Rocky River Watershed Management Plan

Cover Photo. Old Grass Bridge near Cowling Road

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St. Joseph County Road Commission
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Van Buren County Conservation District
Van Buren County Road Commission
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Introduction

In recent years, our nation's water resources have been receiving an increased amount of attention. Michigan has an abundance of water, but its quality shouldn't be taken for granted. Almost every activity on land has the potential to affect water quality of the community. Rain, melting snow and wind can carry pollutants from higher elevations into the water. The rationale for watershed management is that if we properly manage activities on the land that drains to bodies of water, we will protect and improve the water resources of the state.

Watershed management is the process of addressing water related issues upon all land that drains to a common body of water. Since water doesn't recognize political boundaries, this requires working across county, township, and other jurisdictional borders. Watershed management brings federal, state, local agencies, interested organizations, and citizens together for the good of our lakes and streams. People living within the watershed have the opportunity to work together for solutions to water quality problems.

The Rocky River Watershed Management Plan attempts to design a course of action to work cooperatively toward an environmentally and economically healthy watershed that benefits all stakeholders. The plan will identify pollutants and their sources, select, prioritize, and map the significant non-point source pollutants, and identify Best Management Practices (BMPs) to reduce these pollutants. The management plan was developed from the knowledge and expertise of the watershed stakeholders. An in depth description of this process is included in the Public Participation section of the Rocky River Watershed Plan.

Background

Location

The Rocky River Watershed is located in the southwestern corner of Michigan's Lower Peninsula and is a sub-watershed of the St. Joseph River Basin. The Watershed includes all the land that drains into the Rocky River (Fig.1). Its headwaters begin from wetlands in northern Cass County just southwest of the Village of Marcellus. The Rocky River flows east, parallel to M-216, and then continues south, parallel to US-131, to its confluence with the St. Joseph River in St. Joseph County, at the center of the City of Three Rivers. The Rocky River watershed also encompasses five significant tributaries (Sheldon Creek, Four County Drain, Flowerfield Creek, Spring Creek, and Kerr Creek) and several lakes.

The Rocky River Watershed has a total area of about 112,144 acres or 175 square miles. This includes four counties (Cass, St. Joseph, Van Buren, and Kalamazoo) and twelve townships (Texas, Porter, Prairie Ronde, Schoolcraft, Volinia, Marcellus, Flowerfield, Park, Penn, Newberg, Fabius, and Lockport).

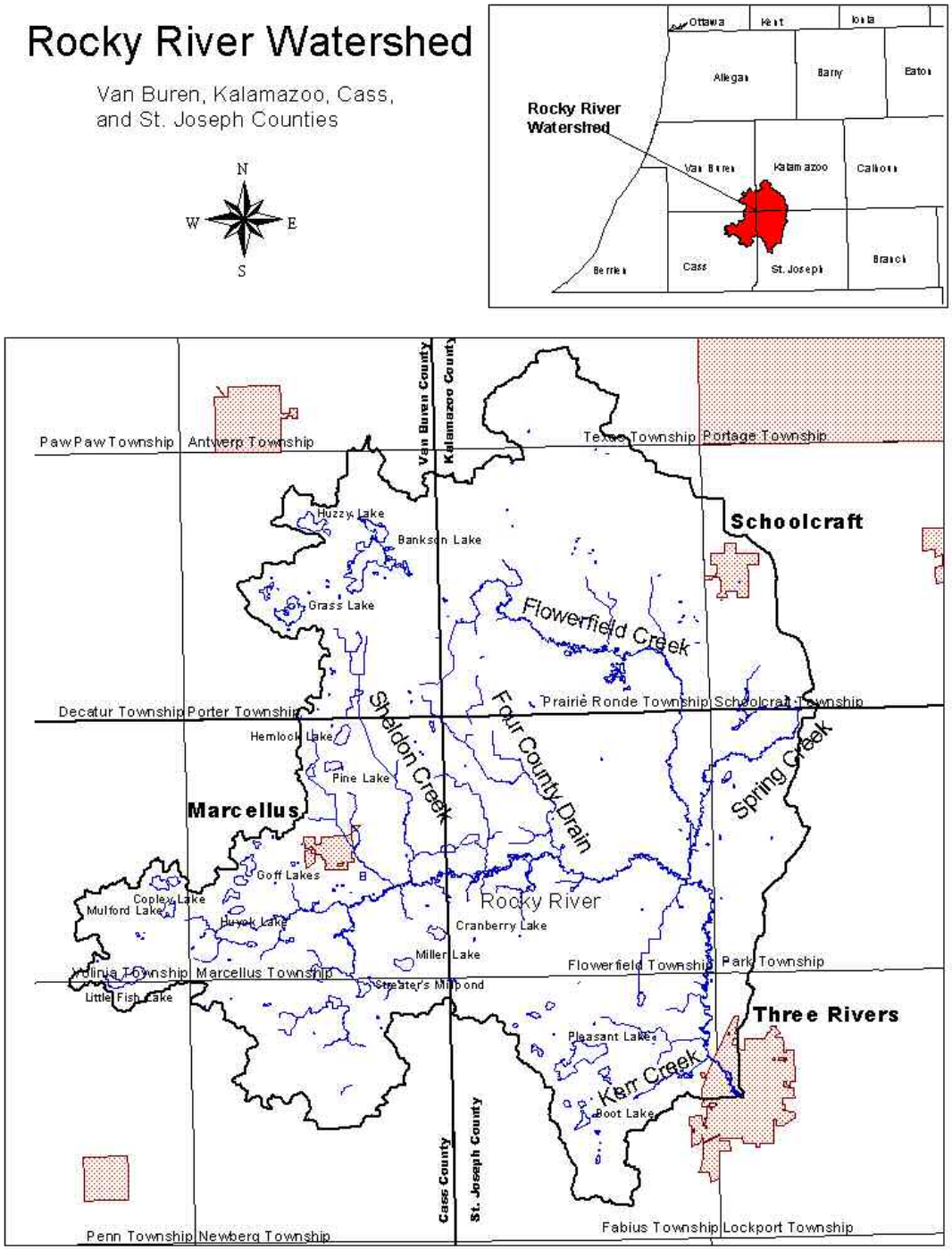


Figure 1. Map of the Rocky River Watershed. This map shows watershed boundaries, surface water, municipalities, townships, and counties. Watershed boundary courtesy of the Natural Resources Conservation Service, Michigan.

Rainfall Characteristics

Wind

The lake effect on the Rocky River Watershed's climate is significant throughout much of the year even though much of it is east of the "Lake Snow Belt". The prevailing westerly winds, in combination with Lake Michigan to the west, produce this lake effect. The lake effect increases cloudiness and snowfall during the fall and winter, and moderates the temperature throughout most of the year. Northeasterly to southerly winds may produce clearing skies with the associated colder temperatures more common to areas further removed from the lake influence. Diminished wind speeds or winds that do not traverse large unfrozen lakes often produce clearing skies and the colder temperatures expected at continental locations.

Humidity

Because the movement of pressure systems controls the day to day weather across the nation this area seldom experiences prolonged periods of hot, humid weather in the summer or extreme cold during the winter. Long term wind and humidity records are not available for this location, but these data should be similar to the following values which were observed at the National Weather Service Office in South Bend, Indiana. South Bend, Indiana is approximately 50 miles southwest of Three Rivers, Michigan. The prevailing wind is south-southwesterly, averaging 10 mph. The strongest one minute wind speed, 63 mph, was recorded in August 1953. The average relative humidity at 1:00 p.m. varies from 55% for May to 76% for December, and averages 63% annually.

Temperature

The following climate information was obtained from the Three Rivers, Michigan weather station. Moderately warm temperatures with a 1951-80 average of 15 days exceeding the 90 degree Fahrenheit mark dominate summers. During the same period, 5 days in two different years were 100 degrees Fahrenheit or higher. The lake influence was reflected in the minimum temperature; an average of 143 days was 32 degrees Fahrenheit or lower, an average of 8 days were 0 degrees Fahrenheit or lower, and only 2 years stayed above 0 degrees Fahrenheit. The highest average monthly maximum temperature of 89.4 degrees Fahrenheit was recorded July 1955, and the lowest average monthly minimum temperature of 2.0 degrees Fahrenheit was recorded February 1978. The following temperature extremes, based on the time period of this station's published record are: maximum, 107 degrees Fahrenheit, recorded July 14, 1936 and earlier dates; minimum, -22 degrees Fahrenheit, recorded February 12, 1899; warmest monthly mean, 77.1 degrees Fahrenheit, recorded July 1955; and coldest monthly mean, 11.4 degrees Fahrenheit, recorded January 1977 (National Weather Service, 2003).

Freezing

Based on the 1951-80 period, the average date of the last freezing temperature in the spring was May 7, while the average date of the first freezing temperature in the fall was October 1. The freeze free period, or growing season, averages 146 days annually.

Precipitation

Precipitation was well distributed throughout the year with the crop season, April-September, receiving an average of 20.39 inches or 61% of the average annual total for the 1951-1980 period. During this same time the average wettest month was June with 3.95 inches, while the average driest month was February with 1.49 inches. Temperature and precipitation averages for the City of Three Rivers were also recorded from 1971-2000 (Table 1). These averages were similar to the 1951-1980 timeframe.

Table 1. Temperature and precipitation averages for Three Rivers, Michigan. Information recorded between 1971 and 2000.

THREE RIVERS MI	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Precipitation (Inches)	2.0	1.6	2.6	3.3	3.7	3.7	4.0	3.8	3.7	3.0	3.0	2.6	37.0
Max Temp ^{o}F	30	34	45	58	70	80	83	81	74	62	47	35	58
Min Temp ^{o}F	13	15	24	34	45	55	59	57	49	37	29	19	36
Average Temp ^{o}F	22	25	35	46	45	67	71	69	61	50	38.	27	47

Summer precipitation comes mainly in the form of afternoon showers and thunder showers. Annually, thunderstorms will occur on an average of 36 days. Michigan is located on the northeast fringe of the Midwest tornado belt. The lower frequency of tornados occurring in Michigan may be, in part, the result of the colder water of Lake Michigan during the spring and early summer months, a prime period of tornado activity. During 1950-87, Michigan has averaged 15 tornados each year.

Snowfall

The 1950-80 average seasonal snowfall was 45.9 inches. During this period, 59 days per season averaged 1 inch or more of snow on the ground, but varied greatly from season to season.

Evapotranspiration

Irrigation scheduling using climatic data requires the use of evapotranspiration data. There are two types of pans that are commonly used to gather this information. The Class “A” Pan is the standard used by research stations and climate stations where a standard method of measurement is essential (British Columbia Ministry of Agriculture, Food and Fisheries, 2001). Evaporation data from the Class “A” pan were not available for this station, but these data should be similar to those observed at South Haven, Michigan (National Weather Service, 2003). During 1952-80, the pan evaporation for April through October exceeded the average precipitation by 58%. Therefore, soil moisture replenishment during the fall and winter months plays an important role in the success of agriculture for this area. While drought occurs periodically, the Palmer Drought Index indicated drought conditions reached extreme severity only 1% of the time.

Geology and Soils

The dominant landforms of the watershed are of glacial origin. Rolling Moraines cover most of the northern part of Fabius Township and the central part of Flowerfield Township. In the morainic areas that have been cleared for farming, cobbles and stones of assorted sizes are common. In most of the watershed, broad, nearly level to undulating outwash plains are the dominant landform. The plains are the result of the deposits left by glacial melt waters in front of the ice (Soil Conservation Service, 1983).

There are numerous small ponds and bogs throughout the watershed, especially on the moraines and till plains where depressions were left by irregular glacial melt. There are many lakes along the rivers and streams on the outwash plains or concentrated on the moraines and till plains (Fig. 2) (Soil Conservation Service, 1991).

Six main series of soils types dominate throughout the watershed: Coloma-Spinks-Oshtemo, Houghton-Carlisle-Adrian, Oshtemo-Kalamazoo-Houghton, Riddles-Hillsdale-Gilford, Schoolcraft-Kalamazoo-Elston, and Sebewa-Cohoctah-Brady (Table 2).

Table 2. Soil series and description in the Rocky River Watershed.

Coloma-Spinks-Oshtemo	Nearly level to rolling, somewhat excessively drained or well drained that have sandy subsoil or a loamy and sandy subsoil; formed in glacial outwash and sandy moraine deposits.
Houghton-Carlisle-Adrian	Nearly level, very poorly drained soil in broad, flat areas and in depressions and drainage ways. It is ponded frequently and for long periods. Short steep slopes and escarpments are adjacent to uplands.
Oshtemo-Kalamazoo-Houghton	Nearly level to hilly, well drained, loamy soils; on outwash plains and moraines.
Riddles-Hillsdale-Gilford	Undulating to rolling, well drained loamy soils; on till plains and moraines.
Schoolcraft-Kalamazoo-Elston	Nearly level to rolling, well drained soils that have loamy or loamy and sandy subsoil; formed in glacial outwash.
Sebewa-Cohoctah-Grady	Nearly level, very poorly drained and poorly drained loamy soils; on outwash plains and flood plains.

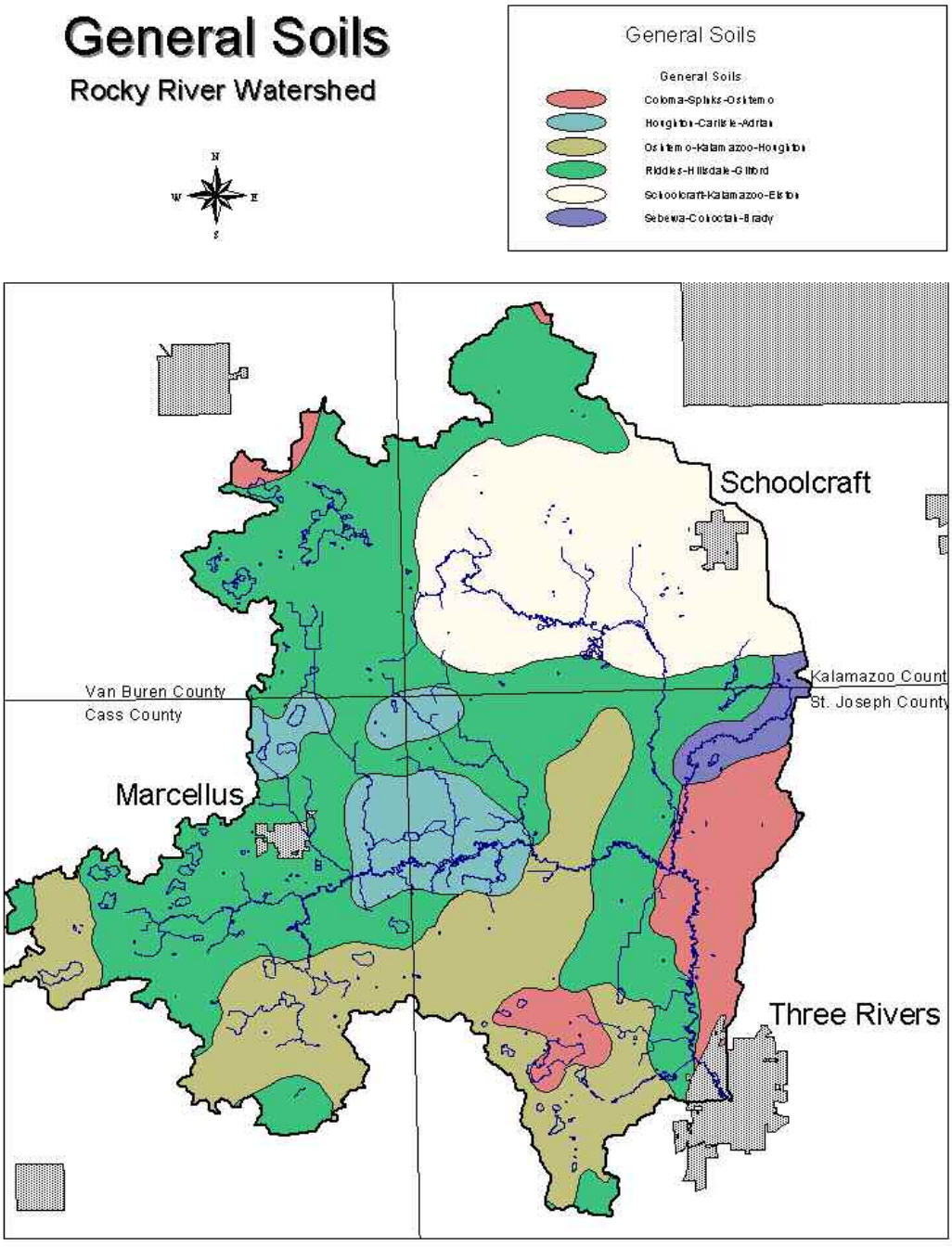


Figure 2. Map of general soil classifications for the Rocky River Watershed. Courtesy Natural Resources Conservation Service

According to the Memory Isle Siltation Evaluation prepared for the City of Three Rivers in 1990, the expected annual long term rate of siltation delivered by the Rocky River to the Memory Isle Park area was determined to be 1,800 cubic yards per year (Wade-Trim/Associates, 1990). This can be compared to approximately 180 loaded dump trucks of sediment being deposited into the Memory Park area. In 1987 the City of Three Rivers removed 65,000 cubic yards of sediment from the Memory Isle Pond Sediment Basin. By 1995 Joan Duffy of the Michigan Department of Natural Resources and Merritt Brown, City Engineer for the City of Three Rivers, determined that the sediment basin was again full. This suggested a rate closer to 8125 cubic yards/year. The sediment basin had been sized so that it could be cleaned every three years. The Wade –Trim study was conducted in response to the accelerated filling of the sediment basin and the 60,000 cubic yard pond area. The Natural Resources Conservation Service has estimated sediment channel delivery rates to be between 50 and 200 tons per square mile per year for the entire St. Joseph River Watershed. The Memory Isle siltation basin is experiencing a delivery rate of approximately 50 tons per square mile per year. Total erosion within the Rocky River watershed averages 7 tons per acre per year, or 4 cubic yards per acre per year. A portion of the watershed contains rolling land with slopes in the 8 to 14 percent range. Potential erosion rates on these lands approach 30 tons per acre per year. Based on visual observations of nonpoint source pollution sources upstream and on baseline water quality monitoring (described later in detail) additional monitoring within the City limits is necessary to better determine that actual sediment delivery to the system.

Historical

Water power was the motivating factor behind the interest in the settlement of the Three Rivers during its early days. The Rocky River drew much attention for mill locations and navigation. The Rocky was used for transportation of grain before the dams were built and service was provided by the railroads (Table 3).

Table 3. Years when bridges were built on the Rocky River. Bridges built in or near Three Rivers, Michigan prior to 1920.

Year Built	Location
1904	Mill Street across the Rocky
1912	West Michigan across the Rocky

Research suggests that the Rocky River was originally named Stoney Creek. At one time the river's rushing waters surged around huge boulders in the main stream and smaller stones dotted the river banks. Those boulders were removed for use in building construction on such landmarks as the Carnegie Center for the Arts in Downtown Three Rivers (see Fig. 3).

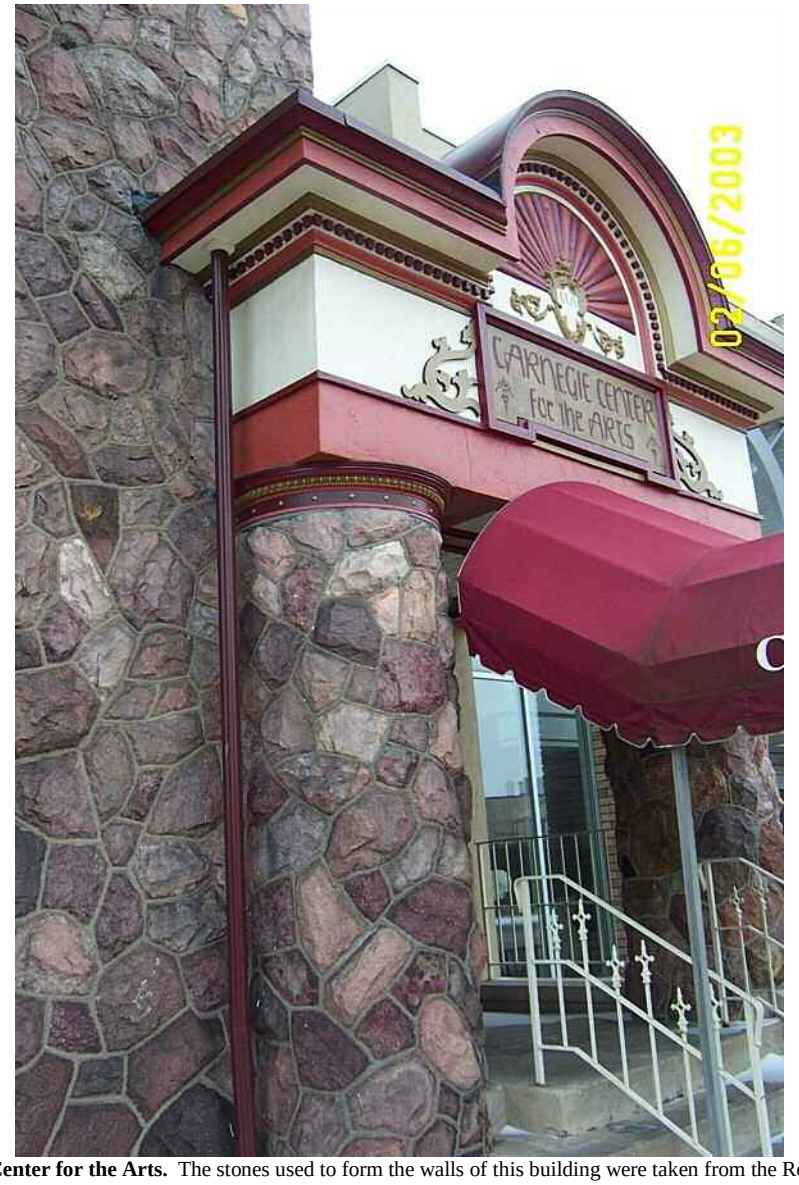


Figure 3. Carnegie Center for the Arts. The stones used to form the walls of this building were taken from the Rocky River.

Many mills were built along the river from its headwaters to its confluence with the St. Joseph River. In 1830, the first mill was started on the west side of the Rocky just north of West Michigan Avenue. A larger mill was built in 1836 on the east side. In the 1870's, it was said that this mill had a capacity of 500 barrels daily and a capacity of 250 horse power. Its product in 1876 was 40,000 barrels of flour. It burned in 1904 and was never rebuilt.

After this fire, a small power plant was built on the site in 1909. This later became known as the City Water Works and Electric Light Plant. In 1915, the plant was torn down to make room for the City Power Plant which was built in 1916. The plant closed following the dam collapse of 1948 (Werkosan, 1989).

The taming of the river for public use was no easy task. The Rocky has flooded many times throughout the years. One observer of such a flood, W. H. Clute, editor, wrote a graphic description for the News Reporter of 1866 (Silliman, 1931). The following is an excerpt of what Mr. Clute wrote.

> "One of the most drenching rains commenced the middle of last week and continued steadily to fall upon the unprecedented body of snow which in a furious gale has fallen a few days before, rendering travel impossible."
> "On Sunday the Rocky River, whose source is among the bluffs and knobs in the region of sawmills west of here, rushed madly down to its confluence with the St. Joseph River. To save the mills along the shores, several dams were allowed to be cut out by the ice floes and rushing water."
> "All day Sunday the St. Joseph in a silent majesty, lay ice bound as though it would never unbend to a popular excitement, but a busy scene was going on at the mouth of the Rocky. The stream 'took the railroad' and cut for itself a new bed, turning three rivers into four. Freight cars tilting at all angles were sunk three and four feet below the grade. Stumps, straw, stone, trees, and sand were used in making a dam to the high bank across the track. Without stopping to eat, the shovelers and teamsters worked without ceasing until the careening waters of the turbulent Rocky were turned back to their original course."

During the same flood, the school board paid to have the students ferried to school, and the telegraph operator at the Michigan Central had to hire a boat to get to his hotel room. The Portage, Rocky and St. Joseph Rivers have had many floods through the years (Three Rivers: The Early Years, 1986).

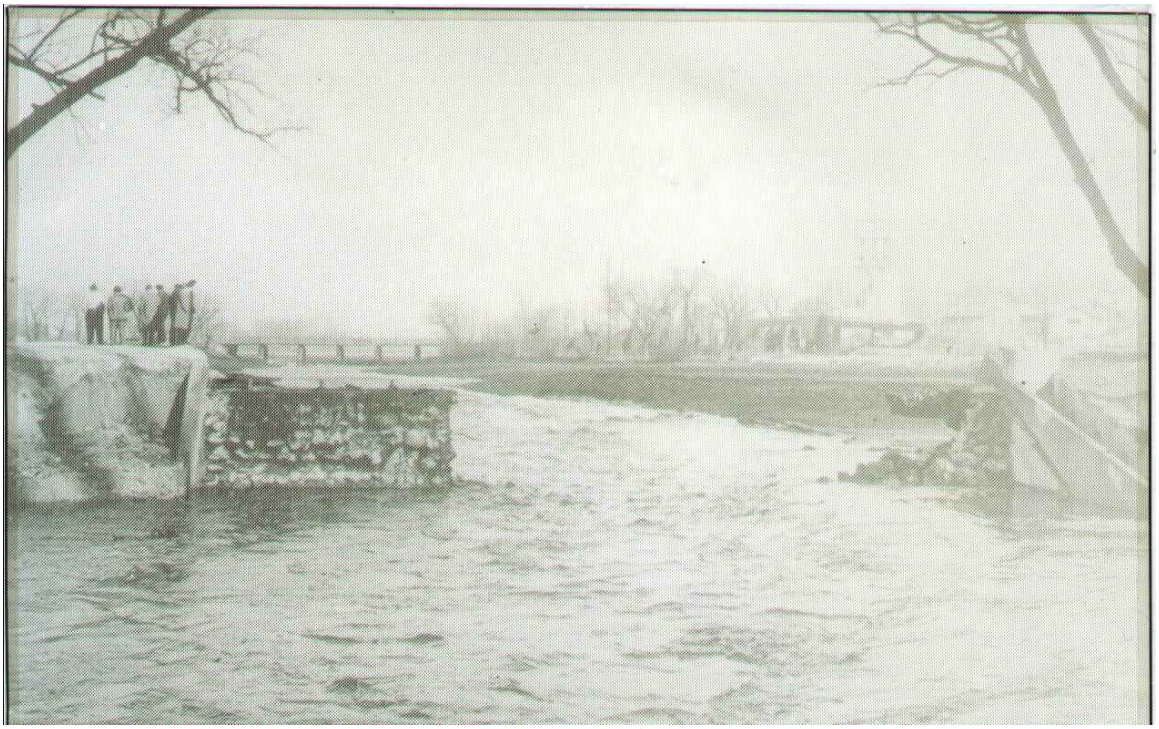


Figure 4. Dam break on the Rocky River. Citizens survey the break of the Municipal Power Dam and the Rocky River on March 23, 1948 in Three Rivers, Michigan. Photograph courtesy Three Rivers Commercial News.

On March 23, 1948, following two days of heavy rains, the approximately 60 year old Municipal Power Dam, which impounded water from Emery Pond on the Rocky River, broke at 3 a.m. (Fig. 4). The river that had been harnessed almost continuously since 1832 was free. The following are excerpts from the Three Rivers Commercial from the story published in 1948 and the fifty years ago today story from 1998 (Griffiths, 1998).

> "Alec Walls saw the rubble and timber dam give way at 3a.m. "The dam caved in the center and the great wall of water rushed down through the river channel to spread out in a great gush over Scidmore Park on its way to join the swollen St. Joseph""
> "In the way of the flood was the footbridge across the ordinarily calm Rocky's channel connecting Scidmore Park with Conservation Park. The bridge was swept away. Tenantless bird and animal cages, the occupants removed to safety by Parks Superintendent Estes Griffin last Friday, were smashed against trees."
> "Scidmore Park had flooded earlier, forcing animals and supplies to be moved. The pond drained into the roaring channel with its mud, silt and debris, but many fish were left floundering in small pools, later to be scooped up by eager fisherman willing to risk the soppy, stinking mud for a fish dinner.
> "As the flood swollen Rocky chased out through the broken dam, it badly washed banks in its channel and around the city's underground concrete water storage tank. City workers shored up the bank as quickly as possible with sandbags."
> "The greatest damage was of course to the totally demolished dam. The city now has a useless power plant and must now purchase electric current for some time to come."

> "The Pealer Street Bridge, which goes over Emery Pond, was closed at noon on March 23, 1948 shortly after a large semi truck rumbled across it and a central pillar in the north side of the bridge gave way and toppled down half way into the mud."
> "Meanwhile, the bed of the Emery Pond was visible for the first time in the lives of any living person. What they saw was silt, mud, and great banks of pond lilies, old tin pails and sunken fish shanties. It was a desolate, decayed picture."

Unofficially, city leaders and employees believed the heavy spring rush of water had undermined the dam, boring through the old, rotted timber frame of the dam. This condition had been in progress over many years, they believed, and the weight of the spring flood brought the climax.

Several parks are located along the Rocky River in the City of Three Rivers. One of these parks has an interesting background that demonstrates how much different the concept of environmental quality was 80 years ago.

One of Three Rivers' mayors was Dr. Arthur Scidmore, a well known physician and wild life lover. One evening after a busy day of making his rounds of the sick, the Doctor wandered down to the east side of the Rocky between the mill race and where the river met the St. Joseph River. He envisioned a park carved out of the wilderness. Due to his efforts, the park was dedicated in 1922. In 1905, the city purchased the west side of the Rocky River from Millard St. to West Michigan Avenue from a Mr. Charles J. Haines. For many years the property was a mixture of bog, tin cans, fruit jars, rubbish and swamp, also known as the city dump. In 1938, the dump along Spring and West Michigan Streets had to be filled in, covering tons of glass, ashes and tin cans. Springs on the high ground were capped and ponds were cleaned and lined with stone. The lowland behind the hospital was filled with old cars and draped with a layer of top soil. Where the Rocky River drained into the St. Joseph, the land was a slimy green with swamp. Into that bog of cattails, quicksand and muck, the city dumped 2,100 truck loads of fill. It took many years to convert that area into the park found there today. At first there were no animals. They were acquired a few at a time. For a number of years it was a zoo with an eclectic assortment of wildlife. Most recently, it has been changed into a petting zoo that is open to the public (Three Rivers: The Early Years, 1986).

Hydrology and Hydraulic Information

The watershed boundary was determined from map studies and field checks performed by the Natural Resources Conservation Service (see fig. 1).

The City of Three Rivers is unique in its situation at the confluence of the Rocky, Portage, and St. Joseph Rivers. It experiences floods on a regular basis, and sometimes large areas of the community are inundated. Flooding problems in the city were recorded as early as 1866.

An evaluation and comparison of current and historical photos of the river and its tributaries was performed to determine the stability of the river channel, and changes in riparian land cover. Aerial photographs that were examined spanned a forty year time frame (2001 Farm Service Agency aerial photograph slides and 1960 or 1967 historical aerial photographs). The four counties within the watershed did not have the same year sets of historical aerial photos, so two different years were used.

The Rocky River is a highly meandering river. Meandering rivers shift their positions across the valley bottom by depositing sediment on the inside bends while simultaneously eroding the outer banks of the meander bends (Colorado State University, 2003). Aerial photos suggest that the Rocky's channel moves relatively slowly over time. Few locations showed any channel change in the forty year time period examined.

The Three Rivers area did see increased development and expansion, but this did not appear to have an impact on the channel sinuosity. However, significant change could be seen in downtown Three Rivers. In the area known as Memory Isle Park, approximately half of the western channel width was lost (Fig. 5). This can be interpreted as an indication of sedimentation from upstream soil loss.

Aerial photos indicate that Flowerfield Creek is seeing increased residential development. A partial impoundment that was observed in a road-steam crossing inventory performed in the fall of 2002 could be seen from the 2001 aerial photos. It appears that the flood plain was the main area impacted by the impoundment.

The Three Rivers area, US-131 corridor, and Flowerfield Creek were the only areas that showed significant change in the forty year period evaluated. Currently, the US-131 corridor development does not appear to be negatively affecting the river channel stability. However, the proposed US-131 bypass that is currently being discussed could have a dramatic impact on the Rocky River Watershed.

Figure 5. Aerial photos of Memory Isle Park. 1967 and 2001 aerial photos of Memory Isle Park located in Three Rivers, Michigan. The filling in of the western channel can be clearly seen. Aerial photos courtesy of St. Joseph County Conservation District and St. Joseph County Farm Service Agency.

Approximately thirty county drains exist within the watershed. Few maintenance activities have been done by drain commissioners in Kalamazoo and St. Joseph Counties in recent years. Any brush clearing or other maintenance in these counties has been performed by adjacent landowners on an irregular basis. Currently, there are no new drain development projects being planned.

Van Buren County has only one major drain that falls within the watershed. This drain happens to be Four County Drain. As its name implies, this drain covers four counties; Kalamazoo, Cass, St. Joseph, and Van Buren Counties. This means that for any improvements or maintenance to be done on this drain, an inter-county drain board needs to concur on a best course of action. Limited maintenance has been completed on this drain due to the complexity of multiple jurisdictions involved. The last recorded date of cleaning was in 1952.

Cass County has several drains that fall within the watershed. Most of these drains are maintained on a somewhat regular basis (at least once a decade). Often these drains are cleared of brush and debris by farmers. The Nottingham-Jones, Mud Lake, and Pine Lake Drains were partially cleaned during the winter of 1999-2000. The Hoover-Kelly Drain was partially cleaned on the St. Joseph County side in 2000-2001. The other drains have not been cleaned recently.

A road stream crossing inventory indicated that stream bank erosion, downed trees and slight road-stream crossing erosion appear throughout the watershed (Fig.6). The investigation allowed for a visitation of the portions of the watershed that were accessible from road crossings. The main stem of the Rocky River from Pioneer Street in Cass County downstream was surveyed more thoroughly by kayak. These trips down the Rocky River indicated that the river benefits from an incredible buffer. This vegetative filter was broken only at a handful of locations.

Figure 6. Downed trees. One of many downed trees encountered on the kayak inventory of the Rocky River south of Floating Bridge Road.

Specific hydrologic data for the Rocky River Watershed is hard to come by because no stream gauges are located on the Rocky River. Some related information regarding hydrology characteristics can be found in the Rainfall Characteristics and Geology portions of the watershed description.

The following information was gathered for a flood plain management study done for a major tributary of the Rocky, Flowerfield Creek, in 1999. Much of this information is applicable to the entire Rocky River Watershed.

Annual flooding occurs throughout the watershed in the early spring due to a combination of snowmelt and rainfall, and occasionally in the fall due to heavy rains. In late May of 1989, a 100-500 year flood (6-8 inches of rain in a 24 hour period) occurred in the Flowerfield Creek Area. As a result of this severe flood, many road crossings were inundated. There are areas in Prairie Ronde and Flowerfield Townships that are flood prone. These areas are a result of soil and high water table conditions (Natural Resources Conservation Service. 1999).

Significant Natural Resources

Historically the headwaters area of the watershed was dominated by beech-sugar maple and oak-hickory forests. Grasslands were found in the watershed just north of Flowerfield Creek in what is now Prairie Ronde Township. The Presettlement vegetation of the southern reaches of the watershed consisted of a variety of vegetation types including mixed oak forest, black oak barren, pine barren, beech-sugar maple forest, mixed conifer swamp, mixed oak savanna, and oak-hickory forest (Fig.7).

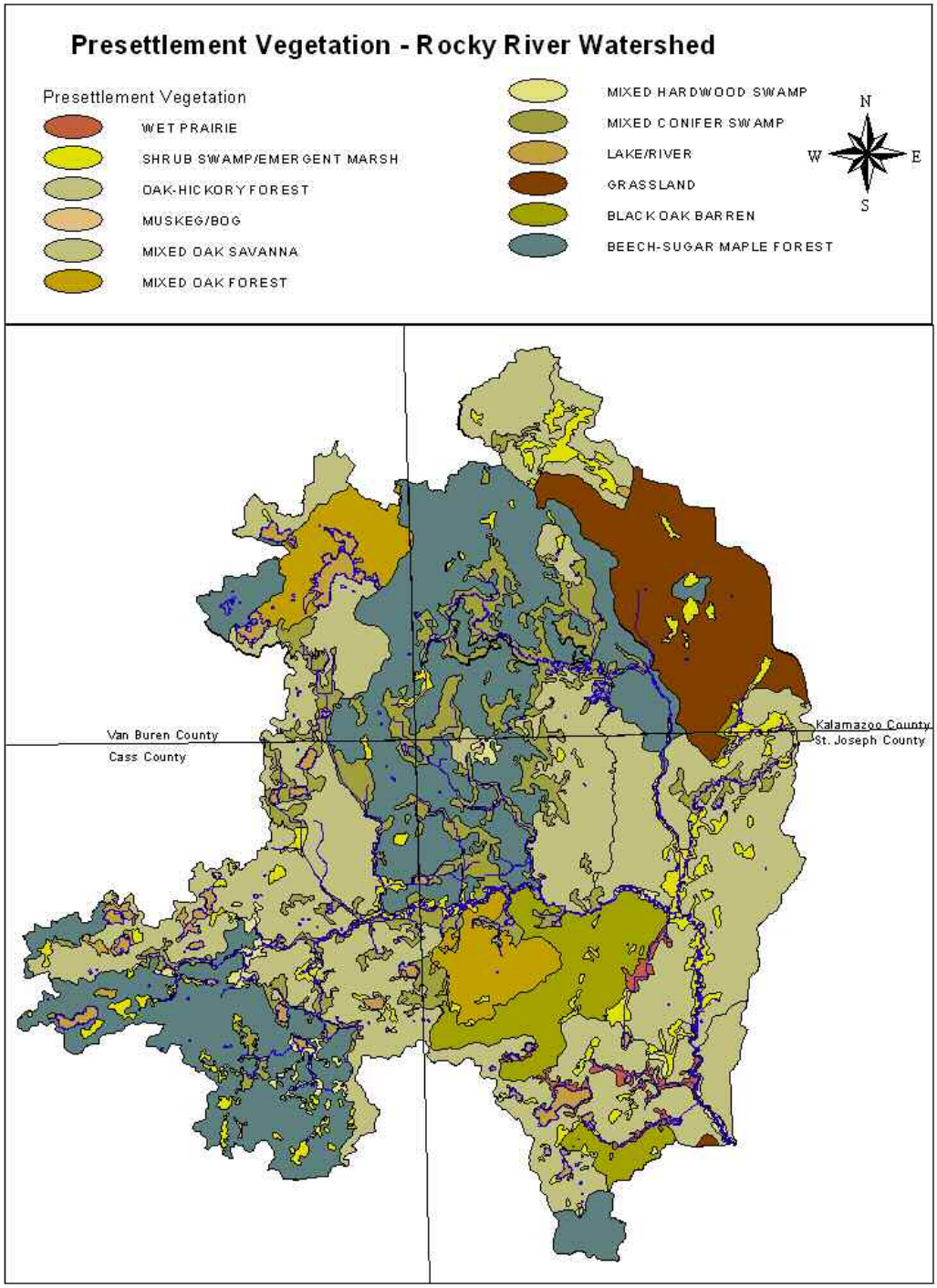


Figure 7. Presettlement vegetation map of the Rocky River Watershed. Courtesy Natural Resources Conservation Service.

Today, the watershed is dominated by agriculture with only a few areas of upland forests remaining. Small areas of Mesic Southern Forest, Coastal Plain Marsh, Emergent Marsh, Bog, and Dry Southern Forest still exist within the watershed according to the Michigan Natural Features Inventory.

A wide variety of plant and animal species listed as Endangered, Threatened, or Special Concern can also be found within the watershed. Some of the more well known include: Mitchell's Satyr Butterfly(Fig. 8), Blanding's Turtle, Spotted Turtle, Indiana Bat, Eastern Box Turtle, and the Eastern Massasauga.

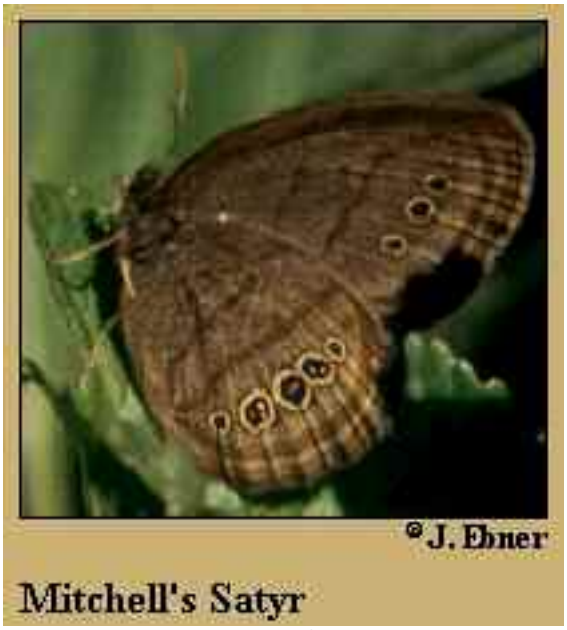


Figure 8. Mitchell's Satyr Butterfly. Photograph by J. Ebner

The Rocky River is a marginal trout stream with the best habitat in the headwaters near the town of Marcellus. It has been managed for trout since 1938 by stocking brook, rainbow, and brown trout. Stocking of the St. Joseph County portion of the river was discontinued in 1990 due to poor survival. The Cass County portion of the river received annual stocking of brown trout until 1996. After an assessment of angler use, it was recommended to discontinue stocking entirely. There is evidence of some natural reproduction in the headwaters, so a limited trout fishery still exists.

Minimum water temperature on the Rocky is 65 degrees Fahrenheit. Maximum temperature of the river is 76 degrees Fahrenheit with a mean temperature of 71 degrees Fahrenheit. According to fisheries biologists with the MDNR a mean temperature of 68 degrees Fahrenheit or less is required to support trout. Many watershed residents recall catching trout on the Rocky in the past, but it would be considered a rare treat today. The Michigan Department of Natural Resources has suggested that sedimentation and vegetation changes (e.g. removal of riparian vegetation and lack of shading) along the river have negatively impacted the Rocky's ability to sustain a healthy trout population, but field studies indicate that the buffer and cover along the river is above average.

Further studies by the Michigan Department of Natural Resources indicated that the temperature of the Rocky River was probably never well suited to supporting trout populations. The MDNR has discontinued stocking trout in the Rocky River for this reason. Current opinion suggests that the Rocky should be managed for cool water game fish such as pike, bass, and perch.

Land Use and Development Trends

Presettlement vegetation maps show that when settlers arrived in this region in the early 1800's Beech-Sugar Maple, and Oak-Hickory Forests dominated the watershed's landscape. Today, only 22% of the watershed has remained forested with approximately 65% of the land use put into agricultural production, due in part to significant portions of the watershed having prime farmland soils (Fig.9).

With over 500 active farms in the area, a wide variety of agricultural production occurs. Crops consist of corn, soybeans, wheat, oats, hay and pastureland, seed corn, potatoes, carrots, snap beans, gladioluses, melons and vineyards. Livestock including hogs, beef, and poultry are also well established in the watershed.

The City of Three Rivers and the Villages of Schoolcraft and Marcellus account for most of the urban land use within the watershed with only 1% of the watershed land use (Fig.10). The Urban/Residential category is the only land use that has increased since 1978. The Rocky River Watershed is fortunate that it hasn't seen the extreme amount of development pressure that many other watersheds face. Even this relatively minor increase cannot be overlooked when townships look to revise their master plans and zoning ordinances. Of interest, is that despite the area increase in urban land use, the population numbers are down. Census data indicates that fewer individuals per housing unit and this urban land use increase could indicate urban sprawl. Most townships would find that when their current zoning ordinances are used in a build-out analysis, the ordinances allow for a ninety percent or more development of the township.

Residential development is concentrated in the urban areas and around the lakes in the watershed. Currently, the northern portion of the watershed is seeing increased housing pressures near Flowerfield Creek in Kalamazoo County.

The Rocky River Watershed is just beginning to experience development expanding into its neighborhood. As The City of Kalamazoo continues to grow, so does the need for more housing and services. Each year the suburban ring around Kalamazoo moves further and further into the watershed. The US-131 corridor is seeing added development pressure as people move from the city to the more rural areas so that they can enjoy the quality of life offered.

Recent talk of a US-131 bypass indicates that in the future the Rocky River Watershed may see a massive highway construction project that has potential to significantly impact the watershed.

Several industries have permits from the Michigan Department of Environmental Quality that allow them to discharge stormwater into the Rocky. Several others have permits to discharge treated waste water.

Water plays an important role in the four counties within the watershed. Almost 12 % of the land use is considered water or wetlands. The City of Three Rivers exists today because the three rivers surrounding it historically provided power to run the mills and transportation for the goods produced, enabling them to reach the consumers. This area still benefits from the residents and tourists drawn by the aesthetic and recreational value of its lakes and rivers. See Table 4 for number of acres in each land use category.

Table 4. Land Use by acreage and Percentage.

Agriculture	72,458.424 acres	64.62% of total
Forested	24,475.231 acres	21.82% of total
Urban	1,253.501 acres	1.12% of total
Water	2,820.309 acres	2.52% of total
Wetlands	11,122.060 acres	9.92% of total

Prime Farm Land Soils

Rocky River Watershed

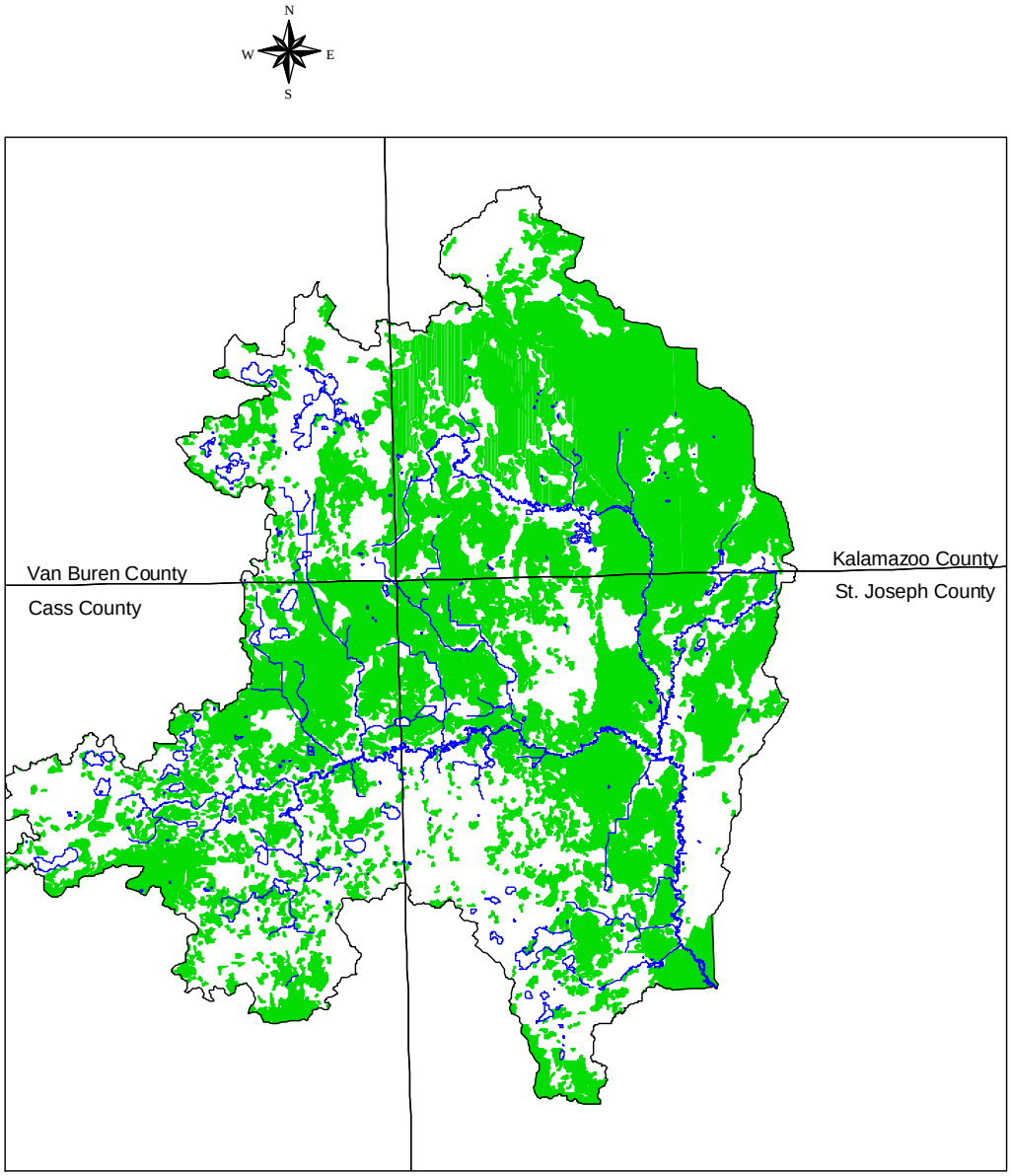


Figure 9. Prime Farmland Soils Map of the Rocky River Watershed. Prime Farmland determined using Natural Resources Conservation Service Soil Surveys.

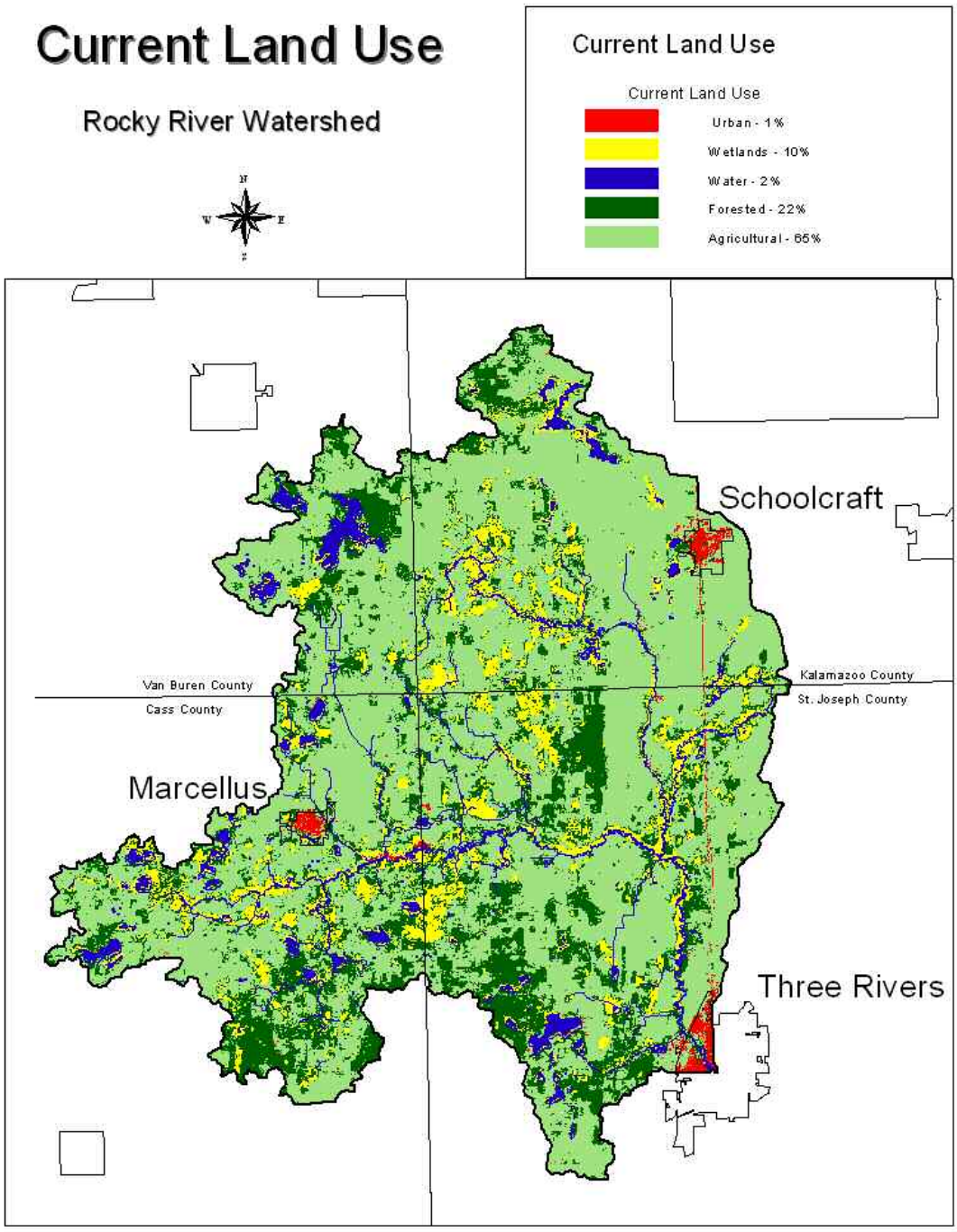


Figure 10. Land Use/Land Cover Map of the Rocky River Watershed. Courtesy of the Natural Resources Conservation Service. USGS EROS Data Center based on early 1990's Landsat satellite imagery.

A land use/land cover map for 1978 is available in appendix 1. This map was digitized using different specifications than the current land use/land cover map (Fig. 10). This causes the land use categories to be incompatible to the current land use map. The 1978 map should be used as a stand alone product. Any comparisons to Figure 10 should be very broad and generalized.

Community Profile

The 2000 Census indicates that the population within the watershed rests around 18,000 (Staron, 2003). Approximately 10 percent of the housing within the watershed is seasonal or for recreational purposes. The many lakes located within the watershed may account for some of the seasonal dwellings.

Surprisingly, the watershed has not been seeing the population boom that many other rural areas are experiencing. In fact, the overall population within the watershed has decreased by almost 20 percent since the last census in 1990. The watershed does not have the job base of a more urban setting. This has limited the growth in the area. The City of Three Rivers and the Villages of Marcellus and Schoolcraft have relatively limited job opportunities. Many employers that were once located in these municipalities have closed due to economic hardships.

The Three Rivers area in particular, however, is seeing an increase in the housing units, but a decrease in population. This is a trend that is being seen throughout the Midwest. The data indicates that the number of persons per household is decreasing. This may point to a population that is generally older and not young couples with children or may be an indicator of urban sprawl.

Several areas within the watershed are seeing population increases however. Prairie Ronde, Schoolcraft and Texas Townships in Kalamazoo County are seeing a surge in residential housing development. The Kalamazoo County townships represented in the watershed saw upwards of a 50% increase in population since the last census. This trend is one reason land use and watershed planning is vital for protecting our natural resources.

Another area of interest is the US-131 corridor that runs parallel to the Rocky River from the City of Three Rivers to M-216. This stretch of US-131 is also seeing increased development pressure. This area bears watching if the discussions about shifting the US-131 corridor to the west become reality. Potential exists for a dramatically changed watershed. Schoolcraft and Three Rivers' growth could be dramatically slowed if US-131 no longer runs through them.

Public Participation

Steering Committee

A successful watershed management plan requires input from the people who live, work, and play in the watershed. Any organization, government entity, or individual that has a stake in or may be affected by a given approach to environmental regulation, pollution prevention, or energy conservation is considered a stakeholder (Michigan Department of Environmental Quality, 2002). By involving stakeholders in the initial stages of project development, long term success can become more secure.

In order to provide consistent public input and stakeholder commitment to the project, the Rocky River Watershed Steering Committee was formed. Representatives with varied backgrounds and occupations are included on the steering committee.

The following organizations/occupations are represented on the team: Branch-Hillsdale-St. Joseph County Health Agency, St. Joseph County Park and Recreation, St. Joseph County Farm Bureau, Natural Resources Conservation Service (Cass, Van Buren, Kalamazoo, and St. Joseph Counties), Michigan State University Extension, Conservation District (Cass, Kalamazoo, Van Buren, and St. Joseph Counties), Conservation District Board Members (Cass, Van Buren, and St. Joseph Counties), Farm Service Agency Board Member (St. Joseph County), St. Joseph County Commissioners, Potawatomi Resources, Conservation & Development, Southwest Michigan Land Conservancy, Township Supervisors (Flowerfield Township, Fabius Township, St. Joseph County; Prairie Ronde Township, Texas Township, Schoolcraft Township, Kalamazoo County), Village of Schoolcraft (Kalamazoo County), City of Three Rivers, Cass County Drain Commissioner, Road Commission (Van Buren County, St. Joseph County, Kalamazoo County), Friends of the St. Joe River, Inc., Sauk Trails Resources, Conservation & Development, Kalamazoo County Environmental Health & Laboratory, St. Joseph County Planning Commission, and Michigan Department of Environmental Quality

Each of the four counties within the watershed had representation on the steering committee. Many of those represented on the steering team also provided input as agriculture producers and/or property owners within the watershed.

Meetings

The Rocky River Watershed Steering Committee met on a quarterly basis to review progress in the development of the Watershed Management Plan during the Planning Phase of the project. Input was provided from the committee members on a number of issues concerning the Rocky River Watershed as well as overall project direction.

Several public meetings were held during the development of the watershed plan. These meetings were intended to provide an overview of the planning process and to gather stakeholder input on watershed concerns and issues.

Outreach

Press releases were used to generate interest in the watershed planning efforts and to solicit public input. Articles ran in the St. Joseph County Conservation District newsletter, the South Bend Tribune, the Three Rivers Commercial and others.

A ten part newspaper series was published in the local paper in order to inform the public about why the Rocky River Watershed is important to the community and to create awareness and excitement about the project. Each article encouraged readers to contact the Conservation District with any questions, comments, or concerns.

The Rocky River Watershed website was created to provide the public with another opportunity to get to know the watershed. This website provided additional information about the project and its goals and once again solicited input from the public.

In many ways, outreach activities solicited the most input and drew the largest amount of people. The watershed program had an educational display and/or stream table at several area events including: Three Rivers River Fest, Kalamazoo Lawn and Landscape Festival, Earth Day, and the Fish Festival. The booth was able to draw people that would not necessarily have been reached through other means. The opportunity for stakeholders to discuss their concerns and desires for the watershed in an impromptu fashion made for some very candid and thought provoking conversations about the river.

That type of informal discussion also took place in the field. Often landowners would notice the Conservation District vehicle and come out to find out what was going on. These encounters often provided personal accounts of the river and how it changed over the years and current concerns for the watershed.

Michigan Municipal Separate Storm Sewer System (MS4) Permittees

In Phase I of the National Pollutant Discharge Elimination System (NPDES) storm water program, Municipalities with Separate Storm Sewer Systems (MS4) which service a population greater than 100,000 were required to obtain a permit. There are six medium or large size communities in Michigan which met the population criteria: Ann Arbor, Flint, Grand Rapids, Sterling Heights, University of Michigan (Ann Arbor), and Warren. In addition, the Michigan Department of Transportation was required to obtain permits for their storm sewer systems associated with the above communities.

Phase II of the Storm Water Regulations expanded the number of municipalities required to obtain a permit to include smaller MS4s identified by the Census Bureau as urbanized areas (residential population of 50,000 and an overall population density of 1000 people per square mile. Several of these entities fall within the Rocky River Watershed: Kalamazoo County, Kalamazoo County Road Commission, Kalamazoo County Drain Commissioner, Village of Schoolcraft, Schoolcraft Township, and Texas Township. These communities opted to obtain a Watershed-based MS4 permit

The Watershed-based MS4 permit is a General Permit for Storm Water Discharges from Separate Storm Water Discharge Systems with Watershed Planning. This permit authorizes the permitee to discharge storm water through a separate storm water drainage system to waters of

the state, including but not limited to the Rocky River or its tributaries. Permittees are required to submit an Illicit Discharge Elimination Plan, a Public Education Plan, and a Public Participation Plan. The Illicit Discharge Elimination Plan (IDEP) is a program that is designed to prohibit and effectively eliminate illicit discharges and connections, including discharges of sanitary wastewater to the permittee's separate storm sewer system. The purpose of the Public Education Plan (PEP) is to promote, publicize, and facilitate education for the purposes of encouraging the public to reduce the discharge of pollutants in storm water to the maximum extent practicable. The Public Participation Plan (PPP) is intended to facilitate the involvement of watershed jurisdictions, agencies, organizations, and the general public in the development of the Watershed Management Plan.

Many of the components associated with the MS4 permitting process correspond to portions of the Rocky River Watershed Plan. The permittees will be implementing portions of the plan as appropriate, and will continue to be involved in the overall watershed steering team as it continues to meet in order to evaluate the accomplishments of the plan and review and update the watershed plan as necessary.

Designated and Desired Uses

The major guide for water quality is whether the waterbody meets designated uses. Designated Uses are recognized uses of water established by state and federal water quality programs. In Michigan, the goal is to have all waters of the state meet designated uses that apply or may apply in the future to the waterbody (Table 5).

Table 5. State determined Designated Uses. All surface waters of the state of Michigan are designated for and shall be protected for all the following uses.

1. **Agriculture** (irrigation, livestock watering systems, etc.)
2. **Industrial water supply**
3. **Public water supply at the point of intake**
4. **Navigation**
5. **Warmwater Fishery**
6. **Other indigenous aquatic life and wildlife**
7. **Partial body contact recreation**
8. **Total body contact recreation between May 1 and October 31**

The steering committee discussed the designated uses for the Rocky River Watershed established by the State of Michigan and determined whether or not they were impaired or threatened. Agriculture, navigation, warmwater fishery, other indigenous aquatic life and wildlife, partial body contact recreation, and total body contact recreation between May 1 and October 31 were determined to be applicable to the watershed. Of these, recreational navigation, aquatic life and other indigenous wildlife and fishery are perceived as being threatened. Agriculture, partial body contact recreation, total body contact recreation between May 1 and October 31 are not currently impaired or threatened, but could quickly become so if the buffer that exists along the Rocky River was destroyed so these are listed as areas of future concern. Industrial water supply and Public water supply at the point of intake are not currently being

utilized within the watershed. Should the need arise; however, they would not be impaired or threatened at this time.

It is important to keep in mind that the Rocky River Watershed is a high quality waterbody. The status "threatened" does not refer to a problem that will necessarily manifest itself tomorrow. The threatened designated uses are those which could be impaired should the land uses in the watershed (especially in zone 1) change.

Several desired uses were also discussed by the steering team and by persons who attended the public meetings. These are additional uses that watershed stakeholders feel are important to meet. The desired uses for the Rocky River Watershed are the development of a waterway system with public access points, open space preservation, connected greenway development and preservation, wetland protection, endangered and threatened species protection, development of a management plan for invasive species, and the preservation of historical/archaeological sites within the watershed.

Groundwater and surface water are closely linked in southwest Michigan. This relationship is important when considering the overall health of the watershed. Four of the City of Three River's five wells fall within the Rocky River Watershed. Therefore, when recent concerns arose for the public water supply provided by groundwater in the watershed, the quality of surface water in the area was also discussed by residents. Several wells near US-131 have been temporarily closed due to Dacthal contamination. Dacthal is a chemical herbicide used primarily on vegetable specialty crops. This contamination issue is being handled by the Michigan Department of Agriculture and the Michigan Department of Environmental Quality. Currently surface water does not appear too effected by this problem. The City of three Rivers has a Well Head Protection Plan in place in order to help protect groundwater. New irrigation requirements have been passed by the State requiring water plans for all large scale irrigators in the state. This effects both surface and groundwater irrigation in the watershed and will help monitor and protect the designated use of agriculture in the watershed. Even though the focus of this grant is on surface water, groundwater for public water supply should be listed as desired use which is currently impaired in parts of the watershed.

Threats and Impairments

A variety of concerns were expressed by watershed stakeholders. Each water quality concern listed for the Rocky River Watershed corresponds with one or more designated uses. The following table is a list of the watershed concerns developed by the steering team and the designated uses that are being impaired, threatened or seen as a future concern (see table 6).

Table 6. Watershed Concerns and Corresponding Uses. Threatened (T), Impaired (I)

Watershed Concern	**Impaired and Threatened Designated Uses**
Sediment From Road-stream Crossings	Navigation (T) Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T)
Loss of Riparian Corridors	Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T)
Environmental Impact of Funneling (Riparian access rights for second tier land owners)	Navigation [erosion from and access](T) Other Indigenous Aquatic life and Wildlife (T)
Sedimentation	Navigation (T) Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T)
Lack of Public Access Points (causing unauthorized access and unrestricted access erosion and vegetation removal)	Navigation (T) Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T)
Cropland Erosion	Navigation (T) Other Indigenous Aquatic Life and Wildlife (T)
Invasive/Exotic Species	Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T)

Livestock Operation – Manure Management	Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T)
	Partial Body Contact Recreation (T)
	Total Body Contact Recreation (T)
Irrigation	Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T)
Wildlife Manure Management (Geese)	Warmwater Fishery (T)
	Other Indigenous Aquatic Life and Wildlife (T)
	Partial Body Contact Recreation (T)
	Total Body Contact Recreation (T)
Unrestricted Livestock Access (causing potential bacterial contamination or erosion problems)	Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T) Navigation (I)
Pesticide/fertilizer Leaching	Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T)
	Groundwater Public Water Supply (T)
Poor Fishing	Warmwater Fishery (T)
Flooding	Warmwater Fishery (T) Navigation (T) Other Indigenous Aquatic Life and Wildlife (T)
Trash	Navigation (T) Warmwater Fishery (T) Other Indigenous Aquatic Life and Wildlife (T)

Industrial Sources	Warmwater Fishery (T)
	Other Indigenous Aquatic Life and Wildlife (T)
Construction Activities	Warmwater Fishery (T)
	Other Indigenous Aquatic Life and Wildlife (T)
	Navigation (T)
Stormwater	Warmwater Fishery (T)
	Other Indigenous Aquatic Life and Wildlife (T)

Pollutants, Causes, and Sources

From the concerns and designated uses in table 5, a list of known and suspected pollutants within the watershed was developed. Then, possible sources and causes of the pollutants were disseminated. The following information is based on data gathered from past studies conducted in the watershed, road-stream crossing and kayak inventories, and input from stakeholders and the steering committee. One or more of the listed pollutants impair each designated use that is listed (see table 7 and table 8.).

Table 7. Watershed impacted or threatened designated uses and typical pollutants.

Designated Use	Typical Pollutants Impacting Use
Warmwater Fishery (Threatened)	Nutrients
	Pesticides
	Sediment
	Hydrologic Flow
Other Indigenous Aquatic Life and Wildlife (Threatened)	Hydrologic Flow
	Sediment
	Nutrients
	Pesticides
	Oils, grease, salt, and metals
Navigation (Threatened)	Sediment
	Hydrologic Flow
Partial Body Contact Recreation (Threatened)	E coli bacteria
	Nutrients
Total Body Contact Recreation (Threatened)	E coli bacteria
	Nutrients

Numerous sources of pollutants that are threatening water quality were identified in the watershed. The following table lists sources and causes of the identified pollutants and a color coded ranking for each. Several inventories were conducted in order to provide accurate information about sources, and to note the impacts on water quality in the field. These inventories and results are summarized in the Non Point Source Inventory section of the plan.

Table 8. Typical Pollutants, sources, and causes. Known (K) Suspected (S) Color coded priority ranking

Pollutants Impairing or Threatening Use	Typical Sources	Typical Causes
Sediment (known) 1	Road-stream crossings (K) 3	Improperly installed or inadequately armored road-stream crossings (K) 1
	Construction sites (S) 5	Lack or improperly installed erosion control measures (S) 1
		Lack of education/awareness of water quality impacts (S) 2
	Human access (K) 6	Uncontrolled human access (K) 1
		Lack of homeowner education/awareness of water quality impacts(K) 2
	Livestock in stream (K) 2	Unrestricted livestock access (K) 1
	Stream bank erosion (K) 1	Lack of or improperly installed erosion control measures (K) 2
		Removal of riparian vegetation (K) 1
	Cropland Erosion (K) 4	Lack of agricultural erosion control practices (K) 1
	Storm Drains (K) 7	Lack of homeowner education/awareness of water quality impacts (K) 1
Salt (suspected) 8	Road-stream crossings (S) 1	Improperly installed road-stream crossings (S) 2
		Lack of or improperly installed erosion control measures (S) 1
Pesticides (suspected) 6	Cropland erosion (S) 1	Lack of agriculture erosion control practices (S) 1
		Improper application (S) 3
		Over application (S) 2
	Golf courses (S) 2	Lack of education/awareness of water quality impacts (S) 1
		Improper application (S) 2
		Over application (S) 3
	Residential yards (S) 3	Improper application (S) 3
		Lack of education/awareness of water quality impacts (S) 1
		Over application (S) 2

Hydrology (known) 3	Lack of vegetative cover (K) 2	Hydrologic fluctuations (K) 1
	Riparian land owner modifications (K) 1	Lack of education/awareness of water quality impacts (K) 1
	Flooding (K) 3	Improperly installed culverts (K) 1
	Increased Flow (storm drains) 4	Lack of education/awareness of water quality impacts (K) 1
Nutrients (suspected) 2	Fertilizers Application Residential/commercial/agricultural (S) 1	Over application (S) 1
		Improper application (S) 2
		Lack of education/awareness (S) 3
		Lack of Agricultural erosion control practices (S) 4
	Failing septic systems (S) 3	Lack of education/awareness of water quality impacts (S) 2
		Improper maintenance (S) 1
	Parks & Golf courses (N) 2	Lack of education/awareness of water quality impacts (S) 3
		Over application of fertilizers(S) 4
		Improper application of fertilizers(S) 5
		Lack of adequate vegetative buffer (S) 2
		Goose waste runoff (K) 1
E coli/bacteria (suspected) 4	Geese/ducks in park & Park-like areas (K) 1	Unrestricted access (K) 1
		Lack of education/awareness of water quality impacts (K) 2
	Failing Septic Systems (S) 2	Lack of education/awareness of water quality impacts (K) 1
	Livestock Access to river (K) 3	Unrestricted access (K) 1
Oils grease etc (suspected) 7	Storm Drains (S) 1	Lack of education/awareness of water quality impacts (S) 1
		Lack of Upgraded input controls to system (S) 2

Cropland, streambank, wind and road-stream crossing erosion are known sources of nonpoint source pollution and are a serious threat to existing water quality. A road-stream crossing inventory has been conducted in the watershed which documents this problem. According to the road-stream crossing inventory, kayak inventories and biological surveys conducted by Michigan Department of Environmental Quality, the water quality of the Rocky River and its tributaries is threatened primarily by sedimentation and secondarily by nutrients. Other pollutants can be seen in Table 7.

Non Point Source Inventories

Several inventories were performed throughout the watershed in order to determine the pollutants that were adversely affecting the designated uses of the watershed and the priority in which these pollutants should be addressed. These inventories were conducted through the summer and fall of 2002 and the spring of 2003.

Field Survey

A field inventory was conducted in order to identify and verify the pollutants along with their sources and causes. This was accomplished by observing conditions and sites while driving throughout the watershed.

A significant amount of sediment was visible in the main stream Rocky River and its tributaries. Several known sources of this sediment could be seen in the field including; road-stream crossings, cropland erosion, stream bank erosion, and construction sites.

Several other pollutants were also observed. Exotic species were visible near the confluence with the St. Joseph River. Purple loosestrife (Lythrum salicaria) is a wetland plant from Europe and Asia that can be seen in the watershed. The plant can form dense, impenetrable stands that are unsuitable as cover, food, or nesting sites for a wide range of native wetland animals, including ducks, geese, rails, bitterns, muskrats, frogs, toads and turtles. Many rare and endangered wetland plants and animals are also at risk.

Zebra Mussels (Dreissena polymprpha) have been found in the St. Joseph River near the Rocky River. The zebra mussel has the possibility of severely impacting electric power generation, industrial water intake facilities; disrupt food webs and ecosystems, sport and commercial fishing and navigation, recreational boating, beaches and agriculture. It is currently unknown whether or not zebra mussels are in the Rocky River, but it is essential to stop their spread.

A potential source of E coli was found in Three Rivers' parks. A large population of Canada Geese and other waterfowl reside in Scidmore and Memory Isle Parks. Geese droppings cover the park lawns. Any significant precipitation will cause it to run directly into the Rocky River or into park ponds that drain into the River (see figure 11).

Figure 11. Scidmore Park Ponds that Drain into the Rocky. Some of Scidmore Park's resident waterfowl population next to one of the small ponds that drains into the Rocky River.

Kayak Inventory

Kayak inventories on the mainstream Rocky River were conducted in October 2002 and May and July of 2003. These trips provided an opportunity to view the river and the adjacent land that is usually only accessible from private property.

The October kayak trip was from Floating Bridge Road south to the confluence with the St. Joseph River. The May kayak tour started at Flatbush Road, then went downstream to end at Floating Bridge Road. In July, the inventory was conducted from Pioneer Street in Cass County to Bent Road in Howardsville.

Figure 12. Kayak Inventory. Downed trees can make for a scenic kayak trip, but completely downed and submerged trees can impede navigation.

The Rocky River has an exceptional riparian buffer except for a few locations. Several areas had some streambank erosion, but these erosion areas appeared to be somewhat natural or wildlife caused. Sediment still seemed to be the primary pollutant. Navigability was impaired due to sediment deposition and downed trees. It would be difficult to take a canoe or rowboat down the river due to the shallow stream bed.

The numerous downed trees are causing the sediment to drop out in some locations and for the channel to change in others. Lack of adequate portage sites and put in/take out sites contribute to erosion on the streambanks, especially near the road stream crossings (see figure 12).

Road Stream Crossing Inventory

A road stream crossing inventory was performed in the summer and fall of 2002. Data were gathered at each location the Rocky River or one of its tributaries was crossed by a road. A variety of information was collected including: background information, physical appearance, substrate, in stream cover, river morphology, stream corridor, adjacent land uses, road crossing information, potential sources, and site summary information.

The road-stream crossing inventory reinforced information gathered both from the kayak trip and the field inventories. Erosion and sedimentation were listed as potential sources of pollution. Highway/road/bridge maintenance and runoff was a potential source seen at almost every road-stream crossing. Without proper training for workers responsible for maintaining them, these crossings input a significant amount of sediment into the river (see figure 13).

Figure 13. Crossing erosion entering Four County Drain.

Recreational uses are also impacting the river according to road stream crossing inventory evaluations. Lack of adequate public access sites and launch platforms cause foot traffic and boat entry to be unrestricted. In some cases sensitive areas are disturbed. This causes increased erosion and some loss of shoreline vegetation.

The road stream crossings also revealed some agriculture related sources of pollutants. In some areas, especially along the tributaries, the land is tilled and planted right up to the water's edge. Without proper buffers, cropland erosion can occur transporting both sediment and nutrients (fertilizers, herbicides, pesticides) into the river.

Livestock in the stream can also contribute to non point source pollution. Not only can livestock defecate in the river causing E. coli risks, but more importantly, unrestricted livestock access to the river can cause major erosion problems (see figure 14).

Figure 14. Livestock access erosion to the Rocky River. Here, the bank and shore have been severely eroded where the cattle have been entering the river.

Another potential problem was with culverts. A number of culverts with problems causing environmental impact were observed throughout the watershed. A variety issues were seen including: poor alignment, inadequate armoring, impounded water, obstructions, structural integrity, and drop culverts. These problems can impact the fishery and other indigenous aquatic life and wildlife. Drop culverts make it impossible for fish to get upstream from those locations (see figure 15).

Figure 15. Drop culvert with plunge pool near Ayers Lake

Sometimes culverts become obstructed, impeding flow. This causes flooding upstream of the impoundment which can also impact the fishery and other indigenous aquatic life and wildlife. These situations can often look similar to culverts that are improperly installed. When culverts are installed incorrectly they will not meet the capacity needed to maintain flow. This can do one of two things, the culvert will overflow causing flooding or the culvert will undercut and pool (see figure 16).

Figure 16. Obstructed culvert. This picture was taken during a period of dry weather in fall of 2002. Imagine what this looks like in the spring rainy season.

Aerial Photo Review

An aerial photo review was conducted in order to determine the stability of the river system. Historical photographs from the 1960's were compared to 2001 aerial photographs. Rivers are dynamic systems that change over time. It is essential to know how stable the channel is in order to properly place Best Management Practices (BMP). If a BMP is placed in a part of the channel that is rapidly changing, the river could potentially destroy or circumvent the practice within a few years, rendering the BMP useless.

Aerial photographs and topographic maps indicate that the Rocky River is highly meandering. Natural channel changes will occur from the erosion/deposition processes that all rivers have. The pictures showed little channel change in the approximately forty year span that the aerial photos covered. It is important to remember that although this is a long time for people, for a river this is a relatively short amount of time. This does, however, indicate that Best Management Practices can be installed on the river with reasonable certainty that they will not be undermined.

Land use along the river and the vegetative riparian buffer were also examined in the aerial photo review. A good buffer was observed along most of the mainstream Rocky River. Some of the tributaries to the Rocky had smaller buffers. Land use in the watershed has changed slightly in three particular areas. Fabius Township and the Three Rivers area in the south and Prairie Ronde and Texas Township to the north have been experiencing residential housing increases in the past forty years. The southern part of the watershed is experiencing development

from the Chicago area, while the northern part is being pressured by the Cities of Kalamazoo and Portage.

People have been moving further away from the cities so that they can experience the quality of life offered in a more rural setting while still being able to commute to jobs in the city. The influx of residential homes is also from retired people that move away from the bigger cities as they enter their retirement years.

The third land use change was along the US 131 corridor that runs north-south through the eastern edge of the watershed. A variety of businesses have popped up on this stretch in the past few years. The traffic that travels up and down US 131 brings a lot of money into the businesses there. This increase in economic traffic would stagnate if the proposed US 131 bypass goes through in the future.

Looking Toward the Future

The Rocky River Watershed has always been shaped and molded by its water resources and will continue to be impacted by their quality in the future. This watershed management plan has attempted to address the many factors that contribute to the degradation of water quality and the tasks that can be accomplished to mitigate existing problems, prevent future problems from developing, and preserve the wonderful characteristics that make the Rocky River Watershed surprisingly wild and surpassingly beautiful.

There are two specific qualities that make the Rocky River a priority watershed for implementing changes to preserve and restore water quality; first, the watershed is relatively undeveloped along the river corridor and has tremendous potential for protection through land use planning and preservation; second, the Rocky River is a high quality waterbody that needs protection and maintenance to ensure that future generations will benefit from the unspoiled waters.

Land Use Planning

From the beginning of this project, the Rocky River Watershed has been full of surprises. Typically, southern Michigan watersheds are seeing increased development along the water and the removal of riparian buffers. It was initially expected that the Rocky River would follow this trend, but as the kayak inventory progressed it became evident that the Rocky was not a typical southern Michigan river.

The mainstream portion of the Rocky exhibits an almost unbroken buffer. This buffer serves not only as a barrier to sediment and nutrients, but also as wildlife habitat and shade for aquatic life. The river corridor is an excellent candidate for conservation easements and land donations, but could also be protected by working through townships to establish master plans and zoning ordinances that protect the riparian buffer.

The typical watershed in Southwest Michigan is in questionable shape. As waterfront property around area lakes becomes crowded, many are looking at river front property as an

alternative. Houses are springing up along most rivers in the region. The Rocky River Watershed is just beginning to see some of this development pressure near its northern fringes, just south of the Village of Schoolcraft. Other areas do not have the luxury of acting before the buffer has been lost or the wildlife has been displaced . . . the development has already occurred. The Rocky, however, retains almost all of the qualities that many Upper Peninsula rivers are prized for.

Too often, watershed management plans are reactive as opposed to proactive due to the current state of the waterbody. By addressing potential issues before they become problems, a watershed plan can not only save a considerable amount of money, but also maintain many characteristics that are difficult to regain, such as habitat for endangered, threatened and special concern species and the occurrence of natural wetlands and floodplains.

The opportune time to act in the Rocky River Watershed is NOW. All four counties within the watershed are beginning to attempt the task of land use planning for the future. Unfortunately, natural resources are not always addressed in master plans. In St. Joseph County a land use planning task force has been assembled for the purpose of trying to address a wide range of land use issues including the Purchase of Development Rights (PDR) program.

This task force came up with the following recommendations: implementation of an interactive GIS mapping capability for the County's webpage; Site plans should be reviewed by all entities that have the ability to impact the implementation of the site plan; ongoing surface water sampling program for the St. Joseph River and its tributaries the data from which will be compiled into a water quality database; the formation of an on-site septic system management committee; collaborative governmental planning and zoning in land use issues while retaining their autonomy; the Economic Development Corporation be charged to research the pros and cons of establishing a County wide Brownfield; that the Michigan State Housing Development Authority (MISHDA) be expanded to cover the entire county; that the county maintain and strengthen the Economic Development Council (EDC); the facilitation of collaborative efforts in community marketing; the County Board of Commissioners direct the County Planning Commission to coordinate the compilation of current land use plans prepared by the townships, villages, and cities into a county land use plan; the appointment of a Farmland Preservation Committee to develop, within a year, a proposed St. Joseph County Farmland and Open Space Preservation Ordinance; citizen recruitment and training for duty on many public boards in the county by continuing the support of training activities and urges the continuation of the Citizen Planner program offered by Michigan State University Extension; that the county help cities and villages obtain funding for the extension of existing infrastructure so that building can occur adjacent to them at a reasonable cost; that the Economic Development Corporation promote the direct marketing of agricultural goods and the establishment of agricultural processing plants in the region; townships to designate areas of viable agricultural land where agriculture would be the preferred use distinct from traditional agriculture/residential zoned areas. Complete recommendations of the Land Use Planning Task Force can be found in Appendix 4. Many of these recommendations are similar to those made in this document.

Townships in all of the counties are becoming more aware of prime farmland (Abundant within the watershed) and areas adjacent to development. They are also learning more about cross boundary issues, but need to have the necessary tools to create zoning that will not only support continued residential and economic growth, but will also help foster environmental awareness and maintain the rural character that is drawing the development.

Townships recognize the need for additional training in land use measures and 37 individuals participated in the Citizen Planner courses offered by the Michigan State University Extension in St. Joseph County alone.

Land use planning with natural resources in mind can be a long term extension of the planning and implementation efforts that take place within the watershed, especially for a watershed that has not been developed extensively. The primary land use challenge within the Rocky River Watershed is the act of achieving a balance between the needs and requirements of existing agriculture and protecting natural resources while allowing new development to occur in the watershed without unreasonable restriction to private property rights.

One way to effectively promote and maintain the watershed's water quality in a sustainable manner is through improvements to land use decision making at the local level. To do this effectively, a comprehensive land use planning approach is necessary.

Land use planning in the Rocky River Watershed is conducted at the County, Township, City and Village levels, usually with limited opportunity for intergovernmental cooperation. Because the units of government within the watershed are largely rural, they typically do not employ a full time land use planner or planning staff. This can often hinder the planning process, forcing planning and zoning administrators to take a reactive stance on planning issues. Because of limited funding for technical staffing or assistance, there is a risk that local land use decisions may be made without a thorough technical understanding of watershed resources and issues.

Land use planning intended to protect or conserve natural resources must be based on a sound understanding of the resources in question. Natural systems are complex and, therefore, require consideration of local conditions and issues in order to protect them effectively. Because species habitat can range over miles and because surface and groundwater flows do not stop at political boundaries, regional cooperation in natural resources land use planning is essential. Because of the complexity and interrelatedness of the natural world, efforts aimed at the protection or conservation of natural resources require a proactive and comprehensive approach. The impacts of poor land use decisions are often irreparable and irreversible (McKenna, 2000).

The Rocky River Watershed Management Plan focuses largely on proactively addressing water quality issues. The plan promotes watershed awareness and education with landowners and the general public. In addition, several Natural Resources Inventories and Land Use Policy Evaluations are being planned with watershed townships to provide a demonstration of how efforts at the institutional level can be utilized to advance water quality management and general natural resource protection. By making changes at the local level, proactive and comprehensive watershed protection can be achieved.

Protection of a High Quality Waterbody

According to the Michigan Department of Environmental Quality, high quality water is defined as any waterbody that can be demonstrated to MDEQ as containing an abundance, diversity, and widespread distribution of members from each of the order plecoptera (stoneflies), ephemeroptera (mayflies), and tricoptera (caddisflies).

Several methods have been used when monitoring macro invertebrates within the watershed. The first, utilized home schooled students in a volunteer monitoring situation. Friends of the St. Joseph River provided training for the Assistant Librarian of the Three Rivers Public Library in water quality monitoring techniques. She passed this training on to the group of high school aged homeschoolers who perform the monitoring twice annually.

The students use kick and dip nets to collect the aquatic bugs and also take measurements on river characteristics in two locations near the mouth of the Rocky (Fig.17). The collected bugs are then keyed out and counted. The results are tabulated giving a rough estimate of water quality. All results are passed on to the Friends of the St. Joseph River and to Michigan Department of Environmental Quality.

Figure 17. Students sampling tailrace

The results from the volunteer monitoring indicate that the Rocky River ranges from fair to good in water quality. The location that ranked in the fair category was on the tail race portion of the river. Downtown Three Rivers originally had an operating hydroelectric plant. Just upstream of M-60, a portion of the river is diverted to run through the plant, and then back out to the main stem of the St. Joseph River. The man made channel that this water flows through is called a head race above the plant and a tail race below it.

The water velocity that runs through the tail race is greatly reduced. This causes the variety and abundance of macro invertebrates found there to be less than the main portion of the river. In addition, the old mill is an obstruction to upstream movement of aquatic life, which also decreases diversity and abundance of invertebrates. These factors contribute to the tailrace portion of the Rocky scoring slightly lower in macro invertebrates. The tail race is sampled more for educational value and less as an overall watershed health indicator. The volunteer monitoring results can be found in appendix 2 or at www.fotsjr.org .

Another example of water quality monitoring has been the continued biological surveys that are performed on a five year cycle by the Michigan Department of Environmental Quality. The staff of the Great Lakes and Environmental Assessment Section (GLEAS) conducted qualitative biological surveys during the summer of 2000 to assess point and nonpoint source pollution in the Rocky River Watershed (see appendix 3).

The macro invertebrate communities were scored with metrics that rate waterbodies from excellent (+5 to +9) to poor (-5 to -9). Ratings from +4 to -4 are considered acceptable. Negative ratings that are acceptable are indicative of waterbodies that are strongly tending towards poor, while positive ratings that are acceptable indicate slight impairment. The macro invertebrate communities at the two stations on the Rocky River that were rated with this technique scored +3 and +2. Sheldon Creek and Four County Drain also scored +3. The narrow range of scores at these stations reflected the presence of macro invertebrate communities that were generally consistent in terms of abundance and diversity. Likewise, the habitat ratings were similar and consistently in the good range (74-78) at these stations. Historic dredging of the Four County Drain created a relatively homogonous channel, lacking meanders and riffle/pool sequences. Natural processes are slowly creating more stable and diverse environment that harbors good biological communities. Visual assessment of the headwaters of Four County Drain revealed that the stream channel is maintained as an agricultural drain. The macro invertebrate community inhabiting Spring Creek rated excellent (+5) and the site received the highest habitat score (83) in the Rocky River Watershed (Michigan Department of Environmental Quality, 2002)

Kieser and Associates (K&A), an environmental science and engineering firm, contracted with the Rocky River Watershed Project to conduct water quality monitoring on the Rocky River. In the course of the project they performed water quality sampling for total suspended solids, dissolved oxygen, conductance, total phosphorous (TP), and several other parameters to establish baseline data for water quality trends and performed a macro invertebrate assessment of the Rocky River and its tributaries. The sampling locations chosen corresponded to the locations of the Michigan Department of Environmental Quality biosurvey sites.

Water quality in the upper Rocky River during this 19 month study period showed few signs of significant impairment related to watershed impacts based on the data collected. All Rocky River water quality samples analyzed for the 20 sampling events showed TP concentrations below USEPA recommendations for rivers not flowing into a reservoir (<100*u*g

TP/L). TSS values were also low, with all samples measuring below 33mg/L. These data suggest that existing buffer zones should be maintained in the upper Rocky River watershed. In addition, land owners should continue to maintain or improve riparian areas and ensure that any new development incorporates responsible stormwater management practices. More detailed results of this study can be found in Appendix 3.

Zones of Implementation

Watershed Plans often have a component called Critical Area. Critical Areas are used for a variety of reasons, but mainly in order to narrow the scope of the watershed plan. There are several ways to determine critical areas. One way is the corridor method, which defines the critical area as a standard width from the waterbody's center. Another way is the subwatershed method. This approach uses smaller hydrologically distinct watersheds that may have specific problem areas or more sensitive zones that may affect water quality. The watershed method is also used to determine critical area. This technique is most often utilized in small watersheds.

The approach used in the Rocky River Watershed will be tackling the issue of narrowing the range of the project in a different way. Zones of Implementation will be used to better define the scope of the project. This method is similar to the critical area corridor method, but is meant as a method of defining the Best Management Practices and Strategies that should be implemented in each zone as opposed to defining the zone that is the primary focus of all implementation. This approach can be related to the system of rings on an archery target (see figure 18).

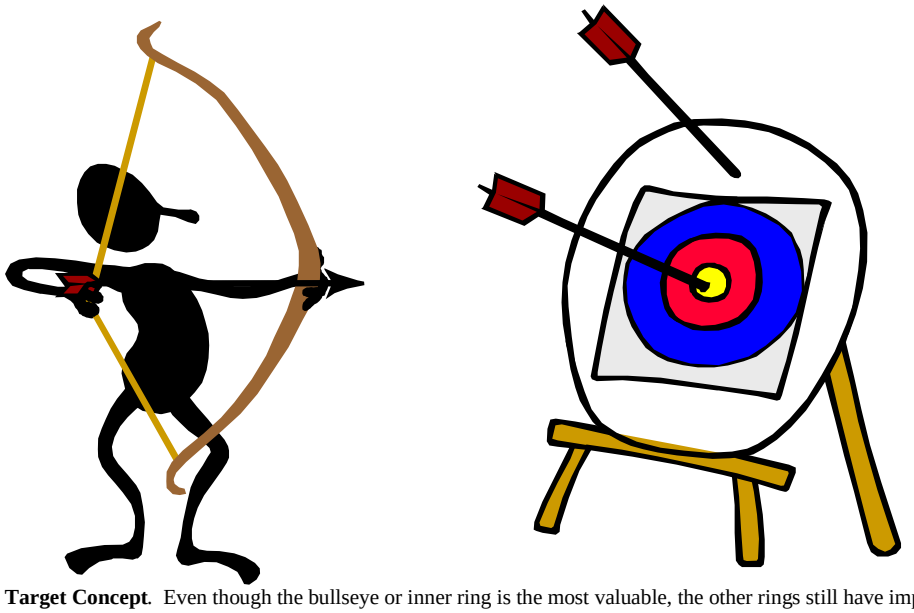


Figure 18. Archery Target Concept. Even though the bullseye or inner ring is the most valuable, the other rings still have importance.

Much like the rings on an archery target, the Rocky River Watershed will have zones that change with the distance away from the river (centermost point on the target). The "bullseye" or Zone 1 will have the most value associated with it because the majority of the Best Management Practices and pollution control strategies will apply directly to that zone and those practices

should have the greatest direct impact on water quality. This zone covers all areas up to one quarter kilometer away from the Rocky River and its major tributaries. Some of the BMPs prioritized for this area include streambank stabilization, riparian buffers, slope/shoreline stabilization, bioengineering, revegetation, rock riprap, education, and zoning and planning assistance for townships.

The first zone was determined using similar methodology to the corridor method. Best Management Practices emphasized in this area are directly related to causes of water quality degradation that take place around or near surface water. All of the BMPs suggested in the Rocky River Watershed Management Plan are applicable and intended to be used in this zone.

Zone 2 on our "target" covers the area from one quarter kilometer away from surface water to three quarters of kilometer away. This area is meant to take into account some of the practices that get overlooked when using the traditional corridor method to determine critical areas. The Rocky River Watershed experiences a significant amount of wind erosion that contributes to the sedimentation that the watershed is experiencing. A variety of erosion control techniques can be utilized to stop wind and water erosion in the areas that are at a slightly further distance away from surface water, but still can impact water quality. Zone 2 attempts to focus on BMPs that can have an impact on surface water quality, but that may not have the more immediate impact that Zone 1 strategies have. These practices can include grassed waterways, windbreaks, field borders, information and education, land use planning, and restoration and management of declining habitats, etc.

The upland portions of the Rocky River Watershed fall into Zone 3. In many watershed plans this areas is located outside of the determined critical area. With the bullseye method landowners that live in this area are not overlooked because they can play a very important role in protecting surface water quality. This zone will have fewer management tools associated with it. Specifically, information and education, restoration and management of declining habitats, and land use planning will be directed at these areas.

The bullseye method of narrowing the scope of the management efforts takes a unique path. These zones of implementation act to better define which activities should be focused where within the watershed while instilling the key point that water quality is everyone's responsibility. When a stakeholder looks at the Implementation Zone maps he or she can quickly determine what activities correspond to his or her location. Even those individuals that live the farthest away from the river can see that they are an important component in the success of the watershed management project (See Fig. 19 and Fig. 20).

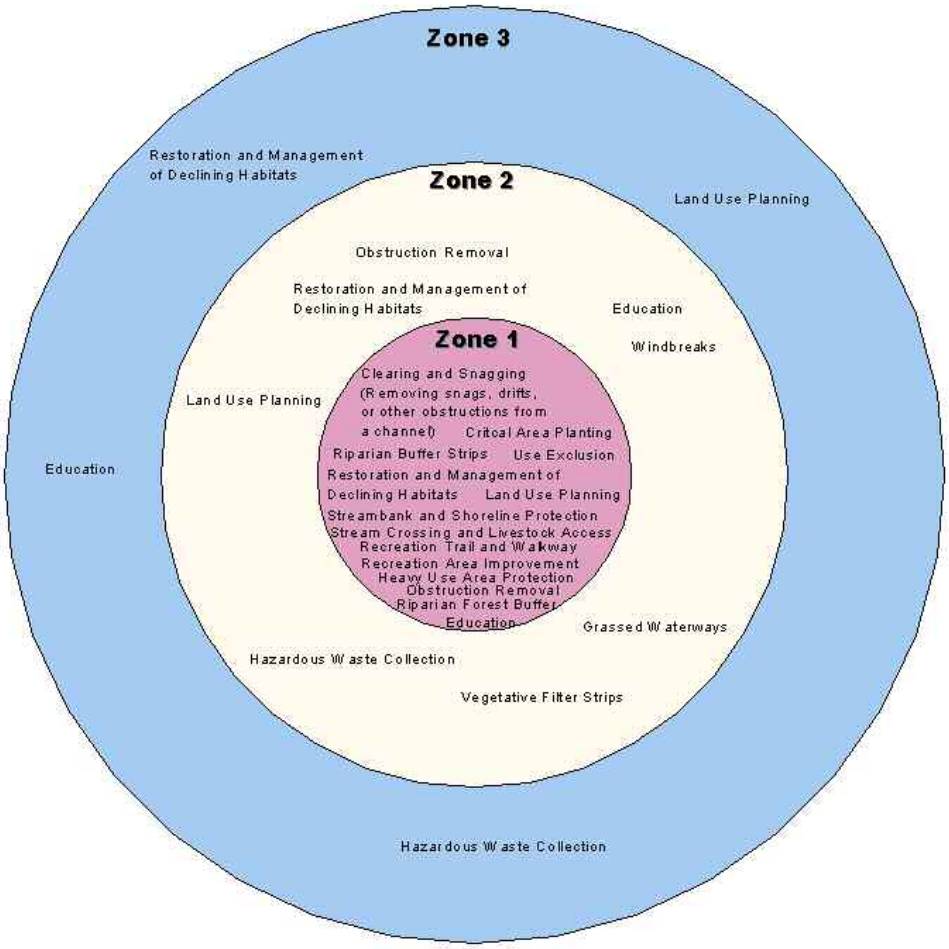


Figure 19. Zones of Implementation Bullseye. This target lists some of the Management Practices and strategies associated with each zone of implementation.

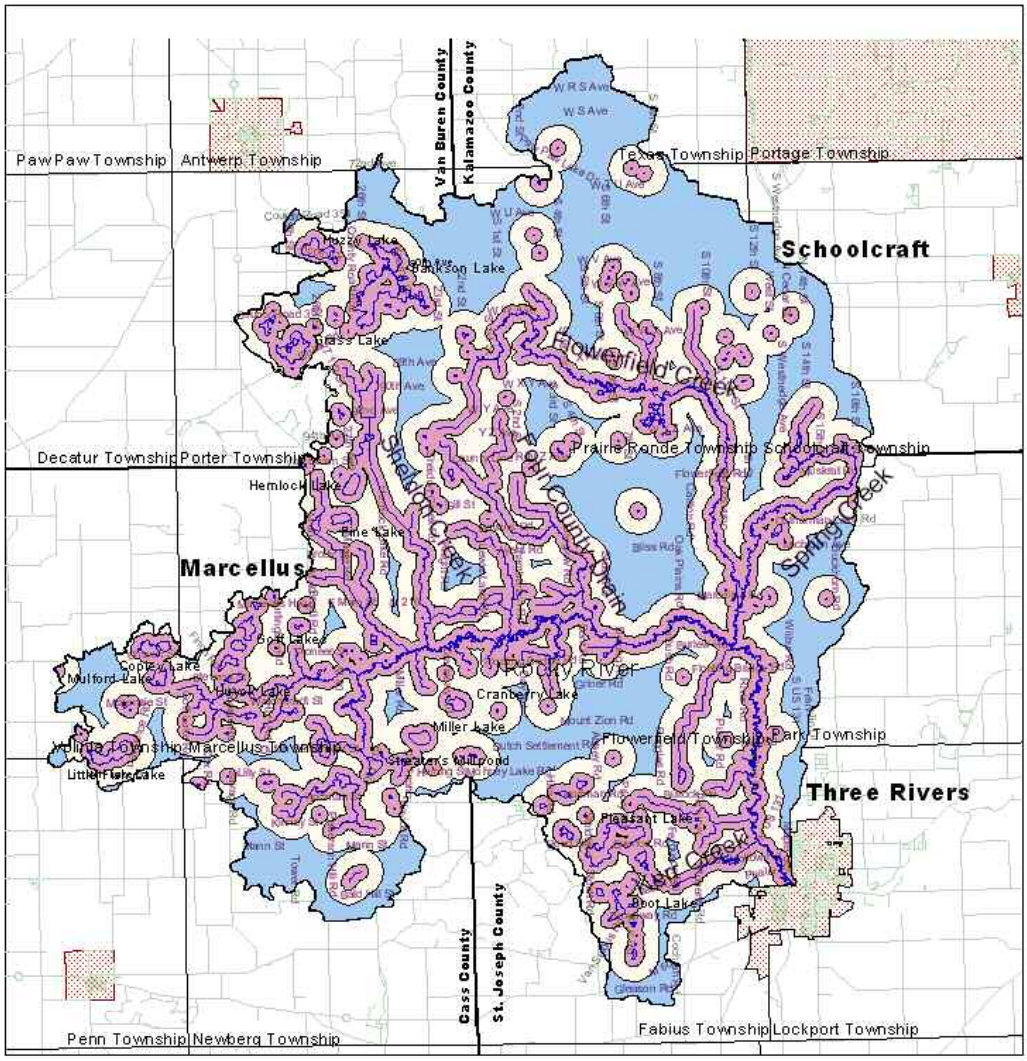


Figure 20. Implementation Zone Map of the Rocky River Watershed.

Water Quality Summary

Water Quality in the Rocky River Watershed ranges from acceptable to excellent. Throughout the watershed water quality is adequate to support the designated uses determined by the State of Michigan at locations with suitable riparian and in-stream habitat. Unfortunately, historical channelization of tributary streams, current land management practices and inadequate environmental education of watershed residents have the potential to impact the ability of the watershed to sustain these uses.

Navigation, fishery and aquatic life, partial body contact recreation, total body contact recreation, and other indigenous life and wildlife designated uses are threatened within the watershed. Although the threat to these uses does not mean that they will be impaired tomorrow, it is a very real danger should land use changes occur within the watershed, especially zone 1.

Sediment and nutrients are the primary pollutants threatening these designated uses. Unrestricted livestock access can also contribute to sedimentation from the cattle punching up the stream bank and from possible E. coli from cows defecating in the river. Nutrient inputs can come from concentrated animal feeding operations where manure is not being managed properly and from agriculture operations where fertilizers, herbicides, or pesticides are not properly applied and the chemicals are transported to the river through runoff or infiltration through the soil.

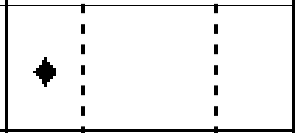
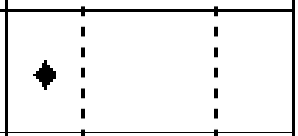
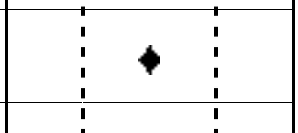
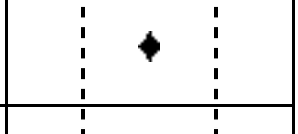
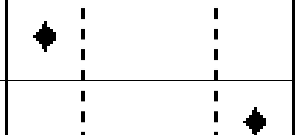
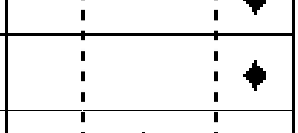
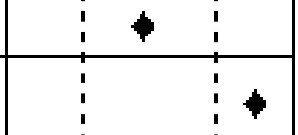
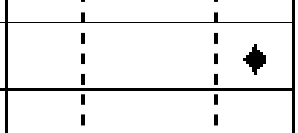
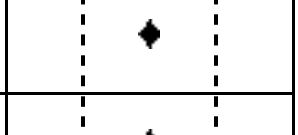
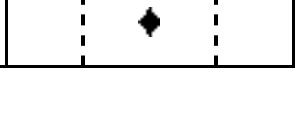
Agriculture is a designated use applicable to the Rocky River Watershed. When considering the status of this use, it is important to remember that, in this case, agriculture refers to the ability for farmers to irrigate or to water livestock. The Rocky River and its tributaries provide a water source for irrigation for many area farmers. Sediment levels can impact irrigation mechanisms by making them more difficult to set up and operate. Zebra mussels, a suspected exotic species in the watershed, can also impact irrigation and watering systems by clogging intake pipes. Currently, however, the Rocky is able to support this use, but damage to the buffer along the river could not only impact this use, but all others as well.

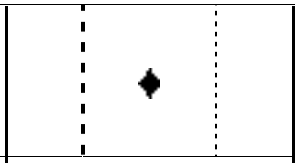
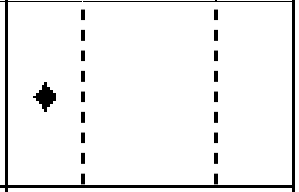
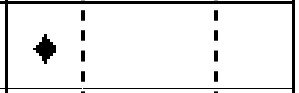
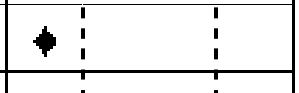
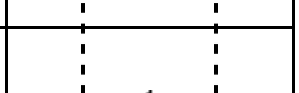
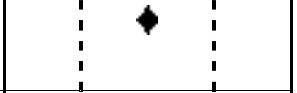
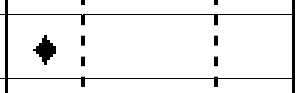
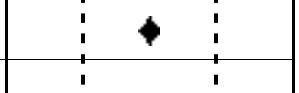
Groundwater viability was listed as a desired use within the watershed and is currently impaired in some site specific locations near US-131. This is a major concern for residents in the area and is currently being handled by the Michigan Department of Agriculture and the Michigan Department of Environmental Quality.

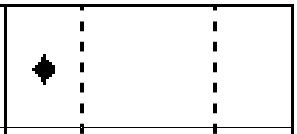
Based on the impaired and threatened designated uses and the input and concerns of stakeholders, a list of watershed goals, objectives, and tasks was developed. A summary is provided in table 9, and a detailed explanation of the tasks is provided in table 10. This list does not appear in order of priority but a general priority for each task is given. High priority tasks should be started within 1 to 3 years; moderate priority tasks should be started within 4 to 6 years; and low priority tasks should be started within 7 to 10 years. It is important to note that these priority timelines are just recommendations and the watershed plan should be reviewed at least every five years by the steering committee in order to insure that the recommendations and timelines are still appropriate.

Table 9. Goals, Objectives, and tasks summary of the Watershed Management Plan

Goal	Objective	Task	Priority		
			High	Moderate	Low
Goal One: To improve and protect the navigability, aquatic life and other indigenous wildlife, and the fishery of the Watershed by reducing the amount of sediment entering the system	Objective One: Stabilize priority streambank erosion sites through the installation of corrective measures	Task 1: Implement structural BMPs on at least 490 linear feet of streambanks to reduce the amount of sediment from entering the river	◆		
		Task 2: Target riparian landowners with information regarding shoreline protection	◆		
	Objective Two: Establish a road/stream crossing improvement program to correct identified problems	Task 1: Stabilize erosion at road/stream crossings	◆		
		Task 2: Integrate the prototype road/stream crossing form, developed by Kieser & Associates for the St. Joseph River Watershed Planning Grant, with current Road Commission procedures in order to improve monitoring of road/stream crossing integrity		◆	
		Task 3: hold a workshop for Road Commissioners highlighting streambank stabilization techniques, sizing and placement of culvers with fisheries in mind			◆
	Objective Three: Work directly with landowners to eliminate livestock access to the river	Task 1: Implement structural BMPs at both identifies livestock access points	◆		
	Objective Four: Reduce/eliminate construction site erosion	Task 1: Offer training to contractors in soil erosion control Best Management Practices		◆	
	Objective Five: Reduce/eliminate erosion at human access points	Task 1: Secure and develop access sites		◆	
	Objective Six: Prevent/reduce erosion from farm fields	Task 1: Hold tours highlighting agricultural best management practices "field walks"	◆		
	Objective Seven: Prevent/reduce sediment entering the river from storm drains	Task 1: Develop and implement storm water education programs in urban areas		◆	
Goal Two: To improve and protect the warmwater fishery and other indigenous aquatic life and wildlife in the Rocky River Watershed by limiting the amount of road salt (NaCl) entering the system	Objective One: Work with Road Commissioners to limit the amount of road salt entering surface water	Task 1: Work with Road Commissioners to alter winter/spring road maintenance near surface water to limit the amount of salt entering the system			◆
		Task 2: Evaluate the use of Calcium Magnesium Acetate (CMA) as an alternative to road salt and for use in critical areas			◆

Goal Three: To improve and protect the warmwater fishery and other indigenous aquatic life and wildlife in the Rocky River Watershed by reducing the amount of nutrients entering the system	Objective One: Reduce/prevent nutrients from agricultural practices from reaching surface water	Task 1: Hold tours highlighting agricultural best management practices "field walks"	
		Task 2: Develop a Certified Nutrient Management Plan or Manure Management Plan and barnyard runoff management for the petting zoo in Scidmore Park	
	Objective Two: Reduce/prevent nutrients from parks and park-like areas from entering surface water	Task 1: Work with the Parks Department and golf courses to eliminate/reduce wildlife (goose) waste runoff using comprehensive management techniques	
		Task 2: Educate private landowners in how buffers can eliminate/reduce fertilizer and goose waste runoff	
		Task 3: Work with golf courses to obtain certification in Audubon International Sanctuary program (water quality management certification)	
	Objective Three: Reduce/eliminate nutrient inputs from residential yards from entering the river	Task 1: Work with townships to develop buffer ordinances near surface water	
		Task 2: Establish a Super Soils Day in the Watershed	
	Objective Four: Prevent nutrients from failing septic systems from entering surface water	Task 1: Educate Landowners with septic systems on how to maintain them	
		Task 2: Develop septic system management and design ordinances	
Goal Four: To improve and protect the warmwater fishery and other indigenous aquatic life and wildlife by preventing or reducing the amount of pesticides entering surface water	Objective One: Reduce/eliminate pesticides used in residential applications from reaching surface water	Task 1: hold a regional clean sweep pick up day in the watershed	
		Task 2: Hold a workshop on integrated pest management and the safe use of pesticides	
	Objective Two: Reduce/eliminate pesticide used in golf course applications that enter surface water	Task 1: Work with golf courses to obtain certification in Audubon International Sanctuary Program (chemical use reduction and safety certification)	
	Objective Three: Reduce/eliminate pesticides used in an agricultural setting that enter surface water	Task 1: Perform Farm*A*Syst with at least 50% of all farms in the watershed	

Goal Five: To improve or maintain current hydrology in order to protect water quality	Objective One: Perform flood plain management to prevent damaging effects of floods and preserve and enhance natural values and provide optimal use of land and water resources within the floodplain	Task 1: Reduce and delay runoff from parking lotas and residential development through incentive programs that promote installation of BMPs in urban areas	
		Task 2: Reduce the development within the floodplain of the river by developing, implementing, or updating a flood plain protection and zoning ordinance based on the 100 year frequency high water profile and the floodplain delineation	
	Objective Two: Protect the warmwater fishery and other indigenous aquatic life and wildlife by preventing land use changes that increase stream temperature	Task 1: Work with townships to develop buffer ordinances near surface water	
		Task 2: Target riparian landowners with information regrading shoreline protection	
	Objective Three: Protect the warmwater fisheries and other indigenous aquatic life and wildlife by reducing inputs from storm drains	Task 1: Develop and implement storm water education programs in urban areas	
	Objective Four: Preserve open space, protect identified sensitive areas and decrease impervious surfaces in order to limit runoff and lover cover changes associated with increased development	Task 1: Work with townships to develop and implement language and ordinances to facilitate "conservation by design" for subdivision planning	
		Task 2: Work with townships in the development of a Natural Resources Inventory and land use policy evaluation	
		Task 3: Develop and implement land protection programs for sensitive areas	
		Task 4: Work with counties and townships to implement Low Impact Development Codes	
		Task 5: Develop a Purchase of Development Rights program in each township, and promote similar programs like the Farmland Development Rights Agreements (PA 116), Local Open Space Easements, and Designated Open Space Agreements	

Goal Six: To protect/improve the recreational uses of the watershed by preventing E coli/bacteria from entering the system	Objective One: Reduce/prevent E coli/bacteria from parks and park-like areas from entering surface water	Task 1: Work with the Parks Department and golf courses to eliminate/reduce wildlife (goose) waste runoff using comprehensive management techniques	
		Task 2: Work with golf courses to obtain certification in Audubon International Sanctuary Program (water quality management certification)	
	Objective Two: Reduce/prevent E coli bacteria from failing septic systems from entering surface water	Task 1: Educate landowners with septic systems on how to maintain them	
		Task 2: Develop septic system management and design ordinances	
	Objective Three: Work directly with landowners to eliminate livestock access to the river	Task 1: Implement structural BMPs at both identifies livestock access points	
Goal Seven: Protect the warmwater fishery and other indigenous life and wildlife of the watershed by reducing the amount of oils, grease, etc. reaching surface water	Objective One: Prevent oils, grease, etc. from urban areas from reaching surface water	Task 1: Develop and implement storm water education programs in urban areas	
		Task 2: Community wide storm drain stenciling program	
		Task 3: Continue and Promote efforts for annual collection days of Household Hazardous Waste to prevent them from entering surface water	
		Task 4: Create and hold tour of Demonstration stormwater sites	
		Task 5: Reduce and delay runoff from parking lots and residential development through incentive programs that promote installation of BMPs in urban areas	
Desired Use One: Obtain more information about the watershed in order to better protect it	Objective One: Collect watershed information that would help protect and maintain water quality	Task 1: Use GPS to accurately map and delineate designated drains, locate area that need improvement, work with county drain commissioners to make improvements	
		Task 2: Conduct Volunteer Monitoring to supplement state monitoring	
Desired Use Two: Prevent the introduction and spread of invasive species through management practices	Objective One: Establish invasive species control programs to prevent the spread of exotics	Task 1: Establish invasive species information and education programs to prevent the spread of exotics	
Desired Use Three: Improve recreational opportunities in the watershed	Objective One: Cut path through downed trees that inhibit navigation on the Rocky River	Task 1: Identify downed trees that inhibit navigation and cut out centers of these obstructions	
		Task 2: identify areas where downed trees impair navigation, but are not reasonable to cut through and place structures to assist in portaging	

Recommendations

The Rocky River Watershed currently displays good water quality. However, both corrective and proactive measures are necessary to provide for the protection and enhancement of the river system.

Remediation should entail streambank erosion control, road-stream crossing upgrades, and the installation of BMPs at agricultural areas of concern.

In order to provide for long term protection of the Rocky River Watershed, proactive steps must be taken. Such measures include the implementation of information and education program, land use controls, zoning ordinances, and the establishment of greenway corridors.

Based on inventory results and steering committee input, the following strategies were developed for the reduction of nonpoint sources of pollutants in the Rocky River Watershed. The recommendations utilize a combination approach with both reactive and proactive measures. Each recommendation integrates BMPs, information and education strategies, partnerships, and intergovernmental coordination. Each task targets a specific objective of the plan. Responsible parties, appropriate Best Management Practices, milestones, timeline and priority, estimated costs and evaluation methods are outlined in Table 10. These recommendations are listed in the same order as the goals and objectives listed in Table 9 and are not listed in priority order. Partners listed in bold should be considered the lead agencies responsible for the task. Priority ranking is listed as high (should be accomplished in 1-3 years), moderate (should be accomplished in 4-6 years), and low (should be accomplished in 7-10 years).

Table 10. Tasks to Accomplish. Goals and objectives with list of tasks, milestones, BMPs and cost associated with each objective.

Goal One	To improve and protect the navigability, aquatic life and other indigenous wildlife, and the fishery of the Watershed by reducing the amount of sediment entering the system
Objective One	Stabilize priority streambank erosion sites through the installation of corrective measures
Pollutant	Sediment
Source/Cause	Streambank Erosion - 4 sites totaling 490 ft in length accounting for 7.66 tons/yr requiring stabilization; Approximately 250 miles of streambank in the watershed are in need of protection in order to keep them in their current, natural state.

Task 1	Implement structural BMPs on at least 490 linear feet of streambanks to reduce the amount of sediment from entering the river
BMPs	Slope/shoreline stabilization, streambank stabilization, critical area stabilization, bioengineering, re vegetation, stairways, rock riprap
Milestones	Develop site plans, obtain proper permits and landowner permission for 490 linear feet (year 1 of task) Secure funding and organize materials (year 1 to 2 of task) Organize work crew and install BMPs (year 2 to 3 of task) Complete 250 linear feet of streambank restoration by the second year of task. Complete 490 linear feet of streambank stabilization by third year of task
Estimated Load Reductions	For each site currently experiencing erosion the BMPs installed will have controlled the gully erosion. For the 4 sites identified it would be a reduction of 7.66 tons/yr.
Zone of Implementation	Zone 1
Responsible parties	**NRCS**, Conservation Districts
Overall Task Duration and Priority	3 years to complete High Priority
Estimated Cost	Approximately $20.00 per linear foot ($9,800)
Evaluation	Take before and after photographs and document number of sites completed Before and after erosion rate calculations Before, during, and after observations of downstream impacts Before and After Benthic Invertebrate samples at each stabilization site if financially feasible Measurement of sediment depth before and after stabilization at key locations Habitat scores of each site before and after stabilization using MDEQ Procedure 51
Threshold	TSS levels for the watershed should remain at or below 20mg/L in order to maintain its current status as "clear" waters. This should be evaluated visually on a routine basis each year along with monitoring every five years to coincide with MDEQ biosurvey schedule. Overall habitat score and characterization, based on MDEQ Procedure 51, for the tributary in question (if applicable) and for the watershed in general should remain the same or above (better than) the results listed on Table 4. in Appendix 3 of the plan.
Timeline for Evaluation	1 to 5 years

Task 2	Target riparian landowners with information regarding shoreline protection including: streambank stabilization, critical area treatment, conservation easements, Conservation Reserve Program, Continuous Conservation Reserve Program, Wetland Reserve Program, Environmental Quality Incentive Program, Wildlife Habitat Incentive Program, etc.
To be performed in conjunction with Goal 5, Objective 2, Task 2 and Goal 6, Objective 1, Task 3	
Target Audience	Riparian Landowners
Message	Maintaining shoreline vegetation and landscaping with native plants protects water quality; conservation easements can protect land of environmental significance and provide tax incentives in some cases.
Delivery Mechanisms	Publish a newsletter/flyer highlighting incentive programs, shoreline management techniques, conservation easements, etc.; Offer workshops that teach shoreline management techniques; Target mail riparian landowners with Southwest Michigan Land Conservancy information detailing the benefits and "how tos" of conservation easements
Milestones	Establish a mailing list targeting riparian landowners in the watershed (year 1 of task) Produce and mail one flyer/newsletter per quarter (year 1 thru 3 of task) Hold 3 workshops for riparian landowners on landscaping for water quality (years 1 thru 3 of task) Target mail riparian landowners SWMLC information (year 1 thru 3 of task) Follow up and pursue all contacts generated (year 1 thru 3 of task) Establish at least 3 conservation easements within the watershed within three years Establish at least 500 acres of conservation easements in the watershed within 15 years Provide conservation technical assistance to at least 75 landowners per year
Estimated Load Reductions	Exposure through the newsletter/flyer to best management practices, farm bill programs, and other ways to protect shoreline will change some landowners' practices and encourage participation in programs that protect water quality and can be expected to improve and maintain current water quality. Landowners who attend workshops regarding shoreline management can be expected to come away with increased awareness of how their land management decisions impact water quality and many will change their current shoreline management practices. This can be expected to improve and maintain current water quality. Targeted mailing of conservation easement information can be expected to generate interest and contact with several watershed landowners. Obtaining the goal of getting 3 easements and the long term goal of 500 acres of easements within the watershed can be expected to improve and maintain water quality.
Zone of Implementation	Zone 1
Responsible parties	**Conservation Districts**, MSUE, NRCS, Southwest Michigan Land Conservancy
Overall Task Duration and Priority	15 years to complete High Priority
Estimated Cost	$500/workshop $500/mailing ($8,500); plus the cost of the conservation easements

Evaluation	Record contacts generated by mailings Before and after knowledge surveys in conjunction with workshops Average of 5 conservation technical assistance contacts per month 3 conservation easements within 3 years At least 500 acres of conservation easements within 15 years
Timeline for Evaluation	1 to 15 years

Objective Two	Establish a road/stream crossing improvement program to correct identified problems
Pollutant	Sediment
Source/Cause	1 site accounting for .17 tons/yr requiring stabilization; 58 total road/stream crossings requiring continued maintenance in order to maintain riparian area around them in a natural state
Task 1	Stabilize erosion at road/stream crossings
BMPs	Replace culverts, install diversion outlets, pavement, reduce grade of approaches, revegetation
Milestones	Develop site plans, obtain proper permits and landowner permissions for 1 site per year - year 1 of task Secure funding and organize materials - years 2 thru 3 of task Organize work crew and implement BMPs at the selected site - years 2 thru 3 of task
Estimated Load Reductions	For the site currently experiencing erosion the BMPs installed will have controlled the gully erosion, resulting in a reduction of .17 tons/yr
Zone of Implementation	Zone 1
Responsible parties	**St Joseph, Van Buren, Kalamazoo, and Cass County Road Commissions,** Conservation Districts, County Drain Commissioners
Overall Task Duration and Priority	2 to 3 years High Priority
Estimated Cost	$50,000/site
Evaluation	Before and after photographs; erosion rate calculations before and after, Benthic invertebrate samples at stabilization site, measurement of sediment depth before and after stabilization at key locations, habitat scores of each site before and after stabilization using MDEQ Procedure 51
Threshold	TSS levels for the watershed should remain at or below 20mg/L in order to maintain its current status as "clear" waters. This should be evaluated visually on a routine basis each year along with monitoring every five years to coincide with MDEQ biosurvey schedule. Overall habitat score and characterization, based on MDEQ Procedure 51, for the tributary in question (if applicable) and for the watershed in general should remain the same or above (better than) the results listed on Table 4. in Appendix 3 of the plan.
Timeline for Evaluation	2 to 5 years

Task 2	Integrate the prototype road-stream crossing form found in Appendix 5 with current Road Commission procedures in order to improve monitoring of road-stream crossing integrity
Target Audience	Road Commissioners
Message	Adding evaluation techniques to existing procedures currently being used can lessen the environmental impact of road stream crossings
Delivery Mechanisms	One on One training and integration of the road-stream crossing form
Milestones	Introduce and train road commission personnel in form usage – year 1 of task Develop database and cost-benefit analysis tools and method incorporating results into decision making processes. Years 1 thru 2 of task Begin usage of form and evaluation process to evaluate and prioritize projects in each of the four counties years 2 thru 3 of task
Estimated Load Reductions	Integrating the road-stream crossing form into current road commission inventory documents/procedures can be expected to result in earlier identification of eroding areas and more information about the impacts of these areas so that road commissions can prioritize their maintenance and repair efforts. This can be expected to improve and/or maintain water quality.
Zone of Implementation	Zone 1
Responsible parties	**Conservation Districts,** Road Commissions, MS4s
Overall Task Duration and Priority	1 to 3 years Moderate Priority
Estimated Cost	$1000
Evaluation	Survey Road Commissions to determine effectiveness and value of erosion form. Cost savings analysis.
Timeline for Evaluation	2 to 5 years

Task 3	Hold a workshop for Road Commissioners highlighting streambank stabilization techniques, sizing and placement of culverts with fisheries, and the role that Road Commissioners play in water quality issues
Target Audience	Road Commissioners and staff
Message	New techniques for installation and maintenance of road-stream crossings can protect water quality
Delivery Mechanisms	Workshop highlighting streambank stabilization techniques, sizing and placement of culverts with fisheries in mind, and the role that road/stream crossings play in water quality issues.
Milestones	Hold 1 workshop for Road Commissioners year 1 of task
Estimated Load Reductions	Attendees of a workshop highlighting streambank stabilization techniques, sizing and placement of culverts with fisheries in mind, and the role that road/stream crossings play in water quality issues can be expected to leave with a better understanding of these topics and may improve their current practices. This can be expected to improve and/or maintain water quality
Zone of Implementation	Zone 1
Responsible parties	**Conservation Districts,** Road Commissions, MDNR
Overall Task Duration and Priority	1 year, Low Priority
Estimated Cost	$500.00
Evaluation	Before and after knowledge surveys in conjunction with the workshop. Follow up survey on changes in practices
Timeline for Evaluation	1 year

Objective Three	Work directly with landowners to eliminate livestock access to the river
Pollutant	Sediment
Source/Cause	2 sites accounting for a total of 1.1 tons/yr of erosion (RRM10 with .7 tons/yr and RRM57 with .4 tons/yr) requiring livestock exclusions and alternative watering systems
Task 1	Implement structural BMPs at both identified livestock access points
To be done in conjunction with Goal 6, Objective 3, Task 1	
BMPs	Fencing, stream crossings, watering devices, revegetation
Milestones	Create conservation plans for each landowner and site plans year 1 of task Obtain proper permits and landowner permission - year 1 of task Organize work crew and install BMPs - years 2 thru 3 of task
Estimated Load Reductions	For each site currently experiencing erosion the BMPs installed will have controlled the gully erosion, resulting in a reduction of 1.1 tons/yr
Zone of Implementation	Zone 1
Responsible parties	**Cass and St. Joseph County Conservation Districts**, NRCS, Landowners
Overall Task Duration and Priority	2 to 3 years High Priority
Potential Improvement Locations	Cowling Road on Rocky River and Huff Road on Rocky River
Estimated Cost	$10,000/site (2 sites $20,000),
Evaluation	Before and after photographs; document number of sites completed, Before and after erosion rate calculations, Benthic invertebrate studies at or near site before and after if financially feasible, E coli grab samples before and after, Before and after measurement of sediment depth at key locations, habitat scores of each site before and after stabilization using MDEQ Procedure 51
Threshold	TSS levels for the watershed should remain at or below 20mg/L in order to maintain its current status as "clear" waters. This should be evaluated visually on a routine basis each year along with monitoring every five years to coincide with MDEQ biosurvey schedule. Overall habitat score and characterization, based on MDEQ Procedure 51, for the tributary in question (if applicable) and for the watershed in general should remain the same or above (better than) the results listed on Table 4. in Appendix 3 of the plan.
Timeline for Evaluation	2 to 3 years

Objective Four	Reduce/eliminate construction site erosion
Pollutant	Sediment
Source/Cause	15-20 construction sites per year within 500 ft. of surface water or larger than 1 acre in size requiring contractor training and permitting
Task 1	Offer training to contractors in soil erosion control Best Management Practices
Target Audience	Contractors
Message	Construction sites can contribute to erosion problems, but simple practices can prevent this from occurring
Delivery Mechanisms	One workshop highlighting how to comply with Part 91 soil erosion requirements and soil erosion best management practices in each county
Milestones	Obtain a list of area contractors, building officials, and others (year 1 of task) Develop training materials and presentation (year 1 of task) Hold 1 training in each county (year 1 of task)
Estimated Load Reductions	It can be expected that workshop attendees would come away with an increased knowledge of soil erosion best management practices and the steps involved in the part 91 permitting process. This should result in a change of practices that can be expected to improve and/or maintain water quality
Zone of Implementation	Zone 1
Responsible parties	**SESC Officials,** Conservation Districts, Counties
Overall Task Duration and Priority	1 year Moderate Priority
Estimated Cost	$3,000
Evaluation	Record # permit violations per county before and after workshop, before and after knowledge gained survey, follow up with contractors following the workshop to determine if practices have changed or if more workshops are needed
Timeline for Evaluation	1 to 2 years

Objective Five	Reduce/eliminate erosion at human access points
Pollutant	Sediment
Source/Cause	1 site accounting for .0025 tons/yr requiring improved access. 11 unimproved road stream crossings are the only current access points. 2-3 additional recreational access sites would need to be established in order to meet current recreational needs and to prevent erosion problems at those locations. All sites should be evaluated annually to insure that unimproved sites remain in a natural condition or are improved as usage dictates
Task 1	Secure and develop access sites
BMPs	Provide parking, create launch pads, steps, walkway
Milestones	Obtain current landowner permission to provide public access - years 1 thru 3 of task Develop site plans and obtain proper permits - years 1 thru 3 of task Secure funding if land purchase is required, purchase and organize materials - years 1 thru 3 of task Organize work crew and implement BMPs at select sites years 2 thru 6 of task Establish 2 sites within 3 years and 4 sites within 6 years
Estimated Load Reductions	For the site currently experiencing erosion the BMPs installed will have controlled the gully erosion, resulting in a reduction of .0025 tons/yr
Zone of Implementation	Zone 1
Responsible parties	**St. Joseph and Cass County Parks Departments**, Road Commissions, St. Joseph and Cass Conservation Districts, Heritage Water trails
Overall Task Duration and Priority	3 to 6 years Moderate Priority
Potential Improvement Locations	Pioneer Street, Bent Road, Floating Bridge Road, Null Road
Estimated Cost	$10,000/site (4 sites $40,000)
Evaluation	Before and after photographs; document number of sites completed, Before and after erosion rate calculations, Benthic invertebrate studies at or near site before and after if financially feasible, Before and after measurement of sediment depth at key locations, habitat scores of each site before and after stabilization using MDEQ Procedure 51
Threshold	TSS levels for the watershed should remain at or below 20mg/L in order to maintain its current status as "clear" waters. This should be evaluated visually on a routine basis each year along with monitoring every five years to coincide with MDEQ biosurvey schedule. Overall habitat score and characterization, based on MDEQ Procedure 51, for the tributary in question (if applicable) and for the watershed in general should remain the same or above (better than) the results listed on Table 4. in Appendix 3 of the plan.
Timeline for Evaluation	3 to 8 years

Objective six	Prevent/reduce erosion from farm fields
Pollutant	sediment
Source/Cause	There are approximately 18,300 acres of land in agricultural land use within zone 1 (1 kilometer of the river) that are priorities for Best Management Practices and continued education/awareness training of landowners in order to prevent future problems
Task 1	Hold tours highlighting agricultural best management practices "field walks"
To be performed in conjunction with Goal Three, Objective 1, Task 1	
Target Audience	Zone 1 producers
Message	Your colleagues are trying new practices that are benefiting their bottom line and the environment. You could get similar results
Delivery Mechanisms	"Field Walks" monthly 1-2 hour field walks where producers get to showcase the Best Management Practices they've installed and how they have benefited from them
Milestones	Select sites/producers willing to host walks - year 1 of task Publicize the events - year 1 of task Hold one "field walk" every other month March - October years 1 thru 3 of task
Estimated Load Reductions	Exposure to new practices and the personal testimonies of colleagues can be expected to result in a portion of the attendees changing their current practices. This can be expected to improve and maintain water quality
Zone of Implementation	Zone 1
Responsible parties	**MSUE,** Conservation Districts, NRCS
Overall Task Duration and Priority	3 years to complete High Priority
Estimated Cost	$250/field walk ($3000)
Evaluation	Before and after knowledge surveys in conjunction with field walks follow-up surveys to determine if a change in practice has been made or if more walks are needed
Timeline for Evaluation	1 to 4 years

Objective Seven	Prevent/reduce sediment entering the river from storm drains
Pollutant	Sediment
Source/Cause	There are approximately 15 storm drain outfalls into the Rocky River that potentially carry sediment to the river. An area of 1,253.501 acres (approximately 2 square miles) is in an urban land use within the watershed.
Task 1	Develop and implement storm water education programs in urban areas
To be performed in conjunction with Goal 5, Objective 3, Task 1 and Goal 7, Objective 1, Task 1	
Target Audience	Urban Landowners
Delivery Mechanisms	Newspaper articles, Public Service Announcements, Traveler's Information Station, Newsletters
Milestones	Obtain public service announcement campaigns and add local contact information - year 1 of task Publish 1 newspaper article per quarter in the Three Rivers Commercial, Marcellus News, Cassopolis Vigilant, and the Kalamazoo Gazette regarding storm water issues - years 1 thru 3 of task Publish a bi-annual newsletter for urban residents - years 1 thru 3 of task Obtain funding and establish a travelers information station - years 1 thru 5 of task
Estimated Load Reductions	It can be expected that some landowners exposed to information and education campaigns will change their practices based on a greater awareness of water quality issues. This can be expected to improve and/or maintain water quality
Zone of Implementation	Zone 1, Zone 2, Zone 3 (urban areas)
Responsible parties	**MS4 Permittees,** Conservation Districts, MSUE, Three Rivers Chamber of Commerce, River Country Tourism, Road Commissions, MDOT
Overall Duration of Task and Priority	1 to 5 years to complete Moderate Priority (High for MS4s)
Estimated Cost	$1000/newsletter ($6000) Traveler's Information Station $15,000
Evaluation	Record contacts generated by mailings/Travelers Information Station Survey urban landowners before and after about their management techniques to determine if a change in practices has been made, and to determine future public education needs
Timeline for Evaluation	1 to 6 years

Goal Two	To improve and protect the warmwater fishery and other indigenous aquatic life and wildlife in the Rocky River Watershed by limiting the amount of road salt (NaCl) entering the system
Objective One	Work with Road Commissioners to limit the amount of road salt entering surface water
Pollutant	Salt
Source/Cause	58 road/stream crossings exist in the watershed that are potential locations of salt inputs
Task 1	Work with Road Commissioners to alter winter/spring road maintenance near surface water to limit the amount of salt entering the system
Target Audience	Road Commissioners
Message	Road salt can have a negative impact on water quality. This can be minimized through adjusting road maintenance practices near surface water.
Delivery Mechanisms	One on One consultations with road commissioners about current practices and potential changes that could lessen the amount of salt reaching surface waters
Milestones	Work with road commissioners to evaluate the potential for road salt to enter surface water with their current practices - year 1 of task Work with road commissioners to evaluate alternative practices and their effectiveness -years 1 thru 2 of task Implement new management practices years 2 thru 4 of task
Estimated Load Reductions	Working one on one with road commissioners in evaluating their procedures and how to improve upon them can be expected to result in a change in practices in some cases. Changes in management practices can be expected to improve and maintain water quality.
Zone of Implementation	Zone 1
Responsible parties	**Road Commissioners,** Conservation Districts, MS4s
Overall Duration of Task and Priority	4 years to complete Low Priority
Estimated Cost	undetermined
Evaluation	Monitor conductivity at key road stream crossings, record practices changed
Timeline for Evaluation	1 to 4 years

Task 2	Evaluate the use of Calcium Magnesium Acetate (CMA) as an alternative to road salt and for use in critical areas
Target Audience	Road Commissioners
Message	Alternatives exist to road salt and should be considered when evaluating road maintenance techniques
Delivery Mechanisms	One on One consultations with road commissioners about current practices and potential changes that could lessen the amount of salt reaching surface waters
Milestones	Work with road commissioners to evaluate the potential for using CMA as an alternative to road salt - years 1 thru 2 of task Work with road commissioners to evaluate critical areas that would benefit from use of this alternative - years 1 thru 2 of task
Estimated Load Reductions	Use of CMA as an alternative to road salt can be expected to improve and/or maintain water quality
Zone of Implementation	Zone 1
Responsible parties	**Road Commissioners,** Conservation Districts, MS4s
Overall Task Duration and Priority	2 years Low Priority
Estimated Cost	undetermined
Evaluation	Monitor conductivity at key road stream crossings, record practices changed
Timeline for Evaluation	2 years

Goal Three	To improve and protect the warmwater fishery and Other Indigenous Aquatic life and Wildlife in the Rocky River Watershed by reducing the amount of nutrients entering the system
Objective One	Reduce/prevent nutrients from agricultural practices from reaching surface water
Pollutant	Nutrients
Source/Cause	There are approximately 18,300 acres of land in agricultural land use within zone 1 (1 kilometer of the river) that are priorities for Best Management Practices and continued education/awareness training of landowners in order to prevent future problems plus 1 highly visible site under an acre in size (Scidmore park petting zoo) needing BMPs to minimize contaminated runoff. This petting zoo has an estimated annual Phosphorous loading rate of 30 lbs/year
Task 1	Hold tours highlighting agricultural best management practices "field walks"
To be performed in conjunction with Goal 1, Objective 7, Task 1	
Target Audience	Zone 1 producers
Message	Your colleagues are trying new practices that are benefiting their bottom line and the environment. You could get similar results
Delivery Mechanisms	"Field Walks" monthly 1-2 hour field walks where producers get to showcase the Best Management Practices they've installed and how they have benefited from them
Milestones	Select sites/producers willing to host walks - year 1 of task Publicize the events - year 1 of task Hold one "field walk" every other month March - October years 1thru 3 of task
Estimated Load Reductions	Exposure to new practices and the personal testimonies of colleagues can be expected to result in a portion of the attendees changing their current practices. This can be expected to improve and maintain water quality
Zone of Implementation	Zone 1
Responsible parties	**MSUE,** Conservation Districts, NRCS
Overall Duration of Task and Priority	3 years to complete High Priority
Estimated Cost	$250/field walk ($3000)
Evaluation	Before and after knowledge surveys in conjunction with field walks follow-up surveys to determine if a change in practice has been made
Timeline for Evaluation	1 to 4 years

Task 2	Develop a Certified Nutrient Management Plan or Manure Management Plan and a barnyard runoff management for the Petting Zoo in Scidmore Park
BMPs	Certified Nutrient Management Plan (CNMP) or Manure Management Plan, Barnyard runoff management
Milestones	Create a CNMP or Manure Management Plan for the Scidmore Park Petting Zoo - year 1 of task Implement the practices outlined in the CNMP or Manure Management Plan - year 1 of task Identify runoff improvement areas - year 1 of task Implement strategies to divert clean water from the barnyard and prevent it from becoming contaminated - years 1 thru 3 of task
Estimated Load Reductions	Based on nutrient removal rates for agricultural BMPs referenced in the bibliography under websites entitled "Appendix F . . ." Manure Management can be expected to have an average dissolved P removal of 10% and an average particulate P removal of 50% on each site implemented. Barnyard runoff management can be expected to have a mean dissolved P removal of 30% and a particulate P removal of 63% on each site implemented
Zone of Implementation	Zone 1
Responsible parties	**City of Three Rivers**, NRCS
Overall Task Duration and Priority	1 to 3 years High Priority
Estimated Cost	$0 for Management Plan Development; undetermined cost for barnyard runoff management strategy implementation
Evaluation	Documentation of number of practices changed; sample the outlet before and after implementation of manure management plan during wet events for total phosphorous, nitrates, ammonia, bacteria and BOD
Threshold	The USEPA recommends that TP levels remain below 100ug/L in rivers not discharging directly to a reservoir. Evaluation of this should include annual visual observations of the stream for excessive aquatic plant and algae growth and monitoring to correspond with the five year MDEQ monitoring schedule
Timeline for Evaluation	1 to 3 years

Objective Two	Reduce/prevent nutrients from Park and park-like areas from entering surface water
Pollutant	Nutrients
Source/Cause	2 parks totaling approximately 20 acres. Two golf courses totaling 375 acres. The parks have a daily goose population of 50-100 per day this equates to a phosphorous load of 19.715 lbs/year - 39.43 lbs/year. The golf courses average between 25-50 geese per day this equates to a phosphorous load of 9.857 - 19.715 lbs/year.
Task 1	Work with the Parks Department and golf courses to eliminate/reduce wildlife (goose) waste runoff using comprehensive management techniques
To be performed in conjunction with Goal 6, Objective 1, Task 1	
BMPs	Alternative riparian vegetation (buffers), Hazing, egg addling, physical barriers
Milestones	Evaluate current management practices and determine if they are encouraging or discouraging geese populations - year 1 Evaluate which alternative(s) best suits the needs of the parks and implement the practice - years 2 thru 3
Estimated Load Reductions	It can be assumed that changing management practices will reduce the amount of phosphorous entering the system. Goose reductions will depend on the practice implemented, but on average phosphorous loading will be reduced by .4 lbs/year for each goose displaced
Zone of Implementation	Zone 1
Responsible parties	**Parks Departments, Old Mill Golf Course, Pine View Golf Course,** Conservation Districts, Health Departments, Municipality
Overall Task Duration and Priority	2-3 years High Priority
Potential Improvement Locations	Scidmore Park, Memory Isle Park, Old Mill Gold Course, Pine View Golf Course
Estimated Cost	$5,000
Evaluation	# of animals before and after, Nutrient loading estimates before and after, before and after photos, visitor surveys before and after
Threshold	The USEPA recommends that TP levels remain below 100ug/L in rivers not discharging directly to a reservoir. Evaluation of this should include annual visual observations of the stream for excessive aquatic plant and algae growth indicators and monitoring to correspond with the five year MDEQ monitoring schedule
Timeline for Evaluation	1-3 years

Task 2	Educate private landowners in how buffers can eliminate/reduce fertilizer and goose waste runoff
To be performed in conjunction with Goal 4, Objective 1, Task 2	
Target Audience	Zone 1 Landowners
Message	Buffers can deter unwanted geese from taking up residence at your residence and can prevent nutrients from reaching our lakes and streams
Delivery Mechanisms	Workshop on managing land to prevent nutrient runoff and to deter geese
Milestones	Hold a workshop in preventing nutrient runoff and deterring geese - year 1 of task
Estimated Load Reductions	Attendees of the workshop can be expected to come away with a better understanding of how their management of their property can protect water quality and some of the attendees will change their management practices accordingly. This can be expected to improve or maintain water quality. Goose reductions will depend on the practice implemented, but on average phosphorous loading will be reduced by .4 lbs/year for each goose displaced
Zone of Implementation	Zone 1
Responsible parties	**Conservation Districts,** MSUE, Lake Associations
Overall Duration of Task and Priority	1 year Moderate Priority
Estimated Cost	$500
Evaluation	Before and after knowledge surveys in conjunction with workshop follow-up surveys to determine if a change in practice has been made, or if additional workshops are needed
Timeline for Evaluation	1 to 2 years

Task 3	Work with Golf Courses to obtain certification in Audubon International Sanctuary program (water quality management certification)
To be performed in conjunction with Goal 3, Objective 2, Task 1 and Goal 6, Objective 1, Task 2	
BMPs	Vegetative filter strips
Milestones	Enrollment of each golf course into the sanctuary program year 1 of task Progress through each step in order to become certified year 1 of task Obtain certification - year 1 of task
Estimated Load Reductions	Obtaining certification in the Audubon Sanctuary water quality management criteria requires changes in practices and implementation of BMPs that control nutrient runoff. This will improve or maintain water quality
Zone of Implementation	Zone 1
Responsible parties	**Golf Courses,** Audubon International, Conservation Districts
Overall Duration of Task and Priority	1 year Moderate Priority
Estimated Cost	$150/yr membership fee per golf course, cost of implementing BMPs
Evaluation	Successful completion of water quality management certification; track of fertilizer usage before and after; documentation of number of practices changed
Threshold	The USEPA recommends that TP levels remain below 100ug/L in rivers not discharging directly to a reservoir. Evaluation of this should include annual visual observations of the stream for excessive aquatic plant and algae growth indicators and monitoring to correspond with the five year MDEQ monitoring schedule
Timeline for Evaluation	1 to 2 years

Objective Three	Reduce/eliminate nutrient inputs from residential yards from entering the river
Pollutant	Nutrients
Source/Cause	There are approximately 5000 residential yards in the watershed. 12 townships have all or some of their area encompassed by the watershed
Task 1	Work with townships to develop buffer ordinances near surface water
To be performed in conjunction with Goal 5, Objective 2, Task 1	
BMPs	Buffer ordinance
Milestones	Evaluate model buffer ordinances with townships to determine what ordinance language and setbacks would be most acceptable for the township year 1 thru 2 of task Work with townships to alter model ordinance to meet township needs - year 2 of task Adopt ordinances - years 2 thru 5 Adopt buffer ordinances in 3 of the 12 townships - by the end of the 3rd year Adopt buffer ordinances in 6 of the 12 townships - by the end of the 5th year
Estimated Load Reductions	For each township adopting a buffer ordinance it can be expected to improve and/or maintain water quality through the change in practices outline by the ordinance
Zone of Implementation	Zone 1
Responsible parties	**Townships,** Conservation Districts
Overall Duration of Task and Priority	2 to 5 years High Priority
Estimated Cost	$1,200 - $1,500 per township to work with a consultant to develop and adopt an ordinance (This estimate assumes minimal consultant oversight and assistance with the majority of the work being performed by the township)
Evaluation	Document number of townships adopting ordinances and the miles of shoreline protected in each township where ordinances are developed
Threshold	The USEPA recommends that TP levels remain below 100ug/L in rivers not discharging directly to a reservoir. Evaluation of this should include annual visual observations of the stream for excessive aquatic plant and algae growth indicators and monitoring to correspond with the five year MDEQ monitoring schedule
Timeline for Evaluation	3 to 6 years

Task 2	Establish a Super Soils Day in the Watershed
Target Audience	Residential Landowner
Message	While nitrogen, phosphorous, potassium, and other nutrients are necessary for a healthy lawn, over-application of fertilizers wastes money, ruins plants, and pollutes water
Delivery Mechanisms	Free Soil testing day. Results come with educational information on how to choose the correct fertilizer for lawn needs and how to protect water quality
Milestones	Obtain partnering retailers in or near the watershed - year 1 of task Provide training to staff and obtain volunteers to supplement staff on SS day -each year of task Hold 1 Super Soils Day each year for at least 3 years
Estimated Load Reductions	It can be assumed that educating people about why soil testing is important and how to choose the correct fertilizer will result in changes in their management practices. This can be expected to improve or maintain water quality
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	**MSUE, Local fertilizer retailers,** Conservation Districts
Overall Duration of Task and Priority	At Least 1 to 3 years Low Priority
Estimated Cost	$5,000
Evaluation	Tracking of the number of tests given each year; track the amount of phosphorous free fertilizer sold each year; follow up surveys to determine change in practices (fertilizer use) and the need for future Super Soils Days
Timeline for Evaluation	1 to 4 years

Objective Four	Prevent nutrients from failing septic systems from entering surface water
Pollutant	Nutrients
Source/Cause	Failing Septic Systems
Task 1	Educate landowners with septic systems on how to maintain them
To be performed in conjunction with Goal 6, Objective 2, Task 1	
Target Audience	Landowners with septic systems
Message	In shoreland areas it is particularly important to maintain your septic system properly because soil and water conditions near shore may make the system less efficient in treating wastewater. Incomplete treatment can result in health risks for humans and water quality problems
Delivery Mechanisms	Township newsletters, Offer coupons from local septic care professionals
Milestones	Obtain permissions from the townships to include a septic care article in their newsletters - year 1 of task Obtain discounts from local septic care professionals to accompany articles - year 1 of task Write at least two articles for each of the newsletters year 1 and 2 of task
Estimated Load Reductions	It can be expected that landowners who read the articles in the newsletters will become more informed as to how their management practices can impact water quality. Some of these landowners can be expected to change their practices and this will improve or maintain water quality
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	**Conservation district**, Townships, Septic care professionals
Overall Duration of Task and Priority	1 to 2 years Low Priority
Estimated Cost	% of postage and printing costs proportional to size of article
Evaluation	Monitor usage of coupons
Timeline for Evaluation	1 to 2 years

Task 2	Develop septic management and design ordinances
To be performed in conjunction with Goal 6, Objective 2, Task 2	
BMPs	Septic management ordinance, septic system design ordinance
Milestones	Evaluate model septic system ordinances with townships to determine what ordinance language and setbacks would be most acceptable for the township year 1 thru 2 of task Work with townships to alter model ordinance to meet township needs - year 2 of task Adopt ordinances - years 2 thru 15 Adopt septic system ordinances in 1of the 12 townships by the end of the 3rd year of the task Adopt septic system ordinances in 3 of the 12 townships by the end of the 5th year of the task Adopt septic system ordinances in 12 of the 12 townships by the end of the 15th year of the of task
Estimated Load Reductions	For each township adopting a septic system ordinance it can be expected to improve and/or maintain water quality through the change in practices outline by the ordinance
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	**Townships,** Conservation Districts
Overall Duration of Task and Priority	1 to 12 years Moderate Priority
Estimated Cost	$1,200 - $1,500 per township to work with a consultant to develop and adopt an ordinance
Evaluation	Document number of townships adopting ordinances and number of septic systems effected by ordinances
Threshold	The USEPA recommends that TP levels remain below 100ug/L in rivers not discharging directly to a reservoir. Evaluation of this should include annual visual observations of the stream for excessive aquatic plant and algae growth indicators and monitoring to correspond with the five year MDEQ monitoring schedule
Timeline for Evaluation	2 to 12 years

Goal Four	To improve and protect the warmwater fishery and other indigenous aquatic life and wildlife by preventing or reducing the amount of pesticides entering surface water
Objective One	Reduce/eliminate pesticides used in residential applications from reaching surface water
Pollutant	Pesticides
Source/Cause	Approximately 5000 residential landowners in the watershed that have the potential to improperly handle pesticides
Task 1	Hold a annual regional clean sweep pick up day in the watershed
Target Audience	All Landowners who may have unwanted, banned, or nonusable pesticides
Message	It is illegal to dispose of hazardous materials (pesticides) in local landfills and can degrade water quality. The Clean Sweep Program will take your pesticides and dispose of them properly
Delivery Mechanisms	Press releases advertising the watershed collection day; Collection Day
Milestones	Organize a watershed Clean Sweep Collection Day - year 1 of task Publicize and hold Collection Day - Year 1 of task
Estimated Load Reductions	It can be assumed that all individuals taking part in Clean Sweep are disposing of their pesticides properly. We can assume that this will improve or maintain water quality
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	**Michigan Groundwater Stewardship Program**, Conservation Districts, MSUE, Regional Clean Sweep in Kalamazoo
Overall Duration of Task and Priority	1 to ? years Low Priority
Estimated Cost	$0
Evaluation	Pounds of Pesticides Collected; # of participants; # of participants new to the program
Timeline for Evaluation	1 year

Task 2	Hold a workshop on integrated pest management and the safe use of pesticides
To be performed in conjunction with Goal 3, Objective 2, Task 2	
Target Audience	Zone 1 Landowners
Message	Proper handling, storage, use, and disposal of pesticides protects water quality and the environment
Delivery Mechanisms	Workshop on managing land prevent pesticide runoff and leaching
Milestones	Hold a workshop in preventing pesticide runoff and leaching - year 1 of task
Estimated Load Reductions	Attendees of the workshop can be expected to come away with a better understanding of how their management of their property can protect water quality and a portion of the attendees will change their management practices accordingly. This can be expected to improve or maintain water quality.
Zone of Implementation	Zone 1
Responsible parties	**Conservation Districts**, MSUE, Ground Water Stewardship Program
Overall Duration of Task and Priority	1 year Low Priority
Estimated Cost	$500
Evaluation	Before and after knowledge surveys in conjunction with workshop follow-up surveys to determine if a change in practice has been made, and to determine if additional workshops are needed
Timeline for Evaluation	1 to 2 years

Objective Two	Reduce/eliminate Pesticides used in Golf Course applications that enter surface water
Pollutant	Pesticides
Source/Cause	Two golf courses totaling 375 acres exist within the watershed
Task 1	Work with Golf Courses to obtain certification in Audubon International Sanctuary program (Chemical use reduction and safety certification)
To be performed in conjunction with Goal 3, Objective 2, Task 1 and Goal 6, Objective 1, Task 2	
BMPs	Integrated Pest Management Plan, No spray zones, buffers, filter strips
Milestones	Enrollment of each golf course into the sanctuary program year 1 of task Progress through each step in order to become certified year 1 of task Obtain certification - year 1 of task
Estimated Load Reductions	Obtaining certification in the Audubon Sanctuary water quality management criteria requires changes in practices and implementation of BMPs that control nutrient runoff. This will improve or maintain water quality
Zone of Implementation	Zone 1
Responsible parties	**Golf Courses,** Audubon International, Conservation Districts
Overall Duration of Task and Priority	1 year Moderate Priority
Estimated Cost	$150/yr membership fee per golf course, cost of implementing BMPs
Evaluation	Successful completion of water quality management certification; track of pesticide usage before and after; documentation of number of practices changed
Timeline for Evaluation	1 to 2 years

Objective Three	Reduce/eliminate pesticides used in an agricultural setting that enter surface water
Pollutant	Pesticides
Source/Cause	There are approximately 260 farms in the watershed that would benefit from education and awareness of their risks to water quality from their pesticides
Task 1	Perform Farm*A*Systs with at least 50% of all farms in the watershed
BMPs	Abandon well closure, signage, emergency spill plans, drift management plans
Milestones	Perform at least 33 Farm*A*Systs per year Perform at least 130 Farm*A*Systs by year 4 of task Perform at least 260 Farm*A*Systs by year 8 of task
Estimated Load Reductions	It has been found that 60% of the producers that participate in the Farm*A*Syst change their practices. This results in improved or maintained water quality.
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	**Groundwater Stewardship Program,** Conservation Districts, MSUE
Overall Duration of Task and Priority	8 years Moderate Priority
Estimated Cost	$0 for Farm*A*Syst undetermined cost to implement BMPs outlined by Farm*A*Syst
Evaluation	Annual Survey to Farm*A*Syst participants tracking changes in practices meeting the estimate of 60% Meeting annual goals for number of Farm*A*Syst
Timeline for Evaluation	1 to 9 years

Goal Five	To improve or maintain current hydrology in order to protect water quality
Objective One	Perform flood plain management to prevent damaging effects of floods and preserve and enhance natural values and provide optimal use of land and water resources within the floodplain
Pollutant	Hydrology changes
Source/Cause	Approximately 15,500 acres of undeveloped land exist within zone 1 (1 kilometer of surface water), 1253 acres of Urban area within the watershed; These areas are priorities for flood plain management
Task 1	Reduce and Delay Runoff from parking lots and residential development through incentive programs that promote installation of BMPs in urban areas
To be performed in conjunction with Goal 3, Objective 3, Task 1	
BMPs	Porous Pavement, Vegetative Ponding areas around parking lots, Grassy islands in parking lots, Grassed waterways draining parking lots, gravel driveways, contoured landscaping, vegetative depressions, detention basins, green roofs
Milestones	Obtain "buy in" from townships, Municipalities, Counties, and Building officials, and other permitting agencies - year 1 through 2 of task Work with partners to establish incentives to install BMPs year 1 through 3 of task Have at least 10% of new construction utilizing the incentive program each year by year 10 of the task
Estimated Load Reductions	Each BMP implemented can be expected to reduce or prevent runoff from the site. This will result in improved or maintained water quality
Zone of Implementation	Zone 1
Responsible parties	**Municipalities**, Counties, Building Officials, permitting officials, townships, Conservation Districts
Overall Duration of Task and Priority	1 to 10 years Moderate Priority
Estimated Cost	Dependant on incentive proposed
Evaluation	# of entities participating; number of BMPs installed, meeting goal of 10% participation in 10 years
Timeline for Evaluation	1 to 11 years

Task 2	Reduce the development within the floodplain of the river by developing, implementing, or updating a flood plain protection and zoning ordinance based on the 100 year frequency high water profile and the flood plains delineation
BMPs	Flood Plain Protection and Zoning ordinance
Milestones	Obtain "buy in" from townships years 1 of task Evaluate model flood plain ordinances with townships to determine what ordinance language would be most acceptable for the township year 1 thru 2 of task Work with townships to alter model ordinance to meet township needs - year 2 of task Adopt ordinances - years 2 thru 5 Adopt Flood Plain ordinances in 1of the 12 townships - by the end of the 3rd year Adopt Flood Plain ordinances in 3 of the 12 townships - by the end of the 5th year Adopt Flood Plain ordinances in 12 of the 12 townships – by year 15 of task
Estimated Load Reductions	Each ordinance adopted will minimize development in the flood plan. This will improve or protect water quality
Zone of Implementation	Zone 1
Responsible parties	**Townships**, Conservation Districts
Overall Duration of Task and Priority	1 to 15 years High Priority
Estimated Cost	
Evaluation	# of townships adopting ordinances and # of acres impacted by ordinances
Timeline for Evaluation	1 to 15 years

Objective Two	Protect the warmwater fishery and other indigenous aquatic life and wildlife by preventing land use changes that increase stream temperature
Pollutant	Temperature changes/hydrology changes
Source/Cause	Approximately 15,500 acres of undeveloped land exist within zone 1 (1 kilometer of surface water)
Task 1	Work with townships to develop buffer ordinances near surface water
To be performed in conjunction with Goal 3, Objective 3, Task 1	
BMPs	Buffer ordinance
Milestones	Evaluate model buffer ordinances with townships to determine what ordinance language and setbacks would be most acceptable for the township year 1 thru 2 of task Work with townships to alter model ordinance to meet township needs - year 2 of task Adopt ordinances - years 2 thru 5 Adopt buffer ordinances in 3 of the 12 townships - by the end of the 3rd year Adopt buffer ordinances in 6 of the 12 townships - by the end of the 5th year Adopt buffer ordinances in 12 of the 12 townships – by year 15 of the task
Estimated Load Reductions	For each township adopting a buffer ordinance it can be expected to improve and/or maintain water quality through the change in practices outline by the ordinance
Zone of Implementation	Zone 1
Responsible parties	**Townships,** Conservation Districts
Overall Duration of Task and Priority	2 to 15 years High Priority
Estimated Cost	$1,200 - $1,500 per township to work with a consultant to develop and adopt an ordinance (this estimate assumes minimal oversight and assistance from the consultant and the majority of the work being completed by the township)
Evaluation	Document number of townships adopting ordinances and the miles of shoreline protected in each township where ordinances are developed
Timeline for Evaluation	3 to 15 years

Task 2	Target riparian landowners with information regarding shoreline protection including: streambank stabilization, critical area treatment, conservation easements, Conservation Reserve Program, Continuous Conservation Reserve Program, Wetland Reserve Program, Environmental Quality Incentive Program, Wildlife Habitat Incentive Program, etc.
To be performed in conjunction with Goal 1, Objective 2, Task 2 and Goal 6, Objective 1, Task 3	
Target Audience	Riparian Landowners
Message	Maintaining shoreline vegetation and landscaping with native plants protects water quality; conservation easements can protect land of environmental significance and provide tax incentives in some cases.
Delivery Mechanisms	Publish a newsletter/flyer highlighting incentive programs, shoreline management techniques, conservation easements, etc.; Offer workshops that teach shoreline management techniques; Target mail riparian landowners with Southwest Michigan Land Conservancy information detailing the benefits and "how tos" of conservation easements
Milestones	Establish a mailing list targeting riparian landowners in the watershed (year 1 of task) Produce and mail one flyer/newsletter per quarter (year 1 thru 3 of task) Hold 3 workshops for riparian landowners on landscaping for water quality (years 1 thru 3 of task) Target mail riparian landowners SWMLC information (year 1 thru 3 of task) Follow up and pursue all contacts generated (year 1 thru 3 of task) Establish at least 3 conservation easements within the watershed within three years Obtain conservation easements on at least 500 acres by year 15 of task Provide conservation technical assistance to at least 75 landowners per year
Estimated Load Reductions	Exposure through the newsletter/flyer to best management practices, farm bill programs, and other ways to protect shoreline will change some landowners' practices and encourage participate in programs that protect water quality and can be expected to improve and maintain current water quality. Landowners who attend workshops regarding shoreline management can be expected to come away with increased awareness of how their land management decisions impact water quality and many will change their current shoreline management practices. This can be expected to improve and maintain current water quality. Targeted mailing of conservation easement information can be expected to generate interest and contact with several watershed landowners. Obtaining the goal of getting 3 easements within the watershed can be expected to improve and maintain water quality.
Zone of Implementation	Zone 1
Responsible parties	**Conservation Districts**, MSUE, NRCS, Southwest Michigan Land Conservancy
Overall Task Duration and Priority	15 years to complete High Priority
Estimated Cost	$500/workshop $500/mailing ($8,500) and costs of conservation easements

Evaluation	Record contacts generated by mailings Before and after knowledge surveys in conjunction with workshops Average of 5 conservation technical assistance contacts per month 3 conservation easements within 3 years. 500 acres of easements by year 15 of task
Timeline for Evaluation	1 to 15 years

Objective Three	Protect the warmwater fisheries and other indigenous aquatic life and wildlife by reducing volume of water entering the system directly from storm drains
Pollutant	Hydrology changes
Source/Cause	There are approximately 15 storm drain outfalls into the Rocky River that potentially carry sediment to the river. An area of 1,253.501 acres (approximately 2 square miles) is in an urban land use within the watershed.
Task 1	Develop and implement storm water education programs in urban areas
To be performed in conjunction with Goal 1, Objective 7, Task 1, Goal 7, Objective 1, Task 1	
Target Audience	Urban Landowners
Delivery Mechanisms	Newspaper articles, Public Service Announcements, Traveler's Information Station, Newsletters
Milestones	Obtain public service announcement campaigns and add local contact information - year 1 of task Publish 1 newspaper article per quarter in the Three Rivers Commercial, Kalamazoo Gazette, Marcellus News, and the Cassopolis Vigilant regarding storm water issues - years 1 thru 3 of task Publish a bi-annual newsletter for urban residents - years 1 thru 3 of task Obtain funding and establish a travelers information station - years 1 thru 5 of task
Estimated Load Reductions	It can be expected that some landowners exposed to information and education campaigns will change their practices based on a greater awareness of water quality issues. This can be expected to improve and/or maintain water quality
Zone of Implementation	Zone 1, Zone 2, Zone 3 (urban areas)
Responsible parties	**MS4 Permittees,** Conservation Districts, MSUE, Three Rivers Chamber of Commerce, River Country Tourism, Road Commissions, MDOT
Overall Task Priority and Priority	1 to 5 years to complete Moderate Priority
Estimated Cost	$1000/newsletter ($6000) Traveler's Information Station $15,000
Evaluation	Record contacts generated by mailings/Travelers Information Station Survey urban landowners before and after about their management techniques to determine if a change in practices has been made or if more education efforts are needed
Timeline for Evaluation	1 to 6 years

Objective Four	Preserve open space, Protect identified sensitive areas and decrease impervious surfaces in order to limit runoff and land cover changes associated with increased development
Pollutant	Hydrology Changes
Source/Cause	53,712 acres or 47% of the watershed is currently considered open space. (Based on total acres in forested and wetland land uses plus 25% of the acreage in an agricultural land use)
Task 1	Work with the townships to develop and implement language and ordinances to facilitate "conservation by design" for subdivision planning
BMPs	Conservation by Design ordinance
Milestones	Research and identify where ordinances are in use for review and analysis - year 1 of task Analyze literature on subject and collect sample ordinances -year 1 of task draft a model ordinance text and prepare illustrations of how ordinance is applied - year 1 of task Make a formal group presentation at a meeting sponsored by the watershed to the townships - year 1 of task Assist interested townships in adopting this ordinance - years 2 through 3 of task Adopt ordinance in at least two townships - year 3 through 4 of task Adopt ordinances in 12 of the 12 townships by year 12 of task
Estimated Load Reductions	Each township adopting Conservation by Design ordinance can be expected to have increased open space preservation within the township. This will result in improved or maintained water quality
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	Consultant, **Townships,** Conservation Districts
Overall Duration of Task and Priority	1 to 12 years Moderate Priority
Estimated Cost	$5,000
Evaluation	Documentation of number of townships who adopt a conservation by design ordinance, Document the number of applications of the conservation by design strategy
Timeline for Evaluation	1 to 10 years (results will be long term)

Task 2	Work with townships in the development of a Natural Resources Inventory and land use policy evaluation
BMPs	Natural Resources Inventory (NRI) and land use policy evaluation for each township (Fabius township NRI completed)
Milestones	Secure townships who wish to participate years 1 through 7 of task Hire consultant to work with townships in this process - years 1 through 7 of task Work with townships and consultant in analysis of current zoning ordinances and suggest options for better protection of their natural resources - years 1 through 8 of task Complete the NRI with at least 6 townships by year 5 of task Complete the NRI with 11 townships by year 8 of task
Estimated Load Reductions	Each township participating in a Natural Resource Inventory will come away with a better understanding of their natural resources and how to protect them. This will result in improved or maintained water quality
Zone of Implementation	Zone 1 Zone 2 Zone 3
Responsible parties	**Consultant, Townships**, St. Joseph County Conservation District, Potawatomi RC&D, Watershed Coordinator
Overall Duration of Task and Priority	2 to 8 years High Priority
Estimated Cost	$15,000/township
Evaluation	Before and after build out analysis of township and focus group sessions to evaluate the effectiveness of ordinances
Timeline for Evaluation	2-10 years (results may be long term)

Task 3	Develop and implement land protection programs for sensitive areas
To be performed in conjunction with Goal 1, Objective 1, Task 2 and Goal 5, objective 2, Task 2	
BMPs	Conservation Easements/ preserves
Milestones	Distribution of land protection information to landowners years 1 through 3 of task Work with private landowners to discuss land protection options for their properties - years 1 to 3 of task Secure funds and permanently protect at least three key identified areas - years 1 to 3 of task Obtain conservation Easements or preserves on at least three properties in the watershed within three years Obtain Conservation Easements on at least 500 acres by year 15 of task
Estimated Load Reductions	Each easement/preserve will protect sensitive areas. This will result in improved and maintained water quality
Zone of Implementation	Zone 1 Zone 2 Zone 3
Responsible parties	**Southwest Michigan Land Conservancy**, County Conservation Districts, Townships
Overall Duration of Task and Priority	2 to 15 years High Priority
Estimated Cost	30,000 ($1,200 to 2,000 per acre per easement)
Evaluation	Document number of areas and acreage permanently protected and conduct landowner interviews, perform natural features inventory on each site to determine type and numbers of species protected
Timeline for Evaluation	2 to 15 years results will be long term

Task 4	Work with Counties and Townships to implement Low Impact Development Codes
BMPs	Low Impact Development
Milestones	Remove disincentives or prohibitions of LID from existing ordinances and policy - year 1 through 2 of task Adopt national LID manual by reference - year 2 of task Request and adopt incentives for developers to choose LID - year 2 of task Adopt and Implement LID code in four townships by year 3 of task Adopt and Implement LID code in 12 townships by year 10 of task
Estimated Load Reductions	Adopting Low Impact Development can be expected to result in the development of LID subdivisions as opposed to normal development. This can be expected to improve and protect water quality.
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	**Townships**, Counties, Conservation Districts, MS4s
Overall Duration of Task and Priority	1 to 10 years, Moderate Priority
Estimated Cost	$1,200 - $1,500 per township to work with a consultant to develop and adopt an ordinance (this estimate assumes minimal consultant oversight and assistance and the majority of the work to be completed by the township)
Evaluation	# of townships adopting LID codes and # of LID developments resulting
Timeline for Evaluation	1 to 10 years

Task 5	Develop a Purchase of Development Rights program in each township, and promote similar programs like the Farmland Development Rights Agreements (PA 116), Local Open Space Easements, and Designated Open Space Agreements
BMPs	PDR, Open Space Preservation
Milestones	Promote programs through Township newsletters and local papers - year 1 of task Develop a PDR program in 2 townships - year 5 of task Develop a PDR program in 6 townships - year 8 of task Develop a PDR program in all of the townships - year 15 of task Enroll at least 2000 acres in any combination of the programs listed above by year 5 of task Enroll at least 6000 acres in any combination of the programs listed above by year 15 of task
Estimated Load Reductions	Protecting land through PDR, PA 116, and Open Space Preservation limits the amount of land developed within the watershed. This will result in improved or maintained water quality
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	**Townships,** Conservation Districts, Counties
Overall Duration of Task and Priority	15 years to complete Moderate Priority
Estimated Cost	dependant on the developmental pressure, zoning, and land appraisal
Evaluation	Number of townships participating, Number of acre enrolled
Timeline for Evaluation	1 to 15 years

Goal Six	To protect/improve the recreational uses of the watershed by preventing E coli/ bacteria from entering the system
Objective One	Reduce/prevent E Coli/bacteria from Park and park-like areas from entering surface water
Pollutant	E Coli/bacteria
Source/Cause	2 parks totaling approximately 20 acres. Two golf courses totaling 375 acres. The parks have a daily goose population of 50-100 per day. The golf courses average between 25-50 geese per day. Goose excrement can contains E Coli/bacteria and if enough reaches surface water it can become a health risk
Task 1	Work with the Parks Department and golf courses to eliminate/reduce wildlife (goose) waste runoff using comprehensive management techniques
To be performed in conjunction with Goal Three, Objective 2, Task 1	
BMPs	Alternative riparian vegetation (buffers), Hazing, egg addling, physical barriers
Milestones	Evaluate current management practices and determine if they are encouraging or discouraging geese populations - year 1 Evaluate which alternative(s) best suits the needs of the parks and implement the practice - years 2 thru 3
Estimated Load Reductions	It can be assumed that changing management practices will reduce the amount of E Coli/bacteria entering the system. Goose reductions will depend on the practice implemented.
Zone of Implementation	Zone 1
Responsible parties	**Parks Departments, Old Mill Golf Course, Pine View Golf Course,** Conservation Districts, Health Departments, Municipality
Overall Task Duration and Priority	2-3 years High Priority
Potential Improvement Locations	Scidmore Park, Memory Isle Park, Old Mill Golf Course, Pine View Golf Course
Estimated Cost	$5,000
Evaluation	# of animals before and after, E Coli/bacteria sampling before and after, before and after photos, visitor surveys before and after
Threshold	Waters of the state protected for total body contact recreation must meet limits of 130 E coli per 100 ml waters as a 30 day average and 300 E coli per 100 ml of water at any time
Timeline for Evaluation	1-3 years

Task 2	Work with Golf Courses to obtain certification in Audubon International Sanctuary program (water quality management certification)
To be performed in conjunction with Goal 3, Objective 2, Task 1 and Goal 4, Objective 2, Task 1	
BMPs	Vegetative filter strips
Milestones	Enrollment of each golf course into the sanctuary program year 1 of task Progress through each step in order to become certified year 1 of task Obtain certification - year 1 of task
Estimated Load Reductions	Obtaining certification in the Audubon Sanctuary water quality management criteria requires changes in practices and implementation of BMPs that control nutrient runoff. This will improve or maintain water quality.
Zone of Implementation	Zone 1
Responsible parties	**Golf Courses,** Audubon International, Conservation Districts
Overall Duration of Task and Priority	1 year Low Priority
Estimated Cost	$150/yr membership fee per golf course, cost of implementing BMPs
Evaluation	Successful completion of water quality management certification; track of Goose numbers before and after; documentation of number of practices changed
Timeline for Evaluation	1 to 2 years

Objective Two	Reduce/prevent E Coli/bacteria from failing septic systems from entering surface water
Pollutant	Nutrients
Source/Cause	Failing Septic Systems
Task 1	Educate landowners with septic systems on how to maintain them
To be performed in conjunction with Goal 3, Objective 4, Task 1	
Target Audience	Landowners with septic systems
Message	In shoreland areas it is particularly important to maintain your septic system properly because soil and water conditions near shore may make the system less efficient in treating wastewater. Incomplete treatment can result in health risks for humans and water quality problems.
Delivery Mechanisms	Township newsletters, Offer coupons from local septic care professionals
Milestones	Obtain permissions from the townships to include a septic care article in their newsletters - year 1 of task Obtain discounts from local septic care professionals to accompany articles - year 1 of task Write at least two articles for each of the newsletters year 1 and 2 of task
Estimated Load Reductions	It can be expected that landowners who read the articles in the newsletters will become more informed as to how their management practices can impact water quality. Some of these landowners can be expected to change their practices and this will improve or maintain water quality
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	**Conservation district**, Townships, Septic care professionals
Overall Duration of Task and Priority	1 to 2 years Low Priority
Estimated Cost	% of postage and printing costs proportional to size of article
Evaluation	Monitor usage of coupons
Timeline for Evaluation	1 to 2 years

Task 2	Develop septic management and design ordinances
To be performed in conjunction with Goal 3, Objective 4, Task 2	
BMPs	Septic management ordinance, septic system design ordinance
Milestones	Evaluate model septic system ordinances with townships to determine what ordinance language and setbacks would be most acceptable for the township year 1 thru 2 of task Work with townships to alter model ordinance to meet township needs - year 2 of task Adopt ordinances - years 2 thru 15 Adopt septic system ordinances in 1of the 12 townships by the end of the 3rd year of the task Adopt septic system ordinances in 3 of the 12 townships by the end of the 5th year of the task Adopt septic system ordinances in 12 of the 12 townships by the end of the 15th year of the of task
Estimated Load Reductions	For each township adopting a septic system ordinance it can be expected to improve and/or maintain water quality through the change in practices outline by the ordinance
Zone of Implementation	Zone 1, Zone 2, Zone 3
Responsible parties	**Townships,** Conservation Districts
Overall Duration of Task and Priority	1 to 12 years Low Priority
Estimated Cost	$1,200 - $1,500 per township to work with a consultant to develop and adopt an ordinance (This estimate assumes minimal oversight and assistance from the consultant with the majority of the work being performed by the Townships)
Evaluation	Document number of townships adopting ordinances and number of septic systems effected by ordinances
Threshold	Waters of the state protected for total body contact recreation must meet limits of 130 E coli per 100 ml waters as a 30 day average and 300 E coli per 100 ml of water at any time
Timeline for Evaluation	2 to 12 years

Objective Three	Work directly with landowners to eliminate livestock access to the river
Pollutant	E coli/bacteria
Source/Cause	2 sites requiring livestock exclusions and alternative watering systems
Task 1	Implement structural BMPs at both identified livestock access points
To be performed in conjunction with Goal 1, Objective 3, Task 1	
BMPs	Fencing, stream crossings, watering devices, revegetation
Milestones	Create conservation plans for each landowner and site plans year 1 of task Obtain proper permits and landowner permission - year 1 of task Organize work crew and install BMPs - years 2 thru 3 of task
Estimated Load Reductions	For each site the BMPs installed will have eliminated access. This will result in improved or maintained water quality
Zone of Implementation	Zone 1
Responsible parties	**Cass and St. Joseph County Conservation Districts**, NRCS, Landowners
Overall Task Duration and Priority	2 to 3 years High Priority
Potential Improvement Locations	Cowling Road on Rocky River and Huff Road on Rocky River
Estimated Cost	$10,000/site (2 sites $20,000),
Evaluation	Before and after photographs; document number of sites completed, E coli grab samples before and after
Threshold	Waters of the state protected for total body contact recreation must meet limits of 130 E coli per 100 ml waters as a 30 day average and 300 E coli per 100 ml of water at any time
Timeline for Evaluation	2 to 3 years

Goal Seven	Protect the warmwater fishery and other indigenous life and wildlife of the watershed by reducing the amount of oils, grease, etc. reaching surface water
Objective One	Prevent oils, grease, etc. from urban areas from reaching surface water
Pollutant	Oils, grease, etc.
Source/Cause	There are approximately 15 storm drain outfalls into the Rocky River that potentially carry sediment to the river. An area of 1,253.501 acres (approximately 2 square miles) is in an urban land use within the watershed.
Task 1	Develop and implement storm water education programs in urban areas
To be performed in conjunction with Goal 1, Objective 3, Task 1 and Goal 5, Objective 3, Task 1	
Target Audience	Urban Landowners
Delivery Mechanisms	Newspaper articles, Public Service Announcements, Traveler's Information Station, Newsletters
Milestones	Obtain public service announcement campaigns and add local contact information - year 1 of task Publish 1 newspaper article per quarter in the Three Rivers Commercial regarding storm water issues - years 1 thru 3 of task Publish a bi-annual newsletter for urban residents - years 1 thru 3 of task Obtain funding and establish a travelers information station - years 1 thru 5 of task
Estimated Load Reductions	It can be expected that some landowners exposed to information and education campaigns will change their practices based on a greater awareness of water quality issues. This can be expected to improve and/or maintain water quality
Zone of Implementation	Zone 1, Zone 2, Zone 3 (urban areas)
Responsible parties	**MS4 Permittees,** Conservation Districts, MSUE, Three Rivers Chamber of Commerce, River Country Tourism, Road Commissions, MDOT
Overall Task Priority and Priority	1 to 5 years to complete Moderate Priority
Estimated Cost	$1000/newsletter ($6000) Traveler's Information Station $15,000
Evaluation	Record contacts generated by mailings/Travelers Information Station Survey urban landowners before and after about their management techniques to determine if a change in practices has been made, or if more education efforts are needed
Timeline for Evaluation	1 to 6 years

Task 2	Community wide storm drain stenciling program
Target Audience	Urban Landowners
Message	Dump no waste Drains to river
Delivery Mechanisms	Drain stenciling, media campaign
Milestones	Develop Drain Stencil - 1 year of task Stencil Stormwater intakes in Three Rivers (in Schoolcraft when they get stormwater hookup) years 1 to 3 of task Develop Lesson plan and materials for stormwater education for students year 1 of task
Estimated Load Reductions	Stenciling the drains can be expected to result in increased awareness of landowner impacts to surface water. This should result in a change in practices that will improve and maintain water quality
Responsible parties	School Districts, MSUE, **MS4 Permittees,** Conservation Districts
Overall Duration of Task and Priority	1 to 3 years Moderate Priority
Estimated Cost	$500
Evaluation	Before and after photographs, document the number of sites stenciled before and after surveys of drain stencil program and classroom lesson plan participants to determine knowledge gained
Timeline for Evaluation	2-5 years

Task 3	Continue annual collection days of Household Hazardous waste to prevent them from entering surface water
Target Audience	Residential Landowner
Message	Some household items are hazardous to water quality and need to be disposed of properly
Delivery Mechanisms	Household Hazardous Waste Watershed Collection Days
Milestones	Designate and Promote a day for land owners to properly discard harmful substances - year 1 to 5 of task
Estimated Load Reductions	Each landowner properly disposing of hazardous materials will result in maintained and improved water quality
Zone of Implementation	Zone 1 Zone 2 Zone 3
Responsible parties	**MSUE**, Kalamazoo, Van Buren, Cass, and St. Joseph County Conservation Districts, MS4 permittees
Overall Duration of Task and Priority	5 years Low Priority
Anticipated Products	Flyers to promote "Household Hazardous Waste Day"
Estimated Cost	$250/year ($1250)
Evaluation	Document the amount of hazardous substances brought in on collection days before and after increased educational campaign
Timeline for Evaluation	2 to 5 years

Task 4	Create and hold tour of Demonstration stormwater sites
BMPs	Rain gardens
Milestones	Choose sites and obtain landowner permission - year 1 of task Install rain gardens year 2 through 3 of task Hold tour of model stormwater sites - year 4 of task
Estimated Load Reductions	Each rain garden installed can be expected to decrease the amount of water and pollutants entering storm drains. This will result in improved or maintained water quality
Zone of Implementation	Zone 1 Zone 2 Zone 3
Responsible parties	MSUE, **Kalamazoo, Cass, and St. Joseph County Conservation Districts**, Wild Ones, Kalamazoo Nature Center, **MS4 permittees**
Overall Duration of Task and Priority	1-3 years Moderate Priority
Estimated Cost	$5/sq ft $3000
Evaluation	Number of rain gardens completed, before and after knowledge surveys of tour participants
Timeline for Evaluation	1 to 3 years

Task 5	Reduce and Delay Runoff from parking lots and residential development through incentive programs that promote installation of BMPs in urban areas
BMPs	Porous Pavement, Vegetative Ponding areas around parking lots, Grassy islands in parking lots, Grassed waterways draining parking lots, gravel driveways, contoured landscaping, vegetative depressions, detention basins, green roofs
Milestones	Obtain "buy in" from townships, Municipalities, Counties, and Building officials, and other permitting agencies - year 1 through 2 of task Work with partners to establish incentives to install BMPs year 1 through 3 of task Have at least 10% of new construction utilizing the incentive program each year by year 10 of the task
Estimated Load Reductions	Each BMP implemented can be expected to reduce or prevent runoff from the site. This will result in improved or maintained water quality
Zone of Implementation	Zone 1
Responsible parties	**Municipalities**, Counties, Building Officials, permitting officials, townships, Conservation Districts
Overall Duration of Task and Priority	1 to 10 years Moderate Priority
Estimated Cost	Dependant on incentive proposed
Evaluation	# of entities participating; number of BMPs installed, meeting goal of 10% participation in 10 years
Timeline for Evaluation	1 to 11 years

Desired Use One	Obtain more information about the watershed in order to better protect it
Objective One	Collect watershed information that would help protect and maintain water quality
Task 1	Use GPS to accurately map and delineate designated drains, locate areas that need buffers, critical area treatments, etc., work with County Drain Commissioners to make improvements
Milestones	GPS all designated drains in the watershed years 1 through 2 of task Work with Drain commissioners to identify improvement areas year 3 of task Complete necessary improvements years 3 to 10 of task
Zone of Implementation	Zone 1
Responsible parties	**County Drain Commissioners**, County Conservation Districts
Overall Duration of Task and Priority	5 to 10 years Low Priority
Estimated Cost	$3,000/county ($12,000)
Evaluation	Record number of miles of drains mapped; Record average percentage of cover on drains before and after drain improvements, Record observations while surveying, % of accuracy of records before and after
Timeline for Evaluation	5 to 10 years

Task 2	Conduct Volunteer Monitoring to supplement state monitoring
Volunteer Stream monitoring can be used as an evaluation tool	
Milestones	Secure Volunteers – year 1 through 3 of task Obtain Equipment – year 1 of task Provide Training – year 1 through 3 of task Conduct Volunteer Monitoring – year 1 through 5 of task
Zone of Implementation	Zone 1
Responsible parties	**Friends of the St. Joseph River**, County Conservation Districts
Overall Duration of Task and Priority	1 year High Priority
Estimated Cost	$1,000
Evaluation	Survey Volunteers before and after, record the number of monitoring stations before and after, record findings and track over time
Timeline for Evaluation	3 to 5 years

Desired Use Two	Prevent the introduction and spread of invasive species through management practices
Objective One	Establish invasive species control programs to prevent the spread of exotics
Task 1	Establish invasive species information and education programs to prevent the spread of exotics
Target Audience	Watershed Residents Especially Zone 1 and recreational users
Message	Invasive species can kill off valuable native species prevent their spread
Delivery Mechanisms	Signage, Flyers, Newspaper articles
Milestones	Research and develop program opportunities – year 1 of task Establish and implement program – years 2 to 10 of task Publish one newspaper article per quarter – year 1 through 3 of task Establish signage in parks and access sites – year 1 through 3 of task
Zone of Implementation	Zone 1 Zone 2
Responsible parties	**St. Joseph County Conservation District**, St. Joseph County Parks, MSUE
Overall Duration of Task and Priority	1 to 5 years Moderate Priority
Estimated Cost	$1,000 per year
Evaluation	Monitor spread of invasive species before and after
Timeline for Evaluation	1 to 10 years

Desired Use Three	Improve Recreational Opportunities in the Watershed
Objective One	Cut path through downed trees that inhibit navigation on the Rocky River
Task 1	Identify downed trees that inhibit navigation and cut out centers of these obstructions
Milestones	Develop guidelines for the size of tree and width of cut to be performed - year 1 of task Inform landowners - year 1 of task Organize work crew and perform cutting - year 1 of task
Zone of Implementation	Zone 1
Responsible parties	**St. Joseph and Cass Conservation Districts,** Heritage Water Trails
Overall Duration of Task and Priority	1 year Low Priority
Estimated Cost	$750
Evaluation	Before and after pictures; documentation of time traveled between road-stream crossings before and after, long term evaluation of how often maintenance is necessary
Timeline for Evaluation	1 to 2 years

Task 2	Identify areas where downed trees impair navigation, but are not reasonable to cut through and place structures to assist in portaging
Milestones	Select sites to have portaging structures installed - year 1 of task Develop site plans, obtain proper permits and landowner permission - year 1 of task Organize work crew and implement portaging structures at the selected site - years 1 to 2 of task
Zone of Implementation	Zone 1
Responsible parties	**St. Joseph and Cass County Parks Departments,** St. Joseph and Cass Conservation Districts, Heritage Water Trails
Overall Duration of Task and Priority	1-2 years Low Priority
Estimated Cost	$2,000
Evaluation	Before and after pictures; documentation of time traveled between road-stream crossings before and after, Surveys of users to determine how valuable the practice was to them
Timeline for Evaluation	2-3 years

Evaluation

It is important to evaluate the effectiveness of the watershed management plan throughout the implementation process in order to determine how well the plan is addressing water quality goals and objectives. When discussing the evaluation methods outlined in Table 10 it is important to differentiate between task milestones and task evaluation. Milestones are those accomplishments that mark completion of key components within the task. Evaluation outlines the techniques that will be used to determine if the task is meeting the objective and goal the task falls under. Where applicable, the Threshold category outlines the level of pollutant that the waterbody can tolerate before experiencing impairments of its designated uses. As Table 10 indicates, a variety of methods will be used to evaluate the effectiveness of the tasks at meeting the goals and objectives. The following summarizes some of the evaluation techniques recommended.

The first evaluation tool will be ongoing professional water quality monitoring. Currently, water quality monitoring has been taking place on the Rocky River to establish baseline data. Continued physical, chemical, and biological or aquatic life monitoring will show water quality trends over time. (See Appendix 3 for more detailed information on the parameters monitored). The results should improve or stay the same if management techniques are effective in reducing nonpoint source pollution. The approximate cost for this type of ongoing monitoring would be $15,000 per year.

Professional monitoring also takes place on a five year rotating basis within the watershed and is performed by the Michigan Department of Environmental Quality. This monitoring may be supplemented with additional locations if the Conservation District or other

local entities within the watershed contact the Department of Environmental Quality and ask them to establish specific biosurvey sites at areas of concern.

Volunteer Monitoring (a task outlined under desired uses) can also be used as an evaluation tool in order to supplement the professional water quality monitoring. The Friends of the St. Joseph River Association provides this training to interested groups. They typically monitor macroinvertebrate communities, but could be trained to perform visual monitoring of total suspended solids, sediment depth measurements, and other visual observation that can indicate non point source pollution like excessive plant growth. Additional monitoring locations could be added to correspond with implementation sites in order to determine fish habitat and benthic invertebrate improvements from the installation of best management practices at those sites if adequate volunteers are obtained.

Photographic or visual evidence can be used at BMP installation sites to document improvement. In these areas, the benefits of streambank stabilization, recreational access sites, buffer strips, etc. will be documented using before and after pictures.

The number of BMP sites can be documented as an evaluation tool. For instance, the number of BMP sites that are implemented through grant funding can be recorded. These sites can be used for demonstration value to encourage others to participate in the installation of BMPs. Any additional BMPs installed by individuals can be counted and used as an indicator of program success.

Sediment is the primary nonpoint source pollutant in the Rocky River Watershed. Reduction of sediment can be evaluated using several different methods. On a small scale, erosion rates can be calculated using equations used by the Natural Resources Conservation Service like RUSLE2. In these cases, most often on farm fields, a variety of factors can be plugged into an equation to determine the soil erosion rate for the site. This information can be compared before and after BMP installation to determine the amount of sediment reduction to the system.

On a larger scale, a sediment basin can be used to determine the effectiveness of the watershed plan and the BMPs installed. A sediment basin was located in the City of Three Rivers and had a sediment delivery rate of 1,800 cubic yards per year. This sediment delivery rate can be used as a baseline rate. Following the installation of BMPs throughout the watershed the change in delivery rate can be used to evaluate the effectiveness of the BMPs. Similarly, one can use sediment depth measurements at key sites before and after installation of BMPs to determine change in sediment loading from particular locations

Several tours and workshops will take place throughout the implementation phase of the project. The participant in these activities will be placed into the focus groups at the end of their event in order to evaluate how effective the workshop or tour was in teaching watershed information and ways to prevent water quality degradation.

The use of surveys will be an important tool in evaluating the success of the tasks. A general knowledge survey was performed in the watershed during the initial planning process. The results of this survey are included in Appendix 6. This survey could be embellished upon and redistributed to watershed residents at the major timeline changes in the plan (3 years, 6 years 10 years). The survey results will be able to show if watershed residents are changing their current behaviors and becoming more aware of water quality issues and how their actions can impact water quality.

Before and after surveys at workshops and field days will also be a good evaluation tool. These surveys can evaluate whether or not the workshop was effective in raising awareness of water quality issues and if the information provided was enough to encourage participants to change their behaviors.

The statistical counters on the websites that will be established through the grant will help monitor the number of people utilizing and seeking information about the Rocky River. In addition, the Traveler's Information Station can be utilized to direct individuals to the websites to fill out survey forms to evaluate education obtained from the Information Station and the websites.

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Appendix 1. 1978 Land Use/Land Cover Map

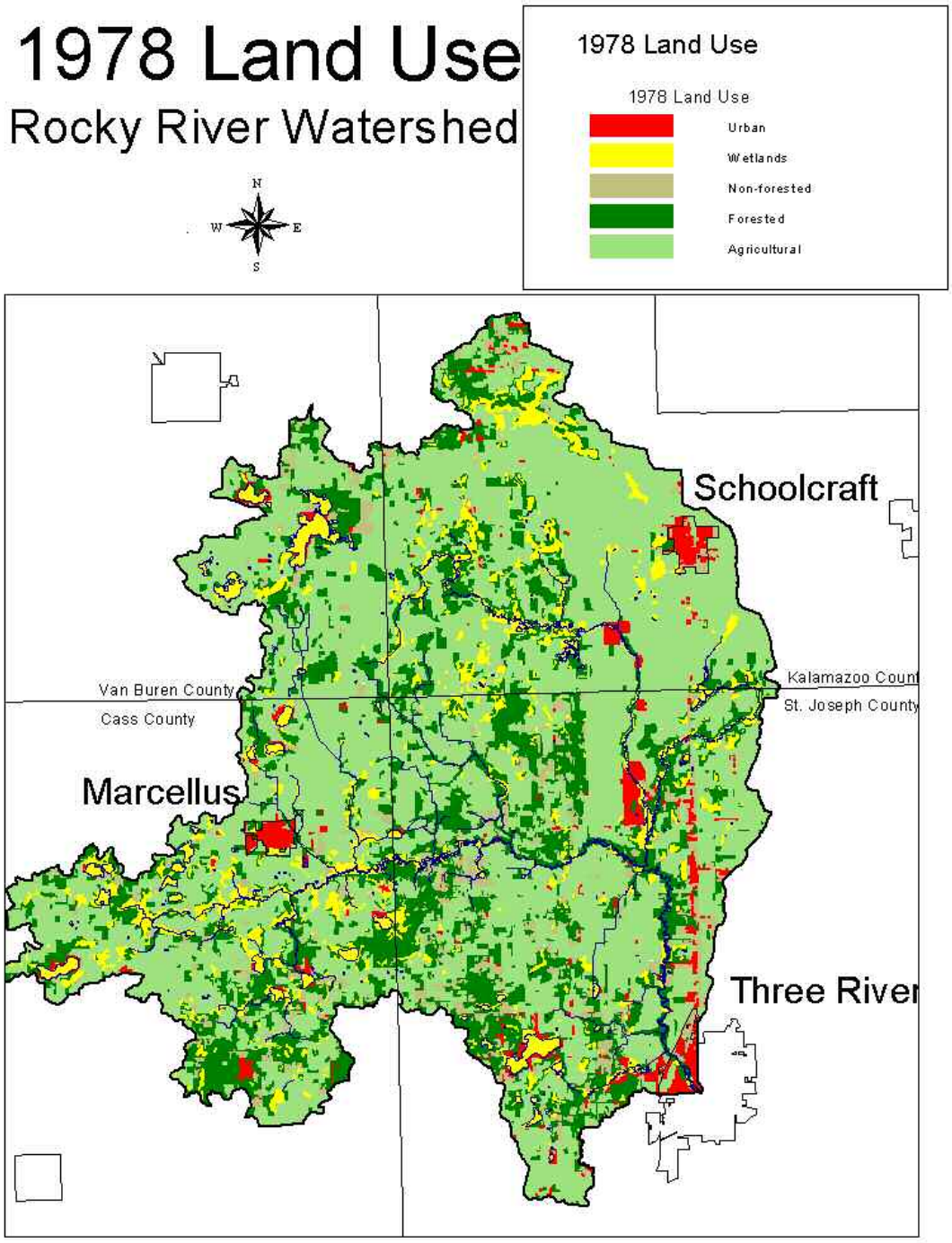

Figure 21. Land Use 1978

Appendix 2. Volunteer Water Quality Monitoring

Cited from the Friends of the St. Joseph River Website www.fotsjr.org

#	Stream Name	Location	County	Township	Average Rating
1	Old Biddy	Hills Haven Rd.	Berrien	Buchanan	Poor
2	Dowagiac Creek	Below Pucker St. Dam	Berrien	Niles	Good
3	Big Meadow Creek	Business 31 south of Benton Harbor	Berrien	Scottdale	Good
4	Lemon Creek	Andrews University	Berrien	Oronoko	Fair
5	Brandywine Creek	Odd Fellows Park	Berrien	Niles	Fair
6	McCoy Creek	City of Buchanan	Berrien	Buchanan	Fair
7	St. Joseph River	Headwaters of St. Joseph River	Hillsdale	Hillsdale	Fair
8	St. Joseph River	Roadway on	Hillsdale	Hillsdale	Fair
9	Beebe Creek	Moor Rd.	Hillsdale	Hillsdale	Fair
10	St. Joseph River	Fireman's Park M-49	Hillsdale	Litchfield	Fair
11	**Rocky River**	**City of Three Rivers**	**St. Joseph**	**Lock-Port**	Good
12	Swan Creek	City of Colon North of Dallas St.	St. Joseph	Colon	Good
13	St. Joseph River	Union City	Branch	Union City	Fair
14	St. Joseph River	R Drive bridge	Calhoun	Homer	Fair
15	**Rocky River**	**Tail Race of Rocky River**	**St. Joseph**	**Three Rivers**	Fair

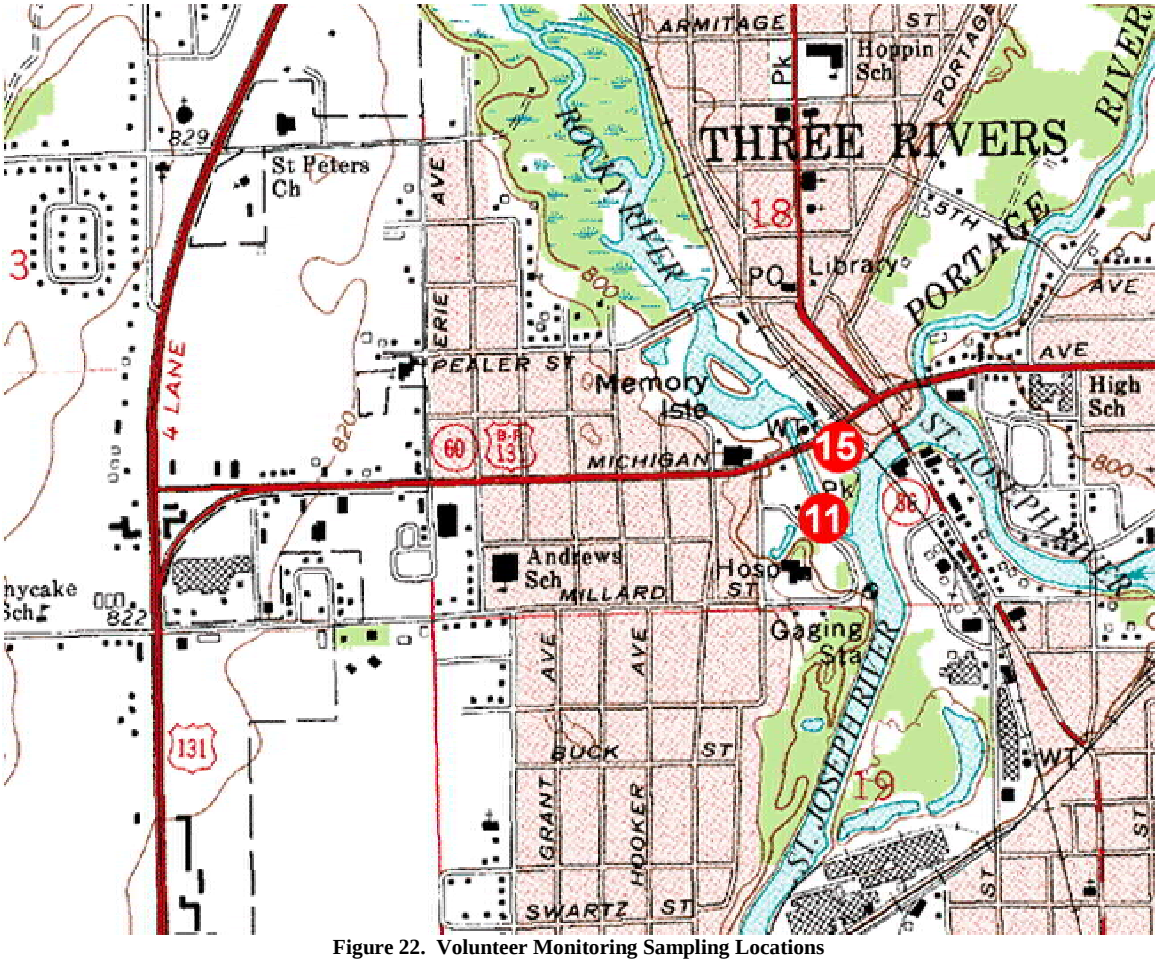

Figure 22. Volunteer Monitoring Sampling Locations

Site Data for the Tail Race of the Rocky River #15

Location	Date	Site Survey Form	Water Chemistry Form	Macroinvertebrates Form	Rating	Images
15 - Rocky River	09/30/1999	View	No Data	View	Poor	
15 - Rocky River	09/28/2000	View	No Data	View	Poor	
15 - Rocky River	05/24/2000	View	No Data	View	Poor	
15 - Rocky River	09/26/2002	View	View	View	Good	
15 - Rocky River	05/29/2003	View	No Data	View	Good	
15 - Rocky River	//	View	No Data	View	Good	

Site Location	15 - Rocky River	Date:	09 / 30 / 1999 (mm/dd/yyyy)	Time:	3 : 00 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.645' N
Location:	Tail Race of	Township:	Three Rivers	Longitude:	85° 37.999' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	**No**
Water Temp (F):	**60**	Pool:	**Yes**
Water Color:	**Clear**	Channel:	
Stream Width (ft.)	**46**	Designated Drain:	
Average Stream Depth:	**1.2**		
Water Velocity (ft/sec):	**0.4**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	%	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	%	Turbidity:	
		Oil Sheen:	
Sand - coarse grain:	%	Trash:	
Silt/Detritus/Muck - fine grain/organic matter:	%		
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive	Group 2 Somewhat-Sensitive	Group 3 Tolerant
Beetle adults (Coleoptera): **0** Caddisfly larvae (Trichoptera): **1-10.** Hellgrammites (Megaloptera): **0** Mayfly nymphs (Ephemeroptera): **0** Gilled Snails (Gastropoda): **1-10.** Stonefly nymphs (Plecoptera): **0** Water penny (Coleoptera): **0** Blackfly larvae (Diptera): **0**	Beetle larvae (Coleoptera): **1-10.** Clams (Pelecypoda): **1-10.** Cranefly larvae (Diptera): **0** Crayfish (Decapoda): **0** Damselfly nymphs (Odonata): **0** Dragonfly nymphs (Odonata): **0** Scuds (Amphipoda): **0** Alderfly larvae (Megaloptera): **0**	Aquatic worms (Oligochaeta): **0** Leeches (Hirudina): **0** Midge larvae (Diptera): **0** Pouch snails (Gastropoda): **0** Sowbugs (Isopoda): **0** True Bugs (Hemiptera): **0** Other Diptera: **0**

Site Location	15 - Rocky River	Date:	09 / 28 / 2000 (mm/dd/yyyy)	Time:	1 : 20 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.645' N
Location:	Tail Race of	Township:	Three Rivers	Longitude:	85° 37.999' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	**No**
Water Temp (F):	**57**	Pool:	**No**
Water Color:	**Clear**	Channel:	
Stream Width (ft.)	**50.5**	Designated Drain:	
Average Stream Depth:	**1.4**		
Water Velocity (ft/sec):	**0.26**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	%	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	%	Turbidity:	
		Oil Sheen:	
Sand - coarse grain:	%	Trash:	
Silt/Detritus/Muck - fine grain/organic matter:	%		
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive	Group 2 Somewhat-Sensitive	Group 3 Tolerant
Beetle adults (Coleoptera): **0** Caddisfly larvae (Trichoptera): **>10** Hellgrammites (Megaloptera): **0** Mayfly nymphs (Ephemeroptera): **0** Gilled Snails (Gastropoda): **0** Stonefly nymphs (Plecoptera): **0** Water penny (Coleoptera): **1-10.** Blackfly larvae (Diptera): **0**	Beetle larvae (Coleoptera): **0** Clams (Pelecypoda): **0** Cranefly larvae (Diptera): **0** Crayfish (Decapoda): **0** Damselfly nymphs (Odonata): **0** Dragonfly nymphs (Odonata): **1-10.** Scuds (Amphipoda): **1-10.** Alderfly larvae (Megaloptera): **0**	Aquatic worms (Oligochaeta): **0** Leeches (Hirudina): **0** Midge larvae (Diptera): **0** Pouch snails (Gastropoda): **0** Sowbugs (Isopoda): **0** True Bugs (Hemiptera): **0** Other Diptera: **0**

Site Location	15 - Rocky River	Date:	05 / 24 / 2000 (mm/dd/yyyy)	Time:	1 : 05 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.645' N
Location:	Tail Race of	Township:	Three Rivers	Longitude:	85° 37.999' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	**No**
Water Temp (F):	**68**	Pool:	**No**
Water Color:	**Clear**	Channel:	
Stream Width (ft.)	**48**	Designated Drain:	
Average Stream Depth:	**2.9**		
Water Velocity (ft/sec):	**3.31**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	%	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	%	Turbidity:	
		Oil Sheen:	
Sand - coarse grain:	%	Trash:	
Silt/Detritus/Muck - fine grain/organic matter:	%		
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive	Group 2 Somewhat-Sensitive	Group 3 Tolerant
Beetle adults (Coleoptera): **0** Caddisfly larvae (Trichoptera): **1-10.** Hellgrammites (Megaloptera): **0** Mayfly nymphs (Ephemeroptera): **0** Gilled Snails (Gastropoda): **0** Stonefly nymphs (Plecoptera): **0** Water penny (Coleoptera): **0** Blackfly larvae (Diptera): **0**	Beetle larvae (Coleoptera): **0** Clams (Pelecypoda): **1-10.** Cranefly larvae (Diptera): **0** Crayfish (Decapoda): **1-10.** Damselfly nymphs (Odonata): **1-10.** Dragonfly nymphs (Odonata): **0** Scuds (Amphipoda): **0** Alderfly larvae (Megaloptera): **0**	Aquatic worms (Oligochaeta): **0** Leeches (Hirudina): **0** Midge larvae (Diptera): **1-10.** Pouch snails (Gastropoda): **1-10.** Sowbugs (Isopoda): **0** True Bugs (Hemiptera): **1-10.** Other Diptera: **0**

Site Location	15 - Rocky River	Date:	09 / 26 / 2002 (mm/dd/yyyy)	Time:	12 : 30 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.645' N
Location:	Tail Race of	Township:	Three Rivers	Longitude:	85° 37.999' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	
Water Temp (F):	**59**	Pool:	
Water Color:	**Clear**	Channel:	
Stream Width (ft.)		Designated Drain:	
Average Stream Depth:	**1-3**		
Water Velocity (ft/sec):	**0.41**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	**<10** %	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	**<10** %	Turbidity:	
Sand - coarse grain:	%	Oil Sheen:	
Silt/Detritus/Muck - fine grain/organic matter:	**90-100.** %	Trash:	
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

	Units	Sample 1	Sample 2	Sample 3	Average
Dissolved Oxygen	mg/L	**8.1**			8.10
E. Coli	colonies/100 mL				
pH	units				
Total Phosphate	mg/L				
Nitrate	mg/L				
Turbidity	NTU = JTU				

Group 1 Sensitive	Group 2 Somewhat-Sensitive	Group 3 Tolerant
	Beetle larvae (Coleoptera): Clams (Pelecypoda): **>10** Cranefly larvae (Diptera): Crayfish (Decapoda): Damselfly nymphs (Odonata): Dragonfly nymphs (Odonata): **1-10.** Scuds (Amphipoda): **>10** Alderfly larvae (Megaloptera): **1-10.**	Aquatic worms (Oligochaeta): **1-10.** Leeches (Hirudina): Midge larvae (Diptera): **1-10.** Pouch snails (Gastropoda): **1-10.** Sowbugs (Isopoda): True Bugs (Hemiptera): **1-10.** Other Diptera:

	Alderfly larvae (Megaloptera): **1-10.**	

Site Location	15 - Rocky River	Date:	05 / 29 / 2003 (mm/dd/yyyy)	Time:	1 : 20 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.645' N
Location:	Tail Race of	Township:	Three Rivers	Longitude:	85° 37.999' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:	**Unknown**	Riffle:	
Water Temp (F):	**62.4**	Pool:	
Water Color:	**Clear**	Channel:	
Stream Width (ft.)	**25-50**	Designated Drain:	
Average Stream Depth:	**1-3**		
Water Velocity (ft/sec):	**0.47**		
D.O.:	**9.46**		
pH:	**8.3**		
Substrate (add up to 100%)		**Physical Appearance**	
Boulder - 10 in. diam.:	**10-20.** %	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	**10-20.** %	Turbidity:	
Sand - coarse grain:	**10-20.** %	Oil Sheen:	
Silt/Detritus/Muck - fine grain/organic matter:	**40-50.** %	Trash:	
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		
Instream Cover		**Stream Corridor**	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive		Group 2 Somewhat-Sensitive		Group 3 Tolerant	
Beetle adults (Coleoptera):		Beetle larvae (Coleoptera):		Aquatic worms (Oligochaeta):	**1-10.**
Caddisfly larvae (Trichoptera):	**>10**	Clams (Pelecypoda):	**1-10.**	Leeches (Hirudina):	**1-10.**
Hellgrammites (Megaloptera):		Cranefly larvae (Diptera):		Midge larvae (Diptera):	**1-10.**
Mayfly nymphs (Ephemeroptera):	**>10**	Crayfish (Decapoda):		Pouch snails (Gastropoda):	**1-10.**
Gilled Snails (Gastropoda):	**1-10.**	Damselfly nymphs (Odonata):		Sowbugs (Isopoda):	
Stonefly nymphs (Plecoptera):	**1-10.**	Dragonfly nymphs (Odonata):	**1-10.**	True Bugs (Hemiptera):	
Water penny (Coleoptera):	**1-10.**	Scuds (Amphipoda):	**>10**	Other Diptera:	
Blackfly larvae (Diptera):		Alderfly larvae (Megaloptera):	**1-10.**		

Site Location	15 - Rocky River	Date:	/ / (mm/dd/yyyy)	Time:	: am
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.645' N
Location:	Tail Race of	Township:	Three Rivers	Longitude:	85° 37.999' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	
Water Temp (F):	**59**	Pool:	
Water Color:	**Clear**	Channel:	
Stream Width (ft.)	**25-50**	Designated Drain:	
Average Stream Depth:	**1-3**		
Water Velocity (ft/sec):	**0.41**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	**<10** %	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	**<10** %	Turbidity:	
Sand - coarse grain:	%	Oil Sheen:	
Silt/Detritus/Muck - fine grain/organic matter:	**90-100.** %	Trash:	
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive	Group 2 Somewhat-Sensitive	Group 3 Tolerant
Beetle adults (Coleoptera): **1-10.** Caddisfly larvae (Trichoptera): **>10** Hellgrammites (Megaloptera): Mayfly nymphs (Ephemeroptera): **1-10.** Gilled Snails (Gastropoda): **>10** Stonefly nymphs (Plecoptera): **1-10.** Water penny (Coleoptera): **1-10.** Blackfly larvae (Diptera):	Beetle larvae (Coleoptera): Clams (Pelecypoda): **>10** Cranefly larvae (Diptera): Crayfish (Decapoda): Damselfly nymphs (Odonata): Dragonfly nymphs (Odonata): **1-10.** Scuds (Amphipoda): **>10** Alderfly larvae (Megaloptera): **1-10.**	Aquatic worms (Oligochaeta): **1-10.** Leeches (Hirudina): Midge larvae (Diptera): **1-10.** Pouch snails (Gastropoda): **1-10.** Sowbugs (Isopoda): True Bugs (Hemiptera): **1-10.** Other Diptera:

Figure 23. Home schooled students using a kick net to find aquatic invertebrates

Figure 24. Volunteer Identifying Invertebrates

Mainstream Rocky River

Location	Date	Site Survey Form	Water Chemistry Form	Macroinvertebrates Form	Rating	Images
11 - Rocky River	09/30/1999	View	No Data	View	Excellent	
11 - Rocky River	09/28/2000	View	No Data	View	Good	
11 - Rocky River	05/24/2000	View	No Data	View	Good	
11 - Rocky River	10/04/2001	View	No Data	View	Fair	
11 - Rocky River	09/26/2002	View	No Data	View	Good	
11 - Rocky River	05/29/2003	View	No Data	View	Good	

Site Location	11 - Rocky River	Date:	09 / 30 / 1999 (mm/dd/yyyy)	Time:	1 : 15 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.492' N
Location:	City of Three	Township:	Lock-Port	Longitude:	85° 38.017' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	**Yes**
Water Temp (F):	**60**	Pool:	**No**
Water Color:	**Clear**	Channel:	
Stream Width (ft.)	**31.83**	Designated Drain:	
Average Stream Depth:	**1.7**		
Water Velocity (ft/sec):	**3.1**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	%	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	%	Turbidity:	
		Oil Sheen:	
Sand - coarse grain:	%	Trash:	
Silt/Detritus/Muck - fine grain/organic matter:	%		
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive		Group 2 Somewhat-Sensitive		Group 3 Tolerant	
Beetle adults (Coleoptera):	**1-10.**	Beetle larvae (Coleoptera):	**0**	Aquatic worms (Oligochaeta):	**0**
Caddisfly larvae (Trichoptera):	**>10**	Clams (Pelecypoda):	**1-10.**	Leeches (Hirudina):	**0**
Hellgrammites (Megaloptera):	**1-10.**	Cranefly larvae (Diptera):	**0**	Midge larvae (Diptera):	**1-10.**
Mayfly nymphs (Ephemeroptera):	**>10**	Crayfish (Decapoda):	**1-10.**	Pouch snails (Gastropoda):	**1-10.**
Gilled Snails (Gastropoda):	**1-10.**	Damselfly nymphs (Odonata):	**1-10.**	Sowbugs (Isopoda):	**0**
Stonefly nymphs (Plecoptera):	**0**	Dragonfly nymphs (Odonata):	**1-10.**	True Bugs (Hemiptera):	**0**
Water penny (Coleoptera):	**0**	Scuds (Amphipoda):	**>10**	Other Diptera:	**0**
Blackfly larvae (Diptera):	**0**	Alderfly larvae (Megaloptera):	**0**		

Site Location	11 - Rocky River	Date:	09 / 28 / 2000 (mm/dd/yyyy)	Time:	3 : 00 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.492' N
Location:	City of Three	Township:	Lock-Port	Longitude:	85° 38.017' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	**No**
Water Temp (F):	**59**	Pool:	**No**
Water Color:	**Clear**	Channel:	
Stream Width (ft.)	**31.9**	Designated Drain:	
Average Stream Depth:	**2.39**		
Water Velocity (ft/sec):	**2.06**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	%	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	%	Turbidity:	
Sand - coarse grain:	%	Oil Sheen:	
Silt/Detritus/Muck - fine grain/organic matter:	%	Trash:	
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive	Group 2 Somewhat-Sensitive	Group 3 Tolerant
Beetle adults (Coleoptera): **1-10.** Caddisfly larvae (Trichoptera): **>10** Hellgrammites (Megaloptera): **0** Mayfly nymphs (Ephemeroptera): **1-10.** Gilled Snails (Gastropoda): **>10** Stonefly nymphs (Plecoptera): **0** Water penny (Coleoptera): **0** Blackfly larvae (Diptera): **0**	Beetle larvae (Coleoptera): **0** Clams (Pelecypoda): **>10** Cranefly larvae (Diptera): **0** Crayfish (Decapoda): **0** Damselfly nymphs (Odonata): **0** Dragonfly nymphs (Odonata): **0** Scuds (Amphipoda): **0** Alderfly larvae (Megaloptera): **0**	Aquatic worms (Oligochaeta): **0** Leeches (Hirudina): **0** Midge larvae (Diptera): **1-10.** Pouch snails (Gastropoda): **1-10.** Sowbugs (Isopoda): **0** True Bugs (Hemiptera): **0** Other Diptera: **0**

Site Location	11 - Rocky River	Date:	05 / 24 / 2000 (mm/dd/yyyy)	Time:	2 : 45 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.492' N
Location:	City of Three	Township:	Lock-Port	Longitude:	85° 38.017' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	**Yes**
Water Temp (F):	**68**	Pool:	**No**
Water Color:	**Clear**	Channel:	
Stream Width (ft.)	**31.83**	Designated Drain:	
Average Stream Depth:	**4.33**		
Water Velocity (ft/sec):	**0.64**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	%	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	%	Turbidity:	
		Oil Sheen:	
Sand - coarse grain:	%	Trash:	
Silt/Detritus/Muck - fine grain/organic matter:	%		
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive		Group 2 Somewhat-Sensitive		Group 3 Tolerant	
Beetle adults (Coleoptera):	**0**	Beetle larvae (Coleoptera):	**0**	Aquatic worms (Oligochaeta):	**0**
Caddisfly larvae (Trichoptera):	**1-10.**	Clams (Pelecypoda):	**0**	Leeches (Hirudina):	**0**
Hellgrammites (Megaloptera):	**0**	Cranefly larvae (Diptera):	**0**	Midge larvae (Diptera):	**0**
Mayfly nymphs (Ephemeroptera):	**1-10.**	Crayfish (Decapoda):	**1-10.**	Pouch snails (Gastropoda):	**>10**
Gilled Snails (Gastropoda):	**0**	Damselfly nymphs (Odonata):	**>10**	Sowbugs (Isopoda):	**0**
Stonefly nymphs (Plecoptera):	**0**	Dragonfly nymphs (Odonata):	**1-10.**	True Bugs (Hemiptera):	**0**
Water penny (Coleoptera):	**1-10.**	Scuds (Amphipoda):	**1-10.**	Other Diptera:	**0**
Blackfly larvae (Diptera):	**0**	Alderfly larvae (Megaloptera):	**1-10.**		

Site Location	11 - Rocky River	Date:	10 / 04 / 2001 (mm/dd/yyyy)	Time:	1 : 15 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.492' N
Location:	City of Three	Township:	Lock-Port	Longitude:	85° 38.017' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	
Water Temp (F):	**64**	Pool:	
Water Color:	**Clear**	Channel:	
Stream Width (ft.)		Designated Drain:	
Average Stream Depth:	**1-3**		
Water Velocity (ft/sec):	**0.35**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	**<10** %	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	**<10** %	Turbidity:	
Sand - coarse grain:	%	Oil Sheen:	
Silt/Detritus/Muck - fine grain/organic matter:	**80-90.** %	Trash:	
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive		Group 2 Somewhat-Sensitive		Group 3 Tolerant	
Beetle adults (Coleoptera):		Beetle larvae (Coleoptera):		Aquatic worms (Oligochaeta):	**1-10.**
Caddisfly larvae (Trichoptera):	**>10**	Clams (Pelecypoda):	**>10**	Leeches (Hirudina):	**1-10.**
Hellgrammites (Megaloptera):		Cranefly larvae (Diptera):		Midge larvae (Diptera):	
Mayfly nymphs (Ephemeroptera):		Crayfish (Decapoda):		Pouch snails (Gastropoda):	**1-10.**
Gilled Snails (Gastropoda):	**>10**	Damselfly nymphs (Odonata):		Sowbugs (Isopoda):	
Stonefly nymphs (Plecoptera):		Dragonfly nymphs (Odonata):	**1-10.**	True Bugs (Hemiptera):	
Water penny (Coleoptera):	**1-10.**	Scuds (Amphipoda):	**1-10.**	Other Diptera:	
Blackfly larvae (Diptera):		Alderfly larvae (Megaloptera):			

Site Location	11 - Rocky River	Date:	09 / 26 / 2002 (mm/dd/yyyy)	Time:	: am
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.492' N
Location:	City of Three	Township:	Lock-Port	Longitude:	85° 38.017' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:		Riffle:	
Water Temp (F):	**57**	Pool:	
Water Color:		Channel:	
Stream Width (ft.)	**25-50**	Designated Drain:	
Average Stream Depth:	**>3**		
Water Velocity (ft/sec):	**4.7**		
D.O.:			
pH:			

Substrate (add up to 100%)		Physical Appearance	
Boulder - 10 in. diam.:	**10-20.** %	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	**80-90.** %	Turbidity:	
Sand - coarse grain:	%	Oil Sheen:	
Silt/Detritus/Muck - fine grain/organic matter:	%	Trash:	
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		

Instream Cover		Stream Corridor	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	Highest Water Mark (ft.):

Group 1 Sensitive		Group 2 Somewhat-Sensitive		Group 3 Tolerant	
Beetle adults (Coleoptera):		Beetle larvae (Coleoptera):		Aquatic worms (Oligochaeta):	**1-10.**
Caddisfly larvae (Trichoptera):	**>10**	Clams (Pelecypoda):	**>10**	Leeches (Hirudina):	
Hellgrammites (Megaloptera):		Cranefly larvae (Diptera):		Midge larvae (Diptera):	**1-10.**
Mayfly nymphs (Ephemeroptera):	**1-10.**	Crayfish (Decapoda):	**1-10.**	Pouch snails (Gastropoda):	
Gilled Snails (Gastropoda):	**>10**	Damselfly nymphs (Odonata):		Sowbugs (Isopoda):	
Stonefly nymphs (Plecoptera):	**1-10.**	Dragonfly nymphs (Odonata):	**>10**	True Bugs (Hemiptera):	
Water penny (Coleoptera):	**1-10.**	Scuds (Amphipoda):	**>10**	Other Diptera:	
Blackfly larvae (Diptera):		Alderfly larvae (Megaloptera):			

Site Location	11 - Rocky River	Date:	05 / 29 / 2003 (mm/dd/yyyy)	Time:	2 : 30 pm
Waterbody Name:	Rocky River	County:	St. Joseph	Latitude:	41° 56.492' N
Location:	City of Three	Township:	Lock-Port	Longitude:	85° 38.017' W

Physical Habitat

Background Information		River Morphology	
Days Since Rain:	**Unknown**	Riffle:	
Water Temp (F):	**75**	Pool:	
Water Color:	**Brown**	Channel:	
Stream Width (ft.)	**25-50**	Designated Drain:	
Average Stream Depth:	**1-3**		
Water Velocity (ft/sec):	**1.44**		
D.O.:	**8.83**		
pH:	**8.4**		
Substrate (add up to 100%)		**Physical Appearance**	
Boulder - 10 in. diam.:	**10-20.** %	Algae:	
Cobble/Gravel - 10 to .08 in. diam.:	**20-30.** %	Turbidity:	
		Oil Sheen:	
Sand - coarse grain:	**10-20.** %	Trash:	
Silt/Detritus/Muck - fine grain/organic matter:	**40-50.** %		
Hardpan/Bedrock - solid clay/rock surface:	%		
Artificial - manmade:	%		
Unknown:	%		
Instream Cover		**Stream Corridor**	
Undercut Banks:		Riparian Veg. Width ft.(L):	
Overhanging Vegetation:		Riparian Veg. Width ft.(R):	
Deep Pools:		Bank Erosion:	
Boulders:		Streamside Land Cover:	
Aquatic Plants:			

	Stream Canopy % %
Adjacent Land Uses	**Stream Cross Section**
Wetlands: Shrub or Old Field: Forest: Pasture: Crop Residue: Rowcrop: Residential Lawns, Parks: Impervious Surfaces: Disturbed Ground: No Vegetation:	

Group 1 Sensitive		Group 2 Somewhat-Sensitive		Group 3 Tolerant	
Beetle adults (Coleoptera):		Beetle larvae (Coleoptera):		Aquatic worms (Oligochaeta):	**1-10.**
Caddisfly larvae (Trichoptera):	**>10**	Clams (Pelecypoda):	**>10**	Leeches (Hirudina):	**1-10.**
Hellgrammites (Megaloptera):		Cranefly larvae (Diptera):		Midge larvae (Diptera):	**1-10.**
Mayfly nymphs (Ephemeroptera):	**>10**	Crayfish (Decapoda):		Pouch snails (Gastropoda):	**1-10.**
Gilled Snails (Gastropoda):	**>10**	Damselfly nymphs (Odonata):		Sowbugs (Isopoda):	
Stonefly nymphs (Plecoptera):	**1-10.**	Dragonfly nymphs (Odonata):		True Bugs (Hemiptera):	
Water penny (Coleoptera):		Scuds (Amphipoda):	**>10**	Other Diptera:	
Blackfly larvae (Diptera):	**1-10.**	Alderfly larvae (Megaloptera):			

Appendix 3. Water Quality Sampling Data for the Rocky River Watershed

ROCKY RIVER 319 GRANT
WATER QUALITY STUDY

Final Report

Prepared for:

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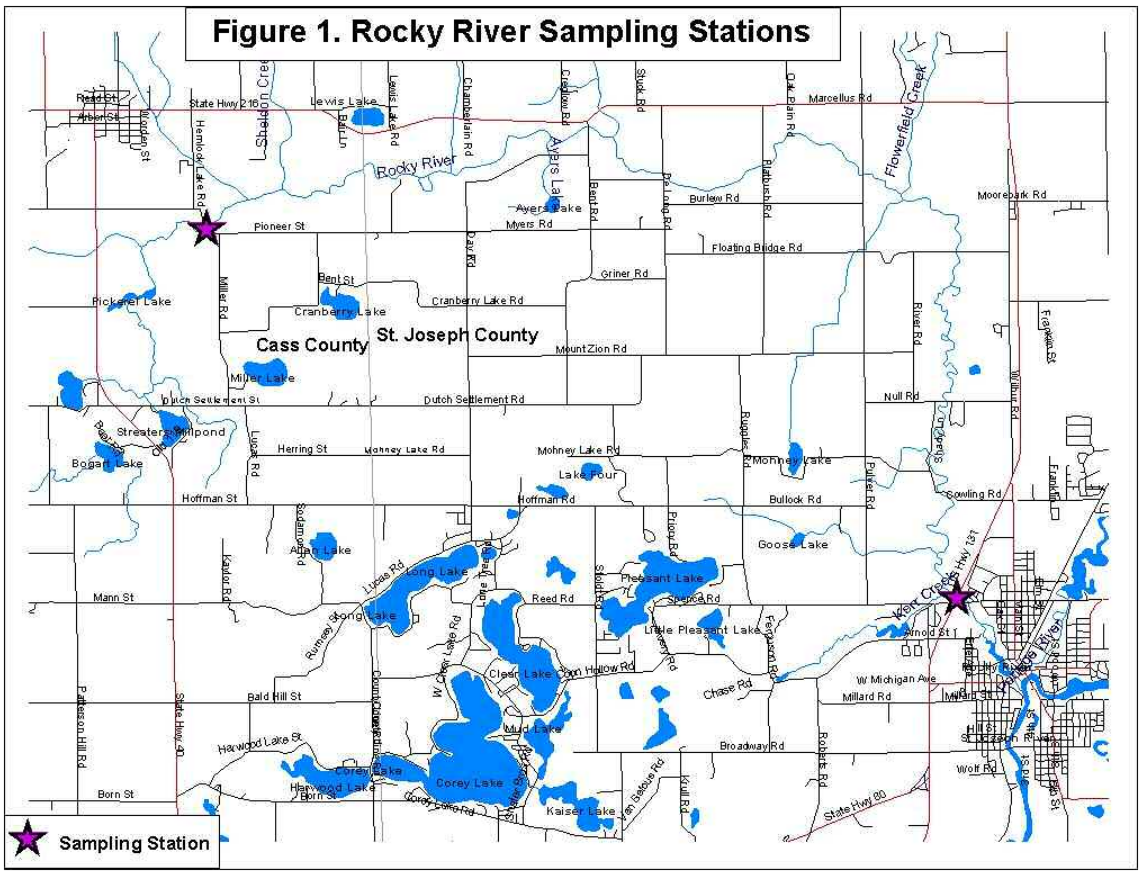
June 29, 2004

1.0 OVERVIEW

The Rocky River Watershed encompasses 112,144 acres spanning into St. Joseph, Cass, Kalamazoo and Van Buren counties in southwest Michigan (Figure 1). Since 2002, this watershed has been the focus of a 319 Grant funded by the US Environmental Protection Agency (USEPA) and the Michigan Department of Environmental Quality (MDEQ). As part of this 319 Grant, KIESER & ASSOCIATES (K&A) was contracted to conduct the water quality portion of this project.

As stated in the 319 Grant, 20 water quality sampling events were conducted at two sites on the Rocky River over a 19-month study period. The Rocky River was monitored monthly at Pioneer Street in Cass County and at US-131 in St. Joseph County (Figure 1). As only two sampling sites were designated in the Grant, K&A selected locations which best represented upper reach conditions (Pioneer Street) and lower reach conditions (US-131) while still allowing access for monitoring. Sedimentation from rural and agricultural areas was a suspected cause of impairment in the Rocky River, therefore this was a target of investigations. The US-131 site represents the downstream conditions just prior to storm sewer influences from the City of Three Rivers. Impacts of storm sewer inputs from the City of Three Rivers remains unknown due to the limited scope of this study. Annual pollutants loads to the Rocky River were estimated using two different modeling techniques.

In addition, during this project a bioassessment was conducted on the Rocky River and selected tributaries to assess the health of the river based on the macroinvertebrate community present during the survey.



2.0 RESULTS

Water Quality Monitoring:

Water quality sampling began on December 30, 2002 and continued to June 7, 2004. Two sampling events were conducted in September 2003 to accommodate the 19-month time frame of the Grant. A combination of both dry (16) and wet (4) weather conditions were sampled during the study to provide a better understanding of water quality conditions throughout the year and during differing weather conditions.

K&A collected samples to monitor total phosphorus (TP) and total suspended solids (TSS) at each location during each sampling event. Duplicate samples were collected and analyzed for every tenth sample (i.e. every five sampling events). TP samples were sent to Upstate Freshwater Institute (UFI) in Syracuse, New York for analysis. KAR Laboratories in Kalamazoo, Michigan analyzed samples for TSS. (Laboratory results are included in the Appendix.) In addition, field parameters of temperature, dissolved oxygen, pH and specific conductance were monitored during each of the 20 field visits. Water quality data are presented in Table 1.

Dissolved oxygen (DO) concentrations ranged from a low of 6.0 mg/L (May 2004) to a high of 17.4 mg/L (February 2003) at the Pioneer Street site during this study. DO concentrations at US-131 ranged from 7.2 mg/L (May 2004) to high of 14.6 mg/L (January 2003). All levels detected during the study period were above the 5 mg/L criterion set by USEPA for rivers. pH levels were between 6.99 and 9.32 for all events monitored during the study. In addition, specific conductance levels were detected at a low of 109 umhos/cm (January 2003) and ranged to 533 umhos/cm (August 2003) at Pioneer Street. Specific conductance ranged from 107 (February 2004) to 569 umhos/cm (June 2003) at the US-131 site.

TP values ranged from 7.6 to 84.8 ug/L at the upstream Pioneer Street site and from 13.8 to 84.8 ug/L at the downstream US-131 site during this study. TSS concentrations varied from 2 to 23 mg/L at Pioneer Street and from 2 to 33 mg/L at US-131 during the same time period. These pollutant concentrations are very low considering that these concentrations were detected during sampling events which included both rain events and dry weather. Suspended solids and phosphorus concentrations are typically elevated in samples collected during a rain event due to runoff and erosion. This was not evident in the Rocky River samples collected during this study with the exception of the November 3, 2003 wet weather event which did correspond with spikes in TP at the both the Pioneer and US-131 sites with 83.8 and 82.5 ug/L TP, respectively. TSS levels were slightly elevated on this same sampling date with 17 mg/L detected at Pioneer Street and 21 mg/L at US-131. Figures 2 and 3 show TSS concentrations at the Pioneer Street and US-131 locations, respectively, along with flows measured at the time of sample collection. These figures illustrate that increases in Rocky River flow do not consistently correspond to an increase in TSS concentration at these two stations. Similar results were seen for TP concentrations at both sites (Figures 4 and 5).

There are currently no water quality criteria for TSS and TP in surface waters. As a point of reference, the USEPA recommends that TP levels remain below 100 ug/L in rivers not directly discharging to a reservoir and below 50 ug/L in rivers discharging directly to a reservoir. In addition, Rule 50 of the Michigan Water Quality Standards (Part 4 of Act 451) lists unnatural physical properties that shall not be present in quantities which are or may become injurious to any designated use in waters of the state. Suspended solids is listed as one of these unnatural physical properties. Most people consider water with a TSS level of less than 20 mg/L to be clear and waters with concentrations between 40 and 80 mg/L to be cloudy (MDEQ, 2004).

During the 19-month water quality sampling study on the Rocky River, TSS values were not detected at levels above 33 mg/L at either site. During the 20 sampling events at the Pioneer Street location, TSS values were detected below 20 mg/L on 19 occasions. TSS values were below 20 mg/L at the US-131 sampling stations during 15 of the 20 sampling events. In addition, detected TP levels were also quite low during this study with concentrations reaching up to approximately 85 ug/L during only two sampling events. As noted above, increased flow during wet weather events did not correspond to higher TSS or TP concentrations in the collected samples. These data indicate that erosion caused by runoff in this upper watershed is not a significant problem at this time. Based on these collected data, no discernable water quality issues were identified on the Rocky River between Pioneer Street and US-131.

Flow:

Cross-sectional water velocities were monitored at both the upstream and downstream sites during each of the 20 field visits. Velocities were measured with a Marsh-M^{c}Birney Model 2000 velocity meter. Flows measured during the study are presented in Table 2.

Measured flows at the Pioneer Street location ranged from 11.09 cubic feet per second (cfs) in August 2003 to 55.70 cfs in November 2003 (Figure 6). Flows at the US-131 site varied from 73.40 cfs in August 2003 to 212.80 cfs in March 2004.

Modeled Pollutant Loads:

K&A estimated pollutant loads in the Rocky River using two different approaches. The first is termed an "instantaneous load" estimate which uses both the measured flow at a given point in time along with the pollutant concentration detected at this same time. The product of the flow and pollutant concentration is then multiplied by a conversion factor to yield load per day. For those sampling events where duplicate samples were collected, an average concentration was used in the loading calculation. These data are presented in Table 3. Again, these are rough estimates based on one sample collected at a single point in time which estimates pollutants *within* the river. Calculated instantaneous TSS loads ranged from 2,393 to 51,089 lbs/day at Pioneer Street during this study. TSS loads at US-131 ranged from 10,953 to 361,439 lbs/day. Similarly, TP loads ranged from 0.46 to 25 lb/day at the Pioneer location. Loads at the US-131 site ranged from 10 to 89 lb TP/day. Estimates of annual pollutant loads were calculated for each water quality sampling station by multiplying the average daily wet weather load by 60 days of wet weather per year and adding that to the product of the average dry weather load multiplied by 305 dry weather days. This resulted in an estimated annual TSS load at Pioneer Street of 2,300 tons and 17,825 tons at US-131. Estimated annual TP loads were 1.01 tons/year at Pioneer Street and 6.1 tons/year at the US-131 site.

The second pollutant load estimation method is that used by the MDEQ to estimate watershed non-point source pollution (MDEQ, 1999) entering the river during wet weather events. This method considers land cover types within the watershed, runoff estimates and Event Mean Concentration (EMC) values corresponding to those specific land cover types. Based on this method, an estimated 4,461 tons of sediment and 9.7 tons of phosphorus enter the Rocky River watershed upstream of US-131 each year during runoff events. To compare the two pollutant load estimation methods, TSS wet weather loads in the upper water Rocky River watershed were 5,323 tons/year using the instantaneous load method versus 4,461 tons/year based on the MDEQ nonpoint source estimates. Wet weather TP load estimates were 1.17 tons/year using the instantaneous load method versus 9.7 tons/year based on the MDEQ estimation method.

Although K&A was not authorized to sample the Rocky River downstream of the City of Three Rivers during this study, this section from US-131 to the St. Joseph River was modeled using the MDEQ method to estimate additional loads from urban stormwater. An estimated additional 66.7 tons TSS/yr and 0.2 tons TP/yr is added to the Rocky River during wet weather from this downstream portion of the watershed.

Macroinvertebrate Bioassessment:

A survey of the Rocky River and select tributaries was conducted on June 30, 2003 to assess aquatic macroinvertebrate community health. The survey was conducted according to guidelines in the MDEQ Great Lakes Environmental Assessment Section (GLEAS) Procedure #51 (MDEQ, 1997). The five survey sites are:

· Rocky River at Pioneer Street
· Sheldon Creek at M-216
· Spring Creek at Muskrat Lake Road
· Flowerfield Creek at YZ Avenue
· Rocky River at US-131

The first four listed stations were sites surveyed by the MDEQ in 2000. The downstream US-131 water quality monitoring site was also surveyed to provide additional data at this site.

Using the Procedure #51 scoring protocol, all five locations were rated "good" based on the habitat evaluations (Table 4). All sites were rated "acceptable" and tending toward "excellent" with the exception of Flowerfield Creek which rated "excellent" (Table 5) for the macroinvertebrate community. A complete list of the taxa found at each site is displayed in Table 6.

Table 4. Habitat score for sites in the Rocky River watershed, St. Joseph, Cass, and Kalamazoo Counties, June 30, 2003. Additional metric scores of corresponding MDEQ 2000 sites are listed for comparison.

Habitat Parameter	Highest Possible Score	Sampling Location Site Score				
		Rocky River-US131	Spring Creek	Sheldon Creek	Rocky River-Pioneer	Flowerfield Creek
Bottom Substrate/Available Cover	20	15	9	11	15	19
Embeddedness/Siltation	20	17	13	12	15	15
Velocity Depth	20	5	6	10	9	6
Flow Stability	15	11	8	12	11	9
Bottom Deposition/Sedimentation	15	7	6	6	6	13
Pools-Riffles-Runs-Bends	15	7	7	7	8	7
Bank Stability	10	9	9	10	10	8
Bank Vegetative Stability	10	9	9	9	10	10
Streamside Cover	10	8	5	8	5	8
Total Habitat Score	**135**	**88**	**72 (83)***	**85 (74)***	**89 (78)***	**95 (79)***
Habitat Characterization		**Good**	**Good**	**Good**	**Good**	**Good**

* Score in parentheses from MDEQ 2000

Table 5. Macroinvertebrate metric evaluation of sites in the Rocky River watershed, St. Joseph, Cass, and Kalamazoo Counties, June 30, 2003.

METRIC	Rocky River US-131		Rocky River Pioneer		Sheldon Creek		Spring Creek		Flowerfield Creek	
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	22	0	26	1	15	0	16	0	24	0
NUMBER OF MAYFLY TAXA	4	1	3	0	1	-1	3	0	4	1
NUMBER OF CADDISFLY TAXA	3	0	4	0	1	-1	2	0	3	0
NUMBER OF STONEFLY TAXA	1	1	0	-1	2	1	1	1	1	1
PERCENT MAYFLY COMP.	65	1	10	0	76	1	19	1	22	1
PERCENT CADDISFLY COMP.	6	0	24	0	4	0	4	0	22	0
PERCENT CONTR. DOM. TAXON	62	-1	33	0	76	-1	22	0	21	0
PERCENT ISOPOD, SNAIL, LEECH	1	1	2	1	0	1	3	1	2	1
PERCENT SURF. AIR BREATHERS	2	1	1	1	2	1	10	0	0	1
TOTAL SCORE		**4**		**2**		**1**		**3**		**5**
MACROINV. COMMUNITY RATING		**accept**		**accept**		**accept**		**accept**		**excel**
MDEQ 2000 TOTAL SCORE		**na**		**2**		**3**		**5**		**-1**
MDEQ 2000 COMMUNITY RATING		**na**		**accept**		**accept**		**excel**		**accept**

Additional metric scores and evaluation of corresponding MDEQ 2000 sites are also listed for comparison.

na = not available

Table 6. Qualitative macroinvertebrate sampling results for sites in the Rocky River watershed, St. Joseph, Cass, and Kalamazoo Counties, June 30, 2003.

TAXA	Rocky River US-131 6/30/2003	Rocky River Pioneer 6/30/2003	Sheldon Creek 6/30/2003	Spring Creek 6/30/2003	Flowerfield Creek 6/30/2003
PLATYHELMINTHES (flatworms)					
Turbellaria		3			3
ANNELIDA (segmented worms)					
Oligochaeta (worms)		3			12
ARTHROPODA					
Crustacea					
Isopoda				3	
Amphipoda (scuds)	8	68	1	30	28
Decapoda (crayfish)	2	3	1		2
Arachnoidea					
Hydracarina	1	8	1		7
Lebertia	1	9	10	1	5
Insecta					
Collembola					
Collembola	1				1
Ephemeroptera (mayflies)					
Baetidae	165	13	107	20	4
Caenidae	5			6	7
Heptageniidae	3	1			12
Leptophlebiidae		6		1	47
Polymitarcyidae	1				
Odonata					
Anisoptera (dragonflies)					
Aeshidae	1				1
Gomphidae			1		
Zygoptera (damselflies)					
Calopterygidae				1	
Coenagrionidae		5			
Plecoptera (stoneflies)					
Nemouridae			1		
Perlidae	5		1	21	11
Hemiptera (true bugs)					
Corixidae		1	1	14	
Gerridae	1		1		
Veliidae			1		
Trichoptera (caddisflies)					
Brachycentridae	3	1			
Hydropsychidae	12	21	5	4	64
Hydroptilidae		6			
Leptoceridae	1	21		2	3
Uenoidae					2
Coleoptera (beetles)					
Elmidae		1	1		13
Gyrinidae	4	1			
Hydrophilidae		1			
Diptera (flies)					
Chironomidae	34	19	8	28	68
Dixidae			1	1	
Simuliidae	12	2		1	7
Tipulidae	1	1			1
MOLLUSCA					
Gastropoda (snails)					
Ancylidae (limpets)	2				1
Hydrobiidae		1			
Lymnaeidae		1			
Physidae	1	3		1	1
Planorbidae					3
Pelecypoda (bivalves)					
Sphaeriidae (clams)		1			
Corbiculidae	2	4		5	14
TOTAL INDIVIDUALS	**266**	**204**	**141**	**139**	**317**

3.0 CONCLUSIONS

Water quality in the upper Rocky River during this 19-month study period showed no signs of impairment based on the data collected. All Rocky River water quality samples analyzed for the 20 sampling events showed TP concentrations below USEPA recommendations for rivers not flowing into a reservoir (<100 ug TP/L) . TSS values were also low, with all samples measuring below 33 mg/L. These data suggest that existing buffer zones are effective in controlling runoff and erosion and should be maintained in the upper Rocky River watershed. In addition, agricultural practices in this upper watershed do not appear to be impacting water quality at this time under existing conditions. Land owners should continue to maintain or improve riparian areas and ensure that any new development incorporates responsible stormwater management practices.

A major shortfall of this study is the lack of data available for the urban area of the Rocky River downstream of the US-131 sampling location. This area encompasses nearly 900 acres of urban land with some existing problem areas. The 319 Grant restricted sampling to only two locations during this project, therefore additional sampling to quantify TP and TSS contributions were not permitted. K&A strongly recommends additional sampling in the lower Rocky River watershed to further document Rocky River water quality over time and to better estimate loads to the St. Joseph River. While this study established a solid baseline of water quality and flow in the upper Rocky River over the 19-month study period, potential problem areas within the lower watershed remain unstudied.

4.0 REFERENCES:

Michigan Department of Environmental Quality (MDEQ). 2004. http://www.deq.state.mi.us/documents/deq-swq-npdes-TotalSuspendedSolids.pdf.

Michigan Department of Environmental Quality (MDEQ). 2002. A Biological Survey of Sites in the Upper St. Joseph Watershed, Cass, Kalamazoo, and St. Joseph Counties, July 18, 2000. MDEQ, SWQD, Report #MI/DEQ/SWQ-02/006.

Michigan Department of Environmental Quality (MDEQ). 1999. State of Michigan Draft Part 30-Water Quality Trading Rules (MI-ORR. 1999).

Michigan Department of Environmental Quality (MDEQ). 1997. GLEAS Procedure #51: Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers.

Appendix 4. St Joseph County Land Use Policy Task Force Proposed Recommendations

Recommendation
The Land Use Policy Task Force recommends that St. Joseph County implement an interactive GIS mapping capability on the website

Support: The Task Force believes the benefits to the Land Resource Center, other county departments and clients of the Land Resource Center of interactive mapping are significant, and any existing resources allocated for short-term static mapping on the website should be reallocated to GIS capability. Organizations like Land Information Access Association (LIAA), and perhaps others, have the experience and capability to partner with and assist the County with this project.

Approximate cost: Establish a basic interactive web mapping system, $10,000.

Recommendation
The Land Use Policy Task Force recommends that Site Plans be reviewed by all entities that have the ability to impact the implementation of the Site Plan.

Support: This non-binding review will help landowners and developers avoid costly or inconvenient delays, or worse, a major revision of the site plan.

Approximate cost: No additional cost.

Recommendation
The Land Use Policy Task Force recommends that anon-going surface water sampling program for the St. Joseph River and its tributaries. The collected data will be compiled into a water quality database.,

Support: The establishment of baseline data surface water quality data and continued collection of such data will allow negative water quality trends to be identified quickly.

Approximate cost: Depends on the number of sites and frequency of sampling.

Recommendation
The Land Use Policy Task Force recommends that an on-site septic system management committee be formed.

Support: The committee will define problem areas where existing septic systems have a direct impact on surface waters. The committee could help develop methods for financing the management of existing on-site septic systems.

Approximate cost: Unknown

Recommendation
The Land Use Policy Task Force recommends that all governmental planning and zoning work collaboratively on land use issues while retaining their autonomy.

Support: Collaboration will: help insure that development plans and processes that have an impact on a regional area are considered by those affected; simplify the land use process and foster the development of common goals which impact controlled growth; and encourage reuse of existing infrastructure

Recommendation
The Land Use Policy Task Force recommends the Economic Development Corporation be charged to research the pros and cons of establishing a County Wide Brownfield.

Support: If a countywide Brownfield is established, it will enable small communities to economically establish Brownfield projects while assisting the larger communities.

Recommendation
The Land Use Policy Task Force recommends that MISHDA be expanded to cover the entire county.

Support: Work with the other entities to expand housing assistance through the County to include qualification for downtown apartments, not just single family dwellings. This type of housing stock is vastly underutilized and can meet a specific housing need while assisting communities and developers rehabilitate downtown structures.

Recommendation
The Land Use Policy Task Force recommends that the county maintain and strengthen EDC.

Support: The St. Joseph County EDC is a vital partner in the regional economy. With ever changing missions for economic development at the state and federal levels, more demands will be placed in local EDCs to complete the mission that larger entities have traditionally fulfilled. Further, EDC with a stronger commitment for staffing can concentrate on even a greater scale for the economic development including the agricultural and commercial portions of our regional economy. This strengthening can be done by continued financial support for the EDC Director, and support of other governmental units and the private sector.

Recommendation
The Land Use Policy Task Force recommends that the county facilitate collaborative efforts in community marketing.

Support: With an intense national competition to take away jobs from St. Joseph County let alone the need to stay competitive to expand and locate jobs within the County, all communities must work together to market ourselves. This includes conceptually supporting the economic improvement based organizations in the County. All segments of the County from agriculture to downtowns to industrial suppliers, to housing organizations, to chamber of commerce councils need to maximize limited resources to get our message that St. Joseph County is the place to be. The County can play a role in facilitating cooperative efforts amongst all who are attempting to make our County a better place to live.

Recommendation
The Land Use Policy Task Force recommends that the County Boards of Commissioners direct the County Planning Commission to coordinate the compilation of current land use plans prepared by the townships, villages and cities into a county land use plan.

Recommendation
The Land Use Policy Task Force recommends that the County Board of Commissioners appoint a Farmland Preservation Committee to develop, within a year, a proposed St. Joseph County Farmland and Open Space Preservation Ordinance for the Commission to consider. A suggested composition of the committee is:

Three representing agriculture
One representing real estate interests
One township official
One county commissioner
One representing natural resource preservation
One representing urban areas

Recommendation
The Land Use Policy Task Force recommends citizen recruitment and training for duty on the many public boards in the county by continuing support of training activities. The committee applauds the Citizen Planner program offered by the MSU Extension and urges that this program be offered on a regular basis.

Support: The committee recognizes the valuable contribution that township, village, city and county officials give to maintaining rural character. One of the keys to appropriate development is the establishment of well-conceived zoning ordinances. To make good ordinances effective they must be well enforced. Dedicated and competent zoning boards of appeal are instrumental in administering zoning requirements. The need to recruit and train these individuals is an ever-present situation.

Recommendation
The Land Use Policy Task Force recommends that the county help cities and villages obtain funding for the extension of existing infrastructure so that building can occur adjacent to them at a reasonable cost.

Support: One of the factors that causes the development of farmland is its lower cost for a building site compared to an urban setting that has infrastructure such as water, sewer and paving in place. Because of the installation fees for existing water, sewer, etc., it normally costs less to build in a rural area than an urban area even when the additional costs of a well and septic system are added. Programs that would lower the cost of lots where existing infrastructure can be used would reduce the use of rural land for residential and commercial construction.

Recommendation
The Land Use Policy Task Force recommends that the Economic Development Corporation promote the direct marketing of agricultural goods and the establishment of agricultural processing plants in the region.

Support: Increasing the profitability of farm enterprises would be of great help in maintaining rural character. Landowners are less prone to sell their land for development if they are engaged in a moneymaking farm enterprise. The work of the Michigan State University Extension Service is a valuable asset in this service and urges that it be continued. Direct marketing can provide a small but significant number of producers with the potential of increasing the profit from their land. This would include outlets on the farm, farmers' markets in towns, internet marketing, etc. The establishment of more agricultural processing facilities in the county would boost the general economy of the area as well as the farm sector. The local seed corn plants are a good example.

Recommendation
The Land Use Policy Task Force recommends that the Board of Commissioners continue to financially support the Michigan State University Extension at an adequate level.

Recommendation
The Land Use Policy Task Force recommends that townships designate areas of viable agricultural land where agriculture would be the preferred use. This should be a distinct category from the traditional general agriculture and residential areas. Other categories could include: wetlands, woodlands, lake residential, medium density housing, commercial, industrial, parks, and urban.

Appendix 5: Prototype Road/Stream Crossing Inventory Form

Developed by Kieser & Associates for the St. Joseph River Watershed Planning Grant

Road Stream Crossing Inventory
Scoring for Erosion Quantification

SITE NUMBER

Soil Texture (check one)
____sand ____gravel ____ silt clay _____ organic matter

if the bank is stratified or multiple soil textures are observed, indicate the approximate percentage of each soil texture.

Height of Erosion Site
_____feet

Length of Erosion Site
_____feet

Erosion Severity
_____very severe ___severe ____moderate ____slight

Erosion Scoring Form Instructions

Soil texture
If the bank is stratified, please estimate the percentage of each soil type observed. Estimate soil type visually. However, if you can determine a more specific soil type by touching the soils, record this observation. You can use this more specific classification to determine a dry density (for calculation of annual loading. See below.)

Height of erosion site
Determine the height of the eroding bank from the water line to the top of the bank.

Length of erosion site
Determine the length of the eroding bank.

Erosion Severity
Estimate the severity of erosion using the following descriptions. This estimation can be used to approximate the lateral recession rate.

Category	Description	Lateral Recession Rate (feet/year)
Slight	Some bare bank, but active erosion not readily apparent. Some rills but not vegetative overhang. No exposed tree roots.	0.01-0.05
Moderate	Bank is predominantly bare with some rills and some vegetative overhang.	0.06-0.2
Severe	Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross-section becomes more U-shaped as opposed to V-shaped.	0.3-0.5
Very Severe	Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains and culverts eroding out and changes in cultural features as above. Massive slips or washouts common. Channel cross-section is U-shaped and stream course or gully may be meandering.	0.5+

Calculating Sediment Loading

Sediment loading from each site can be estimated based upon the geometry of the site and an estimation of the lateral recession rate. The lateral recession rate is the thickness of soil eroded from a bank surface perpendicular to its face in an average year. It can be estimated by using the above table, by reviewing aerial photographs (in which a change in the bank location can be measured over time) or by observing the bank's position relative to a stationary object (such as a utility pole or culvert) over time. Use the following equations to calculate the volume and weight of sediment loss in an average year.

Volume of annual soil loss (cubic feet/year) = length of eroding bank (feet) * height of eroding bank (feet) * lateral recission rate (feet/year).

Weight of annual soil loss (tons/year) = volume of annual soil loss (cubic feet/year) * dry density (tons/cubic foot).

Use your estimation of soil type to determine dry density. If the soils are stratified or mixed, determine the average density by multiplying the percentages of each soil texture by their respective densities and adding. For example, for an eroding bank composed of 40% clay and 60% silt, use the following equation:

0.4 * 0.035 + 0.6 * 0.0425 = 0.0395

Use the following dry density soil weights to determine the weight of annual soil loss. If you were able to determine a more specific soil textual class, use that determination to estimate a dry density from a source on soil physical properties. For example, sandy clay loam has a density of 0.045 tons/cubic foot.

Soil textural class	**Dry density (tons/cubic foot)**
organic matter	0.011
gravel*	0.05
sand	0.055
silt	0.0425
clay	0.035

Sources

MDEQ Surface Water Quality Division. Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual. Revised June 1999.

*gravel dry density source: Dewberry & Davis. Land Development Handbook. McGraw Hill. New York. 1996.

Appendix 6. Rocky River Watershed Survey developed by MSUE

	Question	Answer Description	Total	Amt	Percent
1	Surface water quality		372		
		Very Important		251	67.5%
		Important		112	30.1%
		Unimportant		2	0.5%
		Very Unimportant		1	0.3%
		Don't Know		6	1.6%
2	Groundwater quality		371		
		Very Important		315	84.9%
		Important		52	14.0%
		Very Unimportant		2	0.5%
		Don't Know		2	0.5%
3	Frequency of flooding		366		
		Very Important		68	18.6%
		Important		156	42.6%
		Unimportant		94	25.7%
		Very Unimportant		19	5.2%
		Don't Know		29	7.9%
4	Wetlands		366		
		Very Important		185	50.5%
		Important		153	41.8%
		Unimportant		23	6.3%
		Very Unimportant		1	0.3%
		Don't Know		4	1.1%
5	Soil erosion		366		
		Very Important		162	44.3%
		Important		174	47.5%
		Unimportant		17	4.6%
		Very Unimportant		3	0.8%
		Don't Know		10	2.7%
6	Irrigation		373		
		Very Important		128	34.3%
		Important		165	44.2%
		Unimportant		41	11.0%
		Very Unimportant		14	3.8%
		Don't Know		25	6.7%
7	Pesticide use		372		
		Very Important		225	60.5%
		Important		118	31.7%
		Unimportant		12	3.2%
		Very Unimportant		6	1.6%
		Don't Know		11	3.0%

	Question	Answer Description	Total	Amt	Percent
8	Fertilizer use		369		
		Very Important		195	52.8%
		Important		152	41.2%
		Unimportant		11	3.0%
		Very Unimportant		3	0.8%
		Don't Know		8	2.2%
9	Fish habitat		372		
		Very Important		210	56.5%
		Important		136	36.6%
		Unimportant		17	4.6%
		Very Unimportant		2	0.5%
		Don't Know		7	1.9%
10	Wildlife habitat		370		
		Very Important		229	61.9%
		Important		121	32.7%
		Unimportant		13	3.5%
		Very Unimportant		2	0.5%
		Don't Know		5	1.4%
11	Woodlands		371		
		Very Important		201	54.2%
		Important		149	40.2%
		Unimportant		16	4.3%
		Very Unimportant		2	0.5%
		Don't Know		3	0.8%
12	Housing development		369		
		Very Important		120	32.5%
		Important		152	41.2%
		Unimportant		63	17.1%
		Very Unimportant		25	6.8%
		Don't Know		9	2.4%
13	Economic development		368		
		Very Important		107	29.1%
		Important		196	53.3%
		Unimportant		42	11.4%
		Very Unimportant		11	3.0%
		Don't Know		12	3.3%
14	Public land management		368		
		Very Important		144	39.1%
		Important		170	46.2%
		Unimportant		35	9.5%
		Very Unimportant		4	1.1%
		Don't Know		15	4.1%

	Question	Answer Description	Total	Amt	Percent
15	Environmental assistance for landowners		371		
		Very Important		104	28.0%
		Important		178	48.0%
		Unimportant		49	13.2%
		Very Unimportant		10	2.7%
		Don't Know		30	8.1%
16	Accessibility of assistance programs		366		
		Very Important		95	26.0%
		Important		171	46.7%
		Unimportant		51	13.9%
		Very Unimportant		12	3.3%
		Don't Know		37	10.1%
17	Farm operations		373		
		Very Important		156	41.8%
		Important		167	44.8%
		Unimportant		28	7.5%
		Very Unimportant		5	1.3%
		Don't Know		17	4.6%
18	Rural character		366		
		Very Important		154	42.1%
		Important		152	41.5%
		Unimportant		25	6.8%
		Very Unimportant		9	2.5%
		Don't Know		26	7.1%
19	My quality of life depends on the health of the environment.		375		
		Stongly Disagree		6	1.6%
		Mildly Disagree		5	1.3%
		Neither		7	1.9%
		Mildly Agree		76	20.3%
		Strongly Agree		277	73.9%
		Don't Know		4	1.1%
20	An important step in maintaining environmental quality is to develop community goals for the environment in our region.		371		
		Stongly Disagree		6	1.6%
		Mildly Disagree		13	3.5%
		Neither		17	4.6%
		Mildly Agree		129	34.8%
		Strongly Agree		193	52.0%
		Don't Know		13	3.5%
21	Public policies that influence land use and environmental quality should be developed.		369		
		Stongly Disagree		13	3.5%
		Mildly Disagree		23	6.2%
		Neither		25	6.8%
		Mildly Agree		118	32.0%
		Strongly Agree		178	48.2%

		Don't Know		12	3.3%

	Question	Answer Description	Total	Amt	Percent
22	Professionals should develop land use policies.		371		
		Stongly Disagree		47	12.7%
		Mildly Disagree		57	15.4%
		Neither		31	8.4%
		Mildly Agree		137	36.9%
		Strongly Agree		82	22.1%
		Don't Know		17	4.6%
23	Land use policy should be developed with much public input.		368		
		Stongly Disagree		12	3.3%
		Mildly Disagree		11	3.0%
		Neither		9	2.4%
		Mildly Agree		82	22.3%
		Strongly Agree		247	67.1%
		Don't Know		7	1.9%
24	It is appropriate to promote economic development when there is some environmental impact.		370		
		Stongly Disagree		48	13.0%
		Mildly Disagree		61	16.5%
		Neither		35	9.5%
		Mildly Agree		115	31.1%
		Strongly Agree		80	21.6%
		Don't Know		31	8.4%
25	A healthy economy depends on a healthy environment.		369		
		Stongly Disagree		9	2.4%
		Mildly Disagree		21	5.7%
		Neither		34	9.2%
		Mildly Agree		108	29.3%
		Strongly Agree		185	50.1%
		Don't Know		12	3.3%
26	Cost should be an important consideration in making decisions on preserving rare plants and animals.		370		
		Stongly Disagree		51	13.8%
		Mildly Disagree		64	17.3%
		Neither		26	7.0%
		Mildly Agree		124	33.5%
		Strongly Agree		95	25.7%
		Don't Know		10	2.7%
27	We should limit our development and use of the environment today so that future generations will have the resources they need to live.		376		
		Stongly Disagree		9	2.4%
		Mildly Disagree		16	4.3%
		Neither		17	4.5%
		Mildly Agree		77	20.5%
		Strongly Agree		247	65.7%
		Don't Know		10	2.7%

	Question	Answer Description	Total	Amt	Percent
28	Conserving and restoring native plant communities should be an important goal of public agencies.		371		
		Stongly Disagree		8	2.2%
		Mildly Disagree		28	7.5%
		Neither		37	10.0%
		Mildly Agree		147	39.6%
		Strongly Agree		136	36.7%
		Don't Know		15	4.0%
29	Economic development activities in my region should broaden the job opportunities.		371		
		Stongly Disagree		13	3.5%
		Mildly Disagree		19	5.1%
		Neither		45	12.1%
		Mildly Agree		152	41.0%
		Strongly Agree		116	31.3%
		Don't Know		26	7.0%
30	When managing public lands, the economic impact on my community should be given priority.		375		
		Stongly Disagree		20	5.3%
		Mildly Disagree		61	16.3%
		Neither		50	13.3%
		Mildly Agree		133	35.5%
		Strongly Agree		93	24.8%
		Don't Know		16	4.3%
31	River flood plains should exist in a natural state, free of buildings or other structures.		375		
		Stongly Disagree		10	2.7%
		Mildly Disagree		14	3.7%
		Neither		22	5.9%
		Mildly Agree		113	30.1%
		Strongly Agree		198	52.8%
		Don't Know		18	4.8%
32	We should maintain or enhance the diversity of wildlife populations.		373		
		Stongly Disagree		12	3.2%
		Mildly Disagree		13	3.5%
		Neither		23	6.2%
		Mildly Agree		130	34.9%
		Strongly Agree		183	49.1%
		Don't Know		12	3.2%
33	Private landowners and public land managers currently work together effectively to protect the environment.		372		
		Stongly Disagree		47	12.6%
		Mildly Disagree		75	20.2%
		Neither		44	11.8%
		Mildly Agree		85	22.8%
		Strongly Agree		55	14.8%
		Don't Know		66	17.7%

	Question	Answer Description	Total	Amt	Percent
34	New residential development should be restricted to areas adjacent to existing cities or villages.		370		
		Stongly Disagree		24	6.5%
		Mildly Disagree		51	13.8%
		Neither		39	10.5%
		Mildly Agree		111	30.0%
		Strongly Agree		127	34.3%
		Don't Know		18	4.9%
35	Funding for environmental improvements should be obtained through private sources like foundations or civic organizations.		367		
		Stongly Disagree		17	4.6%
		Mildly Disagree		32	8.7%
		Neither		34	9.3%
		Mildly Agree		165	45.0%
		Strongly Agree		101	27.5%
		Don't Know		18	4.9%
36	Funding should be obtained by governmental units increasing taxes.		364		
		Stongly Disagree		100	27.5%
		Mildly Disagree		70	19.2%
		Neither		36	9.9%
		Mildly Agree		117	32.1%
		Strongly Agree		30	8.2%
		Don't Know		11	3.0%
37	Funding should be obtained by governmental units cutting other programs and services.		369		
		Stongly Disagree		62	16.8%
		Mildly Disagree		74	20.1%
		Neither		70	19.0%
		Mildly Agree		92	24.9%
		Strongly Agree		47	12.7%
		Don't Know		24	6.5%
38	Funding should be the responsibility of the landowner.		367		
		Stongly Disagree		81	22.1%
		Mildly Disagree		89	24.3%
		Neither		59	16.1%
		Mildly Agree		100	27.2%
		Strongly Agree		21	5.7%
		Don't Know		17	4.6%
39	Mail		358		
		Favored		165	46.1%
		Acceptable		157	43.9%
		Unacceptable		36	10.1%
40	E-Mail		329		
		Favored		43	13.1%
		Acceptable		111	33.7%
		Unacceptable		175	53.2%

	Question	Answer Description	Total	Amt	Percent
41	TV		349		
		Favored		118	33.8%
		Acceptable		194	55.6%
		Unacceptable		37	10.6%
42	Newspaper articles		360		
		Favored		154	42.8%
		Acceptable		192	53.3%
		Unacceptable		14	3.9%
43	Booth at festivals or fairs		338		
		Favored		60	17.8%
		Acceptable		222	65.7%
		Unacceptable		56	16.6%
44	Internet		340		
		Favored		67	19.7%
		Acceptable		158	46.5%
		Unacceptable		115	33.8%
45	Workshops		324		
		Favored		77	23.8%
		Acceptable		206	63.6%
		Unacceptable		41	12.7%
46	Field Days		321		
		Favored		68	21.2%
		Acceptable		220	68.5%
		Unacceptable		33	10.3%
47	Visit Government offices		323		
		Favored		30	9.3%
		Acceptable		204	63.2%
		Unacceptable		89	27.6%
48	Phone		323		
		Favored		14	4.3%
		Acceptable		81	25.1%
		Unacceptable		228	70.6%
49	Personal consultations		316		
		Favored		38	12.0%
		Acceptable		169	53.5%
		Unacceptable		109	34.5%
50	Do you find environmental information easy to obtain?		364		
		Yes		132	36.3%
		No		99	27.2%
		Don’t Know		133	36.5%

	Question	Answer Description	Total	Amt	Percent
51	What is the greatest hindrance trying to find information of the environment?		311		
		Don't know where to look or who to ask		163	52.4%
		The people I ask don't have the answers to my questions		38	12.2%
		I am referred to other sources		45	14.5%
		Lack of information available		65	20.9%
52	Land conservancies		343		
		Would like to learn more about		211	61.5%
		Know the subject well		47	13.7%
		Not interested		85	24.8%
53	Money to help me pay for implementing new practices		338		
		Would like to learn more about		199	58.9%
		Know the subject well		14	4.1%
		Not interested		125	37.0%
54	Practices you can do on you own to protect the Rocky River		341		
		Would like to learn more about		220	64.5%
		Know the subject well		20	5.9%
		Not interested		101	29.6%
55	Environmental organizations		335		
		Would like to learn more about		191	57.0%
		Know the subject well		43	12.8%
		Not interested		101	30.1%
56	Free landowner assistance		334		
		Would like to learn more about		242	72.5%
		Know the subject well		11	3.3%
		Not interested		81	24.3%
57	Wildlife improvements		345		
		Would like to learn more about		262	75.9%
		Know the subject well		37	10.7%
		Not interested		46	13.3%
58	Water quality improvements		350		
		Would like to learn more about		288	82.3%
		Know the subject well		33	9.4%
		Not interested		29	8.3%
59	Environmental education events		334		
		Would like to learn more about		213	63.8%
		Know the subject well		22	6.6%
		Not interested		99	29.6%
60	Environmental permits		333		
		Would like to learn more about		186	55.9%
		Know the subject well		23	6.9%
		Not interested		124	37.2%

	Question	Answer Description	Total	Amt	Percent
61	How long have you lived in this area?		369		
		Less than 1 year		13	3.5%
		1 to 5 years		44	11.9%
		6 to 10 years		36	9.8%
		11 to 20 years		64	17.3%
		More than 20 years		212	57.5%
62	Do you live in the Rocky River watershed?		360		
		Yes		130	36.1%
		No		135	37.5%
		Don't Know		95	26.4%
63	Would you like to continue to reside in the area?		357		
		Yes		339	95.0%
		No		18	5.0%
64	If you own land, how many acres do you own?		360		
		Less than one		105	29.2%
		1 to 5		96	26.7%
		6 to 20		75	20.8%
		21 to 100		54	15.0%
		101 to 250		16	4.4%
		251 to 600		8	2.2%
		More than 600		6	1.7%
66	How would you rate the general quality of life in your community?		363		
		Excellent		99	27.3%
		Good		207	57.0%
		Fair		43	11.8%
		Poor		10	2.8%
		Don't know		4	1.1%
67	Where do you live?		366		
		Rural non-farm		208	56.8%
		Farm		91	24.9%
		City		37	10.1%
		Village		22	6.0%
		Urban		8	2.2%
68	How would you rate the environmental quality of life in your area?		374		
		Excellent		57	15.2%
		Good		203	54.3%
		Fair		79	21.1%
		Poor		15	4.0%
		Don't know		20	5.3%
69	Do you live on a lakeshore or river front?		356		
		Yes		82	23.0%
		No		274	77.0%

	Question	Answer Description	Total	Amt	Percent
70	What is your age?		369		
		Under 18		6	1.6%
		18 to 25		19	5.1%
		26 to 45		76	20.6%
		46 to 65		178	48.2%
		66 or older		90	24.4%
71	Do you earn more than $1,000 in gross income from farming?		358		
		Yes		57	15.9%
		No		301	84.1%
72	Swimming in an inland lake or river		369		
		Never		78	21.1%
		Rarely		95	25.7%
		Occasionally		114	30.9%
		Frequently		82	22.2%
73	Fishing in an inland lake or river		369		
		Never		85	23.0%
		Rarely		62	16.8%
		Occasionally		115	31.2%
		Frequently		107	29.0%
74	Irrigation - crop production		366		
		Never		315	86.1%
		Rarely		19	5.2%
		Occasionally		17	4.6%
		Frequently		15	4.1%
75	Power boating		368		
		Never		174	47.3%
		Rarely		64	17.4%
		Occasionally		72	19.6%
		Frequently		58	15.8%
76	Non-motorized boating		367		
		Never		111	30.2%
		Rarely		83	22.6%
		Occasionally		122	33.2%
		Frequently		51	13.9%
77	Motorized boating/water sports		365		
		Never		172	47.1%
		Rarely		69	18.9%
		Occasionally		70	19.2%
		Frequently		54	14.8%
78	Hiking		368		
		Never		66	17.9%

		Rarely	74	20.1%
		Occasionally	152	41.3%
		Frequently	76	20.7%

	Question	Answer Description	Total	Amt	Percent
79	Watering lawn		371		
		Never		101	27.2%
		Rarely		102	27.5%
		Occasionally		115	31.0%
		Frequently		53	14.3%
80	Mountain biking		368		
		Never		232	63.0%
		Rarely		57	15.5%
		Occasionally		62	16.8%
		Frequently		17	4.6%
81	Hunting		364		
		Never		160	44.0%
		Rarely		33	9.1%
		Occasionally		67	18.4%
		Frequently		104	28.6%
82	Nature watching		373		
		Never		18	4.8%
		Rarely		31	8.3%
		Occasionally		116	31.1%
		Frequently		206	55.2%
				2	0.5%
83	Area of natural cover, including forests, woodlands prairies, and wetlands		372		
		Less		12	3.2%
		Same		155	41.7%
		More		186	50.0%
		Don't Know		19	5.1%
84	Area of new residential development in rural areas		370		
		Less		263	71.1%
		Same		72	19.5%
		More		18	4.9%
		Don't Know		17	4.6%
85	Area devoted to the protection of rare plant and animal species		371		
		Less		17	4.6%
		Same		149	40.2%
		More		159	42.9%
		Don't Know		46	12.4%
86	Area of native plant communities that are being conserved or have been restored		371		
		Less		17	4.6%
		Same		150	40.4%
		More		151	40.7%

		Don't Know		53	14.3%
87	Area of new light industrial development in rural areas		372		
		Less		223	59.9%
		Same		86	23.1%
		More		37	9.9%
		Don't Know		26	7.0%
	Question	**Answer Description**	**Total**	**Amt**	**Percent**
88	Area of public land managed using techniques that attempt to imitate nature		369		
		Less		47	12.7%
		Same		100	27.1%
		More		158	42.8%
		Don't Know		64	17.3%
89	Length of rivers or streams that have been straightened or channeled		368		
		Less		170	46.2%
		Same		86	23.4%
		More		26	7.1%
		Don't Know		86	23.4%
90	Area of wetlands that have been restored or conserved		370		
		Less		18	4.9%
		Same		126	34.1%
		More		187	50.5%
		Don't Know		39	10.5%
91	Number of recreation areas devoted to non-motorized outdoor recreation		365		
		Less		20	5.5%
		Same		121	33.2%
		More		191	52.3%
		Don't Know		33	9.0%
92	Area of river flood plains that have been maintained or restored to their natural state, free of structures		370		
		Less		18	4.9%
		Same		124	33.5%
		More		184	49.7%
		Don't Know		44	11.9%
93	Public access to rivers and lakes		373		
		Less		40	10.7%
		Same		176	47.2%
		More		143	38.3%
		Don't Know		14	3.8%
94	Areas in towns and cities planted with trees and shrubs		371		
		Less		12	3.2%
		Same		76	20.5%
		More		260	70.1%
		Don't Know		23	6.2%
95	Areas of forest devoted to support the local wood products industries		371		
		Less		83	22.4%
		Same		140	37.7%
		More		100	27.0%

		Don't Know		48	12.9%
96	Areas in villages and cities should be redeveloped for housing		370		
		Less		39	10.5%
		Same		88	23.8%
		More		199	53.8%
		Don't Know		44	11.9%

	Question	Answer Description	Total	Amt	Percent
97	Federal offices (for example the Fish and Wildlife Service, Natural Resource Conservation Service, and others)		367		
		Never		107	29.2%
		Rarely		99	27.0%
		Occasionally		140	38.1%
		Frequently		21	5.7%
98	State offices (Departments of Environment Quality, Natural Resources, Agriculture and others)		362		
		Never		97	26.8%
		Rarely		101	27.9%
		Occasionally		130	35.9%
		Frequently		34	9.4%
99	County or township offices (for example planning and zoning boards or land resource centers)		363		
		Never		102	28.1%
		Rarely		106	29.2%
		Occasionally		131	36.1%
		Frequently		24	6.6%
100	Michigan State University Extension Service		360		
		Never		169	46.9%
		Rarely		81	22.5%
		Occasionally		81	22.5%
		Frequently		29	8.1%
101	Conservation District		357		
		Never		164	45.9%
		Rarely		96	26.9%
		Occasionally		76	21.3%
		Frequently		21	5.9%
102	Western Michigan University		356		
		Never		261	73.3%
		Rarely		65	18.3%
		Occasionally		27	7.6%
		Frequently		3	0.8%
103	Internet		359		
		Never		185	51.5%
		Rarely		45	12.5%
		Occasionally		92	25.6%
		Frequently		37	10.3%
104	TV		359		
		Never		137	38.2%
		Rarely		81	22.6%

		Occasionally		118	32.9%
		Frequently		23	6.4%
105	Radio		357		
		Never		109	30.5%
		Rarely		102	28.6%
		Occasionally		108	30.3%
		Frequently		38	10.6%

	Question	Answer Description	Total	Amt	Percent
106	Newspapers/Magazines		352		
		Never		51	14.5%
		Rarely		60	17.0%
		Occasionally		173	49.1%
		Frequently		68	19.3%
107	Conservation groups		350		
		Never		135	38.6%
		Rarely		93	26.6%
		Occasionally		97	27.7%
		Frequently		25	7.1%
108	Environmental groups		351		
		Never		168	47.9%
		Rarely		95	27.1%
		Occasionally		71	20.2%
		Frequently		17	4.8%
109	Local civics groups		355		
		Never		201	56.6%
		Rarely		94	26.5%
		Occasionally		54	15.2%
		Frequently		6	1.7%
110	Libraries		350		
		Never		139	39.7%
		Rarely		95	27.1%
		Occasionally		92	26.3%
		Frequently		24	6.9%
111	Family members		357		
		Never		91	25.5%
		Rarely		103	28.9%
		Occasionally		129	36.1%
		Frequently		34	9.5%
112	Friends and other people		358		
		Never		44	12.3%
		Rarely		92	25.7%
		Occasionally		164	45.8%
		Frequently		58	16.2%
113	Conservation Reserve Program		364		
		Participate		30	8.2%

		Have researched		16	4.4%
		Heard of Program		126	34.6%
		Never Heard of Program		192	52.7%
114	Environmental Quality Incentive Program		359		
		Participate		9	2.5%
		Have researched		9	2.5%
		Heard of Program		111	30.9%
		Never Heard of Program		230	64.1%

	Question	Answer Description	Total	Amt	Percent
115	Wildlife Habitat Incentive Program		360		
		Participate		7	1.9%
		Have researched		13	3.6%
		Heard of Program		185	51.4%
		Never Heard of Program		155	43.1%
116	Wetland Reserve Program		358		
		Participate		3	0.8%
		Have researched		17	4.7%
		Heard of Program		199	55.6%
		Never Heard of Program		139	38.8%
117	Michigan Ground Water Stewardship		358		
		Participate		11	3.1%
		Have researched		13	3.6%
		Heard of Program		139	38.8%
		Never Heard of Program		195	54.5%
118	Farm*A*Syst		358		
		Participate		8	2.2%
		Have researched		6	1.7%
		Heard of Program		36	10.1%
		Never Heard of Program		308	86.0%
119	Home*A*Syst		355		
		Participate		10	2.8%
		Have researched		7	2.0%
		Heard of Program		31	8.7%
		Never Heard of Program		307	86.5%
120	Utilized the political process to advance environmental concerns		357		
		Never		174	48.7%
		Rarely		54	15.1%
		Occasionally		84	23.5%
		Frequently		45	12.6%
121	Recycled		361		
		Never		15	4.2%
		Rarely		21	5.8%
		Occasionally		92	25.5%
		Frequently		233	64.5%
122	Reduced the amount of pesticides I use in		357		

	my home	Never		16	4.5%
		Rarely		14	3.9%
		Occasionally		98	27.5%
		Frequently		229	64.1%
123	Reduced the amount of pesticides and fertilizer in my lawn and garden		354		
		Never		12	3.4%
		Rarely		20	5.6%
		Occasionally		95	26.8%
		Frequently		227	64.1%

	Question	Answer Description	Total	Amt	Percent
124	Properly disposed of hazardous materials through Household Hazardous Waste program		358		
		Never		23	6.4%
		Rarely		32	8.9%
		Occasionally		100	27.9%
		Frequently		203	56.7%
125	Implemented water conservation practices at my home		360		
		Never		35	9.7%
		Rarely		49	13.6%
		Occasionally		119	33.1%
		Frequently		157	43.6%
126	Participated in "adopt a highway" clean ups		362		
		Never		266	73.5%
		Rarely		39	10.8%
		Occasionally		31	8.6%
		Frequently		26	7.2%
127	Participated in river clean ups		357		
		Never		264	73.9%
		Rarely		44	12.3%
		Occasionally		40	11.2%
		Frequently		9	2.5%
128	Worked on panels or task forces		361		
		Never		298	82.5%
		Rarely		24	6.6%
		Occasionally		26	7.2%
		Frequently		13	3.6%
129	Attended public meetings		361		
		Never		174	48.2%
		Rarely		84	23.3%
		Occasionally		79	21.9%
		Frequently		24	6.6%
130	Joined a conservation group		359		
		Never		255	71.0%
		Rarely		31	8.6%
		Occasionally		43	12.0%
		Frequently		30	8.4%

131	Joined an environmental group		358		
		Never		271	75.7%
		Rarely		28	7.8%
		Occasionally		30	8.4%
		Frequently		29	8.1%
132	Changed some things I do in my home		357		
		Never		30	8.4%
		Rarely		35	9.8%
		Occasionally		188	52.7%
		Frequently		104	29.1%

	Question	Answer Description	Total	Amt	Percent
133	Changed some of the practices where I work		320		
		Never		65	20.3%
		Rarely		52	16.3%
		Occasionally		135	42.2%
		Frequently		68	21.3%
134	Changed the way I manage my land to reduce soil erosion		328		
		Never		81	24.7%
		Rarely		36	11.0%
		Occasionally		97	29.6%
		Frequently		114	34.8%
135	Where does water on your property drain?		230		
		Flowerfield Creek		48	20.9%
		Spring Creek		8	3.5%
		Rocky River		106	46.1%
		County Drain		34	14.8%
		Storm Drain		34	14.8%
137	What watershed do you live in?		288		
		Kalamazoo River		20	6.9%
		Rocky River		180	62.5%
		Portage River		12	4.2%
		Dowagiac River		10	3.5%
		None of these		66	22.9%
138	People who do not live next to water have little impact on water quality. (check one)		366		
		Yes		58	15.8%
		No		308	84.2%
139	What is the most effective way to protect stream banks from erosion? (check one)		321		
		Make the bank a lawn with grass		31	9.7%
		Plant warm season prairie grasses		58	18.1%
		Rip Rap the bank (large stones)		47	14.6%
		Plant trees and shrubs		141	43.9%
		Do nothing		20	6.2%
		Install a “sea” wall		24	7.5%