impact Development Workshop	1	$3,500	----	$1,000	$2,500
Rice Creek Watershed Corridor Plan	6	$800	----	$4,800	----
Develop a Storm Water Management Ordinance	1 at County level or 8 at individual townships	----	----	----	----
Program to help Enforce County Soil Erosion Control Program	1 Workshop	$2000	----	$500	$1,500
Wetlands Ordinance	1 at County level or 8 at township level	----	----	----	----

Information & Education BMP	Quantity	Cost Each Or Total	Cost-Share	Local Match	Total Grant
Newsletters, Promotional Items, Awards, I&E Programs,etc. See complete I&E list of activities in chapter 9	4 newsletters, promotion & outreach budget items	$17,405	----	$3,405	$9,000
Project WET	2 Workshops 20 Classrooms	$1,000	----	$250	$750
Historical Documentation Program	1 Program	$3,500	----	$1,200	$2,300
Stream Ecology Program	3 Groups	$2,000	----	$250	$1,750
Groundwater Stewardship Program Assessments	40 Assessments	$1,800	----	$1,800	----
Contractual BMP	**Quantity**	**Cost Each Or Total**	**Cost/Share**	**Local Match**	**Total Grant**
Forest Management Plans	24	$134/each	75%	$804	$2,412
Fluvial Geomorphic Assessment	1 Assessment	$100,000	----	$80,000	$20,000
Reconnect Rice Creek to Floodplain Demonstration Project	2 Sites	$25,000	----	$5,000	$45,000
Wetland restoration	20 acres	$1,100/acre	75%	$5,500	$16,500

Rice Creek Watershed Plan BMP Implementation Timetable

Physical BMP Implementation	#	Match Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Develop Water Quality Resource Mgmt. Plans (WQRMP's) in critical areas	15	Y	Y	Y	Y	Y	Y					
Implement WQRMP's in critical areas	15	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Land Use BMP												
Conduct resource inventories and implement protection ordinances w/twps.	2	Y	Y	Y	Y	Y	Y					
Provide instructional workshops to assist townships w/implementation of inventory data	2	Y	Y	Y	Y							
Work with townships across political boundaries to direct growth and development to specific areas	8	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Hold pollution reduction workshops	1	Y	Y	Y								
Conduct "Low Impact Development" Mtgs.	1	Y	Y									
Develop and implement a "Rice Creek Open Spaces Corridor Plan"	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Information & Education BMP												
Project WET Workshops	2	Y	Y	Y								
Host Clean Sweep Programs	2	Y	Y	Y								
Develop and distribute awards	4			Y	Y							
Outreach & Promotion	--	Y	Y	Y	Y	Y	Y					
Historical Documentation Program	1	Y	Y	Y								
Stream Ecology Program	3	Y	Y	Y								
Groundwater Stewardship Assessments	40	Y	Y	Y								

Rice Creek Watershed Project BMP Implementation Timetable (con't)

Information & Education BMP Cont'd.	#	Match Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Develop and distribute watershed newsletters	4	Y	Y	Y	Y							
Collect drinking water samples from residents for analysis in critical areas	50	Y	Y	Y								
Promote Farm, Home, and Lake Assessment Programs to residents in watershed	40	Y	Y	Y	Y							
Assist with Hazardous Waste and Tire Collection Days in watershed	2	Y	Y	Y								
Establish Adopt-A-Stream Program	1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Give presentations to township governments regarding watershed project activities	8	Y	Y	Y								
Develop & implement stream ecology program at area schools	2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Produce and distribute t-shirts & hats	150		Y	Y								
Develop and work with Watershed Action Committee to oversee plan implementation	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Conduct watershed tour	1	Y		Y								
Provide before & after slide presentation	1	Y		Y								

Rice Creek Watershed Project BMP Implementation Timetable (con't)

Contractual BMP	#	Match Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Fluvial Geomorphic Assessment	1	Y	Y	Y								
Reconnect Creek to Floodplain	2	Y		Y								
Forest Management Plans	24	Y	Y	Y								
Wetland Restoration	20	Y	Y	Y								
Fluvial Geomorphic Assessment - MDNR												
Gather and analyze watershed/stream corridor data												
Conduct hydrologic analysis of watershed												
Conduct field reconnaissance survey of Rice Creek and collect geomorphic data												
Determine geomorphic instability through data analysis												
Classify stream reaches using geomorphic data												
Create information maps using GIS software												
Provide final report and recommendations												

Chapter XI - Evaluation Process and Sustainability

Evaluation

The overall success of the Rice Creek Watershed Management Plan will be best evaluated by reporting the number of and the types and effectiveness of the systems of best management practices that are implemented as “water quality resource management plans” (WQRMP’s) are developed and implemented. Also by reporting the number of, diversity of, level of understanding and subsequent conservation actions by the key people in the watershed, targeted for information and education programs in the management plan. Success of implementation often depends on the availability of funds to cost/share needed best management practices. And on the level of landowner and group participation in applying planned practices and programs. Conservation practices, information and education programs and all project actions will be recorded and tracked, including the number of landowners and citizens who are involved with the project. Before and after photographs will be taken on each project and video footage will be captured on all major projects. These steps will provide an excellent measure of program participation and implementation by simply comparing them with the measures outlined in the management plan.

Additionally, the Rice Creek Watershed Project will continue to receive oversight by the Rice Creek Watershed Advisory Committee. Once implementation of the plan begins, the watershed coordinator will maintain a weekly schedule of activities and prepare monthly reports on plan progress. The watershed coordinator will also *develop a reporting form* that reflects the number, type, and effectiveness of each best management practice implemented as discussed above. Concerning information and education programs the number of, diversity of, level of understanding (before and after events) will also be tracked and recorded on this reporting form.

The primary non-point source pollutants of concern are sediments and nutrients so further evaluation of the project’s effectiveness will include erosion reduction and stream loading changes occurring from installed bmp’s. These changes will be recorded using USDA’s Revised Universal Soil Loss Equation (RUSLE) and sediment delivery ratios for surface water. Pre-installation loadings will be calculated as a means of comparison.

Biological surveys of the watershed stream ecosystems have been completed by the Michigan Department of Environmental Quality (MDEQ) in the past at selected sites along Rice Creek. During the planning phase of the Rice Creek Watershed Project Albion College was contracted to perform further monitoring of the water quality of Rice Creek.

As part of the plan, three stream ecology teams will be developed to gather basic water quality data over a long period of time. This basic data includes evaluating macroinvertebrate communities, which can reveal improving or degrading water quality over a long period of time.

Follow-up biological surveys at the selected sites will be requested from MDEQ during the implementation phase of the project to provide more comparative data on surface water quality trends. These trends could also reflect marked improvements in water quality due to implementation of portions of the watershed management plan.

The information and education portion of the plan will have its own specific evaluation procedures as they are implemented. Questionnaires will be used to assess awareness and knowledge of watershed water quality problems, issues, and solutions. Post workshop evaluation questionnaires will also be used at the completion of each workshop held during implementation to gauge workshop effectiveness.

The fluvial geomorphic assessment will be evaluated by the documentation of a final report of recommendations for reconnection of Rice Creek to the floodplain. This would be followed by the development of an engineering plan and implementation of the assessment recommendations. The evaluation of the forested stream corridor management plans will be completed by a follow-up questionnaire sent to each landowner who participates in the development of a plan.

Sustainability

In January of 2002 the Rice Creek Watershed Technical Committee developed and submitted a CMI grant application to MDEQ to complete some stream bank restoration in the watershed. Due to a limited number of projects able to be funded the proposal was denied. This stream bank restoration work remains a part of this implementation plan.

The Calhoun Conservation District in cooperation with the Rice Creek Watershed Project Action Committee will apply for funding from various sources to implement all or part of the Rice Creek Watershed Management Plan, as set forth in this document. Although there is not MDEQ funding at this time to move directly into a full-scale implementation project, the "Action Committee" will continue to meet and has set forth a plan of action, to begin implementing portions of the plan until such time as funding can be secured to complete the entire plan. The largest portion of this plan would be completed in 3 – 5 years with some portions continuing over 10 years.

In addition, ongoing volunteer support was specifically sought from individuals who attended the 2003 "watershed management short course". Eight members of the Rice Creek Advisory Committee attended the watershed training course. At the February 2003 Advisory Committee meeting a brainstorming session was facilitated by a committee member Dan Kesselring, USDA-NRCS. The session helped develop ideas on how best to continue the implementation of the newly developed watershed plan. The Committee's final official "planning project meeting" was held on July 16, 2003. The Advisory Committee will continue to meet bi-annually with a volunteer group the “Action Committee” to meet bi-monthly. They will guide ongoing projects and direct implementation efforts.

Many educational projects are planned to begin or continue after the planning stage of the project is completed. This will keep the project foremost in watershed resident’s minds and continue to promote water quality related best management practices. Promotion of clean sweep program activities are planned with the cooperation of the Groundwater Stewardship Program; Farm*A*Syst, Home*A*Syst, Turf*A*Syst, and Lake*A*Syst evaluations will be promoted with watershed residents to evaluate their risk to groundwater and surface water and to promote practices to reduce those risks; hazardous waste drop-off sites will be promoted by each Counties health department; and Project WET (water education for teachers) will be promoted with teachers across the watershed.

Appendix A - Questionnaire

The following questionnaire was mailed to every resident in the Rice Creek Watershed. A return rate of over 15% was achieved with no reminders sent. Below is the questionnaire that was sent and the collective response from the watershed residents, in the form of pie charts. The purpose of the questionnaire was to collect information about the resident's awareness and concerns about water quality problems in the watershed. Willingness to participate in the project was also determined. Forty percent of those responding expressed an interest in volunteering their time and/or resources.

Rice Creek Watershed Questionnaire

1. Are you familiar with the land area that drains into the Rice Creek?
   __________yes __________no

2. What are your current activities with regard to the Rice Creek Watershed?
   Please check all that apply.
   a. _____Fishing
   b. _____Irrigating crop fields/pastures
   c. _____Swimming
   d. _____Drainage
   e. _____Watering lawn/garden
   f. _____Canoeing
   g. _____Drinking water for livestock, pets
   h. _____Household water supply
   i. _____Viewing wildlife/nature
   j. _____Hunting
   k. _____Irrigating commercial vegetable crops
   l. _____Other (please specify)____

3. Does your lawn or field extend to the edge of the creek or drain?
   a)___yes
   b)___no

4. How often do you have your soil tested to determine lime and/or fertilizer needs?
   a)___regularly, on some type of schedule

b)___occasionally, or only when needed
c)___never

5. Is your yard or field drained by a subsurface tile system?
a)___yes
b)___no
c)___don't know

6. Does your property have a strip of grass, bushes, or trees along the stream or drain?
a)___yes   If yes, how wide? _________feet
b)___no
c)___no stream or drain on my property

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

	Much Worse	Worse	Same	Better	Much Better
a. fishing	1	2	3	4	5
b. hunting	1	2	3	4	5
c. swimming	1	2	3	4	5
d. canoeing	1	2	3	4	5
e. drainage	1	2	3	4	5
f. observing wildlife	1	2	3	4	5
g. water clarity	1	2	3	4	5
h. pollution	1	2	3	4	5
i. stream bank erosion	1	2	3	4	5
j. flooding	1	2	3	4	5
k. littering	1	2	3	4	5
l. household water supply	1	2	3	4	5

8. Rank the following sources, according to their degree of importance. Where do you think that most of the problems originate in the watershed.

a. ___faulty septic systems (H=high, M=medium, L=low)
b. ___household chemicals
c. ___storm water runoff
d. ___soil erosion from farmlands
e. ___livestock access to streams
f. ___construction site erosion
g. ___fertilizer, pesticides, and other chemicals from lawns and gardens
h. ___fertilizer, pesticides, and other chemicals from agriculture
i. ___nitrates in drinking water
j. ___old dump sites
k. ___soil erosion from road crossings
l. ___urban sprawl
m. ___other (please specify)_______________________________________

9. Rate your level of concern for the water quality of the Rice Creek Watershed and its major tributaries. Please circle one choice.

Very concerned Slightly concerned Not at all concerned

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

	High Priority	Moderate Priority	Low Priority	Not a Priority
a. planning development	1	2	3	4
b. environmental education	1	2	3	4
c. farmland preservation	1	2	3	4
d. hunting & fishing	1	2	3	4
e. parks & outdoor recreation	1	2	3	4
f. preserving woodlands	1	2	3	4
g. water quality	1	2	3	4
h. preserving wetlands	1	2	3	4
i. drainage	1	2	3	4
j. wildlife preservation	1	2	3	4
k. promoting development	1	2	3	4
l. watershed protection	1	2	3	4
m. flooding concerns	1	2	3	4
n. septic systems concerns	1	2	3	4
o. other (_________________)	1	2	3	4

Who do you think is responsible for protecting the Rice Creek Watershed?
a. _____citizens
b. _____local government (twp., village, etc.)
c. _____state government
d. _____federal government
f. _____other (please specify)

11. If cost were not a factor, of the following management practices, which ones would you like to learn more about for your property?
    a. _____ conservation tillage, crop residue management
    b. _____ grassed waterway
    c. _____ managing riparian area (streamside filter strips etc.)
    d. _____ animal waste management
    e. _____ pasture management (excluding livestock from streams)
    f. _____ wildlife habitat management/wetland restoration
    g. _____ integrated crop management (crop scouting, pesticide & fertilizer mgmt.)
    h. _____ structures for erosion or water control
    i. _____ septic system maintenance
    j. _____ composting
    k. _____ lawn care
    l. _____ other (please specify) ______________________________

12. Please circle below the response that best reflects your opinion of the overall water quality of Rice Creek.

    1 = excellent   2 = good   3 = fair   4 = poor

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

    No   Yes   If yes, what is it?

____

14. If given the opportunity, would you volunteer your services to help this project?

    Yes   No

Where do you typically look to find reliable information about water quality and resource protection practices?

a. Local Newspapers
b. TV/Radio
c. University or Extension services
d. Magazines
e. Local Organizations
f. Workshops/Seminars
g. FSA/NRCS/Conservation District

Questions 17 – 21 seek information that will help us better interpret your responses to the survey. All of your answers will be kept confidential.

15. Where do you live?

_____ On a farm
_____ Rural, non-farm
_____ Within village or city limits

If on a farm, please circle the type of farm operations.

a. cultivated row crops
b. pastured livestock
c. confined livestock/poultry
d. horses
e. sheep
f. other _____________

16. How many acres do you own? ___________acres

19. How many people live in your household?

a. _____ 1 – 2
b. _____ 3 – 4
c. _____ 5 or more

20. What is your age?

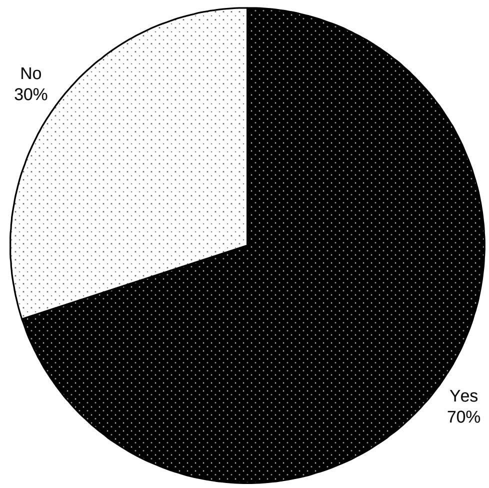
a. _____ under 25
b. _____ 26 – 35
c. _____ 36 – 45
d. _____ 46 – 55
e. _____ over 55

21. What is your occupation?

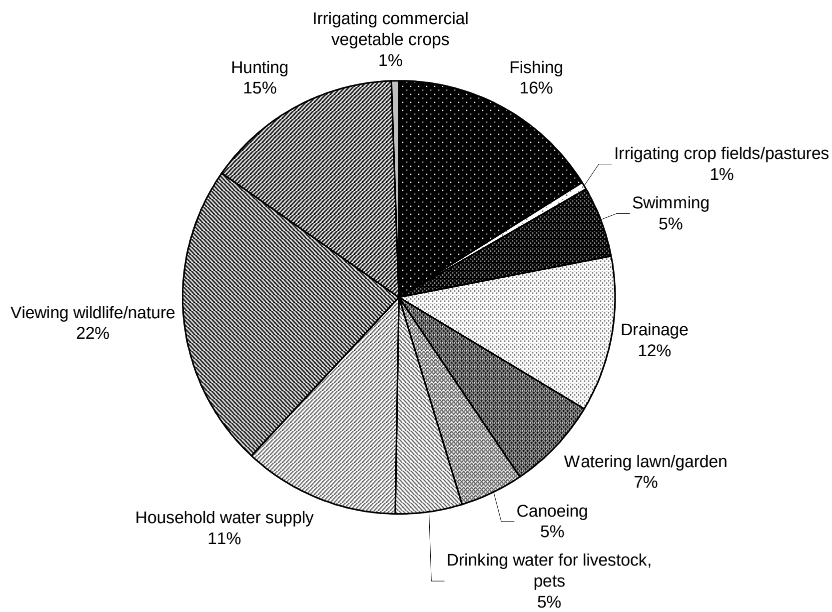
Please include any comments or concerns you have concerning the Rice Creek Watershed

Note: Below are pie charts revealing the results of the questionnaire conducted with the residents of the Rice Creek Watershed at the beginning of the project in 2001. For copies of the results of the post planning project questionnaire being conducted at the time of the finalization of this plan contact the Calhoun Conservation District.

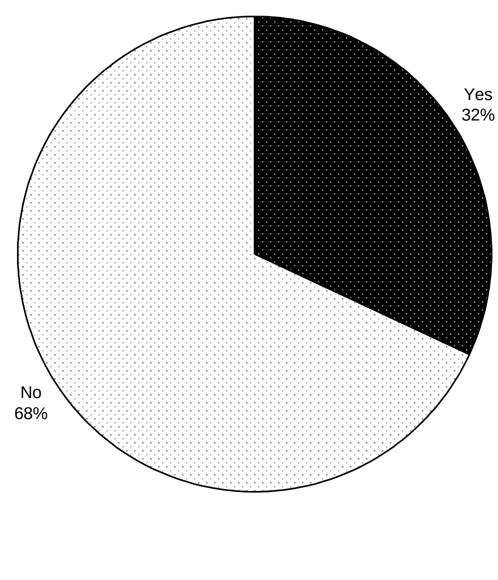
Are you familiar with the land area that drains into the Rice Creek?



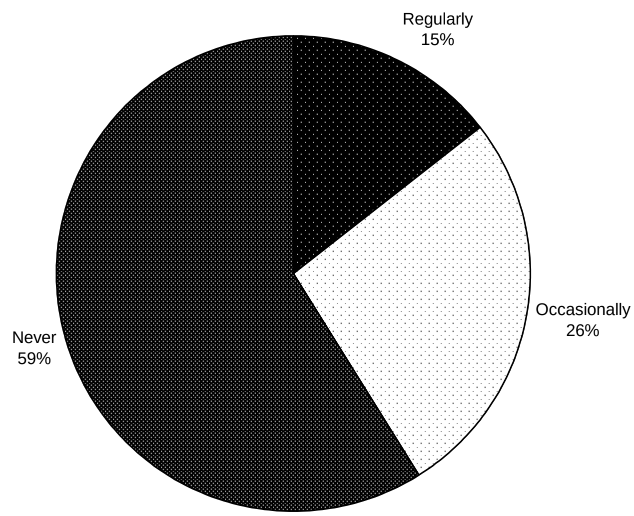
What are your current activities with regard to the Rice Creek Watershed?



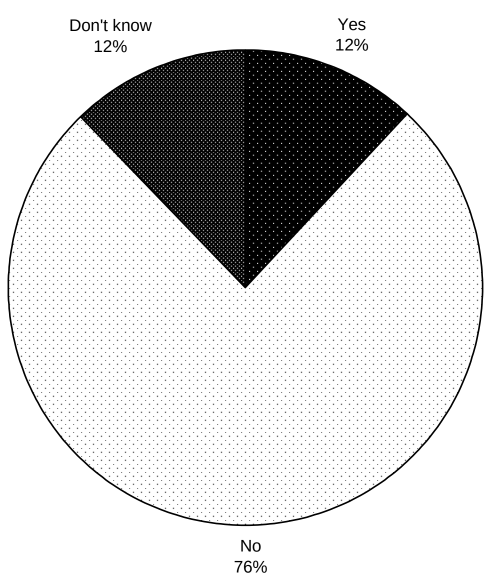
Does your lawn or field extend to the edge of the creek or drain?



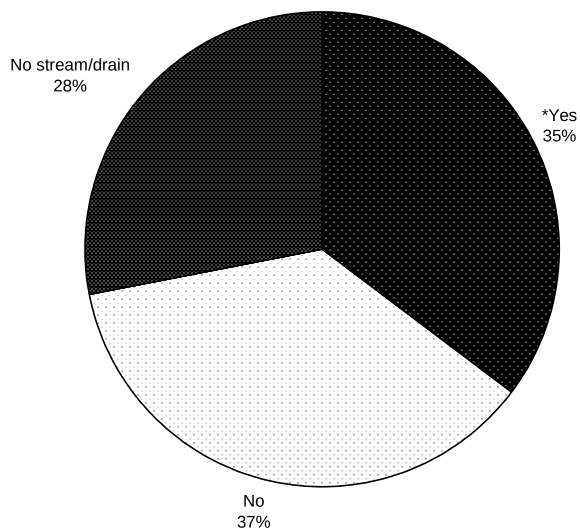
How often do you have your soil tested to determine lime and/or fertilizer needs?



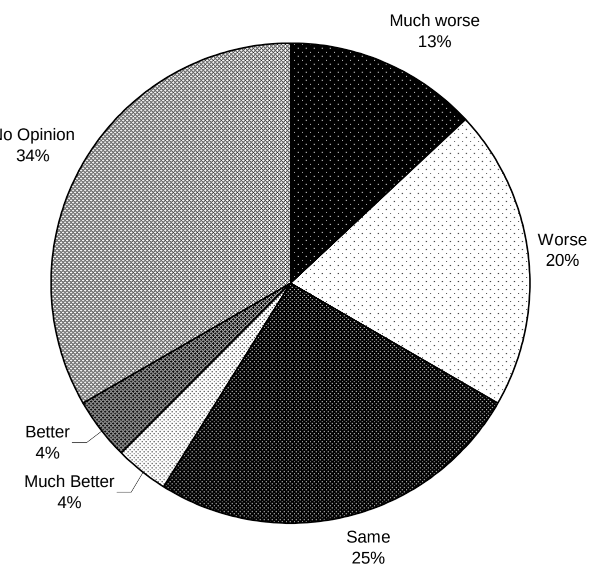
Is your yard or field drained by a subsurface tile system?



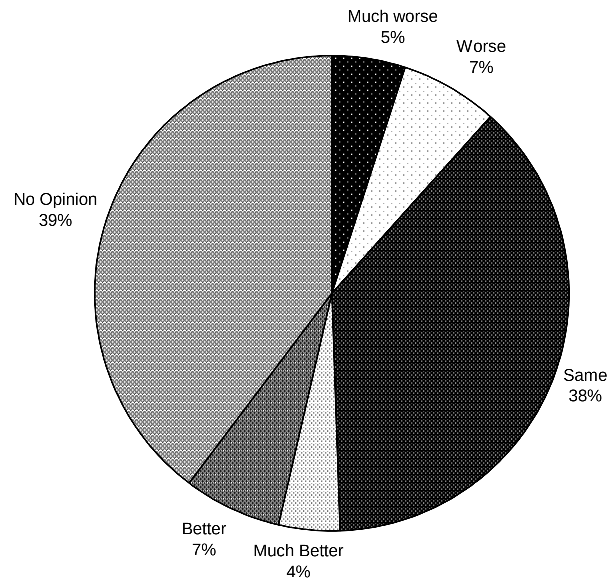
Does your property have a strip of grass, bushes, or trees along the stream or drain?



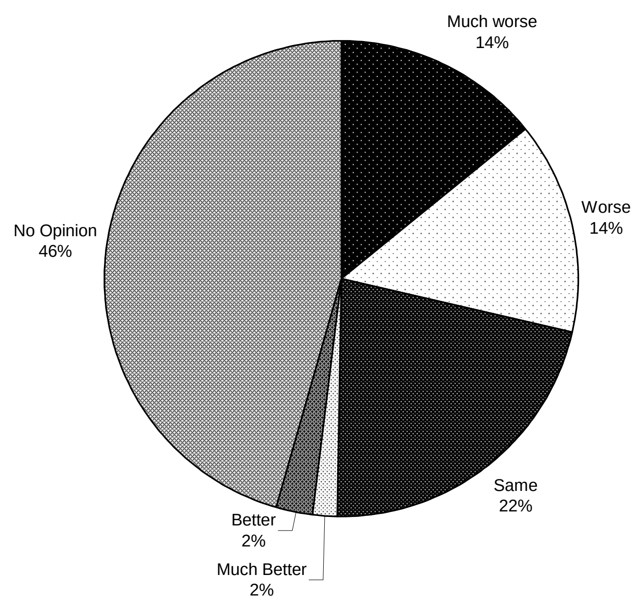
Fishing



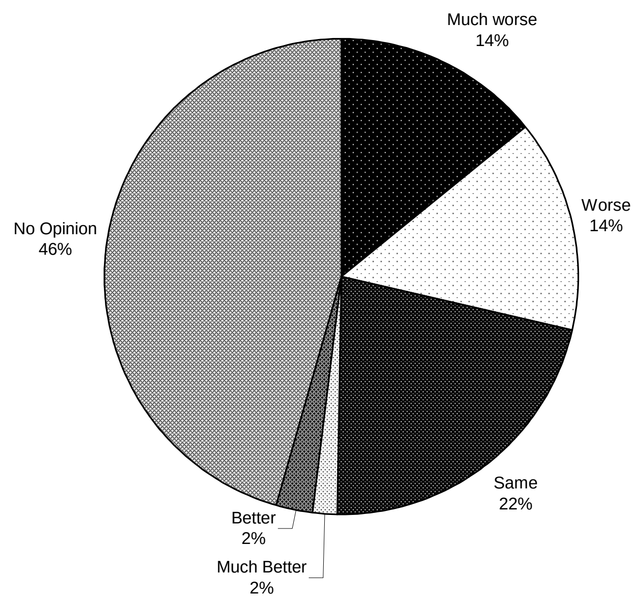
Hunting



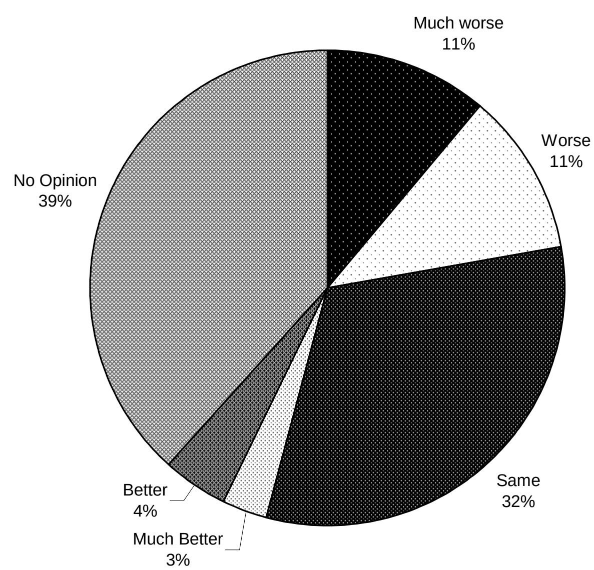
Swimming



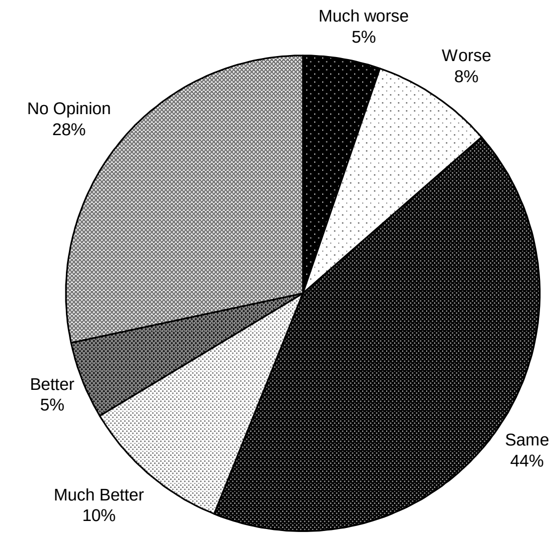
Canoeing



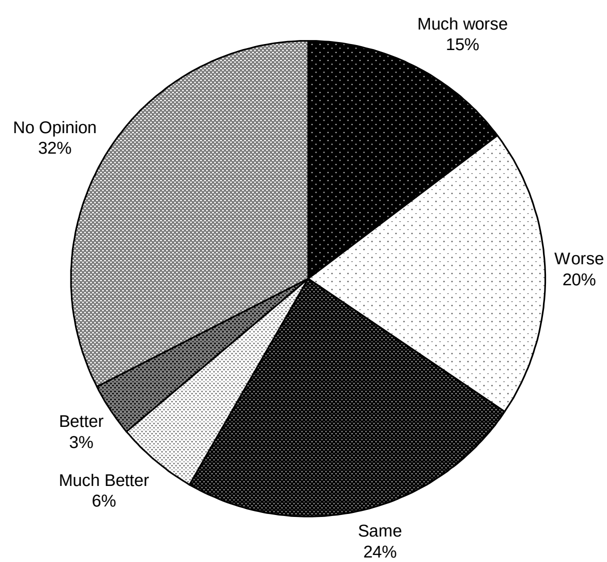
Drainage



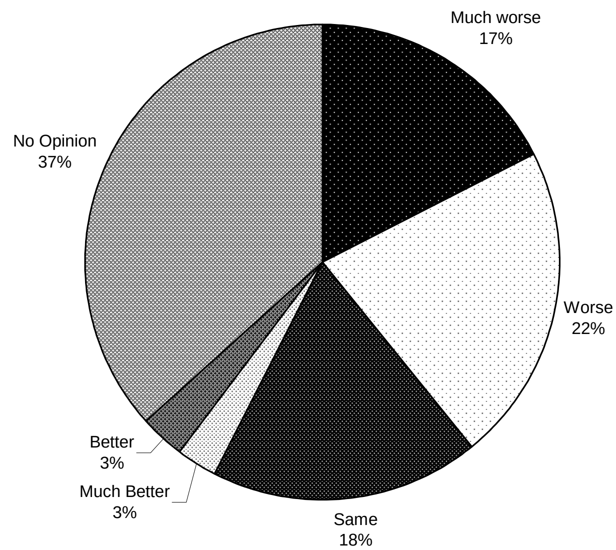
Observing Wildlife



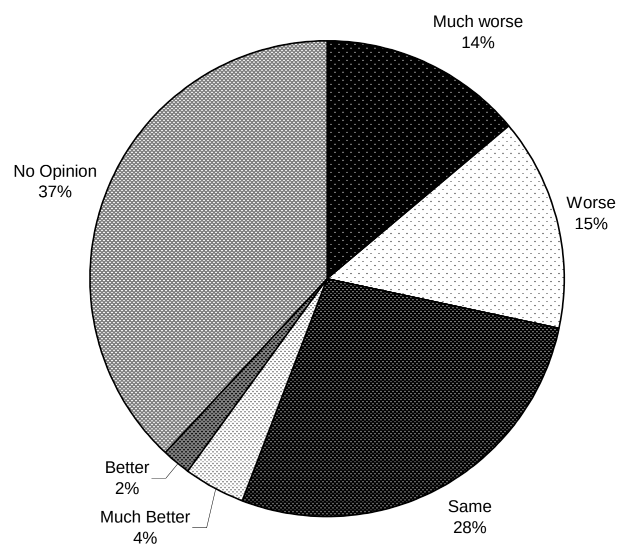
Water Clarity



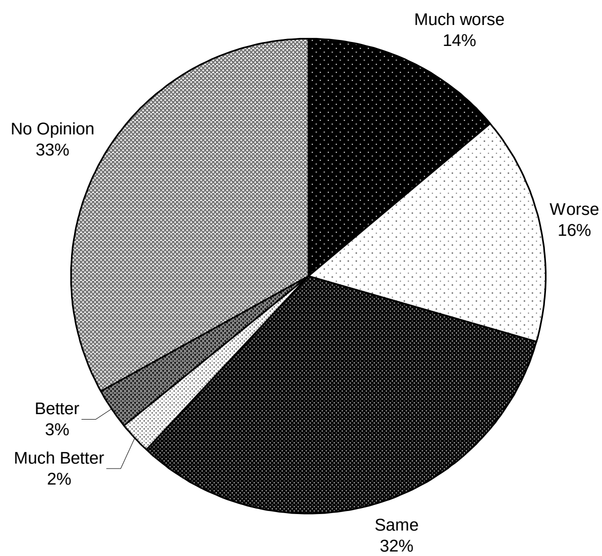
Pollution



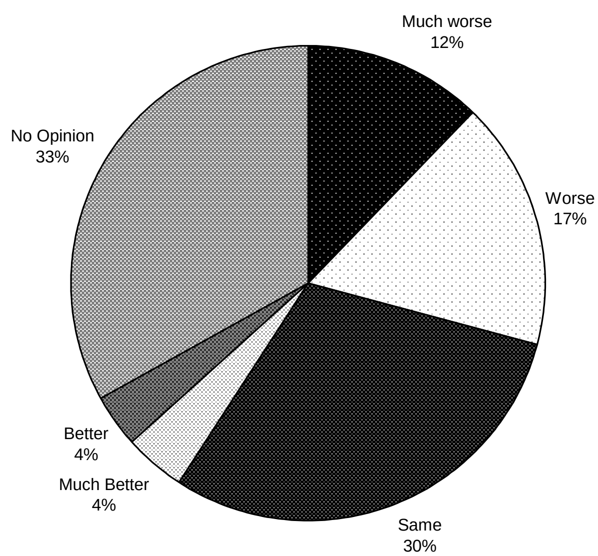
Stream Bank Erosion



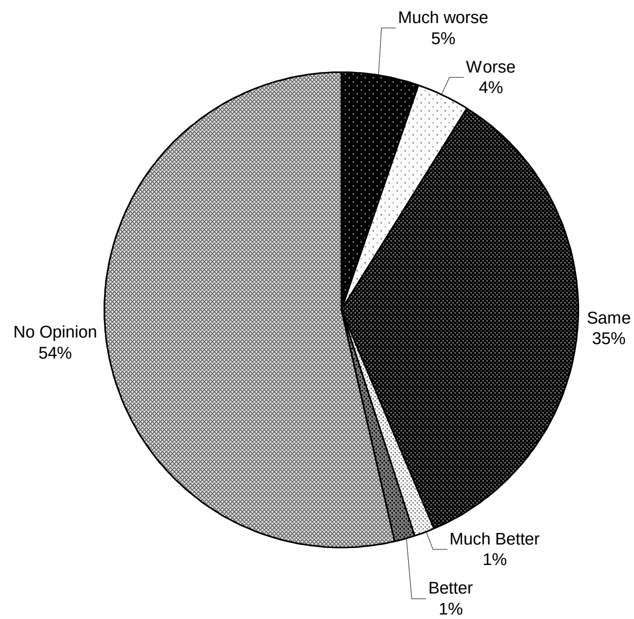
Flooding



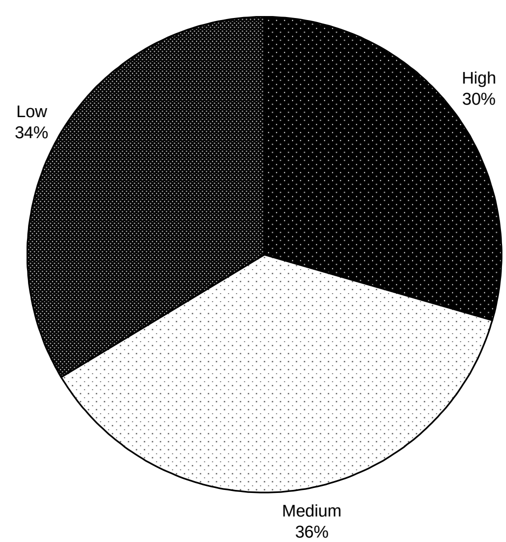
Littering



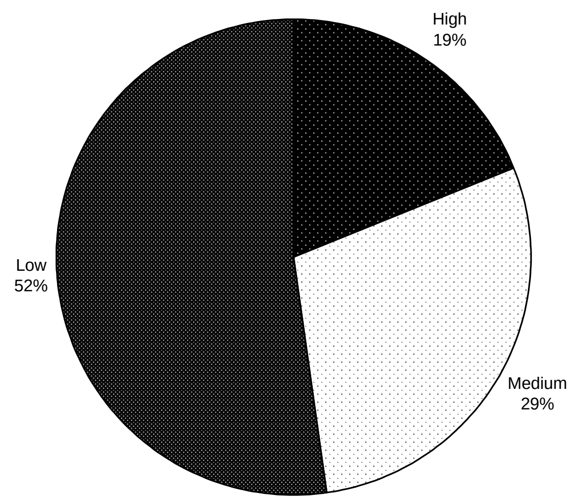
Household Water Supply



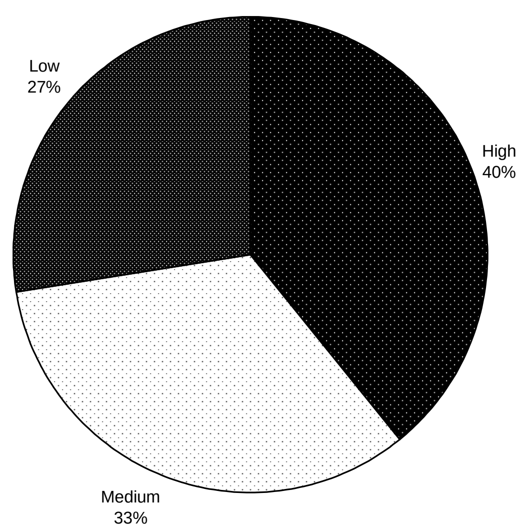
Faulty Septic Systems



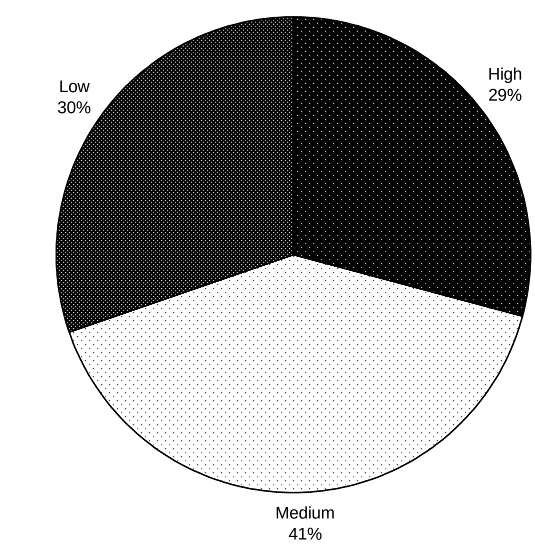
Household Chemicals



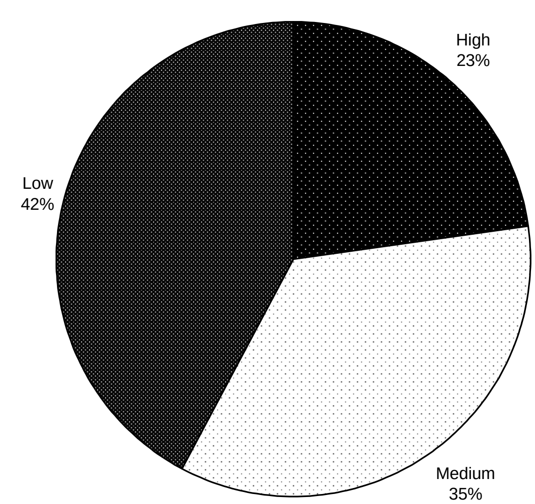
Storm Water Erosion



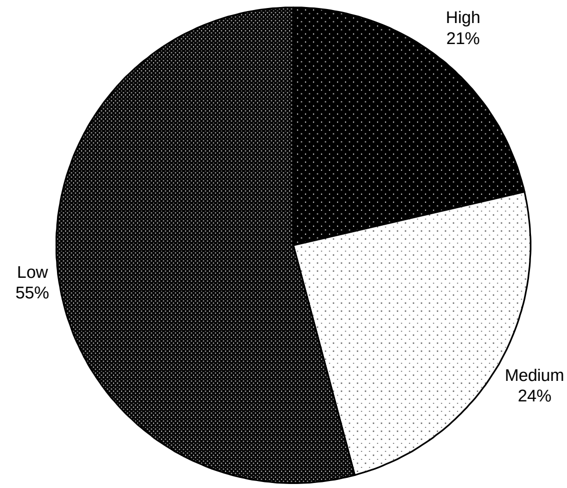
Soil Erosion From Farmlands



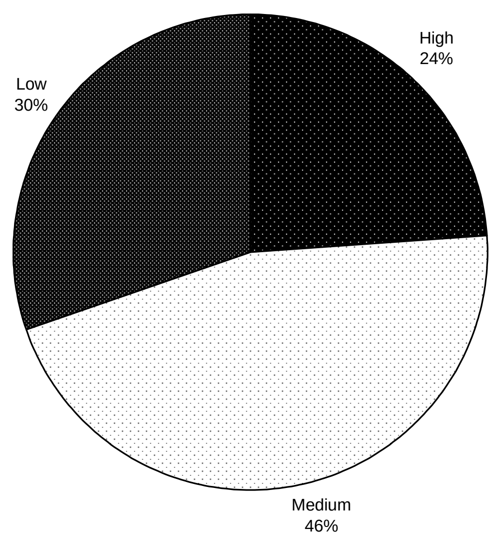
Livestock Access to Streams



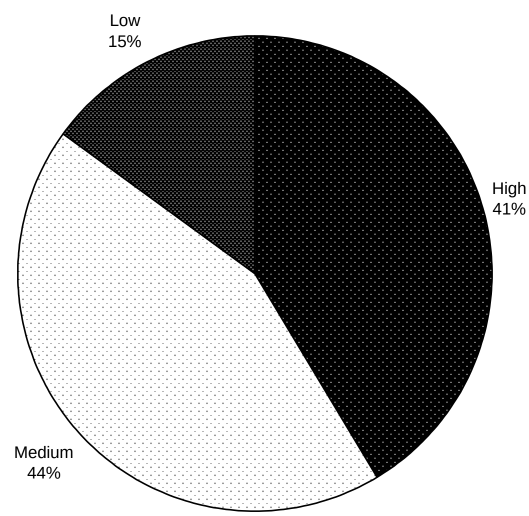
Construction Site Erosion



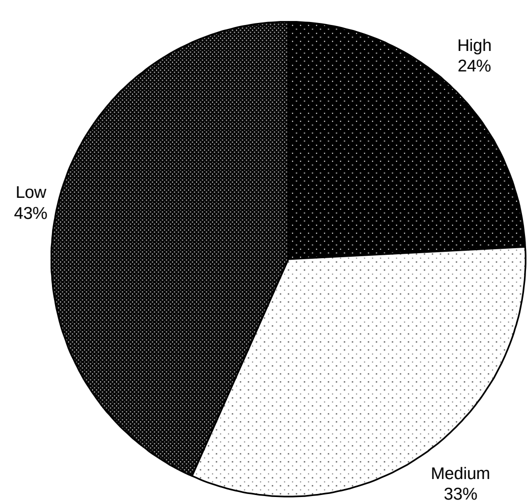
Fertilizers, Pesticides, Other Chemicals from Lawns & Gardens



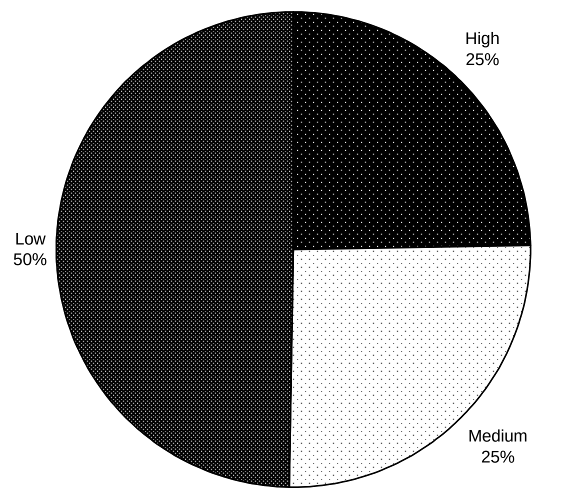
Fertilizers, Pesticides, Other Chemicals from Agriculture



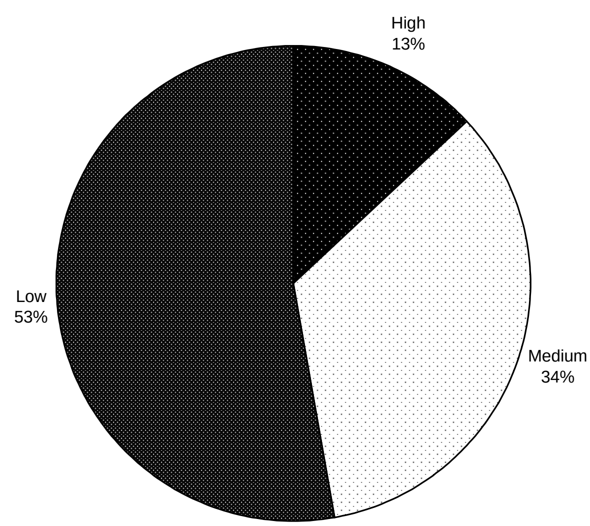
Nitrates in Drinking Water



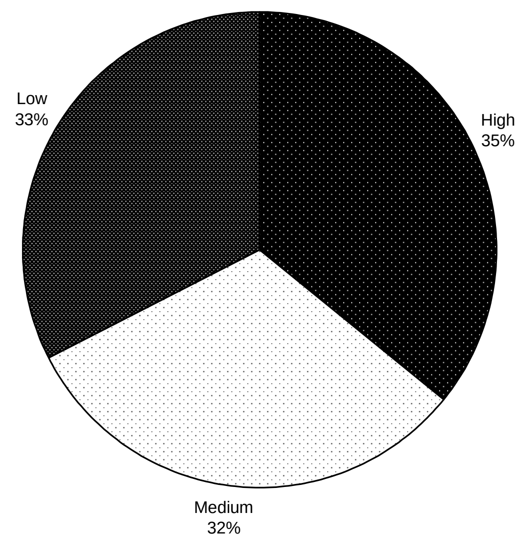
Old Dump Sites



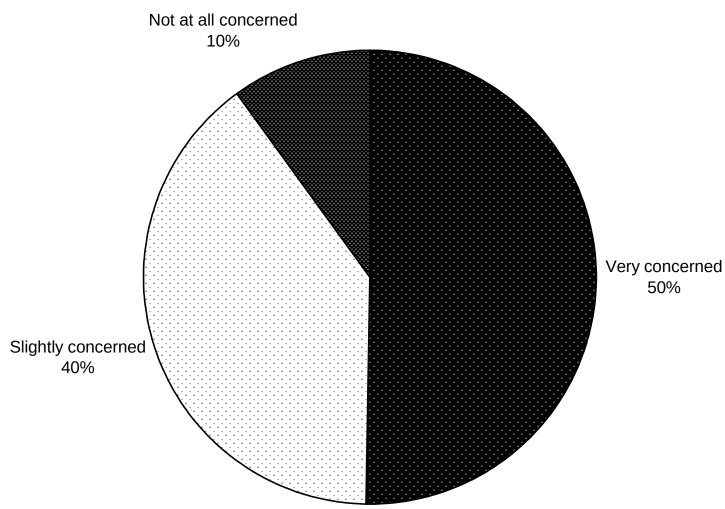
Soil Erosion From Road Crossings



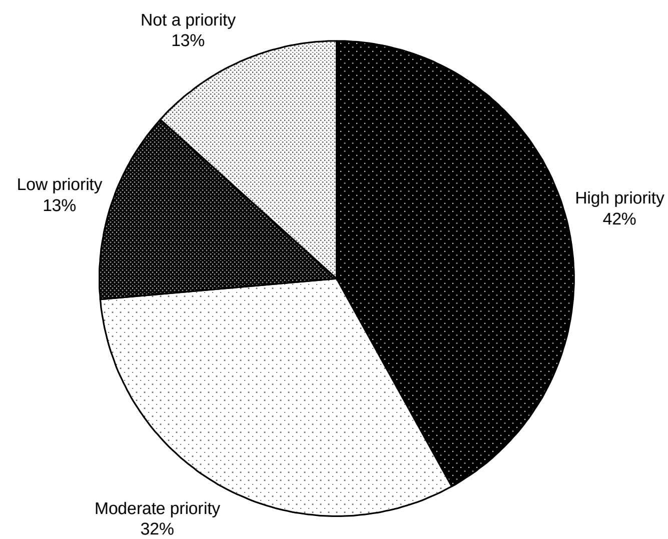
Urban Sprawl



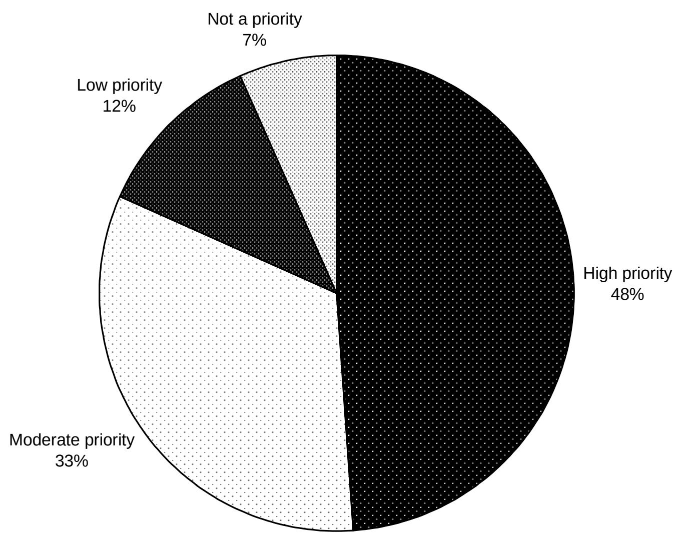
Rate your level of concern for the water quality of the Rice Creek Watershed and its major tributaries



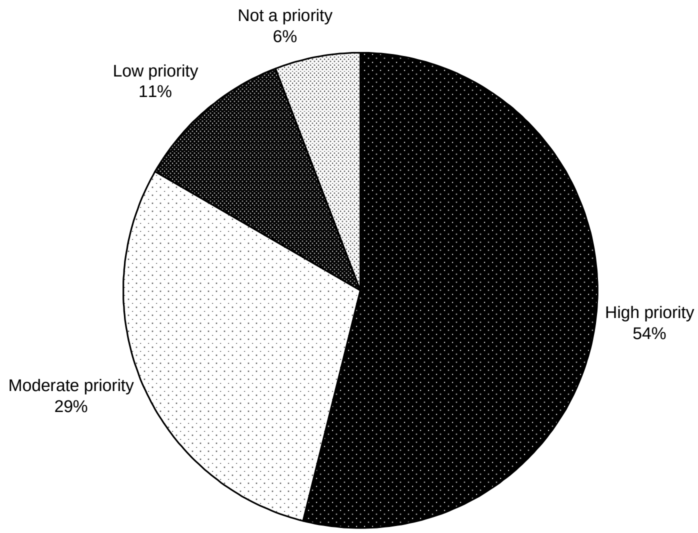
Planning development



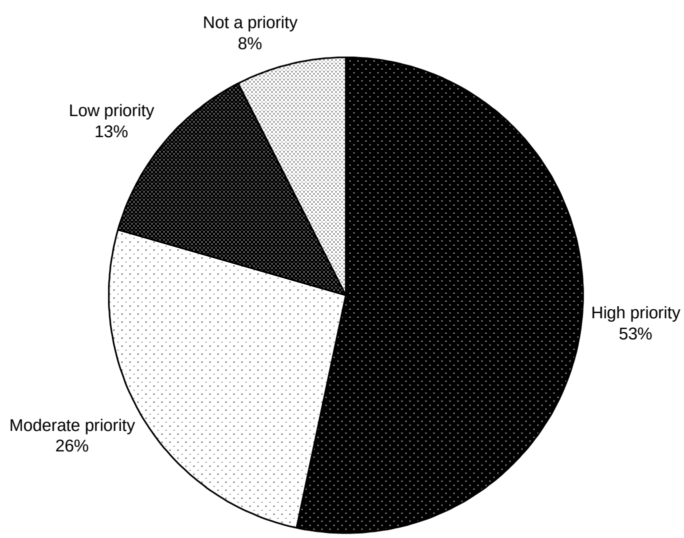
Environmental Education



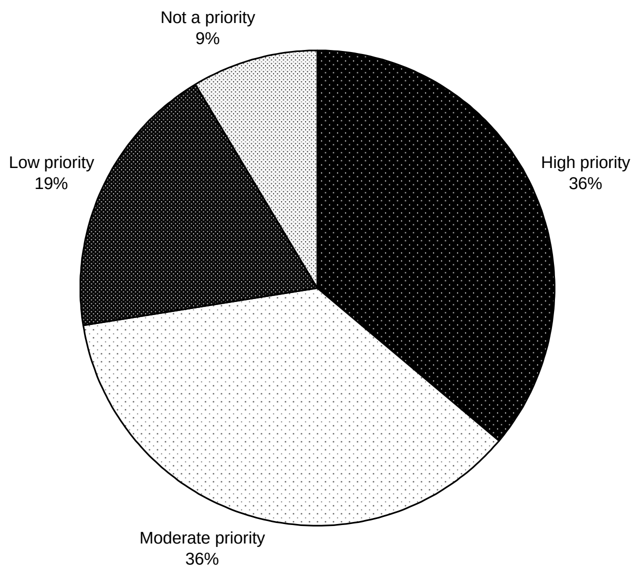
Farmland Preservation



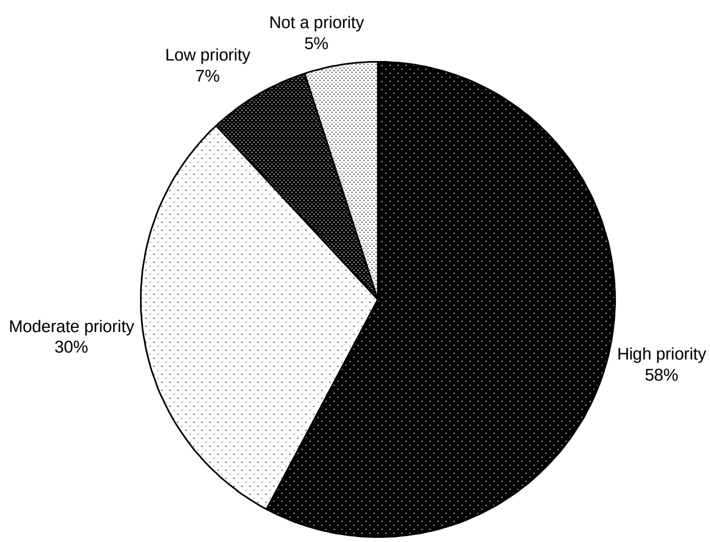
Hunting & Fishing



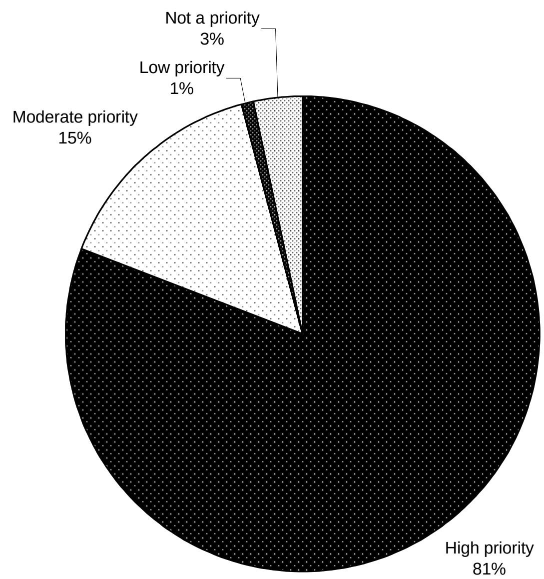
Parks & Outdoor Recreation



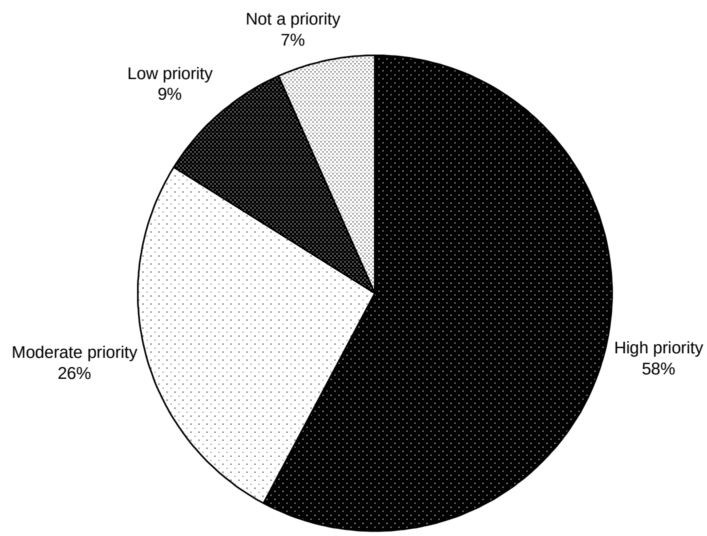
Preserving Woodlands



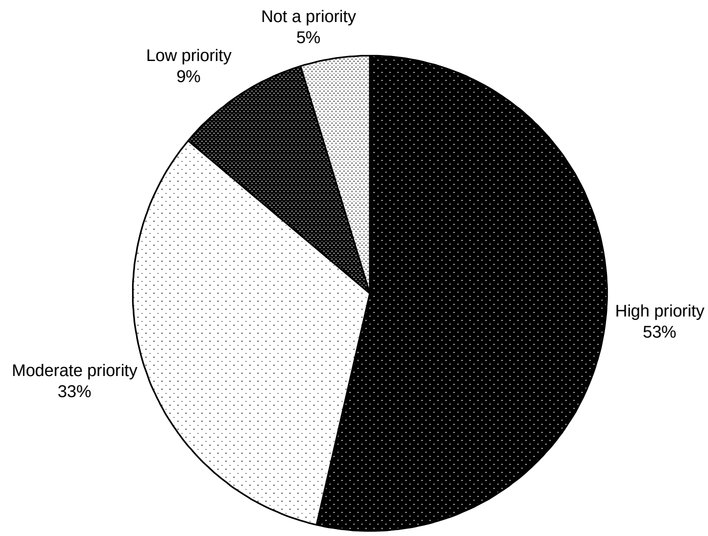
Water Quality



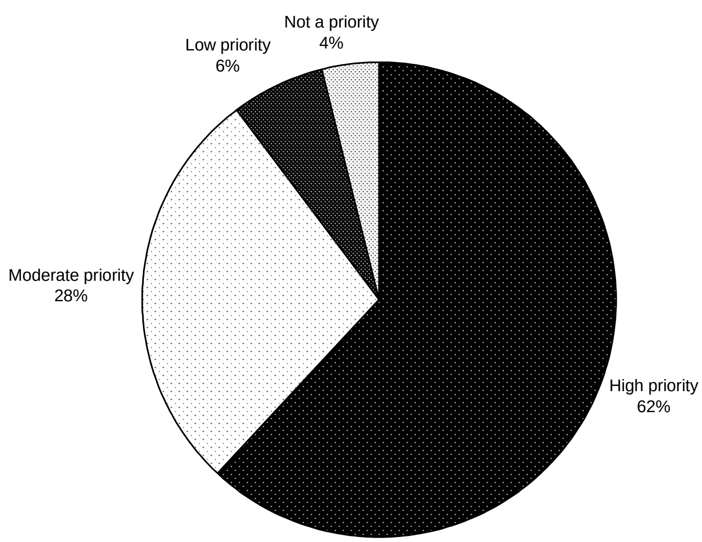
Preserving Wetlands



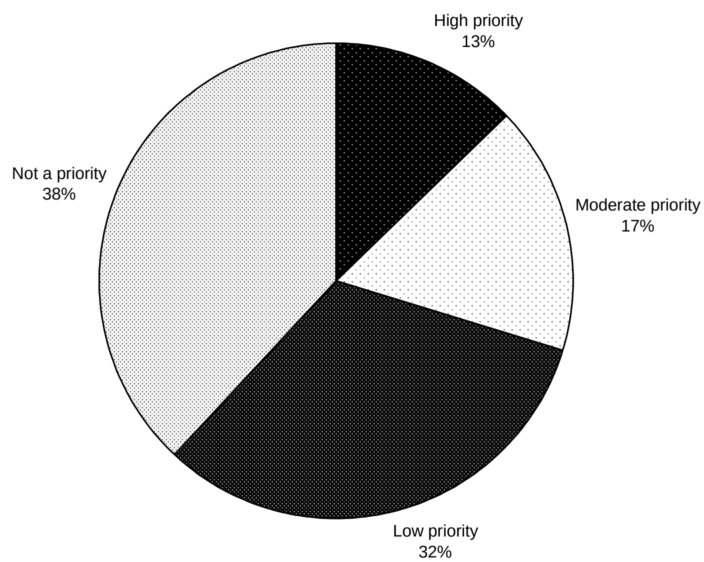
Drainage



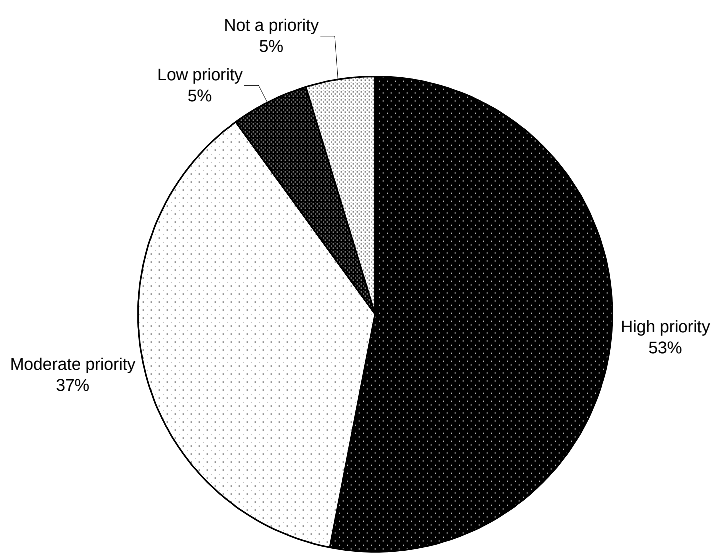
Wildlife Preservation



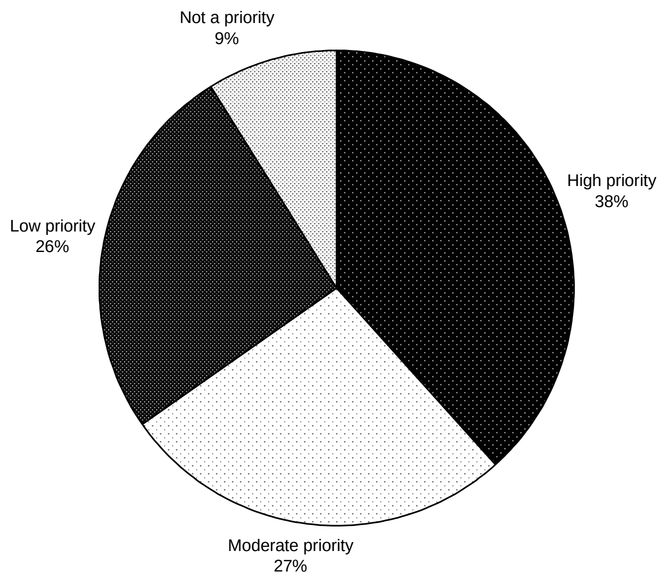
Promoting Development



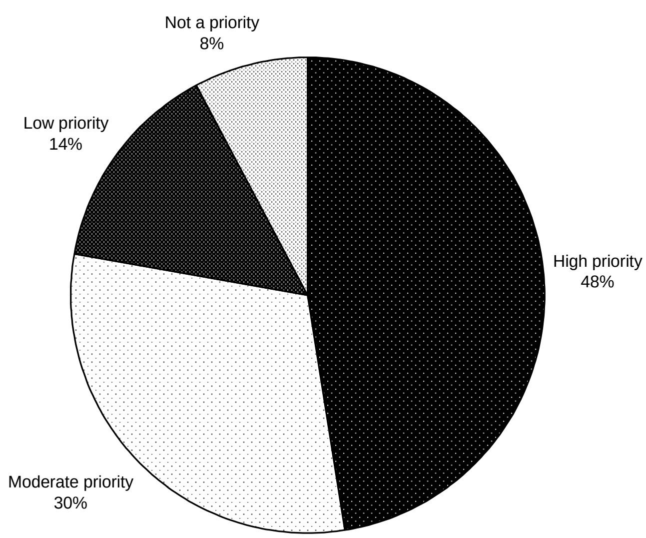
Watershed Protection



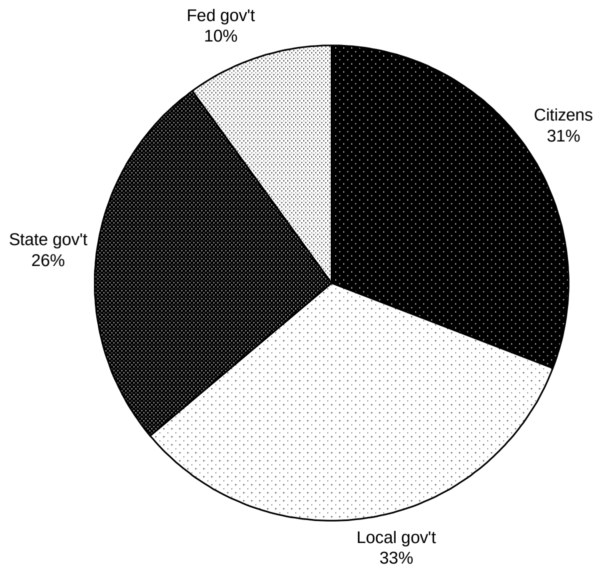
Flooding Concerns



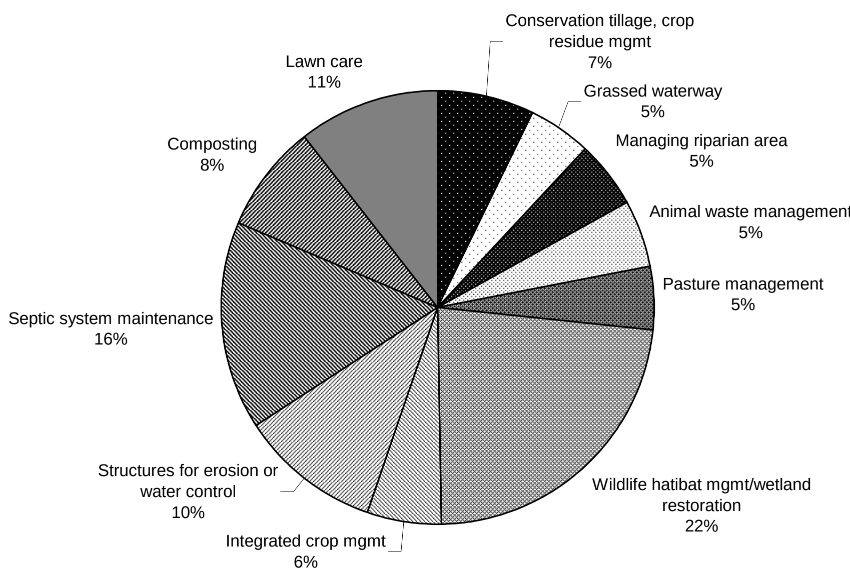
Septic Systems



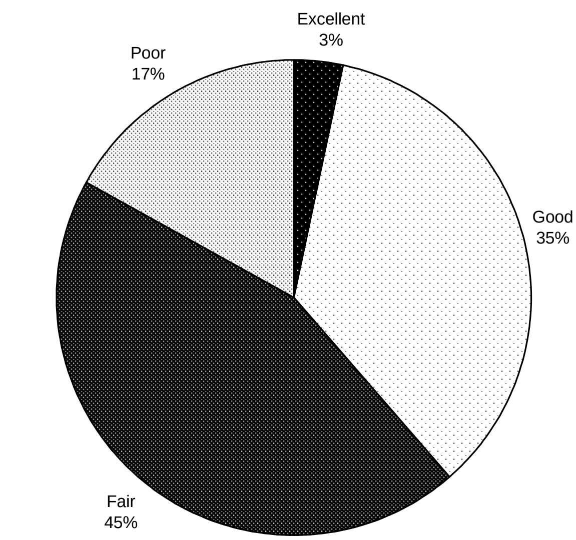
Who is responsible for protecting the Rice Creek Watershed?



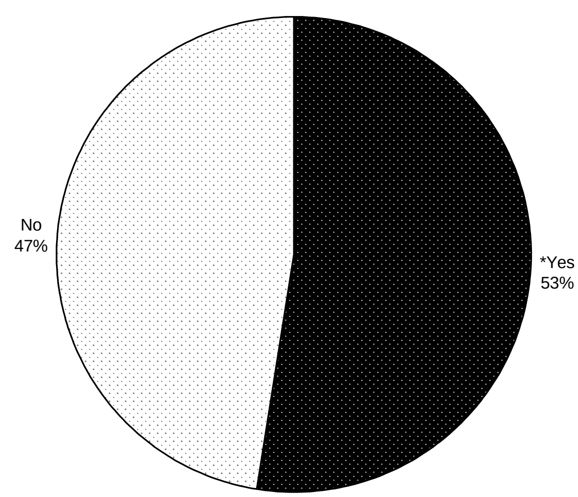
Which management practices would you like to learn more about?



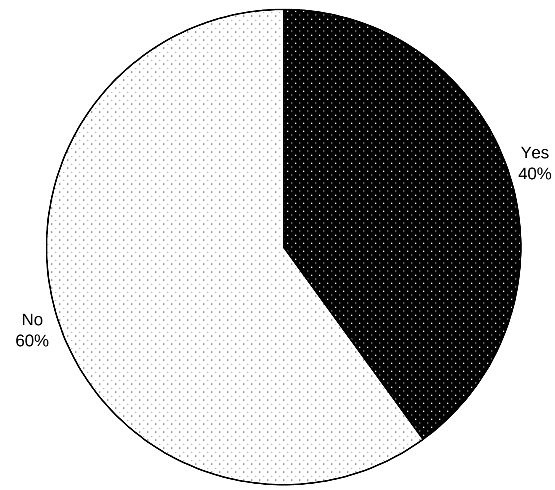
Your opinion of the overall water quality of Rice Creek



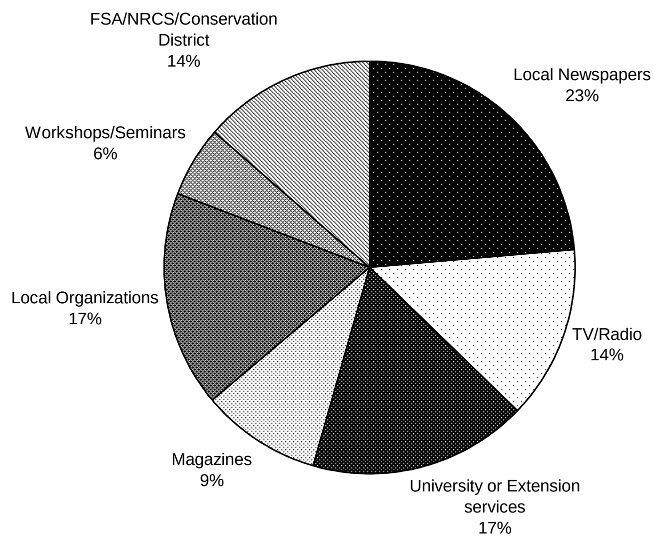
Is there a specific problem affecting the watershed that is of the greatest concern to you?



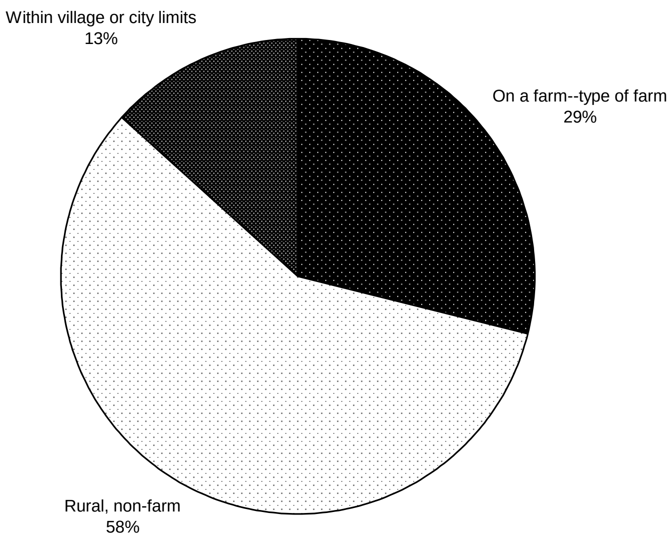
Would you volunteer your time and/or services to help this project?



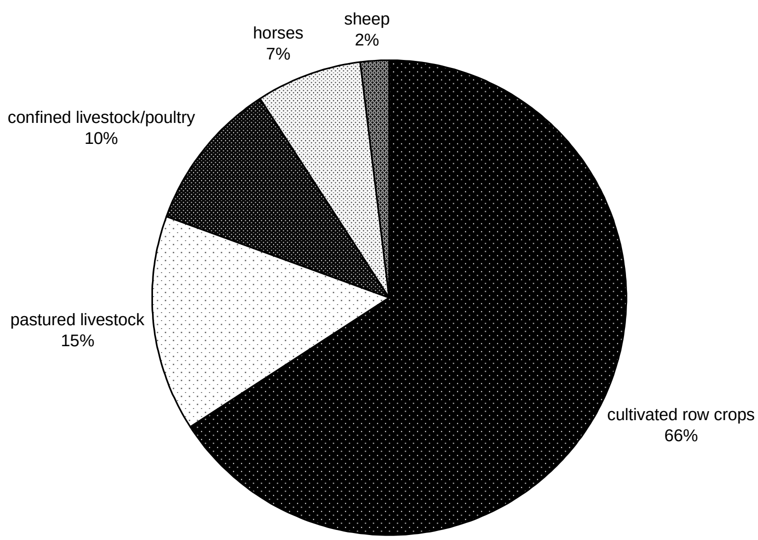
Where do you typicaly look to find reliable information about water quality and natural resource protection practices?



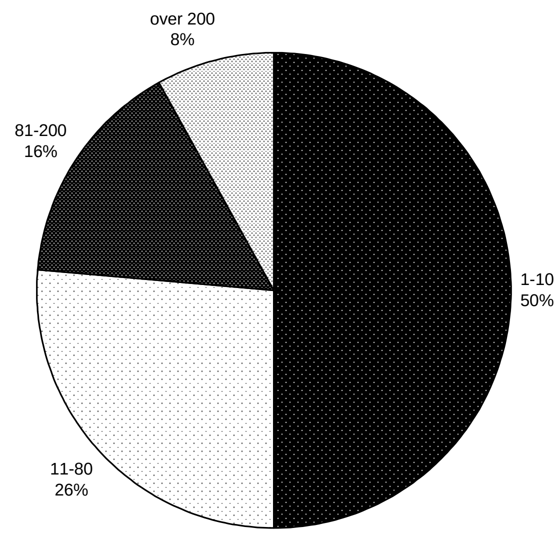
Where do you live?



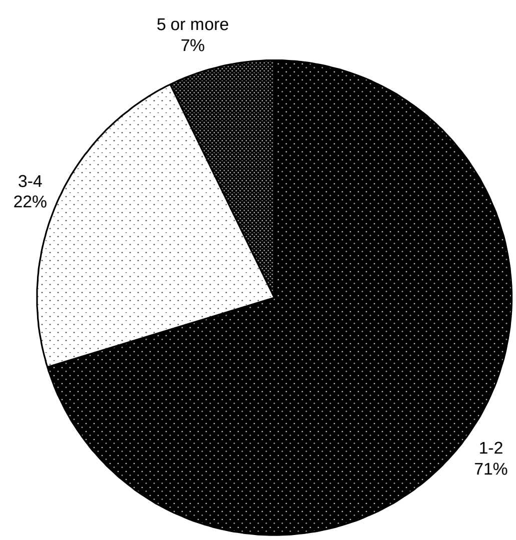
Type of Farm



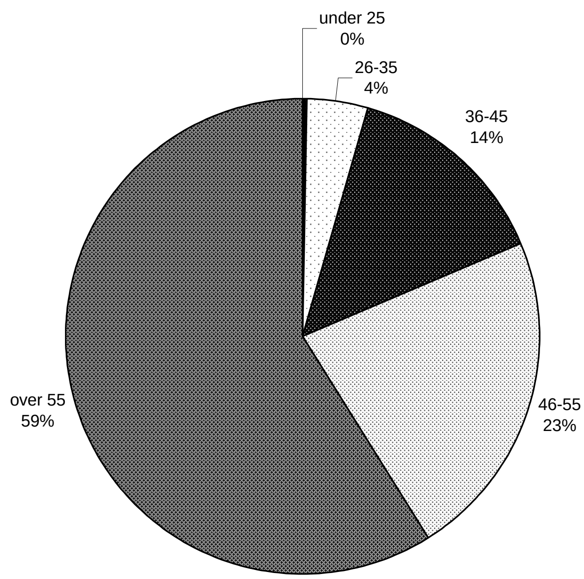
Number of Acres



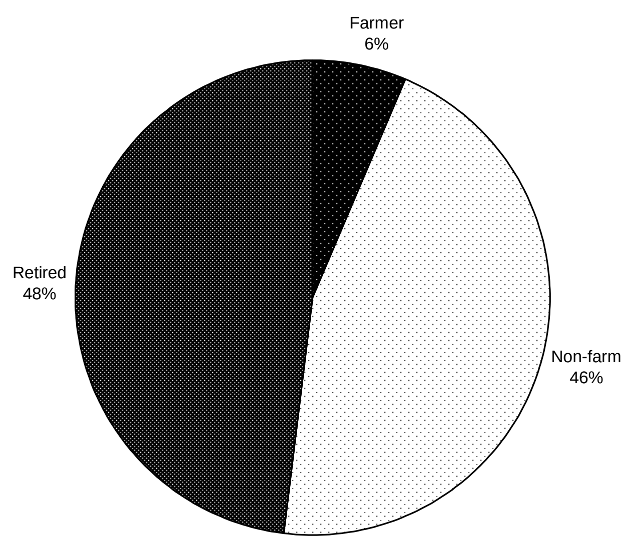
How many people live in your household?



What is your age?



What is your occupation?



Appendix B – Rice Creek Watershed Project 2 Year Work Plan

The **work plan** incorporates the task/bmp's listed in the watershed management plan into working goals and objectives and includes a budget of the associated costs included in the management plan. The physical bmp practices will be implemented in the "Water Quality Resource Management Plans" (WQRMP) developed for individual landowners. This work plan represents a 2-year short-term strategy to begin implementation of this watershed management plan.

Task 1: Water Quality Resource Management Plans (Project Coordinator -30%)

A. Develop Water Quality Resource Management Plans (WQRMP's) with landowners primarily in critical areas. The plans will contain a system of best management practices and cost of practices to be used, schedule of implementation, funding source, site plan, maintenance schedule, standards & specifications, and engineering designs if required. Plan will include forestry/wildlife management planning in stream and tributary corridors when applicable.

Product: 15 plans developed

B. Implement WQRMP's utilizing 319 funds in addition to other programs such as the Environmental Quality Incentives Program (EQIP), Conservation Reserve Program (CRP), Wildlife Habitat Incentives Program (WHIP), Groundwater Stewardship Program (GSP), Wetland Reserve Program (WRP) and any other programs available to the landowner.

Product: 15 plans implemented

Task 2: Land Use Planning (Rice Creek Steering Team - 20%)

A. Conduct long-range planning with townships to protect natural resources. Assist two townships in conducting and implementing a natural resources inventory to be incorporated into their Master Plans and Zoning Ordinances. The inventory will identify key natural resources such as prime farmland, wetlands, vulnerable groundwater areas, floodplain protection areas, etc. that are in need of protection. These inventories will then be used as a model for other townships in Jackson and Calhoun County to follow. The inventories will be completed in partnership with the County Planning Department.

Product: Conduct 2 natural resource inventories

B. Provide instructional workshops to assist township officials with implementation of natural resource inventory data into their plans and ordinances. The workshops will be held for all townships in the watershed once the individual inventories are completed. This will promote the benefits of natural resource inventories being included in land use planning. And will encourage additional townships to consider their natural resource in the planning process.

Product: Conduct 6 workshops

C. Assist all townships in working across political boundaries to direct growth and development to limited areas. Make efforts to expand their knowledge and provide tools for more effective land use planning that can be implemented at the local level.
Provide information through conferences, workshops, and meetings regarding current ordinances and issues related to the impacts of growth pressure and other land uses on water quality, and how other communities are dealing with these topics.

D. Develop and hold a workshop for contractors emphasizing alternative approaches to reduce pollutant loading into lakes and streams (i.e., controlling storm-water runoff and erosion).

Product: 1 workshop

E. Conduct a "Residential Low Impact Development" workshop. Show the potential benefits of high density development, presented by successful "low impact" developers in Michigan. Also included will be the additional benefits that can be achieved by creating a highly desired "high density" community. Realtors, developers, builders, consultants, township planners and officials, village officials, and city officials will all be invited to attend.

Product: 1 workshop

F. Designate and promote a Rice Creek Corridor Preservation Plan (¼ mile wide along floodplain) with townships, promoting protection of wildlife, wetlands, water quality, and conservation practices (ie. buffer strips, wetland restorations, soil testing, etc.), within the corridor.

Product: 1 plan per township in the watershed

Task 3: Public Participation/Education Activities (Project Coordinator - 30%)

A. Host Clean Sweep Program (collection of unused, banned chemicals) in the watershed in cooperation with the Michigan Groundwater Stewardship Program

Product: 2 drop-off days

B. Develop outstanding awards programs for farmers, urban residents, lake/rural residents, schools, etc.

Product: Develop and distribute 4 awards

C. Create Watershed Cooperator Signs

Product: Design, create, and place 10 signs

D. Develop and distribute newsletters to watershed stakeholders emphasizing project accomplishments, water quality education, current activities, cost-share opportunities, and other issues.

Product: 1 newsletter distributed bi-annually

E. Develop a drinking water sampling program for residents in critical areas in cooperation with the Groundwater Stewardship Program.

Product: Provide analysis for 50 households

F. Promote Farm*A*Syst, Home*A*Syst, Turf*A*Syst, and Lake*A*Syst to area residents in cooperation with the Groundwater Stewardship Program.

Product: Refer 15 farmers/15 homeowners/15 lake shore landowners/2 golf courses

G. Assist in conducting hazardous waste and tire collection days in the watershed.

Product: 2 collection days

H. Promote and establish an annual Adopt-A-Stream Program in the Marshall River walk area. Conduct a canoeing event and cookout to promote the program.

Product: 1 canoeing event/cookout

I. Give presentations at each township to provide updates about watershed activities, strengthen the partnership, and encourage participation.

Product: 8 presentations

J. Develop and implement long-term water quality stream ecology program with local schools in cooperation with Calhoun Conservation District. Also provide educational materials to students about groundwater and surface water resources.

Product: Implement 1 program at 2 area schools and 1 residents volunteer group

K. Produce and distribute t-shirts and hats to promote the watershed

Product: 75 t-shirts and 75 hats

L. Develop a Rice Creek Watershed Action Committee from local leaders of the Rice Creek Advisory Committee that attended the "watershed management short course", held in March 2003, for local leaders in Jackson and Calhoun Counties. This Committee will oversee the long-term implementation of the watershed management plan and coordinate those activities with the Calhoun Conservation District.

Product: 1 Rice Creek Watershed Action Committee developed

M. Provide Project WET (Water Education for Teachers) Workshops for local teachers in the watershed to allow teachers to continue useful water education in their classrooms.

Product: 2 workshops reaching 15-20 teachers

N. Give presentations to students in the watershed to promote the awareness, appreciation, knowledge, and stewardship of water resources through hands-on water related activities.

Product: 6 classroom presentations

O. Prepare for and conduct a watershed tour for local officials, the general public, and other target audiences. Provide a complete overview of all activities that have been implemented in the watershed.

Product: Conduct 1 tour

P. Develop a before and after slide show presentation of watershed projects.

Product: 1 presentation

Stream Ecology Program – Study of Rice Creek Water Quality - Contracted with Calhoun Conservation District

Develop a volunteer stream ecology education program for the Rice Creek watershed.

Product: Establish a stream ecology education program with two schools and one concerned citizens group, to study macroinvertebrates and macrophytes, and report their findings to the Calhoun Conservation District annually.

Historical Documentation/Public Outreach – Conducted with Albion Public Library (Project Coordinator 5%)

Develop a Rice Creek Watershed "Historical Documentation Program" using volunteers from the watershed. The volunteers will investigate all historical Rice Creek Watershed data sources from the late 1800's to present, interview watershed residents and officials, and compile all of the information discovered in a historical public file at the Albion Public Library. Rice Creek has a significant number of documented water quality related issues on record from many different sources. This program will be used to promote public participation in other areas of implementation via exploring their individual historical connection to the watershed. Product: 1 program established

Task 4: Fluvial Geomorphic Assessment (75% partnership)(20% contractual) (5% Project Coordinator)

A. Gather and analyze watershed and stream corridor data.
B. Conduct a hydrologic analysis of the watershed.
C. Conduct a field reconnaissance survey of the key areas in Rice Creek and collect geomorphic data.
D. Perform an analysis of all watershed data to determine the current state of geomorphic instability.
E. Classify each key stream reach using geomorphic data. Rosgen classification will be completed for each comprehensive survey reach.

Product: One final report and recommendations including:

~ Historic watershed data
~ Classification of key stream reaches
~ Quantify project hydrology/record flow
~ Water quality data coordination
~ Key stream areas reconnaissance survey
~ Comprehensive reach survey
~ Geomorphic data analysis
~ Prioritize areas for treatment
~ Identify watershed issues/BMP's
~best site for demonstration project(s)

F. Seek funding to implement identified BMP's. (ie. stream habitat improvement, reconnection of Rice Creek to floodplain, etc.) using what has been learned to direct planning and implementation efforts.

Task 5: Conservation Resource Management (CRM) - Contracted

A. Jim Bruce (Forester/Wildlife Biologist) will meet with landowners, walk through their property and discuss their goals/objectives for managing the forestland.

Product: Meet with 12 landowners per year (24 total)

B. Develop forested stream corridor stewardship plans for landowners. The plans will take into consideration the health of the forest ecosystem as well as the overall impact to the Rice Creek Watershed and water quality.

Plans may include tree planting, deer herd reduction, buffer strip establishment, timber stand improvement techniques, erosion control management, and other forestry best management practices.

Product: Develop 12 plans per year (24 total)

Task 6: Training and Meetings
(Calhoun Conservation District/Project Coordinator - 10%)

A. Conduct and participate in Advisory Committee and Action Committee Meetings

Product: 10 meetings/yr.

B. Attend workshops, meetings, and on-the-job training as necessary

Product: 6 workshops, meetings held, and training as applicable

2 year Work Plan Budget

Budget Categories	Grant Funds	Local Match	Total
Staffing Cost:			
Project Coordinator	$ 60,320.00		$ 60,320.00
(4160 hrs @$14.50/hr)			
Clerical	$ 10,800.00	$3,500.00	$ 14,300.00
(800 hrs @ $13.50/hr)			
Conservation District Assistance		$ 2,700.00	$ 2,700.00
Subtotal	$ 71,120.00	$6,200.00	$ 77,320.00
Fringe Benefits:			
Project Coordinator	$ 15,080.00		$ 15,080.00
(25% of salary)			
Clerical (15% of salary)	$ 1,620.00		$ 1,620.00
Subtotal	$ 16,700.00	$ -	$ 16,700.00
Supplies & Equipment:			
Project Supplies & Materials	$ 2,000.00		$ 2,000.00
Office Supplies		$ 2,000.00	$ 2,000.00
Computer Software & Use		$ 6,000.00	$ 6,000.00
Subtotal	$ 2,000.00	$ 8,000.00	$ 10,000.00
Travel:			
13,500 Miles @ .32/mile	$ 4,320.00		$ 4,320.00
Subtotal	$ 4,320.00	$ -	$ 4,320.00
Other Direct Expenses:			
Land Use Planning			
Natural Resource Inventories (2)	$ 5,000.00	$ 2,000.00	$ 7,000.00
Inventory Implementation Workshops (6)	$ 2,200.00	$ 1,000.00	$ 3,200.00
Pollutant Reduction Workshop	$ 1,500.00	$ 500.00	$ 2,000.00
Low Impact Development Workshop	$ 2,500.00	$ 1,000.00	$ 3,500.00
Land Use Planning Subtotal	$ 11,200.00	$ 4,500.00	$ 15,700.00
Public Participation/Education Activities			
Newsletters, promotional items, awards, collection days,			
fact sheets, tour, Adopt-A-Stream, other	$ 17,405.00	$ 3,000.00	$ 12,405.00
Project WET Workshop	$ 750.00	$ 250.00	$ 1,000.00
Historical Documentation Program	$ 1,500.00	$ 500.00	$ 2,000.00
Water quality monitoring program (2 schools)	$ 1,750.00	$ 250.00	$ 2,000.00
Groundwater Stewardardship Program (assessments)		$ 1,800.00	$ 1,800.00
Public Participation Subtotal	$ 21,405.00	$ 5,800.00	$ 19,205.00
Other Direct Subtotal	$ 32,605.00	$10,300.00	$ 34,905.00

2 year Work Plan Budget (con't)

Indirect Costs: (Rate= 15% of salary, fringes)				
Includes office space, phones, etc.		$ 13,173.00		$ 13,173.00
Indirect Subtotal		$ 13,173.00	$ -	$ 13,173.00
BMP Costs:				
Subtotal		$121,282.00	$16,198.70	$137,480.70
Contractual:	Forest Mgmt. Plans	$2,400.00		
Albion Public Library		$ 2,300.00	$ -	$ 2,300.00
Fluvial Geomorphic Assessment		$20,000.00		$100,000.00
Subtotal		$24,700.00	$ -	$102,300.00
TOTAL		$295,900.00	$40,698.70	$396,198.70

Appendix C - Description of Best Management Practices

Definitions

Agrichemical Containment Facility

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

Automatic Shut-off Gas Dispensing Unit

A gas dispensing handle that automatically shuts off when fuel enters the nozzle.

Conservation Cover

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 Sequence

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

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

Diversion

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 disposed 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

Restricts access to surface water, resulting in streambank protection; reduction of organic matter, fecal coliform and nutrient loadings; and prevents shallowing and widening of streams to keep water cooler.

Filter or Buffer Strip

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 Improvement
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.

Floodplain Restoration
The process of conducting the proper survey analysis and hydrologic evaluation of a stream system and then based on the survey analysis reconnecting the stream system to the corridor floodplain and wetlands.

Fluvial Geomorphic Assessment
The study of the form and structure of the surface of the earth as affected by the flow of water.

Forestry/Wildlife Habitat Enhancement
The planning and implementation of practices specifically designed for the purpose of improving forest management and/or wildlife habitat.

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

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

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

In-field Mix/Load System
Usually running gear with a water tank, pump, motor, and transfer hose used for transporting water to the field, so that the mixing and loading of pesticides and fertilizers can occur away from the wellhead. Reducing the risk of groundwater and/or surface water contamination.

Irrigation Water Management
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.

Lawn Maintenance
The proper nutrient and pesticide management practices and lawn clipping disposal pactices to reduce and/or eliminate pollutants from entering surface waters.

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

Nutrient Management
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
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/Pesticide Management
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. Implementation of pesticide management practices to promote the proper use and storage of pesticides. This protects both groundwater and surface water from excess pesticides.

Residue Management (Mulch-till)
Growing crops where field is tilled prior to planting, leaving some residue. This practice will help 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)
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
A created stabilized area for collecting, controlling and disposing of runoff water from roofs and excessive overland flows. The goal is to prevent runoff water from flowing across concentrated waste areas and barnyards or reduce erosion and improve water quality.

Sediment Basin

A barrier is constructed to form 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.

Soil Testing

Analysis of soils to determine the amount of nutrient content present, to determine the balance of nutrients needed for a specific purpose.

Stabilized Outlets

Geo-textile fabric and rock used to dissipate energy at the outlet of a created concentrated flow.

Storm Water Conveyance Channel

A stabilized channel created for the purpose of transporting storm water run-off. Usually down an otherwise erosive slope.

Storm Water Management Ordinance

Established rules for managing the difference between the pre-development and the post-development storm water run-off created on a parcel of land.

Stream bank Protection

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

Stream Channel Improvement

Stabilization and enhancement practices that occur in the stream channel, guided by proper hydrologic and stream survey analysis.

Tile Surface Inlet Filter Areas

Areas of vegetation, usually perennial grasses or legumes, around a surface inlet to aid in the removal of sediment, organic matter and other pollutants.

Tree/Shrub Establishment

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

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.

Updated Township Master Plans

The process of evaluating the build-out analysis of the current zoning master plan, determining needed changes to fit the current and future desires of the Township, and rewriting the master plan to meet the new changes.

Use Exclusion

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

Waste Storage Facility

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.

Well

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

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

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

Appendix D - Acronyms

BMP	Best Management Practice
CCD	Calhoun Conservation District
CCCD	Calhoun County Community Development
CFS	Cubic Feet/Second
CRM	Conservation Resource Management
GLEAS # 51	Great Lakes Environmental Assessment Section Survey Protocols for Wadable Rivers
GSP	Groundwater Stewardship Program
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MSU-E	Michigan State University-Extension
NPS	Non-point Source Pollution
NRCS	Natural Resources Conservation Service
Potawatomi RC&D /	Potowatomi Resource Conservation and Development
RC&D	Resource Conservation & Development
RMS	Resource Management System
USDA	United States Department of Agriculture
USLE	Universal Soil Loss Equation
WHPP	Wellhead Protection Plan
WQRMP	Water Quality Resource Management Plan