The Battle Creek River Watershed Management Plan

September 2004

Executive Summary

The Battle Creek River Watershed covers 196,750 acres/307 square miles in northern Calhoun, southeastern Barry, and southern Eaton counties. Land use consists primarily of agriculture followed with forestland, wetland, and urban/rural/non-farm. The headwaters of the Battle Creek River begin at the Duck Lake/Narrow Lake areas as the Battle Creek Drain. As it leaves Narrow Lake, it heads north through the City of Charlotte, southwest through the Village of Bellevue, and finally south towards the City of Battle Creek to where it empties into the Kalamazoo River, and ultimately journeys to Lake Michigan. The Michigan Department of Environmental Quality has identified the Battle Creek River as one of the leading tributaries contributing sediment and phosphorus to the Kalamazoo River. Designated uses for the Battle Creek River are Agriculture (irrigation and livestock watering), Warm Water Fishery, Indigenous Aquatic Life and Wildlife, Industrial Water Supply, Recreation, and Partial Body Contact Recreation and Total Body Contact Recreation with regards to the Aesthetic Beauty in the Watershed.

The Watershed Management Plan for the Battle Creek River was written as part of a Planning Grant funded through section 319 of the Clean Water Act. The stakeholders, landowners, municipalities, townships, and counties within the watershed developed this plan. Information contained in the plan is the product of the hard work and determination of this watershed community and reflects the goals and objectives to help restore and protect the Battle Creek River Watershed from non-point source pollution. In cooperation with the Advisory Committee, Steering Team, and the Watershed Project Coordinator, this plan was also made to reflect the hopes, concerns, and desires of improving recreational opportunities, utilization, and an appreciation for this natural resource that runs through our own backyard.

The goals and objectives of the Battle Creek River Watershed Management Plan originated from the identification of the impaired and threatened uses, and the non-point source pollution that was negatively impacting the surface waters of the Battle Creek River Watershed. The Battle Creek River Planning Project's Steering Team and Advisory Committee prioritized the known and suspected sources and causes of pollution from information gathered through road stream crossing inventories, aerial photos, canoe trip surveys, topographic maps, plat maps, soil surveys, biological assessments and reports administrated by various agencies, historical research, and information gathered from landowners within the watershed. Reducing the non-point sources of pollution will help to protect and restore the designated and threatened uses of the Warm Water Fishery, Indigenous Aquatic Life and Wildlife, Partial Body Contact Recreation and Total Body Contact Recreation with regard to the aesthetic beauty in the Battle Creek River Watershed, Agriculture Irrigation and Livestock Watering, and the Public and Private Drinking Water Supply.

The goals and objectives for the Watershed Management Plan will be accomplished by implementing appropriate Best Management Practices (BMP's) on critical sites and areas, providing information and education to residents, landowners, townships, and counties, and protecting prime farmland, open space, and the natural floodplain through appropriate land use planning.

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Introduction

Over one and a half million years ago, Michigan was completely inundated by at least five distinct glacial periods including the Pre-Nebraskan, Nebraskan, Kansan, Illinoian, and the Wisconsin stage, which extended to the Ohio River Valley. As the Wisconsin Period glacier began to recede, nearly 10,000 years ago, Michigan's landscape was born. River valleys and channels were formed as the ice melted. Tons of soil, gravel, and rocks were deposited and have now become our aquifers, prime farmland, and the basis of our land use. The area now known as Hillsdale County became the mother of four major watersheds: the Kalamazoo, St. Joseph-Maumee, St. Joseph-Michigan, and Grand Rivers. The land area of Calhoun, Barry, and Eaton counties was exposed by the receding glacier and became the drainage of what is now called the Battle Creek River Watershed. Over time, oak savannas, beech-sugar maple forests, cedar and hardwood swamps, and wetlands began to develop.

Native Americans of Potowatomi and Ojibwa origin traveled, foraged, and settled in areas along Kalamazoo and its tributaries because of the abundance of water, fertile ground, and wild game in the areas of Battle Creek, Bellevue, and Olivet. Later, La Salle, the French explorer traveled through the vast swamplands in the late 1600's, and wrote about his journey in southern Michigan. Two hundred years later General Duncan Mc Arthur, who commanded Fort Detroit in 1813, went so far as to tell former President Thomas Jefferson that Michigan was uninhabitable. In 1825, the U.S. government sent surveyors to map and survey township lines in Calhoun and Eaton counties. The settlers began to arrive and Michigan received its statehood in 1837.

From the very beginning, the landscape of the Battle Creek River Watershed has been changing. The land was drained for farming, forests cut for timber, dams were erected to provide power for mills, roads and bridges were built, electricity and automobiles were invented, gas and oil became an invaluable natural resource, and rivers, lakes and streams became the dumping ground for untreated waste. Rain and snow melt filtered into the ground and ran off the land picking up chemicals, oils, grease, manure, sediment, pesticides, and nutrients to deliver them to our surface waters. Used and abused, water quality began to diminish, and man discovered the wrath he had brought upon his land.

The Watershed Management Plan for the Battle Creek River Watershed was written as part of a Planning Grant funded through Section 319 of the Clean Water Act. This plan belongs to the stakeholders, landowners, municipalities, townships, and counties within the watershed. Information contained in this plan is the product of the hard work and determination of this watershed community and reflects the goals and objectives to help restore and protect the Battle Creek River Watershed from non-point source pollution. In cooperation with the Advisory Committee, Steering Team, and the Watershed Project Coordinator, this plan was developed to reflect the hopes and

desires of improving recreational opportunities, utilization, and an appreciation for this natural resource that runs through our own backyard. Contained in this plan is the evaluation of the natural resource and water quality needs, problems, and solutions for the Battle Creek River Watershed.

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Geographic Scope

Geographic Information Systems (GIS) Data on the Battle Creek River Watershed

Michigan State University's Institute of Water Research created a GIS website for the Battle Creek River Watershed. The website contains valuable geographic information for creating maps and learning about the watershed area. Maps include land cover, wetlands, lakes, soils, drains, and much more. This website was created for stakeholders within the watershed to use. The website address is:

35.8.121.114/website/bcw

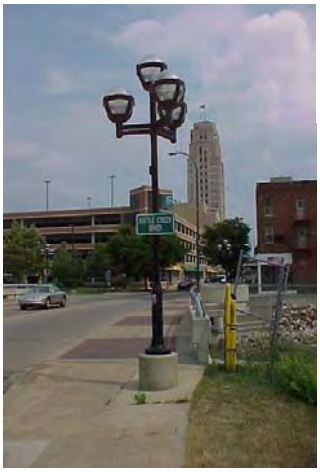
Location and Size

The Battle Creek River Watershed covers 196,750 acres/307 square miles in southwest central Lower Michigan in northern Calhoun, southeastern Barry, and southern Eaton counties. A total of 13 townships and 4 municipalities are located within the watershed. The main drainage is the Battle Creek River, which flows into the Kalamazoo River, and ultimately into Lake Michigan. The headwaters of the Battle Creek River begins in section 25 of Brookfield Township (Narrow Lake), Eaton County and flows north towards the City of Charlotte, heads southwest through the Village of Bellevue, and meets the Kalamazoo River in the City of Battle Creek. The overall channel length is approximately 54.5 miles long with an average gradient of 1.25 feet/mile.

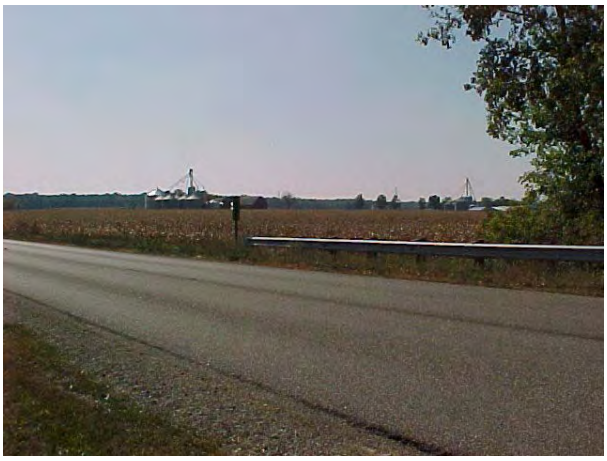
Townships and Municipalities in the Battle Creek River Watershed by County

County	Calhoun	Barry	Eaton
Townships	Emmett Pennfield Convis Lee Clarence Marengo	Assyria Maple Grove	Bellevue Walton Brookfield Kalamo Carmel Eaton
Municipalities	City of Battle Creek		City of Charlotte City of Olivet Village of Bellevue

Land Uses



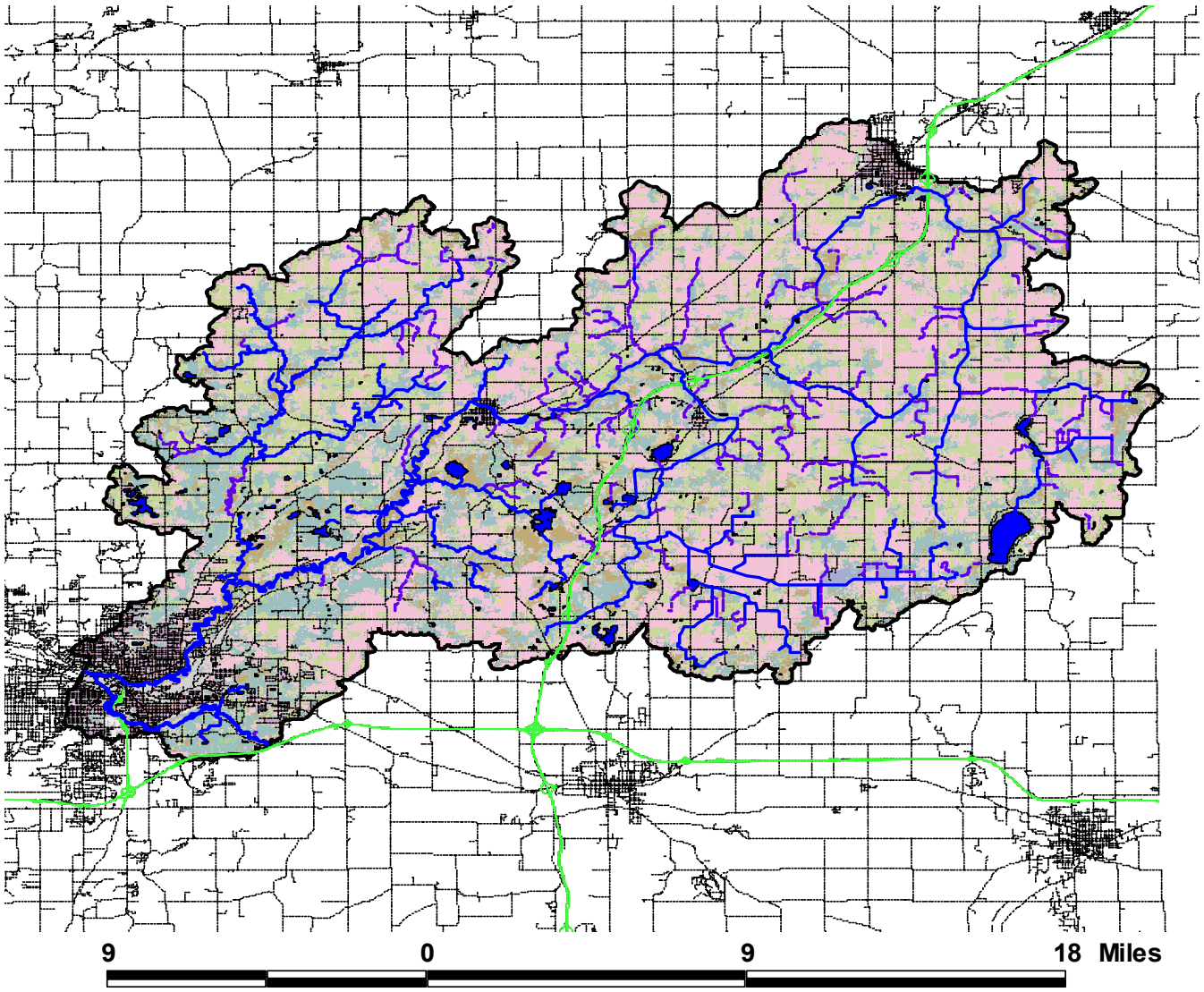
Nearly 68% of the Battle Creek River Watershed is in agriculture use. Intensive row crop farming and livestock production are the primary uses. Corn, soybeans, wheat, and hay are the principle crops within the watershed. Specialty crops include carrots and onions produced by muck farms in Lee Township. Approximately 13% of the watershed is forested, 10% wetlands, while the remaining 9% is urban/rural non-farm. The more urbanized areas include the City of Battle Creek, the Village of Bellevue, the City of Olivet, and the City of Charlotte. A forested riparian corridor still exists along many reaches of the Battle Creek River. As populations continue to increase in the watershed, land use planning will be an important force in protecting vulnerable and prominent natural resources from development.



Brookfield Township

Walton Township

Battle Creek River Watershed Land Cover Map



Geology and Landforms

Glaciers that covered the area about one and a half million years ago created the geology and landforms within the Battle Creek River Watershed. As temperatures began to increase, the glaciers began to recede and melt. Assorted glacial till including sands, silts, clay, and gravel were deposited and arranged by glacial action and melt water. These glacial deposits created the landforms and geology we see today. The moraine deposits are characterized by nearly level to hilly relief and uneven knoblike hills and pothole depressions that cover the townships of Pennfield, Convis, Assyria, Maple Grove, and the City of Battle Creek. Till plains are characterized as nearly level to hilly slopes and are visible in Lee, Clarence, Bellevue, Carmel, Eaton, Walton, and Brookfield Townships. The outwash plains are a combination of morainic areas and till plains. These outwash areas are characterized by nearly level to sloping topography and have some pitted areas and are found in Marengo and Emmett Townships (USDA, 1992).

Topography and Soils

The topography and soils vary throughout the watershed. Dominant soil associations in the Battle Creek River basin are characterized as being well drained sandy loamy soils to more poorly drained mucky soils along glacial drainage ways and floodplains (MDEQ, 2000). Area topography is described as being nearly level to gently undulating (USDA, 1978). Soil Associations indicate a distinctive pattern of soils, relief, and drainage. These associations consist of one or more major soils and some minor soils (USDA, 1978). There are 183 different soil types within the watershed. Specific soil type information can be found in Soil Surveys conducted by the United States Department of Agriculture, and are available through Conservation Districts by county.

Soil Associations in the Battle Creek River Watershed

Calhoun County	Description
Oshtemo-Spinks association	Gently rolling to steep, well drained, loamy and sandy soils on outwash plains
Morely-Blount association	Nearly level to strongly sloping, well drained to somewhat poorly drained, loamy soils on till plains and moraines
Houghton-Blount-Pewamo association	Nearly level or gently undulating, very poorly drained to somewhat poorly drained, mucky and loamy soils on till plains and moraines
Houghton-Oshtemo-Coloma association	Nearly level to steep, very poorly drained to excessively drained, mucky soils on floodplains and loamy and sandy soils on outwash plains, moraines, and stream terraces and in glacial drainage ways
Oshtemo-Kalamazoo association	Nearly level to steep, well drained, loamy sands on outwash plains and stream terraces
Houghton-Sebewa-Matherton association	Nearly level or gently undulating, very poorly drained, mucky soils on floodplains and loamy soils on stream terraces and in glacial drainage ways
Hillsdale-Kalamazoo-Oshtemo association	Nearly level to steep, well drained, loamy soils on moraines, till plains, outwash plains, and terraces
Eaton County	**Description**
Marlette-Capac association	Nearly level to gently undulating, well drained to somewhat poorly drained, loamy soils on till plains
Marlette-Capac-Owosso association	Nearly level to hilly, well drained to somewhat poorly drained, loamy soils on moraines and till plains
Boyer-Cohoctah-Houghton association	Nearly level to hilly, well drained, poorly drained, and very poorly drained, sandy and loamy soils, and nearly level, very poorly drained, mucky soils; in and along glacial drainage ways and on floodplains
Houghton-Gilford-Adrian association	Nearly level, very poorly drained, mucky

	and loamy soils in glacial drainage ways
Boyer-Bixby-Oshtemo association	Nearly level to sloping, well drained, loamy soils in glacial drainage ways and on outwash plains
Capac-Parkhill association	Nearly level to gently undulating, somewhat poorly drained, loamy soils and nearly level, poorly drained and very poorly drained, loamy soils; on till plains and low moraines
Barry County	**Description**
Oshtemo-Coloma-Marlette association	Moderately sloping to steep, excessively drained and well drained, sandy and loamy soils on till plains, outwash plains, and moraines
Coloma-Boyer-Spinks association	Moderately sloping to steep, excessively drained and well drained sandy soils on outwash plains and moraines
Houghton-Sloan association	Nearly level, very poorly drained, loamy and mucky soils on floodplains
Marlette-Capac association	Nearly level to gently rolling, well drained to somewhat poorly drained, loamy soils on till plains and moraines
Perrinton-Ithaca-Marlette association	Nearly level to rolling, well drained to somewhat poorly drained, loamy soils on till plains and moraines
Marlette-Oshtemo association	Moderately sloping to steep, well drained, loamy soils on till plains, outwash plains, and moraines

Information obtained from the United States Department of Agriculture's Calhoun, Eaton, and Barry counties Soil Surveys.

Hydrology

Surface Water

The Battle Creek River encompasses a network of rivers, streams, and constructed drains. The Battle Creek River is an established designated drain upstream of Bellevue in Eaton County. Much of the upper portion of the main stem of the Battle Creek River has been disconnected from the floodplain due to historical construction of the drain. Dredging, ditching, widening, deepening and straightening have occurred on many of the formerly natural creeks and streams to provide drainage for agriculture lands. These drains that have been constructed are both public and private. County Drain Commissioners have jurisdiction over established county drains and ditches.

Channel Morphology

The channel morphology of the Battle Creek River has changed significantly since the late 1800's. The headwaters in Eaton County have been dredged and ditched, while dams were put in place to provide hydrologic power. A majority of the main stem of the Battle Creek River in Eaton County has been straightened, widened, and deepened. The dredging work consisted of widening, straightening, and deepening the river channel. The spoils were then placed along the stream bank. This has created berms and terraces that disconnect the river from its original floodplain.

After a storm event that creates bankfull (the incipient point of flooding) conditions, the Battle Creek River cannot spread into its floodplain, therefore, energy from high flows scour the stream banks. This has created severe stream bed and stream bank degradation. In several locations along the main stem of the Battle Creek River, remnants of the historical channel can still be seen. Aerial photos also provide a good historical account of what the stream channel's path used to look like before straightening.

In order to understand the stability of the Battle Creek River and predict the response the river will have to a proposed change, the Battle Creek River Watershed Project (BCRWP) initiated a multi-year study to better understand the system. This is being done so that everyone interested in the Battle Creek River is better able to manage and protect the river. The BCRWP is partnering with the Michigan Department of Natural Resources, Habitat Management Unit, to begin to answer some of these questions. Staff from the Habitat Management Unit have extensive training and related work experience studying river systems throughout Michigan.

Work began in the winter of 2003 when maps and aerial photos were studied to further our understanding of the river by observing how the river flows, its width, where it begins and ends, how many dams are along the river, how much development occurs along the river, and other pertinent information. Once this information was documented the study crew determined locations of assessment sites along the course of the river. To date, a total of three stations have been chosen which are representative of much of the Battle Creek River. As time and budget allow the BCRWP plans to expand the scope of the study and add more assessment sites along the length of the Battle Creek River.

Fieldwork began at each of the assessment sites in the spring of 2003 after the ice on the rivers melted and spring flows subsided. Hundreds of individual data measurements were taken at each of the assessment sites to document the current dimensions of the channel. Some of the measurements included measuring the gradient or slope of the stream in a reach (most of which are 1,000 to 2,500 long), and measuring cross sections at a riffle and a pool across the river from floodplain to floodplain. Measurements include taking elevations along the river that document features in the channel which include pools, riffles, runs and glides. In order to capture these features, measurements may be taken as much as every inch to several feet apart. Other data that is collected include measuring the size of material (sand, gravel, cobble) that make up the bed of the stream and banks, bank height, presence or absence of bank vegetation, density and type of vegetation and amount of bank erosion.

There are a number of other measurements that are taken in the field. However, once all the field data is collected, additional information is gathered from aerial photos. All of the compiled data is analyzed with the assistance of computer modeling. The compiled data is required in order to determine the current stability of the river and predict impacts future changes in the watershed will have on the river. These sites will continue to be visited by the team of scientists annually and remeasured to determine if or how the river has changed.

The information collected from the study will be shared with drain commissioners, landowners, farmers, developers, local units of government, and other stakeholders so that sound management decisions can be made. There are many competing uses for the Battle Creek River. The real challenge faced by watershed residents is how to meet the current and future demands for traditional uses and intrinsic values of the river without impairing its stability and function.

Seasonal Water Flow

Stream flow is an important factor in the characteristics of a stream because of its relationship to stream channel formation. Stream flows increase and channels become

larger in a downstream direction. Stream flow patterns also have a direct influence on stream organisms. Streams with stable flows tend to have less variation in stream temperature and have more stable channels. As a result, fish in stable streams have more specialized feeding and reproductive behaviors compared to fish in streams with more variable flow patterns (Gordon et al. 1992).

Stability of flow provides or represents a tool to examine the combined effects of stream characteristics, including source of flow, channel shape and gradient, geology, temperature, and land cover in the watershed. If similar seasonal climatic patterns exist in a watershed, differences in flow stability can be attributed to surficial geology, land cover, or human influences such as storm sewers, stream channelization, or land use (Wesley, 2003).

Flow stability can be characterized using flow duration curves built from percent exceedence data from USGS gauging stations. An exceedence value is discharge that can be expected to be exceeded for a given percentage of the time. For example, the 5% exceedence value is that discharge that can be expected to be exceeded 5% of the time within a given water year (October - September). A 5% or less exceedence value represents relatively rare high flow events, for example, during snowmelt or extraordinary storm events. The 50% exceedence value represents median discharge for a particular station, as half of the time it is higher, and half of the time flow is less than this value. The 95% exceedence value is referred to as base flow (or low flow) and indicates steady contributions of groundwater to the stream, meaning that 95% of the time discharge is expected to be greater than this value (Wesley, 2003).

When comparing exceedence values for streams of varying sizes, it is necessary to standardize values for direct comparison. One method of standardization requires dividing exceedence values by median exceedence. This number represents the magnitude of discharge variance from the median flow at each exceedence range. For exceedence flow over 50%, the smaller the standardized value, the more stable the stream. For example, (5% exceedence)/(50% exceedence)=standardized discharge at the 5% exceedence level - if this value is equal to 2, then flood flow is two times greater than median flow (Wesley and Duffy 1999).

Flow stability can also be analyzed using low-flow or base-flow patterns. In general, the higher the base flow relative to overland flow, the more stable the stream. The higher the ratio between each exceedence rate and the median discharge, the less variation in stream flow. The Rouge River has a standardized 95% exceedence of 0.2, whereas the groundwater-fed South Branch Au Sable River near Luzerne has a value of 0.6 (Wesley, 2003).

The Battle Creek River is the flashiest gauged tributary in the Kalamazoo River basin. The Battle Creek River at Charlotte and Bellevue both have high-standardized 5% exceedence flows with values above 6.5 (Figure 11). Flows are more stable near the City of Battle Creek with standardized 5% exceedence flows for the Battle Creek being 30% lower than the Battle Creek at Bellevue. Wanadoga Creek is 50% lower than the Battle Creek at Bellevue. The upper Battle Creek River has been extensively channelized, which may increase flashiness of seasonal flows. Wanandoga Creek and Battle Creek River near the City of Battle Creek also have higher standardized 95% exceedence flows. These flows were 17% higher at the city of Battle Creek compared to the Battle Creek River at Charlotte and Bellevue (Figure 12). This may give some support that the difference between the two areas is due to channelization and not entirely to groundwater yield. The Kalamazoo River at the Battle Creek gauge has the highest standardized 5% exceedence value compared to the rest of the mainstem. With a value of 2.8, it is still considered to be stable compared to other southern Michigan streams. The slight increase may be due to the confluence of the Battle Creek (which experiences more flashy flows) just upstream from the gauge location (Wesley, 2003).

Dams, Barriers, and Culverts

Five dams are located throughout the main stem of the Battle Creek River. In the past, dams were used to provide waterpower for mills. When electricity was discovered, dams were installed to provide hydroelectric power. Dams are also used to control water levels. Beginning at the headwaters of the Battle Creek River at the north end of Narrow Lake in Eaton County, a dam was built in the 1940's to control Narrow Lake water levels (Narrow Lake Dam). Dams are also located east of Cochran Road in Charlotte (Charlotte Dam), east of Main Street in Bellevue (Bellevue Dam), north of Emmett Street in Battle Creek (Verona Dam), and east of Elm Street in Battle Creek (Elm Street Dam).

The Bellevue Dam, originally built in the 1840's to generate power for a mill, is regulated by Federal Energy Regulatory Commission (FERC) and produces hydroelectric power. The Verona Dam was also originally built to generate mill power in the 1830's. The Elm Street Dam, owned by Consumers Energy, is constructed of sheet piling and was used for cooling water for a coal fired plant. The Verona and Bellevue Dams have large impoundments upstream that provide recreational opportunities to the public.

In 2001, stakeholders began looking at the possible removal of the Elm Street Dam located in the City of Battle Creek. Information on the dam was collected including surveying, sediment sampling, and identifying a contractor to perform the removal. Working with Consumers Energy, funding has been secured, and removal will begin in spring of 2004.

The Charlotte Dam located adjacent to Bennett Park and the City of Charlotte's public water wells, is a cement structure. Through routine monitoring of the city wells, it was discovered that some wells contained high bacteria counts during high water flow of the Battle Creek River impoundment created by the Charlotte Dam. In the fall of 2003, the City of Charlotte opened the gates of the dam to reduce river flows to obtain data on the cause of the high bacteria levels. Currently, stakeholders are working with the City of Charlotte to investigate the possibility of dam removal.

Commonly, dams are controversial. Many have been abandoned and can create a safety concern to the public that are utilizing local watercourses. Dams also impede the natural flow of rivers causing impoundments that are settling grounds for nutrients and sediments. These impoundments slow down hydrologic flow, create larger surface water areas, and can cause water temperature increases. Dams also create recreational havoc to canoers and kayakers that have to portage around these structures. Recreational opportunities from impoundments, historical, economic, and cultural aspects are also relevant to erected dams. Dams also block fish passage upstream which can ultimately effect fish diversity in sections of river that are obstructed. Fish passage should be considered for dam sites that are still in use or that have social or historical significance.

Elm Street Dam

Bellevue Dam Impoundment

Culverts can also create hydrological and fish passage issues due to being improperly placed, sized, and/or constructed and can become a perched, velocity, or exhaustion barrier to aquatic organisms. It is important that drain commissioners and/or road commissions consider various factors before designing and implementing culvert projects. These include culvert design to handle a 50 year storm event, match culvert width to stream bankfull width, extend culvert length entirely through road prism, match slope of culvert with slope of stream, bury bottom of culvert to allow sediment

transport and the development of a natural stream bottom, consider the use of floodplain culverts, and align culvert with stream. Experience around the country has shown that when field measurements are taken to collect the above parameters, that culvert life is greatly extended, maintenance is significantly reduced, bank erosion and stream bed scour are eliminated, and it provides for passage of aquatic organisms.

Ackley Creek

Tributaries

Several tributaries and drains empty into the Battle Creek River throughout the watershed. Wanadoga Creek begins in section 32 and 33 in Kalamo Township, Eaton County and is the largest tributary that joins the Battle Creek River near Pennfield. The stream flows south-southwest through Barry and Calhoun counties and the total channel length is approximately 22 miles long with an average gradient of 4.6 feet/mile. The main tributaries of Wanadoga Creek are Ellis Creek and Crooked Brook. Ellis Creek begins in section 3 and meets Wanadoga Creek in section 23 of Assyria Township. The stream flows south 4.9 miles with an average gradient of 12.2 feet/mile. Crooked Brook Creek begins in sections 5 and 8 in Bellevue Township, Eaton County and flows 6.7 miles to its confluence at Wanadoga Creek in section 35 in Assyria Township with an average gradient of 9 feet/mile.

Other major tributaries and drains to the Battle Creek River include Goose Creek, Ackley Creek, Indian Creek (an established inter-county drain), State and Indian Drain, and Big Creek. Ackley Creek begins in section 27 in Convis Township and flows north through a portion of land owned by the Michigan Audubon Society and through Big Marsh Lake. Big Marsh Lake is a sanctuary and is largely owned by the Michigan Audubon Society and the Battle Creek Kiwanis Club. It then heads west to its confluence with the Battle Creek River in section 6 of Convis Township with a total length of 9.4 miles and an average gradient of 9.7 feet/mile. The lower portions of Ackley Creek flow through wetland areas with very little gradient.

Drainage

Historically, the Battle Creek River Watershed has been drained and now consists of a network of ditches and drains that eventually empty into natural rivers and streams. These drains and ditches alleviated the high water tables composed of wetlands, swamps, and bogs to provide productive cropland and to reduce populations of mosquitoes that caused malaria and yellow fever.

Locally elected County Drain Commissioners administer jurisdiction over the maintenance and development of drains. Michigan's first dependence on drainage was first articulated in a territorial law entitled An Act to Regulate Highways, which was passed in 1819 that authorized county commissioners to appoint township highway commissioners to construct, clean out, and cut timber to the least disruption of the property owner to alleviate flooding of roads and highways. The landowner was prohibited from filling up or plugging these drains and ditches, and if caught could receive a penalty of eight dollars. This Act was the first of many that now have been altered and improved from past challenges to become what is now P.A. 40, The Drain Code of 1956.

The Drain Code, nearly 50 years old, is now under scrutiny by various state agencies, citizens, and environmental organizations. Updates and revisions to the code are being attempted to consider a more watershed management approach, but the complexity of the code has made this effort slow moving. Since the 1970's Drain Commissioners have moved forward from the old techniques of moving water as fast as possible to reduce flooding in a straightened channel to more updated conservation-oriented practices to reduce sedimentation and improve water quality that consider characteristics of watershed management.

The main channel of the Battle Creek River from the headwaters at Narrow Lake (Brookfield Township) to the Bellevue Dam (Bellevue Township) in Eaton County is an established inter-county drain under jurisdiction of the Eaton County Drain Commissioner. This stretch of the river was first established as a drain in 1875 and comprises 28.9 miles. Since 1875, no major work has been done except the maintenance of clearing debris from the channel and cutting back trees.

Other main drains with more than 3 miles in length that empty into the Battle Creek River are Indian Creek, State and Indian, Devils Lake, Childs, Huber & Cooper, Frost & Reynolds, Paige-Sleeper & Big Creek, Murray & Roberts, Lake of the Woods South Extension, and Paige-Murray Drains.

Major Drains in the Battle Creek River Watershed

County	Township	Drain	Length	Date of Est.
Eaton County	Brookfield Township	Battle Creek	8.92	1875
		Croup	1.69	
		Devils Lake	3.00	
		Duck Lake	0.23	
		East Page	2.08	1867
		Elliott	0.61	
		Finch	0.77	
		Hall	1.77	1867
		Hess	0.77	1867
		Hogle Miller	2.54	
		Hotchkiss	1.31	
		Hyatt	1.23	
		Mack	1.46	1866
		Narrow Lake	1.00	
		Relaid Mills	1.54	1877
		Sherman	0.77	
		Tuma	1.69	
		Wilcox	0.61	1867
	Eaton Township	Battle Creek	4.92	1875
		Childs	3.38	
		Cooley	1.54	1875
		Huber	3.00	1876
	Carmel Township	Ames	1.38	1875
		Battle Creek	3.38	1875
		Brown	2.54	
		Carmel and Eaton	0.77	
		Cole	2.08	1877
		Cooper. Frost, Reynolds	3.61	1881
		Dillon	2.00	1877
		Foote	1.54	1877
		Glenview Terrace	0.46	
		Ochsenbein	1.00	1877
		Ransom	1.53	
		Ray	0.31	
		Stemphler	1.69	
		Townline Brook	1.08	
	Walton Township	Battle Creek	7.07	1875

		Brown	0.38	
		Butterfield	0.62	
		Denniston	1.38	
		Dillon Relaid	2.92	1877
		East Page	0.38	1867
		Fisher	1.54	
		Five Corners	2.23	
		Foote	0.31	1877
		Griffin	1.31	
		Indian Creek	4.85	
		Loveless	0.38	1867
		Martins	1.54	1876
		Martins #1	0.77	1876
		McCreery	1.62	
		New Comb	0.31	
		Olivet	0.31	
		Page	0.69	1867
		Page, Sleeper, Big Creek	4.92	1867
		Riddle	1.00	
		State	0.62	
		Townline Brook	2.85	
	Kalamo Township	Mud Lake	1.50	1875
		Murray and Roberts	3.33	1874
	Bellevue Township	Battle Creek	4.61	
		Bellevue	0.54	
		Denniston	0.38	1980
		Denniston Treadwell	2.54	
		Hamilton	1.85	
		Monroe	0.85	
		Owen	1.38	
Calhoun County	Clarence Township	Baseline Drain	0.40	1944
		Burkwalt Drain	0.30	1947
		Cooper & McGee Drain	1.70	1887
		Duck Lake Drain	1.70	1883
		Gillett & Craft Drain	0.50	1878
		Hogle Miller Drain		
		Noviss Drain	1.10	1947
		Ponto-Linger Drain	1.60	1902
		Root & Small Creek Drain	1.10	1884
		Seifert Drain	0.60	

		Smith, Landon & Snyder Drain	0.80	1892
		Spring Groove Drain	0.60	1983
		Starks & Henderson Drain	0.90	1885
		State & Indian Creek Drain	10.60	1914
		Vannocker Drain	0.90	
	Lee Township	Bolles Brown Drain	1.20	1894
		Brott Drain	0.50	1922
		Church & Hookway Drain	1.70	1909
		Clute & Long Drain	1.0	1955
		Coon & Stults Drain	1.30	1928
		Finch & Miller Drain	2.50	1887
		Fountain Drain	0.60	1906
		Hogel Miller Intercounty Drain	2.10	1897
		Lake of the Woods South Extension Drain	7.70	1909
		Langton & Jackson Drain	2.0	1914
		Lee Center Drain	2.80	1894
		Mather Drain	1.50	1915
		McCreery Drain	0.70	1906
		Paige-Big Creek & Sleeper Drain	3.90	1888
		Page-Murray Drain	3.40	1884
		Parker & Crow Drain	0.90	1955
		Phillips & Sanders Drain	1.60	1912
		Sellen Drain	0.70	1914
	Convis Township	Debolt Drain	2.30	1920
		Garfield Lake Drain	1.90	1896
		Kenyon Lake Drain	0.50	1921
		Otto, Winans & VanSickle Drain	1.40	1914
		Pardy Lake Drain	0.30	1915
		Steward Dilno Drain	1.30	1897
		Wheaton & Pardy Lake	2.0	
	Pennfield Township	Pennfield Township #1	0.80	1974
Barry County	Maple Grove Township	Lower Squaw Creek	1.12	

	Assyria Township	Assyria Center	0.09	
		Briggs	0.45	
		Butler Lake	0.17	
		Ely	0.39	
		Fox/Yourex/Hoffman	2.70	
		Gibson/Triscott	3.43	
		Green	1.17	
		High Hill	1.69	
		Kent	0.84	
		Kenyon	2.47	
		Mayo	1.12	
		Murray/Roberts	2.39	
		Quaker Brook	5.87	
		Shafe	0.39	
		Spruce Swamp	2.83	
		Welcher	0.50	
		Wertz	0.60	

Battle Creek River-Eaton Township

State and Indian Drain-Lee Township

Lakes

Many inland lakes dot the landscape of the Battle Creek River Watershed. Land surrounding some lakes within the watershed are private, however, a few lakes have designated public access or user developed sites. Major Lakes within the Battle Creek River Watershed include Duck Lake, Pardy Lake, Sellen Lake, Potters Lake, Narrow Lake, Lake of the Woods, Pine Lake, Garfield Lake, Lanes Lake, Clear Lake, Ackley Lake, Mud Lake, Loon Lake, and Grass Lake. Big Marsh Lake is an artificial impoundment created by a dam on Ackley Creek.

Major Lakes in the Battle Creek River Watershed

County	Private Lakes	Public Lakes
Calhoun	Bear Lake	Ackley Lake
	Big Marsh Lake	Lanes Lake
	Clear Lake	Lake of the Woods
	Deep Lake	Duck Lake
	Garfield Lake	
	Goose Lake	
	Kinyon Lake	
	Mud Lake	
	Pardy Lake	
	Pine Lake	
	Potters Lake	
	Wiegands Lake	
	Willis Lake	
	Wolf Lake	
Eaton	Pine Lake	Narrow Lake
	Mud Lake	
Barry	Grass Lake	
	West Lake	
	Loon Lake	

Several issues effect lake water quality within the watershed. Septic systems adjacent to a lake can contribute nutrients and bacteria if they are not placed and/or designed properly. Groundwater is higher near lakes, and during high water conditions, septic systems can be submerged. Effluent from the system will not be able to filter through the soil profile and will make its way to the lake untreated.

Many lakes within the Battle Creek River Watershed have lost their riparian corridors due to development pressure. Trees, shrubs, wetlands, marshes, and grasses that once protected the lake from run-off have been removed and replaced with turf grass. Turf grass with its smaller root system does not have the ability to efficiently remove nutrients and other pollutants carried by run-off from lawns, gardens, and impervious surfaces. Bufferstrips or natural areas with native grasses and wild flowers placed along the shoreline can be an effective way to filter out run-off carried by precipitation to the lake and provide a beautiful alternative to a mowed lawn.

Excess nutrient loading can often plague lakes. Phosphorus, found in most fertilizers and represented by the middle number on the bag, can contribute to weed and algae

problems in a lake. Abundant weed growth and algae can reduce oxygen levels, limit fish diversity, and create unpleasant recreational experiences.

Duck Lake is the only lake within the watershed that has a constructed sewer system that is treated by wastewater lagoons located in the Rice Creek Watershed. The lagoons are emptied by irrigation through a permit issued by Michigan Department of Environmental Quality (MDEQ). Due to ground water contamination issues as a result of the irrigation discharge, the MDEQ has referred other options to Calhoun County Community Development (CCCD). CCCD is currently looking at several opportunities to deal with the treated waste. One recommendation is for the design of a sewer system that would be piped from the Duck Lake area and City of Springport to the City of Albion's wastewater treatment plant that has the capacity to treat the sewage properly. Currently, Calhoun Community Development is looking for funding for this alternative to ground water discharge. An approved plan and funding for an extensive sewer line from Duck Lake to Albion must take place by 2004 before a new permit will be granted by MDEQ. CCCD, as of now, holds a permit that would allow them to discharge secondary treated wastewater into Indian and State Drain from the Duck Lake sewage ponds. If funding does not go through for treatment at the wastewater plant in Albion, the alternative would be a secondary treated discharge into State and Indian Drain. Narrow Lake residents in Brookfield Township are also considering installing a sewer system and could combine efforts with the City of Springport and Duck Lake for a regional sewer system.

Battle Creek River outlet at Narrow Lake-Brookfield Township

Ground Water

Ground water is a crucial component to the Battle Creek River Watershed system. Till deposited by glaciers have provided the watershed with an abundant ground water supply. Rain and snowmelt infiltrate in the ground between soil particle spaces and becomes ground water. Surface water and ground water are interconnected, and can

impact one another. Recharge and discharge areas are very important to the interaction of ground water and surface water. Ground water discharge areas provide a constant flow and temperature range into surface waters. Recharge areas allow rain and snowmelt to filter into the ground and replenish the ground water supply.

Most of the aquifers in the Battle Creek Watershed are composed of Marshall Sandstone. Sandstone aquifers are excellent ground water sources, but can be vulnerable to contamination because of its permeability and the over-lying confining layers. For example, the Verona Wellfield, located adjacent to the Battle Creek River in Emmett Township, was discovered to be contaminated by volatile organic compounds (VOCs). A series of blocking wells are being used to pump groundwater in order to minimize the spread of the VOCs and to reduce the mass of the compounds. Groundwater purged from the aquifer is treated and then discharged into the Battle Creek River.

There are four ground water wellhead areas within the watershed that provide drinking water to the public for the Cities of Battle Creek, Olivet, Charlotte, and the Village of Bellevue. The Cities of Battle Creek and Charlotte have identified their wellhead areas and have written management plans to reduce the risk of contamination with funding provided through the Michigan Department of Environmental Quality. The City of Olivet and the Village of Bellevue have both identified a one-mile radius of their ground water supply that is contributing to their municipal water system through tritium testing. Funding to develop protection plans have not been sought for these two communities.

Significant Natural Resources

Wetlands

Wetlands are an integral part of the entire watershed system. A wetland is defined as lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (US Fish and Wildlife Service, 1979). Wetlands have the ability to help control floods, filter run-off that may be carrying non-point sources of pollutants such as fertilizers, sediment, and pesticides, and provide valuable habitat for various wildlife and plant species. Classes of wetlands that still exist within the watershed include aquatic bed, emergent, forested, open water/unknown bottom, scrub-shrub, unconsolidated bottom, and unconsolidated shore. A majority of these wetlands are forested and follow the main stem of the Battle Creek River and Wanandoga Creek. Only 10% of wetlands remain in the Battle Creek River Watershed. This is a result of the historical settlement of Michigan. Settlers began to drain Michigan's landscape to alleviate malaria cases caused by mosquitoes and for the development of farmland.

Wetlands in Michigan are regulated by the Natural Resources and Environmental Protection Act (Part 303, 1994 PA 451). Activities in a wetland that require a permit from the Michigan Department of Environmental Quality include filling or placing material in a wetland, dredging or removing soil from a wetland, constructing or maintaining a use or development in a wetland (Clark, 1999).

Wetlands in the Battle Creek River Watershed are an essential resource in providing filtration of pollutants, flood control, and species diversity. The protection, enhancement, and restoration of these wetlands will offer residents within the watershed a better quality of life, open space, and an aesthetically pleasing landscape. Wetlands adjacent to the floodplains of the Battle Creek River are an important force in protecting water quality.

Most of the wetlands that still exist today in the Battle Creek River Watershed are located along streams and ditches. Historically wetlands were drained to provide fertile soil for farming. By examining hydric soils and topography in the watershed, historical wetlands can easily be located.

Battle Creek River Wetland Resources Map – See additional file on CD

Class of Wetlands in the Battle Creek River Watershed

Class of Wetlands	Definition
Aquatic Bed	Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.
Emergent	Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season and are dominated by perennial plants.
Forested	Characterized by woody vegetation that is 6m tall or taller.
Scrub-Shrub	Includes areas dominated by woody vegetation less than 6 m (20 feet) tall. The species include tree shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions.
Unconsolidated Bottom	Includes all wetlands and deepwater habitats with at least 25% cover of particles smaller than stones, and a vegetative cover of less than 30%.
Unconsolidated shore	Includes all wetlands habitats having 3 characteristics: 1) unconsolidated substrates with less than 75% area cover of stones, boulders, or bedrock; 2) less than 30%areal cover of vegetation other than pioneering plants; 3) any of the following water regimes: irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded.

Classes of wetlands information obtained from The Classification of Wetlands and Deepwater Habitats of the United States, US Fish and Wildlife Service, 1979.

Forests

Forests are a fundamental part of the watershed ecosystem. The Battle Creek River Watershed's landscape is comprised of only 13% of forests. Riparian-forest follow most of the main stem of the Battle Creek River, Wanandoga Creek, and Ackley Creek. These forested corridors are an integral part of the floodplain and provide shade for streams and help anchor stream banks. Much of the forested areas within the watershed are heavily fragmented as a result of deforestation for new development and cropland. Forests are not only valuable economically, but are beneficial biologically. As forests continue to become more fragmented, habitats are being destroyed.

The forested uplands of the Battle Creek River Watershed are comprised of oak and hickory and the lowlands of ash and soft maple. In the past other trees such as elm and butternut populations have also been reduced because of disease. Soils within the watershed are sensitive and are capable of producing burr oak and soft maples.

It is very important that the forests that still remain within the watershed are managed properly. Good management of a timber stand will not only provide biological diversity, but also valuable forest health. Most of the forested areas in the watershed are privately owned. Landowners should seek professional advice and use reputable consultants and sawmills. Protection of the riparian-forest along stream corridors for floodplain functions will provide continuous corridors. These forested areas within the watershed are significant to the aesthetic beauty and function of the watershed. Land use planning will be a fundamental force in protecting these resources through local government.

Several state and federal programs are available to landowners interested in the protection, enhancement, and restoration of forests within the Battle Creek River Watershed.

Fisheries

The Battle Creek River maintains a quality fishery that receives little attention from anglers except around population centers in Charlotte, the City of Battle Creek, and select road crossings. The Battle Creek River is a warmwater system that contains both warm and coolwater fish species whose predator base is dominated by smallmouth bass and northern pike. Currently, channel catfish are actively managed and stocked by the Michigan Department of Natural Resources (MDNR) in the Verona Impoundment in the lower most reach of the river where it provides urban fishing opportunities in the City of Battle Creek.

The MDNR has historically managed the Battle Creek River as a warmwater river system; however water temperature data collected by the MDNR in summer 2001 documented that the upper reaches of the Battle Creek River and its tributary stream Indian Creek maintain summer water temperatures that would be indicative of a coldwater system. Further, during a 2002 fisheries survey mottled sculpin were sampled in Indian Creek. Mottled Sculpin are considered an indicator species found in coldwater systems.

Maintaining and restoring fisheries habitat is important in order to maintain and improve fish diversity and fish populations in the Battle Creek River. Historical and current practices that negatively impact fisheries habitat and stream stability such as channelization of tributaries and the main channel, storm water discharge and, land use changes will continue to negatively impact fisheries resources.

Benthic Macroinvertebrates

Benthic Macroinvertebrates are animals that do not have backbones, but are visible to the naked eye. They play a key role as biological indicators of stream health and water quality. Macroinvertebrates are important links to the food chain, can be pollutant tolerant or intolerant, and have specific requirements that a stream must provide in order for survival. They also have a short life cycle and detection of problems can be identified quickly after collection. Macroinvertebrate habitat can vary from oxygen rich, cobble substrate to more stagnant, silty substrate.

A biological survey conducted by the Michigan Department of Environmental Quality in 1999 for the Kalamazoo River Watershed and selected tributaries, indicates that a portion of the Battle Creek River and two portions of Wanandoga Creek rated poor in macroinvertebrates. Other tributaries within the watershed were acceptable. Habitat ratings ranged from good, fair, and poor.

Biological Survey

Stream	Township/County	Macroinvertebrate	Habitat
Crooked Brook Creek	Assyria/Barry	Acceptable	Good
Ellis Creek	Assyria/Barry	Acceptable	Fair
Wanandoga Creek	Assyria/Barry	Poor	Poor
Wanandoga Creek	Assyria/Barry	Poor	Fair
Wanandoga Creek	Pennfield/Calhoun	Acceptable	Good
Battle Creek River	Eaton/Eaton	Acceptable	Fair
Battle Creek River	Eaton/Eaton	Acceptable	Good
Battle Creek River	Carmel/Eaton	Acceptable	Good
Battle Creek River	Carmel/Eaton	Γ Poor	Γ Fair
Battle Creek River	Bellevue/Eaton	Acceptable	Good
Battle Creek River	Bellevue/Eaton	Acceptable	Good
Ackley Creek	Convis/Calhoun	Acceptable	Fair

Information obtained from the Michigan Department of Environmental Quality's A Biological Survey of the Kalamazoo River and Selected Tributaries, 2000.

Γ Indicates a dredged channel condition

Channel modification, large scale land use change, and removal of riparian buffer zones promotes flow instability, habitat loss, in-stream sedimentation, and an overall reduction in the physical and biological processes that maintain macroinvertebrate and fish communities (document). The integrity of macroinvertebrate populations within the Battle Creek River and its tributaries will depend on future land use planning and drainage maintenance practices.

Recreation and Tourism

The Battle Creek River Watershed has a plethora of opportunities to explore and discover valuable social, natural, and historical features within the watershed community. Many state, county, city, and township parks can be found throughout the area. There are public access sites to lakes and rivers for fishing, boating, canoeing, and kayaking opportunities, historical museums, structures and monuments, summer festivals, camping, hiking, biking, running, walking, protected lands, and sanctuaries. Recreation and tourism opportunities within the watershed are often underutilized.

Recreational and tourism opportunities in the Battle Creek River Watershed include Battle Creek's Linear Path (part of the North Country Trail). A portion of the Linear Path follows along the banks of the Battle Creek River and the Verona Impoundment at Bailey Park. Bailey Park is home of the Battle Creek Yankees in the Minor League and is great place to watch a good game of baseball in the spring and summer months. Several historical museums are also available to the public in the City of Battle Creek, Village of Bellevue, and Charlotte. Battle Creek's Cereal City is a hands-on exploration of the

world of cereal making. Full Blast is a water park opened in the summer months in Battle Creek. There are also summer festivals, including Cranefest in Bellevue, Frontier Days in Charlotte, and the Taste of Battle Creek.

Access sites to the Battle Creek River include Bailey Park in Battle Creek, Butler Park in Bellevue, and Bennett Park in Charlotte. Access to Indian Creek is available at Veteran's Park in Olivet. Several road stream crossings within the watershed also provide user access.

Other trails within the Battle Creek River Watershed include Bakers Sanctuary and Doty Wildflower trail off of Junction Road (Convis Township), Michigan Audubon Society's Meadow and Marshland Trail off of 15 Mile Road (Convis Township), Keehne Environmental Area off of Bellevue Road (Bellevue Township-17 acres), and Bennett Park off of Cochran Road (Carmel Township-120 acres). The trails vary in length and can be used in a variety of ways such as hiking, running, walking, bird watching, and cross-country skiing.

An expansion of state, county, city, and township parks that provide access to the Battle Creek River and its tributaries to the public will be important in protecting resources that are valuable to the watershed. Residents that are more acquainted with the Battle Creek River and/or its tributaries will create a better affiliation and appreciation of the watershed and its resources.

Protected Lands, Farmland Preservation, and Open Space

Protected lands in the Battle Creek River Watershed vary in methods and level of protection. The largest protected land area within the Watershed of 897.5 acres is owned and managed by the Michigan Audubon Society. Adjacent to the Audubon's property is 131 acres owned by the Kiwanis Club of Battle Creek. Both of these properties surround Big Marsh Lake, which was created by the erection of an earthen dam on Ackley Creek in the early 1960's. The shallow impoundment area is about 200 acres in size, and is the home of thousands of sandhill cranes during migration in the fall. Bird watchers from all over visit the area to witness the spectacular event of watching the cranes fly in to Big Marsh Lake during early evening hours. The Cranefest sponsored by the Michigan Audubon Society and Battle Creek Kiwanis Club bring in around 700 people to the bird/art festival. Activities include art projects for children, demonstration workshops, nature walks, art booths, and informational booths. The Kiwanis Club and Calhoun County Michigan State University Extension also sponsors 5th Grade Conservation Field Days in the spring for schools in the Calhoun County area. Children learn about soils, water quality, wetlands, wildlife, and conservation.

The City of Charlotte owns 120 acres called Bennett Park within the Battle Creek River Watershed. Bennett Park is also home to the City of Charlotte's public water supply.

The Battle Creek River splits the park in half, and shares the same aquifer as the city wells. Bennett park has both paved and dirt trails that meander along the Battle Creek River. Remnants of the Battle Creek River's old stream channel, before straightening, can be seen south of the river in the park.

The Southwest Michigan Land Conservancy owns 29.6 acres of forested floodplain along the confluence of Wanandoga Creek and the Battle Creek River in section 21 of Pennfield Township. The property was donated in 1994 for a nature preserve. The Southwest Michigan Land Conservancy holds nature hikes several times throughout the year. This property is also well known to local bird watchers who hope to catch a glimpse of the Prothonotary Warbler who nest in the area.

The concept of protecting farmland from conversion to other uses is first about protecting a natural resource, and second about preserving a business. To be sustainable, an agricultural enterprise must have the necessary resources and social environment to function efficiently. The number one resource agriculture depends on is a natural resource, productive soil. The number one social environment agriculture depends on is space to operate without conflicts with competing land uses. Farmland protection or preservation involves meeting both needs.

One way farmland can be protected or preserved is with a tool called "Purchase of Development Rights (PDR)." The Calhoun County Board of Commissioners passed a Purchase of Development Rights Ordinance in the spring of 2003. This was the culmination of a year long effort by a local PDR Workgroup endorsed by the Commissioners a year earlier. With assistance from Dr. David Skjaerlund and Stacy Sheridan of Midwest Land Legacies; and Jennifer Bomba, Planning Director, Calhoun County Community Development; the PDR Workgroup put together a strategy, a ranking system and the ordinance for submission to the Commissioners. The PDR Workgroup recently reviewed a group of applicants and selected candidates to recommend to the County Board of Commissioners for the first Calhoun County Farmland Preservation Board. This Board should be ready to start receiving applications and looking for funding sources sometime in 2004.

P.A. 116, also referred to as the Farmland and Open Space Preservation Program, is another method that can be used to protect farmland. This particular program authorizes the state to preserve farmland by purchasing the development rights of land. Landowners can submit an application to protect valuable farmland, and if the property is selected, the state will pay a portion of the value if that property was developed. The

state in return would keep the property from being developed to permanently preserve it for future agricultural use.

These methods of conservation and protection of land mentioned above will be key to the character of the landscape that future generations will be left with. How we decide to protect and conserve natural resources will depend on long-term land use planning and the ability to recognize that the decisions we make will ultimately impact the Battle Creek River Watershed indefinitely.

Social, Historical, Cultural, and Economic Factors

History

For many years prior to the settlement of the Battle Creek River Watershed, Indian villages once stood in the areas of Olivet and Bellevue. Worn down Indian trails covered much of the area that are now primary roads and the Grand Trunk railway which follows the Battle Creek River from Battle Creek to Charlotte. Past writings indicate that most of the Indians inhabiting the Battle Creek River Watershed were of Potowatomi, Ojibwa, and Chippewa descent. Buildings consisted of both wigwams and mounds built near waterways. They grew corn and pumpkins, gathered roots and berries, and made sugar from sugar maple trees. Encounters between the settlers and Indian were of good nature. They often helped each other through the winters and traded goods.

Many historical accounts vary on how the Battle Creek River was named. Recorded in the Detroit Post and Tribune on June 16, 1878, an anonymous author wrote:

"…many generations ago, two strong tribes of Indian fought here all day long, until the limpid waters of the stream ran red, like frothing wine, and the Indians named it Waupkisco, 'River of Battle" or 'River of Blood.' This is said to be confirmed by traditions of Canadian Indians."

To date, there has been no archeological evidence to confirm this legend. A more probable story is that of a small fight between the government's first surveying party that traveled through the Calhoun County area in 1825 and Indians that inhabited the area. Colonel John Mullett, leader of the surveying party, which surveyed and mapped the exterior township lines that divided much of Lower Michigan including Calhoun and Eaton counties, wrote a letter to Territorial Governor Lewis Cass. Other accounts indicate the frustrations between the surveyors that were trying to get their job finished and the Indians that were trying to harvest sap from sugar maple trees. Different writings vary on the severity of the fight, which bore the name of the stream called Battle Creek. In the Bellevue area, there are historical references describing the origins of the name for the Battle Creek River. Originally it was called the Indian name "Me-Josh Ke-wap-pi-kis-co," which is the long name for "stone-pipe" named for the limestone in Bellevue from which the Indians carved their pipes.

Community Profile

The Battle Creek River Watershed is positioned in southwest Michigan. Interstate 69 divides the watershed in half to the east and west. The watershed is primarily a rural setting with the main urban areas of Charlotte to the north and Battle Creek to the south. Development pressure has increased within the watershed because of its location near two major highways (I69 and I94) and close proximity to Lansing, Charlotte, Battle Creek, and Kalamazoo. The higher population areas are continually encroaching into the more rural areas of the watershed. These urban areas are cultural

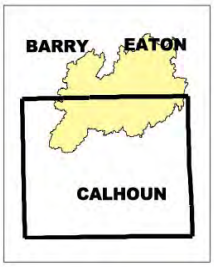
centers that provide shopping and employment. The population is beginning to leave these urban centers and move out to the rural areas. Farmland is being sold and the rural landscape is becoming dotted with residential housing.

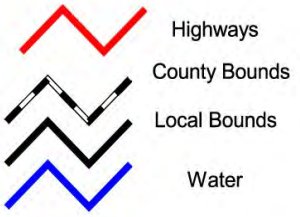
Population

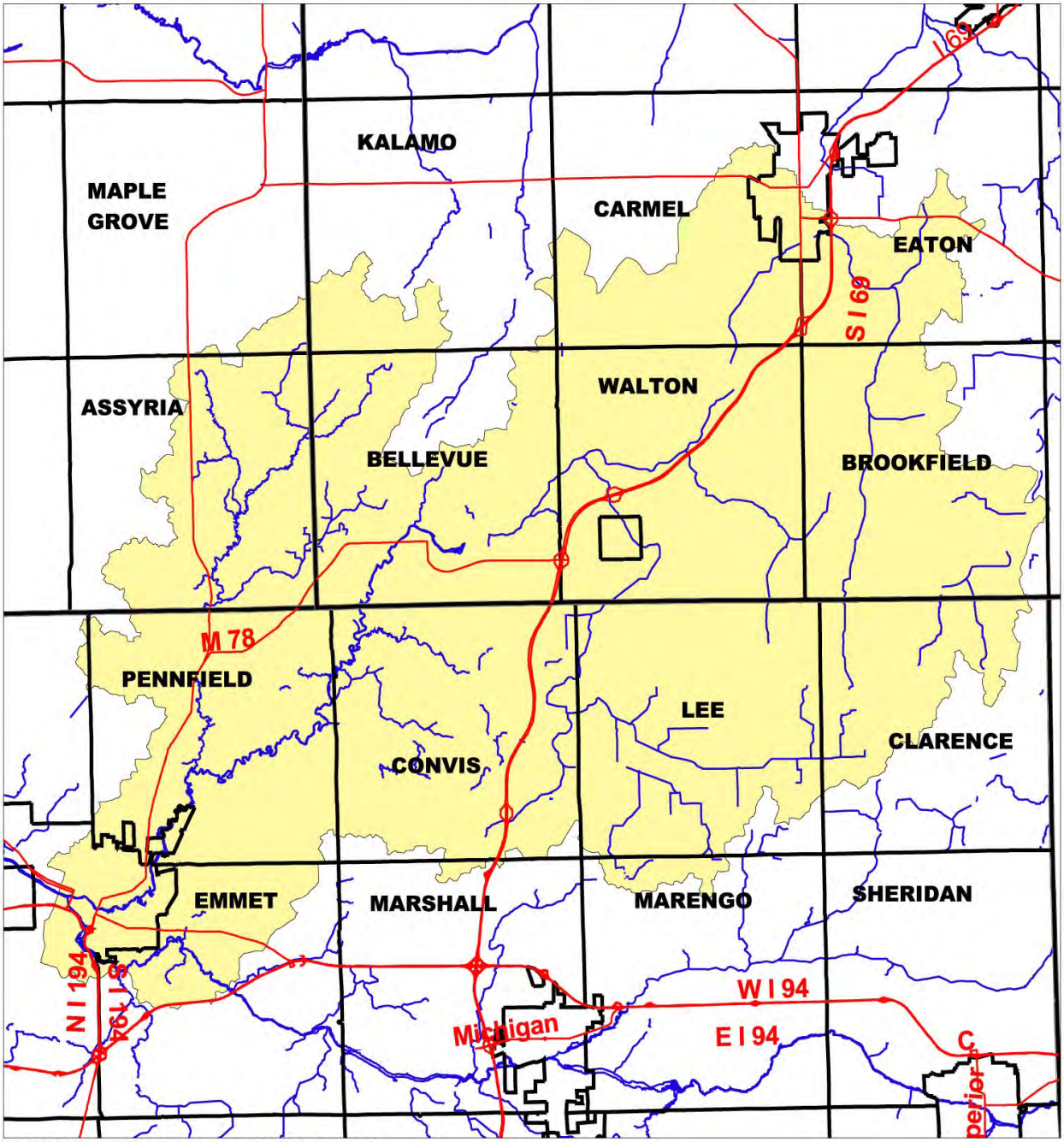
According to the U.S. Census Bureau, Census 2000, the estimated population of the Battle Creek River Watershed is 29,293.

Battle Creek Watershed

Barry, Calhoun, and Eaton Counties







DATA SOURCE: MDNR MIRIS Base and NRCS Hydrologic Units
Map Produced by: Chad Fizzell
Institute of Water Research

February, 2003
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Public Involvement

Stakeholders within the Battle Creek River Watershed initiated the Battle Creek River Watershed Planning Project and are the driving force of project success. These stakeholders have been involved in either the Steering Team (meeting monthly) or Advisory Committee (meeting quarterly). Both committees served as support for information and data collection, technical assistance, overall watershed concerns and issues, local knowledge, and general expertise.

During management plan development, the public was involved through a variety of methods. After project approval from the Michigan Department of Environmental Quality, an article on the project was in several newspapers that serve the Battle Creek River Watershed area. Newsletters were also a means for involving the public. Subjects pertaining to soil erosion, stream morphology, overall project goals and objectives were used to educate and inform watershed residents. Several positive responses from the public were initiated through the newsletter.

The first Saturday in October marks the City of Battle Creek's Global Citizens River Clean-up Day. Each year volunteers in the area take a Saturday morning to pick-up trash along the banks of both the Battle Creek and Kalamazoo Rivers. Hundreds of tires and tons of miscellaneous trash are hauled away from the two major rivers.

A workshop was held in February of 2003 in cooperation with the Rice Creek Watershed Project, which is adjacent to the Battle Creek River Watershed. Both watersheds have comparable issues and concerns. The conference agenda was based on comments from watershed residents from previous presentations and workshops. The meeting was called "On the Edge-Stream Issues and Answers Conference" and was held at Clarence Township Hall, which is located on the watershed boundary between Rice Creek and the Battle Creek River. Speakers were brought from various backgrounds to be able to address the main concerns of watershed stakeholders. Topics included: Identifying the Issues, Striving Towards Solutions, Lagoon Wastewater Treatment Systems-system abilities and limitations, Proposed Regional Sewer Project-updates and alternatives, Water Quality Monitoring-a summary of the findings, and the State of the Warmwater and Coldwater Fisheries. The final session was a discussion panel between workshop participants and speakers.

In March of 2003, several partners including the Calhoun Conservation District, Calhoun and Jackson MSU Extension initiated a "Watershed Management Short Course." The course was held on Monday evenings in March and included a field trip on a Saturday that highlighted various conservation projects in Calhoun and Jackson counties. One of the objectives for the course was to help educate and inform watershed residents on becoming leaders in watershed management within their community. Several of the

participants were from the Battle Creek River Watershed and continue to serve as advocates of the project.

In mid-April, the TMDL Kalamazoo River and Lake Allegan Implementation Committee holds a Super Soils Saturday to educate homeowners on the impacts of excess phosphorus in their soil. Stakeholders in the watershed are invited to bring a sample of their soil to designated locations to test their soil and get recommendations on fertilizing. Each location has 0 phosphorus fertilizer available for purchase. Hundreds of people have tested their soil over the last couple of years and 99% of the samples indicated having excess phosphorus.

In the summer of 2003, several partners wanted to get the public more involved with the Kalamazoo River Watershed. As a result, an event called "Kanoe the Kazoo" evolved into a ten-day canoe trip down the Kalamazoo River on weekends in June and July. The main goal of the event was to get watershed residents to rediscover this valuable natural resource that runs through their backyard. Over 650 people participated in the event. A portion of the Battle Creek River was a part of the ten-day journey. Over 60 people participated and learned about the history, wildlife, concerns, and issues of the Battle Creek River. "Kanoe the Kazoo" proved to be huge success, and specifically got people back to the river.

The Calhoun Conservation District in partnership with the Battle Creek River Watershed Project also created a student stream ecology program and a teacher-training program. Five schools within the watershed have trained teachers to continue educating their students on stream ecology and watersheds. Students are taken out in the field to put their lessons to use by testing pH, turbidity, sampling macroinvertebrates, determining flow, and surveying their stretch of stream. This program will continue to grow with direction from the Calhoun Conservation District.

A display on the Battle Creek River Watershed Planning Project was created to inform residents on the project at specific events held throughout the planning phase of the project. The display exhibited project goals and objectives, a map of the watershed, issues and concerns, and pictures of the Battle Creek River. A brochure was also created to inform the public on the project, and was placed at various locations throughout the watershed.

Presentations on the project were also used to involve the public during the planning phase. A PowerPoint and transparency presentation on the Battle Creek River Watershed was created and used to educate various groups and organizations on the project.

Partners and Stakeholders

The Battle Creek River Watershed Management Plan could not have been possible without the efforts of stakeholders from a variety of backgrounds. In the table below is a summary of those involved in the planning process and their roles and responsibilities they contributed to the planning project.

Partners and Stakeholders	Organization, Agency, or Affiliation	Roles and Responsibilities
Kristine Boley-Morse	Battle Creek River Watershed Project Coordinator	Coordinate meetings, incorporate comments and suggestions into watershed plan, inventory and gather pertinent information on the watershed, information and education, general watershed coordination
Tracy Bronson	Executive Director, Calhoun Conservation District	General assistance, administrative support, and Steering Team Member
Gregg Strand	Rice Creek and Battle Creek River Watershed Partnership Project Coordinator	Provides technical assistance, landowner site-visit support, and information and education, Steering Team Member
Adam DeShano	Michigan Groundwater Stewardship Program, Calhoun Conservation District, Groundwater Technician	On-farm technical support (Farm*A*Syst), on-river inventory, information education, and Advisory Committee Member
Jim Smith	Calhoun Conservation District, Board of Director/Pheasants Forever, Habitat Chairman	Steering Team Member, prairie restoration expertise, planning support, information and education
Daniel Kesselring	USDA Natural Resources Conservation Service, District Conservationist, Marshall Field Office	Technical assistance, Steering Team Member, landowner site visit support, information and education, planning support, and general expertise

Tara Egnatuk	Calhoun Conservation District, Environmental Education Coordinator	Planning support, educational support, and stream ecology program coordinator
Blain VanSickle	Calhoun County Drain Commissioner/Farmer	Steering Team Member, technical assistance, planning support, drain and drainage expertise, knowledge of critical areas, local knowledge
Braden Harrington	Eaton County Drain Commissioner	Steering Team Member, technical assistance, planning support, drain and drainage expertise, knowledge of critical areas
Sue Hauxwell	Calhoun County Environmental Health Department, Sanitarian	Steering Team Member, technical and informational assistance on septic systems, wells, and groundwater issues, critical area knowledge, planning support, information and education
Christine Kosmowski	City of Battle Creek, Environmental Programs Director	Steering Team Member, stormwater and wastewater expertise, information and education, planning support, and watershed liason for the Greater Battle Creek area
Jennifer Bomba	Calhoun Community Development, County Planning Director	Steering Team Member, technical and informational assistance on land use and planning issues, planning support, information and education, general expertise

James Coury	Potawatomi Resource Conservation and Development Coordinator	Steering Team member, general expertise, planning support, and technical and informational assistance
Doug Carter	Kellogg Biological Station, Michigan State University Extension	Steering Team Member, planning support, Kalamazoo River and Lake Allegan Phosphorus TMDL liason, information and education, and general expertise
Greg Potter	Kalamazoo Valley Trout Unlimited/Business owner	Fisheries expertise, planning support, information and education
Mike Boyce	Convis Township, Supervisor/Michigan Audubon Society/Battle Creek Kiwanis Club	Steering Team Member, general expertise, planning support, local knowledge, representative to township meetings
Judy MacKinder	Pennfield Township, Supervisor	Advisory Committee Member, local knowledge, representative to township meetings, planning and project support
Marcia Magiera	Real Estate Agent	Advisory Committee Member, real estate expertise, project support
Charles Bugby	Narrow Lake Association/Farmer	Advisory Committee Member, local knowledge, project support
Karry Trickey	USDA Natural Resources Conservation Service, District Conservationist, Charlotte Field Office	Advisory Committee Member, general knowledge, and technical assistance
Margaret Parker	Consumers Energy, Senior Environmental Planner	Advisory Committee Member, general expertise, dam removal support
Elaine Russell	Thornapple/Grand Conservation District, Executive Director	Advisory Committee Member, general and local knowledge

Annette Chapman	Calhoun Community Development, Director of Parks and Recreation	Project support, parks and recreation information, GIS information, general expertise
Chris Freiburger	Michigan Department of Natural Resources, Habitat Management Unit, Fisheries Biologist	Steering Team Member, informational assistance, geomorphic assessment technical assistance, informational support, fisheries and water quality expertise, dam removal expertise
Jay Wesley	Michigan Department of Natural Resources, Fisheries Division, Fisheries Biologist	Fisheries knowledge, informational knowledge, data analysis, Kalamazoo River Watershed knowledge, and technical assistance
Scott Hanshue	Michigan Department of Natural Resources, Fisheries Division, Fisheries Biologist	Data collection, fisheries knowledge, informational knowledge, and technical assistance
Chris Bauer	Michigan Department of Environmental Quality, Environmental Quality Analyst	DEQ representative, watershed, 319, and regulatory knowledge, general expertise
Jenny Molloy	Michigan Department of Environmental Quality, Grant Administrator	DEQ representative, watershed, 319, and regulatory knowledge, general expertise
Susan Kiebala	Olivet College, Marketing Professor	Development of a marketing plan, Advisory Committee Member, and general expertise
Jim Hazelman	US Fish and Wildlife Service, Biologist	Informational knowledge, technical assistance, and planning support

Tom Eitniear	US Fish and Wildlife Service, Biologist	Informational knowledge, wetland expertise, and technical assistance
Chad Fizzell	Michigan State University-Institute of Water Research, Information Technology/GIS	GIS website development and technical support
Bill Skidmore	Battle Creek River Rescue/Watershed Resident	Informational knowledge and project support
Howard McCaffery	City of Charlotte, Director of Public Works	Informational and local knowledge, project support

Supporting Programs

Rice Creek and Battle Creek River Watershed Partnership and Cooperation Program

This program constitutes a non-regulatory Partnership Cooperation Agreement between various units of government, businesses and private sector organizations dedicated to securing a productive and beneficial future for the Rice Creek and Battle Creek River watersheds. The partnership is not a contract. It is a statement of intent, support and willingness to participate at a level appropriate to the respective interest.

The groups committed to this partnership jointly recognize the need for improving, maintaining and protecting the quality and flow characteristics of the Rice and Battle Creek River watersheds. They share a desire to protect and enhance the designated and desired uses of the watersheds. The parties do so in the unanimous belief that restoring these assets to their full potential will provide significant aesthetic, recreational and economic benefits to the area for years to come.

BACKGROUND

Section 2003 of the Farm Security and Rural Investment Act of 2002, entitled *Partnerships and Cooperation (P&C*), authorizes the Secretary of Agriculture to enter into stewardship agreements with States, tribes, and non-governmental organizations. The purpose of P&C agreements is to (1) enhance technical and financial assistance provided to owners, operators, and producers, (2) address natural resource issues related to agricultural production, and (3) provide conservation solutions to minimize further regulatory actions. P&C agreements provide flexibility in applying programmatic elements consistent with conservation enhancement and long-term natural resource productivity.

Once this Farm Bill provision is fully implemented, special projects can be designated per the recommendation of the NRCS State Conservationist with advice from the State Technical Committee. The purpose of special projects is to encourage producers to cooperate in installing and maintaining practices affecting multiple operations. This pilot effort will be conducted to develop a protocol and methodology that might be used when the P&C program becomes available through USDA.

Benefits of P&C include: bundled programs and increased flexibility to meet unique, local needs; resources focused on partnerships in critical areas; and collaborative efforts with public and private sector entities.

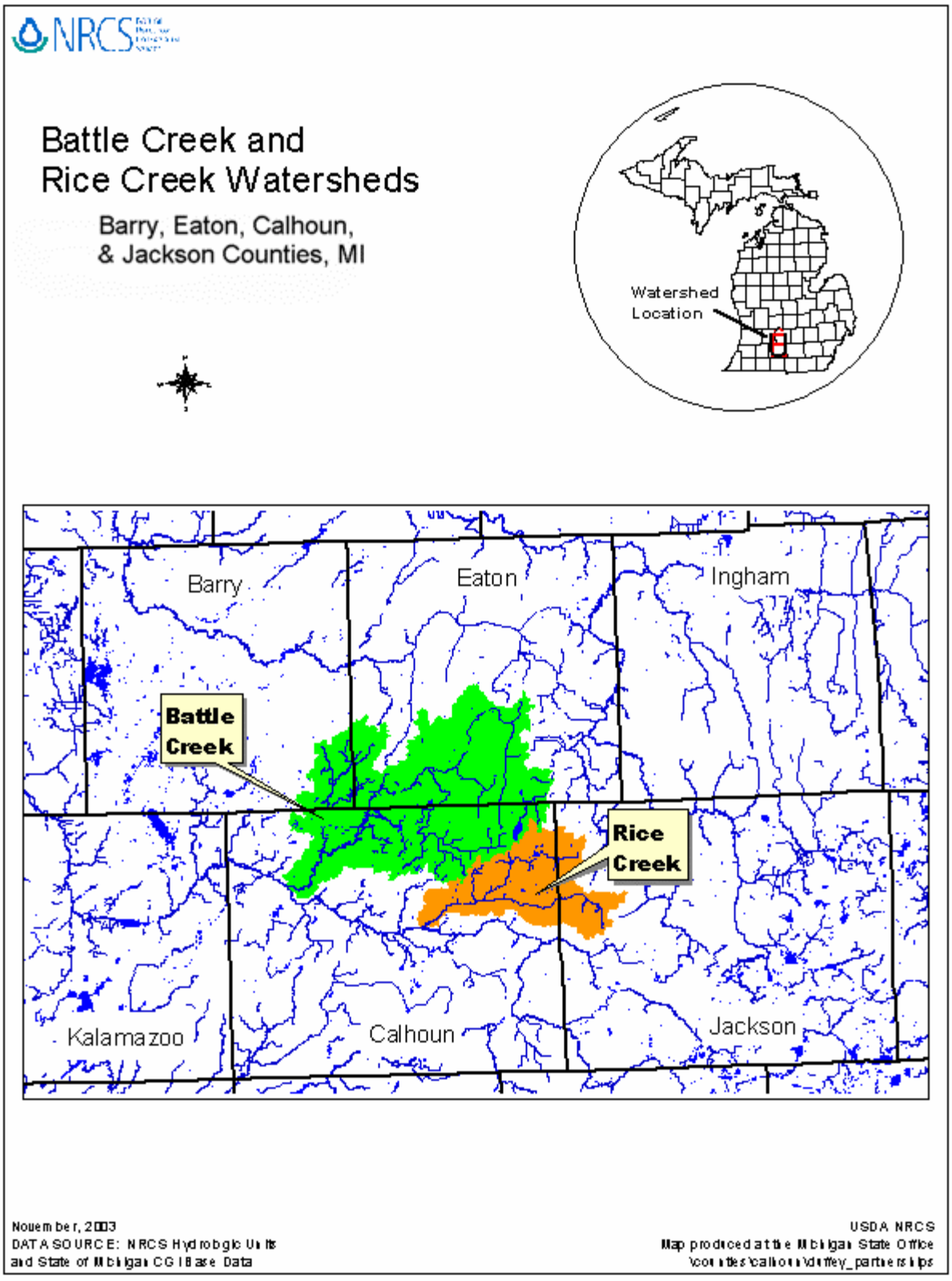
Potential future funding for P&C will be limited to no more that 5 percent of the funds made available to the following Farm Bill programs: Conservation Reserve Program,

Conservation Security Program; Wetland Reserve Program; Environmental Quality Incentives Program; Grasslands Reserve Program; Farmland Protection Program; and Wildlife Habitat Incentives Program.

It is envisioned that this collaborative effort of enhanced financial and technical resources will provide the impetus that is needed for landowners to enter into conservation easements and adopt appropriate conservation measures over the identified geographic area of concern.

PROPOSED ACTION

Building on the Calhoun Conservation District's efforts through the Section 319 program, accelerated financial and technical assistance will be made available to address the following resource concerns: Water Quality (surface and ground water); Species at Risk (plants and animals); Wildlife Habitat (grassland species); Wetland Restoration; and Prescribed Grazing needs. State and federal agencies, in concert with private sector entities, agree to pool their efforts and resources to address the above resource concerns in the Rice Creek and Battle Creek River watersheds.


NRCS
Battle Creek and
Rice Creek Watersheds
Barry, Eaton, Calhoun,
& Jackson Counties, MI
Watershed
Location
Barry
Eaton
Ingham
Battle
Creek
Rice
Creek
Kalamazoo
Calhoun
Jackson
November, 2003
DATA SOURCE: NRCS Hydrologic Units
and State of Michigan GIS Base Data
USDA NRCS
Map produced at the Michigan State Office
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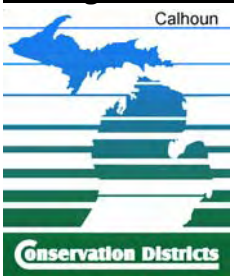
Michigan Conservation Districts



Michigan's Conservation Districts are "unique" local units of State Government that utilize state, federal and private sector resources to solve today's conservation problems. The guiding philosophy of all Conservation Districts is that decisions on conservation issues should be made at the local level, by local people, with technical assistance provided by government.

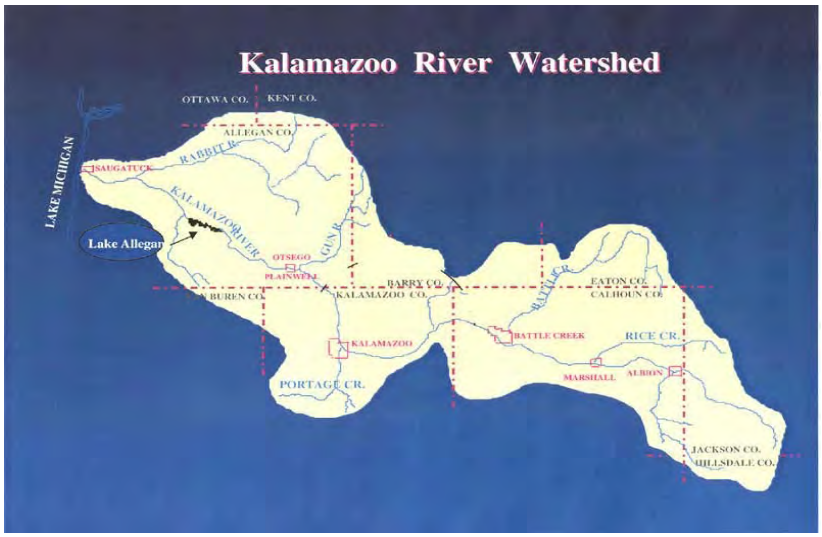
Created to serve as stewards of natural resources, Michigan's Conservation Districts take an ecosystem approach to conservation and protection. Conservation Districts are referred to as "gateways" in their local communities. They provide linkages between land managers and a host of conservation service providers that include state, federal and local governments, conservation organizations, and Internet resources. Conservation Districts continually scan the needs of their local communities, work in partnership with others involved in conservation to set local priorities, and develop action plans to solve natural resource problems. The delivery of these efforts by Conservation Districts allows citizens to manage their private lands for a cleaner, healthier Michigan. It allows the public a point of access in their communities when questions arise on how to manage natural resources.

Programs carried out by Conservation Districts are as diverse as the landscape in Michigan. In southern Michigan, many of the programs deal with conservation needs of the farm community, while in northern Michigan; there is more emphasis on forestry, wildlife, water quality, and recreation. Conservation Districts continue to expand into diverse areas of natural resource management, rising to meet the environmental challenges of their local communities.

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

The Kalamazoo River watershed is a major geographic feature of southwest Michigan. It drains more than 2,020 square miles of land in Allegan, Van Buren, Kalamazoo, Calhoun, Barry, Eaton, Hillsdale and Jackson counties. Many water quality problems have been addressed in the past, including the PCB contamination Area of Concern through development of a Remedial Action Plan (RAP). Today, nutrient enrichment of Lake Allegan is a symptom of significant non-point source problems in a watershed diverse in land use, and experiencing development pressures.

Lake Allegan is a 1,587-acre impoundment at the lower end of the watershed, and a collection point for sediments and nutrients delivered by the river and its tributaries. Lowered water quality in the Lake contributes to algal blooms, low oxygen levels, poor water clarity and a fish community dominated by carp. Lake Allegan, characterized as *hypereutrophic*, does not meet designated use and water quality standards for phosphorus.



Phosphorus and the TMDL

Although a variety of factors can lead to water quality problems, scientists have determined that phosphorus is the primary cause of *eutrophication*, or nutrient enrichment. In the Kalamazoo River watershed, industrial and municipal discharges (wastewater and cooling water), account for approximately 35% of the total load of phosphorus from April through September (the growing season). The remaining 65% is from: runoff (from roads, parking lots, lawns, farms, industry, and commercial activities); poorly functioning septic systems; livestock, pets and wildlife; and improper and illicit connections of sanitary discharges to storm sewers.

Because of excessive phosphorus, Lake Allegan is on Michigan's list of impaired waters. The State of Michigan therefore was mandated by the Federal Clean Water Act to develop a *Total Maximum Daily Load* (TMDL) for Lake Allegan and the Kalamazoo River watershed. A TMDL specifies the maximum amount of a pollutant, in this case phosphorus, that a water body can receive and still meet water quality standards. The phosphorus TMDL also specifies that the limited total acceptable phosphorus loadings will be shared among all categories of dischargers in the watershed, point and non-point alike.

This TMDL is notable for its watershed-wide, community based approach, which began many years ago. Landowners, industry, government, community organizations, small business and citizens from all facets of community life have participated in development of the TMDL Implementation Plan. These local contributors have come together during some 75 to 100 public meetings discussing the future of the Lake Allegan/Kalamazoo River watershed.

TMDL Implementation Plan - Goals and General Provisions

Impressed with the local initiative and commitment, the US Environmental Protection Agency (EPA), gave approval last summer to the group's conceptual plan, opening the door for a more "voluntary" approach than normally allowed. This effort includes reliance on local and regional efforts for watershed restoration, and emphasis on voluntary land and water management changes. A stakeholder led committee will provide overall leadership, oversight and coordination of the Implementation Plan. If successful, the TMDL Implementation Plan will require less direct regulation by state and federal agencies.

Proposed water quality goals for Lake Allegan include improved water clarity, increased oxygen levels, a more balanced fish community and the absence of significant blue-green algae blooms (which cause taste and odor problems as well as fish kills). The TMDL was derived using 1998 data (both ambient water quality and discharge monitoring) as the baseline. All increases and decreases in phosphorus loadings to the watershed will be tracked in relationship to 1998 levels. .
The TMDL is apportioned into 1) Waste Load Allocation, from industrial and municipal point sources, 2) Load Allocation, from all other sources, and 3) a Margin of Safety. Because the symptoms and effects of nutrient enrichment primarily manifest themselves in the spring and summer, the TMDL is seasonal (April through September). These allocations require a 23% reduction in phosphorus loads from municipal and industrial point sources throughout the watershed in the later half of the summer. Most ambitiously, a 50% reduction in phosphorus loadings of phosphorus from non-point sources is the target from April through September.

Although the federal TMDL mandate requires that Lake Allegan be the focal point of phosphorus reductions efforts, the opportunity exists for improving water quality throughout the watershed. Implementing the proposed reductions will reduce other pollutants as well, including sediment, oil, metals, salt, nitrogen, bacteria, and other substances that contribute to water quality degradation. The framework and **resources** provided by this TMDL process will help communities throughout the Kalamazoo River Watershed achieve their water quality goals.

Due to the large size of the watershed, and the diffuse nature of phosphorus sources, significant improvements in the water quality of Lake Allegan will not likely be measurable for at least several years. However, progress has already been made through numerous efforts within the watershed to reduce phosphorus loads to the river. These efforts are highlighted in the Plan.

Specific Targeted Areas and Strategies to Reduce Phosphorus:

Below is a brief description of phosphorus contributions, and a sampling of recommendations on how to reduce such contributions. For each category, the Plan contains a detailed description of the recommendations, as well as of affected stakeholders, the regulatory environment and current efforts, contingency plans, funding and program resources, and suggestions for accountability, cost optimization, reporting, tracking and monitoring. Details for each category are available on the website www.kalamazooriver.net, or by calling MDEQ at 616-567-3500.

Point Sources: 31 permitted dischargers, representing municipal and industrial waste water treatment plants, lagoons and cooling water facilities. Most have signed the Voluntary Agreement and are working cooperatively to: reduce phosphorus by 23% from July – September, and maintain or reduce inputs from 1998 levels the rest of the year; assist and support non-point reduction efforts; and pursue innovative handling, treatment and funding approaches.

Industrial Storm Water: NPDES permits required for facilities that discharge storm water directly to the river or its tributaries. There is a need to identify non-permitted facilities, and otherwise improve compliance. Phosphorus should specifically be targeted for control, and industries should be encouraged to prepare or upgrade Storm Water Pollution Prevention Plans, and seek training and certification for all of their operators.

Municipal Storm Water: Some twenty (20) communities within the watershed are affected by the new federal Phase II Storm Water regulations. This presents a great opportunity to encourage neighbors to get together through the "watershed approach" to storm water management, and share resources to provide enhanced public involvement and public education for area citizens and agencies. Other suggestions include identifying phosphorus reduction as a specific target, searching for and removing illicit discharges to storm water facilities, and improving "housekeeping" practices, such as street sweeping and catch basin clean-out.

Construction Activities: Many types of construction projects can create the potential for significant contributions of phosphorus from site disturbance and inappropriate management. Most critical are sites with direct surface runoff to the river, a tributary or storm sewer, or where soil is easily transported to such areas. Suggestions include: site designs with less potential for runoff to water; increased use of certified Storm Water Operators; education of excavators and on-site construction managers (including the homeowner); logical timing of inspections; well-planned staging of construction activities; and coordination of Soil Erosion enforcing agencies.

Turf Management: It is well documented that turf grass from lawns, golf courses, park and recreation areas, campuses and other areas can add significant levels of phosphorus.

Important for seed and root growth, phosphorus in excess can be conveyed to area waters. The Plan calls for: soil testing prior to fertilization; use of no P fertilizer when appropriate; planting of buffers along lakes and streams; reducing the size of lawns by planting of native species which require no fertilization and less maintenance; and additional directed educational programs. MSU will pursue expansion of its Turf Grass Environmental Stewardship Program by offering its services to golf courses, lawn care providers, turf managers, and retailers throughout the watershed.

Septic Systems and On-Site Wastewater Treatment Systems: Widespread, significant levels of phosphorus are likely not coming from these facilities, but poorly maintained and/or sited facilities immediately adjacent to a lake or stream are a problem. Suggestions include: performance based sanitary codes; optional residential treatment systems (low or no water); expand educational efforts and incentives to property owners for more frequent maintenance; and establish watershed-wide inspection requirements and protocols.

Agriculture: Agriculture represents about 44% of the land use within the watershed, and in some areas is likely a contributor of phosphorus. Phosphorus is not the only environmental concern on farms, however. It is strongly recommended that a "whole farm" or systems approach be taken in analyzing and taking action to control pollutants. Within that context, priority should be given to the following: nutrient management (including feed, manure, fertilizers and crops); conservation practices to prevent soil erosion (including no-till practices and limiting livestock access); and manure and fertilizer storage and handling.

Greenhouse Nutrient Management: Floriculture is a major industry within the watershed, with 40-50 commercial greenhouses currently in operation. This industry requires high technology with precision use of pesticides, fertilizer, light, temperature and bedding, and has the potential to affect ground and surface water resources. Recommended is use of the new Greenhouse *A*Syst program, offered by MSU Extension and the Michigan Groundwater Stewardship Program. This consists of an assisted, confidential and comprehensive audit of a greenhouse operation to evaluate site, cultural and management practices and impacts on water quality. It also advises growers of applicable federal, state and local environmental quality regulations.

Transportation Systems: Roads, highways and other corridors often serve as a ready and efficient delivery system for pollutants generated by other land uses. The goals of this effort include improving techniques to reduce sediment on and from roads, raise standards for employees and develop watershed wide standards and procedures for maintenance and retrofit of older facilities. "One-stop shopping" for permits is desirable, as is a 10-20 page, small field guide for road crew needs, and numerous identified training and education programs.

In-Lake, In-Stream Processes: Data from study of these processes recognizes there is a certain background level of phosphorus within sediments, in suspension of the water column, and from fish and other aquatic life that can be released to move downstream, thereby increasing nutrient enrichment of Lake Allegan. Kieser and Associates is pursuing efforts directed towards identifying and stabilizing eroded riverbanks, establishment of buffer zones, native plantings, and careful removal of carp in Lake Allegan.

Sub-Basin Planning and Management: Watershed management at the sub-basin level provides a chance for stakeholders to balance diverse goals and phosphorus reduction strategies, and to consider how their cumulative actions may affect long-term sustainability of these resources. Existing sub-basin efforts should receive community support, and organization should be pursued on a priority basis for these sub-watersheds: 1) Lake Allegan immediate drainage area; and 2) Schnable Brook, Minges Brook/Harper Creek, Comstock Creek, Spring Valley Creek, Pine Creek, and the drains and creeks in Comstock draining the greenhouse areas.

Support Systems - The Implementation Plan includes significant background information, and sections on Monitoring, Reporting and Tracking, Public Involvement, Information and Education and Program Sustainability. All of these serve to facilitate and support the phosphorus reduction strategies, and are described in detail in the Plan. These and all sections of the Plan are available at www.kalamazooriver.net, or by calling MDEQ at 269-567-3500 or Michigan State University Extension at 269-671-2412 (Carter, 2003).

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) works hand-in-hand with the American people to conserve natural resources on private lands. They help land-users and communities approach conservation planning and implementation with an understanding of how natural resources relate to each other and to all of us-and how our activities affect those resources.

Good science and practical technology are at the center of good land management, productive farming, and sound conservation. NRCS is a key source of resource information and technology including:

- A national soil survey that provides soil resource data-by county. This information enables land users to make the best use of their soil resources and understand how that use affects the broader environment
- Conservation systems designed for local conditions to sustain and improve soil and water quality by addressing erosion control, pesticide and nutrient management, irrigation water management, wetlands conservation and restoration, wildlife habitat improvement, flood control, and streambank stabilization

- A total natural resource approach to conservation, based upon sound science and ecological principles, that enables land users to paint the conservation picture on the landscape
- A plant materials program that introduces new ways to use plants to protect and restore water quality and wetlands, and to reduce soil erosion
- Techniques for assessing and predicting soil erosion, agricultural non-point source water pollution, and the effects of agricultural practices and management decisions on the farm and ranch economics

NRCS Programs:

EQIP-Environmental Quality Incentives Program: The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program administered by the USDA Natural Resources Conservation Service (NRCS). It supports production agriculture and environmental quality as compatible goals. Through EQIP, farmers and ranchers may receive financial and technical assistance to implement structural and land management conservation practices on eligible agricultural land.

Eligible producers are individuals engaged in livestock or crop production. Eligible land includes cropland, rangeland, pasture, and private non-industrial forestland. Unique resource concerns on Tribal lands can be addressed through EQIP.

State priorities are developed annually from input from local workgroups based on county resource assessments and individual plans to address those local needs. A State Technical Committee comprised of representation from these local work groups, Tribal groups, commodity groups, and conservation partners advise NRCS on the implementation of EQIP.

EQIP activities are carried out according to a site specific conservation plan developed in conjunction with the producer. All conservation practices are installed according to NRCS technical standards. Producers may elect to use an approved technical service provider for technical assistance.

EQIP offers contracts with a minimum term of one year after the implementation of the last scheduled practice and a maximum term of ten years. Cost share for individual practices will vary, but they will not exceed 75%. Cost share for limited resource farmers and beginning farmers for individual practices will vary, but they will not exceed 90%. Incentive rates will be established that are appropriate to facilitate an environmentally beneficial land management change.

Wildlife Habitat Incentives Program (WHIP): The Wildlife Habitat Incentives Program (WHIP) is a voluntary program designed to provide technical and financial

assistance to landowners for the establishment and improvement of fish and wildlife habitat. Ranking criteria are used to select the applicants with a conservation plan that will create, enhance or protect wildlife habitat by types of wildlife habitat.

Wetlands Reserve Program (WRP): The Wetlands Reserve Program (WRP) is a voluntary program for the restoration and protection of wetlands on private property. Technical and financial assistance is provided in return for placing a conservation easement on the property for a minimum period of 10-30 years. Permanent easements are also established.

Farm and Ranch Land Protection Program (FRPP): Conversion of prime and unique farm and ranch land to non-agricultural uses has accelerated over the past decade. Michigan currently ranks 9th in the nation for amount of farmland converted. The Farm and Ranch land Protection Program (FRPP) provides federal funding to states, local units of government, non-governmental organizations and federally recognized Indian Tribes to supplement the cost of purchasing conservation easements. Land eligible for conservation easements include land with prime, unique or other productive soil, or land that contains historical or archeological resources.

Grassland Reserve Program (GRP): The Grassland Reserve Program (GRP) offers a new opportunity for landowners to protect privately owned grasslands. The GRP was authorized in the 2002 Farm Bill with the intent of protecting grasslands which play a vital role in protecting water quality and providing wildlife habitat.

Priority grasslands targeted include grasslands threatened by both agricultural and non-agricultural development, grasslands that provide habitat to threatened and endangered plant and animal species, and grasslands currently used for grazing operations.

Enrollment options include:

- Permanent Easements. Payments are based on the fair market value of the property less the grazing value.
- 30-year Easements. The landowner is paid 30 percent of the cost of a permanent easement.
- Rental Agreements. 10, 15, 20, or 30 year options are available. Seventy-five percent of the grazing value will be paid in annual payments for the length of the agreement.
- Restoration Agreements. Up to 90 percent of the restoration cost on grassland or scrubland that has never been cultivated and not more that 75 percent on restored grassland or scrubland that has been cultivated.

Conservation of Private Grazing Land Program: Approximately five percent of Michigan's agricultural land is pasture for animal grazing. Properly managed grazing land provides benefits to animals and farmers as well the environment.

Conservation Security Program (CSP): The CSP is a voluntary program that provides financial and technical assistance to conserve and improve soil, water, air, energy, plant and animal life on tribal and private working lands—cropland, grassland, prairie land, improved pasture and rangeland, as well as certain forested land that is an incidental part of an agriculture operation.

The CSP has a unique role among USDA conservation programs. It identifies and rewards those farmers and ranchers who meet the highest standards of conservation and environmental management on their operations, creates powerful incentives for other producers to meet those same standards of conservation performance on their operations, and provides public benefits for generations to come.

Resource Conservation and Development (RC&D): Resource Conservation and Development (RC&D) program objectives focus on improvement of quality of life achieved through natural resources conservation and community development. The goal of the program is to develop sustainable communities, prudent development, and the management and conservation of natural resources. RC&D areas are locally sponsored areas designated by the Secretary of Agriculture for RC&D technical and financial assistance program funds.

Each RC&D area has a community-based program established and governed by local leaders. Each area is sponsored by the counties and Conservation Districts within its boundaries. Other organizations and units of government may also be co-sponsors.

Activities in each area are governed by a RC&D Council composed of a representative from each sponsor. These councils establish their own governing policies and develop programs to fit local needs. A NRCS employee is designated as the RC&D Coordinator responsible for managing the activities of the RC&D program.

Conservation Reserve Program (CRP): The Conservation Reserve Program (CRP) is administered by the Farm Service Agency (FSA) with the Natural Resources Conservation Service (NRCS) providing technical assistance through conservation planning. Established in 1985, CRP encourages farmers to voluntarily plant permanent areas of grass and trees on land that needs protection from erosion. This vegetative cover also serves as a windbreak and improves soil and water and water quality, creating more areas of vegetation is crucial to maintaining healthy wildlife populations because doing so provides a source of food and habitat.

Farmers enter into CCC contracts that last between 10 and 15 years. In return farmers receive annual rental payments, incentive payments for certain activities, and cost-share assistance to establish protective vegetation. Farmers may also receive additional one-time payment offered under the program. Eligible participants who enroll selected practices receive an up-front Signing Incentive Payment (SIP) of $100 to $150 per acre and/or a Practice Incentive Program (PIP) equal to 40% of the eligible practice installation cost.

The Nature Conservancy (TNC)

The Nature Conservancy's mission is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.

TNC has developed a strategic, science-based planning process, called Conservation by Design, which helps them identify the highest-priority places—landscapes and seascapes that, if conserved, promise to ensure biodiversity over the long term. In other words, Conservation by Design allows them to achieve meaningful, lasting conservation results.

Worldwide, there will be thousands of these precious places. Taken together, they form something extraordinary: a vision of conservation success and a roadmap for getting there—the Conservation Blueprint. Simply put, by protecting and managing these Last Great Places over the long term, we can secure the future of the natural world.

How can The Nature Conservancy protect ALL of these places?
They can't buy them all, and we certainly can't protect them single handedly. But by joining together with communities, businesses, governments, partner organizations and people like you, we can preserve our lands and waters for future generations to use and enjoy.

Here are just a few of the ways by which they achieve their mission:

- Conservation Methods
- Private Lands Conservation
- Land Acquisition
- Conservation Easements
- Conservation Buyer Projects
- Conservation-Friendly Public Policies
- Public Land Management
- Parks in Peril Program
- Funding for Conservation
- Debt for Nature Swaps
- Conservation Trust Funds
- Ecosystem Services Payments

- Resource Extraction Fees
- Public Finance Campaign

Partners:

- Governmental
- Non-Profit
- Local Stakeholders
- International
- Multilateral-Bilateral
- Corporate

The Nature Conservancy has five priority conservation initiatives to address the principal threats to conservation at the sites where they work, focusing on fire, climate change, freshwater, marine, and invasive species.

The Michigan Department of Agriculture

The Michigan Groundwater Stewardship Program (MGSP): To provide information and assessment tools for pesticide and nitrogen fertilizer users which help them identify risks to groundwater associated with their pesticide and nitrogen fertilizer use practices and to coordinate local, state, and federal resources to help individuals reduce those risks.

The MGSP is designed to be voluntary, to be locally driven, to address the concerns of individuals, and to maintain a focus on the financial and technical constraints which drive real-world decisions. The MGSP is relatively narrow in focus addressing only risks to groundwater associated with pesticide and nitrogen fertilizer use. However, it has a wide scope and addresses the many uses of these materials, including agricultural, turfgrass, and household uses.

Farm*A*Syst: Farm *A* Syst (FAS) identifies potential risks posed by farmstead operations. Fact sheets provide educational information and list reference people to contact if questions arise. F*A*S* work sheets use a simple question-and-answer format to evaluate farmstead practices that may pose a risk to groundwater.

Farm *A* Syst is voluntary and confidential. All Farm *A* Syst materials stay with you on your farm. It is important to recognize that Farm *A* Syst only identifies risk. It does not tell you if you have contaminated water or that you will never have contaminated water. Technical assistance with completing Farm *A* Syst evaluations is available free of charge from the Michigan Groundwater Stewardship Program.

Field*A*Syst: Field *A* System is a series of worksheets and fact sheets that help identify and offer ways to reduce the risk of groundwater contamination associated with pesticide and nitrogen fertilizer use. These in-field risk assessment tools are based on the highly popular Farm *A*Syst program which is used to evaluate farmstead practices and structures that may pose a risk to groundwater.

Currently, Field*A*Syst materials are available for the following topics:

* General Pesticide & Nutrient Management Work Sheets
* General Irrigation Management
* Field Screening Work Sheets
* Corn Nutrient & Pesticide Management

The general pesticide, nutrient and irrigation management packages focus on practices such as: split nitrogen application, nitrate testing, pesticide selection, sprayer calibration, and pesticide safety.
The field screening worksheets help evaluate the impact of soils, subsurface geology, cropping practices, and depth to the water table on the relative vulnerability of the fields you manage. The idea is that if you are going to try using a groundwater stewardship practice, you'll get the biggest benefit using it on your most vulnerable fields.
The materials are designed to integrate MSU Extension bulletins and recommendations into a single fact sheet, using the same easy Farm*A*Syst question-and-answer format to help you apply the recommendations to your own fields.

Just like Farm*A*Syst, the Field*A*Syst program is voluntary and confidential. All materials stay with you on your farm.

Abandoned Well Closures: Abandoned wells are wells, which are no longer in use or are in such disrepair that groundwater can no longer be obtained from them. The objective of abandoned well closure is to reduce the risk of contaminants moving down an abandoned well and contaminating groundwater supplies.

No one knows how many abandoned wells are located in Michigan. Some say a million; others claim that a well is abandoned on property by each generation that lives there. It is important to realize that these wells are unsafe and can provide a direct route for contaminants to reach your drinking water.

Abandoned wells that are open on the surface can allow surface runoff and any contaminant contained in that runoff to enter groundwater supplies and completely bypass the natural filtration capacity of the soil. Deep abandoned wells that have

cracked are damaged casings can even allow contaminants to reach groundwater supplies that would normally be protected by a clay or other permeability layer.

Abandoned wells which are open at the surface or have a deteriorated seal or casing below the surface are of particular concern.

The land use surrounding an abandoned well has a huge influence on the level of risk posed. Abandoned wells located near feedlots or pesticide and fertilizer mixing, loading, or storage areas pose a higher risk for groundwater contamination than those located in wood lots or turn areas on which pesticide and fertilizers are not used.

If you have an abandoned well on the farm and there is another well nearby that provides drinking water, this is a high-risk situation. The abandoned well may be contaminating the water in the aquifer, being used as drinking water by the family.

A good rule of thumb is that if there is something on the soil surface you don't want in your drinking water then you should close the abandoned well.
Why Close Abandoned Wells?

- to reduce the risk of groundwater contamination.
- to eliminate the risk of children or livestock being injured by falling into the well.
- to avoid liability under Michigan Polluter Pay Law, 91982 Public Act-307 if groundwater contamination is caused by an abandoned well on your property.

Many financial institutions even require that abandoned wells be closed before they will finance land transactions. Also, the current high level of cost-share makes properly closing abandoned wells the best liability insurance you can buy.

Abandoned wells can be legally closed by the landowner or a licensed well driller. The process for dug wells and hand-driven wells is not difficult. However drilled, deep bedrock and artesian (flowing) wells should be closed by a licensed well driller with the proper equipment.

An improperly closed well may not reduce your groundwater risk. Filling an old well with rocks or gravel may reduce the potential for physical injury but won't reduce the groundwater contamination risk. So, you may want to take advantage of the technical assistance opportunities provided by the Michigan Groundwater Stewardship Program to make sure things go smoothly.

Costs for closing abandoned wells range widely from $50 to $500. Farmers may qualify for technical assistance and cost-share through the Michigan Groundwater Stewardship

Program. Stewardship Teams determine local cost-shares, which are often as high as 75 to 90 percent of the total cost.

Groundwater Stewardship Practices: There are many practices that can be implemented on the farm that can reduce the risk of groundwater contamination. MGSP programs around the state have Groundwater Stewardship Teams that prioritize practices that are made available for cost-share through their specific program. Types of practices that may be available through the MGSP are as follows:

- Abandoned well closures
- Pre-sideress nitrate testing
- Sprayer tips
- Rotational grazing
- Backflow devices
- Manure testing
- Spillkits

Home*A*Syst: Home*A*Syst is a household assessment tool that can be used to help identify risks to groundwater contamination around the home. Groundwater is a limited resource. Its contamination can occur in several ways:

- Contaminants moving down well casings of unused or unusable wells.
- Excess or poorly timed use of yard and garden fertilizers and pesticides, leading to groundwater or surface water contamination.
- Poorly maintained septic systems.
- Improper disposal of wastes.

Home*A*Syst helps you protect your drinking water, the environment, your health, and the health of your family.

Participation will help you:

- Protect your drinking water well.
- Learn the basics about your home septic system.
- Reduce runoff which may harm lakes and streams.
- Gain information on the health and environmental impact of your yard and gardening activities.
- Lower risks from hazardous household products.
- Safely manage liquid, fuels and their storage (gas, fuel oil, kerosene).

How to Use Home *A* Syst:

1. Get a copy of the Home *A* Syst materials from your local Michigan State University Extension Office, Soil Conservation District, or representative of the Michigan Groundwater Stewardship Program.
2. Review the eight sections and select those which apply to your home site. Each of the sections has a table to help you determine your home risks as well as general information.

The eight sections of the Home *A* Syst risk assessment packet covers the following topics:

* Storm Water Management
* Drinking Water Well Management
* Yard and Garden Care
* Household Wastewater
* Hazardous Household Products
* Household Trash
* Liquid Fuels
* Home Site Assessment

3. Complete the assessment tables to determine your risks. The information will provide specific details about the risk categories as well as how to lower your risks.
4. Use the summary work sheets to list your high-risk activities.
5. Take action. Choose your short and long-term goals for risk reduction.

Conservation Reserve Enhancement Program (CREP): Michigan's Conservation Reserve Enhancement Program (CREP) was created to help protect our environment and wildlife. Michigan is partnering with the federal government to implement conservation practices of great significance to the state, and valuable to the nation, in matters of soil erosion, water quality, and wildlife habitat.

CREP is founded upon the federal Conservation Reserve Program (CRP), yet differs from the CRP by offering enhanced financial incentives for participants. In Michigan's CREP, farmers and other landowners in priority watershed areas agree to enroll eligible parcels of land in the program for 15 years, and establish prescribed conservation practices.

In return, landowners receive cost-share assistance in establishing conservation practices. Approved practices include riparian buffers, field windbreaks, filter strips, wetland restoration, shallow-water wildlife areas, controlled livestock access and conservation easements.

Michigan's CREP will be the largest voluntary environmental improvement program in the state's history, initially involving 80,000 acres of land in three watershed areas, which will be dedicated to conservation practices. CREP will be key in reducing non-point source pollution in rural areas. The program will:

* Protect Michigan's lakes, rivers, ponds and streams
* Filter runoff water of silt, pesticides and other pollutants
* Replenish water tables
* Protect topsoil from erosion
* Enhance wildlife habitat
* Encourage wildlife diversity
* Reduce flooding
* Increase oxygen levels

The benefits of Michigan's CREP go beyond the state's borders by helping to maintain the purity of the Great Lakes, which make up 20 percent of the world's surface freshwater. The Great Lakes aesthetic, environmental and commercial value is vitally important to the entire region, and the nation.

CREP priority areas include the Lake Macatawa, River Raisin, and Saginaw Bay Watersheds. Land qualifying for the program includes cropland that has been planted for two of the last five years, and marginal pastureland.

Selected land within Michigan's CREP priority watersheds are eligible for the program. Property owners in these counties are strongly encouraged to take part. In some counties, eligible priority zones are limited to certain areas. The local Farm Service Agency can help landowners identify suitable parcels of land.

Right to Farm Act: The Right to Farm Act Affects Everyone. Michigan agriculture is a $37.5 billion industry involving every county of the state. A wide variety of crop and livestock production strengthens our farm economy and helps to enhance the natural environment.

The Michigan Right to Farm Act, P.A. 93, was enacted in 1981 to provide farmers with protection from nuisance lawsuits. This state statute authorizes the Michigan Commission of Agriculture to develop and adopt Generally Accepted Agricultural and Management Practices (GAAMPs) for farms and farm operations in Michigan. These voluntary practices are based on available technology and scientific research to promote sound environmental stewardship and help maintain a farmer's right to farm.

The Farmland and Open Space Preservation Program: The Farmland and Open Space Preservation Program consists of 5 methods for preserving farmland and open space:

- Farmland Development Rights Agreements is a temporary restriction on the land between the State and a landowner, voluntarily entered into by a landowner, preserving their land for agriculture in exchange for certain tax benefits and exemptions for various special assessments. (commonly known as PA 116).
- Purchase of Development Rights is a permanent restriction on the land between the State and a landowner, voluntarily entered into by a landowner, preserving their land for agriculture in exchange for a cash payment for those rights.
- Agricultural Preservation Fund is a fund established to assist local units of government in implementing a local purchase of development rights program.
- Local Open Space Easement is a temporary restriction on the land between the local government and a landowner, voluntarily entered into by a landowner, preserving their land as open space in exchange for certain tax benefits and exemptions for various special assessments. Click here for a copy of the registration form,
- Designated Open Space Easement is a temporary restriction on specially designated lands between the State and a landowner, voluntarily entered into by a landowner, preserving their land as open space in exchange for certain tax benefits and exemptions for various special assessments.

Michigan's Biosolids Program: Thirty years ago, thousands of American cities dumped their raw sewage directly into our nation's rivers, lakes, and bays. Today, because of improved wastewater treatment, our waterways have been cleaned up and made safer for recreation and seafood harvest. And, because of the strict Federal and state standards, the treated residuals from wastewater treatment (biosolids) can be safely recycled. Local governments make the decision whether to recycle the biosolids as a fertilizer, incinerate it or bury it in a landfill.

Biosolids are the nutrient-rich organic materials resulting from the treatment of sewage sludge (the name for the solid, semisolid or liquid untreated residue generated during the treatment of domestic sewage in a treatment facility). When treated and processed, sewage sludge becomes biosolids which can be safely recycled and applied as fertilizer to sustain, improve, and maintain productive soils and stimulate plant growth.

Only biosolids that meet the most stringent standards spelled out in the Federal and state rules can be approved for use as a fertilizer. Now, through a Voluntary Environmental Management System, being developed for biosolids (EMS) by the National Biosolids Partnership (NBP), community-friendly practices will also be followed.

Although cities decide how best to manage their biosolids, the U.S. Environmental Protection Agency (EPA) is obligated and continues to provide the public with educational information, based on the best science, about the safe recycling and

disposal of biosolids. EPA strongly supports the ongoing efforts of the NBP to develop the EMS and to provide correct and timely information about biosolids via its new communications system.

Michigan's Biosolids Program: The Department of Environmental Quality (DEQ) encourages the use of Biosolids (also known as sewage sludge) to enhance agricultural and silvicultural production in Michigan. Almost all Biosolids that are land applied in Michigan are used to grow crops on sites at agronomic application rates approved by the DEQ. Biosolids are also used to provide nutrients and soil conditioning in mine reclamation programs, tree farms, and forest lands.

Michigan Agriculture Environmental Assurance Program (MAEAP): Michigan's Agriculture Environmental Assurance Program (MAEAP) is yet another way the Michigan Department of Agriculture and Michigan's agriculture industry is proactively and comprehensively addressing environmental concerns. This program is the state's latest tool to assist in the implementation of agricultural pollution prevention practices on farms.

While farmers are traditionally recognized as active conservationists, Dan Wyant, Director of the Michigan Department of Agriculture, said changes in agricultural practices and increased rural population density have contributed to the need for additional environmental stewardship tools like MAEAP.

MAEAP is a voluntary, pro-active program designed by producers and industry partners to reduce producers' legal and environmental risks. It teaches effective land stewardship practices that comply with state and federal regulations and shows producers how to find and prevent agricultural pollution risks on their farms.
The program encompasses three systems designed to help producers evaluate the environmental risks of their operation. Each system—Livestock, Farmstead and Cropping—examines a different aspect of a farm, as each has a different environmental impact. Through each phase, producers will develop and implement economically feasible, effective and environmentally sound pollution prevention practices.

MAEAP is designed as a multi-year program allowing producers to meet personal objectives, while best managing both time and resources. By participating in all three systems, producers comprehensively evaluate their entire farming operation for potential environmental risks.

The Livestock System and Farmstead Systems are currently underway. The Livestock System's primary emphasis is completing and implementing Comprehensive Nutrient Management Plans (CNMPs), including environmental risk assessments and action plans that are site and farm specific. The Farmstead System uses the Farm*A*Syst risk

assessment to evaluate farmstead risks to groundwater and to surface water. Local conservation district groundwater technicians help producers evaluate risk.

After approved CNMPs are developed and implemented for the Livestock System and after the Farm*A*Syst has been completed and immediate risks have been addressed (for the Farmstead System), producers can request Third Party Verification from the Michigan Department of Agriculture. When verification requirements are successfully met, producers receive recognition for their accomplishments and access to incentives. With an on-going commitment to use environmentally sound management practices, and to maintain MAEAP Verification, producers must request a MDA visit every three years.

Organic Farming: Organic farming is widely recognized as an alternative to conventional or chemical farming. It is a system of farming that is both restorative and sustainable. Organic farming is the "art" of partnership with rather than control over nature. It is a management system that enhances biodiversity, biological cycles, and soil biological activity to produce healthy plants and animals and foster human and environmental health. It prohibits the use of synthetic chemicals, genetically modified organisms, and ionizing radiation.

In September 1998, Michigan Department of Agriculture (MDA) Director Dan Wyant created the Michigan Organic Advisory Committee (Committee). The Committee was charged with developing a strategic plan; serving as a framework for advancing a system of production, processing and marketing products of organic agriculture in Michigan.

The Michigan Department of Environmental Quality (MDEQ)

The Department of Environmental Quality Water Programs establish water quality standards, assess water quality, provide regulatory oversight for all public water supplies, issue permits to regulate the discharge of industrial and municipal wastewaters, monitor State Water resources for water quality, the quantity and quality of aquatic habitat, the health of aquatic communities, and compliance with state laws.

Ground Water

Drinking Water: The DEQ has primary enforcement authority in Michigan for the Federal Safe Drinking Water Act under the legislative authority of the Michigan Safe Drinking Water Act. As such, the division has regulatory oversight for all public water supplies, including approximately 1,500 community water supplies and 11,000 noncommunity water supplies. In addition the program regulates drinking water well drilling. Michigan has more households (1.12 million) served by private wells than any other state, with approximately 25,000 domestic wells drilled per year. The DEQ also investigates drinking water well contamination, and oversees remedial activities at sites of groundwater contamination affecting drinking water wells.

Michigan Groundwater Discharge Program: The Groundwater Program regulates discharge to groundwater under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451and Part 22 Rules. Groundwater staff review applications for authorizations to discharge wastes and wastewaters to the ground or groundwaters of the state. Authorizations include permits, self-certifications, and exemptions. Upon completion of an application review, staff make recommendations leading to the determination of appropriate action including issuance or denial of an authorization to discharge.

Field staff review effluent and groundwater sampling data. Field staff also inspect discharge facilities to ensure legal requirements are being met. Field staff review and issue permits for the construction of public sewerage systems under Part 41 of the NREPA. Field staff also review compliance with requirements for storage of hazardous material under the Part 5 Rules issued under Part 31 of the NREPA.

The Groundwater Program also provides toxicological support for the Waste Management Division.

The Michigan Wellhead Protection Program: This program assists local communities utilizing groundwater for their municipal drinking water supply systems in protecting their water source. A WHPP minimizes the potential for contamination by identifying and protecting the area that contributes water to municipal water supply wells and avoids costly groundwater clean-ups.

Groundwater Modeling Program: The Groundwater Modeling Program (GMP) has provided groundwater modeling support on a department-wide basis since 1980 when an EPA grant was used to fund the use of groundwater models for site remediation. Initially, the GMP was part of the Hydrologic Studies Unit (HSU) of the Land and Water Management Division (LWMD), today; it is part of the Remediation and Redevelopment Division.

Surface Water

Inland Lakes and Streams: Michigan has over 36,000 miles of streams, and more than 11,000 lakes and ponds. These precious water resources and the benefits they provide are protected by several state laws from impairment due to pollution, physical alterations and nuisance aquatic species. The State's water resources are monitored by the Department of Environmental Quality and partnering organizations to determine the water quality, the quantity and quality of aquatic habitat, the health of aquatic communities, and compliance with state laws.

The Surface Water Enforcement Unit is responsible for conducting all escalated enforcement actions taken by the division. These actions are conducted in response to violations of state water pollution control statutes and rules, violations of surface water discharge permits, and any violations of administrative or judicial orders. These responsibilities extend statewide and by their very nature comprise the most complicated, complex and controversial compliance and enforcement actions taken by the division. Unit staff are responsible for the development and coordination of escalated enforcement cases assigned to them, and for seeing these cases through to final resolution. The unit serves as the division's liaison with the Michigan Department of Attorney General and also works with the United States Environmental Protection Agency and the U.S. Department of Justice on joint state/federal enforcement cases.

National Pollutant Discharge Elimination System: Perhaps the most notable goal of the Act was the elimination of discharge of pollutants into navigable waters by 1985. This goal was not realized, but remains a principle for establishing permit requirements. The Act had an interim goal to achieve "water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water" by July 1, 1983. This is more commonly known as the "fishable, swimmable" goal.

The enactment of the 1972 amendments marked a distinct change in the philosophy of water pollution in the United States. The amendments maintained the water quality-based controls, but also included technology-based control strategies. The treatment technology-based discharge standards are promulgated by the U.S. Environmental Protection Agency (EPA) and are based on the category of the facility. Dischargers are placed in categories based on industrial processes or on the type of wastewaters generated. As treatment technology improves, these federal standards are expected to become more restrictive in order to progress toward the goal of zero discharge. As permits expire they must be reissued with limits reflecting the most recent treatment technology standards.

The Act also contains four important principles:

1. The discharge of pollutants to navigable waters is not a right.
2. A discharge permit is required to use public resources for waste disposal and limits the amount of pollutants that may be discharged.
3. Wastewater must be treated with the best treatment technology economically achievable - regardless of the condition of the receiving water.
4. Effluent limits must be based on treatment technology performance, but more stringent limits may be imposed if the technology-based limits do not prevent violations of water quality standards in the receiving water.

The first round of NPDES permits issued between 1972 and 1976 provided for control of a number of traditionally regulated pollutants, but focused on 5-day biochemical oxygen demand (BOD5), total suspended solids (TSS), pH, oil and grease, and some metals, by requiring the use of the Best Practicable Control Technology currently available (BPT). The Act established a July 1, 1977, deadline for all facilities to be in compliance with BPT. Additionally, the Act established the compliance deadline for installing Best Available Technology Economically Achievable (BAT) as July 1, 1983. Most of the major permits issued to industrial facilities in the first round of NPDES permitting contained effluent limitations based on Best Professional Judgment (BPJ) because regulations prescribing nationally uniform, technology-based effluent limitations were generally unavailable.

The 1977 amendments to the legislation, known as the Clean Water Act (CWA) of 1977, shifted emphasis from controlling conventional pollutants to controlling toxic discharges. This era of toxic pollution control is referred to as the second round of permitting. The concept of BAT controls was clarified and expanded to include toxic pollutants. Hence, the compliance deadline for BAT was extended to July 1, 1984. The conventional pollutants (BOD5, TSS, pH, fecal coliform and oil and grease) controlled by BPT in the first round of permitting were now subject to a new level of control, termed Best Conventional Pollutant Control Technology (BCT). The compliance deadline for meeting BCT was also July 1, 1984.

In addition to treatment technology-based standards, the Clean Water Act also required that minimum receiving water quality standards be achieved. Water quality standards are promulgated by the states. The Michigan standards are designed to not only protect for aquatic life ("fishable") and recreation ("swimmable"), but also for all other uses of the receiving waters, including agriculture, public and industrial water supply, and navigation.

On February 4, 1987, Congress amended the CWA with the Water Quality Act (WQA) of 1987. The amendments outlined a strategy to accomplish the goal of meeting water quality standards set by the States. The WQA required all States to identify waters that were not expected to meet water quality standards after technology-based controls on point sources have been imposed. The State must then prepare an individual control strategy to reduce toxics from point and nonpoint sources in order to meet the water quality standards. Among other measures, these plans were expected to address control of pollutants beyond technology-based levels.

The WQA once again extended the time to meet BAT and BCT effluent limitations. The new compliance deadline was no later than March 31, 1989. The WQA also established new schedules for industrial and municipal storm water discharges to be regulated by NPDES permits. Industrial storm water discharges must meet the equivalent of

BCT/BAT effluent quality. Discharges from municipal separate storm sewer systems (MS4) require controls to reduce the discharge of pollutants to the maximum extent practicable (MEP). Additionally, the WQA requires EPA to identify toxics in sewage sludge and establish numerical limits to control these pollutants. The WQA also established a statutory anti-backsliding requirement that will not allow an existing permit to be modified or reissued with less stringent effluent limitations, standards, or conditions than those already imposed. There are a few situations under which exceptions can be made, including when the permittee was unable to achieve the previous permit limits and when production is increased.

Nonpoint Source Program: The Nonpoint Source Program offers grants and technical assistance and develops information and education materials to help protect and improve Michigan's lakes and streams. Staff in the program are dedicated to work with agencies, citizens and interest groups to develop watershed plans, install water quality control practices on the land and develop local educational tools. So welcome to our homepage and feel free to contact any of us about all the exciting information on this site.

Water Quality Trading Program: The State of Michigan is developing a statewide water quality trading program. This initiative began in 1995 with a feasibility study that looked at the regulatory, environmental and economic aspects of nutrient trading among and between point and nonpoint sources. This study was completed in July 1997 and lead to the establishment of a Water Quality Trading Workgroup, a watershed-based demonstration project and a series of conferences to provide information and obtain public input in the process.

The Water Quality Trading Workgroup (Workgroup) was established in 1998 by the Surface Water Quality Division to provide the department with recommendations and draft rules for a voluntary trading program. This was completed in August of 1999. The Workgroup recommendations and draft rules have been adopted by the department and the Governor's Steering Committee for Market-Based Environmental Programs (Steering Committee). Formal rulemaking began in January 2000.

There is broad-based support for nutrient trading on a watershed basis, the requirements for the generation of credits and the use of trading ratios to provide a net water quality benefit and the use of discount factors to address site-specific conditions. Environmental groups also support the enhanced enforcement, mandatory program evaluations and monitoring and citizen petition provisions in the proposed rules. Agricultural organizations and agencies support the framework for agricultural participation and accountability.

Environmental groups generally oppose trading that involves "toxics" and cross-pollutant trading. Strong concerns were expressed regarding the proposed level of public participation, a lack of monitoring and enforcement and nutrient trading in impaired waters prior to the development of total maximum daily loads (TMDLs).

The Kalamazoo River Water Quality Trading Demonstration Project was completed in June 2000. This project is nationally recognized as a highly successful innovative program built on partnerships and voluntary local initiatives. The project demonstrated how trading can occur, improved water quality and provided information to help design the state water quality trading program. The Water Environment Research Foundation (WERF) will publish a final report in the near future. The regulatory issues, barriers and solutions and lessons learned from this project are highly transferable to other water quality trading programs across the country. Funding for the project was provided by the Kellogg Foundation, Crown Vantage Paper Company, WERF and the Great Lakes Protection Fund.

The Great Lakes Trading Network (GLTN) was created to maximize the regional impacts of the Kalamazoo Project and create an information clearinghouse for trading projects and programs being implemented across the Great Lakes region. The scope of the GLTN has continued to expand since its kickoff conference in Kalamazoo in May 1998. Today, the GLTN is widely recognized as the national forum on water quality trading programs. It includes representatives from most of the active and developing programs in the country, the National Wildlife Federation (NWF), the United States Environmental Protection Agency (EPA) and several EPA program offices, the World Resources Institute (WRI), state regulatory agencies, agricultural representatives, consultants and local watershed groups. The GLTN has discussed and documented key policy and regulatory issues, and the goals, barriers, solutions and lessons learned from the trading programs that are represented on the network.

Michigan Biosolids & Industrial Pretreatment Program: To further preserve and protect Michigan's water resources, the Michigan Department of Environmental Quality encourages and enforces the use of wastewater treatment systems through the use of Biosolids and the Industrial Pretreatment Program.

Water Management: Activities that may have potential impacts to the public trust, riparian rights, or may impair or destroy the waters or other natural resources of the state, including inland lakes and streams, the Great Lakes, wetlands, and groundwater, are regulated by the DEQ. Information on the DEQ permit processes and water resource related databases and digital maps is provided. Additionally, numerous initiatives and research activities that are conducted for the protection and preservation of the state's water resources can be found. The following are issues that pertain to water management:

- Dam Safety
- Floodplain Management
- National Flood Insurance Program
- Hydrologic Data Collection & Analysis
- Subdivision Floodplain
- Transportation Review

Michigan Water Quality Monitoring: The Department of Environmental Quality has several water quality monitoring programs that assist in keeping all of Michigan's water clean. These programs include the following:

- Beach Water Monitoring
- Assessment of Michigan Waters
- Inland Lakes Monitoring
- Public Swimming Pool Monitoring

Wetlands: Michigan's wetland statute, Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, defines a wetland as "land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp, or marsh." The definition applies to public and private lands regardless of zoning or ownership.

Most people are familiar with the cattail or lily pad wetland found in areas with standing water, but wetlands can also be grassy meadows, shrubby fields, or mature forests. Many wetland areas have only a high ground water table and standing water may not be visible. Types of wetlands include deciduous swamps, wet meadows, emergent marshes, conifer swamps, wet prairies, shrub-scrub swamps, fens, and bogs.

Emergency Response: The Water Division is responsible for implementing the Part 5 Rules - Spillage of Oil and Polluting Materials. The revised Part 5 Rules were made effective August 31, 2001. The Part 5 Rules deal with the storage and release of oil, salt, and polluting materials. Such issues as threshold management quantities, Pollution Incident Prevention Plans (PIPPs), secondary containment, threshold reporting quantities, spill reporting, surveillance of manufacturing processes, treatment systems, and storage areas are described.

The MDEQ/USACE "Joint Permit Application" (JPA): This is a package covers permit requirements pursuant to state and federal rules and regulations for construction activities where the land meets the water and including wetlands, often referred to as the land/water interface. It is intended to prevent duplication of state and federal regulations. The application covers activities on or for:

- Wetlands

- Inland Lakes and Streams
- Floodplains
- Great Lakes Bottom Lands
- Marinas
- Critical Dunes
- Dams
- High Risk Erosion Areas

Michigan Department of Natural Resources

The Department of Natural Resources is responsible for the stewardship of Michigan's natural resources and for the provision of outdoor recreational opportunities; a role it has relished since creation of the original Conservation Department in 1921.

In 1995, Governor John Engler issued Executive Order 1995-18, which separated environmental and natural resources functions into two Departments, elevating environmental protection to Cabinet status for the first time in history, and allowing the DNR to return to its original conservation mission. The Department of Environmental Quality now focuses on environmental regulatory, permitting and related enforcement functions, and the DNR focuses on promoting diverse outdoor recreational opportunities, wildlife and fisheries management, forest management, state lands and minerals, state parks and recreation areas, and conservation and law enforcement.

Federal funding consists mainly of special purpose categorical grants from various Federal agencies, such as the U.S. Department of the Interior and U.S. Department of Agriculture. Federal funds support programs for wildlife and fisheries habitat and development, forest management, recreation and other natural resource efforts. Restricted funding is generated from licenses, user fees and other charges. These funds support programs for wildlife and fisheries programs, operation of Michigan's 96 state parks, harbor development, marine safety enforcement and education, snowmobile and off-road vehicle (ORV) trail repair and development, and operation of Michigan's 150 state forest campgrounds.

Wildlife: Wild animals, from black bear and white-tailed deer to bald eagles and bullfrogs, bring a rich diversity of life to our lands. The DNR manages and protects 400 species of game and non-game birds, mammals and their habitats, along with 70 state game and recreation areas. Wildlife biologists make recommendations on hunting regulations, habitat management, public hunting access, and protect more than 64 threatened and endangered plant and animal species.

Michigan's nearly one million hunters (#1 in the nation) contribute $2 billion annually to our economy, excluding license fees. Some 2.6 million non-consumptive users contribute $1.2 billion annually to Michigan's economy.

The Nongame Wildlife Fund, through the sale of specialty license plates and donations, supports Natural Heritage research, education and habitat restoration projects to identify, protect, manage and restore native plant and animal species.

Fisheries: Michigan offers a wealth of fishing opportunities with more than 11,000 inland lakes and 36,000 miles of rivers and streams, including 1,000 miles of the finest blue ribbon trout mainstreams in the country. We have 3,000 miles of freshwater shoreline (more than any other state) - and more total shoreline than any other state, except Alaska. Our 2 peninsulas touch 4 of the 5 Great Lakes and contain 80% of the nation's fresh water, and 14% of the world's fresh water. In Michigan you're never more than 6 miles from a river or stream, and never more than 85 miles from one of the Great Lakes.

The DNR works to preserve and enhance Michigan's fish populations, as well as other forms of aquatic life.

Fish are monitored and studied by biologists who strive to keep Michigan fishing among the nation's best. More than 20 fish species are reared and hatched at six state hatcheries, and then planted into designated waters to maintain or improve fish populations.

Forest, Mineral and Fire Management: Forest, Mineral and Fire Management administers 5.9 million acres of mineral estate ownership and leasing rights to explore for oil, gas and other minerals on state-owned lands (contributing $20-$30 million each year in royalties to the Natural Resources Trust Fund for recreational land acquisition and development, and for deposit into the Park Endowment Fund); maintains statewide aerial photographs in color infra-red and black and white formats, and provides detailed computerized map information for land utilization, management and resource protection.

Spanning 3.9 million acres, Michigan has the largest dedicated state forest system in the nation--three forests in the Upper Peninsula and three forests in the Lower Peninsula. Forests are popular spots for wildlife viewing, hunting, fishing, hiking, cross country skiing, backpacking and horseback riding. A DNR-established network of 6,100 miles of groomed snowmobile trails is the reason that we register more snowmobiles than any other state. And 150 rustic campgrounds provide valuable recreational opportunities.

The DNR manages the use of forests for timber production, new tree growth (growing trees at 2-1/2 times the rate of harvest), wildlife habitat and recreation. Foresters regularly examine trees, plants and soil characteristics to determine the best management practices to keep the forests healthy. Fire officers protect both public and private lands from wildfires.

Parks and Recreation: Michigan's 96 state parks and recreation areas drew record crowds in 1999, with 27.7 million visitors enjoying the trails, beaches and great natural surroundings. Visitor, interpretive and historical sites offer insight into our natural resources heritage. Nearly five million people use state park campground facilities, including 13,000 campsites, picnic areas and shelters, playgrounds, beach houses, boat launches and hiking and biking trails. The DNR maintains 14 Great Lakes Harbors of Refuge and 750 public access boating sites.

Michigan State Parks have set new attendance records each year for the last five years, and contribute a quarter of a billion dollars to the state's economy, and $200 million in direct visitor spending to nearby retail businesses.

Law Enforcement: Michigan Conservation Officers primarily enforce laws related to hunting, fishing and trapping, as well as laws governing the operation of boats, snowmobiles and recreational vehicles. COs also work with other state, federal and local law-enforcement agencies to enforce a wide range of statutes and assist in undercover investigations, fire prevention and emergency search, rescue and recovery operations.

Conservation Officers help locate lost hunters, provide emergency medical assistance and play an integral role in the Department's educational public outreach efforts with conservation organizations and clubs, community groups and schools. Conservation Officers frequently help establish and serve as instructors of recreational safety programs for hunters, boaters and operators of recreational vehicles.

Office of Property Management: The Office of Property Management assists with the overall administration of approximately 4.5 million acres of publicly owned lands, 25 million acres of Great Lakes bottomlands and 130,000 platted lots under the jurisdiction of the DNR. Staff coordinates activities related to the acquisition and disposition of land or rights in land, and resolves title and boundary issues.

US Fish and Wildlife Service:

Goals:

- Apply problem-solving attitude to natural resource issues of federal interest in Michigan and the Great Lakes ecosystem

- Work with the public and governments on environmental reviews for habitat protection and restoration, environmental contaminants, and federally threatened and endangered species

Services Provided To:
- Private citizens
- Federal, state and local agencies
- Conservation organizations
- Individuals and businesses seeking wetland permits or hydropower licensing

Activity Highlights:
- Kirtland's warbler: Manage for endangered species recovery and conduct public tours. The yearly population census first counted more than 1000 singing males in 2001!
- Piping Plovers: Work toward recovering Region 3's most endangered species.
- Coastal Program: We work with others to conserve and restore coastal resources around the Great Lakes.
- Natural Resource Damage Assessments: Restore ecosystems after they have been contaminated.
    - Saginaw Bay NRDA
    - Kalamazoo River NRDA
- Partners for Fish and Wildlife: Work with private landowners to restore wetlands on their property.
- Mitchell's satyr butterfly and U.S. Highway 31: Protect endangered species during highway development.
- Ludington and Consumer's Power Settlements: Protect fish, wildlife, and their habitats while providing for continued energy production.
    - The Great Lakes Fisheries Trust, resulting from the Ludington Pumped Storage Settlement: Part of the Trust which provides resources for Lake Michigan fishery and habitat restoration.
- Monitor the health of birds like bald eagles, Caspian and Forster's terns, and double-crested cormorants.
- Assist with lake sturgeon recovery.

County Drain Commissioners

What is a County Drain?

A county drain may be an open ditch, stream or underground pipe, retention pond or swale that conveys stormwater. These drains become designated as county drains

through a petition process where property owners or a local city, village or township petitions the Drain Commissioner to establish a county drain.
Responsibilities of the Drain Commissioner for County Drains:
The Drain Commissioner and staff are responsible for operation and maintenance of county drains and storm water management systems. The Drain Commissioner also develops standards and design criteria for management of storm water runoff in new developments, with a goal of protecting private property and natural resources. Within county drainage districts, the Drain Commissioner is responsible for accounting of expenditures and financial statements, for maintaining records of the establishment and operation of each, and for conducting routine maintenance of the drains. Major drain projects (generally defined as those with costs in excess of $2500 per mile) are initiated by citizens or municipality(s) through a petition process. Costs are recovered through special assessments levied on private properties, local governments, county roads, railroads, and state highways. The Drain Commissioner is responsible for review and approval of storm water management systems in private developments under the Michigan Land Division Act and in response to local governments' development review procedures.

When to Call the Office of the Drain Commissioner:

Flooding: The Drain Commissioner's staff responds to flooding situations caused by designated county drains.

Maintenance: Report drain maintenance needs to the Drain Commissioner's office.

Right of Ways: Right of Ways are granted to the Drain Commissioner's office along all designated county drains for the purpose of allowing access to operate, maintain or repair the drain. Property owners retain ownership, but are restricted from building permanent structures that may impede drain maintenance within the easement area. Work done by the property owner within the easement, such as constructing a crossing or tap in, requires a permit. The Michigan Drain Code (Act 40 of Public Acts of 1956 as amended) states that the Drain Commissioner may use and enter upon any easement for maintenance or any other lawful activity with respect to the drain without requiring a larger or different right of way.

Pheasants Forever
Pheasants Forever (PF) is a non-profit conservation organization dedicated to the protection and enhancement of pheasant and other wildlife populations in North America. This mission is carried out through habitat improvement, land management, public awareness, and education. Such efforts benefit landowners and wildlife alike. Pheasants Forever's unique system of county chapters allows 100% of net funds raised by chapters to remain at the chapter level for local habitat projects. This is a unique

distinction. Pheasants Forever is the only national wildlife conservation organization that leaves all of the fundraising dollars at the local, grassroots level where they were raised. This enables our chapters and volunteers to see the benefits of their efforts in their own backyards. Last year alone, those chapter volunteers completed over 35,000 habitat projects. Similarly, Pheasants Forever has always recognized the impact federal Farm Bill policy has on wildlife habitat. Consequently, PF has played an active role in Farm Bill policy development and implementation, which includes the Conservation Reserve Program (CRP). CRP is this country's single most effective conservation program benefiting soil, water, and wildlife.

Ducks Unlimited

The Great Lakes/Atlantic Regional Office, located in Ann Arbor, MI and established in 1998, provides comprehensive conservation solutions to help restore and protect diminishing wetlands in 18 states, from Wisconsin to Virginia and north to Maine.

Historic wetland loss, conversion of lands to development, water quality problems and an expanding human population are the greatest challenges that face this region. DU is dedicated to reversing the trends of wetland habitat losses, restoring and protecting habitats, educating conservation values, and making the Great Lakes/Atlantic region a better place for breeding, migrating and wintering waterfowl.

Significant accomplishments have been made in the Great Lakes/Atlantic Region's five focus initiative areas: the Great Lakes, Upper Mississippi, Chesapeake Bay, Atlantic Coast, and Interior Forest ecosystems. DU has already conserved nearly 400,000 acres of habitat in this region alone, and the Great Lakes/Atlantic Region diligently continues this work now and in the years ahead, positively affecting waterfowl, wildlife, and the quality of life for people.

States Include:
Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia and Wisconsin

Trout Unlimited

Trout Unlimited's mission is to conserve, protect and restore North America's trout and salmon fisheries and their watersheds.

TU accomplishes this mission on local, state and national levels with an extensive and dedicated volunteer network. TU's national office, based just outside of Washington, D.C., and its regional offices employ professionals who testify before Congress, publish a quarterly magazine, intervene in federal legal proceedings, and work with the

organization's 125,000 volunteers in 500 chapters nationwide to keep them active and involved in conservation issues.

History: July 1999 marked the 40th anniversary of TU's founding, on the banks of the Au Sable River near Grayling, Michigan. The 16 fishermen who gathered at the home of George Griffith were united by their love of trout fishing, and by their growing disgust with the state's practice of stocking its waters with "cookie cutter trout"—catchable-sized hatchery fish. Convinced that Michigan's trout streams could turn out a far superior fish if left to their own devices, the anglers formed a new organization: Trout, Unlimited (the comma was dropped a few years later).

From the beginning, TU was guided by the principle that if we "take care of the fish, then the fishing will take care of itself." And that principle was grounded in science. "One of our most important objectives is to develop programs and recommendations based on the very best information and thinking available," said TU's first president, Dr. Casey E. Westell Jr. "In all matters of trout management, we want to know that we are substantially correct, both morally and biologically."

In 1962-63, TU prepared its first policy statement on wild trout, and persuaded the Michigan Department of Natural Resources to discard "put-and-take" trout stocking and start managing for wild trout and healthy habitat. On the heels of that success, anglers quickly founded TU chapters in Illinois, Wisconsin, New York, and Pennsylvania.

TU won its first national campaign in 1965: Stopping the construction of the Reichle dam on Montana's Big Hole River. Five years later, TU helped secure a ban on high-seas fishing for Atlantic salmon. And in 1971, TU took legal action to protect the last free-flowing stretch of the Little Tennessee River. Perhaps one of the most significant early applications of the Endangered Species Act, the action stopped the Tellico dam, but only temporarily: An eleventh-hour congressional appropriations rider later doomed TU's victory.

In 1979 TU's headquarters moved to Washington, D.C., where it remains today. TU's recent accomplishments include:

- an agreement with New York State to restore Catskills trout fisheries damaged by stream work following 1996 floods
- the removal of the Edwards dam on Maine's Kennebec River, which reopened 17 miles of habitat to Atlantic salmon and other fish
- stopping a copper/zinc mine on Wisconsin's Wolf River, the state's largest whitewater trout stream
- breaking the stalemate over the U.S./Canada Pacific Salmon Treaty, which governs salmon harvest by both nations

- the premiere of Trout Unlimited Television on ESPN2
- the listing of Maine Atlantic salmon under the Endangered Species Act
launching the North Coast Coho Project to restore watersheds in California's commercial forests

Driven by a powerful and dedicated grassroots network, TU is meeting the challenges of coldwater conservation and protecting our rivers and fisheries for generations to come.

Townships

There are two types of townships in Michigan—general law and charter townships. Charter township status is a special township classification created by the Michigan Legislature in 1947 to provide additional powers and stream-lined administration for governing a growing community.

Township government is conducted by a township board consisting of either five or seven members—a clerk, supervisor, treasurer, and two or four trustees—that is determined by the desires of the township residents, whether the township has a population of over 3,000 or 5,000 registered electors, and if the township has charter status. The township board may also hire a manager, assessor, police or fire chief, superintendent and other necessary personnel to properly and efficiently operate the township.

State laws authorize townships to perform a wide variety of functions in two important categories: mandated and permissive. Mandated functions are activities that townships are required to perform. The three broadest mandated responsibilities are assessment administration, elections administration and tax collection, which are legally assigned functions of the supervisor, clerk and treasurer, respectively. State laws also specify details for performing these functions.

In addition to these broad mandates, there are other, more narrow state requirements. Procedures for the township's financial administration, such as budgets, accounting, investments and deposits, are closely regulated by the state. Township meetings must comply with Michigan's Open Meetings Act (MCL 15.261-15.275), and township records must be stored and made available in conformance with specific laws, such as the Freedom of Information Act (MCL 15.231-15.246).

The Township Zoning Act (MCL 125.271-125.310) gives townships broad powers to enact and enforce ordinances. Zoning ordinances give townships the authority to regulate land use, while many other specific ordinances control activities that infringe on the rights of citizens.

The Michigan Constitution and state statutes also limit the amount of property tax millage that townships can levy for general township operations. General law townships are allocated at least 1 mill from the constitutionally limited 15/18 mills allocated among townships, the county, public schools and the intermediate school district. Charter townships, like cities, do not share in this allocated millage, but townships chartered by a referendum may levy up to 5 mills. Townships chartered by board resolution after November 22, 1978, must have a vote of the electors authorizing the levy of 5 mills. In either case, the 5 mill limit may be increased up to 10 mills with a vote of the electors.

Townships also utilize other sources of revenue to support services. User fees, permits, fines and special assessments on real property are the most frequently used sources.

Townships serve other governmental units by providing tax collection services. To avoid imposing an unnecessary burden on citizens to pay separate property taxes to the township, schools, special assessment districts and the county, Michigan townships provide uniform assessment of property values and collect all property taxes on behalf of the other units of government. Only a very small portion of the taxes collected are retained by the township for its own operating purposes.

Michigan townships, large and small, provide services tailored to meet the needs of their residents. Township officials represent the level of government closest and most responsive to the wishes of the people.

County Government

Traditionally, counties performed state mandated duties which included assessment of property, record keeping (e.g., property and vital statistics), maintenance of rural roads, administration of election and judicial functions, and poor relief. Today, counties rapidly are moving into other areas, undertaking programs relating to child welfare, consumer protection, economic development, employment/training, planning and zoning, and water quality, to name just a few.

Service delivery responsibilities, however, vary widely among counties. For most, constructing/ maintaining local roads is one of their primary duties. Wide variations also exist in the social service responsibilities and the types of utility services (e.g., water supply) provided by county governments.

The mix of services is oftentimes designated by shared responsibilities with cities and municipalities versus unincorporated areas in the county. The county police - the Sheriff's Department - primarily handles calls only in the unincorporated areas, although all police units are expected to provide mutual aid when needed. Similarly, cities and towns handle their own planning, zoning and building permits; the county provides these services only in the unincorporated areas.

City Government

Most operate on an administrative hierarchy with the council-manager form of government, which is the most common form of municipal governance practiced in Michigan. The Mayor and City Council set policy and give direction to the City Manager, who, in turn, manages the city staff.

The Staff members of the city are divided into six departments: Police, Fire, Treasury, City Clerk, Public Works and Community Development. Each of these departments is supervised by a "Department Head", who is in charge of the day-to-day operation of each department. Some departments, such as the Public Works, employ dozens of people, while others have only a few.

Wild Ones-Natural Landscapers, Ltd

A non-profit organization with a mission to educate and share information with members and community at the 'plants-root' level and to promote biodiversity and environmentally sound practices. They are a diverse membership interested in natural landscaping using native species in developing plant communities.

National Wild Turkey Federation

The NWTF is a half million member grassroots, nonprofit organization with members in 50 states, Canada and 11 other foreign countries. It supports scientific wildlife management on public, private and corporate lands as well as wild turkey hunting as a traditional North American sport.

In 1973, the National Wild Turkey Federation was founded in Fredericksburg, Va. At that time, there were an estimated 1.3 million wild turkeys and 1.5 million turkey hunters. Shortly after its founding, the NWTF moved to Edgefield, S.C., where it is headquartered today.

Thanks to the work of federal, state and provincial wildlife agencies and the NWTF's many volunteers and partners, there are now over 6.4 million wild turkeys and approximately 2.6 million turkey hunters. Turkey hunting has become the fastest growing form of hunting and has the second-highest number of participants of any type of hunting.

Since 1985, more than $186 million NWTF and cooperator dollars have been spent on over 27,000 projects benefiting wild turkeys and other game and nongame species throughout North America. Hunters have also benefited as the NWTF has worked tirelessly to support our hunting heritage and protect and promote laws that increase hunting opportunity and safety.

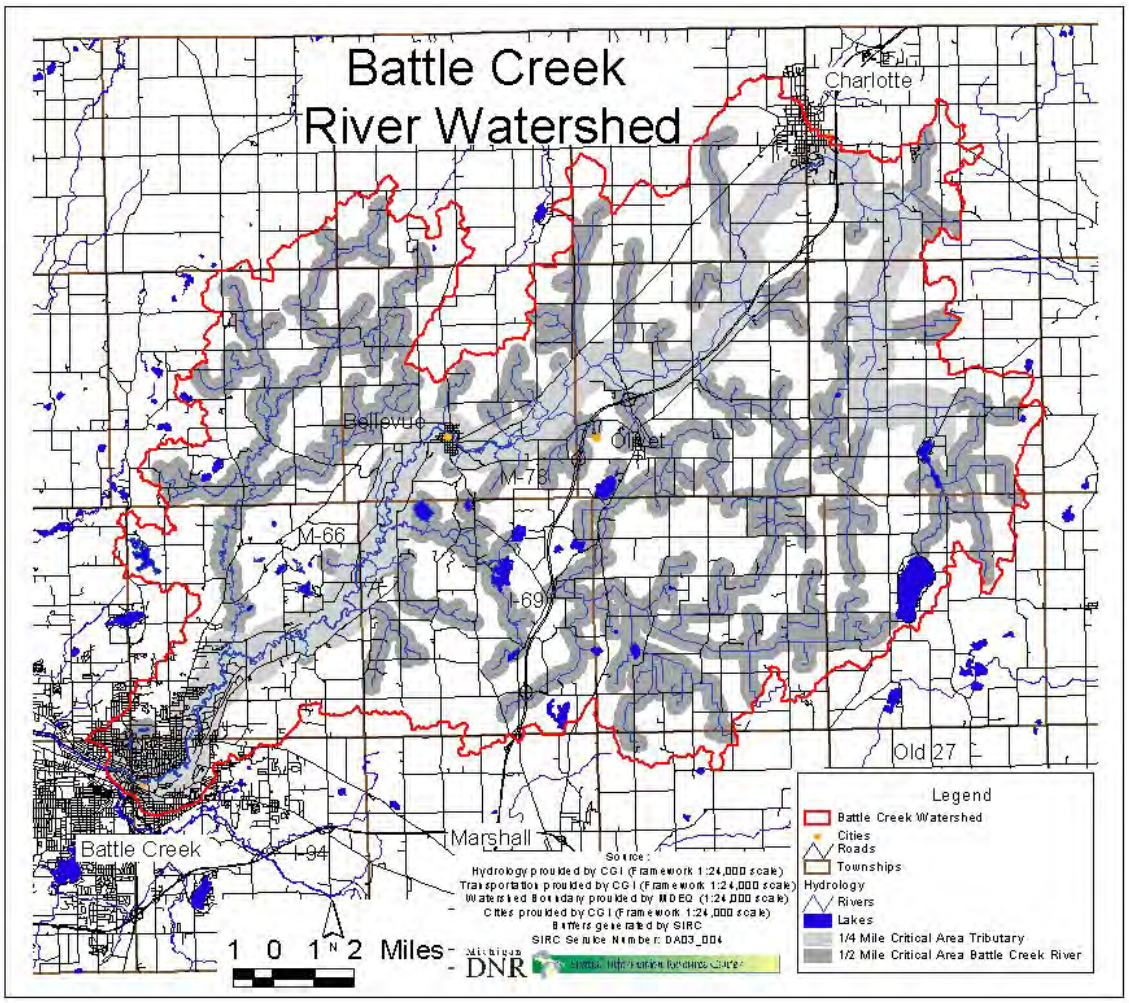
Data Collection and Inventory Methods

Many informational and data sources were used in collecting data on the Battle Creek River Watershed. Aerial photos, plat maps, soil survey maps and data, topographic maps, and watershed boundary maps were collected and organized into a three-ring binder by sub-watershed. Historical information was researched and gathered at community libraries and colleges. Historical and present drainage maintenance information was available through county drain commission offices. County Environmental Health Department's provided past and present environmental concerns and problems within the watershed. Various reports, surveys, and data collection were gathered from various agencies including the Michigan Department of Natural Resources, Michigan Department of Environmental Quality, U.S. Geological Survey, U.S. Department of Agriculture, Natural Resources Conservation Service, and the U.S. Army Corp of Engineers. These agencies and Steering Team participants also offered technical information and advice.

An inventory of the watershed was conducted in the summer and fall of 2002, and the spring of 2003. The inventory was a combination of road stream crossing surveys, canoeing and kayaking portions of the Battle Creek River and its tributaries, visual observation by car, and information provided by landowners within the watershed. The road stream crossing survey entailed an assessment of stream conditions where roads crossed over the Battle Creek River and its main tributaries. Binoculars were used to look upstream and downstream at each location. The road stream crossing survey procedure and completion of the single site watershed survey data sheet compiled by the Michigan Department of Environmental Quality was used. Pictures of downstream, upstream, and critical sites at road stream crossings were taken to accompany each single site survey sheet. This information was then arranged in a three-ring binder format by sub-watershed. The single site survey sheet contained analysis of stream background information, stream substrate, river morphology, physical appearance, in-stream cover, stream corridor, potential sources of non-point source pollution, and general comments of site conditions. These procedures were used to identify areas contributing potential non-point sources of pollution within the watershed.

Critical Areas

Critical areas in the watershed are defined as areas that are contributing the majority of the pollutants that are having considerable impacts on the Battle Creek River. A half mile corridor on each side of the main stream of the Battle Creek River and a quarter mile each side of the main tributaries of the Battle Creek River have been identified as areas where activities would have the most impact on surface water quality in the Battle Creek River Watershed. Issues that may impact water quality are stream bank erosion sites, livestock access to surface water, stormwater from urban areas, road stream crossings, agriculture land use, drainage ditch and tributary confluences, wetlands, forestlands, floodplain protection, and development pressure.

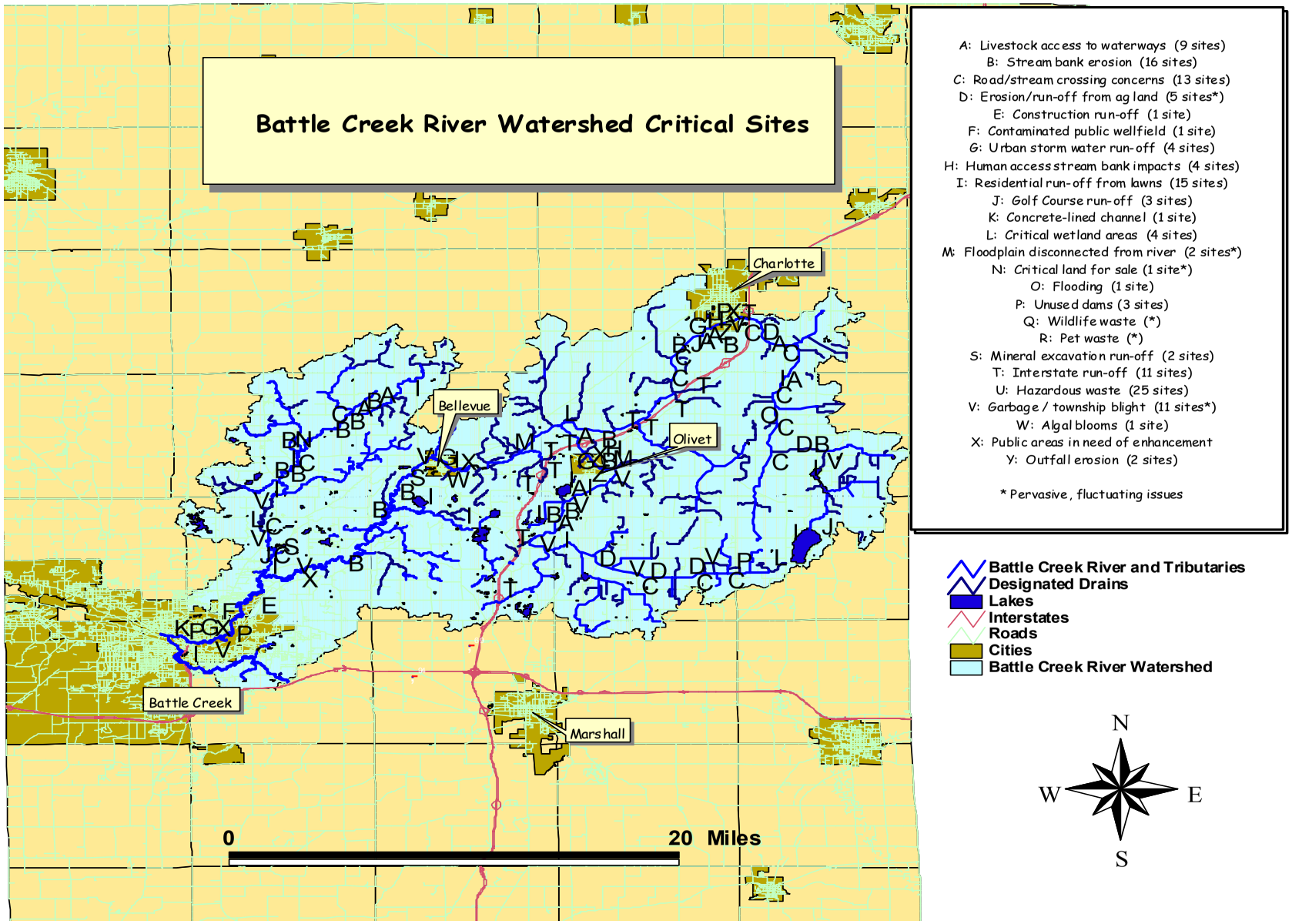


Inventory of Critical Areas

Critical Areas	Number of Sites

Unlimited livestock access to waterways	9
Stream bank erosion	16
Road stream crossing concerns -Culverts (size, placement, and construction) -Erosion from gravel roads -Road edge and ditch design -Bridge abutments	13
Erosion and run-off from agricultural lands -Sheet and rill erosion -Wind erosion	*
Construction run-off	1
Contaminated public wellfield	1
Urban area storm water run-off	4
Human access stream bank impacts	4
Residential run-off from lawns -Adjacent to stream banks -Adjacent to lakes	 9 6 lakes
Golf course run-off	3
Concrete lined channel	1
Critical wetland areas	4
River disconnected from floodplain	*
Critical areas with land for sale	*
Flooding	1
Unused dams	3
Wildlife waste	*
Pet waste	*
Mineral resource excavation run-off	2
Interstate run-off	11
Hazardous waste sites	25
Algal blooms	1
Public areas in need of enhancement	6
Outfall erosion sites	2
Solid Waste	11

* Generally known to be a source, but not quantified


Battle Creek River Watershed Critical Sites
Charlotte
Bellevue
Olivet
Battle Creek
Marshall
0
20 Miles
A: Livestock access to waterways (9 sites)
B: Stream bank erosion (16 sites)
C: Road/stream crossing concerns (13 sites)
D: Erosion/run-off from ag land (5 sites*)
E: Construction run-off (1 site)
F: Contaminated public wellfield (1 site)
G: Urban storm water run-off (4 sites)
H: Human access stream bank impacts (4 sites)
I: Residential run-off from lawns (15 sites)
J: Golf Course run-off (3 sites)
K: Concrete-lined channel (1 site)
L: Critical wetland areas (4 sites)
M: Floodplain disconnected from river (2 sites*)
N: Critical land for sale (1 site*)
O: Flooding (1 site)
P: Unused dams (3 sites)
Q: Wildlife waste (*)
R: Pet waste (*)
S: Mineral excavation run-off (2 sites)
T: Interstate run-off (11 sites)
U: Hazardous waste (25 sites)
V: Garbage / township blight (11 sites*)
W: Algal blooms (1 site)
X: Public areas in need of enhancement
Y: Outfall erosion (2 sites)
* Pervasive, fluctuating issues
Battle Creek River and Tributaries
Designated Drains
Lakes
Interstates
Roads
Cities
Battle Creek River Watershed
N
W
E
S

Water Quality Summary

The Battle Creek Watershed is a valuable natural resource to our community that provides recreational opportunities, wildlife habitat, drainage for agriculture use, open spaces, forestlands, and enhances our quality of life. Attitudes vary towards the river, and often many watershed residents do not know much about the river. Unfortunately, over time, water quality within the watershed has been degraded from non-point source pollution. Portions of the Battle Creek River and Wannadoga Creek have been included on the Michigan Department of Environmental Quality's non-attainment list (305d), where Water Quality Standards (WQS) are not being met. The Battle Creek River has been identified as one of the leading tributaries contributing sediment and phosphorus to the Kalamazoo River and is slated for its own TMDL in 2010. Ten miles upstream from the Kalamazoo River confluence in Calhoun County, the Battle Creek River is listed as containing polychlorinatedbiphenyls (PCB's) by the fish consumption advisory (FCA) on bass and carp. Wannadoga Creek at Baseline Road upstream 14 miles in Barry County has been rated as a poor macroinvertebrate community.

A Biological Survey for the Kalamazoo River and selected tributaries, conducted by the MDEQ in 1999, indicated poor macroinvertebrate scores in two sections of Wannadoga Creek and a section in the Battle Creek River. In Bellevue Township, Eaton County, section 7, the Wannadoga is described as impaired with a poor habitat and macroinvertebrate community. Unconsolidated silts and high nutrient concentrations of ortho/total phosphorus ratio, which has the possibility of negatively impacting the macroinvertebrate population, dominate this portion of the creek. An impaired macroinvertebrate population is also identified in section 14, Assyria Township in Barry County due to excessive amount of sand and silt sediment deposition on the streambed. The macroinvertebrates sampled at this location represented pollution tolerant species such as Amphipods and Chironomids. The Battle Creek River in Eaton County, Carmel Township section 35 is also documented as comprising a poor macroinvertebrate community. This was reported primarily due to the modified channel condition as a result of dredging and high concentrations of unconsolidated silts and sands.

All Michigan surface waters are protected by recognized uses that are established by state and federal water quality programs. All surface waters of the state of Michigan are designated for and shall be protected for all of the following uses (Natural Resource and Environmental Protection Act, 1994 PA 451, as amended).

- Agriculture
- Industrial water supply
- Public water supply at the point of intake
- Navigation

- Warmwater/Coldwater fishery
- Other indigenous aquatic life and wildlife
- Partial body contact recreation
- Total body contact recreation between May 1 and October 31

The designated uses relevant to the Battle Creek River are as follows:

- Agriculture (irrigation and livestock watering).
- Warmwater fishery
- Other indigenous aquatic life and wildlife
- Partial body contact recreation
- Total body contact recreation between May 1 and October 31
- Public Water Supply (ground water only)
- Industrial water supply
- Navigation

The designated use of Public Water Supply at the point of intake for surface water is not currently being utilized in the Battle Creek River Watershed.

Impaired Uses

Designated uses that have been identified as impaired by known and suspected sources of non-point source pollution for the Battle Creek River are as follows:

- Warmwater fishery
- Other indigenous aquatic life and wildlife
- Partial body contact recreation
- Total body contact recreation between May 1 and October 31

Threatened Uses

Threatened uses are defined as those uses that currently meet water quality standards, but may not in the future. Uses that have been identified as threatened from non-point source pollution for the Battle Creek River are the following:

- Groundwater public and private water supply
- Agriculture (irrigation and livestock watering)

Desired Uses

Desired uses for the Battle Creek River Watershed were established and deemed important by stakeholders in the watershed community. These uses include current and potential natural resource concerns.

- Establish a riverscaping program
- Improve fishing and canoeing access to the river
- Promote and establish more bird habitat
- Promote low impact development and increase the use of soil erosion best management practices
- Establish and increase bufferstrips along the stream corridor
- Market the Battle Creek River Watershed area for recreational opportunities
- Promote conservation easements, open space, and farmland protection through available programs
- Protect existing and increase greenway corridors
- Promote and educate the importance of long-term land use planning
- Promote the Battle Creek River Watershed as an option for research projects
- Create a river friendly farms program
- Promote United States Department of Agriculture's programs to landowners within the watershed area
- Stabilize and reconnect the Battle Creek River to its natural wetlands and floodplains
- Promote proper storm water management in urban and residential areas
- Promote the watershed as a learning resource for area schools
- Promote area land conservancies to protect open spaces
- Promote land uses consistent with groundwater protection, especially in Wellhead Protection Areas

Goals

Listed below are the goals for the Battle Creek River Watershed Project which are to restore and enhance the designated, threatened, and desired uses of the Battle Creek River by identifying and prioritizing the non-point sources of pollution that are negatively impairing the watershed system:

Impaired Uses	**Goals**
Warm Water Fishery	Restore and enhance the warm water fishery by reducing sediment, nutrients, salts, oil, grease, hydro-carbons, heavy metals, pesticides, and pathogens; and by restoring the natural flow hydrograph of the Battle Creek River.
Other Indigenous Aquatic Life and Wildlife	Restore and enhance other indigenous aquatic life and wildlife by reducing sediment, nutrients, salts, oil, grease, hydro-carbons, heavy metals, pesticides, and pathogens; and by restoring the natural flow hydrograph of the Battle Creek River.

Partial/Total Body Contact Recreation	Restore and enhance partial/total body contact recreation by reducing pathogens, nutrients, sediment, oil, grease, hydro-carbons, and heavy metals; and improving the natural flow hydrograph of the Battle Creek River.
Threatened Use	**Goal**
Ground Water Public (Wellhead Protection Areas) and Private Water Supply	Protect ground water public and private water supplies by reducing nitrates, oils, grease, hydro-carbons, heavy metals, and pathogens leaching into ground water recharge areas.
Agriculture	Protect the uses of irrigation and livestock watering by reducing pathogens, nutrients, oils, grease, hydro-carbons, heavy metals, and sediments; and by restoring the natural flow hydrograph of the Battle Creek River.
Desired Uses	**Goals**
Riverscape	Education for riparian landowners on how to design a proper landscape for water quality and wildlife using native and conservation oriented techniques.
Canoe Livery	Establish a canoe livery to get more people out to the BC River
Bird Habitat Promotion	Identify and establish critical bird habitat for wildlife pleasures and designate as a bird watching corridor.
Low Impact Development/Soil Erosion	Promote low impact development within the watershed and educate developers on soil erosion control measures. (Example project?)
Establish Bufferstrips along stream and drain corridors	Design or identify a program to help financially establish buffers.
Recreational/Marketing Program	Design a recreational program with map of tri-county area of watershed promoting activities within watershed (parks, bird sanctuary, public access, Ott Preserve, Linear path, etc.)
Greenway Corridor	Promote open space along the stream corridor by educating landowners and township governments on programs and options. Maintain and expand connected tributary corridors.
Long-term Landuse Planning	Promote long-term landuse planning that would include conservation easements, natural resource inventories,

	farmland preservation, tax reverted land along waterways, etc.)
Research Projects	Promote the BC River as a research project in watershed studies for students obtaining their Masters, and increase University participation.
River Friendly Farms	Design and create a program for farmers with an on-farm assessment and checklist that they need to be in compliance with in order to receive acknowledgement of their practices with a sign or plaque.
United States Department of Agriculture's Conservation Programs	Promote already established programs and initiate more participation within the watershed.
Stabilize and reconnect stream to natural wetlands	Monitor streambed mobility and streambank erosion to evaluate the possibility of reconnecting wetlands to stabilize natural flow and maintain appropriate drainage.
Storm Water Initiative	Education and promotion to rural and urban communities on managing their stormwater run-off by creating demonstration sites (rain gardens, roof run-off management, parking lot designs, low impact development, etc.).
Educational Resource	Promote BC River as a learning resource for schools within the watershed (Clean-ups, long-term volunteer stream monitoring programs, etc.)
Promote Southwest/Mid-Michigan Land Conservancies	Promote open space and the development of the Mid-Michigan Land Conservancy.

Overall Prioritization of Pollutants

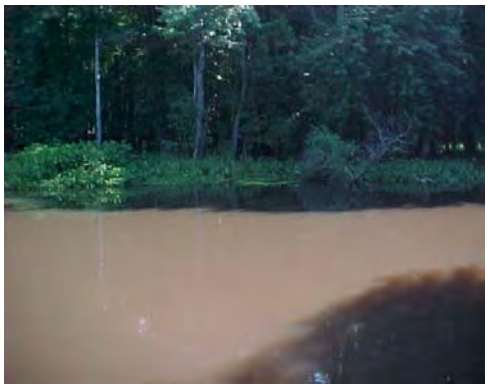
H-High M-Medium L-Low

Pollutants	Priority Ranking
Sediments	**H**
Nutrients	**H**
Hydrological Flow	**H**
Pathogens	**M**
Oils, Grease, Hydro Carbons, and Heavy Metals	**M**
Pesticides	**M**
Salts	**L**
Temperature	**L**
Solid Waste	**L**

Identified and Prioritized Pollution Sources

(S) suspected (K) known (H) high priority (M) medium priority (L) low priority

Sediment (H, K)



The Battle Creek River has been identified by the Michigan Department of Environmental Quality as one of the leading tributaries contributing sediment to the Kalamazoo River. Sediment is the carrier of most pollutants such as phosphorus and other nutrients, pesticides, pathogens, petroleum products, and other contaminants. Sediment reduces fisheries and aquatic wildlife habitat as it settles, covering substrate creating shallow water depths. It also causes elevated water temperatures due to increased turbidity resulting in heightened solar capturing by colloidal and organic sediments. Suspended sediment also limits the amount of sunlight that reaches aquatic plants and clogs the gills of fish.

Potential sources of sediment entering the Battle Creek River Watershed and its tributaries include the following:

- Road stream crossings
- Stream bank erosion
- Agriculture run-off
- Construction site run-off
- Impervious surfaces

- Historical drainage ditch maintenance
- Artificial impoundments
- Urban/Residential/Rural run-off
- Stream bed erosion

Reducing the amount of sediment entering the Battle Creek River and its tributaries will restore and enhance the following:

- Warmwater Fishery
- Indigenous Aquatic Life and Wildlife
- Recreation

Objectives to Reduce Sediment in the Battle Creek River Watershed:

- Improve bridge construction and design
- Improve gravel road maintenance
- Restrict and/or limit livestock access to stream and provide education, information, financial, and technical assistance on alternative watering sources and fencing techniques
- Establish bufferstrips along stream corridors
- Increase awareness through education on the importance of implementing soil erosion control measures and BMP's to developers, contractors, builders, and excavators
- Stabilize critically eroding stream banks
- Increase awareness and promote the use of conservation tillage and other conservation practices on cropland
- Measure stream stability at three locations within the watershed using the Rosgen Method
- Improve storm water management
- Increase awareness through education on the importance of managing storm water

Nutrients (H, K)

The Battle Creek River has been identified by the Michigan Department of Environmental Quality as one of the leading tributaries contributing phosphorus to the Kalamazoo River. When sources of nutrients exceed plant uptake, they can infiltrate into the ground or run-off into surface water. In surface water, nutrients can increase aquatic plant growth, such as algae blooms, which reduces swimming and boating opportunities, creates unpleasant odor and taste in drinking water, decreases the overall diversity of the fish community by reducing sensitive fish species and increasing the abundance of nutrient-tolerant species, and can cause fish kills by eradicating the dissolved oxygen during plant decay.

Nitrogen is also a common groundwater contaminant that can adversely impact young children and the elderly's health when ground water is a source of drinking water.

Potential sources of nutrients entering the Battle Creek River and its tributaries include the following:

- Agriculture run-off and the infiltration of nitrogen (N)
- Urban/residential/rural run-off and infiltration of nitrogen (N)
- Inadequate domestic septic systems
- Livestock access to water courses
- Stream bank erosion
- Wildlife and waterfowl waste
- Run-off from golf courses and the infiltration of nitrogen (N)

Reducing the amount of nutrients entering the Battle Creek River and its tributaries will restore and enhance the following:

- Warmwater Fishery
- Indigenous Aquatic Life and Wildlife
- Public and Private Ground Water Supply
- Recreation

Objectives to Reduce Nutrients in the Battle Creek River Watershed:

- Educate and inform agriculture and residential individuals on proper fertilizer use
- Establish bufferstrips along the stream and drain corridors within the watershed
- Increase awareness, education, and use of conservation tillage and other conservation practices on cropland
- Educate the public on the importance of proper septic system maintenance, illicit discharge, and site design
- Promote Best Management Practices at golf courses through the Turf Grass Stewardship Program
- Restrict and/or limit livestock access to stream and provide education and information on alternative watering sources and fencing techniques
- Educate and inform the farm community on the importance of manure management
- Measure stream stability at three locations within the watershed using the Rosgen Method
- Improve storm water management

Hydrologic Flow (H, K)

Analysis of USGS gauge data indicates that the Battle Creek River is the flashiest gauged tributary in the Kalamazoo River basin. Rivers having flow hydrographs that are flashy in nature (meaning the flow hydrograph rises and falls rapidly) typically are indicative of watersheds that have less permeable soils or have been significantly impacted by subsurface drainage, channelization of tributaries and rivers and/or land

use changes. Wesley (2003) noted in his analysis of USGS gauge data on the Battle Creek River that the flow hydrograph is more stable near the City of Battle Creek than compared to that at Bellevue or Charlotte. Differences in the flow hydrograph among sites is not surprising since the upper Battle Creek River has been extensively channelized, which may increase flashiness of seasonal flows. Wesley determined that standardized 95% excedence flows were 17% higher at the City of Battle Creek compared to the Battle Creek River at Charlotte and Bellevue suggesting that this lends support that the difference between the two areas is due to channelization and not entirely to groundwater yield.

Analysis of the flow hydrograph suggests that the Battle Creek River has as a history of instability due to the upper portions of the river system in Eaton County being channelized. The Eaton County portion of the Battle Creek River is designated as a legal county drain and was dredged from upstream of the Bellevue dam to Narrow Lake. Spoils from the dredging, deepening, and widening of the river have been placed along the stream banks. The creation of the spoil berms and the drop in elevation of the river bed has largely resulted in loss of an active floodplain.

Urban areas containing large amounts of impervious surface within the watershed also increase peak flows, reduce base flows and increase flashiness of the flow hydrograph. Land surface that is covered by buildings, driveways, parking lots, sidewalks, and streets do not allow rain and snowmelt to naturally soak into the ground. Further, urban areas use storm drains to carry run-off, called storm water, from pavement and rooftops to the nearest waterway at a much faster rate.

It is believed these land use changes have increased stream bank instability and erosion, increased sediment input, caused degradation and aggradation of the stream bed, caused loss of riparian habitat and vegetation protection on streambanks, reduced floodplain storage, decreased baseline flows during late summer and increased peak flows resulting from rain and snowmelt events. These changes impact stream stability ultimately impacting fisheries, aquatic wildlife habitat, drainage of agriculture and urban areas, and increased cost to maintain drain function. All stakeholders must work together to maintain and improve water quality, fish and wildlife habitat and provide necessary drainage.

Potential sources impacting the hydrologic flow of the Battle Creek River and its tributaries include the following:

- No connection of river to historic floodplain at some locations
- Historical and current drainage practices
- Impervious surfaces (parking lots, roofs, roads, driveways, etc.)
- Removal of riparian corridor
- Floodplain development
- Wetland drainage
- Artificial Impoundments
- Stream channelization
- Storm water run-off/storm water management policies

Restoration and maintenance of the Natural Flow Hydrograph in the Battle Creek River Watershed and its tributaries will improve and enhance the following:

- Warmwater Fishery
- Indigenous Aquatic Life and Wildlife
- Recreation

Objectives to Restore the Natural Flow Hydrograph in the Battle Creek River Watershed:

- Create or restore connection of the river to floodplain
- Conduct geomorphic assessment of river at a minimum three locations within the watershed to measure stream stability and evolutionary sequence using the Rosgen Method
- Improve storm water management in municipalities and urbanized areas within the watershed
- Educate municipalities, developers, contractors, road commissions, planning commissions, township and county government on site designs that use innovative best management practices to deal with storm water run-off (low-impact development, green roofs, porous pavement, rain gardens, rain barrels, etc.)
- Promote land use planning that considers protection, enhancement, and creation of wetlands, riparian corridors, open spaces, and floodplains
- Disconnect roof drainage systems from storm drains in residential areas

Pathogens (M, S)

Pathogens are living, microscopic, disease-causing organisms that include harmful bacteria, viruses, fungi, parasites, and protozoa. Humans may be at risk from pathogens through skin contact and ingestion of contaminated waters or by eating fish from polluted sources.

Symptoms include dehydration, fever, vomiting, and other gastrointestinal ailments. Pathogens may also place fisheries at risk due to contamination of fish and shellfish. Further, wildlife may also be at risk for disease from exposure to pathogens. Many sources can contribute disease-causing pathogens depending on storm events, flooding and droughts.

Potential sources of pathogens include the following:

- Sanitary sewer overflows
- Livestock manure
- Run-off from livestock pastures
- Feedlots
- Wildlife and waterfowl waste
- Livestock manure application
- Inadequate domestic septic systems
- Improper dead animal disposal
- Pet waste

Reducing the pathogen levels within the Battle Creek River and its tributaries will improve and enhance the following:

- Warmwater Fishery
- Indigenous Aquatic Life and Wildlife
- Partial and Total Body Contact Recreation

Objectives to reduce pathogens in the Battle Creek River Watershed:

- Educate the public on the importance of proper septic system maintenance, illicit discharge, and site design
- Restrict and/or limit livestock access to stream and provide education and information on alternative watering sources and fencing techniques
- Establish bufferstrips along the stream and drain corridors within the watershed especially near and along livestock pastures and feedlots
- Educate and inform livestock producers on the importance of manure management
- Promote research on wildlife waste and its possible threat to surface water contamination in the Battle Creek River Watershed to local universities and colleges
- Promote the importance of proper pet waste management

Oils, Grease, Hydro-Carbons, and Heavy Metals (M, S)

Oils, grease, hydro-carbons, and heavy metals are both man-made and naturally occurring in the environment. These pollutants can accumulate in tissues of plants, macroinvertebrates, and fish. When these pollutants are digested they may create substances that are carcinogenic and toxic to aquatic life. Portions may adhere to

organic matter and accumulate in bottom sediments, may affect biological functions, and reduce water quality. It only takes one pint of oil to cause an oil slick one-acre in size!

Potential sources of oils, grease, hydro-carbons, and heavy metals include the following:

- Discharges from storm drains
- Discharges from road stream crossings
- Discharges from road ditches and edges
- Discharges from impervious surfaces (parking lots, roads, driveways, etc.)
- Leaking fuel tanks
- Run-off from gas stations
- Improper disposal
- Discharges from railroad track stream crossings
- Industry
- Commercial operations

Reduction in the amount of oils, grease, hydro-carbons, and heavy metals entering the Battle Creek River and its tributaries, will improve and enhance the following:

- Warm water Fishery
- Indigenous Aquatic Life and Wildlife
- Recreation

Objectives to reduce oils, grease, hydro-carbons, and heavy metals in the Battle Creek River Watershed:

- Improve bridge construction and design
- Educate and inform the public on proper car maintenance
- Educate and inform the public on proper disposal
- Promote Best Management Practices at gas stations and truck stops
- Educate municipalities, developers, contractors, road commissions, planning commissions, and township and county government on site designs that use innovative best management practices to deal with storm water run-off (low-impact development, green roofs, porous pavement, rain gardens, rain barrels, natural swales, detention ponds, etc.)
- Promote Best Management Practices (BMP's) on farms
- Educate industrial and commercial operations on proper management

Pesticides (M, S)

A pesticide is defined as any chemical or biological agent that controls pests such as plants, animals, fungi, insects, and mites. Pesticides include herbicides, insecticides, fungicides, rodenticides, nematocides, and miticides. They are applied by different means varying from specific site application to covering very large areas. Storage, mixing, rinsing, application, and disposal associated with pesticides increase the risk of environmental pollution.

A pesticide risk to the environment is determined by several factors including the pesticide's individual properties, any number of site-specific characteristics relating to run-off and infiltration rates, evaporation, temperature, wind, rain, and storm events. Exposure to pesticides poses potential health risks to humans, plants, and animals. In surface water, pesticides may kill aquatic organisms that are not targets, negatively impact reproduction, growth, respiration, and development in aquatic organisms; accumulate in tissues of plants, macroinvertebrates, and fish; create health hazards for humans consuming contaminated fish or other aquatic organisms; degrade drinking water quality; and reduce recreational and commercial activities.

Potential sources of pesticides include the following:

- Residential run-off
- Urban run-off
- Golf course run-off
- Agriculture run-off
- Improper disposal

Reducing the amount of pesticides entering the Battle Creek River and its tributaries, will improve and enhance the following:

- Warm water Fishery
- Indigenous Aquatic Life and Wildlife
- Recreation

Objectives to reduce pesticides in the Battle Creek River Watershed:

- Establish buffer strips along stream corridors, drains, and cropland
- Educate and inform agriculture and residential individuals on proper pesticide use
- Promote Integrated Pest Management practices in agriculture and residential areas
- Increase awareness through education, and the use of conservation tillage and other conservation practices on cropland
- Promote improved irrigation efficiency
- Promote the Michigan Groundwater Stewardship Program's Farm*A*Syst evaluation

- Promote United States Department of Agriculture's Conservation Program participation
- Promote Household Hazardous Waste Pick-up Days and Clean Sweep
- Promote the Environmental Turf Grass Stewardship Program

Salts (L, S)

Salt is one of the earth's most common compounds. Salts are also used in pesticides, fertilizers, found in manure and waste, and used to combat ice and snow accumulations during Michigan winters. Excess salinity in surface waters can eliminate salt intolerant species and decrease diversity, can fluctuate in concentration negatively impacting both tolerant and intolerant species, impact stream habitats and plants which are food sources for macroinvertebrates, reduce soil infiltration, reduce crop yields, reduce quality of drinking water and reduce recreation values through high salinity levels and high evaporation rates.

Potential sources of salt include the following:

- Run-off from impervious surfaces (parking lots, roads, driveways, etc.)
- Agriculture run-off
- Road ditches and edges
- Road stream crossings
- Improper application
- Combined sewer overflows

Reducing the amount of salts entering the Battle Creek River and its tributaries, will improve and enhance the following uses:

- Warm Water Fishery
- Indigenous Aquatic Life and Wildlife
- Public and Private Ground Water Supply
- Recreation

Objectives to reduce salts in the Battle Creek River Watershed:

- Educate municipalities, developers, contractors, road commissions, planning commissions, and township and county government on site designs that use innovative best management practices to address storm water run-off (low-impact development, green roofs, porous pavement, rain gardens, rain barrels, natural swales, detention ponds, etc.)
- Promote proper application and storage to road commissions, public works departments, utility departments, and Michigan Department of Transportation
- Promote improved bridge construction and design

- Promote improved road and ditch design
- Promote deicing alternatives for roads, sidewalks, and parking lots

Temperature (L, S)

A stream's temperature is an important characteristic that can determine aquatic diversity. Fish, insects, zooplankton, phytoplankton, and other aquatic species all have a preferred temperature range. Temperature is also important because it influences water chemistry. For example, warm water holds less oxygen than cool water. Storm water run-off can also impact a stream's temperature. Run-off from roofs, roads, and parking lots is generally warmer as it flows on concrete and asphalt. Lack of vegetation along the stream corridor with an increase in sedimentation can have an impact on temperature through solar gain. The velocity of a stream may also influence water temperature. A particle of water in a fast-flowing stream has less exposure to sunlight than a slow-flowing stream therefore, has less opportunity to warm.

Potential sources of thermal pollution include the following:

- Run-off from roofs, roads, and parking lots
- Artificial impoundments
- Loss of stream canopy
- Wetland depletion
- Floodplain manipulation
- Treated Wastewater

Maintaining temperatures in the Battle Creek River and its tributaries will improve and enhance the following uses:

- Warm Water Fishery
- Indigenous Aquatic Life and Wildlife

Objectives to maintain water temperatures in the Battle Creek River and its tributaries:

- Promote land use planning that consider protection, enhancement, and creation of wetlands, riparian corridors, open spaces, and floodplains
- Educate municipalities, developers, contractors, road commissions, planning commissions, and township and county government on site designs that use innovative best management practices to deal with storm water run-off (low-impact development, green roofs, porous pavement, rain gardens, rain barrels, natural swales, detention ponds, etc.)
- Improved storm water management

Solid Waste (L, K)

Trash, litter, and solid waste within the Battle Creek River Watershed impact the recreational value and utilization of this natural resource. When items such as barrels, stoves, tires, bottles, shopping carts, plastic wrappers, and empty bottles and cans are noticeable throughout a canoe or fishing trip down the Battle Creek River, it degrades the overall aesthetic quality. Trash can also negatively impact wildlife habitat and safety.

Potential sources of solid waste include the following:

- Humans

Reducing the amount of solid waste entering the Battle Creek River and its tributaries, will improve and enhance the following uses:

- Recreation

Objectives to reduce solid waste in the Battle Creek River Watershed:

- Create awareness for a clean and aesthetically pleasing environment
- Discourage littering and illegal dumping
- Promote river clean-ups and beautification projects throughout the watershed
- Promote recycling and supporting county programs

Sources and Causes of Pollutants and Prescribed BMP's

As a result of the inventory conducted throughout the Battle Creek River Watershed, the pollutants, sources, and causes of the non-point source pollution were identified. Through review and discussion of inventory findings and various agency reports during meetings, the Steering Team and Advisory Committee prioritized the sources and causes of each pollutant that were contributing to the reduction of water quality within the Battle Creek River Watershed. By classifying the sources and causes for each pollutant, the Steering Team and Advisory Committee through discussion was then able to prioritize the proper solution or Best Management Practice (BMP) to control the ability for a pollutant to reach water resources. In the following charts, the sources and causes of each pollutant are prioritized and if those sources and causes are known or suspected derived by consensus of both the Steering Team and Advisory Committee.

Overall BMP's to Reduce Non-Point Source Pollution by Source

Best Management Practices (BMP's) are defined as structural, vegetative and managerial practices implemented to control non-point source pollution. BMP's are used to treat a variety of critical sites and can be a combination of structural, vegetative, and managerial methods. Identifying the pollutant and the problem is the best way to assess what BMP would maximize the reduction of a pollutant reaching water resources.

The following BMP's are an overall list that could be used in reducing non-point source pollution. The Steering Team Committee prioritized and categorized specific BMP's that would have the greatest amount of effectiveness to reduce non-point source pollution in the Battle Creek River Watershed in the BMP Cost Analysis and Timeline.

Prioritization of Sources, Causes, and Tasks/BMP to Reduce Sediment

High-H Medium-M Low-L

(s)-suspected (k)-known

Sources, Causes, and Tasks/BMP to Reduce Sediment				
Sources		**Causes**		**Tasks/BMP's**
Road Stream Crossings (k)	**H**	Bridge Construction and Design (k) Gravel Road Maintenance (k) Culvert placement (k)	**H** **H** **H**	☐ Stabilize critically eroding stream banks ☐ Improve road edge and ditch design ☐ Improve bridge design (curbing, pavement, redirect run-off) ☐ Improve gravel road maintenance ☐ Improve culvert structure and design
Critical Stream Bank Erosion (k)	**H**	Stream Instability/Flow fluctuations (k) Stream Channelization (k) Culvert placement (k) Livestock Access (k) Human Access (k)	**H** **H** **H** **M** **M**	☐ Continue geomorphic assessment using the Rosgen Method ☐ Identify reasons for stream bank instability, and proper stabilization techniques using natural channel design ☐ Improve culvert structure and design ☐ Livestock exclusion using alternative watering sources, fencing techniques, and stream crossings ☐ Construct stairs, docks, and ramps to provide recreational access
Agriculture Run-off (k)	**H**	Lack of Bufferstrips Along Stream Corridor (k) Lack of Conservation Tillage and Other Practices (k) Improperly Installed and/or Designed Drainage (s)	**H** **H** **L**	☐ Irrigation scheduling ☐ Buffer strips/Filter strips ☐ Tile inlet filter areas ☐ Grassed waterways ☐ Protection and enhancement of riparian corridor ☐ Residue management (no-till, mulch till) ☐ Cover crops ☐ Promotion of conservation programs*

Sources		Causes		Tasks/BMP's
Construction (k)	H	Lack of Soil Erosion Control Measures (k)	H	☐ Strengthen County Soil Erosion Control Enforcement Program ☐ Hold soil erosion control workshop for developers, builders, and contractors ☐ Promote pre-construction site planning ☐ Require soil erosion control practices on construction sites
Urban Storm Water Run-off (k)	H	Impervious Surfaces (streets, sidewalks, parking lots, and roofs) (k) Outdated and/or Improperly Designed Systems (s)	H M	☐ Rain Gardens ☐ Green roofs ☐ Outfall stabilization ☐ Downspout management ☐ Wetland/Floodplain restoration and/or protection ☐ Improved parking lot and street design including infiltration BMP's ☐ Grassed waterways ☐ Hold storm water management workshops for homeowners, business owners, and municipality employees ☐ Support a storm water management ordinance ☐ Incorporate land use planning tools ☐ Promote low-impact development ☐ Porous pavement ☐ Rain barrels ☐ Promote voluntary implementation of Phase II requirements ☐ Develop criteria and implement site plan reviews

Sources		Causes		Tasks/BMP's
Drainage Ditch Management Practices Public Drains-BMP's Private Drains	 **M** **H**	Lack of Soils Spread Out and Seeded (k) Destruction of Stream Bank Vegetation (k) Improperly Installed Drainage (s)	**H** **H** **M**	☐ Promote innovative drainage ditch maintenance practices ☐ Conduct geomorphic assessment using the Rosgen Method ☐ Restore a portion of the main stream channel using the Rosgen Method as a demonstration site ☐ Consider long-term restoration utilizing natural channel design ☐ Hold a workshop/tour
Artificial Impoundments (k)	**H**	Accumulation of Sediment Upstream (k) Bank or Bed Erosion Upstream Due to Change in Grade (s)	**H** **M**	❑ Remove dams that are no longer safe or serve a purpose
Residential/Rural Run-off (s)	**M**	Lack of Bufferstrips Along Stream Corridor (k)	**H** **H**	☐ Buffer strips ☐ Protection and enhancement of the riparian corridor
Stream Bed Aggradation (k)	**H**	Stream Instability (k)	**H**	☐ Continue geomorphic assessment using the Rosgen Method ☐ Identify reasons for stream bed aggradation, and proper stabilization techniques using natural channel design

Prioritization of Sources, Causes, and Tasks/BMP to Reduce Nutrients

High-H Medium-M Low-L

(s)-suspected (k)-known

Sources, Causes, and Tasks/BMP to Reduce Nutrients				
Sources		**Causes**		**Tasks/BMP's**
Agriculture Run-off (k)	**H**	Lack of Bufferstrips Along Stream Corridor (k)	**H**	☐ Irrigation scheduling
		Improper Fertilizer Application (s)	**H**	☐ Buffer strips/Filter strips
		Improper Manure Management Practices (s)	**H**	☐ Tile inlet filter areas
		Improper Fertilizer Storage (k)	**M**	☐ Grassed waterways
		Improper Fertilizer Disposal (s)	**H**	☐ Protection and enhancement of riparian corridor
		Lack of Conservation Tillage and Other Practices (k)	**H**	☐ Residue management (no-till, mulch till)
		Improperly Installed and/or Designed Drainage (s)	**L**	☐ Cover crops
				☐ Soil testing
				☐ Nutrient management
				☐ Agri-chemical containment facilities
				☐ In-field mix/load systems
				☐ Manure management (CNMP)
				☐ Improve waste treatment
				☐ Livestock exclusion
				☐ Waste storage facilities
				☐ Roof water run-off management
				☐ Promotion of conservation programs

Sources		Causes		Tasks/BMP's
Residential/Rural Run-off (s)	**M**	Lack of Bufferstrips Along Stream Corridor and Lakeshores (k) Improper Fertilizer Application (s) Lack of Storm Water BMP's (s) Improper Fertilizer Storage (s) Improper Fertilizer Disposal (s)	**H** **H** **H** **M** **M**	□ Buffer strips □ Protection and enhancement of the riparian corridor □ Soil testing (Super Soils Saturday) □ Proper lawn care techniques □ Education and information through workshops, brochures, demonstration sites, and newsletters □ Promotion of conservation programs
Septic Systems (s)	**H**	Improperly Sited, Designed and/or Maintained (s) Illicit Discharge (k)	**H** **H**	□ Promote proper septic system maintenance □ Provide information and education through workshops, newsletters, brochures, and demonstration sites □ Hook-up to municipal sanitary sewer systems □ Encourage alternatives to on-site systems
Urban Storm Water Run-off (s)	**H**	Impervious Surfaces (streets, sidewalks, parking lots, and roofs) (k) Outdated and/or Improperly Designed Systems (s)	**H** **M**	□ Rain Gardens □ Green roofs □ Outfall stabilization □ Downspout management □ Wetland/Floodplain restoration and/or protection □ Improved parking lot and street design including infiltration BMP's □ Grassed waterways □ Hold storm water management workshops for homeowners, business owners, and municipality employees

Urban Storm Water Run-off (s) Cont.				□ Support a storm water management ordinance □ Incorporate land use planning tools for local units of government □ Promote low-impact development □ Porous pavement □ Rain barrels □ Promote voluntary implementation of Phase II requirements □ Develop criteria and implement site plan reviews
Livestock in Stream (k)	**M**	Unrestricted Access (k)	**M**	□ Livestock exclusion using alternative watering sources, fencing techniques, and stream crossings
Stream Bank Erosion (k)	**M**	Stream Instability/Flow Fluctuations (k) Culvert Placement (k) Livestock Access (k) Human Access (k)	**H** **H** **M** **L**	□ Continue geomorphic assessment using the Rosgen Method □ Identify reasons for stream bank instability, and proper stabilization techniques using natural channel design □ Improve culvert structure and design □ Promote alternative watering sources, fencing techniques, and stream crossings □ Construct stairs, docks, and ramps to provide recreational access
Pet/Wildlife Waste (s)	**L**	Lack of Best Management Practices (s)	**L**	□ Provide disposal containers in highly utilized public areas □ Provide educational signage □ Promote buffer strips/filter strips
Golf Course Run-off (s)	**L**	Lack of Best Management Practices (s)	**L**	□ Buffer strips/Filter strips □ Protection and enhancement of the riparian corridor

Golf Course Run-off (s) Cont.				☐ Promote the Michigan Turfgrass Environmental Stewardship Program ☐ Nutrient management ☐ Irrigation scheduling

Prioritization of Sources, Causes, and Tasks/BMP to Improve Hydrologic Flow

High-H Medium-M Low-L

(s)-suspected (k)-known

Sources, Causes, and Tasks/BMP to Improve Hydrologic Flow				
Sources		**Causes**		**Tasks/BMP's**
No Connection of River to the Historic Floodplain (k)	**H**	Concrete Channels and Streambanks (k) Soil Berms and Terraces (k) Developed Floodplains (k) Poor Land Use Planning (k)	**H** **H** **H** **H**	☐ Conduct geomorphic assessment using the Rosgen Method ☐ Restore a portion of the main stream channel to the floodplain using the Rosgen Method as a demonstration site ☐ Consider long-term restoration utilizing natural channel design ☐ Hold a workshop/tour ☐ Protect and restore the floodplain ☐ Promote the designation of a portion of the Battle Creek River as a Natural Scenic River ☐ Incorporate land use planning tools for local units of government
Urban Storm Water Run-off (s)	**H**	Impervious Surfaces (streets, sidewalks, parking lots, and roofs) (s) Lack of Storm Water BMP's (s)	**H** **H**	☐ Implement storm water management policies and drain management to maintain consistent flows ☐ Rain Gardens ☐ Green roofs ☐ Downspout management ☐ Wetland/Floodplain restoration and/or protection ☐ Improved parking lot and street design including infiltration BMP's ☐ Grassed waterways ☐ Hold storm water management workshops for homeowners, business owners, and municipality employees

Urban Storm Water Run-off (s) Cont.				☐ Support a storm water management ordinance ☐ Incorporate land use planning tools ☐ Promote low-impact development ☐ Porous pavement ☐ Rain barrels ☐ Natural swales ☐ Detention ponds ☐ Promote voluntary implementation of Phase II requirements ☐ Develop criteria and implement site plan reviews
Stream Channelization (s)	**H**	Improperly Installed, Managed and/or Designed Drains (s)	**H**	☐ Promote innovative drainage ditch maintenance practices ☐ Conduct geomorphic assessment using the Rosgen Method ☐ Restore a portion of the main stream channel using the Rosgen Method as a demonstration site ☐ Consider long-term restoration utilizing natural channel design ☐ Hold a workshop/tour
Wetland Drainage (s)	**M**	Wetland Conversion (k) Poor Land Use Planning (k)	**H** **H**	☐ Protect and restore wetlands within the watershed ☐ Incorporate land use planning tools ☐ Promote wetlands ordinance
Artificial Impoundments	**M**	Outdated, Unused, Improperly Installed Dams (k)	**M**	☐ Remove dams that are no longer safe or serve a purpose
Natural Obstructions (k)	**L**	Storms/Flooding (k)	**L**	☐ Maintain culverts ☐ Maintain wood debris blockages

Prioritization of Sources, Causes, and Tasks/BMP to Reduce Pathogens

High-H Medium-M Low-L

(s)-suspected (k)-known

Sources, Causes, and Tasks/BMP to Reduce Pathogens				
Sources		**Causes**		**Tasks/BMP's**
Septic Systems	**H**	Improperly Sited, Designed and/or Maintained (s) Illicit Discharge (k)	**H** **H**	☐ Promote proper septic system maintenance ☐ Provide information and education through workshops, newsletters, brochures, and demonstration sites ☐ Hook-up to municipal sanitary sewer systems ☐ Encourage alternatives to on-site systems
Livestock Manure (s)	**M**	Unrestricted Access (k) Run-off from fields, yards, and pastures (s)	**M** **M**	☐ Livestock exclusion using alternative watering sources, fencing techniques, and stream crossings ☐ Buffer strips/filter strips adjacent to pastures and feedlots ☐ Rotational grazing ☐ Manure management (CNMP) ☐ Waste storage facilities ☐ Roof water run-off management ☐ Promotion of conservation programs* ☐ Waste treatment
Pet/Wildlife Waste (s)	**M**	Lack of BMP's (s)	**M**	☐ Provide disposal containers in highly utilized public areas ☐ Provide educational signage ☐ Promote buffer strips/filter strips
Sanitary Sewer Overflows (s)	**L**	Flooding (s)	**L**	☐ Tighten operation and maintenance system

Prioritization of Sources, Causes, and Tasks/BMP to Reduce Oils, Grease, Hydro-carbons, and Heavy Metals

High-H Medium-M Low-L

(s)-suspected (k)-known

Sources, Causes, and Tasks/BMP to Reduce Oils, Grease, Hydro-carbons, and Heavy Metals				
Sources		**Causes**		**Tasks/BMP's**
Urban Storm Water Run-off (k)	**H**	Impervious Surfaces (streets, sidewalks, parking lots, and roofs) (k)	**H**	☐ Rain Gardens ☐ Green roofs
		Outdated and/or Improperly Designed Systems (s)	**H**	☐ Downspout management
		Lack of Storm Water BMP's (s)	**H**	☐ Wetland/Floodplain restoration and/or protection ☐ Improved parking lot and street design including infiltration BMP's ☐ Grassed waterways ☐ Hold storm water management workshops for homeowners, business owners, and municipality employees ☐ Support a storm water management ordinance ☐ Incorporate land use planning tools ☐ Promote low-impact development ☐ Porous pavement ☐ Rain barrels ☐ Develop criteria and implement site plan reviews ☐ Natural swales ☐ Detention ponds ☐ Education and information to the public on proper car maintenance and disposal ☐ Promote voluntary implementation of Phase II requirements ☐ Develop criteria and implement site plan reviews

Sources		Causes		Tasks/BMP's
Road Stream Crossings (k)	**H**	Bridge Construction and Design (k) Impervious Surfaces (k)	**H** **M**	□ Improve road edge and ditch design □ Promote improved bridge design (curbing, pavement-chip and seal, redirect run-off) □ Improve gravel road maintenance
Gas Stations, Truck Stops, On-site Farm Storage, and Repair Shops (s)	**M**	Leaking Fuel Tanks (s) Floor Drain Connections (s) Lack of BMP's (s) Improper Disposal (s)	**M** **M** **M** **M**	□ Fuel containment facilities □ Disconnection of illicit floor drains □ Proper removal of leaking fuel tanks □ Promote proper fuel spill management techniques

Prioritization of Sources, Causes, and Tasks/BMP to Reduce Pesticides

High-H Medium-M Low-L

(s)-suspected (k)-known

Sources, Causes, and Tasks/BMP to Reduce Pesticides				
Sources		**Causes**		**Tasks/BMP's**
Agriculture Run-off (k)	**H**	Lack of Bufferstrips Along Stream Corridor (k) Improper Pesticide Application (s) Improper Pesticide Storage (k) Improper Pesticide Disposal (s) Lack of Conservation Tillage and Other Practices (k) Improperly Installed, Designed, and/or Maintained Artificial Drainage (s)	**H** **M** **M** **M** **M** **L**	❑ Pesticide management ❑ Buffer strips ❑ Agri-chemical containment facilities ❑ Integrated pest management ❑ In-field mix/load systems ❑ Sprayer calibration ❑ Spill kits ❑ Pesticide storage facilities ❑ Clean Sweep pesticide disposal ❑ Pesticide container recycling ❑ Just-in-time delivery ❑ Residue management (no-till, mulch till) ☐ Irrigation scheduling
Rural/Residential Run-off (s)	**M**	Lack of Bufferstrips Along Stream Corridor, Lakeshores, and Other BMP's (k) Improper Pesticide Application (s) Improper Pesticide Storage (s) Improper Pesticide Disposal (s)	**H** **H** **H** **M** **M**	☐ Buffer strips/filter strips ☐ Protection and enhancement of the riparian corridor ☐ Integrated Pest Management ☐ Proper lawn care techniques ☐ Clean Sweep pesticide disposal ☐ Proper storage ☐ Education and information through workshops, brochures, demonstration sites, and newsletters ☐ Promotion of conservation programs*

Sources		Causes		Tasks/BMP's
Urban Storm Water Run-off (s)	**M**	Impervious Surfaces (s) Outdated and/or Improperly Designed Systems (s)	**H** **M**	☐ Buffer strips/filter strips ☐ Protection and enhancement of the riparian corridor ☐ Integrated Pest Management ☐ Proper lawn care techniques ☐ Clean Sweep pesticide disposal ☐ Proper storage ☐ Education and information through workshops, brochures, demonstration sites, and newsletters ☐ Promote voluntary implementation of Phase II requirements ☐ Develop criteria and implement site plan reviews
Golf Courses (s)	**M**	Lack of Bufferstrips Along Stream Corridor, Lakeshores, and Other BMP's (s) Improper Pesticide Application (s) Improper Pesticide Storage (s) Improper Pesticide Disposal (s)	**H** **H** **M** **M**	☐ Buffer strips/filter strips ☐ Protect and enhance the riparian corridor ☐ Promote the Michigan Turfgrass Environmental Stewardship Program ☐ Pesticide management ☐ Irrigation scheduling ☐ Proper storage ☐ Clean Sweep pesticide disposal ☐ Pesticide container recycling

Prioritization of Sources, Causes, and Tasks/BMP to Reduce Salt

High-H Medium-M Low-L

(s)-suspected (k)-known

Sources, Causes, and Tasks/BMP to Reduce Salt				
Sources		**Causes**		**Tasks/BMP's**
Urban Storm Water Run-off (s)	H	Impervious Surfaces (streets, sidewalks, parking lots, and roofs) (k)	H	☐ Rain Gardens ☐ Green roofs
		Improper Application (k)	H	☐ Downspout management
		Outdated and/or Improperly Designed Systems (s)	H	☐ Wetland/Floodplain restoration
		Lack of Storm Water BMP's	H	and/or protection ☐ Improved parking lot and street design ☐ Grassed waterways ☐ Hold storm water management workshops for homeowners, business owners, and municipality employees ☐ Support a storm water management ordinance ☐ Incorporate land use planning tools ☐ Promote low-impact development ☐ Porous pavement ☐ Rain barrels ☐ Deicing alternatives ☐ Natural swales ☐ Detention ponds ☐ Promote voluntary implementation of Phase II requirements ☐ Develop criteria and implement site plan reviews

Sources		Causes		Tasks/BMP's
Road Stream Crossings (k)	**H**	Bridge Construction and Design (k) Impervious Surface (paved bridges) (k) Improper Application (s)	**H** **M** **M**	□ Improve road edge and ditch design □ Improve bridge design (curbing, pavement-chip and seal, redirect run-off) □ Improve gravel road maintenance □ Deicing alternatives
Storage Facilities	**M**	Improper Storage (s)	**M**	□ Improve salt storage □ Deicing alternatives

Prioritization of Sources, Causes, and Tasks/BMP to Reduce Temperature

High-H Medium-M Low-L

(s)-suspected (k)-known

Sources, Causes, and Tasks/BMP to Reduce Temperature				
Sources		**Causes**		**Tasks/BMP's**
Urban Storm Water Run-off (s)	**H**	Impervious Surfaces (streets, sidewalks, parking lots, and roofs) (s)	**H**	☐ Rain Gardens ☐ Green roofs
		Lack of Storm Water BMP's (s)	**H**	☐ Downspout management ☐ Wetland/Floodplain restoration and/or protection ☐ Improved parking lot and street design ☐ Grassed waterways ☐ Hold storm water management workshops for homeowners, business owners, and municipality employees ☐ Support a storm water management ordinance ☐ Incorporate land use planning tools ☐ Promote low-impact development ☐ Porous pavement ☐ Rain barrels ☐ Deicing alternatives ☐ Natural swales ☐ Detention ponds ☐ Promote voluntary implementation of Phase II requirements ☐ Develop criteria and implement site plan reviews
Artificial Impoundments(s)	**H**	Increased Surface Area Exposed to Sunlight	**H**	☐ Remove dams that are no longer safe or serve a purpose

Sources		Causes		Tasks/BMP's
Removal of the Riparian Corridor (s)	**H**	Natural Stream Banks Converted to Lawns and/or Cropland (s)	**H**	□ Protection and restoration of the riparian corridor □ Promote the designation of a portion of the Battle Creek River as a Natural Scenic River □ Incorporate land use planning tools □ Install bufferstrips □ Landscaping for water quality
Wetland Drainage (s)	**M**	Wetland Conversion (k) Poor Land Use Planning (k)	**H** **H**	□ Protect and restore wetlands within the watershed □ Incorporate land use planning tools □ Promote wetlands ordinance

Prioritization of Sources, Causes, and Tasks/BMP to Reduce Solid Waste

High-H Medium-M Low-L

(s)-suspected (k)-known

Sources, Causes, and Tasks/BMP to Reduce Solid Waste				
Sources		**Causes**		**Tasks/BMP's**
Humans (k)	**H**	Illegal Dumping (k) Litter (k) Lack of Awareness (k)	**H** **H** **H**	□ Create awareness and respect for a clean environment through brochures, newsletters, workshops, posters, advertisements, beautification projects, Project WISE (Waste Information Series for Education) in schools, and adopt-a-stream □ Partner with the City of Battle Creek's Global Citizens River Clean-up Day held on the first Saturday in October □ Discourage littering and illegal dumping

Overall Goals and Objectives to Reduce Non-Point Source Pollution within the Battle Creek River Watershed

Goal 1

Reduce non-point source pollution in the Battle Creek River Watershed.

The Battle Creek River Watershed has been identified by the Michigan Department of Environmental Quality as one of the leading tributaries contributing sediment and phosphorus to the Kalamazoo River. Other pollutants such as pesticides, nutrients, heavy metals, petroleum products, bacteria, and salts bond with soil particles and can travel to water resources through erosion. Sources of non-point pollution can also travel by storm water created by impervious surfaces and outfall to water resources through storm drains. Implementing Best Management Practices to reduce soil erosion will also decrease the amount of other sources of non-point source pollution reaching the surface waters within the Battle Creek River Watershed.

Objective 1
Reduce non-point source pollution by implementing Best Management Practices through the Battle Creek River and Rice Creek Watershed Partnership Program. The Partnership Program will focus on landowners within the Battle Creek River and Rice Creek Watersheds to implement conservation programs that are administered through various agencies and organizations. These agencies and organizations will provide landowners with opportunities to manage, conserve, restore, and enhance natural resources and critical areas that may be contributing non-point source pollutants to surface waters within the Rice Creek and Battle Creek River Watersheds. An agreement between these federal, state, and local agencies as well as conservation-oriented organizations have prioritized the Rice Creek and Battle Creek River Watersheds as critical areas in the State of Michigan. This agreement of partnership and cooperation will be the driving force in establishing BMP's to reduce non-point source pollution within the Battle Creek River Watershed.

Responsible Partners: USDA-Natural Resource Conservation Service, Michigan Groundwater Stewardship Program, Calhoun County Community Development, Eaton County Road Commission, and Conservation Districts

Objective 2
Reduce non-point source pollution by implementing demonstration sites that provide improved storm water run-off BMP's. These demonstration sites will educate the public and community dignitaries on innovative practices that are available to deal with storm water issues. Also promote the utilization of innovative BMP's and land use tools to

improve storm water management by moving communities toward MS4 (Municipal Separate Storm Sewer System) requirements.

Responsible Partners: City of Battle Creek, Village of Bellevue, City of Olivet, City of Charlotte, Townships, Kalamazoo River & Lake Allegan TMDL Implementation Committee, Kalamazoo Nature Center, Calhoun County Community Development, Eaton County Community Development, Eaton and Calhoun Drain Commissioners, and Conservation Districts

Objective 3
Continue participation and implementation of common strategies for reducing non-point source pollution in the Battle Creek River Watershed by partnering with other agencies and organizations through workshops, conferences, and special events.

Responsible Partners: Conservation Districts, Kalamazoo River Watershed & Lake Allegan TMDL Implementation Committee, Calhoun County Community Development, Townships, and City of Battle Creek

Objective 4
Develop partnerships and educational programs to strengthen local county soil erosion control enforcement programs within the Battle Creek and Kalamazoo River Watersheds (Calhoun, Barry, Kalamazoo, and Eaton counties) to reduce non-point source soil erosion from construction sites

Responsible Partners: Michigan Department of Environmental Quality, Part 91 Enforcement Agencies, Kalamazoo River & Lake Allegan Phosphorus TMDL Implementation Committee, Calhoun County Community Development, Townships, and Conservation District

Goal 2

Continue conducting the geomorphic assessment using the Rosgen Methodology, analyze data, and implement a restoration demonstration site on a stretch of the Battle Creek River that maintains drainage, restores stream function, and stream stability utilizing natural channel design. Also, conduct three dam removal projects on the Battle Creek River to provide fish migration upstream, restore the natural hydrologic flow, and reduce safety and maintenance liability. If dams cannot be removed due to financial constraints, historical reasons, or public opposition, install a fish passage structures to allow for migration. The long-term goal is to restore that Battle Creek River into a natural functioning system utilizing the Rosgen Methodology by implementing natural channel design on channeled sections of river.

Objective 1
Conduct the geomorphic assessment using the Rosgen Method at four stations on the main stem of the Battle Creek River (Broadway Highway, McDonald Road, Cochran Road, and McAllister Road)

Responsible Partners: Michigan Department of Natural Resources and Conservation Districts

Objective 2
Analyze geomorphic assessment data collected from four stations located on the main stem of the Battle Creek River

Responsible Partners: Michigan Department of Natural Resources and Conservation Districts

Objective 3
Design and implement a restoration demonstration site on a 10-mile stretch of the Battle Creek River that maintains drainage, restores stream function, and stream stability.

Responsible Partners: Michigan Department of Natural Resources, Conservation Districts, Eaton County Drain Commissioner, and Calhoun County Drain Commissioner

Objective 4
Remove three unused dams within the Battle Creek River to provide fish migration upstream, restore the natural hydrologic flow, and reduce safety and maintenance liability

Responsible Partners: Michigan Department of Natural Resources, Conservation Districts, Eaton and Calhoun County Drain Commissioners, and US Fish and Wildlife Service

Objective 5
Install fish passage structures at locations where blockage of migration cannot be removed

Responsible Partners: Michigan Department of Natural Resources, Conservation Districts, Eaton and Calhoun County Drain Commissioners, and US Fish and Wildlife Service

Goal 3

Protect, and enhance critical natural resources within the Battle Creek River watershed by working with private landowners and local governments, and integrating long-term land use planning tools to protect water quality.

Objective 1
Enhance, protect, and restore wetlands and grasslands in critical areas that are crucial to water quality and natural habitat within the Battle Creek River Watershed using various agencies and organizations in the Watershed Partnership Program.

Responsible Partners: USDA-Natural Resource Conservation Service, Conservation Districts, US Fish and Wildlife Service, and Ducks Unlimited

Objective 2
Integrate long-term land use planning tools that protect and/or enhance critical natural resources and improve storm water management tools that protect water quality with local governments within the Battle Creek River Watershed

Responsible Partners: Michigan Department of Environmental Quality, City of Battle Creek, Village of Bellevue, City of Olivet, City of Charlotte, Townships, Michigan Department of Natural Resources, Potowatomi Resource Conservation & Development, and Conservation Districts

Goal 4

Increase public awareness, appreciation, utilization, and protection of the Battle Creek River Watershed by providing more public recreational opportunities that are compatible to the goals and objectives of the Battle Creek River Watershed Project at county, township, villages, and city parks.

Objective 1
Design a map that exhibits the natural, environmental, historical, cultural, and social features to promote tourism and utilization of the Battle Creek River Watershed

Responsible Partners: Conservation District, County Park and Recreation Department, and Chamber of Commerce's

Objective 2
Expand and improve public access at 5 locations adjacent to the Battle Creek River and/or its tributaries

Responsible Partners: City of Battle Creek, Calhoun Conservation District, Michigan Audubon Society, Eaton County Parks and Recreation Department, Village of Bellevue, City of Olivet, and City of Charlotte

Objective 3
Promote the extension of Linear Path that will follow along the Battle Creek River from Bailey Park to the Conservation District property on McAllister Road (approximately 5 miles)

Responsible Partners: Calhoun County Community Development, Pennfield Township, City of Battle Creek, North Country Trail Association, and Conservation District

Goal 5

Implement an information and education program to increase awareness of the Battle Creek River Watershed and non-point source pollution through workshops, newsletters, brochures, classroom presentations, demonstration sites, posters, flyers, and advertisements.

Objective 1
Hold workshops to educate private landowners and townships on conservation easements, farmland preservation, land conservancies, and other options to protect private lands within the watershed

Responsible Partners: Conservation Districts, Southwest Michigan Land Conservancy, Calhoun Community Development, Potowatomi Resource Conservation & Development, Mid-Michigan Land Conservancy, USDA-Natural Resources Conservation Service, Michigan Department of Natural Resources, Nature Conservancy

Objective 2
Promote the Battle Creek River Watershed Project through promotional items at events, workshops, fairs, tours, and presentations

Responsible Partners: Calhoun Conservation District

Objective 3
Continue supporting school stream ecology programs by creating a guidebook, kit, and purchase educational models for water quality education in schools within the Battle Creek River Watershed

Responsible Partners: Calhoun Conservation District and Calhoun Intermediate School District

Objective 4
Implement a storm drain-marking program with public educational materials within the Battle Creek River Watershed and mark 1,000 storm drains.

Responsible Partners: Conservation District, City of Battle Creek, Village of Bellevue, City of Olivet, City of Charlotte, and the Kalamazoo River & Lake Allegan Phosphorus TMDL Implementation Committee

Critical Areas with Prescribed Best Management Practices (BMP's), Cost Analysis, and Timeline

In the BMP charts following, are various practices that were identified by the Steering Team Committee as having the highest priority in reducing non-point source pollution as a result of the findings and prioritization of pollutants that are impairing the watershed through inventory of the Battle Creek River Watershed. Some land areas and BMP's may not be included due to inventory limitations such as private property access, flooding, or other restrictions. Additional BMP's may be needed as more critical sites are observed and identified through landowner contacts and implementation development (Overall BMP's).

Station #	County	Township	Section	Stream	Problem/ Concern	Pollutants	Goal/Desired Use	BMP	Priority	Pollution Reduction/ Year	Ownership	Responsible Partners	Estimated Costs	Funding Sources	Task Duration (years)
1a	Calhoun	COB	1	BC River	Cement weir	Hydrologic Flow	Allow fish passage Improve aquatic habitat	Install rock ramp to allow for fish passage	High	No pollution reduction, but stream aquatic habitat will be enhanced	COB	DNR CD COB	$2,000 - $3,000	Grants COB	1
1b	Calhoun	COB	1	BC River	Streambank Erosion	Sediment Nutrients	Eliminate sediment and nutrient loading Improve water quality	Stabilize 250' of streambank utilizing bio-engineering along Linear Path	High	69 tons of sediment 103 pounds of phosphorus	COB	USDA CD COB	$20,000 - $25,000	Grants COB Cost-Share	0.5
2	Calhoun	COB	1	BC River	Manicured lawn with no vegetative buffer	Nutrients Pesticides	Reduce nutrient and pesticide loadings Improve water quality	Education Install 1500' vegetative bufferstrip	Medium	Reduce phosphorus and pesticides by 75%	Kellogg's COB	Wild Ones CD COB Kellogg's	$3,000 - $4,000	Grants COB Kellogg's Cost-Share	0.25
3a	Calhoun	COB	1	BC River	Excessive stormwater due to impervious surfaces	Sediment Nutrients Hydrologic Flow Temperature	Reduce stormwater flow Reduce sediment and nutrient loadings Reduce temperatures Improve water quality	Replace parking lot with porous pavement, install 10 planter boxes, and 2 rain gardens	High	Reduce stormwater run-off by 50%	COB	COB CD MDEQ	$250,000 - $350,000	Grants	2
3b	Calhoun	COB	1	BC River	Flooding due to straightening and disconnection of the river to the floodplain	Hydrologic Flow	Eliminate flooding Improve aquatic habitat	Conduct in-stream geomorphic assessment to develop natural channel design and remove cemented streambanks	Low	No pollution reduction, but aquatic habitat will be enhanced and hydrologic flow will be restored	COB	DNR CD COB	$250,000 - $500,000	Grants	2
4	Calhoun	Emmett	6	BC River	Manicured lawn with no vegetative buffer Undercutting streambank	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Stabilize 10' of streambank utilizing bio-engineering Install 50' vegetative bufferstrip	Low	6 tons of sediment 9 pounds of phosphorus	COB	Wild Ones NRCS CD	$1,000 - $2,000	Grants	0.5

Station #	County	Township	Section	Stream	Problem/ Concern	Pollutants	Goal/Desired Use	BMP	Priority	Pollution Reduction/ Year	Ownership	Responsible Partners	Estimated Costs	Funding Sources	Task Duration (years)
5a	Calhoun	Emmett	6	BC River	Streambank erosion at culvert	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Stabilize 10' of streambank around culvert utilizing bio-engineering	Medium	1 ton of sediment 1.5 pounds of phosphorus	COB	COB CD MDEQ	$5,000 - $7,000	Grants COB Cost-Share	0.5
5b	Calhoun	Emmett	6	BC River	Excessive stormwater due to impervious surfaces	Sediment Nutrients Hydrologic Flow Temperature	Reduce stormwater flow Reduce sediment and nutrient loadings Reduce temperatures Improve water quality	Install 1 green roof at COB Police Station, replace parking lot with a stormwater reduction design, and install 1 rain garden	High	Reduce stormwater run-off by 50%	COB	COB CD MDEQ	$500,000 - $600,000	Grants COB	2
6a	Calhoun	Emmett	6	BC River	Dam	Hydrologic Flow	Allow fish passage Improve aquatic habitat	Remove dam	High	No pollution reduction, but stream aquatic habitat will be enhanced and hydrologic flow will be restored	CE	CE CD MDNR COB	$25,000 - $30,000	Grants CE	2
6b	Calhoun	Emmett	6	BC River	Waterfowl manure	Nutrients Pathogens	Reduce nutrient and pathogen loadings Improve water quality	Install 75' vegetative bufferstrip	Low	Reduce phosphorus by 75%	CE	COB CE CD COB	$2,000 - $3,000	Grants CE Cost-Share	0.5
7	Calhoun	Emmett	6	BC River	Discharge	Nutrients	Reduce nutrients by identifying source Improve water quality	Investigate source of contaminated discharge and fix problem	High	Eliminate issue by 100%	COB	COB CD MDEQ	$7,000 - $10,000	COB Grants	1

Station #	County	Township	Section	Stream	Problem/ Concern	Pollutants	Goal/Desired Use	BMP	Priority	Pollution Reduction/ Year	Ownership	Responsible Partners	Estimated Costs	Funding Sources	Task Duration (years)
8	Calhoun	Emmett	6	BC River	Dam	Hydrologic Flow	Allow fish passage Improve aquatic habitat	Remove cement dam	High	No pollution reduction, but stream aquatic habitat will be enhanced, fish will be able to migrate upstream and downstream, and hydrologic flow will be restored	COB	MDNR CD COB	$100,000 - $150,000	Grants	2
9	Calhoun	Pennfield	32	BC River	Waterfowl manure	Nutrients Pathogens	Reduce nutrient and pathogen loadings Improve water quality	Install 150' vegetative bufferstrip	Low	Reduce phosphorus by 75%	COB	NRCS CD	$1,500 - $2,000	Grants Cost-Share	0.5
10	Calhoun	Pennfield	28	BC River	Manicured lawn with no vegetative buffer Streambank erosion	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Stabilize 700' of streambank utilizing bio-engineering Install 700' vegetative bufferstrip	Medium	Reduce 385 tons of sediment Reduce 578 pounds of phosphorus	Private	NRCS CD	$20,000 - $25,000	Grants Cost-Share	0.5
11a	Calhoun	Pennfield	21	BC River	Illegal Dumping	Solid Waste	Reduce illegal dumping Create public park w/ access Increase recreational utilization of the BC River	Educational signage Place boulders in front of 2-track to restrict vehicles from dumping Install garbage cans and picnic tables Expand Linear Path from Bailey Park to McAllister Rd.	High	Reduce solid waste by 90%	CCD	CD Township	$25,000 - $35,000	Grants	0.5

Station #	County	Township	Section	Stream	Problem/ Concern	Pollutants	Goal/Desired Use	BMP	Priority	Pollution Reduction/ Year	Ownership	Responsible Partners	Estimated Costs	Funding Sources	Task Duration (years)
11b	Calhoun	Pennfield	21	BC River	Streambank erosion from human access	Sediment Nutrients	Reduce sediment and nutrient loadings Improve recreational utilization	Install canoe launch and access stairs	Medium	Reduce 2 tons of sediment Reduce 3 pounds of phosphorus	CCD	CD Township	$2,500 - $3,500	Grants	0.5
12	Calhoun	Convis	18	BC River	Pasture gully erosion to wetland adjacent to the BC River	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Install a rotational grazing system with 1,000' of fencing and a 200' vegetative bufferstrip adjacent to wetland	Low	Reduce 11 tons of sediment Reduce 17 pounds of phosphorus	Private	NRCS CD	$7,500 - $8,500	Cost-Share	1
13	Calhoun and Eaton	Convis and Bellevue	7 and 6 29 and 32	BC River	Future development	None	Eliminate the concern of floodplain development and destruction of the riparian corridor	Designate this section of the Battle Creek River as a Natural River and conduct a Natural Resources Inventory for Convis Township	High	Preventative	Private	MDNR CD Townships	N/A	N/A	5
14	Eaton	Bellevue	28	BC River	Road edge erosion off bridge	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Plant vegetation that can withstand roadside abuse	Low	Reduce 1 ton of sediment Reduce 1.5 pounds of phosphorus	VOB	NRCS CD VOB	$500 - $1,000	Grants Cost-Share	0.5
15	Eaton	Bellevue	28	BC River	Manicured lawn with no vegetative buffer and streambank erosion	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Stabilize 50' of streambank utilizing bio-engineering Install 50' vegetative bufferstrip	Medium	Reduce 1 ton of sediment Reduce 1.5 pounds of phosphorus	Private	NRCS CD	$500 - $1,000	Grants Cost-Share	0.5
16	Eaton	Bellevue	28	BC River	Dam	Hydrologic Flow	Allow fish passage	Install rock ramp to allow for fish passage	High	No pollution reduction, but fish will be able to migrate upstream and downstream	Private	MDNR CD USFWS	$7,500 - $8,500	Grants	1

Station #	County	Township	Section	Stream	Problem/ Concern	Pollutants	Goal/Desired Use	BMP	Priority	Pollution Reduction/ Year	Ownership	Responsible Partners	Estimated Costs	Funding Sources	Task Duration (years)
17	Eaton	Bellevue	28	BC River	Manicured lawn with no vegetative buffer	Nutrients Pesticides	Reduce nutrient loadings Improve water quality	Install 3,750' vegetative bufferstrip	Medium	Reduce phosphorus and pesticides by 75%	Private	NRCS CD	$2,000 - $3,000	Grants Cost-Share	1
18	Eaton	Walton	18	BC River	Unlimited livestock access (approximately 30 head)	Sediment Nutrients Pathogens	Reduce sediment, nutrient, and pathogen loadings Improve water quality	Install 3,000' of fencing, 200' vegetative bufferstrip, revegetate streambank with seeding, and 2 alternative watering systems	High	Reduce 41 tons of sediment Reduce 61.5 pounds of phosphorus	Private	NRCS CD	$4,000 - $5,000	Grants Cost-Share	0.5
19	Eaton	Walton	17	BC River	Manicured lawn with no vegetative buffer	Nutrients	Reduce nutrient loadings Improve water quality	Install 70' vegetative buffer	Low	Reduce phosphorus and pesticides by 75%	Private	NRCS CD	$1,000 - $1,500	Grants Cost-Share	0.5
20	Eaton	Walton, *Carmel*, Eaton, and **Brookfield**	16 15 10 11 2 1 *35 26 25 24* 19 20 29 28 33 **5 8 17 20 21 22 27**	BC River	River disconnected from the floodplain from bermed banks due to historical dredging	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loadings Improve water quality Improve aquatic habitat Restore hydrologic flow	Restore 1 mile of river from a Type F5 stream to a Type C5 stream utilizing natural channel design	High	986 tons of sediment 1,972 pounds of phosphorus	COC	MDNR CD DC	$100,000 - $125,000	Grants	2
21	Eaton	Carmel	35	BC River	Unpaved road eroding off bridge	Sediment Nutrients Petroleum Salt	Reduce sediment, nutrient, petroleum, and salt loadings Improve water quality	Pave 50'x30' bridge area Install curbing and filter strip	Medium	Reduce 38 tons of sediment Reduce 56 pounds of phosphorus	RC	CCD Township CD	$60,000 - $70,000	Grants CCD	0.5
22	Eaton	Carmel	26	BC River	Unpaved road eroding off bridge	Sediment Nutrients Petroleum Salt	Reduce sediment, nutrient, petroleum, and salt loadings Improve water quality	Pave 50'x30' bridge area Install curbing	Medium	Reduce 38 tons of sediment and 56 pounds of phosphorus	RC	CCD Township CD	$60,000 - $70,000	Grants CCD	0.5

Station #	County	Township	Section	Stream	Problem/ Concern	Pollutants	Goal/Desired Use	BMP	Priority	Pollution Reduction/ Year	Ownership	Responsible Partners	Estimated Costs	Funding Sources	Task Duration (years)
23a	Eaton	Carmel	25	BC River	Limited livestock access (approximately 30 head)	Sediment Nutrients Pathogens	Reduce sediment, nutrient, and pathogen loadings Improve water quality	Install 500' vegetative bufferstrip and 2 watering systems	High	Reduce 14 tons of sediment and 21 pounds of phosphorus	Private	NRCS CD	$2,000 - $2,500	Grants Cost-Share	0.5
23b	Eaton	Carmel	25	BC River	Unpaved road eroding off bridge	Sediment Nutrients Petroleum Salt	Reduce sediment, nutrient, petroleum, and salt loadings Improve water quality	Pave 50'x30' bridge area Install curbing and filter strip	Medium	Reduce 38 tons of sediment and 56 pounds of phosphorus	RC	CCD Township CD	$60,000 - $70,000	Grants CCD	0.5
24	Eaton	Carmel	24	BC River	Possible run-off from pasture and no overhanging vegetation to maintain stream temperatures	Sediment Nutrients Pathogens Temperature	Reduce sediment, nutrient, temperature, pathogen loadings, and temperature increases Improve water quality	Install 3,000' vegetative bufferstrip on left bank and 1,000' vegetative bufferstrip on right bank Install livestock stream crossing and 2 watering systems	Medium	Reduce sediment, nutrient, and pathogen loadings by 75%	Private	NRCS CD	$8,500 - $10,000	Grants Cost-Share	0.5
25a	Eaton	Eaton	19	BC River	Dam	Hydrologic Flow	Allow fish passage Improve aquatic habitat	Conduct in-stream geomorphic assessment and remove cement dam	High	No pollution reduction, but stream aquatic habitat will be enhanced, fish will be able to migrate upstream and downstream, and hydrologic flow will be restored	COC	CD MDNR COC	$15,000 - $20,000	Grants	1
25b	Eaton	Eaton	19	BC River	Manicured lawn with no vegetative buffer	Nutrients	Reduce nutrient loadings Improve water quality	Install 100' vegetative bufferstrip	Medium	Reduce phosphorus by 75%	COC	NRCS CD	$1,000 - $1,500	Grants Cost-Share	1

Station #	County	Township	Section	Stream	Problem/ Concern	Pollutants	Goal/Desired Use	BMP	Priority	Pollution Reduction/ Year	Ownership	Responsible Partners	Estimated Costs	Funding Sources	Task Duration (years)
26a	Eaton	Eaton	20	BC River	Unpaved road eroding off bridge	Sediment Nutrients Petroleum Salt	Reduce sediment, nutrient, petroleum, and salt loadings Improve water quality	Pave 50'x30' bridge area Install curbing and filter strip	Medium	Reduce 38 tons of sediment and 56 pounds of phosphorus	RC	Township CCD	$60,000 - $70,000	Grants CCD	0.5
26b	Eaton	Eaton	20	BC River	Eroding and undercutting stream bank	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Conduct in-stream geomorphic assessment to determine reason for streambank erosion, stabilize 50' of streambank utilizing bio-engineering or an in-stream structure Install 50' vegetative bufferstrip	Medium	Reduce 1 ton of sediment and 2 pounds of phosphorus	Private	NRCS CD	$3,000 - $4,500	Grants Cost-Share	0.5
27	Eaton	Eaton	29	BC River	Manicured lawn with no vegetative buffer	Nutrients	Reduce nutrient loadings Improve water quality	Install 100' vegetative bufferstrip	Medium	Reduce phosphorus by 75%	Private	NRCS CD	$1,000 - $1,500	Grants Cost-Share	1
28	Eaton	Eaton	20	BC River	Cropland planted adjacent to the road with no buffer uphill from river	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Install 500' vegetative bufferstrip	Medium	Reduce sediment by 65% and phosphorus by 75%	Private	NRCS CD	$2,500 - $3,500	Grants Cost-Share	0.5
29a	Eaton	Eaton	29	BC River	Limited livestock access (approximately 20 head)	Sediment Nutrients Pathogens	Reduce sediment, nutrient, and pathogen loadings Improve water quality	Install 1,000' of fencing, 500' vegetative bufferstrip and 1 watering systems	High	Reduce sediment by 65% and phosphorus by 75%	Private	NRCS CD	$5,000 - $6,000	Grants Cost-Share	0.5

Station #	County	Township	Section	Stream	Problem/ Concern	Pollutants	Goal/Desired Use	BMP	Priority	Pollution Reduction/ Year	Ownership	Responsible Partners	Estimated Costs	Funding Sources	Task Duration (years)
29b	Eaton	Eaton	29	BC River	Unpaved road eroding off bridge	Sediment Nutrients Petroleum Salt	Reduce sediment, nutrient, petroleum, and salt loadings Improve water quality	Pave 50'x30' bridge area Install curbing and filter strip	Medium	Reduce 38 tons of sediment and 56 pounds of phosphorus	RC	CCD Township CD	$60,000 - $70,000	Grants CCD	0.5
30	Eaton	Brookfield	20	BC River	Manicured lawn with no vegetative buffer Streambank erosion	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Conduct in-stream assessment to determine reason for streambank erosion, stabilize 50' of streambank utilizing bio-engineering or in-stream structure Install 50' vegetative bufferstrip	Medium	Reduce 14 tons of sediment and 21 pounds of phosphorus	Private	NRCS CD	$5,000 - $5,500	Grants Cost-Share	0.5
31	Eaton	Brookfield	21	BC River	Unlimited livestock access (5 horses)	Sediment Nutrients Pathogens	Reduce sediment, nutrient, and pathogen loadings Improve water quality	Install 1,000' of fencing, 500' vegetative bufferstrip, and 1 watering system	High	Reduce sediment by 65% and phosphorus by 75%	Private	NRCS CD	$5,500 - $7,500	Grants Cost-Share	0.5
32	Eaton	Brookfield	27	BC River	Lake level control structure (dam)	Hydrologic Flow	Allow fish passage	Install rock ramp to allow for fish passage	High	No pollution reduction, but stream aquatic habitat will be enhanced, fish will be able to migrate upstream and downstream, and hydrologic flow will be restored	Private	MDNR CD USFWS	$3,500 - $4,500	Grants	0.5

Station #	County	Township	Section	Stream	Problem/ Concern	Pollutants	Goal/Desired Use	BMP	Priority	Pollution Reduction/ Year	Ownership	Responsible Partners	Estimated Costs	Funding Sources	Task Duration (years)
33	Eaton	Brookfield	27 28 33 34	Narrow Lake	Septic systems in a high water table, manicured lawns with no vegetative buffer, and waterfowl manure	Nutrients Pathogens	Reduce nutrient and pathogen loadings Improve water quality	Install regional sewer system to pipe effluent to the Albion wastewater treatment plan for lake and hold1 lakescaping for water quality educational workshop	High	Reduce phosphorus by 75%	Private	MDEQ CD CCD Township	$3 - $5 million	Grants	3
34	Calhoun	Clarence	9 10 15 16 21 22	Duck Lake	Septic systems in a high water table, manicured lawns with no vegetative buffer, and waterfowl manure	Nutrients Pathogens	Reduce nutrient and pathogen loadings Improve water quality	Install regional sewer system to pipe effluent to the Albion wastewater treatment plan for lake and hold1 lakescaping for water quality educational workshop	High	Reduce phosphorus by 75%	Private	MDEQ CD CCD Township	$3 - $5 million	Grants	3
35	Calhoun	Pennfield	21	Wanandoga Creek	Residential area with manicured lawns with no vegetative buffer and waterfowl manure	Nutrients Pathogens	Reduce nutrient and pathogen loadings Improve water quality	Install 5,000' vegetative bufferstrip	Medium	Reduce phosphorus by 75%	Private	NRCS CD	$3,500 - $5,500	Grants Cost-Share	1
36	Barry	Assyria	34	Wanandoga Creek	Residential area with manicured lawns with no vegetative buffer	Nutrients	Reduce nutrient loadings Improve water quality	Install 250' vegetative bufferstrip	Medium	Reduce phosphorus by 75%	Private	NRCS CD	$1,500 - $2,500	Grants Cost-Share	1
37a	Barry	Assyria	34	Wanandoga Creek	3 perched culverts positioned causing streambank erosion	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loadings Allow fish passage and restore hydrologic flow	Reposition culverts utilizing the MESBOA technique	Medium	Reduce 21 tons of sediment and 32 pounds of phosphorus	CCD	MDNR CCD	$30,000 - $50,000	Grants CCD	1

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37b	Barry	Assyria	34	Wanandoga Creek	Woody debris blocking flow creating backwater and manicured lawn with no vegetative buffer	Hydrologic Flow Nutrients	Restore hydrologic flow and reduce nutrient loadings	Remove culvert blockage and install a 100' bufferstrip		Reduce phosphorus by 75%	CCD	MDNR CCD	$700 - $1,500	Grants CCD	1
38	Barry	Assyria		Wanandoga Creek	Entrenched channel with severe streambank erosion at bend and only one culvert is receiving the active flow	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loadings and restore hydrologic flow	Replace culverts utilizing the MESBOA technique, stabilize streambank by gathering in-stream data and install structure, and establish vegetation	High	Reduce 28 tons of sediment and 42 pounds of phosphorus	CCD	MDNR CD CCD	$30,000 - $50,000	Grants CCD	2
39	Barry	Assyria		Wanandoga Creek	Entrenched channel with severe streambank erosion	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loadings and restore hydrologic flow	Replace culverts utilizing the MESBOA technique, stabilize streambank by gathering in-stream data and install structure and establish vegetation	High	Reduce 83 tons of sediment and 125 pounds of phosphorus	CCD	MDNR CD CCD	$30,000 - $50,000	Grants CCD	2
40	Barry	Assyria		Wanandoga Creek	Unlimited livestock access (30 head)	Nutrients Pathogens	Reduce nutrients and pathogen loadings Improve water quality	Install 1000' of fencing, 1 livestock crossing, and 2 watering systems	Medium	Reduce 10 tons of sediment and 15 pounds of nutrients	Private	NRCS CD	$6,500 - $8,500	Grants Cost-Share	0.5
41	Eaton	Bellevue	7	Wanandoga Creek	Bridge abutments are not as wide as bankfull causing streambank erosion	Hydrologic Flow Sediment Nutrients	Restore hydrologic flow and reduce sediment and nutrient loadings	Conduct in-stream geomorphic assessment to determine bridge design, replace structure, install structure to stabilize bank	Medium	Reduce 21 tons of sediment and 32 pounds of phosphorus	CCD	MDNR CD CCD	$65,000 - $85,000	Grants CCD	1

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42	Eaton	Bellevue	7	Wanandoga Creek	Check Dam	Hydrologic Flow	Restore hydrologic flow Allow fish passage	Conduct in-stream geomorphic assessment and remove dam	High	No pollution reduction, but stream aquatic habitat will be enhanced, fish will be able to migrate upstream and downstream, and hydrologic flow will be restored	Private	MDNR CD	$2,000 - $3,000	Grants Cost-Share	1
43	Eaton	Bellevue	7	Wanandoga Creek	Unpaved road eroding off bridge	Sediment Nutrients Petroleum Salt	Reduce sediment, nutrient, petroleum, and salt loadings Improve water quality	Pave 50'x30' bridge area Install curbing and filter strip	Medium	Reduce 38 tons of sediment and 56 pounds of phosphorus	CCD	Township CCD	$60,000 - $70,000	Grants CCD	0.5
44a	Eaton	Bellevue	7	Wanandoga Creek	Woody debris blocking flow creating backwater and bridge abutments are not as wide as bankfull	Hydrologic Flow	Restore hydrologic flow	Remove blockage, conduct in-stream geomorphic assessment to determine bridge design and possible replacement	Medium	Preventative	CCD	MDNR CD CCD Township	$65,000 - $85,000	Grants CCD	0.5
44b	Eaton	Bellevue	7	Wanandoga Creek	Unpaved road eroding off bridge	Sediment Nutrients Petroleum Salt	Reduce sediment, nutrient, petroleum, and salt loadings Improve water quality	Pave 50'x30' bridge area Install curbing and filter strip	Medium	Reduce 38 tons of sediment and 56 pounds of phosphorus	CCD	Township CCD	$60,000 - $70,000	Grants CCD	0.5

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45a	Eaton	Bellevue	5	Wanandoga Creek	Perched and inadequate sized culvert that is creating erosion from backwater	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loadings, restore hydrologic flow, and allow fish passage	Replace culverts utilizing the MESBOA technique, stabilize streambank by gathering in-stream data and installing an in-stream structure, and re-establish vegetation	Medium	Reduce 17 tons of sediment and 26 pounds of phosphorus	CCD	MDNR CD CCD	$30,000 - $50,000	Grants CCD	1
45b	Eaton	Bellevue	4	Wanandoga Creek	Culvert positioning is creating streambank erosion and narrow vegetative bufferstrip adjacent to cropland	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loading, and restore hydrologic flow	Reposition and size culvert utilizing the MESBOA technique, stabilize streambank by gathering in-stream data and installing an in-stream structure, re-establish vegetation, and expand vegetative bufferstrip	Medium	Reduce 25 tons of sediment and 38 pounds of phosphorus	CCD	MDNR CD CCD	$30,000 - $50,000	Grants CCD	1
46	Calhoun	Convis	11	Ackley Lake	Manicured lawn with no vegetative bufferstrip	Nutrients	Reduce nutrients	Install 150' vegetative bufferstrip	Low	Reduce phosphorus by 75%	Private	NRCS CD	$1,500 - $2,000	Cost-Share	0.5
47	Calhoun	Convis	10	Ackley Creek	Perched and inadequate sized culvert, eroding stream channel, erosion from road run-off, and manicured lawns with no vegetative bufferstrip	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loadings, restore hydrologic flow, and allow fish passage	Replace culverts utilizing the MESBOA technique and install a 400' vegetative bufferstrip along both sides of creek	High	Reduce 1 ton of sediment and 1.5 pounds of phosphorus	Private	MDNR CCD CD NRCS	$30,000 - $50,000	Grants Cost-Share	1

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48a	Eaton	Walton	29	Indian Creek	Excessive stormwater due to impervious surfaces and lack of vegetation on cemented streambanks	Sediment Nutrients Hydrologic Flow Temperature Petroleum Salt	Reduce stormwater flow Reduce sediment, nutrient, salt, and petroleum loadings Reduce temperatures Improve water quality	Install 1 rain garden, remove cemented streambanks and stabilize utilizing bio-engineering, install 150' vegetative bufferstrip on each streambank	High	Reduce phosphorus by 75% and stormwater run-off by 50%	COO	COO CD MDEQ	$15,000 - $16,000	Grants COO	2
48b	Eaton	Walton	29	Indian Creek	Eroding streambank from human access	Sediment Nutrients	Reduce sediment and nutrient loadings Improve recreational utilization	Install access stairs and fishing platform	Medium	Reduce 2 tons of sediment and 3 pounds of phosphorus	COO	CD Township COO	$2,500 - $3,500	Grants	0.5
49	Eaton	Walton	29	Indian Creek	Severely eroding stormwater discharge channel	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loadings Restore hydrologic flow	Remove concrete slabs and reshape bank behind culvert outfall, extend and redirect culvert, reshape banks to 2:1 slope, use rock rip rap, bio-engineering, seeding, and log deflectors Work with Olivet College to install some innovative stormwater BMP's such as rain gardens, roof water control, and parking lot design	High	Reduce 525 tons of sediment and 788 pounds of phosphorus	OC	CCD COO CD OC	$30,000 - $35,000	Grants	1

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50	Eaton	Walton	29	Indian Creek	River disconnected from the floodplain from bermed banks due to historical dredging	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loadings Improve water quality Improve aquatic habitat Restore hydrologic flow	Restore 1 mile of river from a Type F5 stream to a Type C5 stream utilizing natural channel design by conducting an in-stream geomorphic assessment	High	To be determined after geomorphic assessment is completed	COC	MDNR CCD DC	$100,000 - $125,000	Grants	2
51	Eaton	Walton	28	Indian Creek	Eroding streambank	Sediment Nutrients	Reduce sediment and nutrient loadings	Stabilize 75' of streambank utilizing bio-engineering	Medium	Reduce 21 tons of sediment and 32 pounds of phosphorus	Private	NRCS CD	$7,500 - $8,500	Grants Cost-Share	0.5
52	Calhoun	Lee	6	Indian Creek	Eroding and undercutting stream bank	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Stabilize 50' of streambank utilizing bio-engineering and install 50' vegetative bufferstrip	Low	Reduce 6 tons of sediment and 9 pounds of phosphorus	Private	NRCS CD	$5,500 - $6,000	Grants Cost-Share	0.5
53	Calhoun	Lee	5	Indian Creek	Barnyard run-off from roof water and livestock in wetland (30 head)	Sediment Nutrients Pathogens	Reduce sediment, nutrient, and pathogen loadings Improve water quality	Install roof water control structures, rotational grazing system with 4,000' of fencing, Manure storage facility, 2,500' vegetative bufferstrip, 4 watering systems, and restore 2 small wetlands	High	Reduce sediment by 65% and phosphorus by 75%	Private	NRCS CD	$30,500 - $35,500	Grants Cost-Share	3
54	Calhoun	Lee	6	Indian Creek	Lack of overhanging vegetation and manicured lawn with lack of vegetative bufferstrip	Temperature Nutrients	Reduce nutrient loadings Reduce temperatures Improve aquatic habitat	Install 1,000' vegetative bufferstrip and provide overhanging vegetation	Low	Reduce phosphorus by 75%	Private	NRCS CD	$1,000 - $1,500	Grants Cost-Share	0.5

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55	Calhoun	Convis	13	Indian Creek	Narrow vegetative buffer adjacent to cropland and 2 drain tile outlets	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Widen vegetative buffer 45' Install 2 tile inlet filters	Medium	Reduce sediment by 65% and phosphorus by 75%	Private	NRCS CD	$500 - $1,000	Grants Cost-Share	0.5
56a	Calhoun	Convis	18	State and Indian Drain	Eroding and undercutting stream bank	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Stabilize 60' streambank utilizing bio-engineering	Medium	Reduce 8 tons of sediment and 12 pounds of phosphorus	Private	NRCS CD	$6,500 - $7,500	Grants Cost-Share	0.5
56b	Calhoun	Lee	18	State and Indian Drain	Lack of vegetation growing on fabric from reshaped bank adjacent to a manicured lawn	Nutrients	Reduce nutrient loadings Reduce temperatures Improve aquatic habitat	Revegetate bank and establish a 75' bufferstrip	Medium	Reduce sediment by 65% and phosphorus by 75%	Private	NRCS CD	$1,000 - $2,000	Grants Cost-Share	0.5
57	Calhoun	Lee	18	State and Indian Drain	Unlimited livestock access (25 cattle)	Sediment Nutrients Pathogens	Reduce sediment, nutrient, and pathogen loadings Improve water quality	Install 1,000' of fencing, 500' vegetative bufferstrip, and 1 watering systems	High	Reduce sediment by 65% and phosphorus by 75%	Private	NRCS CD	$8,000 - $9,000	Grants Cost-Share	0.5
58	Calhoun	Lee	17	State and Indian Drain	Lack of overhanging vegetation and manicured lawn with lack of vegetative bufferstrip	Temperature Nutrients	Reduce nutrient loadings Reduce temperatures Improve aquatic habitat	Install 1,000' vegetative bufferstrip and provide overhanging vegetation	Low	Reduce phosphorus by 75%	Private	NRCS CD	$3,500 - $4,000	Grants Cost-Share	0.5
59	Calhoun	Lee **Clarence**	20 21 22 23 24 **19 20**	State and Indian Drain	Lack of overhanging vegetation and narrow bufferstrip adjacent to cropland, and 10 drain tile outlets	Nutrients Temperature	Reduce nutrient loadings Reduce temperatures Improve aquatic habitat	Widen vegetative buffer 45' with overhanging vegetation Install 10 tile inlet filters	High	Reduce phosphorus by 75%	Private	NRCS CD	$3,500 - $5,500	Grants Cost-Share	0.5

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60	Calhoun	Clarence	21	State and Indian Drain	Eroding stream bank and manicured lawn with lack of vegetative bufferstrip	Sediment Nutrients	Reduce sediment and nutrient loadings Improve water quality	Stabilize100' streambank utilizing bio-engineering and install a vegetative bufferstrip	Medium	Reduce 25 tons of sediment and 38 pounds of phosphorus	Private	NRCS CD	$5,000 - $5,500	Grants Cost-Share	0.5
61	Calhoun	Lee and **Clarence**	18 17 20 21 22 23 24 **19 20**	State and Indian Drain	River disconnected from the floodplain from bermed banks due to historical dredging	Sediment Nutrients Hydrologic Flow	Reduce sediment and nutrient loadings Improve water quality Improve aquatic habitat Restore hydrologic flow	Restore 1 mile of river from a Type F5 stream to a Type C5 stream utilizing natural channel design by conducting an in-stream geomorphic assessment	High	To be determined after geomorphic assessment is completed	COC	MDNR CCD DC	$100,000 - $125,000	Grants	2
62	Eaton	Brookfield	29	Hogle and Miller Drain	Unlimited livestock access causing severe streambank erosion	Sediment Nutrients Pathogens	Reduce sediment, nutrient, and pathogen loadings Improve water quality	Install 5,000' of fencing and vegetative bufferstrip, 1 livestock crossing, and 2 watering systems Seed eroding bank	High	Reduce 275 tons of sediment and 413 pounds of phosphorus	Private	NRCS CD	$8,500 - $9,500	Grants Cost-Share	0.5
63	Eaton	Walton	15	Big Creek	Lack of vegetative bufferstrips along stream corridors that is adjacent to a golf course	Nutrients Pesticides	Reduce nutrient and pesticide loadings Improve water quality	Install 5,000' vegetative bufferstrip and encourage participation in the Turf Grass Stewardship Program	High	Reduce phosphorus by 75%	Private	MSUE/KBS CD MDA	$5,500 - $7,500	Grants Cost-Share	5

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63	Calhoun **Eaton** Barry	Convis Lee Clarence **Bellevue Carmel Kalamo Eaton Brookfield Walton** Assyria Maple Grove	N/A	Watershed Wide	Development of private lands	N/A	Preserve 50% of private lands within the watershed	Support and educate residents and county farmland preservation programs, conservation easements, P.A.116, CRP, land donations, and land conservancies through a workshop and brochure development	High	Preventative	Private	CCD CD Townships	N/A	Grants	1
64	Calhoun **Eaton** Barry	Convis Lee Clarence **Bellevue Carmel Kalamo Eaton Brookfield Walton** Assyria Maple Grove	N/A	Critical Areas	Lack of conservation planning on farms	N/A	80% of all farms located in the critical area will have a conservation plans for their operations	Write 50 WQRMP to promote conservation practices on the farm	High	Preventative	Private	NRCS CD	$90,000	Grants	5
65	Calhoun **Eaton** Barry	Convis Lee Clarence Pennfield **Bellevue Carmel Kalamo Eaton Brookfield Walton** Assyria Maple Grove	N/A	Critical Areas	Lack of landowner knowledge on forestry management	N/A	Protect and properly manage 25% of forested areas within critical areas	Write 50 Forestry Management Plans	Medium	Preventative	Private	Forester CD	$25,000	Grants Cost-Share In-Kind	5

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66	Calhoun **Eaton**	COB **Bellevue** **Walton** **Eaton**	1 6 5 **28** **29** **19**	Critical Areas	Excessive stormwater run-off	Sediment Nutrients Petroleum Salt	Manage stormwater in urban areas within the watershed more effectively	Promote and implement innovative stormwater management tools such as raingardens, vegetative swales, porous pavement, LID, green roofs, planting boxes, rain barrels, storm drain markers, downspout management, participation with TMDL, improve ordinances, policies, and voluntary implementation of MS4 requirements	High	Preventative	COB VOB COO COC	COB VOB COO COC CCD CD	N/A	Grants Cost-Share	5
67	Calhoun Eaton Barry	N/A	N/A	Watershed Wide	Lack of information and education	All non-point source pollutants	Educate 75% of the watershed through workshops, schools, community groups, special events, presentations, posters, PSA's, commercials, and newsletters	Promote watershed education through Global Citizen's River Conservation Days, Super Soils Saturday, Kanoe the Kazoo, COB Phase II requirements, workshops, and presentations	High	Preventative	CD	KR&LATMDL COB CD CCD	N/A	Grants In-Kind	5

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68	Calhoun **Eaton**	Pennfield **Walton** **Carmel** **Eaton**	21 **16** **26** **19**	BC River	Lack of data to determine stream type, dimension, pattern, and profile	Sediment Nutrients Hydrologic Flow	Collect data to determine streambank erosion severity and hydrologic flow conditions utilizing the Rosgen methodology	Conduct geomorphic assessments at 4 locations in the BC River to determine degree of streambank erosion, stream type, and restoration designs	High	N/A	MDNR	MDNR CD	N/A	In-Kind	5
69	Calhoun **Eaton** Barry	Convis Lee Clarence **Bellevue** **Carmel** **Kalamo** **Eaton** **Brookfield** **Walton** Assyria Maple Grove	N/A	Watershed Wide	Lack of landuse planning to protect natural resources within the watershed	N/A	Protect natural resources in 10 townships within the watershed	Conduct Natural Resources Inventories for 10 townships within the watershed with a Landuse Planning Consultant	High	Preventative	CD	CCD Townships CD	$160,000	Grants	5
70	Calhoun **Eaton** Barry	All	N/A	Watershed Wide	Lack of appreciation and recreational utilization of the BC River	N/A	Increase knowledge, utilization, and appreciation of the Battle Creek River Watershed by 50%	Create a map that identifies recreational, historical, environmental, social, and cultural features of the Battle Creek River Watershed	High	N/A	CD	CCD CD	$20,000 - $30,000	Grants	1
71	Calhoun **Eaton**	Emmett Pennfield Convis **Bellevue** **Walton** **Eaton**	6 5 21 10 **28** **29** **19**	Watershed Wide	Lack of park utilization	N/A	Increase park utilization by 50%	Expand and improve 6 park conditions within the watershed	High	N/A	CD	CCD CD	$50,000 - $75,000	Grants In-Kind	5

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72	Calhoun **Eaton** Barry	All	N/A	Watershed Wide	Lack of knowledge of the Battle Creek River Watershed	N/A	Increase stakeholder knowledge of the Battle Creek River Watershed by 50%	Develop BCRW promotional items for special events, workshops, tours, fairs, and presentations	Medium	N/A	CD	CD	$5,000 - $10,000	Grants	1
73	Calhoun **Eaton**	N/A	N/A	Critical Areas	Lack of local watershed education in schools	N/A	Increase student knowledge on their local watershed and stream ecology by 50%	Continue to support stream ecology programs by providing teacher trainings and educational tools	High	N/A	CD	CD	$10,000 - $15,000	Grants	5
74	Kalamazoo Calhoun Eaton Jackson	N/A	N/A	Kalamazoo River Watershed	Lack of enforcement of the Soil Erosion Control Program	Sediment	Reduce erosion from construction sites by 75%	Conduct a soil erosion control workshop for contractors, developers, and excavators	High	N/A	MDEQ	MDEQ CD CCD KR&LATMD	$2,500 - $5,500	Grants	1
75	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Development and destruction of wetlands	N/A	Reduce wetland development and destruction by 50%	Restore and/or protect wetland in critical areas	High	N/A	CD	NRCS CD USF&WS	N/A	Grants Cost-Share	5
76	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Development and destruction of prairies and grasslands	N/A	Reduce prairies and grassland development and destruction by 50%	Restore and/or protect prairies and grasslands in critical areas	High	N/A	CD	MDNR CD NRCS PF WO	N/A	Grants Cost-Share	5

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77	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Manicured and over-treated lawns with lack of vegetative bufferstrips	Nutrients	Reduce nutrient run-off from manicured lawns by 50%	Create a riverscaping program to educate landowners on how to design a proper landscape for water quality and wildlife using native and conservation-oriented techniques	High	N/A	CD	MSUE/KBS CD WO LA	$2,500 - $5,500	Grants Cost-Share	10
78	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Lack of appreciation and recreational utilization of the BC River	N/A	Increase appreciation and recreational utilization of the BC River by 50%	Establish a canoe livery on the BC River	High	N/A	Private COB	COB CD	$20,000 - $30,000	Grants	5
79	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Increased development within the BC River Watershed	N/A	Reduce run-off in new developments by 50%	Promote and support Low Impact Developments projects within the watershed	High	N/A	Private	CD CCD MDEQ	N/A	Grants	10
80	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Development and destruction of bird habitat	N/A	Identify and establish critical bird habitat	Promote and designate a bird watching corridor	Medium	N/A	MAS	MAS CD	N/A	Grants	10
81	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Lack of vegetative bufferstrips along stream and drain corridors	Sediment Nutrients	Reduce sediment and nutrient run-off by 50%	Design or identify a program to help landowners financially establish bufferstrips	High	N/A	CD	CD NRCS	N/A	Grants Cost-Share	10

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82	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Lack of protection and a decrease in greenway corridors	N/A	Increase greenway corridors within critical areas of the watershed	Promote open space along the stream corridor by educating landowners and township governments on programs and options Maintain and expand connected tributary corridors	High	N/A	CD	RC&D CD NRCS	N/A	Grants	10
83	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Lack of data and specific subject research on the Battle Creek River	N/A	Increase data collection, analysis, and research on the BC River	Promote the BC River as a topic of research in watershed studies, fisheries, wetlands, and fluvial geomorphology for students obtaining their masters and increase University participation	High	N/A	Universities	MDNR CD MDEQ Universities	N/A	Grants	10
84	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Lack of recognition of farms that are implementing conservation measures to protect and improve water quality	N/A	Recognize farms that are implementing conservation measures in their operation	Design and create a program for farms with an on-farm assessment and checklist that is needed to be in compliance to receive acknowledgement of their conservation efforts to improve water quality on their operation with a sign or plaque	Medium	N/A	CD	NRCS CD RC&D MDA	N/A	Grants	10

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85	Calhoun **Eaton** Barry	All	N/A	Watershed Wide	Lack of participation in conservation programs within the watershed	N/A	Increase participation in conservation programs within the watershed by 50%	Promote already established programs and initiate more participation in the watershed (CRP, WRP, PF&WP)	High	N/A	CD	NRCS CD RC&D USF&W MDNR	N/A	Grants Cost-Share	10
86	Calhoun **Eaton** Barry	All	N/A	Watershed Wide	Lack of knowledge and appreciation of the Battle Creek River Watershed	N/A	Increase appreciation and knowledge of the BC River by 50%	Design promotional items to increase appreciation and knowledge of the BC River Watershed (t-shirts, hats, bobbers, etc.)	Medium	N/A	CD	CD	N/A	Grants	5
87	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Lack of public education on stormwater	N/A	Increase public's knowledge of stormwater by 50%	Implement a storm drain marking program to educate the public on stormwater	High	N/A	CD	CD COB VOB COO COC	N/A	Grants	5
88	Calhoun **Eaton** Barry	All	N/A	Critical Areas	Lack of education on water quality with schools	N/A	Increase water quality education in schools within the watershed	Continue to support stream ecology programs by providing teacher trainings and educational tools	High	N/A	CD	CD Schools	N/A	Grants	10

Evaluation

Evaluating the watershed project will allow stakeholders to judge the effectiveness of the implementation phase.

Interim Milestones:

Interim Milestones are measures of action and progress. They do not necessarily measure environmental improvement, but certainly provide an indication that progress towards environmental improvement is being made. The following interim milestones will be tracked:

- Number and types of BMPs implemented; before and after photographs or videos will be compiled for all physical BMPs
- Phosphorus and sediment pollutant reduction estimates for all physical BMPs
- Number and types of educational materials distributed, and target audiences
- Number and types of educational events, and number of recipients; event follow-up evaluations will be conducted to determine if behaviors were modified
- Adoption of policies, ordinances and other institutional operational procedures designed to protect environmental quality

Long Term Environmental Indicators:
Five different environmental indicators will be used to develop a broad overview and evaluation of the overall water quality of the Battle Creek River now and into the future.

1) Geomorphic Assessment

Geomorphic assessment is a means of evaluating stream stability.

Four geomorphic assessment stations have been established: McAllister Road, McDonald Road, Broadway Highway, and Cochran Road. The four geomorphic assessment stations are long-term monitoring sites that will be visited annually by MDNR staff. Data collection and analysis at the stations will be conducted and evaluated to identify any changes or patterns that may occur in the Battle Creek River.

The Bank Erosion Hazard Index (BEHI) will also be used to measure stream bank erosion severity (Rosgen, 1996). Bank pins will then be utilized to measure stream bank stabilization project efficiency. The Pfankuch method will also be used to determine stream channel stability with any BMP's that will be established in-stream (Pfankuch, 1975).

2) Mussel Surveys

Although mussels have little value as human food, they hold immense ecological value. As a vital link in the food chain, they are a major food item for many animals including muskrats, otters, and raccoons. Ducks, wading birds, and fish also eat young mussels. As important natural filterers, they improve water quality by straining out suspended particles and pollutants from our rivers. A single mussel can filter several gallons of water per day–ultimately making the water cleaner for human uses.

Mussels serve as good indicators of ecosystem health because they remain essentially in one place for a long time and require good water and sediment quality and physical habitat. As such, they are frequently used by biologists as "biological monitors" to indicate past and present water and sediment quality in rivers and lakes. For example, biologists can measure the amount of certain pollutants in mussel tissue to determine the type and extent of water pollution in various rivers and lakes.

Freshwater mussels are often found in aggregations called mussel beds, which can be a mile or more long and contain thousands of mussels. Adults bury themselves in the bottom sediment with a fleshy muscular foot and live by filtering algae and other food items from the water column.

Other species occupy the soft-bottomed sediments typically found in backwaters. Live mussels and dead shells also provide habitat for a variety of aquatic insects and algae. They act like a freshwater "reef," providing the foundation for a variety of life forms and habitat conditions suitable for other aquatic organisms (US Fish and Wildlife Service, 2004). A mussel study will be conducted yearly on the Battle Creek River to evaluate water quality in critical areas in the Battle Creek River Watershed by the MDNR/MNFI.

3) Total Phosphorus Monitoring

Historically, the Battle Creek River has been identified by MDEQ as one of the leading contributors of phosphorus to the Kalamazoo River. MSUE/KBS will be implementing a monitoring program for phosphorus in the Kalamazoo River Watershed for 2 ½ years. Part of the study will take place on the Battle Creek River. One of the outcomes of this study will be to select locations, and determine sample frequencies and numbers for using total phosphorus as a long-term environmental indicator in the watershed.

Wastewater treatment facilities in the watershed, such as Battle Creek and Charlotte, will be responsible for conducting long-term phosphorus monitoring, both sample collection and analysis. This is being undertaken as part of their participation in the Kalamazoo River/Lake Allegan phosphorus TMDL Cooperative Agreement.

4) Land Use and Wetland Changes

Evaluating land use changes within the watershed will help determine any increases in development and impervious surfaces. Calhoun County Community Development will help monitor these changes and evaluate effectiveness of implementation strategies to protect open space. As a part of the land use changes, an evaluation of wetland change will be used as an indication of over-all ecosystem health.

5) Biological Monitoring

Through MSUE/KBS, adult volunteers will be trained to do hands-on physical and biological stream monitoring at various locations within the watershed. These trained volunteers will be utilized to conduct biological monitoring at different locations within the watershed to monitor trends in macro-invertebrates on a yearly basis. The results will then be shared with all stakeholders.

In addition, information from Department of Environmental Quality biosurveys, and Department of Natural Resources fisheries assessments will be used to evaluate the health of biota in the watershed.

Tracking and Synthesis:

The Steering Team will initially track milestones and indicators. However, the long-term intent is the formation of a technical forum, an annual indicator summit, for the purpose of synthesizing data, and making the appropriate decisions based on the data. At this juncture it is envisioned that the Calhoun Conservation District and the Michigan Department of Environmental Quality will convene this summit.

Sustainability

Project sustainability will be obtainable by integrating resources that are already in place. The Battle Creek River and Rice Creek Watershed Partnership Program is a unique cooperation between federal, state, local agencies and organizations that have agreed to work together in uniting conservation efforts and resources. This pilot project will focus conservation priorities in both the Battle Creek River and Rice Creek Watersheds. The Program will be used to implement goals and objectives of the watershed management plan. Research will also continually be conducted to obtain sources of funding available to reduce non-point source pollution within the Battle Creek River Watershed.

Sustainability will also be achieved through other programs such as the Kalamazoo River and Lake Allegan Phosphorous Total Maximum Daily Load Implementation Committee, the Greater Battle Creek Area Watershed Management Committee, and the Kalamazoo River Watershed Council that are addressing watershed and storm water related issues. The Greater Battle Creek Area Watershed Management MS4 process (City of Battle Creek and Calhoun County Community Development) will also create long-term sustainability due to regulatory commitments as a Phase II community. The Battle Creek River Watershed Project will continually be involved with this process. The continued efforts and commitments in partnership and communication with the Battle Creek River Watershed Project will only further the improvement of water quality.

Public involvement in the Battle Creek River Watershed Project will also be utilized to promote project sustainability. The more input a stakeholder has in the project will ultimately provide ownership to promote the implementation of the goals and objectives in the watershed management plan. The creation of a local organization called the "Battle Creek River Watershed Council" or "Friends of the Battle Creek River" will provide local leadership to ultimately lead the efforts of the enhancement of the Battle Creek River Watershed. This organization could solely be its own or a sub-organization of the Kalamazoo River Watershed Council. Members of the council would have yearly membership dues and monthly board meetings with elected members. The organization should be very effective in grant writing, money raising, and implementation of the mission.

Regulatory tools, preventative and institutional measures, and long-term commitments will be an effective means in promoting project sustainability. By implementing regulations, policies, and ordinances that protect water quality, will in turn provide long-term protection and enhancement of water resources. Land use planning at the local level is a tool that will contribute overall long-term conservation of the natural resources that make up the Battle Creek River. Townships that move forward with master plan updates, identification of key natural resources, improve storm water

management and have prepared for future growth will be the leaders in water quality protection. They will determine the future of the landscape for generations to come.

Finally, the geomorphic assessment, in partnership with the DNR Habitat Management Unit, will be utilizing the four stations on the Battle Creek River for long-term data collection and analysis. The assessment on the Battle Creek River is the only one of this kind in Michigan, and will be a model for assessment work for rivers statewide in the future.

It is important that local, state, and federal agencies continue to collaborate together to implement programs, policies, and BMP's' to improve water quality within the Battle Creek River Watershed. Communication will be key to ensuring that water quality continues to recover as new and old partnerships work together to benefit the watershed ecosystem as a whole.

Acronyms

BMP	Best Management Practice
CD	Conservation District
CCD	County Community Development
COB	City of Battle Creek
COC	City of Charlotte
COO	City of Olivet
CRP	Conservation Reserve Program
DC	Drain Commissioner
GSP	Groundwater Stewardship Program
KBS	Kellogg Biological Station
KR&LATMDL	Kalamazoo River & Lake Allegan Phosphorus Total Maximum Daily Load Implementation Committee
LA	Lake Associations
LID	Low Impact Development
MAS	Michigan Audubon Society
MDA	Michigan Department of Agriculture
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MNFI	Michigan Natural Features Inventory
MS4	Municipal Separate Stormwater Sewer Systems
MSU-E	Michigan State University-Extension

NPS	Non-point Source Pollution
NRCS	Natural Resources Conservation Service
OC	Olivet College
Potawatomi RC&D	Potowatomi Resource Conservation and Development
PF	Pheasants Forever
PF&WP	Partners for Fish & Wildlife Program (USF&WS)
PSA	Public Service Announcement
RC&D	Resource Conservation & Development
RMS	Resource Management System
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USLE	Universal Soil Loss Equation
VOB	Village of Bellevue
WHPP	Wellhead Protection Plan
WO	Wild Ones
WQRMP	Water Quality Resource Management Plans
WRP	Wetland Reserve Program