GLRC

on Phase II

Nonpoint Source Pollution Prevention

RED CEDAR Watershed

Management Plan Working Draft

Prepared by Tetra Tech

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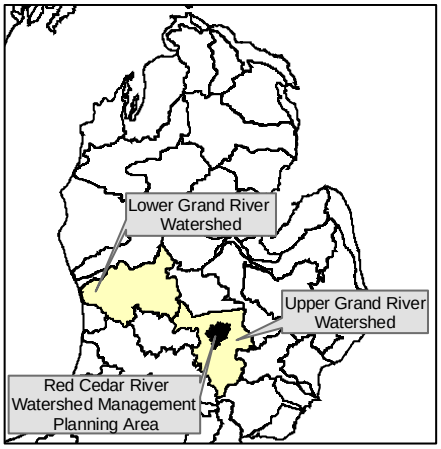
1. Executive Summary

"The significant problems we face cannot be solved at the same level of thinking we were at when they were created."

- Albert Einstein



Michigan Watersheds, Red Cedar River Watershed, Tetra Tech, 2005

The Red Cedar River Watershed is one of three watersheds that was delineated as a result of the formation of the Greater Lansing Regional Committee on Phase II Nonpoint Source Pollution Prevention (GLRC) on May 21, 2004. The GLRC is comprised of 22 political agencies (i.e. communities, drain commissioner's offices, and road commission) that each chose to fulfill the requirements of the Michigan Watershed-Based National Pollutant Discharge Elimination System (NPDES) Phase II Storm Water Permit. The Red Cedar River Watershed contains 19 of the 22 political agencies. Working together as a Red Cedar River Watershed Committee, the permittees have developed this Watershed Management Plan (WMP) to fulfill the permit requirements.

The Red Cedar River Watershed includes both rural and urban areas. Urban land use makes up approximately 33% of the watershed and is mainly located within the Cities of Lansing, East Lansing, Mason, and Williamston; Meridian, Delhi, and Lansing Townships; and Michigan State University. Water quality monitoring has been and continues to be conducted by the Michigan Department of Environmental Quality (MDEQ), the Michigan Department of Natural Resources (MDNR), and local volunteer monitoring groups to determine the effects of various land uses and specific problem areas. As part of this WMP, the permittees will support water quality monitoring to help show changes in water quality as the WMP is implemented.

Priority water bodies within the watershed include the Red Cedar River and the Sycamore Creek. Both of these water bodies have multiple designated uses that are impaired as listed by the MDEQ. The Red Cedar River is impaired for 'Warm Water Fishery', 'Other Aquatic Life and Wildlife', and 'Total and Partial Body Contact'. The Sycamore Creek is impaired for 'Warm Water Fishery' and 'Other Aquatic Life and Wildlife'. It is anticipated that successful completion of the WMP will help protect and restore designated uses of the water bodies within the Red Cedar River Watershed.

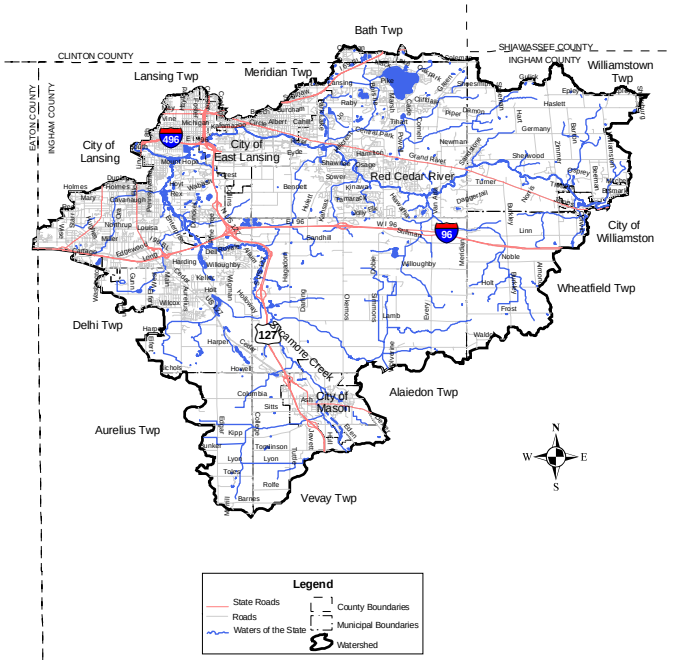
The Red Cedar Watershed has a number of key problems which are discussed in detail in Section 4. Macroinvertebrate and fish communities are only as strong as the habitat available to them in the river corridor. Within that portion of the Red Cedar Watershed covered under this plan, the habitat ranged from excellent to poor. This mixed bag of data tells us that there are areas of the watershed that are still pristine while other areas need restoration. By the time the river reaches Kalamazoo Street, the habitat quality has decreased significantly. In the urbanized area heavy sedimentation deposition, urban debris, and high flow fluctuations were common. The Sycamore Creek also has problems in water quality which has impacted the macroinvertebrate and fish communities, resulting in poor ratings from MDEQ. Sedimentation appears to be the main cause of problems in the Sycamore Creek resulting in low dissolved oxygen.

Development of the WMP and the decision making process of the watershed committee has involved input from the general public and the stakeholders. Multiple public meetings were held at the start of the WMP development, four stakeholder workshops were held throughout the

planning process, and the public was invited to comment near the completion of the plan. At these meetings, the WMP stakeholders and the general public expressed their concerns and vision for the watershed which includes having swimmable and fishable water bodies and significant public education as top priorities. In addition to the vision of the general public and stakeholders, consideration was given to the restoration and protection of the designated uses of the water bodies. The following goals were developed through the public participation and input process:

- Educate the Public about the Importance of Protecting and Managing the Watershed.
- Provide a Sustainable and Equitable Funding Source
- Encourage Water Quality Friendly Development
- Restore and Enhance Recreational Uses Through Development of a Watershed Recreation Plan
- Protect and Enhance Habitat for Wildlife and Aquatic Animals Through Development of a Watershed Habitat Plan
- Protect and Increase Wetlands Through Development of a Watershed Habitat Plan
- Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations
- Strive to Eliminate Pathogens to Meet Total and Partial Body Contact for Recreational Uses
- Encourage Water Quality Friendly Agricultural Practices

Figure 1-1 Watershed Location Map



The goals and objectives were then used to guide the development of the Action Plan in Section 8. The Action Plan is a comprehensive set of actions which support the nine goals and subordinate objectives for the watershed. The goals listed above include the following actions: developing a public education campaign; a funding strategy; development standards; riparian recreation and habitat projects; pollution prevention practices; an illicit discharge elimination program; and agricultural best management practices. The actions are presented in a table under their corresponding goal and objective and are accompanied by a schedule, responsible party, evaluation mechanism, and cost. Permittees are expected to incorporate portions of the WMP Action Plan, which are applicable to their agency, into their individual Storm Water Pollution Prevention Initiatives (SWPPI).

Implementation of the WMP will be predominately through sub-committee actions as discussed in Section 10 of this WMP. As part of the WMP Action Plan, a funding strategy will be developed for procuring start-up and continual funding for WMP implementation. The GLRC currently uses a funding allocation formula based on population and land area of the permitted communities within the watershed.

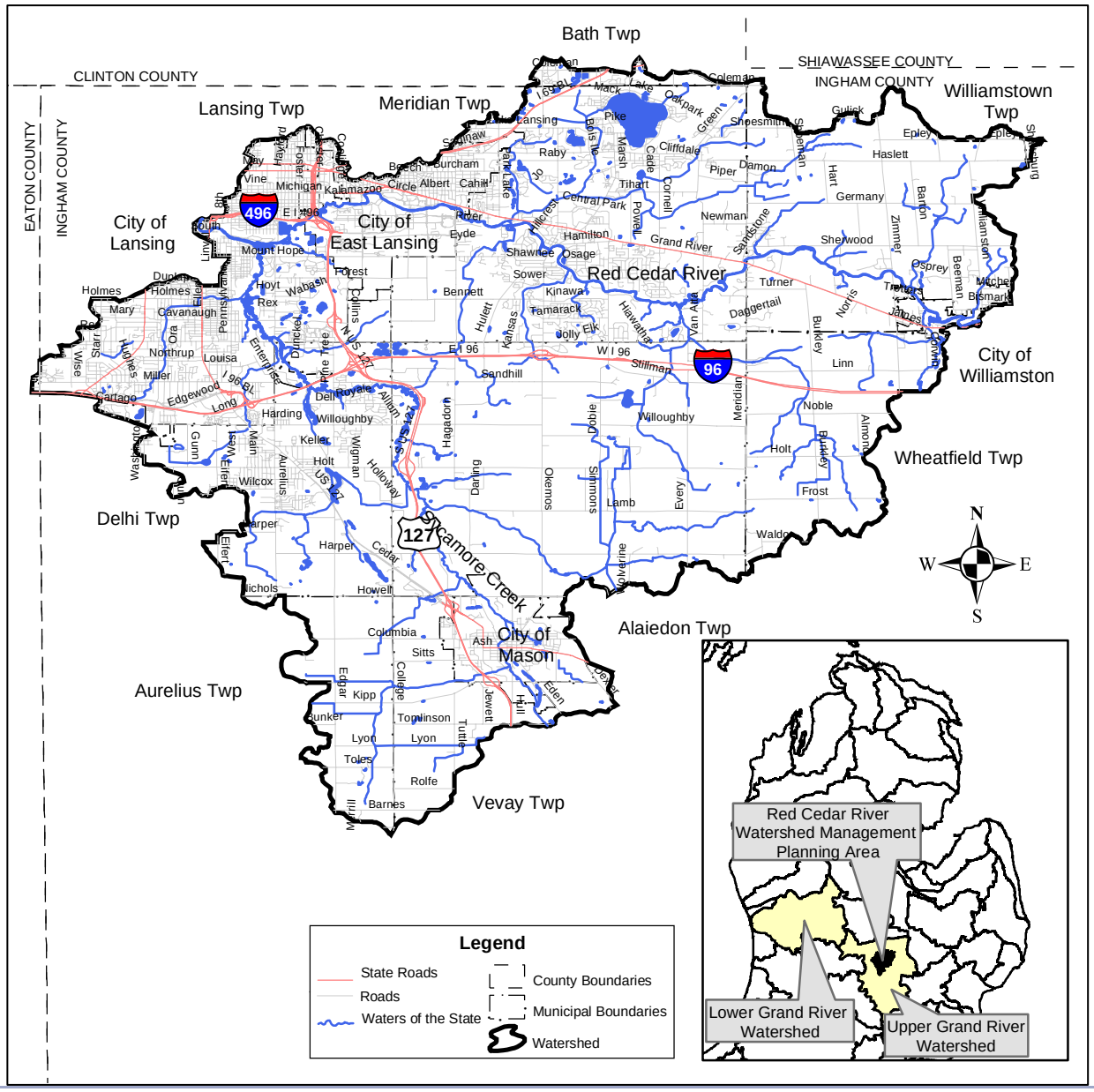
The GLRC will continue to oversee watershed management throughout the tri-county region under their current organizational structure but will consider additional or alternate legal organizational structures if necessary to implement the WMP in the future. This WMP is intended to be a fluid adaptive document that can be changed as needs arise.

2. Introduction

American lotus

Effective April 21, 2004, the State of Michigan, by Public Act 78 of 2004, officially designated the American lotus blossom (*Nelumbo lutea*) as the state symbol for clean water. The American lotus is a showy plant that proliferates in shallow wetland areas during the summer months. Micro and macro invertebrates inhabit submerged portions of the plant, which in turn are used as food for fish and other wildlife. The adoption of this symbol demonstrates Michigan's commitment to wetland protection and clean water. Michigan's commitment is further established by the National Pollutant Discharge Elimination System (NPDES) Phase II storm water permit requiring communities to conduct storm water or watershed planning. The Red Cedar Watershed Management Plan contained herein is one of many planning efforts in Michigan.

Figure 2-1. Watershed location map.



Red Cedar Watershed

The Red Cedar River is a major tributary to the Grand River, located in Central, Lower Michigan (Figure 2-1). The Red Cedar River discharges into the Grand River in Lansing, Michigan, which continues on west and drains into Lake Michigan.

Approximately 106,000 acres of the acres comprising the Red Cedar River Watershed are included in this watershed management plan (WMP). Within the watershed there are about 225 miles of rivers and streams. The two largest are the Red Cedar River and Sycamore Creek. There are also approximately 985 acres of lakes within the watershed with approximately 46% of that area attributed to Lake Lansing.

Purpose of the Watershed Management Plan

On March 10, 2003 any municipality within the Lansing Urbanized Area (UA) was required to submit a NPDES Phase II storm water permit. In Michigan, permittees were given the choice of submitting a jurisdictional or a watershed based permit. Michigan is the only state to offer this permitting option. With over 300 communities in Michigan needing to apply for Phase II Permit coverage, over 250 have decided to use the watershed planning option, due to its many benefits over a traditional permitting program.

Some benefits of the watershed approach include: access to grant funding, including the State Bond Fund known as Clean Michigan Initiative (CMI), expanded schedules for watershed management planning, and choices on how and when implementation will occur. A watershed approach involves coordination with both public and private sectors focusing efforts to address the highest priority problems.

As a result of this watershed permit approach, the Greater Lansing Regional Committee on Phase II Nonpoint Source Pollution Prevention (GLRC) was created. The GLRC has developed this plan to address the requirements outlined in the Phase II permit and to improve and protect the ecological, hydrological, and cultural resources of the Red Cedar River Watershed.

What is a Watershed

A watershed is any area of land that drains to a common point. That common point may be a lake, the outlet of a river, or any point within a river system. Throughout this WMP, the terms basin, subbasin, watershed, subwatershed, and catchment are used to describe the drainages of the river (Figure 2-2).

Watershed Management Units

The largest watershed management unit is the basin. A **basin** drains to a major receiving water such as a large river, estuary or lake. Within each **basin** are a group of **subbasins**, that are a mosaic of many diverse land uses, including forest, agriculture, range and urban areas. **Subbasins** are composed of a group of **watersheds**, which, in turn, are composed of a group of **subwatersheds**. Within **subwatersheds** are **catchments**, which are the smallest units in a watershed, defined as the area that drains an individual development site to its first intersection with a stream.

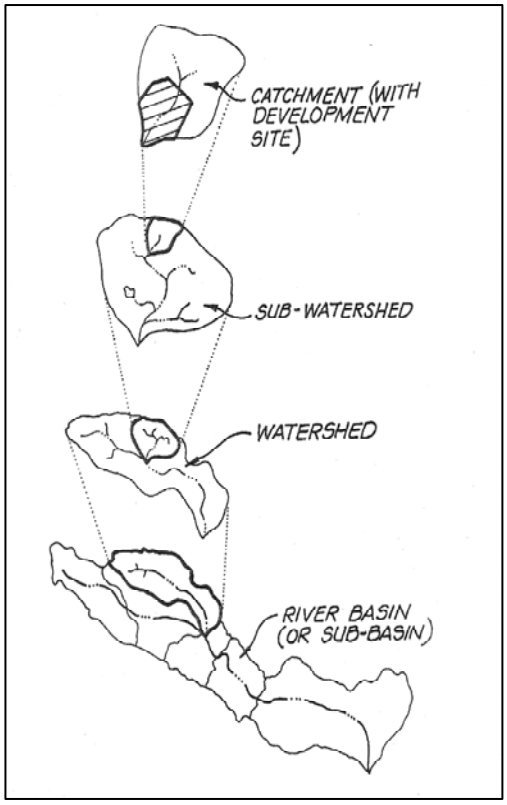
Source: CWP, 1998.

Table 2-1. Description of Watershed management units.

Watershed Management Unit	Typical Area (square miles)	Influence of Impervious Cover	Sample Management Measures
Catchment	0.05 – 0.50	Very Strong	BMP and site design
Subwatershed	1 – 10	Strong	Stream classification and management
Watershed	10 - 100	Moderate	Watershed-based zoning
Subbasin	100 - 1,000	Weak	Basin planning
Basin	1,000 – 10,000	Very Weak	Basin planning

Source: CWP, 1998.

Figure 2-2. Watershed management units.



Source: CWP, 1998.

Plan Requirements

According to the **MDEQ NPDES Wastewater Discharge General Permit** for *Storm Water Discharges from Municipal Separate Storm Sewer Systems Subject to Watershed Plan Requirements*, the WMP shall, at a minimum, contain the following:

- an assessment of the nature and status of the watershed ecosystem to the extent necessary to achieve the purpose of the WMP;
- short-term measurable objectives for the watershed;
- long-term goals for the watershed (which shall include both the protection of designated uses of the receiving waters as defined in Michigan's Water Quality Standards, and attaining compliance with any Total Maximum Daily Load (TMDL) established for a parameter within the watershed);
- determination of the actions needed to achieve the short-term measurable objectives for the watershed;
- determination of the actions needed to achieve the long-term goals for the watershed;
- assessment of both the benefits and costs of the actions identified above (a "cost/benefit analysis" is not required);
- commitments, identified by specific permittee or others as appropriate, to implement actions by specified dates necessary to achieve the short-term measurable objectives;
- commitments, identified by specific permittee or others as appropriate, to implement actions by specified dates necessary to

initiate achievement of the long-term goals; and
- methods for evaluation of progress, which may include chemical or biological indicators, flow measurements, erosion indices, and public surveys.

Relevant Federal, State, and Regional Programs

Clean Water Act

Growing public awareness and concern for controlling water pollution led to enactment of the Clean Water Act (CWA) of 1972. The Act established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave EPA the authority to implement pollution control programs, such as setting wastewater standards for industry. The CWA also continued requirements to set water quality standards for all contaminants in surface waters. The Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions. It also funded the construction of sewage treatment plants under the construction grants program and recognized the need for planning to address the critical problems posed by nonpoint source pollution.

Subsequent enactments modified some of the earlier CWA provisions. Revisions in 1981 streamlined the municipal construction grants process, improving the capabilities of treatment plants built under the program. Changes in 1987 phased out the construction grants program, replacing it with the State Water Pollution Control Revolving Fund, more commonly known as the Clean Water State Revolving Fund (SRF). This new funding strategy addressed water quality needs by building on EPA State partnerships.

The State of Michigan administers the Total Maximum Daily Load (TMDL) program in Michigan. These rules define the water quality goals for a lake or stream. MDEQ defines water quality standards (WQS) as "state rules established to protect the Great Lakes, the connecting waters, and all other surface waters of the state". The goals are in three areas, including the uses of the lake or stream, such as swimming and fishing; safe levels to protect the uses, such as the minimum oxygen level needed for fish to live; and procedures to protect high quality waters." (MDEQ, 2005)

Public Act 451 of 1994 – Natural Resources and Environmental Protection Act

The Natural Resources and Environmental Protection Act is designed to protect the environment and natural resources of the state by:

- regulating pollutant discharges
- regulating land, water, and resource use
- prescribing penalties and remedies for violations.

Notable parts of the act relating to storm water include: Part 31 – Water Resources Protection; Part 41 – Sewerage Systems; Part 87 – Groundwater and Freshwater Protection; Part 91 – Soil Erosion & Sedimentation Control; Part 301 – Inland Lakes and Streams; Part 303 – Wetland Protection; and Part 305 – Natural Rivers Act.

Public Act 40 of 1956 – The Drain Code

The Drain Code sets forth procedures for the creation, maintenance and financing of county and inter-county drains in Michigan. It establishes the office and prescribes the duties and powers of the county drain commissioner. County drains are important to Phase II efforts because many of them are waters of the state, and most of them discharge directly or indirectly to waters of the state. (Pratt, 2005)

State Programs and Permits

State programs that directly enforce and assist in compliance with federal and state storm water regulations include the following MDEQ Water Division groups: Storm Water, Soil Erosion and Sedimentation Control, NPDES Permits, and Nonpoint Source Pollution. State-level funding programs that support storm water related projects include: the SRF, the Strategic Water Quality Initiative Fund, and the CMI.

Despite the NPDES permitting process that covers storm water-specific issues, other permits may apply for a specific case. Many state and federal permits are covered under the MDEQ/U.S. Army Corps of Engineers Joint Permit Application (JPA) package. The JPA covers activities relating to: wetlands, floodplains, marinas, dams, inland lakes and streams, great lakes bottomlands, critical dunes, and high-risk erosion areas. Other permits not included in the JPA include: the Sewerage System Construction Permit and the Groundwater Discharge Permit.

Additional Programs

Specific situations may invoke numerous other federal, state, and local programs that directly or indirectly relate to storm water issues. The following list presents some of these:

- The federal Safe Drinking Water Act establishes wellhead protection provisions that are implemented at the state (MDEQ Water Wellhead Protection program) or local level. Wellhead protection may involve managing and treating storm water to prevent aquifer pollution.
- Coastal and shoreline areas invoke numerous federal laws such as the Shoreline Erosion Protection Act and the Coastal Zone Act, state laws, and state programs such as Coastal Management, Sand Dune Protection, and Shoreland Management.

Commercial/industrial facilities (mines, landfills, agriculture facilities, etc.) have numerous laws and regulations controlling on-site materials use and site-related runoff control requirements that are designed to minimize environmental impacts. Example laws include: the Surface Mining Control & Reclamation Act, the Resource Conservation and Recovery Act, and the Federal Insecticide, Fungicide, and Rodenticide Act.

References

Center for Watershed Protection. "Rapid Watershed Planning Handbook." 1998. Ellicott City, Maryland.

Michigan Department of Environmental Quality. "TMDL Website." Via: www.michigan.gov. Last accessed: February 2nd, 2005.

Pratt, Paul. "E-mail communication concerning Michigan's Drain Code". January 28th, 2005.

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3. Watershed Characteristics

River Quote

"I started out thinking of America as highways and state lines. As I got to know it better, I began to think of it as rivers."

- Charles Kuralt

Subwatersheds

The boundaries of the Red Cedar Watershed and its nineteen subwatersheds are based on United States Geological Survey (USGS) defined boundaries (USGS, 2005). These boundaries, or Hydrologic Unit Codes (HUCs), divide the United States into discrete, nested areas based on common drainage patterns.

The subwatersheds range in size from 10 to 15 square miles. Figure 3-1 presents a map of these subwatersheds. Table 3-1 lists them with corresponding areas and watershed coverage percentages.

Political Jurisdictions

The Red Cedar Watershed is a diverse watershed made up of 15 distinct political jurisdictions. While Alaiedon Township, Meridian Township, Williamstown Township, the City of Lansing, and Delhi Township are the five largest communities in the watershed, they represent very different types of communities.

Figure 3-1. Subwatersheds of the Red Cedar Watershed.

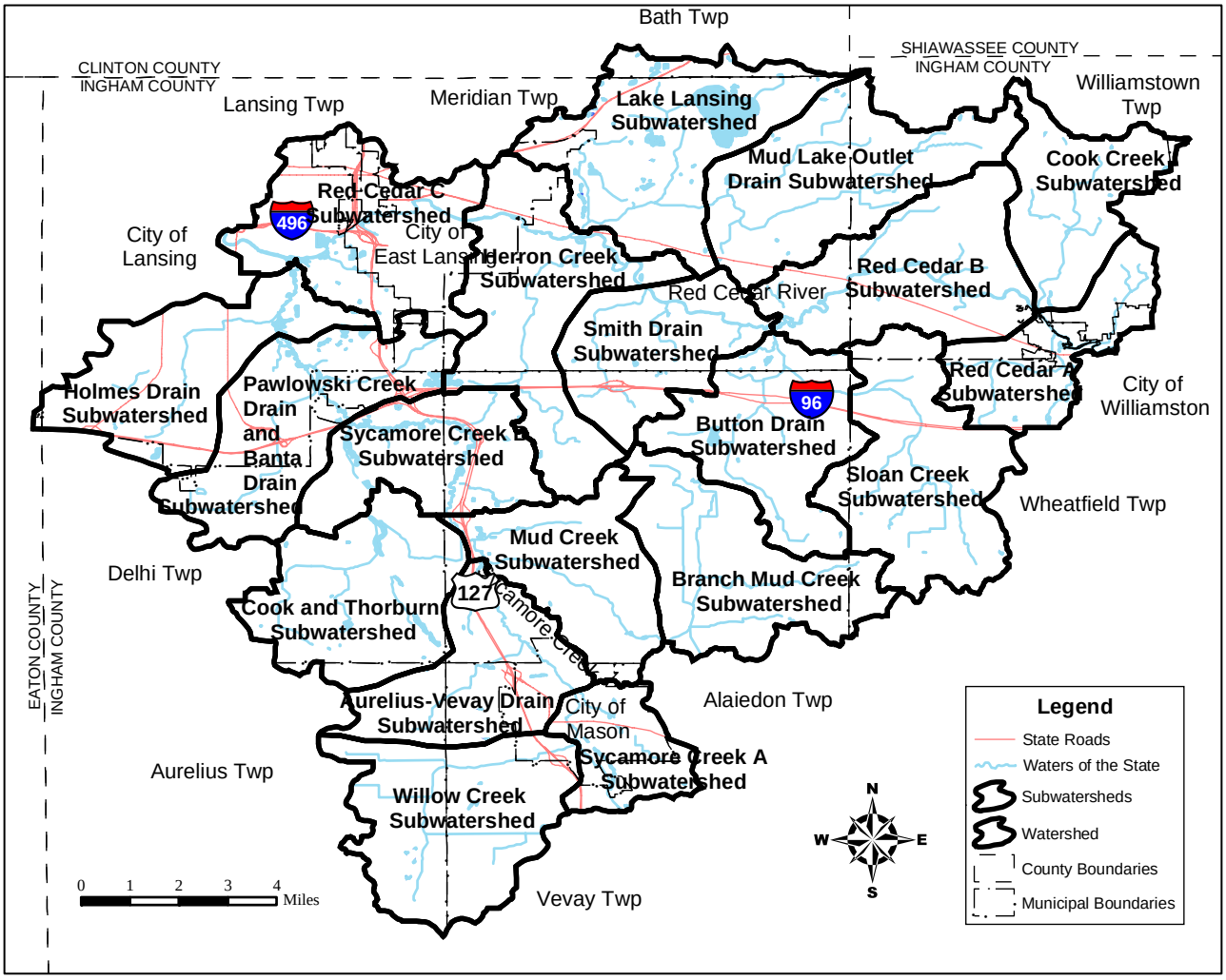


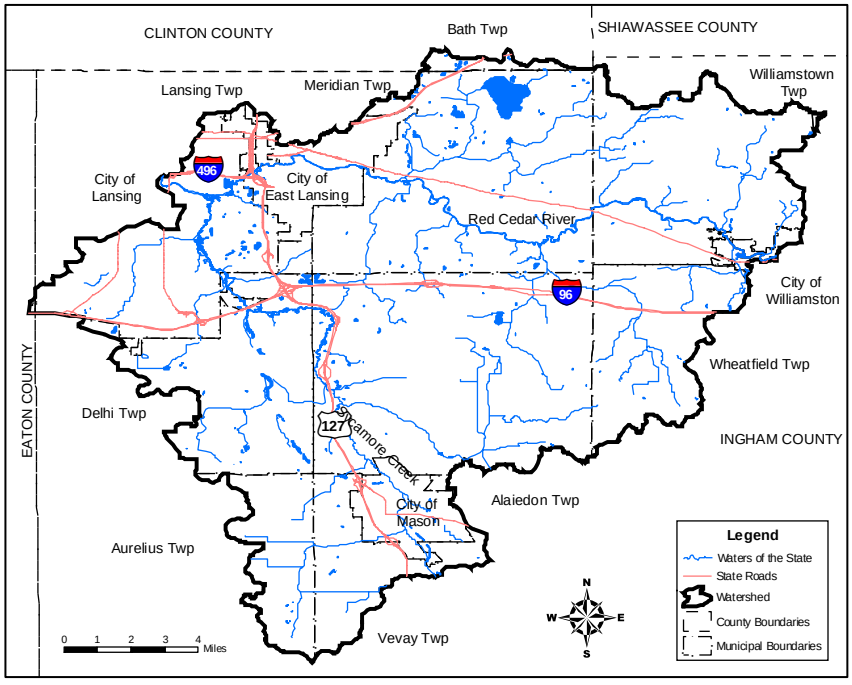
Table 3-1. Political Jurisdictions in the Watershed.

Subwatershed	Alaiedon Township	Meridian Township	Williamston Township	City of Lansing	Delhi Township	Wheatfield Township	Vevay Township	Aurelius Township	City of East Lansing	City of Mason	Lansing Township	Bath Township	City of Williamston	Locke Township	Windsor Township	Total Area (ac)	% of Watershed
Aurelius-Vevay Drain	1,592				8		993	1,263		1,033						4,889	5%
Branch Mud Creek	5,608					518										6,126	6%
Button Drain	4,745	620				150										5,516	5%
Cook and Thorburn	262				5,240			448								5,949	6%
Cook Creek			4,099										3	48		4,150	4%
Herron Creek	1,863	3,442		282					1,263							6,850	6%
Holmes Drain				5,447	249										22	5,718	5%
Mud Creek	4,587				7		109			88						4,791	5%
Pawlowski /Banta Drain		109		2,899	2,824				57		404					6,293	6%
Mud Lake Outlet Drain		3,976	2,639													6,615	6%
Pine Lake Outlet		6,017	14						320			743				7,094	7%
Red Cedar A			1,441			1,613							707			3,761	4%
Red Cedar B		1,501	4,752										11			6,264	6%
Red Cedar C		273		3,197					2,570		540					6,579	6%
Sloan Creek	310	13	458			5,866										6,648	6%
Smith Drain	1,158	3,142		199												4,499	4%
Sycamore Creek A							958			1,598						2,556	2%
Sycamore Creek B	2,099			12	2,564											4,675	4%
Willow Creek							3,196	3,115		343						6,653	6%
Total	22,223	19,095	13,404	12,036	10,892	8,148	5,255	4,826	4,211	3,062	943	743	720	48	22	105,629	100%
% of Watershed	21%	18%	13%	11%	10%	8%	5%	5%	4%	3%	1%	1%	1%	0%	0%	100%	---

Area given in acres. Blank boxes indicate that jurisdiction does not exist in subwatershed.

Alaiedon and Williamstown Townships are both rural areas with increasing development pressure. Meridian and Delhi Townships are more developed but still have rural and agricultural areas that can be protected. The City of Lansing is the center of the metropolitan areas and is almost completely developed. Figure 3-2 presents a map of these local units of government. Table 3-1 shows the acreage of each community in the watershed and watershed coverage percentages.

Figure 3-2. Local units of government in the Red Cedar Watershed.



Early Inhabitants

Lansing, Michigan was first described by British Fur Traders in 1790. They noted: "The banks of red land thence came to a river from the East and a little lower two cabins of Indian from Sagana – they were providing cannots (canoes) for their departure … from high broken land and some pine and cedar" trees. Native Americans, Sagana, were a tribe from the Saginaw band of Chippewa. They had villages or camps at what are now Okemos and Williamston and maintained corn, pumpkins, and beans in surrounding fields. They developed caves in the high, sandy banks of the Red Cedar River and used them as granaries: storing venison, nuts, and other foods for used in the winter.

- Provided by Jerry Lawler from Darling, 1990 & Malik, 1960

Source: UM, 2005.

Demographics

The communities with the highest population in the watershed are the City of Lansing (43%), Meridian Township (24%), Delhi Township (9%), the City of East Lansing (6%), Michigan State University (6%), and the City of Mason (5%). The other municipalities contribute 3% or less to the watershed population.

The fastest growing communities for the period from 1990 to 2000 include Aurelius Township (+24%), Bath Township (+19%), the City of Williamston (+18%), Delhi Township (+18%), Williamstown Township (+13%), Meridian Township (+10%), and Alaiedon Township (+10%). Communities showing population declines over this period include the City of East Lansing (-8%) including Michigan State University (MSU), the City of Lansing (-7%), Lansing Township (-5%), Wheatfield Township (-4%), and Vevay Township (-1%).

Over the next 30 years, the watershed population is expected to grow by 6% every decade with Aurelius Township (+29%), Bath Township (+18%), Windsor Township (+17%), and the City of East Lansing including Michigan State University (+10%) showing the greatest growth per decade.

Table 3-2 shows the past, present, and future population in the region and associated population change percentages (non-participating communities shown in italics).

Source: RSGIS, 2005.

Table 3-2. Population in the watershed.

Community	Population in Watershed			Avg. % Change per 10 yr	
	1990	2000	2030	90-00	00-30
Alaiedon Township	3,098	3,415	3,720	10%	3%
Aurelius Township	556	687	1,279	24%	29%
Bath Township	204	242	372	19%	18%
Delhi Township	11,322	13,316	16,494	18%	8%
City of East Lansing	10,275	9,427	12,379	-8%	10%
Lansing Township	1,161	1,101	1235	-5%	4%
City of Lansing	71,254	66,388	71,093	-7%	2%
Locke Township	3	3	3	0%	0%
City of Mason	6,713	7,164	8,052	7%	4%
Meridian Township	33,910	37,216	46,136	10%	8%
Vevay Township	960	946	1,044	-1%	3%
Wheatfield Township	733	701	808	-4%	5%
City of Williamston	1001	1,178	1,379	18%	6%
Williamstown Township	3,137	3,538	3,747	13%	2%
Windsor Township	6	6	9	0%	17%
Michigan State University	10,189	9,354	12,275	-8%	10%
Total	154,521	154,177	180,026	0%	6%
Total (participating)	149,092	148,070	172,809	-1%	6%

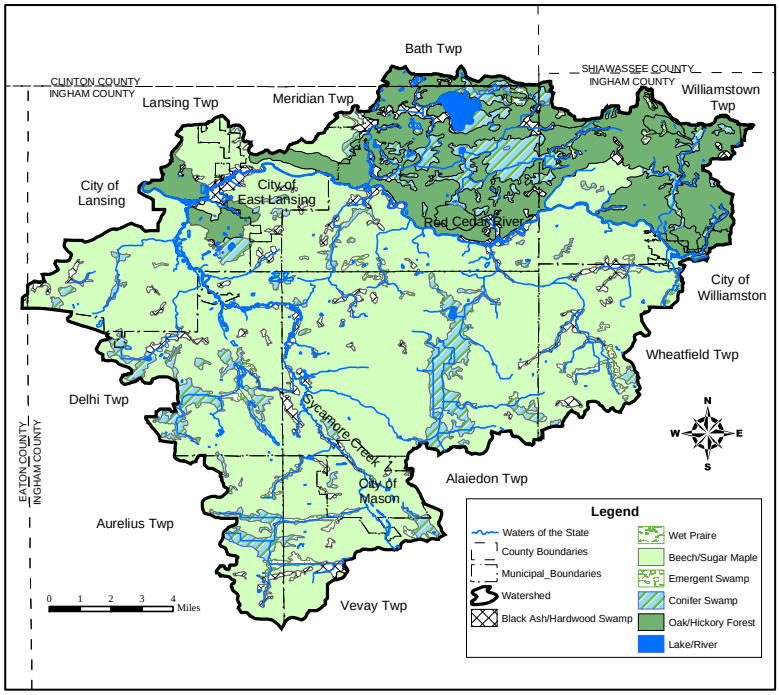
Source: USCB, 2004; TCRPC, no date.

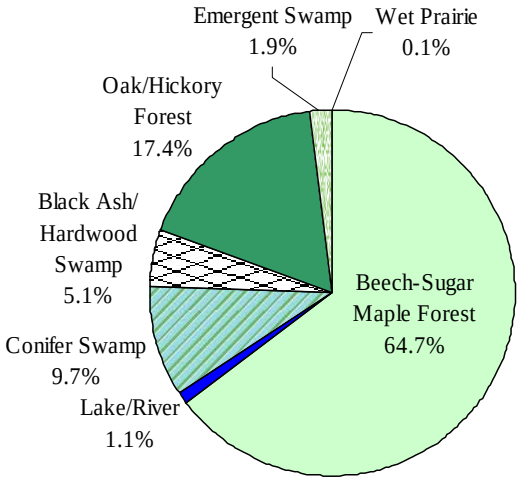
Source: LFC, 2004.

Land Use and Growth Trends

Historically, much of the Red Cedar River watershed was comprised of deep forests and swamps / wetlands. The majority of the upland land ecosystem was comprised of Beech/Sugar Maple Forests, with the area to the north of the Red Cedar comprised of Oak/Hickory Forests with interspersing conifer swamps. Remnants of these conifer swamps can be seen in Lake Lansing Park North. Figure 3-3 shows a map of the land types in the watershed circa 1830 and shows a percentage breakdown of these land types.

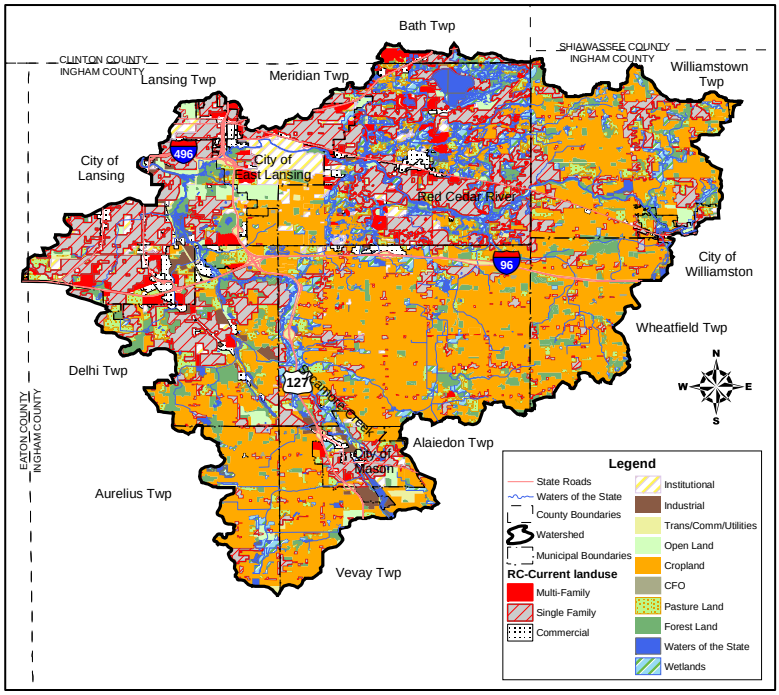
Figure 3-3. Land types - circa 1830.

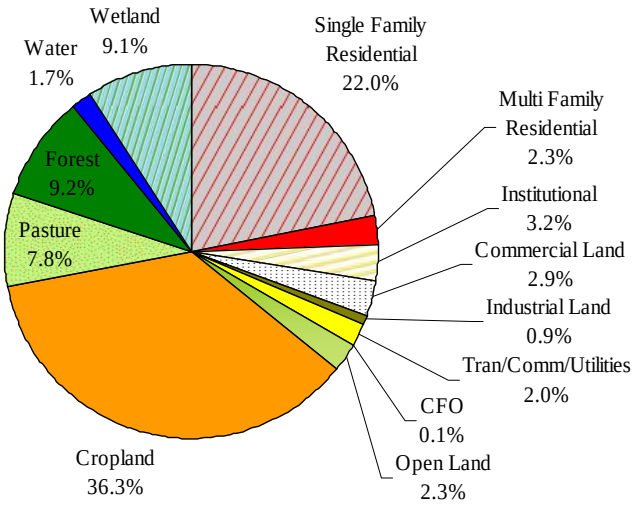




As can been seen in Figure 3-3, a significant portion of the Red Cedar Watershed was forest or swamp/wetland of some type. Permanent human settlement brought great change to the landscape as the land began to be altered for human benefit. One example is that much of the swamps/wetlands were drained to provide land for farming, settlement, and transportation. This and other changes such as urban development, dams, river relocation, and dredging significantly altered the landscape which we now see today (Figure 3-4).

Figure 3-4. Land types – present day.





Source: TCRPC, 2004.

Grand River Plank Road

The construction of the Grand River Plank Road opened up a direct route between Lansing and Detroit. This road provided an easy route for people and goods to travel the area and thus played a role in facilitating settlement and expansion of the areas. Today, this road is called Grand River Avenue.

These changes have resulted in a loss of 90% of the forest cover and 60% of the wetlands.

Based on zoning ordinances for the various watershed communities, the projected future land use indicates that residential, industrial, and commercial land uses will expand in those areas currently seeing such land uses. This includes most of the watershed except for the southern-central area which is projected to be dominated by agricultural use (except for the city of Mason) and the northeastern portion which is projected to show a mix of agriculture and the previously mentioned uses. Figure 3-5 shows the future land use.

Urbanized Land Use

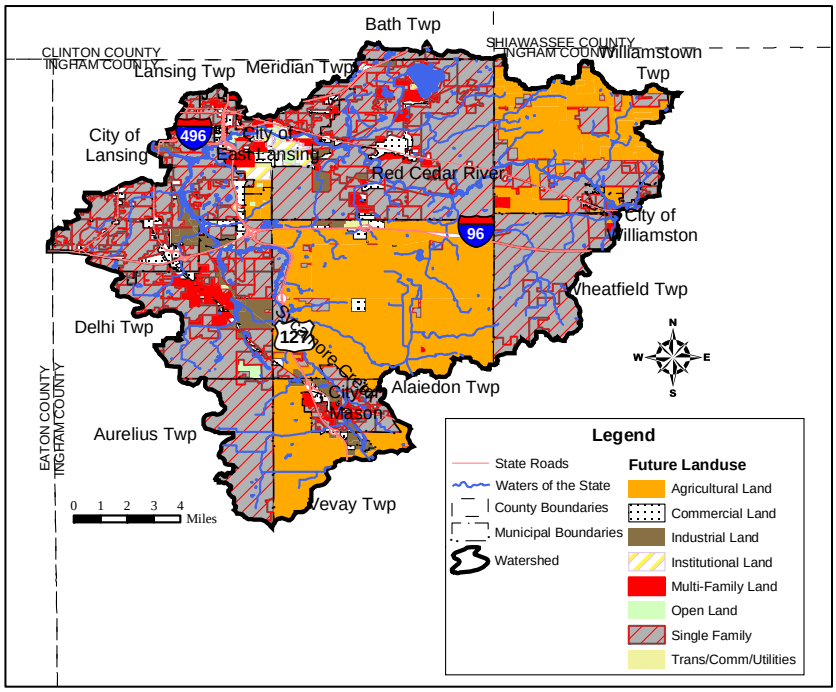
The major urbanization zones of the watershed include the Cities of Lansing, East Lansing, Mason, and Williamston; Meridian, Delhi, and Lansing Townships; and MSU. The predominant land use type within these communities is single-family residential, while the urbanized portion of MSU is dominated by institutional buildings and dormitories or multi-family uses.

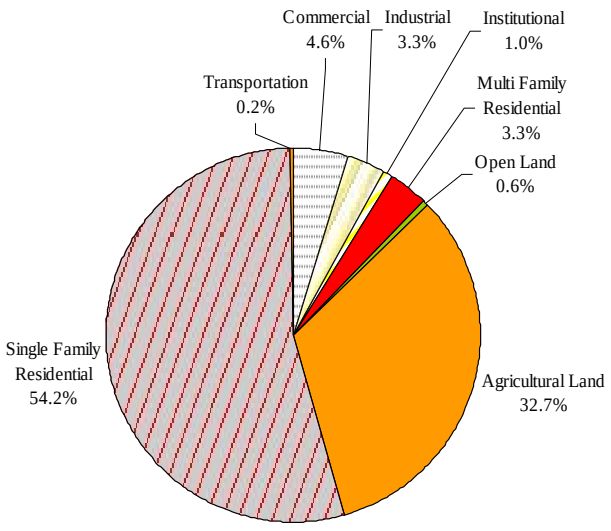
Several major thoroughfares transect the watershed including Interstate 96 (I-96), Interstate 496 (I-496), and US-127. Interstate-69 (I-69) parallels the northern boundary of the watershed, but is not within the boundaries.

Much as the Grand River Plank Road historically served the purposes of travel and commerce, these highways are crucial routes today for transporting people and goods between metropolitan areas in the state. Additionally, they play a role in directing future urbanization by opening up more rural townships and cities to convenient intra- and interstate travel. Consequently, highway access and exit ramps become hubs for development.

Figure 3-5 illustrates that urbanization will become predominant in the Cities of Williamston, and East Lansing; Wheatfield, Aurelius, Bath Townships; and MSU. The population predictions presented in Table 3-2 support the projected land use growth observed in Figure 3-5. Population growth projections for City of Williamston and Wheatfield Township are lower than what might be expected. Substantial development has occurred in this area since 2000 and may not be represented fully in Table 3-2.

Figure 3-5. Land types – future.





Agricultural Land Use

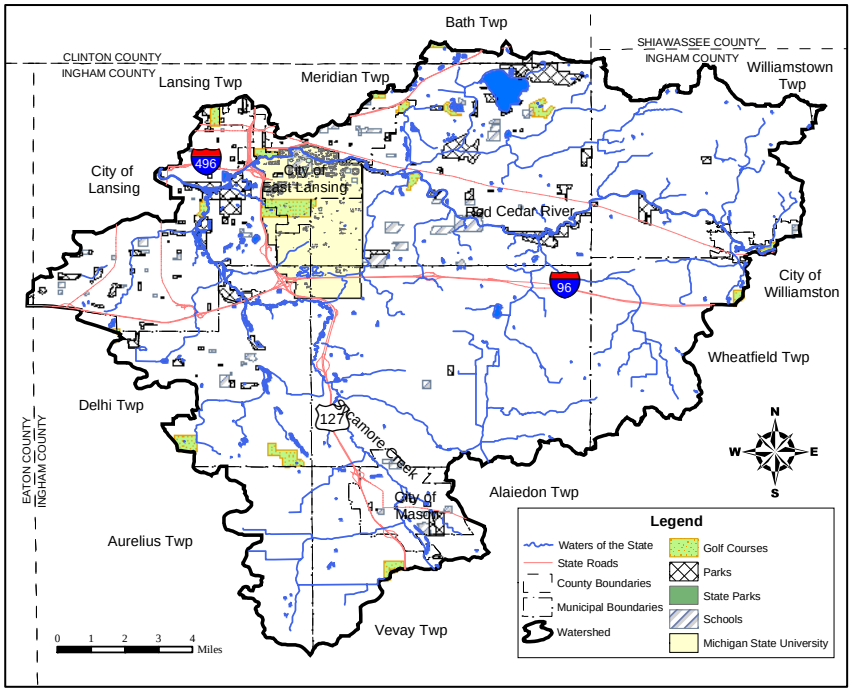
Significant changes in agricultural land use have also occurred in the last century. Although a map is not available, there is data to support this idea. For example, in the 1930s, Ingham County had approximately 350 square miles of cropland. Comparing this to available data for 2002, Ingham County now has 290 square miles still in farmland. This information shows that in 62 years, over 60 square miles of agriculture was converted to another land use type averaging to about one square mile per year.

Public Land

Public land is a valuable component of the land use within the watershed. They provide recreation, resources, and opportunities to improve the watershed through best management practice implementation.

Figure 3-6 shows the location of the known public lands in the watershed. The public land uses include golf courses, parks, state parks, schools, and universities. Approximately 11 percent of the watershed is composed of public lands. Of this 11 percent, MSU makes up about 46 percent of the public lands, local parks - 30 percent, and golf courses and schools - 12 percent each.

Figure 3-6. Public lands.



Source: TCRPC, 2004.

Livestock

Eight-hundred and ninety livestock farms with approximately 68,000 livestock head exist throughout Ingham County. Additional data is presented below:

Livestock	Farms	Head
Cattle / calves	258	15,803
(sold)	206	5,792
Beef cattle	167	2,110
Dairy cattle	44	4,858
Hogs / pigs	31	8,549
(sold)	39	15,578
Sheep / lambs	73	2,502
Layers (20 wks +)	60	9,775
Poultry (sold)	12	3,026
Total	**890**	**67,993**

Crops

Historically, crops grown in Ingham County consisted of oats, wheat and corn.

Today, seven-hundred and thirty-nine farms in Ingham County harvest approximately 143,500 acres of land. Specific crop data is presented below:

Crop	Farms	Acres
Corn for grain	248	49,189
Corn for silage	65	4,325
Sorghum for grain	1	n/a
Wheat for grain	119	14,383
Barley for grain	5	63
Oats for grain	15	311
Sunflower seed	1	n/a

Note that soybean is a main crop in the county although specific data is not available.

Source: Tanner, 2005.

Wetland Types

Aquatic Bed- Areas of shallow permanent water that are dominated by plants that grow on or below the surface of the water

Emergent Wetlands- include marshes, fens, wet meadows, and potholes

Forested- Forested swamps are found throughout the United States. They are often inundated with floodwater from nearby rivers and streams.

Open Water- Deeper, perennial pools within wetlands and shallow portions of lakes and rivers.Typically home to submerged plants

Scrub/Shrub- Shrub swamps, are similar to forested swamps, except that shrubby vegetation predominates.

Wetlands

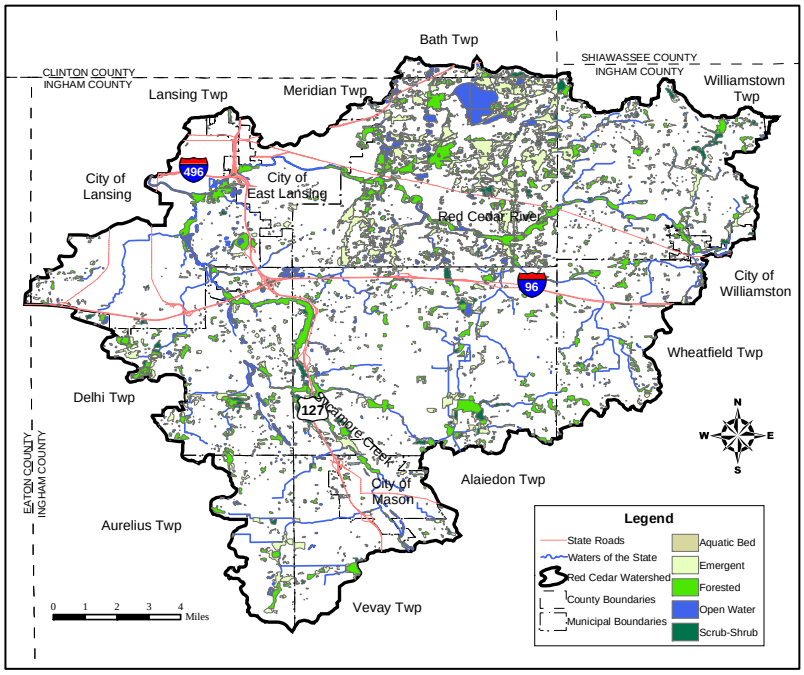
In general terms, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin, 1979).

Wetlands can play critical roles in flood storage, nutrient transformation, and water quality protection and, as part of a healthy riparian corridor, may dampen the effects of impervious cover within the watershed. Important wetland functions and values include:

- Flood prevention and temporary flood storage, allowing the water to be slowly released, evaporated, or percolate into the ground and recharging groundwater.
- Sediment capture and storage.
- Wildlife habitat for a wide diversity of plants, amphibians, reptiles, fish, birds, mammals, and related recreational values.
- Water quality improvement by filtering pollutants out of water.
- The support of approximately 50 percent of Michigan's endangered or threatened species (Cwiekial, 2003).

Figure 3-7 shows the location of wetlands in the watershed. Table 3-3 presents the wetland coverage for the subwatersheds. Currently, wetland coverage in the watershed is 13% of land area. Generally speaking, those subwatersheds that have expansive contiguous areas of residential build-out, such as Holmes Drain, Red Cedar C, Sycamore Creek A have the lowest percentage of land mass existing as wetlands (5%, 6%, and 5%, respectively).

Figure 3-7. Wetlands.



The majority of wetlands in the watershed exist in the subwatersheds of which Meridian Township is a part, including Mud Lake Outlet Drain and Lake Lansing. These subwatersheds also have the highest percentage of land mass existing as wetlands (28% and 34%, respectively). The reason for this, in spite of the development extent and continuing development pressures being placed on the township, is the fact that the township has a wetland ordinance in place that effectively preserves wetlands.

This is an important consideration for the future as development continues to pressure the wetlands in subwatersheds that have not yet experienced extensive development.

Importance of Headwater Streams

Headwater streams and wetlands are often undefined, unmapped, small locations which provide the water that flows and maintains our river systems. The term "headwater" refers to the smallest stream or wetland that flows into a stream network. Regional studies have shown that these headwater streams and wetlands make up more than 80% of the nation's stream network. These waterways provide many of the benefits that scientists call "ecosystem services". They provide groundwater filtering and recharge, recycling of waste products, flood control, spawning and mating grounds for fish and wildlife, and the water for human use. Most importantly, headwater streams and wetlands provide the basis for improved water quality in our watersheds.

"THE PHYSICAL, CHEMICAL, AND BIOTIC INTEGRITY OF OUR NATIONS' WATERS IS SUBTAINED BY SERVICE PROVIDED BY WETLANDS AND HEADWATERS STREAMS"

- Where Rivers are Born: The Scientific Imperative for Defending Small Streams and Wetlands, 2003

Climate

The climate of the Red Cedar Watershed can generally be described as one having a warm summer and a cool-to-cold winter.

The average temperature in the region is highly seasonal. The average temperature for the month of January, the coldest month, is 22.7 °F while August, the warmest month, has an average temperature of 71.2 °F – a difference of 48.5 °F.
The average annual precipitation is 32.82 inches. Like the temperature, it is seasonally variable, with February, the driest month receiving 1.57 inches on average, while June, the wettest month, receives 3.73 inches on average – a difference of about 2.2 inches.

In the months of October through April, a portion of precipitation typically occurs as snowfall. The greatest amount of snowfall occurs in January (13.4 inches on average – approximately equivalent to 1.3 inches of rainfall) and accounts for 75% of the precipitation for the month. The months of June through August average no snowfall, while May and September may receive trace amounts.

The wind in the region generally comes from the west / southwest at 9 mph during the summer and 12 mph during the winter. The peak gusts generally occur in the spring / early summer.

More detailed climatic information is presented in Table 3-4.

Table 3-3. Wetlands.

Subwatershed	Wetland Acres	Wetland Coverage	Subwatershed Wetland (ac) per Watershed Wetland (ac)
Aurelius-Vevay Drain	580	12%	4%
Branch Mud Creek	817	13%	6%
Button Drain	635	12%	5%
Cook and Thorburn	845	14%	6%
Cook Creek	562	14%	4%
Herron Creek	882	13%	6%
Holmes Drain	312	5%	2%
Mud Creek	341	7%	2%
Mud Lake Drain	713	11%	5%
Mud Lake Outlet Drain	1,840	28%	13%
Lake Lansing	2,418	34%	17%
Red Cedar A	420	11%	3%
Red Cedar B	785	13%	6%
Red Cedar C	403	6%	3%
Sloan Creek	435	7%	3%
Smith Drain	739	16%	5%
Sycamore Creek A	124	5%	1%
Sycamore Creek B	588	13%	4%
Willow Creek	530	8%	4%
Watershed Total	**13,967**	**13%**	**100%**

Table 3-4. Climatic variable data for the watershed.

Month	Average Temperature (°F)	Average Precipitation* (inches)	Average Snowfall** (inches)	Prevailing Wind Direction	Average Wind Speed (mph)	Peak Gust Wind Speed (mph)
January	22.7	1.78	13.4	SW	12	55
February	24.4	1.57	9.1	W	12	51
March	33.7	2.28	7.4	W	12	61
April	46.0	3.12	2.0	W	12	70
May	57.4	3.36	Trace	W	10	59
June	67.1	3.73	0.0	W	9	67
July	71.2	3.09	0.0	W	9	60
August	69.2	3.33	0.0	W	8	62
September	61.7	3.27	Trace	S	9	47
October	50.6	2.62	0.3	SW	10	58
November	38.1	2.56	3.6	SW	12	53
December	27.2	2.11	11.3	SW	12	54
Total	---	32.82	46.9	---	---	---

Note: Temperature and precipitation data is an aggregate of data from Ionia, Clinton, Shiawassee, Barry, Eaton, Ingham, Calhoun, Jackson, St. Joseph, Branch, and Hillsdale Counties from 1931-2000. The snowfall data is an average of the 30-year means for stations in Lansing and Jackson. The wind data is from a station in Lansing from 1930-1996.

* - Includes snowfall. ** - As a general rule, divide the snowfall amount by ten to convert to equivalent inches of rainfall.

Source: NOAA, no date; NCDC, 1998; NCDC, 2002.

Soil Associations

The seven soil associations present in the watershed include:

- Urban land/Marlette/Capac
- Marlette/Capac/Owosso
- Houghton/Palms/Edwards
- Oshtema/Houghton/Riddles
- Capac/Marlette/Colwood
- Marlette/Oshtemo/Capac
- Riddles/Hillsdale/Aubbeenanbbee

Geology and Soils

Michigan has been subjected to four glacial periods: Wisconsian, Illinoian, Nebraskan, and Kansian. The last of these continental glaciers, the Wisconsian, existed approximately 11,000 years ago and is responsible for much of the development of Michigan's underlying geology, soils, topography, and the Great Lakes.

In the Red Cedar Watershed the predominant underlying geology is predominantly:

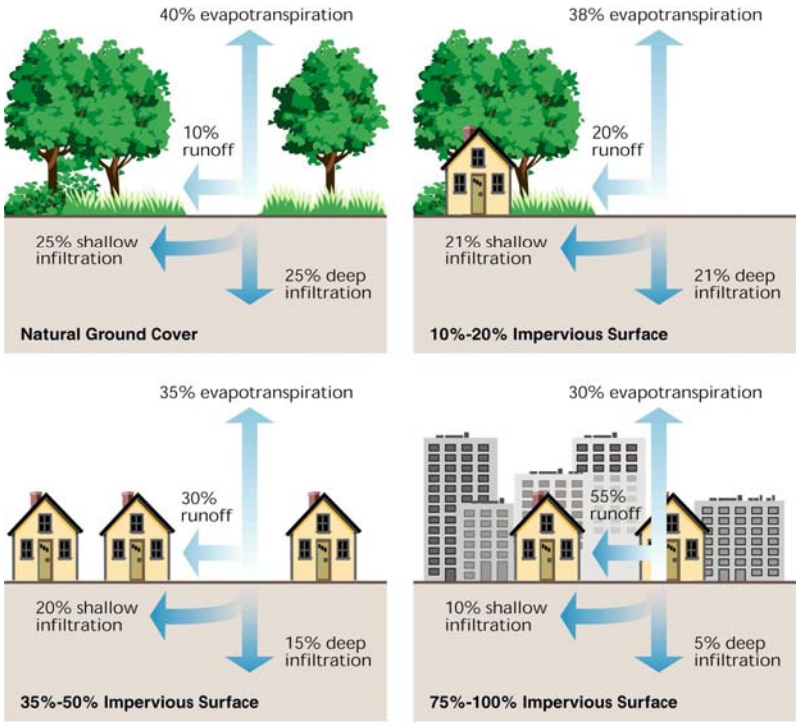
- Glacial till – poorly sorted and poorly rounded material ranging in size from pebbles to boulders
- Glacial outwash – finer material deposited by glacial melt water
- Lacustrian material – fine materials deposited in still or ponded glacial meltwater
- Alluvian material – recently deposited material from local rivers and streams

Each of these deposited materials, along with organic material, are the parent materials of the soils present in the watershed. These soils are predominantly sandy, loamy, or muck soils and are commonly classified as hydrologic soil group B. The topography of the watershed ranges from 800 to 1,000 ft above sea level with rolling plains having slopes ranging from 0 to 30 percent. This, in combination with the soil groups, provides a wide variety of drainage from poorly to very well drained landscape.

Hydrology

Hydrology is the study of water and the circulation of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere. Understanding how hydrologic components respond to land use changes and site development is the basis for developing successful watershed and storm water management programs. Traditional development practices tend to cause a sharp increase in the total volume, peak flow rate and frequency of rainwater reaching the rivers and lakes. In addition, channels experience more bankful flood events each year and are exposed to critical erosive velocities for longer intervals. Since impervious cover prevents rainfall from infiltrating into the soil, less flow is available to recharge ground water. Consequently, during extended periods without rainfall, baseflow levels are often reduced in urban streams. Figure 3-8 illustrates the relationship between impervious cover and surface runoff.

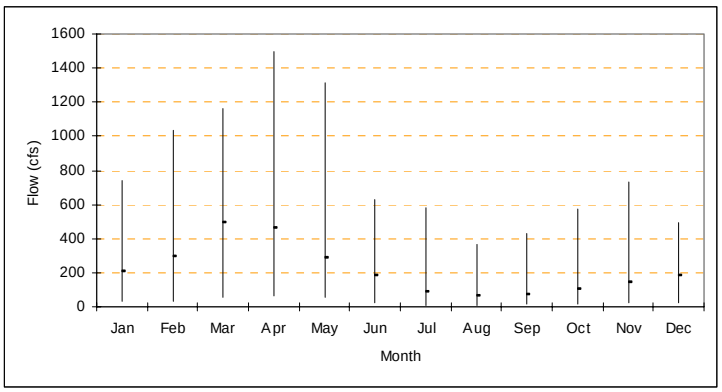
Figure 3-8. Effects of urbanization on runoff.



Source: FISRWG, 1998.

Figure 3-9. Streamflow data for Red Cedar River at East Lansing, MI.

Figure 3-9 provides a summary of USGS stream gauging data from 1902 to 2003 at station 04112500, Farm Lane bridge at Michigan State University in East Lansing, Michigan (USGS, 2005). The presented information is the monthly mean streamflows in cubic feet per second (cfs). The vertical bar above each month illustrates the range of flow recorded and the horizontal tick mark on each vertical bar is the monthly mean stream flow. Stream flow has varied from a low of 6 cfs in July 1934 to a high of 1,500 cfs in April 1947.



Source: Johnson, 2005.

Point Sources of Potential Pollutants

Within the watershed, there exists a number of facilities that are permitted to discharge certain pollutants, such as Waste Water Treatment Plants (WWTPs), others that have the potential for pollutant releases, and sites that are known to be polluted (brownfields). These are identified in Figure 3-10.

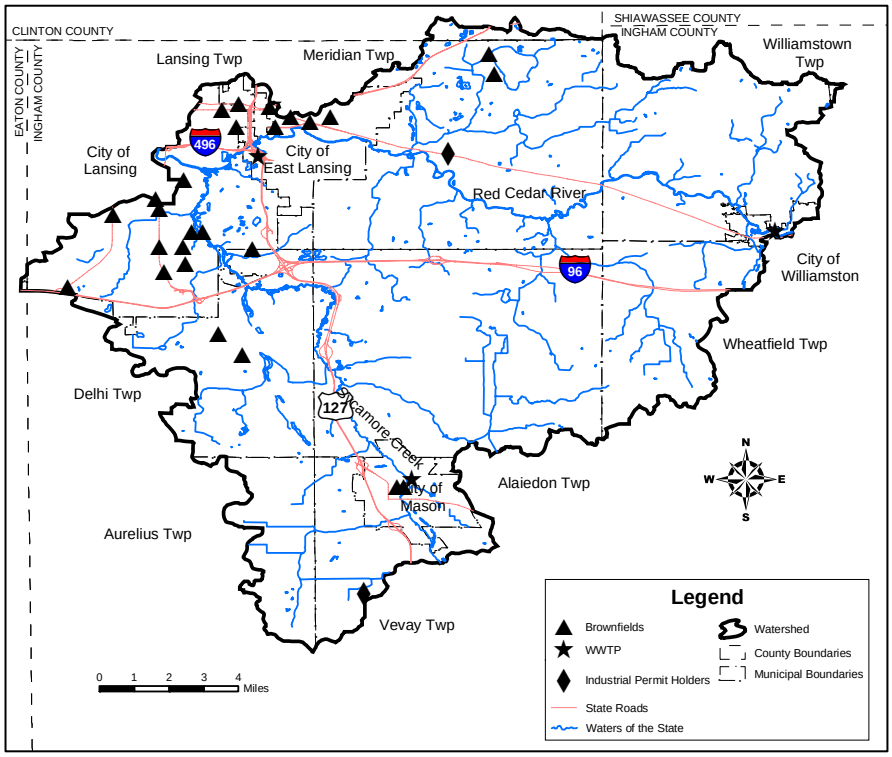
The majority of point source sites in the watershed are brownfields which include such things as abandoned and operating gas stations, commercial business land and development, and convenience stores. The bulk of these are in Lansing with other sites in East Lansing, Meridian and Delhi Townships, and the City of Mason.

Of the five facilities in the watershed having NPDES permits, three of these are WWTPs located in the cities of East Lansing, Mason, and Williamston. The other two facilities are in Meridian Towship and Vevay Township.

Additionally, there are four facilities in the watershed identified as Hazardous Waste Treatment, Storage and Disposal facilities: Americhen Corporation (Mason), Huntsman Advanced Materials / America's Inc. (East Lansing), Michigan State University Waste Storage Facility (East Lansing), and Safety Kleen Systems (Mason) [MDEQ, 2004]. These sites are not included on the map for security reasons.

On a subwatershed basis, point sources are of most concern in the Sycamore Creek A, Cook and Thorburn, Pawlowski Creek Drain and Banta Drain, Holmes Drain, Red Cedar C, Lake Lansing and to a lesser extent, Willow Creek, and Red Cedar A.

Figure 3-10. Point sources.

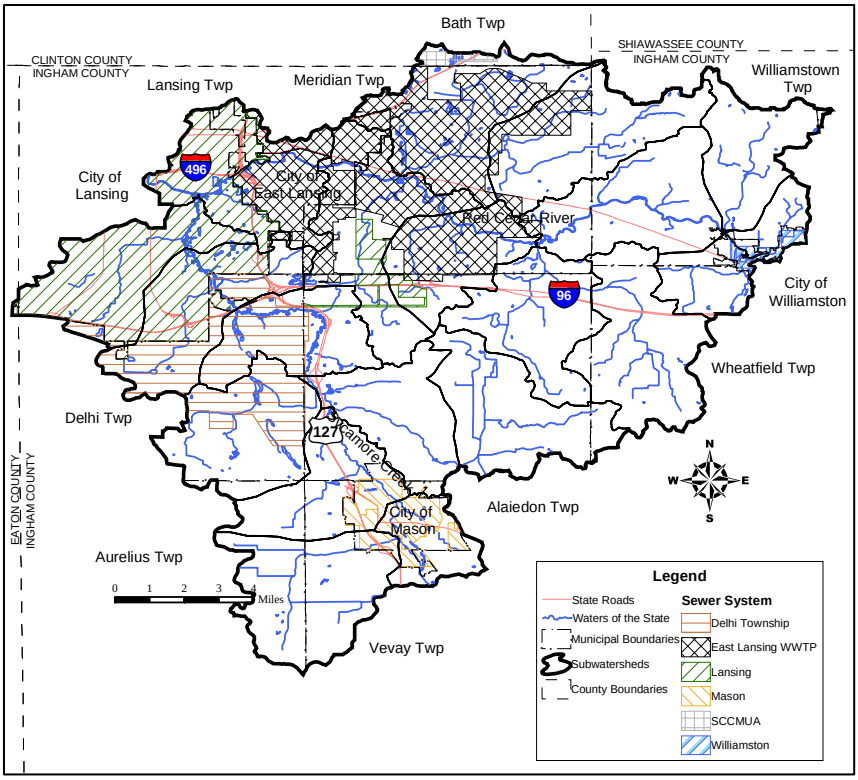


Source: MDEQ, 2004b.

Sewer and Septic System Service Areas

Sanitary sewer service is an important factor that has the potential to affect water quality in the watershed. Where this service does not exist, homes dispose of their waste through a private septic system. Collectively, private systems present a greater risk of pollutant discharge to waters as compared to a centralized treatment facility that is associated with a sanitary sewer system. Sanitary (and combined) sewer service coverage in the watershed is shown in Figure 3-11.

Figure 3-11. Sanitary sewer service.



Generally, the most populous areas of the watershed are those that have sanitary sewer service. The systems serving the watershed include:

- East Lansing WWTP (serving the City of East Lansing, Meridian Township, and Michigan State University)
- Mason (serving the City of Mason)
- Lansing (serving the City of Lansing, Lansing Township, a portion of Delhi Township, and small portions of Meridian and Alaiedon Township)
- Williamston (serving the City of Williamston)
- South Clinton County Municipal Utilities Authority (serving portions of Bath Township)
- Delhi Township (serving Delhi Township)

Some of the above systems serve very small portions of surrounding communities. The Lansing WWTP, SCCMUA WWTP, and Delhi Township WWTP, do not discharge their effluent in the watershed.

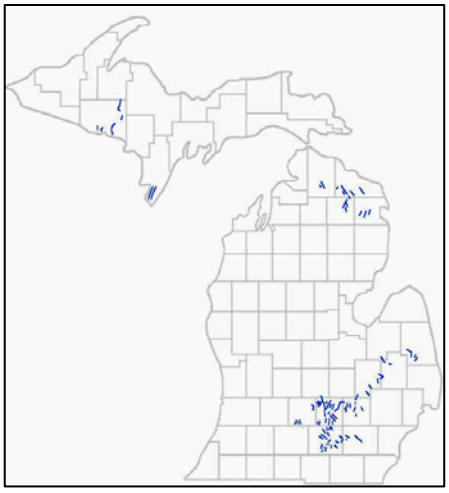
As a whole, only 38% of the watershed land area has sanitary sewer service. On a subwatershed basis, those with the most service include Holmes Drain (100%), Red Cedar C (99%), Pawlowski Creek Drain and Banta Drain (89%), and Lake Lansing (79%). Those with little or no service include Branch Mud Creek (0%), Button Drain (0%), Cook Creek (0%), Mud Creek (0%), Sloan Creek (0%), Red Cedar B (2%), Willow Creek (5%), Red Cedar A (12%), Aurelius-Vevay Drain (15%), and Mud Lake Outlet Drain (20%). The remaining subwatersheds have between 41 and 66 percent sanitary sewer service.

Table 3-5. Sewer service areas.

Subwatershed	Sanitary Sewer	Private Systems
Aurelius-Vevay Drain	15%	85%
Branch Mud Creek	0%	100%
Button Drain	0%	100%
Cook and Thorburn	41%	59%
Cook Creek	0%	100%
Herron Creek	62%	38%
Holmes Drain	100%	0%
Mud Creek	0%	100%
Pawlowski Creek / Banta Drain	89%	11%
Mud Lake Outlet Drain	20%	80%
Lake Lansing	79%	21%
Red Cedar A	12%	88%
Red Cedar B	2%	98%
Red Cedar C	99%	1%
Sloan Creek	0%	100%
Smith Drain	66%	34%
Sycamore Creek A	46%	54%
Sycamore Creek B	54%	46%
Willow Creek	5%	95%
Total	**38%**	**62%**

Heron Rookery

Esker Locations in Michigan



Source: Schaetzl , 2005.

Significant Natural Features to be Protected

Michigan has a number of significant natural features located across the State. These natural features can provide public benefits which may include recreation, bird watching, hunting, fishing, camping, hiking, off-roading, and water sports. These areas also include critical habitat for different species of plants, mammals, amphibians, reptiles, birds, fish, and macroinvertebrates. The features identified in the watershed are presented in Table 3-6.

Threatened and Endangered Species

The Michigan Department of Natural Resources (MDNR) provides information on threatened and endangered species in Michigan by watershed. This work is coordinated by the Michigan Natural Features Inventory (MNFI).

A species is classified as **endangered** if it is near extinction throughout all or a significant portion of its range in Michigan.

A species is **threatened** if it is likely to become classified as endangered within the foreseeable future throughout all or a significant portion of its range in Michigan.

A species is of **special concern** if it is extremely uncommon in Michigan or if it has a unique or highly specific habitat requirement and deserves careful monitoring of its status. A species on the edge or periphery of its range that is not listed as threatened may be included in this category along with any species that was once threatened or endangered but now has an increasing or protected, stable population.

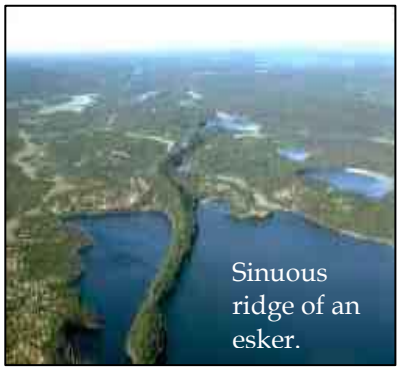
A species is **extinct** if it can no longer be found anywhere in the world. An **extirpated** species is one which doesn't exist in Michigan, but can be found elsewhere in the world.

A species is **stable** if it is not included in the above categories and the population is not declining drastically. A stable species is breeding and reproducing well enough to maintain current population in a given area.

Table 3-6 includes the species of plants and animals found in the watershed which are listed as threatened, endangered, or of special concern.

Eskers

An esker is a geographic natural feature that is formed when glacial meltwater carves subsurface river tunnels within the ice sheet. As the flow of water descreases or is blocked, sediment accumulates beneath the glacier. When the glacier recedes, a snake-like ridge composed of sand and gravel remains. The longest esker in Michigan extends from DeWitt to Mason running through Holt and Lansing. Much of the Mason Esker has been excavated for concrete roadway construction (Schaetzl 2005).


Sinuous ridge of an esker.

Source: Geological Survey of Canada

Table 3-6. Threatened and endangered features in the watershed.

Feature Type[1]	Name	Scientific Name	Federal Status[2]	State Status[2]	Aurelius – Vevay Drain	Branch Mud Creek	Buutton Drain	Cook and Thorburn	Cook Creek	Herron Creek	Holmes Drain	Mud Creek	Pawlowski /Banta Drain	Mud Lake Drain Outlet	Lake Lansing	Red Cedar A	Red Cedar B	Red Cedar C	Sloan Creek	Smith Drain	Sycamore Creek A	Sycamore Creek B	Willow Creek
F	Rich Forest, Central Midwest Type									X	X		X							X		X	
G	Esker										X		X					X				X	
H	Great Blue Heron Rookery																		X				
O	Barrens Buckmoth	Hemileuca maia		SC						X	X		X	X	X			X		X		X	
O	Beak Grass	Diarrhena americana		T		X	X		X	X	X		X	X	X	X	X	X		X		X	
O	Blanchard's Cricket Frog	Acris crepitans blanchardi		SC										X	X								
O	Blanding's Turtle	Emys blandingii		SC					X					X	X	X	X						
O	Bog Bluegrass	Poa paludigena		T										X	X								
O	Cat-tail Sedge	Carex typhina		T							X		X					X				X	
O	Clinton's Bulrush	Scirpus clintonii		SC										X	X								
O	Cooper's Hawk	Accipiter cooperii		SC						X				X	X			X		X			
O	Cooper's Milk-vetch	Astragalus neglectus		SC						X				X	X			X		X			
O	Cup-plant	Silphium perfoliatum		T														X					
O	Davis's Sedge	Carex davisii		SC							X		X					X				X	
O	Dwarf-bulrush	Hemicarpha micrantha		SC										X	X								
O	Eastern Box Turtle	Terrapene carolina carolina		SC	X	X		X				X									X		X
O	Elktoe	Alasmidonta marginata		SC														X					
O	Ellipse	Venustaconcha ellipsiformis		SC					X							X	X	X					
O	False Hop Sedge	Carex lupuliformis		T						X	X		X	X	X			X		X		X	
O	Ginseng	Panax quinquefolius		T						X										X			
O	Goldenseal	Hydrastis canadensis		T						X										X			
O	Green Violet	Hybanthus concolor		SC														X					
O	Hairy Angelica	Angelica venenosa		SC										X	X								
O	Hairy-fruited Sedge	Carex trichocarpa		SC							X		X					X				X	
O	Indiana Bat or Indiana Myotis	Myotis sodalis	LE	E						X	X		X					X		X		X	
O	Kentucky Coffee-tree	Gymnocladus dioicus		SC						X	X		X					X		X		X	
O	King Rail	Rallus elegans		E	X	X	X	X	X	X		X		X	X	X	X	X	X	X	X		X
O	Least Shrew	Cryptotis parva		T	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
O	Pugnose Shiner	Notropis anogenus		SC										X	X								
O	Rainbow	Villosa iris		SC					X		X		X			X	X	X				X	
O	Raven's-foot Sedge	Carex crus-corvi		T	X			X		X	X	X	X	X	X			X		X	X	X	X
O	Red Mulberry	Morus rubra		T						X										X			
O	Regal Fern Borer	Papaipema speciosissima		SC			X		X	X	X		X	X	X	X	X	X		X		X	
O	Regal Fritillary	Speyeria idalia		E					X					X	X	X	X						
O	Round Pigtoe	Pleurobema coccineum		SC														X					
O	Showy Orchis	Galearis spectabilis		T					X	X	X		X	X	X	X	X	X		X		X	
O	Slippershell Mussel	Alasmidonta viridis		SC														X					
O	Small Skullcap	Scutellaria parvula		T						X				X	X					X			
O	Splendid Clubtail	Gomphus lineatifrons		SC						X								X		X			
O	Torrey's Bulrush	Scirpus torreyi		SC			X		X	X				X	X	X	X	X	X	X			
O	Virginia Spiderwort	Tradescantia virginiana		SC						X	X		X	X	X			X		X		X	
O	Virginia Water-horehound	Lycopus virginicus		T		X	X		X	X				X	X	X	X		X	X			
O	White or Prairie False Indigo	Baptisia lactea		SC			X		X	X				X	X	X	X	X	X	X			
O	Woodland Vole	Microtus pinetorum		SC			X		X	X	X		X	X	X	X	X	X		X		X	

[1] – F = Forest, G = Geographical, H = Habitat, O = Organism
[2] – LE = Listed as endangered, LT = Listed as threatened, SC = Special concern, T = Threatened, E = Endangered

References

Cwikiel, Wilfred. "Michigan Wetlands – Yours to Protect: A Citizen's Guide to Wetland Protection (Third Edition). 2003. Tip of the Mitt Watershed Council, Petoskey, MI 49770.

Darlling, Burt. Unnamed article for Gannett News Service. April 1990.

Environmental Protection Agency. "National Priorities List Sites in Michigan." Via: http://www.epa.gov/superfund/sites/npl.htm. Last accessed: July 28th, 2004.

Federal Interagency Stream Restoration Working Group. "Stream Corridor Restoration: Principles, Processes, and Practices." 1998.

Johnson, Aaron. "State works to clean up Red Cedar River." The State News. March 13th, 2002. East Lansing, Michigan.

Laurentian Forestry Centre. Via: http://gis.cfl.forestry.ca/Wetlands/Details/. Last accessed: December 29th, 2004.

Malik, Jahan Ara. "Historical Geography of Ingham County, Michigan." 1960.

Michigan Department of Environmental Quality. "Michigan Hazardous Waste Treatment, Storage, and Disposal Facilities, Directory (TSD)." Via: http://www.deq.state.mi.us/tsd/default.asp. Last accessed: December 3rd, 2004.

Michigan Department of Environmental Quality. "Brownfields – USTfields Database." Via: http://www.deq.state.mi.us/ustfields/default.asp. Last accessed: October 15th, 2004.

National Aeronautic and Space Administration. Via: http://earthobservatory.nasa.gov/Newsroom/NewImages/Images/S2002017181519.L1A_HNSG.jpg. Last accessed: September 7, 2005.

National Oceanic and Atmospheric Administration. "Divisional Normals and Standard Deviations of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000 (and previous normals periods)"

National Climatic Data Center. "United States Climate Normals, 1971-2000: National Weather Service Snow Normals". October 1, 2002.

National Climatic Data Center. "Climatic Wind Data for the United States". November 1998.

Tanner, Ruth. Via: http://www.msu.edu/dig/GRAPHICS/photo/redcedar.jpg. Last accessed: January 6th, 2005.

Remote Sensing and Geographic Information Science Research and Outreach Services at Michigan State University. Via: http://www.rsgis.msu.edu/images/lulc.jpg. Last accessed: September 7, 2005.

Schaetzl, Randall. "GEO 333: Geography of Michigan and the Great Lakes Region." Obtained via: http://www.geo.msu.edu/geo333/eskers.html. Department of Geography, Michigan State University. Last accessed: April 11, 2005.

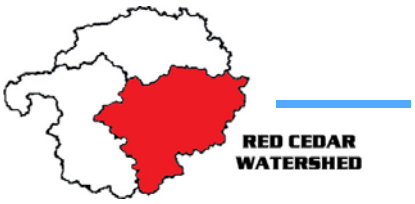
Tri-County Regional Planning Commission. "Trends: 2020 and Beyond" http://www.tri-co.org/Demographics/Trends%20Forecast%202020and%20Beyond.pdf Last accessed: September 7, 2005.

Tri-County Regional Planning Commission. Various GIS files. Provided: 2004.

United States Census Bureau. "Year 2000 Census." 2000

United States Geological Survey. "USGS Hydrologic Units Maps." Obtained via: http://water.usgs.gov/GIS/huc.html. Last accessed: January 6, 2005.
United States Geological Survey. http://waterdata.usgs.gov/mi/nwis/rt
University of Michigan. "Michigan Student Study" Via: http://www.umich.edu/~oami/mss/staff. Last accessed: January 5th, 2005.

4. Water Quality



The Relevance of Impervious Cover

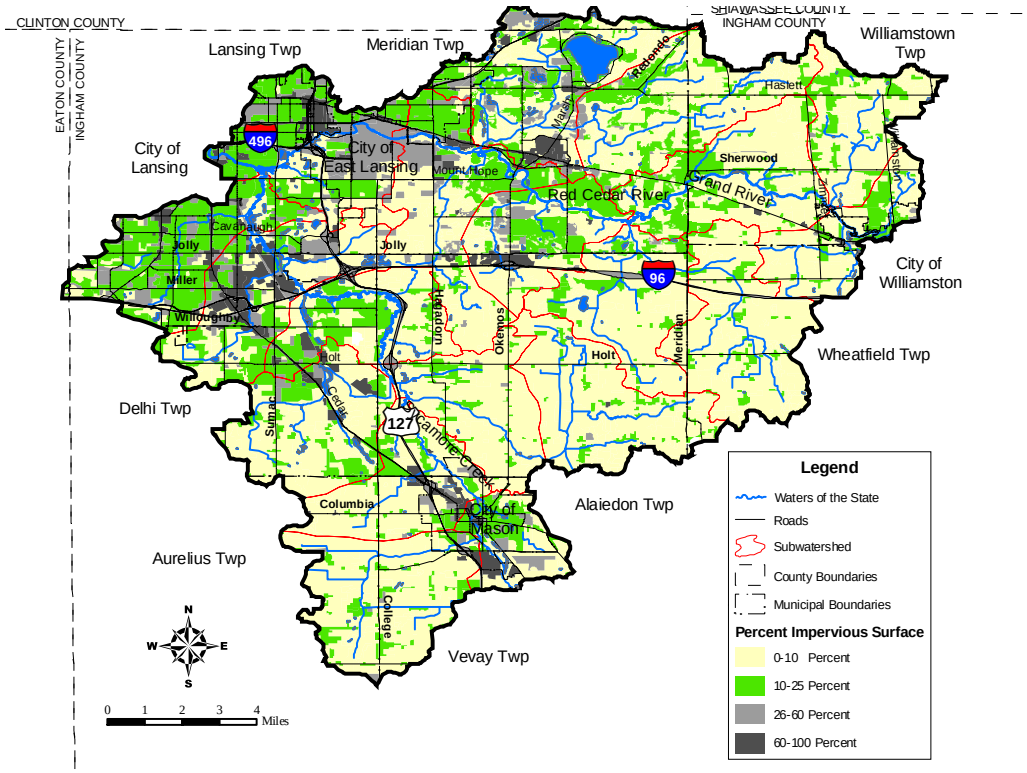
The physical, chemical, and biological integrity of a given stream system has been shown to be strongly correlated to the amount of impervious cover (the area covered by rooftops, streets, parking facilities, and other hard surfaces) in the sub basin or watershed (Schueler, 1994). Imperviousness appears to be one of the principal indicators of watershed "health." Analysis of stream systems across the country seems to indicate that there are thresholds at which watershed imperviousness results in degradation of water quality and physical stream processes.

Downtown East Lansing, (MRP, 2005).

The conversion of natural landscapes (i.e. farmland, forests, and wetlands) into urban landscapes creates a layer of impervious surface. Urbanization has a significant impact on hydrology, morphology, water quality and ecology of surface waters. The amount of impervious cover in a watershed can be used as an indicator to predict how severe differences are in character of urban watersheds and natural watersheds.

In natural settings, there is very little runoff, with most of the rainfall being filtered by the soils, and eventually supplying deep water aquifers. In urbanized areas, however, less and less rainfall is infiltrated, and as a result, less water is available to streams via groundwater.

Figure 4-1 Red Cedar Watershed Percent Impervious



Additional changes in urban streams due to increased impervious cover includes enlarged channels; upstream channel erosion contributing greater sediment load to the stream; in-stream habitat structure degradation; and declining water quality.

> *"Even small increases in impervious change stream morphology and degradation of aquatic habitat. The relationship between impervious cover and subwatershed quality can be predicted by a simple model, projecting current and future quality of streams and other water resources." (Center for Watershed Protection, 2003)*

Research indicates that zones of stream quality exist, most noticeably beginning around 10% impervious cover with a second threshold appearing at around 25-30% impervious cover. These thresholds are powerfully modeled in the Impervious Cover Model, classifying streams into three categories; sensitive, impacted, and non-supporting. Watersheds with less than 10% imperviousness appear to exhibit natural chemical, physical, and biological quality. Between 10 and 25 percent imperviousness; river systems show signs of degradation. Beyond 25 percent imperviousness, the damage to physical, chemical, and biological integrity may be irreversible. It is important to understand the Impervious Cover Model, although a powerful tool predicting quality of streams based on impervious cover change is not without its limitations (Schueler, 1994).

Each land use type in the Red Cedar watershed was given an assumed percent impervious value. A geographic information system (GIS) was used to develop a composite of the impervious surfaces in the watershed. This method was designed to be utilized for urban areas, so impervious cover estimates for rural or agricultural areas will not be presented here. Within the Red Cedar watershed there are several areas of impervious cover which exceed 60 percent of the land area. The larger of these areas are located in the following locations:

- US-127 and Grand River Avenue (Frandor shopping area)
- Downtown East Lansing and northern part of MSU campus
- I-96 and Okemos Road
- Area around Marsh Road and Grand River Avenue (Meridian Mall)
- Areas in the vicinity of US-127 and Mason

Areas greater than 25 percent impervious are predominately located in the areas north of I-96 and West of US-127, including parts of Meridian Township, East Lansing, Lansing, Lansing Township, Delhi Township, Aurelius Township, Vevay Township, and Mason. Areas less than 25 percent imperiousness are scattered throughout these areas and would include rural and agricultural landscapes. Table 4-1 and the percent of impervious located in each municipal Table 4-2. Figure 4-1 shows the overall percent impervious within the Red Cedar Watershed.

Habitat and Populations

Habitat and population information is summarized narratively in the following paragraphs. Figure 4-2 provides a visual depiction for the watershed of the habitat information.

Table 4-1 Impervious Surface for the Red Cedar Watershed

Subwatershed	Average Weighted Percent Impervious
Sycamore Creek A Subwatershed	17.91%
Red Cedar A Subwatershed	6.99%
Cook Creek Subwatershed	5.30%
Smith Drain Subwatershed	15.47%
Sycamore Creek B Subwatershed	12.53%
Mud Creek Subwatershed	4.32%
Aurelius-Vevay Drain Subwatershed	10.89%
Button Drain Subwatershed	5.74%
Holmes Drain Subwatershed	22.50%
Cook and Thorburn Subwatershed	9.73%
Branch Mud Creek Subwatershed	3.63%
Mud Lake Drain Subwatershed	25.08%
Red Cedar B Subwatershed	6.93%
Red Cedar C Subwatershed	24.71%
Mud Lake Outlet Drain Subwatershed	6.64%
Willow Creek Subwatershed	5.69%
Sloan Creek Subwatershed	4.34%
Herron Creek Subwatershed	13.08%
Lake Lansing Subwatershed	16.45%
Average Percent Impervious	**11.52%**

Table 4-2 Percent Municipal Impervious Surfaces for the Red Cedar Watershed

Municipal	Average Weighted Percent Impervious
Windsor Twp	18.63%
Locke Twp	1.94%
Williamston	12.81%
Bath Twp	26.36%
Lansing Twp	18.93%
Mason	21.19%
East Lansing	23.45%
Aurelius Twp	4.50%
Vevay Twp	7.17%
Wheatfield Twp	4.30%
Delhi Twp	13.19%
Lansing	27.32%
Williamstown Twp	5.62%
Meridian Twp	12.43%
Alaiedon Twp	6.08%
Average Percent Impervious	**7.28%**

Table 4-3. Fish in the Red Cedar River.

Species	12/1979 – 5/1981[1]	6/2001 – 8/2002[2]
Brook Silverside		X
White Sucker, Catostomus commersoni	X	X
Northern Hog Sucker, Hypentelium nigricans	X	X
Spotted Sucker, Minytrema melanops	X	
Golden Redhorse, Monostoma ertybrurum	X	X
Silver Redhorse, Monostoma anusurrm	X	X
Shorthead Redhorse		X
Rock Bass, Ambloplites rupestris	X	X
Green Sunfish, Lepomis cyanellus	X	X
Pumpkin Seed, L. gibbosus	X	X
Warmouth, L. gulosus	X	
Bluegill, L. macrochirus	X	X
Smallmouth Bass, Micropterus dolomieui	X	X
Largemouth Bass, M. salmoides	X	X
Black Crappie, Pomoxis nigromaculatus	X	
Mottled Sculpin		X
Stoneroller, Campostoma anomalum	X	X
Carp, Cyprinus carpio	X	
Hornyhead Chub, Nocomis biguttatus	X	
Common Shiner, Notropis cornutus	X	X
Rosyface Shiner, N. rubellus	X	
Sand Shiner, N. stramineus	X	
Bluntnose Minnow, Pimephales notatus	X	X
Spotfin Shiner		X
River Chub		X
Blacknose Dace, Rhinichthys atratulus	X	X
Creek Chub, Semotilus atromaculatus	X	X
Northern Pike		X
Grass Pickerel, Esox americanus vermiculatus	X	
Brook Stickleback, Culaea inconstns	X	
Black Bullhead, Ictalurus melas	X	
Yellow Bullhead, I. natalis	X	X
Brown Bullhead, I. nubulosus	X	
Walleye		X
Johnny Darter		X
Greenside Darter		X
Rainbow Darter, Etheostoma caeruleum	X	X
Johnny Darter, E. nigrum	X	
Yellow Perch, Perca flavescens	X	
Blackside Darter, Percina maculata	X	X
Chestnut Lamprey		X
Northern Brook Lamprey		X
Rainbow Trout		X
Central Mudminnow, Umbra limi	X	X

1 – MSUE, 1997 (as collected by Patrick M. Muzzall, Zoology Department, Miichigan State University
2 – MSU-WATER, 2002

Biota includes all of the plant and animal life in a particular region.

Red Cedar River

Research on the Red Cedar River has been conducted by the State of Michigan and other groups since the 1960s. The data predominately covers macroinvertebrate and fish populations, habitat, and Dissolved Oxygen (DO) levels.

A Michigan State University Extension (MSUE) publication describing the river notes highly variable habitat conditions depending on location in the river and flow conditions (MSUE, 1997). A list of fish present in the river between December 1979 and May 1981 can be seen in Table 4-3.

The MSU Watershed Action Through Education and Research (MSU-WATER) group conducted a fish sampling between June 2001 and August 2002 which indicated the presence of 19 of the 32 previously identified species and 12 additional species. These species are also presented in Table 4-3.

In a 1991 Michigan Department of Natural Resources (MDNR) study fish populations in the Red Cedar Watershed defined in this plan were found to be slightly impaired, but in good condition. An average of 11 species was identified from the three inventory locations with the largest number and diversity being identified where Okemos Road crosses the river. The least diverse and smallest number of species was identified near Kalamazoo Street in Lansing. Additional inventories outside of this watershed planning area indicate similar fish population and diversity conditions with only a few tributaries rated moderately impaired or fair (Scott, 1992).

In 2003 only two sites within the Red Cedar River were studied, 1) at Zimmer Road and 2) at Harrison Road. At Zimmer Road fish populations were found to be acceptable with approximately 15 species identified. At Harrison Road, 15 species were also identified, with the over all fish population rating being excellent (Rockafellow, 2003).

Tissue samples from select species indicated elevated levels of PCBs and mercury. This sampling was coordinated with the Michigan Department of Environmental Quality's (MDEQs) Fish Contaminant Monitoring Program, data which is used by the Michigan Department of Community Health to issue fish consumption advisories for waters of the state. A fish consumption advisory is in effect for the Red Cedar River (for PCBs in carp). Additionally, all inland lakes, reservoirs, and impoundments within the State of Michigan are also under a fish advisory for mercury contamination. The latter is a general advisory applied to all inland lakes in Michigan since not all inland lakes, reservoirs, and impoundments have been tested or monitored. Table 4-4 lists the fish consumption advisories applicable to the watershed.

Macroinvertebrate populations and diversity from Beeman Road downstream of the Williamston Waste Water Treatment Plant (WWTP) to Okemos Road were rated slightly impaired or in good condition by the MDNR in 1991 (Scott, 1992). The total number of species and the diversity of the species decreased slightly as the investigators moved downstream through this region. Within the urbanized regions of the watershed between Okemos Road and Kalamazoo Street in Lansing the population and diversity sampled decreased. The MDNR rated the macroinvertebrate populations near Kalamazoo Street moderately impaired or in fair condition. Upstream of this planning area the average condition over all of

Table 4-4 Fish Consumption Advisory Information.

Water body	Location	Fish Species	Restricted Population	Restriction
Red Cedar River	Entire River	Carp	Women and Children*	6-18 inches: One meal per week
				18+ inches: One meal per month
All inland lakes, reservoirs, and impoundments	Entire State	Bass	General Population	Any size: One meal per week
			Women and Children*	Any size: One meal per month
		Crappie	General Population	9+ inches: One meal per week
			Women and Children*	Any size: One meal per month
		Muskellunge	General Population	Any size: One meal per week
			Women and Children*	Any size: One meal per month
		Northern Pike	General Population	Any size: One meal per week
			Women and Children*	Any size: One meal per month
		Rock Bass	General Population	9+ inches: One meal per week
			Women and Children*	Any size: One meal per month
		Walleye	General Population	Any size: One meal per week
			Women and Children*	Any size: One meal per month
		Yellow Perch	General Population	9+ inches: One meal per week
			Women and Children*	Any size: One meal per month

* - Children are defined as those individuals under 15 years of age
Michigan Department of Community Health, 2004

the sites studied show that macroinvertebrate populations and diversity in slightly impaired or in fair condition (Scott, 1992).

Macroinvertebrate and fish communities are only as strong as the habitat available to them in the river corridor. Within the Red Cedar Watershed covered under this plan, the habitat ranged from excellent to poor. Immediately downstream of the Williamston waste water treatment plant the MDNR found excellent habitat in 1991. This habitat decreased slightly as the study progressed toward Okemos Road and decreased significantly by the time the river reached Kalamazoo Street. In the urbanized area heavy sedimentation deposition, urban debris, and high flow fluctuations were common, which was reflected in both the populations of fish and macroinvertebrates. Upstream of the planning area habitat in the Red Cedar River was significantly degraded and on average was rated poor. The MDNR identified impacts and clean-up activities at the Hoover Ball and Bering plant in Fowlerville and improper agricultural practices as the sources for the degraded habitat (Scott, 1992).

Recent, but limited data collected near MSU's campus indicate that macroinvertebrate communities tend towards poor in quality. This is evidenced by the water quality standard (WQS) violations for macroinvertebrate populations listed for the river (discussed in the following section). However, the presence of a rich mussel population, including several uncommon species is a positive indicator for habitat quality (MSU-WATER, 2002).

Historical Fish Species No Longer Encountered

Bowfin, Lake Chubsucker, Greater Redhorse, Longear Sunfish, Goldfish, Striped Shiner, Pearl Dace, Golden Shiner, Pubnose Shiner, Emerald Shiner, Northern Common Shiner, Blackchin Shiner, Blacknose Shiner, Spottail Shiner, Northern Weed Shiner, Mimic Shiner, Pugnose Minnow, Northern Redbelly Dace, Fathead Minnow, Blackstripe Topminnow, Tadpole Madtom, Common Eastern Madtom, Iowa Darter


Watershed.org, 2004

Crayfish

Sycamore Creek

A concise summary of the sampling results is taken from a MDEQ biological survey published in 2003 and is presented below:

> *Previous work has documented the negative impacts to Sycamore Creek caused by the discharge from the Mason WWTP (Mikula, 1974). More recently in 1996, a biological survey of Sycamore Creek was conducted upstream and downstream from the Mason WWTP outfall. The survey documented macroinvertebrate and fish communities that would be considered acceptable upstream from the outfall and considered poor downstream from the outfall (Thelen, 1999). The survey in 2001*


Watershed.org, 2004

Stone Fly

Mason WWTP Advancements

1977 – Expanded to tertiary treatment
1985 – Significant industrial user complied with industrial pretreatment standards.
1988 – Added fine bubble diffuser to improve oxygen transfer
1993 – Revised NPDES permit to decrease effluent limits for CBOD and ammonia nitrogen, increased DO limit and added limit for residual chlorine
1994 – Nominate by MDNR for an EPA award.
2001 – Replaced tertiary sand filters

indicated that the macroinvertebrate community upstream (Station 37) and downstream (Station 38) from the outfall would be considered acceptable. The fish community upstream from the outfall was considered poor, and the fish community downstream from the outfall was considered acceptable. However, the differences in the scores were very minimal. The habitat was rated as fair (moderately impaired) upstream and downstream from the outfall. Based upon these results, it does not appear that the discharge from the Mason WWTP is negatively impacting the biological communities in Sycamore Creek. (Rockafellow 2003)

The study conducted in 1996 identified embeddedness of the substrate and the lack of pools, riffles and runs is a major cause of the impaired biota. At Toles Road and Willow Creek, for example, 8-12 inches of silt was observed in the channel, which may be caused by the observed channelization and land use impacts within Willow Creek (Thelen, 1999). At least 70 percent of land use within the Sycamore Creek watershed is agricultural land (Supprick, 1999).

A study conducted between 1990 and 1997 (Supprick, 1999) showed that no till farming practices had increased from 4 to 67 percent in the Haines Drain, 0 to 75 percent in the Marshall Drain, and 4 to 35 percent in Willow Creek. A stream bank stabilization program was also implemented in the Willow Creek subwatershed. The study showed that total suspended solids and total phosphorus concentrations were reduced in Willow Creek, but no changes were observed in the Haines or Marshall Drains. The study suggests that changing land use practices alone will not improve the system, but that the system also needs to be stabilized to improve the biota impacts observed in the 1974 and 1996 studies.

Volunteer Monitoring

Project GREEN

Project Global Rivers Environmental Education Network (GREEN) is an interdisciplinary, watershed-based education program providing hands-on opportunities to high school students. Students gain science, math, and social skills outside the classroom primarily through dealing with local water quality problems. Table 4-5 and Figure 4-2 identifies the monitoring locations in the watershed.

Table 4-5 Project GREEN Education Programs

Location Description	Volunteer Group conducting water testing:
Red Cedar River on the Michigan State University Campus behind the Kellogg Center in East Lansing, MI	East Lansing High School students Data collected during Spring and/or Fall of 196, 1997, 2000-2005
West bank of Mud Lake, Haslett, MI	Haslett High School students Data collected during Spring and/or Fall of 1996-1999, 2002
Mud Drain just after it passes under Marsh Rd., Haslett, MI	Haslett High School students Data collected during Spring and/or Fall of 1996-1999, 2002
Red Cedar River on the east side of Aurelius Rd., Lansing, MI	Lansing Catholic Central High School Data collected during Spring and/or Fall of 1997, 1998, 2000, 2001-2003
Sycamore Creek at Austin Park in downtown Mason, MI	Mason High School students Data collected during Spring and/or Fall of 1999-2002, 2004
Red Cedar River at Ferguson Park, Okemos, MI	Okemos High School students Data collected during Spring and/or Fall of 1995-1999, 2001, 2002
Heron Creek just west of the Okemos High School campus, Okemos, MI	Okemos High School students Data collected during Spring and/or Fall of 1995-1999, 2001, 2002
Red Cedar River at McCormick Park, Williamston, MI	Williamston High School students Data collected during Spring and/or of 1999, 2001-2003

Mid Michigan Environmental Action Council

Mid Michigan Environmental Action Council (Mid-MEAC) is a non-profit and volunteer based environmental organization dedicated to improving the environment and quality of life by raising environmental consciousness and activism. Data collection, listed in Table 4-6, was provided in the Michigan Clean Water Corps grant application, which required testing of each site and includes past monitoring data. Monitoring sites are located on Figure 4-2.

Table 4-6 Mid-MEAC Monitoring Data

River Name	Road Location	County	Macro Rating	Location Assessment	Surrounding Areas	Reason to Monitor	Year
Red Cedar River	Okemos Road	Ingham County	Good	Filamentous algae & foam present, highway/bridge/road maintenance & runoff, high channelization, moderate erosion, moderate urban runoff	forest, residential lawns/parks	To assist in documenting changes in the Red Cedar River over time.	2004
Sycamore Creek	Scott Woods Park	Ingham County	Fair	Turbidity present, trash present, moderate removal of riparian vegetation, bank/shoreline erosion, and natural sources	forest, residential lawns/parks	To assess current condition of Sycamore Creek, which is a non-attainment waterbody for dioxin exceedances	2004

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Figure 4-2 Water Quality Data Summary

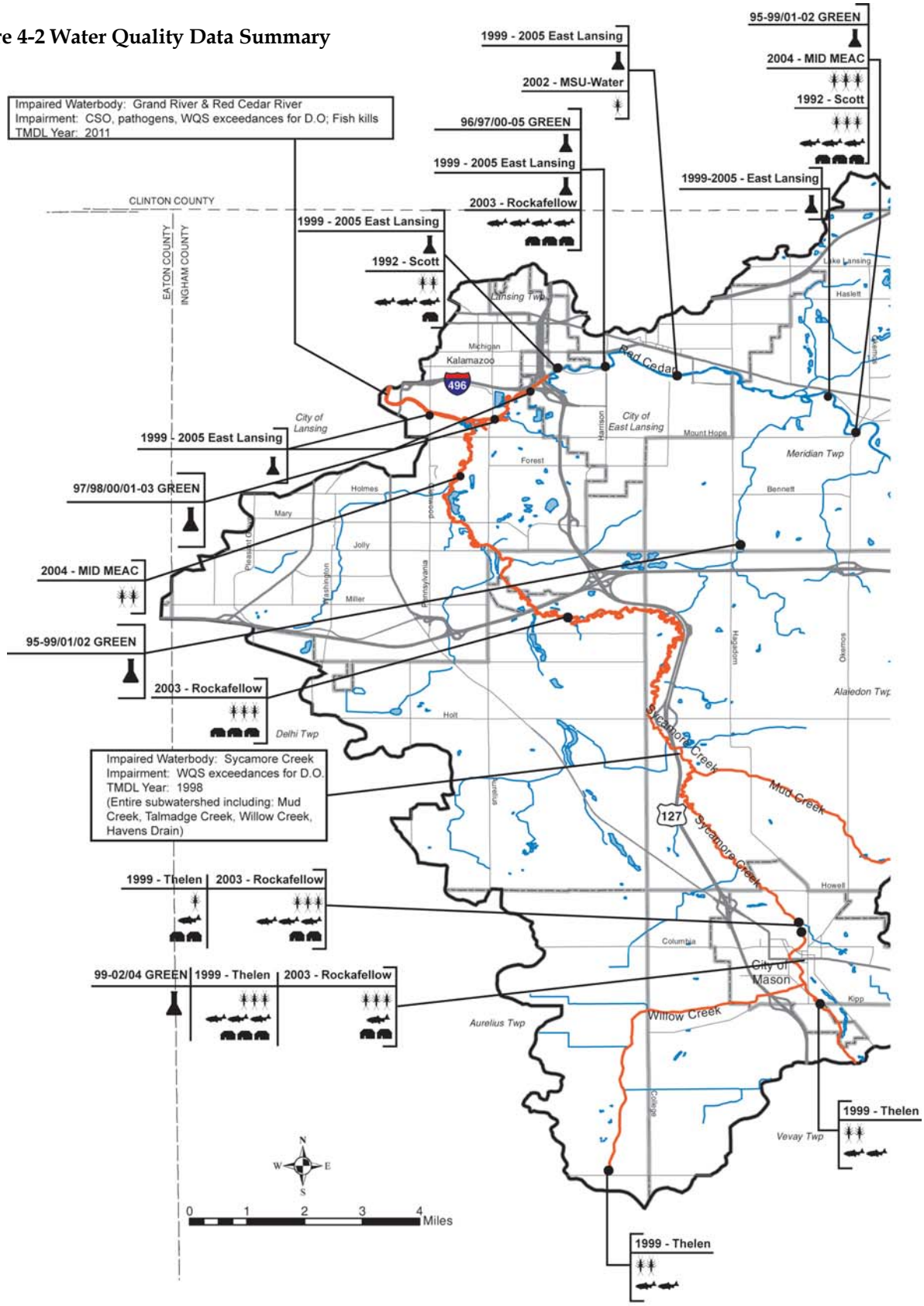
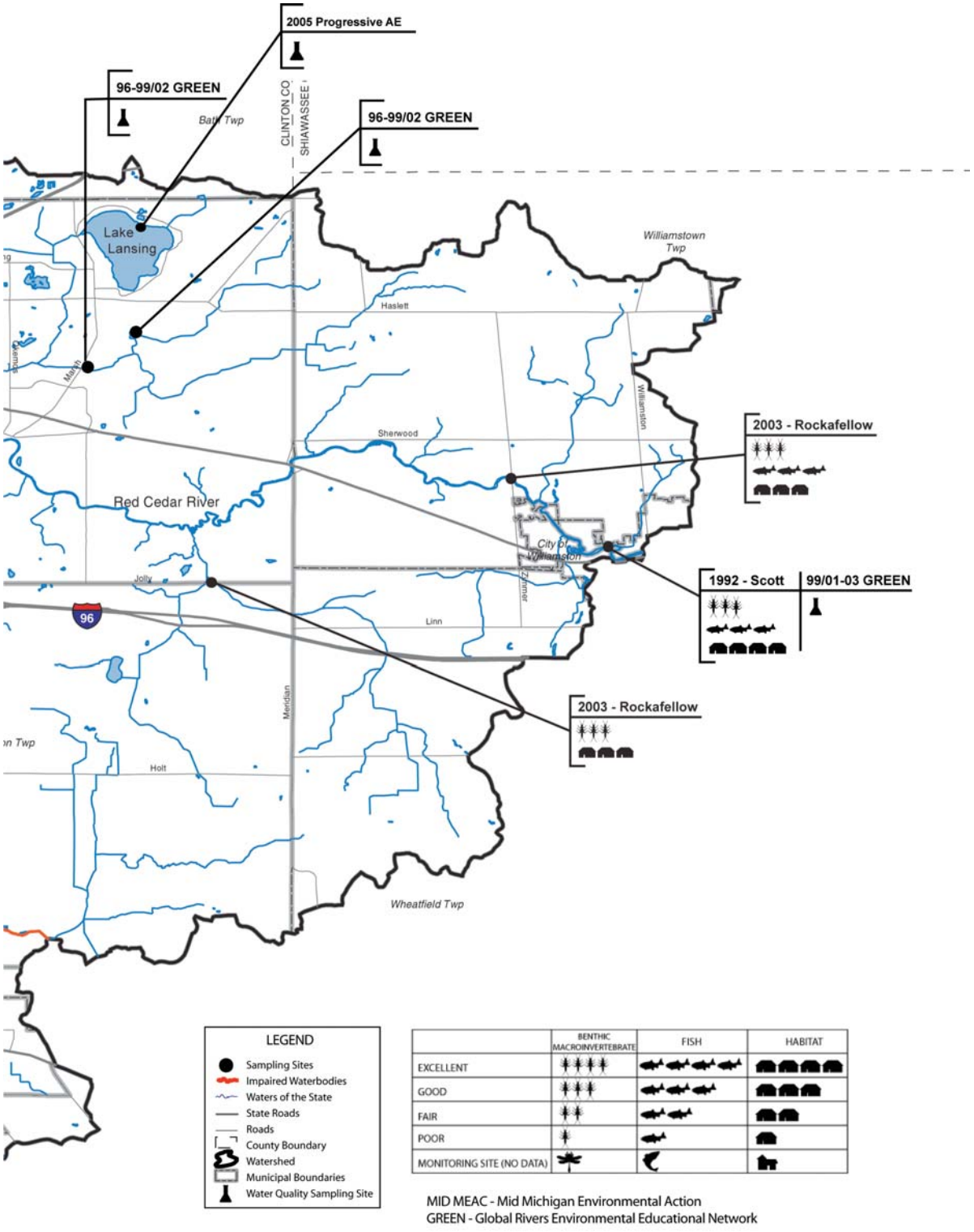


Figure 4-2 Water Quality Data Summary (continued)



Frog and Toad Survey

Michigan is home to 13 native species of anurans (frogs and toads). In recent years, observers have noticed a decline in population of several anuran species in Michigan. Frogs and toads are sensitive to changes in water quality and urbanization. Therefore, their populations serve as an index to environmental quality.

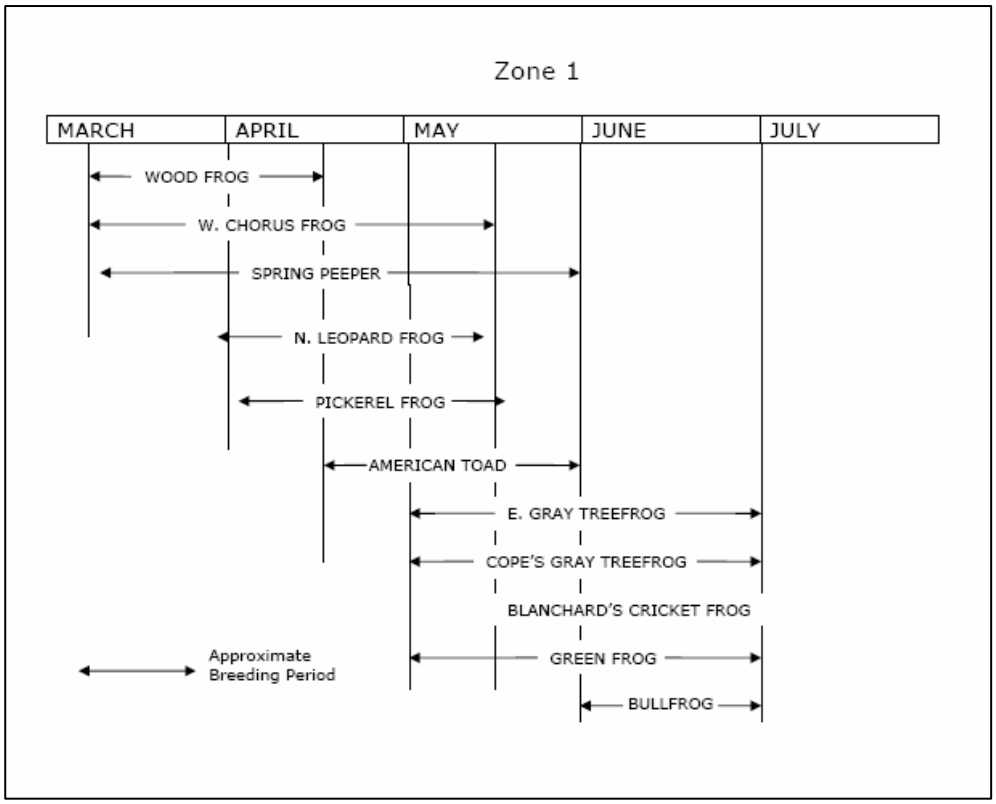
Wood Frog

The State of Michigan is concerned about the decline of anurans. Michigan initiated a volunteer based frog and toad survey program in 1988 to increase the knowledge of anuran distribution and to monitor population over the long-term. Wetland sites are visited in early spring, late spring and summer for monitoring.

Volunteers identify the species based on their breeding season call or songs and determine the abundance of each species using a call index of 1 (1-5 individuals), 2 (6-12 individuals) & 3 (unable to count individuals).

In the Tri-County area, anuran species include the Wood Frog, Western Chorus Frog, Spring Peeper, Northern Leopard Frog, American Toad, Gray Tree Frog, and Green Frog. Volunteers are unable to observe the other species shown in Figure 4-3 because they are primarily found along the lake shore, in the Upper Peninsula, or their population is declining in Michigan. Volunteers monitored the frogs and toads primarily in Watertown Township and Meridian Township. Approximately 13 sections within the Looking Glass River Watershed were surveyed by 30 volunteers. Tri-County area data from the frog and toad surveys are available from the MDNR going back to 1996.

Figure 4-3 Calling Calendar for Frogs and Toads in Michigan



Water Chemistry and Hydrology Studies

Based on the studies conducted by the MDEQ and the MDNR, a number of WQS violations have been identified in the watershed. These impaired waterbodies are assigned a date to implement a Total Maximum Daily Load (TMDL) management strategy to address the violation and ultimately restore the water quality. The impaired waterbodies and the TMDL dates are presented in Table 4-7.

Table 4-7 Impaired Waterbodies.

Water body	Location	Problem	TMDL date
Red Cedar River	From the Grand River confluence upstream to Kalamazoo Street.	CSO, pathogens (Rule 100); WQS exceedances for D.O.; Fish kills.	2011
Sycamore Creek (entire subwatershed including: Mud Creek, Talmadge Creek, Willow Creek, and Havens Drain)	Grand River confluence upstream to headwaters and to included Mud Creek, Talmadge Creek, Willow Creek, and Havens Drain.	WQS exceedances for D.O.	1998

MDEQ, 2004

Red Cedar River

Dissolved Oxygen issues within the Red Cedar Watershed have been documented as far back as the 1960's. In a survey conducted by the Michigan Water Resources Commission, low levels of dissolved oxygen were identified downstream of the East Lansing WWTP and near Potter Park Zoo (Fishbeck, 1960).

In studies conducted from 1968 to 1970, sediments below the East Lansing WWTP were combined with significant amounts of organic sludge and were identified as having a sewage odor. Additionally, phosphorus became three times more concentrated between the WWTP and the mouth of the river (Jackson, 1974). The East Lansing WWTP was upgraded in the mid-1970 to include tertiary treatment, which would assist in removing additional organics. Additionally, the phosphorus levels would likely have been reduced as a result of the phosphorus ban implemented in the early 1970s.

In 1982, a study stated algae, microphytes, and sediments were determined to have the greatest impact to DO levels within the last three quarters of a mile of the river, where DO levels were the lowest (Allen, 1982). Recent studies show low levels of DO upstream of the weir at the Michigan State University campus and near River Point Park in Lansing. Both locations have slower velocities and therefore less opportunity for aeration within the water column (Sunday, 2003). These conditions, combined with accelerated deposition of oxygen depleting sediments and organic materials, increase the demand for oxygen and decrease the DO (Allen, 1982, Sunday, 2003).

Sycamore Creek

Sediment is the primary pollutant causing reduced levels of DO by introducing elevated levels of nutrients, which increase aquatic plant coverage and therefore respiration (Supprick, 1996). The TMDL developed calls for the Mason WWTP to maintain a stable effluent of 4 mg/l or less for BOD and 0.5 mg/l of ammonia. The plan also calls for a reduction of sediment oxygen demand of 52 percent. The major contributors of the sediment oxygen demand include eroding stream banks, agricultural land, and urban sediments (Supprick, 1996).

Lake Lansing

Water quality monitoring was conducted in Lake Lansing during the spring and summer seasons of 1999, 2000, 2003, and 2004 (Progressive AE 2005). Based on the compilation of these studies, Lake Lansing is considered borderline between mesotrophic and eutrophic. Phosphorus levels are moderate to high with dense rooted plant growth and moderate to low algae growth. Water clarity was moderate to good, and pH and alkalinity were normal. Dissolved oxygen (DO) levels were depleted near the bottom of the lake in late summer indicating the decay of abundant plant and animal life; otherwise, DO levels were generally high.

Additional information on water quality issues in Lake Lansing is included in the Lake Lansing Watershed Advisory Committee Watershed Management Plan Executive Summary, April 2002.

Pollutant Load Analysis

The intent of a pollutant load analysis is to derive the potential pollutant contributions to a system for a given area to assist in prioritizing problem areas. Pollutant load analyses are often developed by extrapolating existing data or developing theoretical data from a model.

There is limited data on existing pollutant loads within this watershed. Therefore, it is practical to calculate the pollutant loadings by utilizing a model. The pollutant load analysis conducted for this watershed was modeled utilizing the Environmental Protection Agency's Spreadsheet Tool for Estimating Pollutant Loads (STEPL). Phosphorus, 5-day Biological Oxygen Demand (BOD), and sediment loadings were all calculated on a subwatershed basis using this program. The methods used to calculate urban loadings of phosphorus, sediment, and BOD primarily utilized the runoff volume and land use specific pollutant concentrations for each subwatershed to provide an average annual loading. Agricultural sediment calculations utilized the universal soil loss equation (USLE), which is used widely to calculate average annual soil losses from sheet and rill erosion (EPA, 2004). Phosphorus and BOD were calculated for agricultural areas by multiplying the soil load by a pollutant concentration for nutrients in sediment.

Land Use Specific Pollutant Concentrations

Pollutant concentrations for the watershed were not available, therefore published concentrations from national studies were considered for their applicability to this watershed. Table 4-8 presents the range of urban pollutant load concentrations found in a literature review.

Oligotrophic
- Clear water, low productivity
- Very desirable fishery of large fish

Mesotrophic
- Increased production
- Accumulated organic matter
- Occasional algal bloom
- Good fishery

Eutrophic
- Very productive
- May experience oxygen depletion
- Rough fish common

http://dnr.wi.gov/org/water/fhp/lakes/selfhelp/trophic.htm. Last accessed May 25, 2005

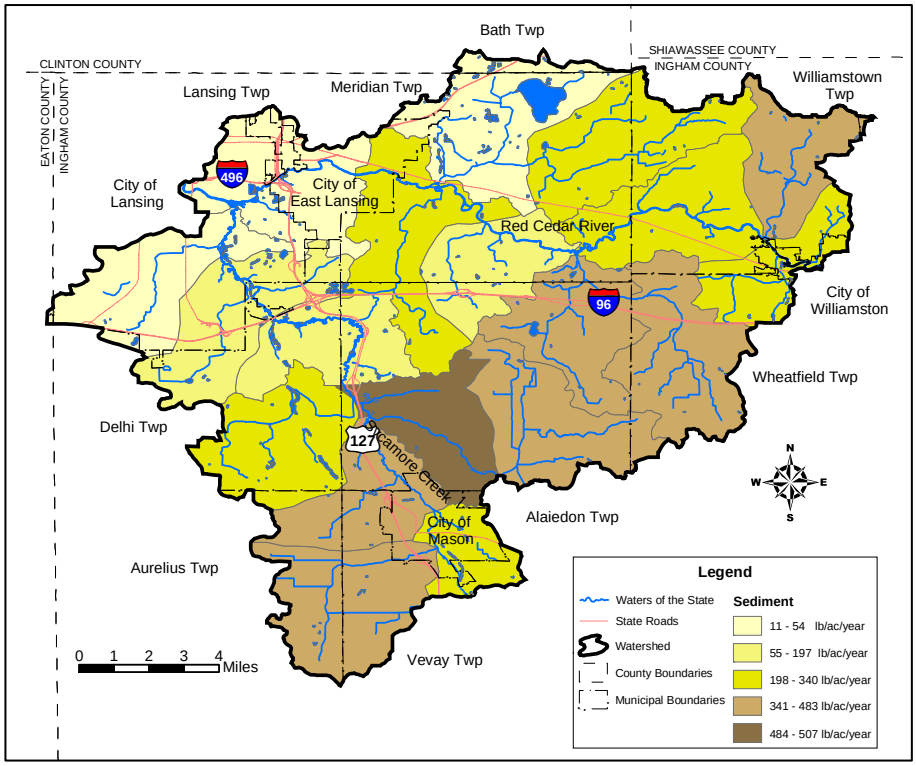
Table 4-8. Urban Pollutant Load Concentrations (mg/l)

Reference	Commercial			Industrial			Institutional			Transportation			Residential			Pasture Land			Forest		
	BOD	TP	TSS	BOD	TP	TSS	BOD	TP	TSS	BOD	TP	TSS	BOD	TP	TSS	BOD	TP	TSS	BOD	TP	TSS
EPA, 1983	9.3	0.2	69	--	--	--	--	--	--	--	--	--	10	0.38	101	--	--	--	--	--	--
EPA, 2004	9.3	0.2	75	9	0.4	120	7.8	0.3	67	9.3	0.5	150	10	0.4	100	13	0.3	--	0.5	0.1	--
MPS, 1992	16	0.26	30	23	0.36	142	--	--	--	--	--	--	43	0.57	205	--	--	--	--	--	--
Pitt, 2004	11	0.22	74	9	0.26	78	8.5	0.18	17	8	0.25	99	9	0.3	49	--	--	--	--	--	--

The data in Table 4-8 illustrate the diversity in land use specific pollutant load concentrations and the potential for error in the pollutant load estimates. For the purposes of this watershed; the concentrations identified in STEPL (EPA, 2004) were chosen for the pollutant load calculations.

These values were chosen with the understanding that the pollutant load analysis is a theoretical calculation of the loadings within the watershed and that the results would be used to draw conclusions and prioritize subwatersheds, in concert, with the published water quality data discussed previously.

Figure 4-4. Unit Area Loadings -Sediments.



Pollutant Load Results

The current unit pollutant loads (lbs/ac/yr) for sediment, phosphorus, and BOD are illustrated by subwatershed in Figure 4-4, Figure 4-5, and Figure 4-6, respectively. Tabular unit pollutant load data for each subwatershed is provided in Table 4-9. Locations and names of subwatersheds are provided in Figure 3-1.

Figure 4-5. Unit Area Loadings – Phosphorus

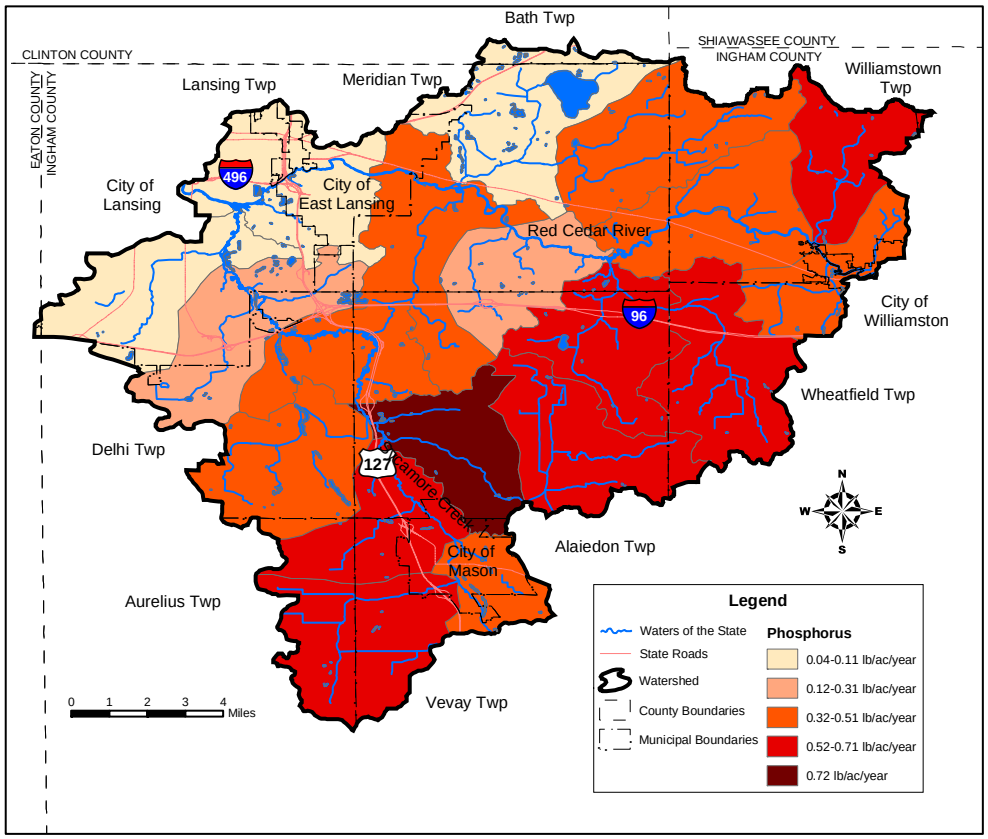


Figure 4-6. Unit Area Loadings - BOD

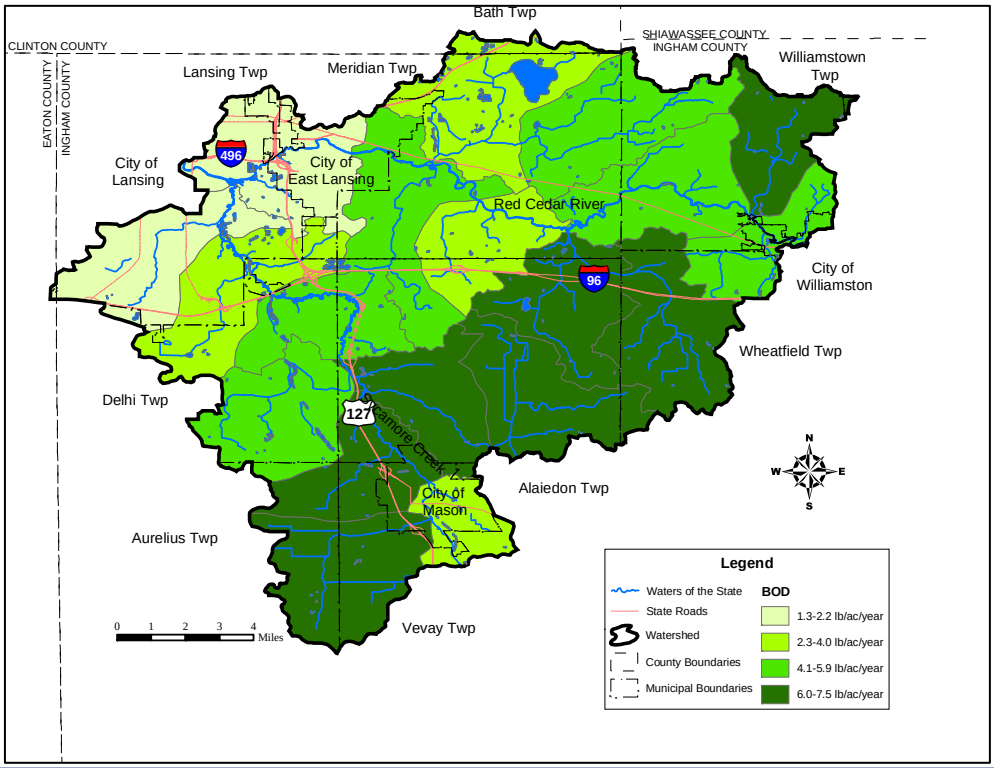


Table 4-9 Unit Area Storm Water Loading Data.

Subwatershed	Phosphorus (lbs/ac/yr)	BOD (lbs/ac/yr)	Sediment (lbs /ac/yr)
Aurelius-Vevay Drain	0.51	5.9	350
Branch Mud Creek	0.66	7.3	440
Button Drain	0.59	6.6	400
Cook and Thorburn Drain	0.43	5.4	270
Cook Creek	0.51	6.1	350
Herron Creek	0.37	4.2	240
Holmes Drain	0.04	1.3	11.2
Lake Lansing	0.09	2.6	33.8
Mud Creek	**0.72**	**7.5**	**510**
Mud Lake Drain	0.21	4	110
Mud Lake Outlet Drain	0.38	5.4	240
Red Cedar A	0.49	5.7	340
Red Cedar B	0.45	5.7	290
Red Cedar C	0.09	1.3	52
Sloan Creek	0.64	6.9	430
Smith Drain	0.26	3.6	170
Sycamore Creek A	0.34	3.8	250
Sycamore Creek B	0.31	4.5	190
Willow Creek	0.65	7.2	440

In Table 4-9 the top five unit area loadings are highlighted with the number one loading, Mud Creek, bolded.

The model is showing that the highest unit loadings are occurring in the more rural or agricultural zones of the watershed. These results are not due to specific sites within the watershed, but are a result of the higher loadings associated with agricultural land uses. Best management practices existing within the watershed were not considered within this loading model.

Pollutant Loading Summary

Overall the loadings calculated may provide an accurate representation of the loadings occurring in the watershed. In many instances agricultural landscapes have the highest loads of sediment, phosphorus, and BOD, although urban areas should not be underestimated in their loading contributions. Much of the urban sediments which may not be accounted for through the pollutant load calculations may be originating from construction sites, poor maintenance of roads and catch basins, and altered urban waterways.

The MDEQ and MDNR found the greatest impact to macroinvertebrates, fish and habitat in the Red Cedar to be occurring in the downstream areas within the urbanized zone. Sediments may be carried from the upstream reach to the urbanized zone where water velocities are slower and the sediment is able to be deposited. The MDEQ identified oxygen-depleting sediments as one component of the decrease in DO near MSU and the mouth of the Red Cedar. The other two major contributors to low DO within the last three quarters of a mile of the river include algae and microphytes (Allen, 1982). Under the same circumstances, the slower water near the mouth of the river may contain dissolved phosphorus and other nutrients, discharged upstream, which enhance the growth and respiration of plants in an environment of limited aeration.

The primary DO sink in Sycamore Creek is attributed to sediment oxygen and demand, which increase aquatic plant coverage and therefore respiration (Suppnick, 1996). The pollutant load calculations identified Willow Creek, Sycamore Creek A, Aurelius-Vevay and Mud Creek subwatersheds as having the highest loadings within the Sycamore Creek watershed for all three parameters. The observations made by Thelen (1999) and Suppnick (1999) support much of the results of the pollutant load calculations.

The published data support the pollutant load calculations produced in the STEPL program for most of the watershed, but suggest that the program is underestimating the urbanized subwatersheds, including: Red Cedar C and Holmes Drain.

Sources and Causes of Pollutants

A list of pollutants, their sources and causes was developed for the watershed. Each pollutant is grouped into one of five categories of pollutants below; oxygen-depleting, physical, toxic, thermal or `other' followed by a description of the pollutant and possible sources and causes.

Oxygen-Depleting Pollutants

Oxygen-depleting pollutants generally are, or cause, organic materials that require a large amount of oxygen for decomposition. Many organisms living in water systems require the presence of oxygen (aerobic organisms) for survival, such as fish and zooplankton, and will suffocate in oxygen-deficient systems. Common oxygen-depleting pollutants of concern in the Red Cedar River watershed are listed below.

Detergents are becoming a serious threat of contamination to storm water. Detergents are the soaps people use to wash their cars, which are carried to waterbodies through storm drains. Once detergents enter a water body they cause excessive algae growth. As the algae begin to decompose, it creates an oxygen-deficient environment. Detergents/soaps also alter the aquatic environment and destroy the mucus layer in fish that protects them from parasites. Washing vehicles on lawns or other pervious surfaces will help reduce the rate at which detergents enter the storm drain.

Table 4-10 Detergents: Sources and Causes

Sources	Cause
Residential Car Washing	Lack of Buffer
Commercial Car Washing	Poor Construction
	Poor Maintenance
	Lack of Ordinance
	Lack of Enforcement
Cleaning Agents Used Outside	Lack of Buffer
	Poor Construction
	Poor Maintenance
	Lack of Ordinance
	Lack of Enforcement

Nitrogen and phosphorus nutrients are crucial elements for aquatic systems when they exist in low concentrations. When concentrations are found in excess, negative impacts are exerted on receiving waters, such as excessive plant growth. Excessive plant growth leads to increased plant decomposition as the plants start to die off. The decomposition process consumes oxygen. Thus increased nutrients lends to oxygen depletion. Nutrient concentrations are found to be directly connected to land use, with urban and agricultural land uses introducing the highest loads and annual rainfall amounts. More annual rainfall results in a greater magnitude of nutrient concentrations. Nitrogen is reported in four concentration forms. Nitrate (NO_3), nitrite (NO_2), total nitrogen (Total N), and total Kjeldhal nitrogen (TKN). Phosphorus is measured using either total phosphorus (Total P) or soluble phosphorus (phosphates) (CWP, March 2003).

Photo Courtesy of Tetra Tech, 2005

Table 4-11 Nutrients: Sources and Causes

Sources	Cause
Livestock	Unrestricted Access
	Lack of Buffer
Manure Storage	Poor Design
	Poor Construction
	Poor Maintenance
Animal Waste (Non-Agricultural)	Pet Owners Not Picking Up Waste
	Wildlife
	Lack of Buffer
Failing Septic Systems	Poor Design
	Poor Construction
	Poor Maintenance
Leaky Sanitary Sewer	Poor Design
	Poor Construction
	Poor Maintenance
Combined Sewer Overflows (CSOs)	Function of Design Criteria
	Increased Development
	Unnecessary Inflow
Sanitary Sewer Overflows (SSOs)	Excessive Infiltration
	Storm Water Inflow
	Increased Development
Fertilizer Use (Non-Agricultural)	Fertilizer Application
	Lack of Buffer
Atmospheric Deposition	Causes Not Appropriate for this Plan but Education Needed
Agricultural Runoff	Poor Nutrient Management
	Lack of Buffer
Increase in Naturally Occurring Sources	Loss of Wetlands
Residential Yard Waste	Poor Maintenance
	Poor Design of Facility
Dumpsters	Poor Construction
	Poor Maintenance
Golf Courses	Fertilizer Application
	Lack of Buffer
Publicly Owned Treatment Works (POTWs)	Plant Effluent Limits
	Poor Design
	Poor Maintenance

Physical Pollutants

Physical pollutants include rubbish and sediments from erosion. These pollutants cover and suffocate plant and animal life, reduce light availability for aquatic plant and micro-algae growth, and may cause a decline in the biological diversity of an ecosystem when they are deposited into streams. The physical pollutants of concern in the Red Cedar River watershed are briefly described below.

Sediment in urban watersheds is an important pollutant; causing problems and negative impacts while furthermore transporting other pollutants that bind to sediment particles. Quantitatively, sediment has been labeled the most important single pollutant in U.S. streams and rivers. Inorganic fine sediments are naturally present to some extent in all streams. However, in the last half century, excessive sediment of anthropogenic origin has caused enormous damage to streams throughout North America (Waters, T.F. 1995). Suspended sediment, through turbidity, reduces light penetration through the water thus reducing photosynthesis. Fish in nature avoid streams or stream reaches with high suspended sediment levels creating environments just as devoid of fish as if they had been killed. Deposited sediment increase the level of embeddedness of the stream bed (termed habitat reduction) resulting in a decrease of invertebrate populations and consequently in food available to fish. Sediment can be measured by Total Suspended Solids (TSS), Total Dissolved Solids (TDS) and turbidity (CWP, March 2003).

Photo Courtesy of Tetra Tech, 2004.

Table 4-12 Sediments: Sources and Causes

Sources	Cause
Livestock in Stream	Unrestricted Access
Agricultural Runoff	Over Grazing of Livestock
	Lack of Buffer
	Poor Conservation Practices
Road-Stream Crossings	Poor Design
	Poor Construction
	Poor Maintenance
	Human Access
Stream Banks	Flow Fluctuations (see Hydrologic Flow)
	Livestock Access
	Human Access
Drainage Ditches	Ditch Cleanout without Soil Stabilization
	Flow Fluctuations (see Hydrologic Flow)
	Livestock Access
	Human Access
Construction Site Runoff	Inadequate Soil Erosion and Sedimentation Controls
Sand Used on Winter Road	Application Practices
	Lack of Buffer
	Poor Clean Up Practices
Gravel Roads, Parking Lots and Driveways	Lack of Buffer
	Poor Maintenance
Loss of Material Around Storm Sewer System	Poor Construction
	Poor Maintenance
Off-Road Vehicles	Unrestricted Access
	Lack of Buffer
Mining Operations/Gravel Pits	Inadequate Soil Erosion and Sedimentation Controls

Photo Courtesy of Tetra Tech, 2004.

Trash & Debris can impact the biota and stability of a waterway. It is also an issue with the aesthetic appeal and perception of a river. Common sources of trash and debris include storm water, combined sewer overflows, beachgoers and other non-point sources, boats, solid waste disposal and landfills, industrial activities, and illegal dumping or littering (EPA, 2004).

Table 4-13 Trash and Debris: Sources and Causes

Sources	Cause
Dumping	Lack of Convenient Disposal Facilities
Animal Scavenging	Lack of Secure Disposal Facilities

Hydrologic Flow is not a pollutant in the terms of heavy metals or pesticides, but does affect biota and stability of streams and rivers. Changes in hydrologic flow typically increase the volume, frequency, and peak discharges of the stream. These changes can cause stream bank erosion, sedimentation, and poor conditions for plants, fish and macroinvertebrates. Increasing impervious surfaces within the watershed, channelization, and removal of riparian vegetation are common causes for changes in hydrologic flow.

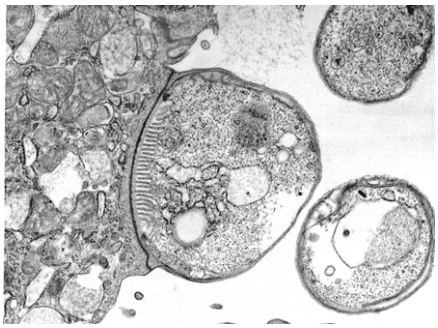
Source: Great Swamp Water Association Conservation Area, 2005

Table 4-14 Hydrologic Flow: Sources and Causes

Sources	Cause
Increased Channelization	Impervious Surfaces
	Lack of Buffer
	More Hydraulically Efficient Drainage Systems
	Additional Drainage Systems
	Development with Poor Storm Water Planning
Loss of Infiltration	Impervious Surfaces
	Turf Grass
	Compacted Soils
	Lack of Buffer
	Loss of Natural Areas
	Development with Poor Storm Water Planning
Loss of Storage	Loss of Wetlands
	Loss of Low Areas Acceptable for Flooding
	Loss of Floodplain
	Development with Poor Storm Water Planning

Toxic Pollutants

Toxic pollutants are non-biodegradable compounds including heavy metals and organic compounds. Toxic pollutants are deadly to organisms because the organism's natural biological processes are disrupted; usually with very low pollutant concentrations. The major toxic pollutants of alarm for the watershed are listed below.



Source: The University of Florida, 2005

A **Pathogen** is a microbe that under certain conditions will cause disease. Because many pathogens are not easily identified in water, an indicator organism such as *Escherichia coli* is commonly used as an estimation of pathogenic organisms. *Cryptosporidium parvum* and *Giardia lambia*, two protozoa, are the most common waterborne pathogens in the U.S. These protozoa, originating from human sewage and animal feces, are waterborne parasites that cause intestinal problems when ingested by creating a cyst that attaches to a host (i.e. cattle host, and then transferred to humans). Elevated levels of both pathogens were detected in a study of urban storm water runoff causing concern over drinking water supplies (CWP, March 2003).

Table 4-15 Pathogens: Sources and Cause

Sources	Cause
Livestock	Unrestricted Access
	Lack of Buffer
Manure Storage	Poor Design
	Poor Construction
	Poor Maintenance
Animal Waste (Non-Agricultural)	Pet Owners Not Picking Up Waste
	Wildlife
	Lack of Buffer
Illicit Connections	Poor Construction Practices
Failed Septic Systems	Poor Design
	Poor Construction
	Poor Maintenance
Leaky Sanitary Sewer	Poor Design
	Poor Construction
	Poor Maintenance
Combined Sewer Overflows (CSOs)	Function of Design Criteria Increased Development with Poor Storm Water Planning Unnecessary Inflow (e.g. connected downspouts and footing drains)
Sanitary Sewer Overflows (SSOs)	Excessive Infiltration
	Storm Water Inflow
	Increased Development with Poor Storm Water Planning
Dumping	Lack of Adequate Disposal Facilities

Source: Morton Salt, 2005

Salt (Deicer) is often used to melt snow and ice on roads and sidewalks. Extremely high concentrations, in the range of 2,000-5,000 mg/l, are typical in snowmelt and storm water runoff particularly in colder regions. However, chloride becomes toxic to organisms at concentrations of 500-1,000 mg/l and may additionally affect soil permeability, drinking water and small streams (CWP, March 2003).

Table 4-16 Salt: Sources and Causes

Sources	Cause
Roadways	Application Practices
	Lack of Buffer
Water Softeners	Poor Design
	Poor Maintenance
	Poor Construction

Oil and grease are often referred to as "hydrocarbons," or petroleum-based substances. Hydrocarbons travel attached to sediment and are frequently found in storm water and accumulate in bottom sediments. Little is known about the direct impacts of hydrocarbons on waterways, however, bioaccumulation and toxicity in aquatic organisms is a large concern. "Hotspots" for high concentrations of hydrocarbons are gas stations, convenience stores, commuter and residential parking areas and streets (CWP, March 2003).

Source: Rouge Valley Council of Governments, 2005

Table 4-17 Oil and Grease: Sources and Causes

Sources	Cause
Automobiles	Poor Maintenance
	Lack of Convenient Disposal Facilities
	Inadequate Disposal Facilities
Dumping from Food Preparation Facilities	Poor Maintenance
	Lack of Convenient Disposal Facilities
Dumpsters	Poor Design
	Poor Construction
	Poor Maintenance
Maintenance/Storage Yards	Poor Maintenance
	Poor Construction
	Lack of Oil/Grease Separator
	Lack of Buffer
Junk Yard	Poor Maintenance
	Lack of Oil/Grease Separator
	Lack of Buffer
Gas Stations	Poor Maintenance
	Poor Design
	Poor Construction
	Lack of Oil/Grease Separator

Source: King County Government, 2005

According to the EPA, as much as 100 pounds of **Household Hazardous Waste** (**HHW)** is generated per home/garage annually. HHW includes paints, solvents, used motor oil, excess pesticides and cleaning products. Although the exact fraction of HHW that is illegally dumped into the storm drain is unknown, it is apparent that during most outdoor rinsing of pesticide applicators and outdoor painting cleanup the waste enters the storm drain system creating potential toxins to aquatic life (CWP, March 2003).

Table 4-18 HHW: Sources and Causes

Sources	Cause
Paint	Lack of Convenient Disposal Facilities
Batteries	Lack of Convenient Disposal Facilities
Solvents	Lack of Convenient Disposal Facilities
Medicines/Antibiotics	Lack of Convenient Disposal Facilities
	Not Removed By POTW

Heavy Metals, specifically zinc, copper, lead, cadmium, and chromium, have been consistently found in urban storm water at levels of concern. EPA studies found that 75% of the time, concentrations of lead, zinc and copper exceed chronic toxicity limits in storm water samples. These metals result from the use of motor vehicles, metals and paint weathering, burning and atmospheric deposition of fossil fuels and have the potential, from bioaccumulation, to be highly toxic to aquatic organisms (CWP, March 2003).

Table 4-19 Heavy Metals: Sources and Causes

Sources	Cause
Automobiles	Normal Result of Usage
	Poor Maintenance
Metal Roofs	Normal Result of Usage
	Lack of Buffer
Soil Leachate	Contaminated Soil from Historic Industrial Practices
	Normal Background Level Present in Soil
Maintenance/Storage Yards	Poor Maintenance
	Poor Construction
	Lack of Buffer
Junk Yard	Poor Maintenance
	Lack of Buffer
Dumping	Lack of Education
	Lack of Convenient Disposal Facilities
Publicly Owned Treatment Works (POTWs)	Plant Effluent Limits
	Poor Design
	Poor Maintenance
Atmospheric Deposition	Causes Not Appropriate for this Plan but Education Needed
Medical Establishments	Lack of Convenient Disposal Facilities
	Poor Management

Polychlorinated Biphenyls (PCBs) were commonly used in industrial and commercial equipment including heat transfer systems and televisions as well as in paints, plastic and rubber products, pigments, dyes and carbonless copy paper until PCBs were banned in 1976. According to the EPA, PCBs are known to cause cancer in animals, cause problems in human immune, reproductive, nervous and endocrine systems and affect intellectual development of children and adults (EPA, 2005).

Table 4-20 PCBs: Sources and Causes

Sources	Cause
Stream Bottom Sediment	Plant Discharges
	Lack of Convenient Disposal Facilities
	Permitted Usage
Brownfield Runoff and Subsurface Leaching	Plant Discharges
	Lack of Convenient Disposal Facilities
	Permitted Usage

Source: DHI Water and Environment, 2005

Pesticides are used to control unwanted pests in the urban environment and vary in mobility, persistence, and potential aquatic impacts. Pesticide detection has been found to proportionally increase with the amount of urban land. Studies have found that high concentrations of pesticides, specifically diazinon, have adverse effects on ecology and human health. The Center for Watershed Protection (CWP) studies identify 100 percent of urban stream fish contain detectable pesticide levels in their tissues (CWP March 2003).

Table 4-21 Pesticide: Sources and Causes

Sources	Cause
Agricultural Lands	Pesticide Application
	Lack of Buffer
Residential Gardens	Pesticide Application
	Lack of Buffer
Drainage Ditches/Retention Basins	Pesticide Application to Reduce Maintenance
Golf Courses	Pesticide Application
	Lack of Buffer
Mosquito Treatment	Pesticide Application
	Lack of Buffer
Lake Management	Pesticide Application
	Lack of Buffer

Thermal Pollutants

Thermal pollution is waste heat generated from industrial processes which use water for cooling. The water is returned back into the water system at a significantly higher temperature, decreasing the dissolved oxygen and increasing the biological demand for oxygen from organisms.

Changes in **temperature**, even slight changes, will cause stress to urban streams and aquatic life. Specifically, increases in temperature result in changes in migration patterns, increased sensitivity and mortality in fish, and an increase in metabolic activity producing greater disease and parasite susceptibility (CWP, March 2003).

Table 4-22 Temperature: Sources and Causes

Sources	Cause
Urban Runoff	Impervious Surfaces Lack of Shade over Drainage and Storage Facilities
Lack of Riparian Buffer	Lack of Shade over Watercourse
Publicly Owned Treatment Works (POTWs)	Plant Effluent Limits Poor Design Poor Maintenance

Photo Courtesy of Tetra Tech, 2005.

Other Potential Problems

While **woody debris** is not technically a pollutant, large amounts of it hinder recreation such as canoeing in rivers and streams and may indicate bank erosion problems. Woody debris can also increase the flood stage and increase flooding on private property. However, woody debris is generally beneficial to the environment since it provides habitat for fish and macroinvertebrates which is critical for maintaining a healthy fishery.

Table 4-23 Woody Debris: Sources and Causes

Sources	Cause
Dead Fall	Natural Causes Flow Fluctuations (see Hydrologic Flow) Clearing by Property Owners (view of river)
Yard Waste Dumping	Lack of Convenient Disposal Facilities
Wildlife Habitat	Natural Causes

Photo Courtesy of Tetra Tech, 2005.

References

Allen, D. Interoffice Communication—Red Cedar River Survey at East Lansing. 1982

Center for Watershed Protection. "On Watershed Education, Watershed Protection Techniques." Article 127. 3(3): 671-679. 2003.

Center for Watershed Protection. "Understanding Watershed Behavior, Watershed Protection Techniques." Article 126,3(3): 671-679. 2003.

Center for Watershed Protection. "IMPACTS of Impervious Cover on Aquatic Systems." Watershed Protection Research Monograph No.1, March 2003.

Cheo, Martha and Tom Murdoch. Streamkeeper's Field Guide. Adopt-A-Stream Foundation. 2001.

DHI Water and Environment. "Fertilizing Photo." Website via : http://www.dhi.dk/Consulting/WaterResources/PlantGrowth/. Last accessed April 2005.

Environmental Protection Agency. "Results of the Nationwide Urban Runoff Program. 1998.

Environmental Protection Agency. Website via: http://it.tetratech-ffx.com/stepl/2004. Last Accessed 2004.

Environmental Protection Agency. Website via: http://www.epa.gov/opptintr/pcb/. Last Accessed April 2005.

Fishbeck, K. Report of Survey of Grand and Red Cedar Rivers. 1960

Jackson, G, Lundgren, R, and Willson, R. Biological Investigations of the Red Cedar River, Okemos to the Mouth, Ingham County, Michigan. 1974

King County Government. "Household Waste Photo." Website via: www.metrokc.gov/dnr/ kidsweb/img/HHWwall.jpg. Last accessed April 2005.

McNamee, Porter and Seeley, Inc. City of Grand Rapids "NPDES Permit Application for Discharges form Municipal Separate Storm Sewer System." 1992.

Michigan Department of Community Health. 2004 Michigan Family Fish Consumption Guide. 2004

Michigan Department of Environmental Quality. Water Quality and Pollution Control in Michigan 2004 Section 303(d) and 305(b) Report. 2004

Michigan Department of Natural Resources. Website via : http://www.michigandnr.com/PUBLICATIONS/PDFS/fishing/research/huntcreek/General-survey-streams.pdf. Last accessed April 2005.

Michigan Road Photos (MRP). "Downtown East Lansing Photo." Website via: http://www.angelfire.com/mi4/michhwypics/. Last accessed May 2005

Michigan State University Extension. "Exploring the Ecology Along the Red Cedar River at Michigan State University." 1997

Morton Salt. "Salt Truck Photo." Website via: www.mortonsalt.com/images/cons/salt_truck.jpg. Last accessed May 2005.

MSU-WATER. Progress Report. 2002

National Oceanic and Atmospheric Administration. Website via: http://www.glerl.noaa.gov/pubs/photogallery/gallery.html. Last accessed March 2005.

Piit, Robert. "The National Stormwater Quality Database (NSQP, Version 1.1). February 2004.

Progressive AE. Lake Lansing 2004 Water Quality Monitoring Report. 2005

Rockafellow, D. A Biological Survey of the Red Cedar River and Selected Tributaries, Livingston and Ingham Counties, Michigan. 2003

Rouge Valley Council of Governments. "Oil and Grease Photo." Website via: http://www.rvcog.org/MN.asp?pg=WR_Stormwater. Last accessed May 2005.

Schueler, T. 1994. The importance of imperviousness. *Watershed Protection Techniques* 1:100-111.

Scott, A. A Biological Survey of the Red Cedar River, Livingston and Ingham Counties, Michigan. 1992

Sunday, E. Dissolved Oxygen and Total Dissolved Solids Study of the Grand and Red Cedar Rivers, Vicinity of Lansing, Ingham, Eaton, and Clinton Counties, Michigan. 2003

Supprick, J. Informational Total Maximum Daily Load for Dissolved Oxygen in Sycamore Creek. 1996

Supprick, J. Water Chemistry Trend Monitoring in Sycamore Creek and Haines Drain, Ingham County, Michigan. 1999

The Great Swamp Watershed Association Conservation Area. "Stream bank Erosion Photo." Website via: www.greatswamp.org/ TOUR/streambank.erosion.jpg. Last accessed April 2005.

The University of Florida. "Pathogen Photo." Website via: medinfo.ufl.edu/.../ bms5300/images/crptospr.jpg. Last accessed January 2005.

Thelen, C. Biological Surveys of Sycamore Creek and Select Tributaries, Ingham County, Michigan. 1999

Waters, T.F., Sediment in streams=sources, biological effects, and control. American Fisheries Society Monograph 7. 1995.

Watersheds.Org. "Micro Organisms Photos." Website via: http://www.watersheds.org/nature/macroinv.htm. Last accessed March 2005.

Wisconsin Department of Natural Resources. "Trophic Water Level Photos." Website via: http://dnr.wi.gov/org/water/fhp/lakes/selfhelp/trophic.htm. Last accessed April 2005.

5. Community Outreach

A watershed plan stands little chance of ever being implemented unless broad consensus is reached among the many stakeholders that might be affected by the plan.

(CWP 1998)

Source: Rapid Watershed Planning Handbook, 1998

Introduction

This section provides information on how outreach was conducted to foster public involvement during the watershed planning process. The general public and specific stakeholders were involved in the development of the watershed management plan (WMP). The bulk of their input was obtained at community forums and stakeholder workshops. At these meetings, the participants were asked to provide a list of their goals and concerns in the watershed. This information was then used to develop the goals and objectives that are outlined in Section 6.

Public Participation Process

The Public Participation Plan (PPP) outlines the roles of the steering committee, stakeholder groups, and the general public in developing the WMP and how the information will be used during the decision-making process. For more information on the steering committee, please refer to Section 10.

The goal of the PPP was to effectively involve stakeholders throughout the watershed management planning process so that they contribute during the process, understand the plan, and support plan implementation. To foster involvement and participation within the community, key stakeholders in the watershed were identified and invited to participate in the planning process. The aim of this process was to engage a wide variety of agencies and interests, including those most affected by the plan or able to help implement the plan.

Obtaining sufficient public input on watershed projects takes creativity, persistence, and commitment. As such, the Public Participation Plan was developed with adaptive management in mind, allowing for the watershed committees to be flexible as they develop a WMP. While the PPP for this watershed outlined specific activities to be completed, these activities were modified as a better understanding how to obtain local public input was gained.


Red Cedar Public Meeting Sep. 23, 2004

Initial Public Meetings

Three public meetings were held at various locations throughout the Red Cedar River Watershed:

- The Hannah Community Center, September 22, 2004
- The Ingham County Fair Grounds, September 23, 2004
- The Foster Community Center, September 29, 2004.

The number of meeting participants ranged from approximately 10 to 40 people. In total, the public identified 19 concerns and problems within the watershed. The following is a compilation of goals and concerns from the public meetings held September 22, September 23, and September 29, 2004.

1. Pollution of Cedar Street Lake (gravel pit) including:
   a. Turbid/cloudy water, first time in seven years

   b. Black water developed at 10-12 ft depth in Aug 2004
   c. No oxygen in water, no plant life
   d. Salmon spawning and fishing area now in jeopardy
   e. New drain (Cook & Thorburn) enters waterbody
2. High Turbidity levels in local waterways
3. Septic system overflows and failures
4. Fish contamination
5. Waterfowl impacts
6. Bacteria and *E-coli* contamination
7. Pollutants (e.g. mercury)
8. Invasive species (Purple Loosestrife, Zebra Mussels)
9. Citizens education needed on:
   a. Current status of water quality and how citizens can make a difference
   b. Not adding to the pollutant load
   c. Storm drains are not garbage cans
   d. Problem of sanitary sewer overflows
10. Inadequate tree management/log jams in local waterways
11. Trash/dumping of yard waste (leaves and grass clippings) into river
12. Flooding
13. Existing negative or non-interested attitudes regarding the river
14. Costs and who will pay
15. Lack of interest or awareness
16. Rising development pressure across the watershed
17. Lack of recreational opportunities, swimming, low quality fishing
18. Water quality concerns (taste, iron content) on MSU campus
19. Flashiness—peak flows and relationship to CSOs
20. Water quality concerns (taste, iron content) on MSU campus
21. Increase River status for restaurants, businesses

Red Cedar Public Meeting Sep. 23, 2004

Public Comment on Draft Plan

A draft copy of the WMP was posted on the www.mywatersheds.org website for review and comment by the general public. A newspaper press release and announcement at municipal board meetings were made to advertise the availability of the plan. Comments received were addressed appropriately.

Stakeholder Workshops

A stakeholder list, including contact information, was developed prior to the stakeholder workshops. This list is included in Appendix B. Prior to each of the four workshops, a letter of invitation was mailed to each of the stakeholders. Approximately one week later, each stakeholder was called and personally invited to attend the meeting by one of the watershed committee members. This method led to solid attendance and stakeholder participation.


Red Cedar Stakeholder Workshop Oct. 10, 2004

The first workshop was an overwhelming success with approximately 40 diverse stakeholders representing various parts of the local communities. They included business owners, developers, local nonprofit and environmental groups, county conservation districts and drain commissioners, school superintendents, community planners, and

interested citizens. After a brief introduction to the watershed management planning process, attendees were divided into four workgroups and were asked to brainstorm together to answer two questions:

- What concerns or problems have you seen within the watershed?
- What desired uses and goals do you think are appropriate for the watershed?

After identifying the concerns, problems, uses, and goals, the lists were voted on and ranked.

Red Cedar Stakeholder Workshop Feb. 2, 2005

For the second stakeholder workshop, watershed characteristics and data that had been obtained were presented. A number of goals and desired uses had been identified by the stakeholders and the committee members during the first workshop. These goals were consolidated and presented to the stakeholders as a concise unit. Goals were also added to assure that Phase II requirements would be met. Once these goals were presented, workshop attendees ranked the goals as a method to prioritize for the action plan.

The third and fourth stakeholder workshops were held jointly by the Red Cedar River Watershed Committee, the Grand River Watershed Committee, and the Looking Glass River Watershed Committee. Because these plans were being developed on a similar time frame, the committee members felt that time and money would be saved by combining the workshops.

Representatives from the Grand River, the Red Cedar River, and the Looking Glass River Watersheds came together for their third stakeholder workshop on June 3, 2005. The purpose of the workshop was for stakeholders to respond to proposed actions designed to meet the previously determined goals and objective for each of the watersheds. Over 60 individuals attended the workshop.

Combined Stakeholder Workshop Sep. 9, 2005

The fourth and final workshop was held on September 9, 2005. The workshop provided stakeholders with an overview of the tri-county watershed planning process. Workshop attendees were provided copies of the draft Watershed Management Plans (WMP) from the three watersheds. Over 40 individuals attended the workshop.

Meeting Fact Sheets

Meeting fact sheets were developed for both the stakeholder workshops and the public meetings. The factsheets served as a meeting summary as well as an educational tool. Factsheets were provided to municipal officials and stakeholders to demonstrate what the public view as critical water resource issues in the watershed. Each factsheet contains a schedule of upcoming meetings to promote participation and input during the planning process.

Report to Municipal Officials

Local appointed and elected officials are critical players in adopting the WMP and allocating resources toward its implementation. Obtaining buy-in and providing education to this group will help ensure the success of implementing the WMP. Local government leaders value the advice, concerns, and issues that community residents vocalize in terms of the watershed conditions of the past, present and future.

Various presentations to municipal officials have been conducted throughout the watershed management planning process. These presentations are given during regular City Council, Township Board, and County Commissioner meetings. These meetings are a great way to provide information on future meetings and improve participation. Many of the people that attended these meetings are potential community participants in public education meetings. A PowerPoint presentation for these meetings was developed by the consultant and presented by a community representative.

Focus Group Meetings

Participants in the combined third stakeholder workshop for the Grand River, the Red Cedar River, and the Looking Glass River Watersheds requested additional time to discuss the draft Action Plan. Tetra Tech conducted focus groups in three key areas including; public education, future development and agriculture. The purpose of the focus groups was to clarify and supplement items contained in the Action Plan.

Key stakeholders in each of the three areas were asked to participate; the idea being that a small group of well informed people would be able to better communicate needed adjustments. Significant effort was made to bring people from different backgrounds and perspectives to each of the focus groups while keeping the size to 6-8 participants. The focus groups took place on July 11 and 12, 2005 and each ran for approximately two hours.

The input received from the focus groups clarified proposed action items and enriched the overall action plan. In the case of the agricultural focus group they opted to continue meeting in the future with the aim of improving water quality by combining and partnering on existing agricultural conservation programs.

Public Education Plan

Public education is inherent in the public participation process. Before the public is interested or willing to participate, they need to have a basic understanding of the issues. The Public Education Plan (PEP) is designed to promote, publicize, and facilitate education to help the public initiate positive watershed management activities.

The DEQ explains that "an adequate PEP will implement the necessary amount of educational activities to ensure that the targeted sectors of the "public" or audiences are reached with the appropriate message(s) for each education category."

The educational activities that have been completed and the materials that are being developed as part of the PEP were designed using the six major requirements in the Permit and on feedback from the public meetings, stakeholder workshops, and focus group sessions. This gave the watershed planning committee a more effective approach to reach individuals and groups that are critical to the long-term success of the watershed planning effort. (For more details about the PEP refer to the specific Plan for each community).

2002 Red Cedar River Survey

In February 2002, a questionnaire was mailed to a stratified random sample of 1000 residents of the Red Cedar River watershed. The sample was made up of 200 agricultural and 800 residential landowners and the overall response rate was 53.4 percent.

The survey produced several significant findings relevant to efforts to educate the public as well as protect and restore the Red Cedar River. One significant finding was that the Red Cedar River is a severely under utilized resource because of its poor water quality. Respondents were aware of the negative water quality impacts associated with urban sprawl but were not as cognizant of the issues surrounding erosion and sediment control. There was a high level of support (> 90%) for instituting best management practices to improve water quality. There was strong support for governmental action to improve water quality as indicated by support for stricter regulation of construction practices (≥ 75%), for increased enforcement of current regulations (≥ 74%), and for the zoning of open space (≥ 61%). Respondents also indicated that a preference for regional planning to protect the watershed.

Coordinating future public education efforts with this watershed management plan is key to successful implementation. The Greater Lansing Regional Committee (GLRC) has formed a public education committee that will facilitate public education ideas for each subwatershed in conjunction with the PEP and the WMP.

Draft Motor Oil Brochure: GLRC 2005

The GLRC is currently working on several major public education and involvement projects that are briefly described below.

- **Storm Drain Stenciling:** The GLRC has purchased curb markers for storm drain stenciling. Storm drain stenciling involves marking storm drain inlets with plaques or stencil painted messages to deter dumping of pollutants down the storm drains. Messages include "No Dumping. Drains to Water Source," "Drains to River," and "You Dump It, You Drink It. No Waste Here." Stenciling allows volunteers to get involved and become more educated and to spread awareness.
- **Watershed Signage:** Another effort by the GLRC to educate the public is to provide signage around the watershed boundary. These signs create an understanding of the extent of connections and distances from one waterbody to another within the watershed. Currently, the committee is in the process of determining locations to post the signs. Once this decision is made, the signs will be posted.
- **Brochure Development:** The Public Education Committee has developed a number of educational brochures that will be distributed to provide education for local citizens.

Many other programs currently exist to educate the public and to help foster public involvement with watershed awareness, storm water management, and water quality protection. These programs are described in detail in Section 7.

References

Center for Watershed Protection, Rapid Watershed Planning Handbook: A Comprehensive Guide for Managing Watersheds. 1998.

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6. Challenges and Goals

Introduction

> "Water is the most critical resource of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land."
>
> - Luna Leopold

As more and more people live, work and interact within a watershed, maintaining a healthy, sustainable environment becomes a challenge. To address these challenges, goals and objectives are developed to direct the actions within the watershed that will improve and protect the environment.

The purpose of this chapter is to:

1. Outline the water quality issues discussed in Section 4, summarize public and stakeholder concerns, and identify which pollutants are perceived to be of most concern.
2. Define designated uses and identify the impaired or threatened water bodies within the watershed that do not meet their designated uses.
3. Define and identify the watershed desires identified through the stakeholder workshops.
4. List the goals and objectives and identify how they were developed.

Photo courtesy of
Michigan State University, 2005.

Water Quality Issues and Concerns

It is important to distinguish between water quality issues and water quality concerns. Water quality issues are those water quality problems that have been identified through water quality monitoring, macroinvertebrate and fish sampling, and habitat surveys. Water quality concerns are problems that are observed or perceived to exist by residence and stakeholders within the watershed.

Water Quality Issues

Section 4 summarized data collected over a span of forty years in the Red Cedar River and Sycamore Creek. The results show that a variety of impacts have been identified; and many are still present in these water bodies.

Analytical sampling has identified Dissolved Oxygen (DO) as a substantial issue in both the Red Cedar and the Sycamore Creek. Additionally, pathogens have also been found to impact the water quality of the Red Cedar.

Biological studies found populations and diversity of fish and macroinvertebrates decreasing in a downstream direction in the Red Cedar River. Biological studies within the Sycamore Creek, likewise, found decreased populations and diversity of fish and macroinvertebrates. However, the decrease was limited to the headwaters.

Based on these studies, a number of Water Quality Standards (WQS) violations have been identified in the watershed. These impaired waterbodies are assigned a date to implement a Total Maximum Daily Load (TMDL) management strategy to address the violation and ultimately restore the water quality. The impaired waterbodies and the TMDL dates were presented in Table 4-3.

Water Quality Concerns

Water quality concerns were solicited from the public and stakeholders though a series of workshops and meetings, described in Section 5.

A list of the public's concerns is provided below.

- Pollution of Cedar Street Lake
- High turbidity levels in local waterways
- Septic system overflows and failures
- Fish contamination
- Waterfowl impacts
- Bacteria and *E. coli* contamination
- Pollutants
- Invasive species
- Education of citizens
- Inadequate tree management/log jams in local waterways
- Trash/dumping of yard waste into river
- Flooding
- Existing negative or non-interested attitudes regarding river costs and who will pay
- Lack of interest or awareness
- Rising development pressure across the watershed
- Lack of recreational opportunities, swimming
- Low quality fishing
- Water quality concerns on MSU campus
- Hydrological flashiness—peak flows and relationship to Combined Sewer Overflows

The concerns identified by the stakeholders are ranked and presented below. The concerns were ranked by the stakeholders to determine which issues they felt were more important.

1. Turbidity/solids load after a runoff event
2. Education
3. Finding proper funding
4. Impact on groundwater/water quality
5. Bacteria/illicit discharges
6. Public Awareness
7. Lawn care/fertilizers and pesticides and pet waste
8. Lack of recreational use/fishing
9. Communication issues
10. Development
11. Dumping of grass clippings, leaves, and litter
12. Road salt runoff
13. Lack of enforcement
14. Erosion/runoff
15. Waterfowl contamination
16. Attain Clean Water Act goals and objectives
17. Public access to waterways
18. Loss of wetlands
19. Septic system failures

Red Cedar River Watershed Stakeholder Meeting Photo Courtesy of Tetra Tech, June 2005

Source: NCSU, 2004.

What are "designated uses"?

- They are recognized as important uses for waterbodies that are protected by state and/or federal regulations.
- They are defined in Rule 100 of MDEQ Administrative Rules under authority of the Natural Resources and Environmental Protection Act (Public Act 451 of 1994, Part 31)

Example Pollutants Affecting Designated Uses

Agricultural Water Supply
- Hydrology (too little flow)
- Excess nutrients
- Toxic contaminants

Industrial Water Supply
- Hydrology (too little flow)
- Suspended solids

Public Water Supply
- Excess nutrients (nitrates)
- Pesticide contaminants

Warm Water Fishery
- Sediment
- Hydrology (flow variability)
- Dissolved oxygen (too little)

Cold Water Fishery
- Sediment
- Hydrology (flow variability)
- Dissolved oxygen (too little)

Other Aquatic Life / Wildlife
- Sediment
- Pesticides
- Temperature

Partial Body Contact
- Pathogens
- Nutrients

Total Body Contact
- Pathogens
- Nutrients

Navigation
- Obstructions

Source: MDEQ, 2000.

Designated Uses in the State

The Michigan Department of Environmental Quality (MDEQ), acting under authority of the federal Clean Water Act, aims to make waters in the state meet certain designated uses (State of Michigan, 1999):

- Agricultural Water Supply
- Public Water Supply
- Other Aquatic Life / Wildlife
- Industrial Water Supply
- Warmwater Fishery
- Partial Body Contact
- Coldwater Fisheries (specifically identified waterbodies only)
- Total Body Contact (May 1st – October 31st)
- Navigation

The designated uses are intended to:

- Protect health and public welfare
- Enhance and maintain the quality of water
- Protect the state's natural resources
- Meet the requirements of state and federal law (including international agreements)

One of the first things people envision when discussing water quality is drinking water. It is extremely important for communities to have a clean source of drinking water that is free from contaminants.

Communities in the subwatershed use groundwater for drinking water supplies, and although the designated uses apply to surface waters, the uses also help protect groundwater drinking supplies because these two water sources are implicitly linked.

Contaminants in water can also affect human health when the water is used to irrigate food sources, when fish living in these waters are eaten, or when humans come in contact with these waters through swimming or boating.

While human health is the most important reason for protecting these resources, the designated uses are also intended to protect wildlife, commerce, and recreation. For example:

- The "warm water and cold water fisheries" uses also ensure healthy fish populations, increases recreational enjoyment of fishing, and ensures a thriving fishing industry that results in fishing related consumer spending, travel, and tourism.
- The "industrial water supply" use ensures that businesses have an inexpensive and sustainable process water supply that helps keep them competitive and providing jobs to Michigan's citizens.
- The "navigation" use ensures that the state's waterways are passable and the "body contact" use ensures that people can safely swim. These uses contribute to the lure of many travelers vacationing during the summer.

The coldwater fishery use does not apply to any waters within the watershed as none have been designated as such by the MDEQ.

Designated Uses Not Being Met

As a result of the State's defined designated uses and the water quality data and impairments discussed in Section 4, the following designated uses are not being met:

- **Warm Water Fishery** and **Other Aquatic Life and Wildlife** are impaired in the Red Cedar River, from the Grand River confluence upstream to Kalamazoo Street, and in the Sycamore Creek. The impaired designation in the Red Cedar River is due to exceedances for DO, fish kills, and poor fish and macroinvertebrate communities. The impaired designation in the Sycamore Creek and several tributaries is due to exceedances of water quality standards for DO.

- **Total and Partial Body Contact** is impaired in the Red Cedar River from the Grand River confluence upstream to Kalamazoo Street due to CSO discharges (pathogens).

Threatened Designated Uses

Additionally, the following designated uses are being met but are threatened (meaning they may not be met in the foreseeable future):

- **Warm Water Fishery, Other Aquatic Life and Wildlife**, and **Navigation** are threatened in the Sycamore Creek due to excessive sedimentation, especially within the headwaters. The sediment was identified as a pollutant causing the reduction of DO. All other inland lakes, reservoirs and impoundments are threatened by the presence of PCBs and / or mercury in fish material (implying the potential for these pollutants to bioaccumulate in other organisms).

Meeting the state-defined designated uses is important to meet legal requirements to protect public health, provide a high quality of life, and protect natural resources. Programs such as the MDEQ TMDL program seek to obtain the restoration of these uses with the ultimate goal of restoring and maintaining the chemical, physical, and biological integrity of the state's waters.

It is important to note that the assessments presented herein are subject to change. Additional data, new pollution sources, changing use locations, and updated water quality standards all may affect the assessment. Waterbodies may be listed or de-listed on Michigan's 303d or 305b list, and the associated status of designated uses may change.

Source: ICD, 2005.

Watershed Desires

The term "watershed desire" is meant to invoke a vision of what watershed stakeholders would like their watershed to look like. The watershed planning committee members and the stakeholders have participated in determining goals and desires for the watershed, such as, developing a recreational trail along the river.

During the public participation process, the public was given the opportunity to express their watershed desires. The public identified the following watershed desires:

- Target lawn care companies, turf grass industry and the public on proper lawn fertilizer applications through education/recognition practices
- Increase community involvement through public education
- Increase river corridor status for restaurants and businesses

Photo courtesy of
Friends of the Looking Glass River

Likewise, the stakeholders were also given an opportunity to develop a list of watershed desires. This list was prioritized by the stakeholders and is provided below:

1. Swimmable and fishable waters
2. Education
3. Public support to allow funding
4. Change public perception
5. Upstream extension of river trail
6. Reduce pollutant loading during runoff
7. More events that include the River/Red Cedar Group
8. Coordination with water protection programs
9. Riverfront development
10. Protect drinking water supply
11. River clean-up day
12. Determine and target largest polluters
13. Prioritize what public should do
14. Meet mandated deadlines
15. Red Cedar public website development
16. Label watershed entry points
17. Control waterfowl protection
18. Better fertilizer/pesticide management
19. Water conservation

Goals and Objectives

A mission statement was developed by the watershed committee during the initial stages of The Public Participation Plan implementation. The mission is:

Improve Water Quality in the Red Cedar River Watershed

Using this mission statement along with the identified known pollutants and watershed desires, a set of goals and objectives was developed. The goals reflect the mission statement and are accompanied by a set of objectives and actions which when implemented will assist in meeting the corresponding goal. The actions associated with these objectives are listed in Section 8.

In addition to considering the desires of the public and stakeholders during goal and objective development, permit requirements were also considered. The watershed management plan as a whole must contain the following: (See Part I.B.1 of the permit in Appendix C).

- An assessment of the nature and status of the watershed ecosystem (Section 3 and 4)
- Long-term goals to include the protection of designated uses of the receiving waters and compliance with TMDLs (Sections 6 and 8)
- Short-term objectives (Sections 6 and 8)
- Action items to achieve goals and objectives (Section 8)
- The benefit and cost of the action items (Section 8)
- A responsible party, schedule, and evaluation mechanism for each action item (Section 8)

Minimum Permit Requirements

The objectives in this plan meet the Watershed-Based NPDES Permit requirements, but because of the significant public and stakeholder response, many additional objectives are included in the plan to expand on voiced desires. These additional objectives go beyond the minimum requirement of the permit.

Because the Watershed-Based NPDES Permit has broad requirement language, and because of the implication that any implemented objective, directly or indirectly, must help protect the designated uses of the receiving water body, it was necessary to include the minimum requirements from other sources. These sources include the U.S. Environmental Protection Agency (US-EPA) Storm Water Phase II Final Rule requirements and the Michigan Jurisdictional-Based NPDES Permit. These two sources were chosen because the Watershed-Based NPDES Permit is based on their requirements. The US-EPA Storm Water Phase II and Jurisdictional-Based NPDES Permit requirements establish six minimum measures.

Each minimum measure requirement as well as each specific Watershed-Based NPDES Permit requirement was reviewed to assure that at least one objective correlated with it. In the section below, each goal is prioritized according to what stakeholders deemed important. Objectives are included in the table under each goal. A 'Yes' indicates that the objective fulfills one or more permit requirements at a minimum level. A 'No' indicates that the objective is considered beyond the minimum requirement of the permit, or that it extends a general effort beyond the minimum requirement of the permit, and may be eligible for certain types of grant funds. During goal and

US-EPA's Six Minimum Measures

Public Education and Outreach

- Distribute educational materials or conduct outreach

Public Involvement/ Participation

- Comply with state, tribal, and local public notice requirements

Illicit Discharge Detection and Elimination

- Map waters of the state and the outfalls that discharge to them
- Legal authority to prohibit non-storm water discharges
- A plan to detect and address non-storm water discharges
- Educate staff, businesses, and public about illicit discharges

Construction Site Runoff Control

- Regulate compliance with proper soil erosion/ sediment control
- Review site plans that have potential for water impacts
- Conduct site inspection and enforcement
- Receive/consider information submitted by public

Post-Construction Storm Water Management

- Implement strategies to include structural/non-structural BMPs
- Require usage of post-construction controls
- Ensure long-term O&M controls

Pollution Prevention/Good Housekeeping

- Prevent/reduce pollutant runoff from municipal operations
- Train employees on pollution prevention/good housekeeping

Source: US-EPA, 2000

objective development, it became clear that some objectives fulfill minimum requirements, some objectives go beyond the minimum requirements, and some objectives are difficult to categorize. Discretion was used to determine how the uncategorical objectives are classified.

Note that each goal and objective should be considered in association with other goals and objectives, as applicable. For example, Goal 1 is focused on educating the public on many different topics. These education efforts will be coordinated with efforts included in the remaining goals as much as practicable to provide the greatest benefit.

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed.

Source: KSU, 2005

The aim of Goal 1 is to develop an aggressive multi-media public education plan to define watersheds and storm water, encourage homeowner stewardship, and advertise watershed events targeted at the general public, stakeholders, municipal officials and planning boards.

While many of the Goal 1 objectives fulfill the minimum Phase II Permit requirements, several go beyond the minimum requirements and are indicated as such. Specifically, the Goal 1 objectives fulfill Part I.A.3.b of the Watershed-Based NPDES Permit. Objectives under this goal will be incorporated into updated Public Education Plans (PEP). The objectives of the education plan recognize that multiple public entities exist, often with specific needs and requiring more tailored educational efforts. Therefore, the objectives have been grouped under three categories intended to reflect the different publics targeted by the PEP. This more focused approach will allow for better connectivity between the identified watershed issues and concerns and the education programs. The three categories are:

- Youth Programs (K-12);
- General Public Education;
- Business/Restaurant Education.

Youth Programs (K-12)

Objective		*Required**
1a	School Education: Assist local school districts in developing a science curriculum on watershed studies.	Yes

General Public Education

Objective		*Required**
1b	Public Participation: Develop and maintain Storm Drain Marking. Provide routine updates to the general public, the stakeholders and the municipal officials.	Yes
1c	Support participation in Adopt-A-River program.	Yes
1d	Develop an educational campaign to encourage preservation and reestablishment of native riparian vegetation and to emphasize the importance of wetlands in the community.	Yes
1e	Homeowner Education: Develop an educational campaign for maintenance and operation of on-site sewage disposal systems, household hazardous waste, lawn maintenance, automobile maintenance, and private wellhead protection for all homeowners.	Yes

PC,

1f	Maintain GLRC Public and Project Web Site.	Yes
1g	Public Participation: Develop a community based volunteer group and train them to assist with watershed-wide actions such as stream corridor inventories and road stream crossing and publicize the results.	No
1h	Update Public Education Plan (PEP) to reflect this WMP.	Yes
Business & Restaurant Education		
Objective		*Required**
1i	Business Education: Salt application, good housekeeping of parking lots and grounds, oil/grease disposal, cleaning agent use. Restaurant Education: No Grease in Storm Drains	Yes

*The 'Required' column indicates whether an objective is required under the Phase II Permit.

Goal 2: Provide a Sustainable and Equitable Funding Source

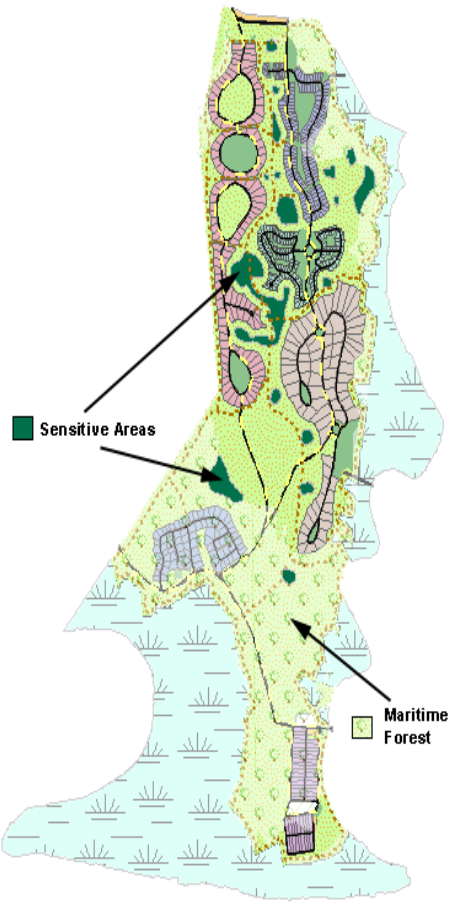
For any plan to be fully implemented and sustained for the long-term, a funding source must be identified. In fulfillment of this goal, it is anticipated that a funding sub-committee will be coordinated to establish budget needs and funding mechanisms.

Objective		*Required**
2a	Develop and adopt a funding strategy to support the WMP.	Yes

Goal 3: Encourage Water Quality Friendly Development

Many of the Goal 3 objectives are aimed at fulfilling Storm Water Pollution Prevention Initiative (SWPPI) requirements from Part I.B.2 of the Watershed-Based NPDES Permit. The permit requires the "development, implementation, and enforcement of a comprehensive storm water management program for post-construction controls for areas of new development and significant redevelopment." Goal 3 objectives aim to prevent or minimize the effects of urbanization on water quality through ordinances, planning, and long-term operation and maintenance requirements for controls.

Objectives		*Required**
3a	Promote intergovernmental coordination and cooperation for Water Quality Friendly Development practices which includes wetland and waterbody setbacks.	Yes
3b	Develop a development standards manual which outlines economically viable Water Quality Friendly Development practices.	Yes
3c	Improve ordinance enforcement of all watershed-related ordinances such as Illicit Discharge Elimination Program (IDEP), waste disposal, and wetland protection.	Yes
3d	Incorporate Water Quality Friendly practices into land use, zoning, and community development master plans.	Yes
3e	Implement watershed-wide septic system inspection and abandoned well closure inspection in conjunction with local health agencies.	Yes
3f	Facilitate the completion of at least one demonstration project	No



Site Planning
Source: NOAA, 2005

	within the watershed using low impact development standards.	
3g	Retrofit areas of high impervious cover with stormwater BMPs to decrease imperviousness. Look for ways to coordinate with groundwater protection and cooperate on grant applications.	No

Goal 4: Restore and Enhance Recreational Uses through Development of a Watershed Recreation Plan

Source: LOAPC, 2004

Goal 4 was developed primarily in response to public input. During the public meetings, many people indicated that they would like to see rivers restored, enhanced, and/or protected so that recreational activities can be enjoyed for the long-term. "Partial Body Contact Recreation" and "Total Body Contact Recreation between May 1 and October 31" are designated uses of surface waters that the individual watershed communities are required to protect. The communities would like to restore, enhance, and protect recreation in their waterways as much as practicable, but they recognize that this is a long-term goal that involves the implementation of this WMP as a whole. Therefore, most of the Goal 4 objectives are considered objectives that go beyond the Phase II permit requirements, save the ongoing task of coordinating efforts to remove trash and debris from the rivers.

Objectives		*Required**
4a	Research deadfall management techniques and adopt a management plan.	No
4b	Restore fishing opportunities in the watershed. Look at both accessibility and habitat.	No
4c	Add at least one canoe landing along the Looking Glass River, Red Cedar River, or Grand River.	No
4d	Recreational Assessment: Examine the river and stream corridors and construct additional access sites, river trails, and observation decks to improve walking, fishing, and observation opportunities.	No

Goal 5: Protect and Enhance Habitat for Wildlife and Aquatic Animals through Development of a Watershed Habitat Plan

Photo courtesy of
Clinton River Watershed Council

Similar to Goal 4, Goal 5 was developed in response to the public's desire to protect and enhance wildlife including aquatic animals. "Warm Water Fisheries" and "Other Indigenous Aquatic Life and Wildlife" are designated uses of surface waters that the individual watershed communities are required to protect. The communities rely on the successful implementation of this WMP to protect these designated uses. Therefore, most of the Goal 5 objectives are considered objectives that go beyond the Phase II permit requirements.

Objectives		*Required**
5a	Conduct an inventory of the stream corridors and identify existing riparian buffers and shade cover over streams. Also, identify areas of eroding stream banks and excessive sedimentation. Identify potential sources and rank in order of importance for restoration.	No
5b	Protect and Enhance Habitat for Wildlife and Aquatic Animals through Development of a Watershed Habitat Plan.	No
5c	Consider restoration or purchase of key wildlife habitat areas based on the management plan.	No

Goal 6: Protect and Increase Wetlands through Development of a Watershed Habitat Plan

Photo courtesy of
Tetra Tech, 2005

Communities would like to protect and increase wetlands as much as practicable and recognize that successful implementation of the WMP is needed to do this. Although the watershed committee is committed to protecting wetlands as part of Goal 3, all Goal 6 objectives go beyond the requirements of the Phase II program.

Objectives		*Required**
6a	Inventory wetlands within the watershed and determine the general health of wetlands, primary impacts and sources of these impacts.	No
6b	Develop and adopt wetland protection measures.	No
6c	Implement advanced wetland restoration/protection measures.	No

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Similar to Goal 3, Goal 7 objectives focus on fulfilling SWPPI requirements from Part I.B.2 of the Watershed-Based NPDES Permit. The permit requires specific activities to be conducted under this section including the following:

1) Maintenance and inspection plans for structural controls;
2) Controls to reduce/eliminate pollutants from roadways, parking lots, and maintenance garages;
3) Procedures for proper disposal of operation and maintenance waste;

Source: Hamilton, 2005.

4) Ways to ensure the flood management projects assess the impacts of water quality; and
5) Controls to reduce the discharge of pesticides and fertilizers in the permittee's regulated area.

The permit also calls for a training and inspection program for staff and contractors. As part of many of these objectives, training will be conducted as outlined in the action plan table in Section 8.

Objectives		*Required**
7a	Ensure that ordinances and Standard Operating Procedures (SOP) comply with Phase II permit requirements.	Yes
7b	Review municipal pesticide and fertilizer application procedures for municipally-owned property. Ensure that directions are followed, low-phosphorus fertilizers are used, and soil testing is conducted to determine fertilizer need.	Yes
7c	Provide maintenance activities and inspection procedures for permanent structural storm water best management practices (retention basins, swales, created wetlands, rain gardens, etc.).	Yes
7d	Assess the impacts on water quality from flood management projects.	Yes
7e	Reduce discharge of pollutants from streets, roads, highways, parking lots, and maintenance garages.	Yes
7f	Dispose of operation and maintenance waste from the separate storm water drainage system appropriately. This includes street sweeping, catch basin cleaning, dredge spoil, sediments, floatables, and other debris.	Yes
7g	Add or revise municipal ordinances to require low or no phosphorus fertilizer for both business and residential use.	No
7h	Ensure that excess salt is not being spread in watershed. (coordinate with Obj. 1i and Obj. 7e)	No
7i	Remove trash and debris from river. Coordinate with O&M Departments to plan for events that result in excessive trash and debris, such as festivals, street fairs, and football games.	Yes
7j	Adopt stream and ditch management techniques for channel rehabilitation focused on drains and open ditches.	Yes

Photo courtesy of Tetra Tech, 2005

Goal 8: Strive to Eliminate Pathogens to Meet Total and Partial Body Contact for Recreational Uses

Individual watershed communities will strive to eliminate pathogens discharging to waterbodies primarily through their Illicit Discharge Elimination Plan (IDEP). Developing and implementing an IDEP, a plan that is approved separately from this WMP, is a requirement of Part I.A.3 of the Watershed-Based NPDES Permit.

Minimization and/or management of sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) is a targeted objective that came out of public and stakeholder involvement. SSO and CSO management is not a requirement of the Phase II program, so any actions taken for this objective are not part of this permit. Alternatively, actions are taken under a separate permit and are managed by other agencies within the communities.

Objectives		*Required**
8a	Minimize and/or manage sanitary sewer overflows (SSOs) and combined sewer overflow (CSOs).	No
8b	Conduct an illicit discharge removal program including: finding problems by checking for leaking sanitary systems, leaking septic systems, and illicit connections; removing the source of the problem and prohibiting their reoccurrence through municipal code and ordinances.	Yes

Goal 9: Encourage Water Quality Friendly Agricultural Practices

Agricultural practices have the potential to contribute large amounts of runoff laden with sediment, nutrients, and other compounds harmful to our rivers and streams. Recognizing this as a problem, Stakeholders and the Public have requested that this goal be added to the WMP. Implementation of agricultural BMPs is not a requirement of the Phase II Program. Therefore, the Goal 9 objectives are considered objectives beyond the requirement of the Phase II permit.

Objectives		*Required**
9a	Promote and support the existing agricultural program and encourage water quality friendly practices. Focus on creating incentives.	No
9b	Support annual community meetings on agriculture in the watershed.	No

Details surrounding the watershed objectives are included in Section 8 of this WMP. Although the objectives are intended to help meet the goals, an iterative process of implementation and evaluation is required to assess the effectiveness of the objectives. Refer to Section 9 for more discussion on evaluation mechanisms.

No-Till

References

DAS Manufacturing. "Curb marker graphic." via http://www.dasmanufacturing.com/storm/. Last accessed February 28, 2005

Hamilton, City of, Ontario, Canada. "Street sweeping photo." via http://hamilton.ca/public-works/Fleet-And-Facilities/Fleet-Services/default.asp. Last accessed May 23, 2005.

Ingham Conservation District (ICD). "Row boat photo." via http://www.inghamconservation.com. Last accessed February 28, 2005.

Kent State University (KSU). "River clean-up photo." via http://www.kent.edu/images/river.jpg. Last accessed May 23, 2005

Lansing Oar and Paddle Club (LOAPC). "Canoeing photo." via http://www.loapc.com. Last accessed February 28, 2005

Michigan Department of Environmental Quality Water Division. "Developing a Watershed Management Plan for Water Quality: An Introductory Guide." 2000.

Michigan Waterfowl. "Wetland habitat photo." via http://www.michiganwaterfowl.com. Last accessed February 28, 2005.

National Oceanic and Atmospheric Association (NOAA). "Site plan illustration" via http://www.csc.noaa.gov/alternatives/conserveStatic.html. Last accessed May 24, 2005.

North Carolina State University (NCSU). "Picture of boy drinking water." via http://www2.ncsu.edu/ncsu/CIL/WRRI/annual/0203SDWA.html. Last accessed December 15, 2004.

State of Michigan. "Michigan Administrative Code." Part 4. Last Revised: April 2, 1999

United States Environmental Protection Agency (US-EPA). "Storm Water Phase II Final Rule Fact Sheet Series." Publication 833-F00-005. January 2000.

United States Environmental Protection Agency (US-EPA). "Smart growth definition." via http://www.epa.gov/smartgrowth/about_sg.htm. Last accessed May 25, 2005.

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7. Watershed Protection Tools

River Quote

"Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land."

- Luna Leopold

Overview

Watershed protection requires a series of tools to protect or restore aquatic resources. Many tools are available and some of these are discussed below. Different subwatersheds may require different combinations of these watershed tools.

Watershed Planning

Watershed planning is an overall tool which examines the characteristics of a watershed including its geology, hydrology, land use, development, demographics and water quality. This data is typically broken down into smaller subwatershed units for effective and efficient planning and actions. A watershed plan may include:

- A prediction of how water resources will react to future land use changes.
- A public consensus on desired goals or uses within the watershed.
- A plan to meet the designated uses and desired goals within the watershed.
- A plan to reduce or abate current or future impervious cover.
- An action plan to select combinations of watershed protection tools for subwatersheds.
- The framework for a sustainable watershed management plan.

Land Conservation

This tool focuses on the conservation of five critical land types:

- Critical Habitats
- Aquatic Corridors
- Hydrologic Reserve Areas
- Water Hazards
- Cultural/Historical Areas

Conservation of these land types helps protect the existing water quality from degradation and encroachment onto these important critical land types. These land types may not occur in every subwatershed, but are likely to occur somewhere in the watershed or basin you are working in. There are several techniques for conducting land conservation which include: land acquisition, conservation easements, regulation of land alteration, setback of water pollution hazards, protection of green space within open space design, landowner stewardship, and public sector stewardship. Conducting land conservation efforts will require community coordination and an examination of the critical resources that are important to protect a subwatershed level.

Several programs are available locally that conduct land conservation efforts, including the following:

Michigan Conservation Districts

Michigan's Conservation Districts are "unique" local resource management agencies that coordinate and implement resource and environmental programs utilizing state, federal and private sector resources. The guiding philosophy of the Conservation Districts is that decision on conservation issues should be made at the local level, by local people and interests, with

technical assistance provided by the government. The Conservation Districts carry out many diverse programs, including programs that deal with land management, erosion control, flood prevention, water use, groundwater, farms, forestry, wildlife, water quality, recreation, and community development. Contact information for local conservation districts can be found at http://www.macd.org/.

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 these resources. The NRCS has several conservation programs, including: the Environmental Quality Incentives Program, the Wildlife Habitat Incentives Program, the Wetlands Reserve Program, the Farm and Ranch Land Protection Program, the Grassland Reserve Program, the Conservation of Private Grazing Land Program, the Conservation Security Program, the Resource Conservation and Development Program, and the Conservation Reserve Program. More information of the NRCS can be found at http://www.nrcs.usda.gov/.

The Nature Conservancy

The Nature Conservancy's (TNC) 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 to identify the highest-priority places that, if conserved, promise to ensure biodiversity over the long term. In other words, Conservation by Design allows TNC to achieve meaningful, lasting conservation results. The TNC website is located at http://nature.org/.

Michigan Department of Agriculture's Conservation Reserve Enhancement Program

The Michigan Department of Agriculture's (MDA) Conservation Reserve Enhancement Program 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 value to the nation in matters of soil erosion, water quality, and wildlife habitat. Information on the program can be obtained through the MDA website at http://www.michigan.gov/mda/.

Michigan Department of Natural Resources

The Michigan Department of Natural Resources (MDNR) 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. Federal funds support programs for wildlife and fisheries habitat and development, forest management, recreation and other natural resource efforts. The MDNR's website is located at http://www.michigan.gov/dnr/.

US Fish and Wildlife Services

The goal of the U.S. Fish and Wildlife Services is to work with the public and government agencies to conduct an environmental review for habitat protection and restoration, environmental contaminants, and federally threatened and endangered species. The agency's website is located at http://www.fws.gov/.

Pheasants Forever

Pheasants Forever 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. The organization's website is located at http://www.pheasantsforever.org/.

Ducks Unlimited

The Ducks Unlimited 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. The organization's website is located at http://www.ducks.org/.

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. The organization's website is located at http://www.tu.org/.

Aquatic Buffers

The aquatic corridor, where land and water meet, needs special protection in the form of buffers. Aquatic buffers may be used along streams, rivers, lakes, ponds, and wetlands. It functions to 1) reduce the amount of pollutants entering waterbodies through filtration and uptake of pollutants and 2) protect waterbodies from encroachment. Aquatic buffers can also provide habitat corridors and protection of floodplains from impervious development.

USDA National Agroforestry Center

The USDA National Agroforestry Center conducts research on how to design and install forested buffers to protect water quality, and develops and delivers technology on a broad set of agroforestry practices to natural resource professionals who directly assist landowners and communities. The center's website is located at http://www.unl.edu/nac/.

Michigan State University Extension

The Michigan State University Extension focuses on bringing knowledge-based educational programs to the people of the state to improve their lives and communities. Today, county-based staff members, in concert with on-campus faculty members, serve every county with programming focused on agriculture and natural resources; children, youth and families; and community and economic development. The program's website is located at http://www.msue.msu.edu/home/.

Better Site Design

Better site design incorporates a number of best management practices in conjunction with sustainable development when designing a subdivision or portion of a community. This has been used in Michigan in several locations with great success. The key to this type of design is that it can reduce impervious cover by 10% to 50% (CWP, 1998). Design strategies that have a good application in watershed protection include: Open Space Residential Subdivisions, Green Parking Lots (minimized impervious

surfaces), Headwater Streets (decreased street widths with decreasing average daily trips), and Rooftop Runoff Management.

Erosion and Sediment Control

Erosion and sediment control is a critical tool that the watershed group uses to protect waters from sedimentation. The potential impacts to waterways are increased by removal of trees and topsoil, exposed soils, alteration of drainage patterns, and disturbing sensitive areas. Many Michigan communities have existing programs, but they are understaffed and under enforced. Steps such as ensuring the use of buffer strips, reducing sediment loads, and maintaining the boundary of conservation areas and buffers are important. Conducting a good erosion and sediment control program is a critical component of effective watershed protection.

Part 31 of Public Act 451 is known as Permit by Rule. Permit by Rule is administered by the Michigan Department of Environmental Quality (MDEQ) and requires any land disturbance greater than 5 acres to obtain a Notice of Coverage in addition to a soil erosion control permit from the local county enforcing agents (CEA) or municipal enforcing agents (MEA). These agencies are identified in the box on the right-hand side of the page.

Part 91 of Public Act 451 is administered by the CEAs and requires that a permit be obtained for any land disturbance greater than 1 acre.

To contact the MDEQ about the Permit by Rule program, use the following contact information:

Michigan Department of Environmental Quality
Water Bureau, Storm Water Administration
PO Box 30657
525 West Allegan, 2nd Floor
Lansing, MI 48909-8157

Storm Water Best Management Practices

As described by the US Environmental Protection Agency (EPA), storm water nonpoint source pollution has a significant impact on water quality in the Unites States. To reduce this impact, it is important that watershed protection measures include examining best management practices (BMPs) used to reduce the amount of pollution that is entering receiving water bodies. Since development causes hydrological changes in the watershed, BMPs must also be chosen to mitigate this effect. A number of BMP types are presented below:

- Erosion and Sediment Control systems – These include silt fences, catch basin inserts, and many other systems/actions that reduce erosion at the source and/or trap traveling sediments.
- Infiltration systems – These include basins and swales that are designed to allow storm water runoff to slowly percolate into the soil. The primary benefits of these systems are runoff volume reduction and pollutant removal, specifically total suspended solids (TSS), phosphorus (P), nitrogen (N), and metals.
- Filtration systems – These include bioretention, sand filters, and filter strips. The primary benefit of these systems is pollutant removal, specifically TSS, P, N, and metals.

MEAs

City of East Lansing
2000 Meritt Road
East Lansing, MI 48912
517-337-9459

City of Lansing
Public Service Department
7th Floor City Hall
124 W. Michigan Ave.
Lansing, MI 48893
517-483-4455

CEAs

Clinton County Drain Commissioner
Clinton County Courthouse
100 East State Street, Suite 2300
St. John's, MI 48879
989-224-5160

Eaton County Drain Commissioner
1045 Independence Blvd
Charlotte, MI 48813
517-543-7500

Ingham County Drain Commissioner
707 Buhl Drive
Mason, MI 48854
517-676-8395

MSU Green Roof

Street Sweeping

- Vegetated Swales / Wetlands – These systems are designed to attenuate and reduce runoff in addition to removing pollutants such as TSS, P, N, and metals.
- Retention systems – These systems include specialized ponds and function in a similar fashion to infiltration systems in that the total volume of storm water runoff is reduced. These systems typically provide some benefits for pollutant removal, principally TSS.
- Detention systems – These systems include basins and vaults that are typically dry and are designed primarily to attenuate runoff discharge but may provide some pollutant removal benefits, specifically TSS.

The BMP types discussed above are classified as either vegetative or structural. Vegetative BMPs are those that use vegetation to slow runoff, infiltrate stormwater, and/or filter pollutants. Structural BMPs include those that are hard-engineered (meaning they are typically constructed of concrete or steel). Other BMPs typically fall under the 'managerial' category. These BMPs typically aim to reduce pollution by standardizing environmentally responsible activities and educating people about environmental issues and proper actions. These BMPs include such things as ordinances, household hazardous waste programs, and street sweeping.

Non-Storm Water Discharges

Non-storm water discharges include discharges from septic systems, sanitary sewers, and others such as industrial NPDES discharges, and manure runoff to name a few. This tool is used to evaluate the need for septic system inspections, failing septic system repairs, ordinance changes, spill prevention, and identifying and removing illicit connections.

Watershed management planning being conducted through the Michigan watershed permit program are already developing and implementing an illicit discharge elimination plan, or IDEP, which is examining the storm sewer systems and other waterways for illicit discharges and connections.

This watershed management plan is also examining current septic system issues and will make recommendations for future improvement in local planning, installation and maintenance operations. This is discussed earlier in Section 3.

Watershed Stewardship Programs

Watershed stewardship is the community investment of time and resources to promote public understanding and awareness of watershed issues. A number of programs are available to consider when selecting a method to promote watershed stewardship including:

- Watershed Advocacy
- Watershed Education
- Pollution Prevention
- Watershed Maintenance
- Indicator Monitoring
- Restoration

These programs provide different ways to promote watershed stewardship, depending on the number, education level, and watershed education level of the community members. One or more of these programs may be used as tools in implementing a watershed management plan.

There are many programs that promote watershed, including the following.

The Michigan Department of Agriculture
Information on the following programs can be obtained through the MDA's website at http://www.michigan.gov/mda/.

The Michigan Groundwater Stewardship Program
The goal of the Michigan Groundwater Stewardship Program (MGSP) is 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.

Farm*A*Syst
Farm*A*Syst identifies potential risks posed by farmstead operations. Technical assistance with completing Farm*A*Syst evaluations is available free of charge from the Michigan Groundwater Stewardship Program.

Home*A*Syst
Home*A*Syst is a household assessment tool that can be used to help identify risks and provide information on how to lower your risks to groundwater contamination around the home. Home*A*Syst helps protect your drinking water, the environment, your health, and the health of your family.

Field*A*Syst
Field*A*Syst 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. Just like Farm*A*Syst, the Field*A*Syst program is voluntary and confidential.

Abandoned Well Closures
The objective of abandoned well closure is to reduce the risk of contaminants moving down an abandoned well and contaminating groundwater supplies. 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. Types of practices that may be available include: abandoned well closures, nitrate testing, sprayer tips, rotational grazing, backflow devices, manure testing, and spill kits.

Right to Farm Act
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 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 methods for preserving farmland and open space.

Silviculture is the science, art and practice of caring for forests with respect to human objectives.

Michigan's Biosolids Program
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. Michigan's Biosolids Program encourages the use of Biosolids to enhance agricultural and silvicultural production in Michigan. Biosolids are also used to provide nutrients and soil conditioning in mine reclamation projects, tree farms, and forest lands.

Michigan Agriculture Environmental Assurance Program
Michigan's Agriculture Environmental Assurance Program 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 is designed as a multi-year program allowing producers to meet personal objectives, while best managing both time and resources.

Organic Farming
Organic farming is widely recognized as an alternative to conventional or chemical farming. In September, 1998, the MDA Director created the Michigan Organic Advisory Committee. This 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
Information on the following programs can be obtained through the MDEQ's website at http://www.michigan.gov/mdeq/.

Groundwater: Drinking Water
The MDEQ has primary enforcement authority in Michigan for the Federal Safe Drinking Water Act under the legislative authority of the Michigan Safe Drinking Water Act. The MDEQ also investigates drinking water well contamination, and oversees remedial activities at sites of groundwater contamination affecting drinking water wells.

Groundwater: 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 451 and Part 22 Rules.

Groundwater: The Michigan Wellhead Protection Program
This program assists local communities utilizing groundwater for their municipal drinking water supply systems in protecting their water source.

Groundwater: Groundwater Modeling Program
The Groundwater Modeling Program 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.

Surface Water: Inland Lakes and Streams
The State's water resources are monitored by the Department of Environmental Quality and partnering organizations to determine water quality, the quantity and quality of aquatic habitat, and the health of aquatic communities, and compliance with state laws.

Surface Water: The Surface Water Enforcement Unit
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.

Surface Water: Nonpoint Source Program
The Nonpoint Source Program offers grants and technical assistance and develops information and educational materials to help protect and improve Michigan's lakes and streams.

Surface Water: Water Quality Trading Program
The State of Michigan is developing a statewide water quality trading program. Water quality trading will allow facilities facing high pollution control costs to meet their regulatory obligations by purchasing environmentally equivalent pollution reductions from another source at lower cost, thus achieving the same water quality improvement at lower overall cost.

Surface Water: 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.

Surface Water: Water Management
The MDEQ regulates 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.

Surface Water: Michigan Water Quality Monitoring
The MDEQ has several water quality monitoring programs that assist in keeping all of Michigan's waters clean. These programs include Beach Water Monitoring, Assessment of Michigan Waters, Inland Lakes Monitoring, and Public Swimming Pool Monitoring.

Surface Water: Emergency Response
The MDEQ is responsible for implementing the Part 5 Rules - Spillage of Oil and Polluting Materials. The Part 5 Rules deal with the storage and release of oil, salt, and polluting materials.

Surface Water: The MDEQ/USACE "Joint Permit Application"
The is a package that 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.

Michigan Environmental Council
The Michigan Environmental Council (MEC) provides a collective voice for the environment at the local, state and federal levels. Working with

member groups and their collective membership of nearly 200,000 residents, MEC is addressing the primary assaults on Michigan's environment; promoting alternatives to urban blight and suburban sprawl; advocating for a sustainable environment and economy; protecting Michigan's water legacy; promoting cleaner energy; and working to diminish environmental impacts on children's health. The MEC website is located at http://www.mecprotects.org/.

Mid-Michigan Environmental Action Council

MID-MEAC is a non-profit environmental organization dedicated to improving the environment and quality of life by raising environmental consciousness and activism. MID-MEAC conducts storm drain labeling, water quality monitoring, tree plantings, youth programs, and trail and greenway planning. The MID-MEAC website is located at http://www.midmeac.org/.

Michigan State University Watershed Action through Education and Research

The Michigan State University Watershed Action through Education and Research group provides watershed education, outreach and research. This includes local school mentoring program, seminars, research, and data. The group's website is located at http://www.msu-water.msu.edu/.

Michigan Turfgrass Environmental Stewardship Program

The mission of the Michigan Turfgrass Environmental Stewardship Program is to advance the environmental stewardship of Michigan's golf industry by increasing the awareness and understanding of environmental issues, ensure regulatory compliance, and recognize stewardship achievements. The program's website is located at http://www.mtesp.org/.

Michigan Nature Centers

Nature Centers are either privately or locally funded entities that focus on research, recreation, and, education. The State of Michigan has approximately 72 nature centers. The MDEQ lists the nature centers in the State of Michigan, which can be found at http://www.michigan.gov/deq/ under "Key Topics" → "Environmental Education".

The Groundwater Foundation

The Groundwater Foundation focuses on educating people and communities about the importance of groundwater and how to protect it. The foundation's Groundwater Guardian program assists communities in organizing a team and developing result oriented activities that focus on education, pollution prevention, public policy, conservation, and best management practices. More information about the Groundwater Foundation can be found at http://www.groundwater.org/.

Tri-County Regional Planning Commission

The Tri-County Regional Planning Commission has published "Regional Choices for Our Future" which outlines goals and visions for an improved quality of life and economic competitiveness. This publication includes the roles of government, citizens, and stakeholders in maintaining a healthy economy and

Local Nature Centers

Audubon Society of Michigan
6011 W. St. Joseph Hwy.
Lansing, MI 48917
http://www.michiganaudubon.org/

Fenner Nature Center
2020 Mount Hope Rd.
Lansing, MI 48917
http://parks.cityoflansingmi.com/fenner/fnc.html

Harris Nature Center
3998 Van Atta Rd.
Okemos, MI 48864

Rails to Trails Conservancy
319 W. Homes Rd., Suite 145
Lansing, MI 48910
http://www.railtrails.org/default.asp

Woldumar Nature Center
5739 Old Lansing Rd.
Lansing, MI 48910
http://www.woldumar.org/

healthy environment, growth and redevelopment of the community, and open space and resource protection.

School Curriculum

Watershed protection will be most effective when the public understands the environmental challenges and is invested in rectifying them. This understanding and investment ultimately comes through education and this education should start when people are young. The education of young people on these issues will pave the way for watershed protection becoming a societal value.

Michigan Department of Environmental Quality

The Department of Environmental Quality (DEQ) is using $1 million of the Clean Michigan Initiative funds and working with the Department of Education to develop and disseminate sound science-based supplementary environmental curriculum materials for use by Michigan educators. The five unit topics under development include: Air Quality, Ecosystems, Energy and Resources, Individuals' Impact on the Land, and Water Quality.

Additional information including classroom resources, grant opportunities, speaker request forms and a list of local nature centers can be found at http://www.michigan.gov/deq/ under "Key Topics" → "Environmental Education".

Global Rivers Environmental Education Network

GREEN is a national network of schools and communities working together to meet critical water resource challenges through a combination of environmental education and civic action. GREEN builds on national academic standards and teaches elementary, middle and high school-aged youth essential skills including critical thinking, teamwork, problem solving and the application of science to real world problems. Additional information can be found at the following website:

http://www.earthforce.org/section/programs/green

Project GREEN
Lansing, MI

Lansing's Project GREEN began in 1992 with a grant from the General Motors Corporation (GM). Woldumar Nature Center became the area Coordinator in 1995 and carries out the Project today with continued support from GM. GREEN satisfies multiple benchmark requirements for teachers in Chemistry, Biology, Environmental Studies, Social Studies, and Math, enhancing curriculums in these areas. Refer to http://www.woldumar.org/programs/green.html for additional information.

Additional Resources

In addition to the programs listed in the previous sections, there are numerous documents by various organizations that describe tools to use for watershed protection. A complete listing of these documents is not possible, but a number of the more popular ones are listed:

- Stormwater Management Guidebook produced by the Land and Water Management Division of the MDNR
- Guidebook of Best Management Practices for Michigan Watershed produced by the Surface Water Quality Division of the MDEQ
- The Michigan Department of Transportation's Drainage Manual

References

Center for Watershed Planning. Rapid Watershed Planning Handbook. 1998.

8. Action Plan

Source: Basetree, 2005.

Acronyms

BMP	Best Management Practices
FSA	Farm Service Agency
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
GAAMPS	Generally Acceptable Agricultural Management Practices
GLA	Greater Lansing Area
GLRC	Greater Lansing Regional Committee
IDEP	Illicit Drain Elimination Program
LID	Low Impact Development
MDA	Michigan Department of Agriculture
MDEQ	Michigan Department of Environmental Quality
MTA	Michigan Township Association
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
O&M	Operations and Maintenance
PEP	Public Education Plan
PIPP	Pollution Incident Prevention plan
SOP	Standard Operating Procedures
TCRPC	Tri-County Regional Planning Commission
WMP	Watershed Management Plan

Introduction

This section details the actions supporting the goals and objectives for the watershed. As discussed in Section 6 of this WMP, the goals and objectives were developed based on input from community stakeholders and the general public. The actions in this section are presented in a table under their corresponding goal and objective and are accompanied by a schedule, responsible party, evaluation mechanism, and cost. In addition, each objective is marked with a 'Yes' or 'No' indicating its role in fulfilling the Michigan Watershed-Based National Pollutant Discharge Elimination System (NPDES) Permit as introduced in Section 6 of this WMP.

Watershed-Based NPDES Permit Fulfillment

The Red Cedar River Watershed is composed of 15 distinct political jurisdictions working together with public and stakeholder involvement to develop a Watershed Management Plan (WMP) as discussed in Section 3 of this WMP. Each jurisdiction is bound to the requirements of the Watershed-Based NPDES Permit and is committed to considering all environmental stressors within their watershed. To this end, the jurisdictions engage in an iterative watershed management planning process that includes goal-setting; data collection and analysis; problem identification; action development and implementation; and evaluation. The development of the action plan in this section is a result of goal-setting, data collection and analysis, and problem identification.

Furthermore, the actions fulfill Storm Water Pollution Prevention Initiative (SWPPI) requirements contained in Part I.B.2 of the Watershed-Based NPDES Permit (see Appendix C). The SWPPI is required to contain actions specified in the WMP and has specific requirements for good house-keeping/pollution prevention and post-construction elements. The WMP action plan was developed so that each watershed jurisdiction can bring the actions they are responsible for directly into their SWPPI.

Critical Items Identified by Stakeholders

In February 2003, Governor Granholm convened a 26 member council to address the trends, causes, and consequences of unmanaged growth and development in Michigan (Executive Order 2003-4). The Michigan Land Use Leadership Council (MLULC) provided more than 150 recommendations to the governor and the legislature designed to minimize the impact of current land use trends on Michigan's environment and economy. The council used the following smart growth tenets for many of the recommendations. These ten tenets can form the basis for establishing a set of state land use goals.

1. Create a range of housing opportunities and choices
2. Create walkable neighborhoods
3. Encourage community and stakeholder collaboration
4. Foster distinctive, attractive communities with a strong sense of place
5. Make development decisions predictable, fair, and cost-effective
6. Mix land uses
7. Preserve open space, farmland, natural beauty and critical environmental areas
8. Provide a variety of transportation choices
9. Strengthen and direct development towards existing communities
10. Take advantage of compact development design

Stakeholders who participated in the workshops consistently referred to the ten smart growth tenets but recognized that with regard to watershed management they encompass more than may be necessary for the WMPs purposes. Consequently, it was agreed that in the WMP any actions that were intended to mitigate developments' impacts on waterways (e.g. BMPs like riparian buffers) would be referred to as "Water Quality Friendly Development."

Participants in the workshops also made the connection between surface water and groundwater; that they were two key components of the whole hydrologic cycle. As such, combining programs where appropriate only seems logical. It was recommended that the GLRC should look for ways to coordinate with groundwater protection initiatives and cooperate on grant applications.

There was recognition by stakeholders of the need to be good neighbors due to potential upstream and downstream pollution impacts on water quality. This recognition was extended to rural areas too. Although NPDES permitting is only required for municipalities, it was felt there was a need to include the agricultural community. Stakeholders thought the best way to engage farmers was through existing agricultural programs (see Section 7).

The current fiscal climate faced by municipalities dictates that they look for new and creative ways to deliver programming. Stakeholders recommended that municipalities and watershed committees look to form partnerships with existing organization to achieve their goals. Two examples of programs that have public service requirements in order for participants to achieve certification are MSU Extension's "Master Gardner" and "Citizen Planner" programs.

"Anything else you're interested in is not going to happen if you can't breathe the air and drink the water.

Don't sit this one out.

Do something.

You are by accident of fate alive at an absolutely critical moment in the history of our planet."

- Carl Sagan

Action Plan Table

The remainder of this section is composed primarily of the action plan table. There are nine goals and a number of objectives and actions to assist in fulfilling each goal.

The Action Plan contains a number of new committees that have been developed to assist in implementation of the WMP. These committees are discussed in detail in Section 10, Plan Sustainability.

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed

Objective 1 a: **Youth Programs (K-12) School Education: Assist local school districts in developing a science curriculum on watershed studies.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships

Supporting Agencies: MDEQ, Project Green

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Conduct information and educational presentations to school boards on stormwater and MDEQ Water Quality Curriculum.	PEP Subcommittee and/or GLRC Coordinator	Jan - April 2006	none	4 hours per presentation	School Boards adopt curriculum.
2. Purchase curriculum and distribute to School Administrators/Teachers. Post to GLRC Public Web Site.	PEP Subcommittee	May-July 2006	Reproduction: $30 per manual 50 copies $1500 - $2000	40 hours	Number of watershed curriculum purchased and distributed.
3. Work with teachers one on one and with schools to implement curriculum and develop a contact database.	PEP Subcommittee and/or GLRC Coordinator	Jul 2006 - Jun 2007	none	100-200 hours/year	Teachers implementing curriculum in their classroom.
4. Work to link Project Green and the Lansing water festival to MDEQ water quality curriculum to broaden and deepen program (e.g. Okemos School District program)	PEP Subcommittee and/or GLRC Coordinator	Beginning Jul 2006 and annually thereafter	none	40 hours/year	Number of schools participating in Project Green and MDEQ Curriculum.

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed

Objective 1 b: General Education: Public Participation Develop and maintain Storm Drain Marking. Provide routine updates to the general public, the stakeholders and the municipal officials.

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commission, Road Commission, MSU

Supporting Agencies: GLRC

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Design and purchase curb markers and door hangers.	PEP Sub-committee/ Individual Communities	Apr-June 2005	Curb markers: ~ $1-$3 each 500 ct. per year $500 - $1,500 annually Door hangers: ~ $0.25 each 500 ct. per year $125 annually	10 hours of designing and purchasing curb markers and door hangers.	NA
2. Develop Curb Marker Volunteer Program Instructions and Start Up Kit.	PEP Sub-committee	July-Oct 2005	Volunteer kit ~$50 per kit 5 kits $250.00	20 hours	Number of kits developed
3. Solicit and Train Volunteers.	Individual Communities	Jan 2006 - Mar 2008	none	40 hours	Number of volunteers that have participated in the program.
4. Install Curb Markers in targeted community locations.	Individual Communities	Mar 2006 - Mar 2008 seasonally	none	40 hours/year	Number of curb markers and door hangers installed.
5. Compile/Track all Curb Marker Locations in watershed.	Tri-County Regional Planning Commission / Individual Communities	Ongoing once installation begins	none	40 hours/year	Area of watersheds marked. Number of Phone calls received by community members regarding illicit discharges

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed

Objective 1 c: **General Education: Support participation in Adopt-A-River program.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commission, Road Commission, MSU

Supporting Agencies: Conservation Districts

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Coordinate with Conservation Districts to promote and participate in semi-annual Adopt-A-River program.	PEP Sub-committee	Twice yearly - April and October	$500/year	40 hours/year	Number of volunteers that participate in the program.

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed

Objective 1 d: **General Education: Develop an educational campaign to encourage preservation and reestablishment of native riparian vegetation and to emphasize the importance of wetlands in the community. (Links to Goal 7 Municipal O&M Practices)**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commission, Road Commission, MSU

Supporting Agencies: Master Gardeners, Local Gardening Clubs, MSUE

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Identify prominent municipal locations as candidates to install riparian buffer preservation (no mow).	Watershed Committee	Jun-Aug 2006	none	20-200 hours of identifying riparian buffer locations	NA
2. Determine and mark areas where riparian buffers will be allowed to grow. Where opportunities exist, encourage the planting of native wild flowers and prairie grasses.	Watershed Committee, Master Gardner, Local Gardening Clubs	Sep 2006	minimal	40-400 hours marking buffer locations	Estimate number of acres of municipal property protected by riparian buffers
3. Install an educational posting within buffer to create a demonstration project and explain and promote the practice of Riparian Buffer BMPs and the reestablishment of native vegetative species.	Watershed Committee	Oct-Dec 2006	Sign: $50 each 2- 20 signs depending on size of riparian buffer	·4-20 hours of designing sign ·4-40 hours of installing signs	-
4. Determine best media to reach riparian landowners and develop campaign based on municipal experience.	PEP Sub-committee	Jan-Mar 2007	Brochures: $0.20 each 10,000 - 50,000 ct. $2,000-$10,000	20-100 hours of determining communication	Number of Brochures distributed

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed

Objective 1e: **General Education: Homeowner Education, Develop an educational campaign for maintenance and operation of on-site sewage disposal systems, household hazardous waste, lawn maintenance, automobile maintenance, and private wellhead protection for all homeowners.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commission, MSU

Supporting Agencies: Realtors, Civic Organizations

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Develop partnership with local organizations (possibly realtors) to promote homeowner information topics such as septic maintenance, lawn & auto care, well water, proper household hazardous waste disposal, and wellhead protection. Track contracts in a database.	PEP Sub-committee/ Individual Communities	June-Nov 2006	none	20-200 hours	NA
2. Create homeowner information packet (brochures and tip cards) for distribution; use advertising to potentially fund printing costs.	PEP Sub-committee/ Individual Communities	Dec 2006 - May 2007	$1-$3.00 per packet 500-1000 packets $500-$3000 Total minus advertising reimbursement	•40-100 hours of creating information •20-50 hours of distributing to realtors annually	•Number of packets printed. •Number of packets distributed to homeowners.
3. Distribute brochures and tip cards to homeowners through a mailing.	PEP Sub-committee	Jun 2007- May 2008	Brochures/tip cards: $0.20 each 10,000 - 50,000 ct. $2,000-$10,000	40 hours of organizing mailing	Number of brochures/tip cards distributed.
4. Evaluate success of information through discussion/survey of homeowners. Refer to Section 9.	PEP Sub-committee	Annually	none	20 hours of evaluation	Determine any changes needed for future packets.
5. Post information on GLRC Public Web Site. (Obj 1f), and distribute additional informational material to environmental organization (Mid-MEAC).	GLRC Executive Committee	As needed.	none	4 hours of posting	Number of downloads of information.

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed

Objective 1 f: **General Education: Maintain GLRC Public and Project Web Site.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commission, Road Commission, MSU

Supporting Agencies: None

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Appoint person to maintain Web Site. Consider contract employee.	GLRC Executive Committee	Jan-06	none	none	NA
2. Update site with educational material for public viewing and reproduction. Conduct routine maintenance.	Appointed person	Ongoing	none	80-200 hours per year	•Number of hits per page. •Number of downloads.
3. Review and update Web site for significant changes. Include links to all community Web sites.	Appointed person	Ongoing	none	200 hours annually	List of information kept on Web site.

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed

Objective 1 g: **Public Participation: Develop a community based volunteer group and train them to assist with watershed-wide actions such as stream corridor inventories and road stream crossings and publicize the results.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commission, Road Commission, MSU

Supporting Agencies: Target Girl Scouts, Boy Scouts, 4H groups, lake associations, homeowner associations, environmental groups

MID-MEAC volunteer contact list

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Appoint group chairperson.	PEP Sub-committee, Mid-MEAC has volunteer contact list.	Feb-Mar 2006	none	none	NA
2. Chairperson to solicit members and set priorities.	Chairperson	Apr-July 2006	none	10-40 hours of soliciting members and setting priorities	NA
3. Prioritize needed projects and find funding sources (both in kind, grants, and donations from communities and sponsors).	Volunteer Group	Aug 2006 - Dec 2006	none	40-200 hours of prioritizing projects and finding funding	Number of grant(s) received.
4. Develop a Technical Memorandum specifying the priority projects, costs, and responsible parties.	Volunteer Group	Jan -Apr 2007	none	20-100 hours	NA
5. Implement chosen projects; supply volunteer labor toward field projects.	Volunteer Group	Jan-Dec 2007	TBD	TBD	Number of volunteers
6. Post results on GLRC Public Web Site. (Obj. 1f)	GLRC Coordinator	As needed.	none	Objective 1 f	Number of downloads of information.

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed

Objective 1 h: **Update Public Education Plan (PEP) to reflect this WMP.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commission, Road Commission, MSU

Supporting Agencies: None

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Compare existing plan with objectives and actions from Goal 1 of this WMP.	PEP Sub-committee	Nov-Dec 2005	none	10 hours	NA
2. Update PEP to reflect objectives and actions presented in this WMP.	PEP Sub-committee	Jan-Feb 2006	none	20-60 hours of revising	NA
3. Submit revised PEP to MDEQ.	PEP Sub-committee	Mar 2006	none	2 hours	NA

Goal 1: Educate the Public about the Importance of Protecting and Managing the Watershed

Objective 1 i: **Business Education: Salt application, good housekeeping of parking lots and grounds, oil/grease disposal, cleaning agent use Restaurant Education: No Grease in Storm Drains**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commission, Road Commission, MSU

Supporting Agencies: Central Michigan Sustainable Business Forum

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Prioritize businesses through a focus group. Include private salt appliers, restaurants, and automobile service stations.	Individual Communities/ Focus Group	Jun - Sep 2006	none	40-80 hours of prioritizing businesses	NA
2. Work with Central MI Sustainable Business Forum (CMSBF) to identify companies that conduct their business in an environmentally responsible way. Mid-MEAC and Chamber of Commerce are starting point.	PEP Sub-committee and GLRC Coordinator	Jan 2006 through life of program.	none	40-80 hours	List of sustainable businesses, presentations to CMSBF and others.
3. Determine the best way to reach the businesses. Work with companies identified in Action 2 to devise strategies.	Individual Communities/ Focus Group	Oct-Nov 2006	none	20-40 hours	NA
4. Develop and provide businesses with educational materials. Such as a Tour of Environmentally Friendly Businesses, Dumpster Stickers, Industry Certifications, and Presentations. Consider requiring permit for private salt appliers.	PEP Sub-committee draft information/ Individual Communities distribute	Beginning Dec 2006	Brochures: $0.20 each 2,000 copies $400	40-200 hours/ per year	Number of brochures distributed.

Goal 2: Provide a Sustainable and Equitable Funding Source

Objective 2a: Develop and adopt a funding strategy to support the WMP.

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: None

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Create a Funding Sub-committee and evaluate need to hire a consultant.	GLRC Executive Committee	Jan 2006	none	10-50 hours	NA
2. Determine anticipated budget needs.	Funding Sub-committee/ Consultant (if needed)	Feb-Apr 2006	none	40-100 hours	NA
3. Determine alternate funding mechanism with advantages and disadvantages.	Funding Sub-committee/ Consultant (if needed)	May-Aug 2006	none	40-200 hours	NA
4. Select preferred mechanism.	Funding Sub-committee/ Individual Communities	Sep-Oct 2006	none	50-100 hours	NA

Goal 3: Encourage Water Quality Friendly Development

Objective 3 a: **Promote intergovernmental coordination and cooperation for Water Quality Friendly Development practices which includes wetland and waterbody setbacks.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: Michigan Townships Association, Greater Lansing Area Homebuilders and Realtors

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Create Policy and Procedure Sub-committee.	GLRC	Feb 2006	none	none	NA
2. Research and compile an information packet regarding Water Quality Friendly Development. Work with MTA, GLA Homebuilders and Realtors to find incentives and economically viable implementation vehicles.	Policy and Procedure Sub-committee.	Mar-May 2006	$10 per packet 200 copies $2000 Total	40-200 hours	NA
3. Present and distribute Water Quality Friendly Development information to government officials and other applicable persons.	Policy and Procedure Sub-committee	June-Nov 2006	$100-$300 in presentation and reproduction costs	20 hours of distributing plus 4 hours per presentation	Number of Water Quality Friendly Development information packets distributed.
4. Conduct a Water Quality Friendly Development roundtable to discuss issues associated with promoting and implementing Water Quality Friendly Development practices within the community.	Policy and Procedure Sub-committee	Dec 2006	$100-$300 in presentation and reproduction costs	40-100 hours	Attendance of roundtable discussion.

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
5. Hold a watershed-wide workshop to discuss Water Quality Friendly Development practices with builders, planners, developers, businesses, and interested residents.	Individual Communities with Policy and Procedure Sub-committee	Jan-June 2007	Cost of Workshop: $50-$150 per person assuming at least 40 people	40-100 hours	Number of Workshop attendees
6. Provide informational packets for those not able to attend workshop.	Individual Communities	July 2007 - Dec 2007	none	none	Number of additional packets distributed
7. Plan the next stop.	Policy and Procedure Sub-committee	Jan-Mar 2008	none	40-100 hours	Description of future plans.

Goal 3: Encourage Water Quality Friendly Development

Objective 3 b: **Develop a development standards manual which outlines economically viable Water Quality Friendly Development practices.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: Interested Stakeholders

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review existing development standards for Water Quality Friendly Development requirements including storm water BMPs, wellhead protection, and floodplain development control. Consider input from roundtable discussions (Obj 3a).	Policy and Procedure Sub-committee	Jan-Apr 2007	none	100-500 hours	NA
2. Recommend revisions to, or a new draft of, a development standards manual, including performance standards. Allow for different standard levels to accommodate various community needs.	Policy and Procedure Sub-committee	2007	TBD	200-2,000 hours for manual	Number of development manuals distributed.
3. Adopt new ordinances and standards manual watershed-wide which support the development standards manual.	Individual Communities/ Attorneys	2008	TBD	40-200 hours per community	Number of communities that adopt ordinances.
4. Announce new ordinances through notices to appropriate businesses, developers, and builders and through public service announcements (PSA) directed to residents.	Individual Communities	2009	$500-$2,000	100-300 hours	•Number of notices distributed. •Number of PSAs broadcasted. •Estimated number of people reached.

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
5. Site Plan Review using agreed upon standards.	Individual Communities	Beginning 2008	Dependent on Municipality	Dependent on Municipality	•Number of site plans reviewed each year •Summary of water quality impact of typical new development

Goal 3: Encourage Water Quality Friendly Development

Objective 3 c: **Improve ordinance enforcement of all watershed-related ordinances such as Illicit Discharge Elimination Program (IDEP), waste disposal, and wetland protection.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: County Agencies

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review existing ordinance enforcement techniques and develop new or modify existing practices to be more effective in protecting water quality.	Individual communities, Policy and Procedure Sub-committee	Jan-Apr 2007	none	100-200 hours	NA
2. Recommend changes to enforcement techniques.	Policy and Procedure Sub-committee	May-Oct 2007	none	40-200 hours	Evaluate effectiveness of enforcement techniques by reviewing the number and type of annual ordinance offenses.

Goal 3: Encourage Water Quality Friendly Development

Objective 3 d: Incorporate Water Quality Friendly Development practices into land use, zoning, and community development master plans.

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: County Agencies, Tri-County Planning Commission

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review existing land use, zoning plans, and master plans. Use Regional Growth Plan as a starting point.	Policy and Procedure Sub-committee	Nov 2006 - Feb 2007	none	100-300 hours	NA
2. Recommend revisions to land use, zoning plans, and master plans.	Policy and Procedure Sub-committee	Mar-Aug 2007	Reproduction: ~$10 per manual 50 copies $400 - $700	80-200 hours	NA
3. Work with applicable government staff to implement changes to plans.	Individual Communities	Sept 2007 - Aug 2008	none	100-300 hours	Number of meetings held with government staff.

Goal 3: Encourage Water Quality Friendly Development

Objective 3 e: **Implement watershed-wide septic system inspection and abandoned well closure inspection in conjunction with local health agencies.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships

Supporting Agencies: County Health Departments

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Research existing time of sale septic system ordinances and abandoned well closure ordinances.	Policy and Procedure Sub-committee/ Individual Communities.	Jan-Apr 2007	none	80-200 hours	NA
2. Develop septic system/abandoned well closure ordinance. Require point of sale inspection or inspection every 5 years. Consider having septic hauler certified for inspections.	Policy and Procedure Sub-committee/ Individual Communities.	May-Oct 2007	none	80-200 hours	NA
3. Adopt the new ordinance watershed-wide.	Individual Communities	Nov 2007 - Apr 2008	$500-$2,000	20-100 hours per community	Number of copies distributed.
4. Work with both businesses and residents to implement the new ordinance.	Policy and Procedure Sub-committee/ Individual Communities.	May 2008 - Apr 2009	Advertising: $300-$2,000	100-400 hours	Number and circulation of advertisements.
5. Post information on GLRC Public Web Site. (Obj. 1f)	GLRC Executive Committee	As needed.	none	Objective 1 f	Number of downloads of information.

Goal 3: Encourage Water Quality Friendly Development

Objective 3 f: Facilitate the completion of at least one demonstration project within the watershed using low impact development standards.

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review new development properties and approach planners/developers early in the project planning phase. Consider offering incentives.	Policy and Procedure Sub-committee	Jan 2006 - Dec 2006	none	20–200hours	Number of planners/developers approached.
2. Work with developer to incorporate low impact designs into the plans.	Policy and Procedure Sub-committee	Mar 2006 - Feb 2007	none	20-200 hours	Number of LID designs constructed.
3. Promote LID project as a regional model.	Policy and Procedure Sub-committee	Mar 2006 - Feb 2009	Advertising: $100-$1,500	200-400 hours	Number and circulation of advertisements.

Goal 3: Encourage Water Quality Friendly Development

Objective 3 g: **Retrofit areas of high impervious cover with stormwater BMPs to decrease imperviousness. Look for ways to coordinate with groundwater protection and cooperate on grant applications.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review areas (both municipal and private) with high impervious cover and rank according to potential water quality impact, cost, and potential public support.	Policy and Procedure Sub-committee	Jan 2006 - Dec 2006	none	40–200hours	NA
2. Meet with appropriate developers/government staff and officials to gain support.	Policy and Procedure Sub-committee	Jan - Apr 2007	none	20-200 hours	NA
3. Design the project.	Appropriate Staff/ Consultant	May 2007- Apr 2008	TBD	TBD	Estimate annual water quality load reductions
4. Construct project.	Appropriate Staff/ Contractor	May 2008 - Dec 2008	TBD	TBD	NA

Goal 4: Restore and Enhance Recreational Uses through Development of a Watershed Recreation Plan

Objective 4 a: **Research deadfall management techniques and adopt a management plan.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: Natural Resources Conservation Service (NRCS), Michigan Department of Natural Resources (MDNR), MDEQ

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Conduct a literature review of appropriate deadfall management techniques.	Habitat and Recreation Sub-committee (consider working with MSU or similar organization to conduct research)	June-Nov 2007	none	•120 hours of meeting and review for the committee •80 hours of meeting and review for consultant	NA
2. Discuss options and outline a plan with local NRCS Staff, MDNR, MDEQ, Drain Commissioners, MSU extension agents, professors, and municipal officials.	Habitat and Recreation Sub-committee	Dec 2007 - Feb 2008	none	120 hours of meeting	NA
3. Develop a deadfall management plan to manage woody debris in an ecosystem friendly manner as part of an over arching Recreation Plan.	Habitat and Recreation Sub-committee	Mar 2008 - Feb 2009	$1,000 - $1,500	•120 hours for committee •150 hours of development time for appointed person or contractor	NA
4. Promote and adopt plan.	Individual Communities/ Local agencies	Mar-Apr 2009	none	200 hours of discussion	Track the number of local agencies and municipalities that adopt the plan.
5. Post information on GLRC Public Web Site. (Obj. 1e)	GLRC Executive Committee	As needed.	none	Refer to Objective 1 f	Number of downloads of plan.

Goal 4: Restore and Enhance Recreational Uses through Development of a Watershed Recreation Plan

Objective 4 b: **Restore fishing opportunities in the watershed. Look at both accessibility and habitat.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: MDNR

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Create a panel composed of watershed representatives, MDNR staff, and representatives from local groups such as Trout Unlimited to discuss the deficiencies in local fishing opportunities and identify potential solutions.	Habitat and Recreation Sub-committee	June-Nov 2007	none	50-200 hours	NA
2. Review solutions and develop a set of actions to improve fishing opportunities. Include in an overarching Recreation Plan. Work with MDNR to select areas for fishery studies.	Habitat and Recreation Sub-committee	Dec 2007 - Feb 2008	TBD	TBD	NA
3. Identify applicable groups, agencies, or municipalities to implement actions and develop a method of measuring progress.	Habitat and Recreation Sub-committee	Mar 2008 - Feb 2009	none	TBD	NA

Goal 4: Restore and Enhance Recreational Uses through Development of a Watershed Recreation Plan

Objective 4 c: **Add at least one canoe landing along Looking Glass River, Red Cedar River, or Grand River.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review public lands along river corridors and other riparian properties for applicable sites, such as the future Water's Edge Park on the Looking Glass River (Wood Rd. & Round Lake Rd.) Determine appropriate location and size for canoe landing demonstration project. Identify appropriate agency to maintain canoe landings.	Habitat and Recreation Sub-committee	Jan-Jun 2007	none	40-120 hours	NA
2. Design landing. Include project in an overarching Recreation Plan.	Habitat and Recreation Sub-committee / Contractor	Jul-Sep 2007	none	TBD	NA
3. Construct canoe landing.	Local jurisdiction or agency / Contractor	Oct 2007 - Jun 2008	TBD	TBD	NA
4. Advertise canoe landing.	Habitat and Recreation Sub-committee	Jun-Sep 2008	Advertising: $300 - $1,500	20-40 hours	Number and circulation of advertisements.

Goal 4: Restore and Enhance Recreational Uses through Development of a Watershed Recreation Plan

Objective 4 d: **Recreational Assessment: Examine the river and stream corridors and construct additional access sites, river trails, and observation decks to improve walking, fishing, and observation opportunities.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review public lands along river corridors and other riparian properties for applicable sites.	Habitat and Recreation Sub-committee	Jan-Jun 2007	none	Coordinate with Action 4c-1	NA
2. Outline possible recreational options and assess feasibility of each option.	Habitat and Recreation Sub-committee	Jul-Dec 2007	none	40-100 hours	NA
3. Determine appropriate project, meet with government officials, and hire a design consultant, if appropriate.	Habitat and Recreation Sub-committee	Jan-Jun 2008	none	•60 hours for the committee •40-100 hours for a contractor	NA
4. Identify appropriate agency to maintain access sites, river trails and/or observation decks.	Habitat and Recreation Sub-committee	Jun-Aug 2008	none	10-20 hours	NA
5. Construct recreational project.	Local jurisdiction or agency / Contractor	Sep 2008 - Jun 2009	TBD	TBD	NA
6. Advertise recreational project.	Habitat and Recreation Sub-committee	Jun-Sep 2009	Advertising: $300 - $1,500	20-40 hours	Number and circulation of advertisements.

Goal 5: Protect and Enhance Habitat for Wildlife and Aquatic Animals through Development of a Watershed Habitat Plan

Objective 5a: **Conduct an inventory of the stream corridors and identify existing riparian buffers and shade cover over streams. Also, identify areas of eroding stream banks and excessive sedimentation. Identify potential sources and rank in order of importance for restoration.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Research stream corridor inventory methods and adopt a methodology applicable to the objective.	Habitat and Recreation Sub-committee/ Contractor (if needed)	July - Dec 2007	none	•30 hours for the committee •60 hours for a contractor	NA
2. Prioritize areas considering location, schedule, and volunteer base.	Habitat and Recreation Sub-committee/ Contractor (if needed)	Jan-Mar 2008	none	•30 hours for the committee •60 hours for a contractor	NA
3. Organize an inventory team and conduct stream corridor inventories throughout the watershed. Consider using volunteers or non-profit organizations.	Habitat and Recreation Sub-committee/ Contractor	Jan 2008 - Dec 2010	Water Quality Testing Equipment: ~$100/kit 10 kits $800-$1,200 GPS unit and software: ~$500-$1,000	•30 hours for the committee •250 hours coordination for contractor and training •For budgeting purposes, investigation average about 2 miles/day for a 3 person crew	•Number of volunteers •Linear miles inventoried.
4. Review the results of the inventory and rank areas in order of severity for restoration.	Habitat and Recreation Sub-committee/ Contractor	Jan - Dec 2011	none	•20 hours for the committee •80 hours for contractor	Ranked list of areas to be restored
5. Identify actions and a timeline for restoring areas of the stream corridor. Include in Watershed Habitat Plan.	Habitat and Recreation Sub-committee/ Contractor	Jan -Dec 2012	none	•20 hours for the committee •50 hours for contractor	Number of sites restored.

Goal 5: Protect and Enhance Habitat for Wildlife and Aquatic Animals through Development of a Watershed Habitat Plan

Objective 5b: **Protect and Enhance Habitat for Wildlife and Aquatic Animals Through Development of a Watershed Habitat Plan.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: NRCS, MDNR, MDEQ

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Meet with local NRCS Staff, MDNR, MDEQ, Drain Commissioners, MSU extension agents, professors, and municipal officials to identify habitat deficiencies within the watershed. Use results of the inventory (Obj. 5b) to assist with this.	Habitat and Recreation Sub-committee/ Contractor	July - Dec 2007	none	•60 hours for committee •100 hours for contractor	NA
2. Discuss options and develop a comprehensive plan with local NRCS Staff, MDNR, MDEQ, Drain Commissioners, MSU extension agents, professors, and municipal officials.	Habitat and Recreation Sub-committee/ Contractor	Jan-Jun 2008	none	•80 hours for committee •100 hours for contractor	NA
3. Adopt the aquatic and terrestrial wildlife plan and include in Watershed Habitat Plan.	Individual Communities/ Local agencies	July 2008 - Jun 2009	Reproduction: ~$25 per plan 50 copies $1,000 - $1,500	80 hours for the communities	Number of local agencies and municipalities that adopt the plan.
4. Implement plan.	Individual communities	Ongoing following adoption	none	Varies annually	Summarize annual accomplishments.
5. Post information on GLRC Public Web Site. (Obj. 1f)	GLRC Executive Committee	As needed.	none	Objective 1 f	Number of downloads of information.

Goal 5: Protect and Enhance Habitat for Wildlife and Aquatic Animals through Development of a Watershed Habitat Plan

Objective 5c: **Consider restoration or purchase of key wildlife habitat areas based on the management plan.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Identify jurisdictions or organizations interested in purchasing or restoring key wildlife habitat areas. Consider acquisition options including fee simple and development rights.	Watershed Committee	Nov 2006 - Jan 2007	none	20 hours of meeting	NA
2. Identify funding options and practicality. Promote in kind grants and donations from communities and sponsors. Include recommendation in Watershed Habitat Plan.	Watershed Committee and GLRC	Feb-Jul 2007	none	60 hours for identifying funding options	Provide a document to the GLRC discussing the effectiveness and next steps.

Goal 6: Protect and Increase Wetlands through Development of a Watershed Habitat Plan

Objective 6 a: **Inventory wetlands within the watershed and determine the general health of wetlands, primary impacts and sources of these impacts.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Create a Habitat and Recreation Sub-committee.	GLRC	Jul-06	none	none	NA
2. Develop methods to inventory wetlands, wetland health, impacts, and sources. (See Chapter 3 of this WMP for a definition of wetland.)	Habitat and Recreation Sub-committee/ Contractor	Aug-Sep 2006	none	•30 hours for committee •80 hours for contractor	NA
3. Prioritize wetland areas based on location, schedule, volunteer base, and opportunities.	Habitat and Recreation Sub-committee/ Contractor	Oct-Dec 2006	none	•30 hours for committee •80 hours for contractor	NA
4. Conduct wetland inventory. Consider acquisition opportunities.	Habitat and Recreation Sub-committee/ Contractor	Several years begin 2007	none	•20 hours for committee •8 hours per wetland for contractor	NA
5. Review data and present findings to GLRC. Post data and reports on project Web site and include in the Watershed Habitat Plan.	Habitat and Recreation Sub-committee/ Contractor	Jan-Jun 2007	none	•20 hours for committee •5 hours per wetland for contractor	Findings presented to appropriate audience

Goal 6: Protect and Increase Wetlands through Development of a Watershed Habitat Plan

Objective 6 b: **Develop and adopt wetland protection measures.**

Permit Requirement: No

Participating Permit tees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Use the findings of the inventory to develop a list of development standards to preserve and protect wetlands.	Habitat and Recreation Sub-committee/ Contractor	Mar-Apr 2007	none	•20 hours for committee •40 hours for contractor	Number of development standards considered
2. Based on the list of development standards, develop an ordinance to be adopted by each community. Include in Watershed Habitat Plan.	Habitat and Recreation Sub-committee/ Contractor / Policy and Procedure Sub-committee	May-Jun 2007	none	•30 hours for committee •20 hours for contractor	NA
3. Adopt ordinance.	Individual Communities	July-Sep 2007	none	None	Number of communities adopting ordinance

Goal 6: Protect and Increase Wetlands through Development of a Watershed Habitat Plan

Objective 6 c: **Implement advanced wetland restoration / protection measures**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Research advanced measures (e.g., 'wetland conservancy', 'wetland banking') and determine applicability.	Habitat and Recreation Sub-committee/ Contractor	Apr-May 2006	none	•20 hours for committee •30 hours for contractor	Number of advanced measures considered
2. Develop plan to implement advanced measures and assess feasibility. Include in Watershed Habitat Plan.	Habitat and Recreation Sub-committee/ Contractor	Jun-Nov 2006	none	•20 hours for committee •60 hours for contractor	Criteria used to assess feasibility
3. Implement feasible measures on appropriate scale.	Habitat and Recreation Sub-committee / Individual Communities	Ongoing once plan is complete	none	40 hours annually	•Number of measures implemented by each community •Scale of implementation

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 a: **Ensure that ordinances and Standard Operating Procedures (SOP) comply with Phase II permit requirements.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissioners, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review existing operation and maintenance-related ordinances and SOPs for compliance with Phase II requirements.	Policy and Procedure Sub-committee	Present - Jan 2006	none	100 hours of reviewing each community's ordinance	NA
2. Recommend changes to ordinances and SOPs to make them Phase II compliant.	Policy and Procedure Sub-committee	Feb-Mar 2006	none	•20 hours of meeting •40 hours of drafting changes	NA
3. Adopt new ordinances and revise SOPs appropriately.	Individual Communities/ Attorneys	Apr 2006 - Jul 2007	none	100 hours of revising and adopting	Number of new ordinances adopted.
4. Train municipal staff, other appropriate agencies, and public utilities on new procedures. Include basic storm water management awareness information.	Individual Communities	Ongoing begin once ordinance is adopted	Training Materials: $100-$300	50 hours initial training; 20 hours annually thereafter	•Number of staff trained. •Frequency of training.

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 b: **Review municipal pesticide and fertilizer application procedures for municipally-owned property. Ensure that directions are followed, low-phosphorus fertilizers are used, and soil testing is conducted to determine fertilizer need.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissioners, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Determine a baseline model of fertilizer and pesticide procedures and compare with existing community procedures.	Policy and Procedure Sub-committee/ Individual Communities	Jan-Feb 2007	none	20 hours of reviewing per community	NA
2. Recommend improvements to be made to procedures.	Policy and Procedure Sub-committee/ Individual Communities	Mar-Jul 2007	none	30 hours of meeting and drafting changes per community	NA
3. Train Staff on new application procedures, as needed.	Individual Communities	Ongoing once procedures are accepted	Training Materials: $100-$300	30 hours initial training preparation per community; 20 hours annually thereafter per community	•Number of staff trained. •Frequency of training.

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 c: **Provide maintenance activities and inspection procedures for permanent structural storm water best management practices (retention basins, swales, created wetlands, rain gardens, etc.).**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissioners, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Research permanent structural BMPs including inspection and maintenance procedures and pollutant removal efficiencies.	Policy and Procedure Sub-committee	Nov 2006 - Jan 2007	none	•30 hours of meeting •30 hours of BMP research	NA
2. Develop a BMP manual including design standards, inspection requirements, maintenance requirements, and pollutant removal efficiencies. Consider consultant assistance.	Policy and Procedure Sub-committee / Consultant (if necessary)	Feb-Jul 2007	none	•80 hours for the committee •consultant fees	Number of people that use the manual.
3. Adopt BMP manual.	Individual Communities/ Local agencies	Aug - Sep 2007	Reproduction: ~$25 per plan 50 copies $1,000 - $1,500	80 hours for the communities	Number of local agencies and municipalities that adopt the manual.
4. Implement manual.	Individual communities	Ongoing following adoption	none	TBD	Summarize annual accomplishments.
5. Post information on GLRC Public Web Site. (Obj. 1e)	GLRC Executive Committee	As needed.	none	4 hours of posting	Number of downloads of information.
6. Train Staff on new BMPs and BMP maintenance procedures, as needed.	Individual Communities	Ongoing once manual is adopted	Training Materials: $100-$300	30 hours initial training; 20 hours annually thereafter	•Number of staff trained. •Frequency of training.

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 d: **Assess the impacts on water quality from flood management projects.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissioners, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Use the BMP Manual when designing new flood management BMPs. Determine pollutant removal efficiencies to assess impacts on water quality.	Individual Communities	Ongoing once manual is adopted	none	NA	Specific location of flood management BMPs throughout watershed.

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 e: **Reduce discharge of pollutants from streets, roads, highways, parking lots, and maintenance garages.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissioners, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Determine a baseline model of street sweeping, catch basin cleaning, and hydrant flushing procedures and compare to existing procedures. Review Pollution Incident Prevention Plans (PIPP) for maintenance garages, if they exist.	Policy and Procedure Sub-committee/ Individual Communities (include procedure discussions with public utilities and drain commissioners)	Aug-Sep 2007	none	10-40 hours of reviewing	NA
2. Depending on review results, recommend improvements to be made to existing programs or create new programs.	Policy and Procedure Sub-committee/ Individual Communities	Oct - Dec 2007	none	50 hours of meeting and drafting changes	NA
3. Train Staff on new street sweeping, catch basin cleaning, hydrant flushing, and PIPP procedures, as needed.	Individual Communities	Ongoing once procedures are accepted	Training Materials: $100-$300	30 hours initial training; 20 hours annually thereafter	•Number of staff trained. •Frequency of training.
4. Develop method to track quantity of sediment and debris removed.	Individual Communities	Jan-Dec 2008	none	50 hours of developing debris tracking method	Quantity of debris removed from streets and catch basins annually.

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 f: **Dispose of operation and maintenance waste from the separate storm water drainage system appropriately. This includes street sweeping, catch basin cleaning, dredge spoil, sediments, floatables, and other debris.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissioners, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review existing operation and maintenance waste disposal procedures for proper practices.	Individual Communities	Jan-Feb 2007	none	20 hours of reviewing	NA
2. Recommend improvements to be made to disposal procedures.	Individual Communities	Mar-May 2007	none	50 hours of meeting and drafting changes	NA
3. Train Staff on new waste disposal procedures as needed.	Individual Communities	Ongoing once procedures are accepted	Training Materials: $100-$300	30 hours initial training; 20 hours annually thereafter	•Number of training attendees. •Frequency of training.

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 g: **Add or revise municipal ordinances to require low or no phosphorus fertilizer for both business and residential use.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Research and develop an ordinance that requires low or no phosphorous fertilizers. Discuss with local distributors and manufacturers.	Policy and Procedure Sub-committee	Mar - Dec 2007	none	•20 hours of meeting •40 hours of ordinance development	NA
2. Adopt ordinance in watershed communities.	Individual Communities	Jan 2008 - Jan 2009	none	30 hours of meetings	Number of communities that adopted ordinance.
3. Work with both businesses and residents to see this new ordinance implemented.	Individual Communities	Mar 2008 - Feb 2010	Advertising: $300- $1,500	100 hours of meetings and communication initially; 20 hours annually thereafter	Number and circulation of advertisements.
4. Develop/Distribute brochures and tip cards to businesses and residents through a mailing.	PEP Sub-committee	Mar 2008- Feb 2009	Brochures/tip cards: $0.20 each 10,000 - 50,000 ct. $2,000-$10,000	•80 hours of developing •40 hours of organizing mailing	Number of brochures/tip cards distributed.

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 h: **Ensure that excess salt is not being spread in watershed. (Coordinate with Obj. 1 i and Obj. 7 e)**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Review existing excess salt application practices including truck calibration, salt loading, and salt storage.	Individual Communities	Jun - Jul 2006	none	20 hours of reviewing	NA
2. Recommend improvements to be made to existing practices or create new practices.	Individual Communities	Aug - Sep 2006	none	50 hours of meeting and drafting changes	NA
3. Train Staff on new salt storage, application, and truck calibration practices, as needed.	Individual Communities	Ongoing once procedures are accepted	Training Materials: $100-$300	50 hours initial training; 20 hours annually thereafter	•Number of training attendees. •Frequency of training.

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 i: **Remove trash and debris from river. Coordinate with O&M Departments to plan for events that result in excessive trash and debris, such as festivals, street fairs, and football games.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissioners, MSU

Supporting Agencies: School Districts, Chamber of Commerce's, Parks and Recreation Departments

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Coordinate with existing river clean-up programs to identify new locations and extend programs to other portions within the watershed.	PEP Sub-committee	Mar 2006 - Feb 2007	none	120 hours for coordination and planning	•Number of clean-up events. •Number of volunteers. •Quantity of trash collected.
2. Meet with MSU, school districts, chamber of commerce, parks and recreation department, and O & M departments to coordinate public service following community events.	PEP Sub-committee	Mar 2007 - Feb 2008	none	120 hours for meeting	•Number of clean-up events. •Number of volunteers. •Quantity of trash collected.

Goal 7: Provide Pollution Prevention/Good Housekeeping Practices for Municipal Operations

Objective 7 j: **Adopt stream and ditch management techniques for channel rehabilitation focused on drains and open ditches.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissioners

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Research stream and ditch management techniques used in other areas around Michigan and nationwide to both maintain drains and protect the environment.	Policy and Procedure Sub-committee	Mar-May 2006	none	•20 hours for committee •100 hours for contractor	NA
2. Hold roundtable discussion with those involved in ditch and drain cleanout/maintenance.	Policy and Procedure Sub-committee / Contractor	Jun - Jul 2006	Roundtable Materials: $100-$300	•20hours for committee •50 hours for contractor	NA
3. Develop a management plan.	Policy and Procedure Sub-committee / Contractor	Aug 2006 - Jan 2007	Reproduction: ~$10 per plan 50 copies $400 - $700	•20 hours for committee •100 hours for contractor	NA
4. Adopt management plan.	Individual communities	Feb-Apr 2007	none	80 hours of discussions	NA
5. Implement management plan.	Individual communities	Ongoing begin May 2007	none	varies annually	Track locations of ditch and channel rehabilitation projects.
6. Evaluate areas of ditches that have been rehabilitated.	Policy and Procedure Sub-committee / Contractor	Annually	none	80 hours of evaluation and recommendation annually	NA
7. Post information on GLRC Public Web Site. (Obj. 1e)	GLRC Executive Committee	As needed.	none	4 hours of posting	Number of downloads of information.

Goal 8: Strive to Eliminate Pathogens to Meet Total and Partial Body Contact for Recreational Uses

Objective 8a: **Minimize and/or manage sanitary sewer overflows (SSOs) and combined sewer overflow (CSOs).**

Permit Requirement: No

Participating Permittees: Wastewater Treatment Plant NPDES Permit

Supporting Agencies: TBD

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. None	NA	NA	NA	NA	NA

Actions associated with SSOs and CSOs are managed by other agencies within the municipality.

Goal 8: Strive to Eliminate Pathogens to Meet Total and Partial Body Contact for Recreational Uses

Objective 8b: **Conduct an illicit discharge removal program including: finding problems by checking for leaking sanitary systems, leaking septic systems, and illicit connections; removing the source of the problem and prohibiting their reoccurrence through municipal code and ordinances.**

Permit Requirement: Yes

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: County Health Departments

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Implement municipal separate storm sewer system illicit discharge elimination plans. (Part of IDEP document.)	Individual Communities	Apr 2005 - Nov 2009	To be determined	Contractor cost and cost to correct problems.	Number of Corrective Actions Taken.
2. Work with the county health department to develop septic system tracking program.	IDEP Sub-committee/ Health Departments	May 2007 - April 2008	none	100 hours of developing program	NA
3. Implement septic system tracking program in the Tri-County Area.	IDEP Sub-committee/ Health Departments	Ongoing beginning May 2008	none	•80 hours of initial implementation •20 hours annually of updating	Willingness of County Health Departments to use tracking system
4. Develop a campaign to reduce pet waste. Consider signs in parks and pet waste bags.	IDEP Sub-committee/ Health Departments	May 2007 - April 2008	none	100 hours of developing campaign	Track usage of pet waste bags.

Goal 9: Encourage Water Quality Friendly Agricultural Practices

Objective 9a: **Promote and support the existing agricultural programs and encourage water quality friendly practices. Focus on creating incentives.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: Conservation Districts, Michigan Department of Agriculture (MDA), Farm Service Agency (FSA), Natural Resources Conservation Service (NRCS)

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Create an Agricultural Water Quality Committee that links urban and rural concerns.	Conservation Districts	Apr 2007 - Mar 2008	none	20 hours of meetings and coordination	Number of partnerships with agencies.
2. Research agricultural programs designed to protect water quality. Examples include CREP (Federal and State) CRP (Federal), Effluent trading, MI Agriculture Environmental Assurance Program (MAEAP), and tax assessment on drains. Identify incentives to be promoted.	Individual Communities and Agricultural Water Quality Committee(s)	Aug-Sept 2006	none	20-400 hours	NA
3. Promote water quality friendly agricultural practices with local farmers through NRCS, FSA and MDA etc.	Individual Communities	Oct 2006 - Mar 2007	Advertisement: $500-$1,500	40-200 hours	•Number of farmers contacted. •Number of farmers willing to consider water quality friendly practices.
4. Implement demonstration projects.	Agricultural Water Quality Committee(s)	Oct 2006 - Mar 2007	none (grant funded)	40-200 hours	Number of people attending site.
5. Ensure that water quality friendly agricultural practices are promoted through the distribution of existing materials and programs.	Individual Community	Ongoing once partnerships are established	Brochures: ~$0.20 each 2,000 - 5,000 ct. $400 - $1,000	Ongoing 20 hours annually	Number of brochures distributed.

Goal 9: Encourage Water Quality Friendly Agricultural Practices

Objective 9b: **Support annual community meetings on agriculture in the watershed.**

Permit Requirement: No

Participating Permittees: Cities, Townships, Drain Commissioners, Road Commissions, MSU

Supporting Agencies: Conservation Districts, Natural Resources Conservation Service (NRCS)

Action	Lead Agency	Schedule	Material Cost Estimate	Labor Hour Estimate	Evaluation Mechanisms Measure of Usage of Facilities or Material
1. Coordinate with the Conservation District to incorporate annual community meeting on agricultural practices into their annual meeting.	Watershed Committee / NRCS	Annually begin Feb 2008	Annual Advertising: $300 - $600	40 hours of coordinating annually	Number of people attending.
2. Set annual goals during each meeting.	Watershed Committee / NRCS	Annually begin Mar 2008	none	20 hours of meeting and follow-up	Record annual goals.

References

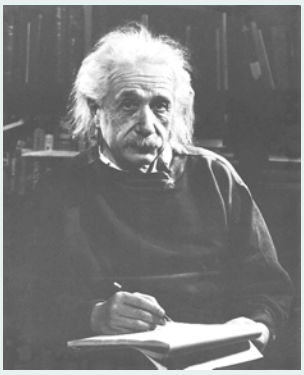
Basetree. "Starting line photo." via http://www.basetree.com/photos/bay-to-breakers/the-race.html. Last accessed May 24, 2005.

Michigan Land Use Leadership Council, (August, 2003). *Michigan's Land, Michigan's Future* (2003). Accessed July 26, 2005 at *http://www.smartgrowth.org/pdf/gettosg.pdf.*

9. Evaluation Mechanisms

"Not everything that can be counted counts, and not everything that counts can be counted."

- Albert Einstein



Introduction

Watershed planning is meant to be an iterative process that provides for continuous input and revision of procedures, processes, and products. This Watershed Management Plan (WMP) is a living document and is meant to be used, revised, and altered to fit the changing needs of the watershed as new information becomes available. This section establishes an overall program framework which emphasizes the importance of an on-going iterative process that consists of three elements: Program Planning, Program Implementation, and Effectiveness Assessment. The relationship between the three elements is presented in Figure 9-1. Portions of this chapter are based on "A Framework for Assessing the Effectiveness of Jurisdictional Urban Runoff Management Programs" developed by the San Diego Municipal Storm Water Co-Permittees (2003)..

The evaluation mechanisms for each action item are provided in Section 8. The purpose of this section is to explain the different evaluation mechanisms and how they fit into the permit requirements.

Figure 9-1. Program elements.

Permit Requirements

Watershed management is intended to be a tool in a comprehensive and systematic approach to balancing land uses and human activities to meet mutually agreed upon social, economic, and environmental goals and objectives in a watershed. As required by the NPDES Wastewater Discharge General Permit, the WMP must include the components listed in the dialog box on the next page, all of which are intended to be done in the context of significant public participation (Section 5).

Program Planning

The program planning phase requires a significant amount of public participation to characterize the watershed and develop and prioritize goals and objectives for the watershed. This phase can be broken down into the four steps below:

1. Goal and Objective Development
2. Action Plan Development
3. Evaluation Mechanisms
4. Assessment

While the elements of program planning interact in a cyclical manner, developing goals and objectives typically initiates the cycle. However, program planning also occurs following the effectiveness assessment phase if changes to the WMP are necessary.

Goal and Objective Development

The watershed committee has worked with the stakeholders and public to obtain input and comments during the initial watershed planning process. A facilitated workshop was held to develop and rank goals and objectives. Discussions at watershed committee meetings and stakeholder workshops helped to prioritize long-term watershed goals and objectives that would impact water quality within the watershed. Every effort was made to involve the public during the development process in order to gain support for implementation. The public participation efforts are documented in Section 5. The finalized goals and objectives are presented in Section 6.

Action Plan Development

To implement the goals and objectives, specific actions were developed for each objective. Action plan development was completed as part of this WMP and is presented in detail in Section 8. The actions were assigned a schedule, responsible party, cost, and means to measure success (refer to the following paragraph, 'Evaluation Mechanisms',).

Evaluation Mechanisms

Evaluation mechanisms are essential to gauge implementation status and assess the effectiveness of the overall program. Identification of quantifiable measures provides both measurability and accountability within the program. Six success levels have been established, as shown in Figure 9-2, to provide an organizing framework for the evaluation mechanisms. These success levels are discussed further in the dialog box on the left-hand-side of the page. Note that measures may be classified in more than one level.

MDEQ-Required Components of the WMP

1. Assess the nature and status of the watershed ecosystem. (Sections 3 & 4)
2. Define long-term goals and short-term objectives for the system. (Section 6)
3. Determine actions needed to achieve long-term goals and short-term objectives. (Section 8)
4. Assess both benefits and costs of each action. (Sections 8 & 9)
5. Implement desired actions and permittee commitments by a specified schedule.
6. Evaluate the effects of the implemented actions and the progress toward goals and objectives.
7. Re-evaluate goals and objectives as part of an on-going, iterative process.

Source: MDEQ, 1997.

Evaluation Mechanisms

Level One – Activities conducted include those that are described or required in the permit. These activities are expected to be beneficial to water quality because they are part of a successful WMP. This plan addresses the permit requirements including specific requirements of the Storm Water Pollution Prevention Initiative (SWPPI).

Level Two – Changes in knowledge and awareness are targeted through the Public Participation Plan (PPP) and Public Education Plan (PEP), such as conducting stakeholder workshops and public briefings.

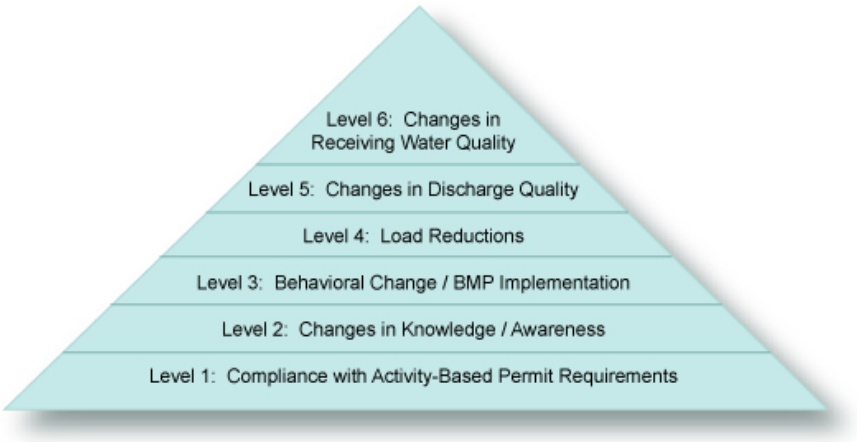
Level Three – The desired success of Level Three is behavioral change due to an increase in knowledge. This may be documented through the use of a survey or tracking the number of Best Management Practices (BMPs) installed or retrofitted. Section 7 discusses possible tools for watershed protection such as watershed planning, land conservation, and soil erosion and sediment control.

Level Four – BMPs are used to reduce the amount of pollutants entering local water bodies from storm water runoff. Load reductions may be calculated based on information provided once a BMP is installed. Load reductions may also be estimated for illicit discharges that are removed.

Level Five – Changes in the water quality of storm water discharge show the direct environmental benefit gained by the installation of BMPs and pollution prevention practices. Permittees will be working on this task through their Illicit Discharge Elimination Program (IDEP), which seeks to correct illicit discharges that are discovered through outfall screening and investigation. Should a sample show poor water quality, further sampling and testing will take place to pinpoint the source and work to remove it.

Level Six - The ultimate goal of the permit program is to improve the water quality of receiving water bodies. Monitoring may be conducted on a periodic basis to show change in water quality and environmental benefit. More details concerning monitoring efforts are included in the discussion on effectiveness assessments.

Figure 9-2. Success levels.



Each measure can also be classified based on the data required for an appropriate assessment. There are three data classifications, including:

- Measure of Activity Completion – requires only an indication of whether or not an activity has been completed (i.e. "Complete" or "Incomplete"). These measures are used to assess implementation.
- Measure of Usage – requires data concerning how much a facility has been used or how much of a material has been distributed or collected (i.e. "200 brochures distributed"). These measures are used to assess implementation.
- Measure of Change – requires data concerning baseline and post-action levels of knowledge or water quality (i.e. "a comparison of baseline and post-action results for macroinvertebrate monitoring in the river show signs of improvement"). These measures are used to assess effectiveness.

Table 9-1 gives examples of evaluation mechanisms from the action plan table based on the six different success levels. Note that actions must have at least one measurable in any data classification category and may have one in each category.

One other distinction that can be made to classify the evaluation mechanisms is whether they are direct or indirect. Direct evaluation mechanisms are associated with characterizing water quality and quantifying pollutant loads. Indirect evaluation mechanisms deal with degrees of activity or program implementation.

Table 9-1. Examples of evaluation mechanisms by type.

Level	Example Objective / Action	Measure of Activity Completion	Measure of Usage	Measure of Change
One	Objective 7d: Provide maintenance activities and inspection procedures for permanent structural storm water BMPs. Action 3: Adopt BMP Manual.	A manual has been adopted.	Number of local agencies and municipalities that adopt the manual.	Evaluate changes in water quality based on ongoing monitoring results.
Two	Objective 1b: Assist local school districts in developing a science curriculum on watershed studies. Action 3: Work with schools to see that this is implemented and that a standard survey or test is conducted following the presentation of the curriculum.	Communication / meetings between the community and the schools have occurred.	▪ Number of teachers presenting material. ▪ Number of students the curriculum reaches.	Evaluate changes in awareness through student survey or test.
Three	Objective 1h: Conduct 'Public Watershed Awareness Survey'. Action 3: Mail surveys and compile results.	Surveys have been mailed.	Number of surveys returned.	Results of survey to measure knowledge and behavior change.
Four	Objective 7f: Reduce discharge of pollutants from streets, roads, highways, parking lots, and maintenance garages. Action 4: Develop method to track quantity of sediment and debris removed	A method to track quantity of debris removed from system has been developed.	Quantity of debris removed from streets and catch basins annually.	Evaluate changes in water quality based on on-going monitoring results.
Five	Objective 8b: Conduct an illicit discharge removal program including: finding problems by checking for leaking sanitary systems, leaking septic systems, and illicit connections; removing the source of the problem and prohibiting their reoccurrence through municipal code and ordinances Action 3: Implement septic system tracking program in the Tri-County Area	Septic system tracking program has been implemented	Willingness of County Health Departments to use tracking system	Evaluate changes in water quality based on ongoing monitoring results.
Six	Evaluate changes in water quality based on ongoing monitoring results. See Table 9-2 for details concerning water quality monitoring within the watershed.			

Assessment

Assessment is the process of evaluating the Evaluation Mechanisms. The following describes how each of the three types of evaluation mechanisms is assessed.

- Measure of Activity Completion - A 'yes' or 'no' is required to evaluate the measure.
- Measure of Usage - The actual usage amount is required to evaluate the measure.
- Measure of Change - The actual change in water quality or public behavior is required to evaluate the measure.

Program Implementation

Program implementation is the second phase of the cycle and consists of applying the WMP which was developed or updated during the program planning phase.

Lessons learned and comments on the WMP are compiled during the implementation phase and are subsequently addressed in the effectiveness assessment phase.

Effectiveness Assessment

The effectiveness assessment phase consists of a water quality assessment, a program assessment, and an integrated assessment. The integrated assessment facilitates examining the causal relationships between program implementation and changes in water quality.

Water Quality Assessment

Water quality assessment is the analysis of water quality data to draw conclusions on the condition of or changes to the condition of receiving waters or discharges to those waters. The water quality assessment provides a way to assess the direct evaluation mechanisms. Long-term assessment is also necessary to ensure that seasonal, annual, and other variables can be identified and are considered when interpreting the results.

Generally, determining the effectiveness of the actions is a qualitative process that relies on the water quality assessment showing at least minimal improvement in water quality over time.

Many watershed monitoring methods may be used throughout the watershed to help evaluate the effectiveness of WMP implementation. Examples of the methods include the following:

- Benthic Macroinvertebrate Monitoring
- Frog and Toad Survey
- Fish Studies
- Analytical Chemistry Testing
- Stream Corridor Assessments
- Stream Crossing Watershed Survey and Photographs
- Hot Spot Testing

The different monitoring activities will be conducted in close proximity to one another in order to develop relationships between them and a holistic view of a particular area. For example, the photographic monitoring will be done at the macroinvertebrate monitoring sites along with the basic water quality monitoring sites. The road/stream crossing surveys will be done immediately upstream and downstream of the macroinvertebrate monitoring sites and will include photographic log files.

A community-based research group made up of volunteers from the general public will be trained to assist with monitoring activities. The benefits of using volunteers to conduct monitoring include increasing public participation, increasing public education and decreasing the cost of the monitoring program. Including established volunteer programs in the monitoring effort may be beneficial. Established groups include the Mid-Michigan Environmental Action Council (MID-MEAC), public school projects such as GREEN (Global Rivers Environmental Education Network), or other organized activities such as 4H clubs, scouting groups, and senior citizen groups.

The following describes the various monitoring methods:

Benthic Macroinvertebrate Monitoring

The presence or absence of certain species of benthic macroinvertebrates is a good indicator of the health of a stream. A benthic macroinvertebrate is an organism having no backbone that dwells on the bottom of a water body. The presence of organisms tolerant to pollution and few or no organisms sensitive to pollution indicates pollution in the water.

MSUWATER, MDEQ/MDNR, and MID-MEAC have conducted macroinvertebrate monitoring in the past (see Section 4) and may do so again in the future at their discretion.

Benthic Monitoring, Clinton River Watershed Council, 2005

Frog and Toad Survey

Like benthic macroinvertebrates, frogs and toads are sensitive to changes in water quality. The absence or decline of a frog and toad population indicates a loss of the quality of their wetland habitat and ultimately their ecosystem. As a result of the concern for the rarity, decline, and population die-off of several species, the Michigan Department of Natural Resources (MDNR) developed the Michigan Frog and Toad Survey which uses volunteers to monitor wetland sites three times annually during early spring, late spring, and summer. At each site, the volunteer listens for frog and toad breeding season calls and makes a simple estimate on the population size. Detailed information is given to the volunteer including how to establish a survey route and a tape or CD of frog and toad calls.

Fish Studies

Fish studies may consist of assessing habitat, population diversity and abundance, and contaminants in tissue. All of these factors can be used as indicators of the health of the river.

MSUWATER or the MDEQ / MDNR have conducted fish studies in the past (see Section 4) and may do so again in the future at their discretion.

Analytical Chemistry Testing

Many different analytical chemistry tests may be performed to determine the quality of surface water. The tests may be considered individually or combined together in an index. An example of one such index was created and designed by the National Sanitation Foundation (NSF) in 1970 called the Water Quality Index (WQI). The purpose of the index is to measure water quality changes in a particular river reach over time and provide a means to compare results with different reaches of the same river or other rivers. The WQI includes testing the water for dissolved oxygen, fecal coliform, pH, biochemical oxygen demand (BOD), temperature, total phosphate, nitrates, turbidity, and total solids. The nine resulting values are then added, with weighting factors, to arrive at an overall water quality index (Mitchell, 2000). Sampling and testing may be done by either volunteer or professionals depending on the desired results and budgetary constraints.

The MDEQ/MDNR have conducted analytical chemistry testing in the past and may do so again in the future at their discretion.

Photo Courtesy of CWP, June 2005.

Stream Corridor Assessments

During this effort the participants walk reaches of a stream looking for and recording issues potentially impacting the waterbody such as outfalls, bank erosion, buffer, channel modifications, trash and debris, and impacts from utilities. Issues such as substrate, water clarity, plant and wildlife, shade cover can also be noted. Some data collected during the assessments overlaps with data collected using other methods.

Stream corridor assessments may be conducted as part of a canoe trip on waterways large enough to support canoeing.

Stream Crossing Watershed Survey with Photograph

The stream crossing watershed survey is an approach used to collect information about the quality of a stream. A standard data collection form is used to ensure uniformity throughout the watersheds. The physical habitat of the site including water characteristics, stream characteristics, plant life, foam and trash presence, substrate type, stream morphology, land use, and corridor description are recorded. Also potential sources of pollution upstream and downstream of the site are identified if apparent. This method is similar to the stream corridor assessment but is conducted at discrete sites where streams and roads cross as opposed to entire stretches of stream.

The MDEQ maintains a statewide database and standard protocol set that can easily be implemented. The MDEQ may provide training upon request.

River Sampling, Courtesy of Tetra Tech, June 2005.

Hot Spot Testing

Parts of the watershed encompass land once and currently used for industrial and commercial purposes. Prior to government regulation, a number of pollutants were released without realizing their potential impacts on public health and safety and water quality in aquatic environments. In addition to this historical pollution, various hot spots of pollution may exist due to accidental release or intentional, illegal

releases. Any known or discovered hot spots may be monitored for the applicable pollutants.

Program Assessment

Program assessment involves reviewing the attainment of the evaluation mechanisms. Evaluation mechanisms will be reviewed for implementation and effectiveness and if not implemented or effective, an investigation will be conducted to determine possible factors causing the delay or failure.

The program assessment involves a number of techniques such as: a public watershed awareness survey, a student awareness survey, meeting evaluations, inspection results, and staff training surveys. Table 9-2 is an action plan specifically for conducting program assessment techniques. The table is similar to the action plan table in Section 8 and addresses the actions, schedule, responsible party, and cost to implement the assessment techniques.

Generally, determining the effectiveness of the actions is a qualitative process that relies on the program assessment showing at least minimal improvement in awareness and knowledge over time.

Assessing the evaluation mechanisms is an annual task that will be reported in the annual progress reports. The annual progress report is required to cover decisions made, actions performed, and results of the IDEP, PEP, SWPPI, and other storm water actions conducted during the previous permit year. The IDEP and PEP are separate documents containing additional actions and evaluation mechanisms not covered in this WMP. The annual report must also cover updates of nested drainage system agreements and point source discharges to the storm water system.

Integrated Assessment

The integrated assessment incorporates the water quality assessment and program assessment and evaluates the entire watershed management plan as a whole. The integrated assessment identifies and addresses data gaps in the water quality monitoring program and finds causal relationships between actions taken through the WMP and changes in load reductions, discharge quality, and receiving water quality.

As a result of the integrated assessment, targeted updates and revisions will be made to the WMP for submittal to the MDEQ by the March 1, 2007 deadline indicated on the certificate of coverage.

Evaluation Action Plan

Table 9-2 *(Insert detailed evaluation action plan here)*

Summary

The framework presented here is not meant to be inclusive, but rather a guide illustrating the embodiment of the watershed management plan. The emphasis of the plan is to focus on high priority constituents, sources, benefits etc. rather than all potential problems. Attention is given to the importance of long-term assessments that boast strategy rather than ambition.

References

CWP (Center for Watershed Protection). "Stormwater Practice Design; Watershed Leadership Kit." Volume 5. Last accessed, June 2005.

Michigan Department of Environmental Quality. "Wastewater Discharge General Permit". 1997.

Mitchell, Mark K. and William B. Stapp. "Field Manual for Water Quality Monitoring". 2000.

San Diego Municipal Storm Water Co-Permittees. "A Framework for Assessing the Effectiveness of Jurisdictional Urban Runoff Management Programs". 2003.

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10. Plan Sustainability

Source: stock.xchng, 2005.

Introduction

Plan sustainability refers to an essential component of watershed management planning that involves finding ways to continue efforts to implement this watershed management plan (WMP). Implementation involves taking the appropriate actions to achieve the goals and objectives, evaluate the effectiveness of the plan, and update / improve the plan when necessary.

A key component of sustainability is obtaining and keeping a wide variety of local support. This support and public involvement will help maintain momentum for implementing this WMP. Local support will also help obtain funding through all available means and open doors for partnerships in areas where other groups have similar missions.

This section of the plan discusses past implementation and future sustainability efforts.

History of Greater Lansing Regional Committee[1]

On November 15, 1999, Delta Township and the City of Lansing hosted a meeting for several local communities. The meeting notice stated that this was to be "an informal meeting to discuss the Storm Water Phase II program and how, or if, there may be a way to pool resources on a regional basis".

Representatives from various communities, counties, and the MDEQ discussed the Federal Regulations for Storm Water Phase II and the MDEQ's program allowing a "Voluntary Permit Program." Originally, eleven communities and three counties were listed as designated Phase II communities by the MDEQ.

Subsequent meetings were held to continue exploring the feasibility and cost of a cooperative effort. On June 8, 2000, a draft Resolution was prepared for the establishment of the "Greater Lansing Area Regional NPDES Phase II Storm Water Regulations Committee" for each of the communities to adopt. Each community was also asked to name a representative to serve on the committee.

Throughout the remainder of 2000, the committee obtained Resolutions from each community, elected offices, received proposals, and interviewed four consulting firms. Tetra Tech was selected to assist the Committee in determining how to best comply with the Phase II Storm Water Rules. Tri-County Regional Planning Commission (TCRPC) also assisted the Committee in providing contractual, fiduciary, and administrative support.

In May 2001, Tetra Tech completed the "Step 1 – Permit Strategy Development" study, which incorporated the Committee's decision (April 20, 2001) to proceed as a group using the State's Voluntary General Permit approach. The Committee then agreed to retain Tetra Tech to prepare the

Original Phase II Jurisdictions

Bath, Charter Township of
Delhi, Charter Township of
Delta, Charter Township of
DeWitt, Charter Township of
East Lansing, City of
Lansing, Charter Township of
Lansing, City of
Meridian, Charter Township of
Williamstown, Township of
Clinton, County of
Eaton, County of
Ingham, County of
Capital Region Airport Authority
Michigan State University

[1] The text from this section is taken from the GLRC "Memorandum of Agreement" with minor edits.

Voluntary General Permit Application for each of the nine communities. The cost for each community was based on a formula that included weighted factors for population and land area. Each of the nine communities then passed a second resolution agreeing to continue as a group to pursue a Voluntary General Permit using the previous distribution of costs.

The committee defined appropriate watershed boundaries for the Grand River Watershed, the Red Cedar River Watershed, and the Looking Glass River Watershed. On January 25, 2002, the Committee agreed to retain Tetra Tech to prepare WMPs for these watersheds. Again, the allocation of cost was based on the previously agreed upon formula. Each community adopted a third resolution committing their appropriate funds for the watershed management plans.

A Public Education Advisory Committee was organized to assist in the educational portion of the Voluntary General Permit Applications, including in this an inventory of current community practices.

Throughout 2002 and 2003, fourteen additional communities within the three watersheds were invited to join the committee. Ten of these communities were required to meet the Stormwater Phase II requirements based on the 2000 census. Eight communities joined and participated in the regional approach and completed the Voluntary General Permit Application in 2000.

In March 2003, all seventeen communities; (the original nine plus the additional eight communities); and the three counties submitted their Voluntary General Permit Applications to MDEQ. In November 2003, certificates of coverage were issued to each of the seventeen communities and to each of the three counties.

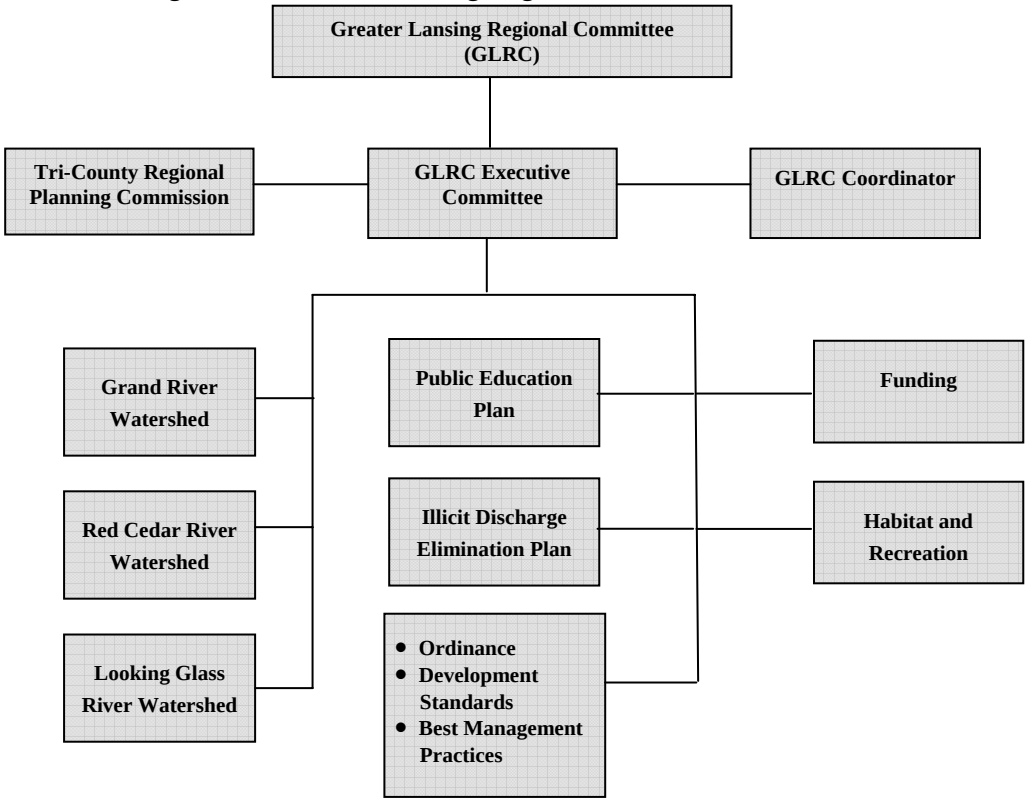
Additional Committee Members (as of 2004)

Alaeidon, Township of
DeWitt, City of
Dimondale, Village of
Grand Ledge, City of
Mason, City of
Oneida, Township of
Vevay, Township of
Watertown, Township of
Windsor, Township of

In early 2004, Alaeidon Township joined the committee and submitted its permit application in November.

Throughout 2004, the communities involved in the voluntary committee adopted a 'Memorandum of Agreement' (GLRC, 2004) to establish the "Greater Lansing Regional Committee on Phase II Nonpoint Source Pollution Prevention" (GLRC). The committee was formally convened on May 21, 2004. This committee structure is outlined in the flowchart on the right (Figure 10-1) and is discussed under the "Phase II Legal Relationship" heading below.

Figure 10-1 Greater Lansing Regional Committee Structure



Other Communities in the Watersheds

Aurelius, Township of
Benton, Township of
Eaton Rapids, Township of
Locke, Township of
Olive, Township of
Riley, Township of
Sciota, Township of
Victor, Township of
Wheatfield, Township of
Williamston, City of
Woodhull, Township of

Watershed Committees

Although each individual community is ultimately responsible for fulfilling permit requirements, actual implementation of the WMP will be predominately by committee, particularly during the initial stages of the WMP. For many of the proposed objectives in the action plan, the first action in support of the objective is to create a committee. Committees will be assigned a chairperson who will then solicit members from the watershed committee, municipal staff, stakeholders, the general public, or any other individual pertinent to the decision-making process. Depending on the nature of the task they are appointed to oversee, committees may have a short or long lifespan. It is anticipated that each committee will make decisions and represent the wishes to the full watershed committee.

Existing committees that were created as part of the WMP development process will also be utilized during WMP implementation. The individual make-up of these committees will be reevaluated for applicability to the new assignments. Volunteers who identified interest during a Stakeholder Workshop are also included in these committees. Existing committees include the following:

Illicit Discharge Elimination Plan (IDEP) Committee

- *Illicit connection and septic system ordinances and enforcement.*

Committee Members
Village of Dimondale
City of Lansing
Ingham County Health Dept.
City of Mason
Delhi Township
City of DeWitt
Meridian Township
City of Lansing
Meridian Township

Public Education Plan (PEP) Committee

- *Public education materials and outreach strategies.*

Committee Members
Ingham County Health Department
Woldumar Nature Center
Capitol Area Trans. Authority
Lansing Township
Michigan State University
Michigan State University
DeWitt Township
Area Assoc. Groesbeck Neighborhood
Tri-County Regional Planning Commission
Lansing Community College
Bath High School

Ordinance, Development, Storm Water Best Management Practice (BMP) Committee

- *Ordinances related to IDEP, development standards, and operation and maintenance .*
- *Water quality friendly site development standards planning practices.*
- *Structural storm water BMPs, ditch/drain BMPs, and stream recreation.*

Committee Members

City of Lansing
Meridian Township
Meridian Township
Ingham County Health Dept.
Ingham County
Capitol Area Trans. Authority
Delhi Charter Township
Friends of the Carrier Crank
Michigan State University
SME (Grand Ledge Public Schools)
Area Assoc. Groesbeck Neighborhood
City of DeWitt
Watertown Township
MSU Grounds Maintenance
Ingham County Road Commission
Board of Water & Light
Village of Dimondale
Consumers Energy
Realtors
General Motors

The following committees will be created as part of WMP implementation. The members indicated have volunteered to participate.

Funding Committee

- *Funding strategy for WMP implementation.*

Committee Members

Ingham County Health Department
Capitol Area Transportation Authority
Delhi Charter Township
Lansing Township
Meridian Township
City of East Lansing
General Motors

Habitat and Recreation Committee

- *Studies and research explicit to the health of local streams and habitat.*
- *Wetland inventory, protection, and restoration.*

Committee Members

Michigan State University
Meridian Township
Meridian Township
Ingham County Health Department
Woldumar Nature Center
Ingham County
Delhi Charter Township
Area Assoc. Groesbeck Neighborhood
Watertown Township
Village of Dimondale
Oneida Township
Lansing Community College

Phase II Legal Relationship

As previously mentioned, the communities formed the GLRC in 2004 by adopting a 'Memorandum of Agreement'. The stated purpose of this agreement is as follows (GLRC, 2004):

> "It is the purpose of this Memorandum of Agreement (hereinafter the Agreement) to set forth the composition, duties, and responsibilities of the Greater Lansing Regional Committee Phase II Nonpoint Source Pollution Prevention (hereinafter the "GLRC") to be formed as more particularly described below. Local public agencies and communities believe there are substantial benefits that can be derived under this Agreement through cooperative management of the Grand River, Red Cedar [River] and Looking Glass River watersheds and in providing mutual assistance in meeting the storm water permit requirements under the Michigan Department of Environmental Quality (MDEQ) watershed-based, general storm water discharge permit, or similar storm water discharge permits issued to public entities within the Grand River, Red Cedar [River], and Looking Glass River watersheds.
>
> The Agreement will also provide a framework for consideration of new, permanent watershed organizations with potentially broader responsibilities that could provide a more cost effective and efficient means to meet state and federal requirements, and public expectations for restoration and maintenance of the beneficial uses of the watersheds."

This agreement included fund allocation and authorization mechanisms and other by-laws of the committee including the term, composition, public participation, voting, election, meetings, duties, fiduciary services, and insurance/legal requirements of the committee.

By passing a resolution committing to the agreement, each community formalized its participation in the committee. The powers of the committee are derived from the 'Inter-Municipal Committee Act' (PA 200, 1957) and include studying problems and preparing plans to address problems.

Under the Act, the committee can employ staff or hire public or private agencies or businesses to perform surveys and studies. In-kind services by municipal personnel, the use of equipment and office space, and other services can be accepted as financial support by any of the members.

The primary limitation of the committee is that the Act provides it with no powers to perform construction or to operate and maintain facilities. Under the current structure, these activities will have to be pursued by the individual communities. However, the purpose statement indicates that other organizational frameworks will be considered in the future that allow for broader powers to implement the WMP.

Funding

As introduced in Section 6, Goal 2 of the WMP is to "Provide a Sustainable and Equitable Funding Source". The funding strategy to be developed includes procuring start-up and continual funding for implementing WMP recommendations. The actions associated with this goal (Section 8) involve developing budget needs, comparing funding mechanisms, selecting a funding mechanism, and implementing the mechanism.

The GLRC currently uses a funding allocation formula, based on population and land area within the watershed. Land area and populations were carefully reviewed as input into the funding allocation formula. Corrections were made for communities holding utility service and tax sharing agreements to assure they are accurately reflected in the calculations. Land area that was owned by Michigan State University, MSU, in the City of Lansing, City of East Lansing, and Lansing Township was also subtracted from the total land area since MSU is participating as an ad-hoc member of the GLRC and is implementing storm water management activities through an internally-funded watershed management initiative known as MSU-WATER.

In the short–term, and as a means to supplement the above funding strategy, several additional tactics should be undertaken. Specifically, grant seeking, voluntary initiatives, and piggy backing on existing programs can yield significant resources for achieving the WMP goals and objectives. Grants targeted for environmental action, land use issues and community development can help fund specific initiatives.

Voluntary initiatives can have significant impact in a community and act as a catalyst for others to be good stewards. For example, if planning departments make information available on alternative development options that are watershed friendly then developers may more readily undertake these options. Giving companies public recognition and publicity for these initiative often encourages business to try new ideas.

Currently, the Conservation Districts run both the Adopt-A-River and the landowner conservation programs. Both of these programs present opportunities to add watershed protection components to their programs. This is only one example of an existing program which could provide a

Example Funding Idea

One objective identified in Chapter 8 is to undertake watershed friendly development practices. A possible source of grant funding for implementing this objective is People and Land (PAL), a project funded by the W.K. Kellogg Foundation, whose mission is to enable people in Michigan to live in diverse, healthy communities that are environmentally sustainable, economically viable, and socially equitable. Please see http://www.peopleandland.org/index.html for more information.

vehicle for helping to meet the objectives outlined in the WMP. Other possible organizations that currently conduct complementary programs include 4-H through their Junior Citizen Planner program and MSU Extension with its watershed short courses.

GLRC Future

The GLRC will to continue to operate under their current organizational structure. This structure has successfully accomplished many tasks including:

- Hiring a part time executive director,
- Developing a public and project team website,
- Designing and purchasing curb markers,
- Installing watershed boundary signs,
- Developing brochures and posters, and
- Guiding the development of this WMP and all the effort contained therein.

These accomplishments would not have been possible without the support of local community groups, local government agencies, and the dedication of committee members participating in this process.

The committee will continue to encourage local support and partnerships through public involvement activities and watershed implantation. A concerted effort will be made to foster a network of local subwatershed stewardship organizations. The network will bring together volunteer stewards throughout the watershed to share their experiences and learn from each other about how to protect and restore natural areas in and around their neighborhoods. Drawing from the lessons learned in the Huron River Watershed, (http://www.hrwc.org) it is anticipated that the network will work together to protect natural areas, learn about the functioning and identification of many parts of a watershed (plants, animals, natural systems, etc), and help one another become effective advocates for the natural world.

While this organizational structure is working well at this time, it may need adjusting in the future. This watershed plan is intended to be a fluid adaptive document that can be changed as needs arise. If it becomes apparent, in the future, that implementation is insufficient; the committee will consider additional or alternate legal organizational structures that provide greater opportunities to implement the actions in this plan.

References

Greater Lansing Regional Committee on Phase II Nonpoint Source Pollution Prevention. "Memorandum of Agreement". 2004.

stock.xchng. "stock.xchng" website. Via: http://www.sxc.hu/. Last accessed: May 20, 2005.

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