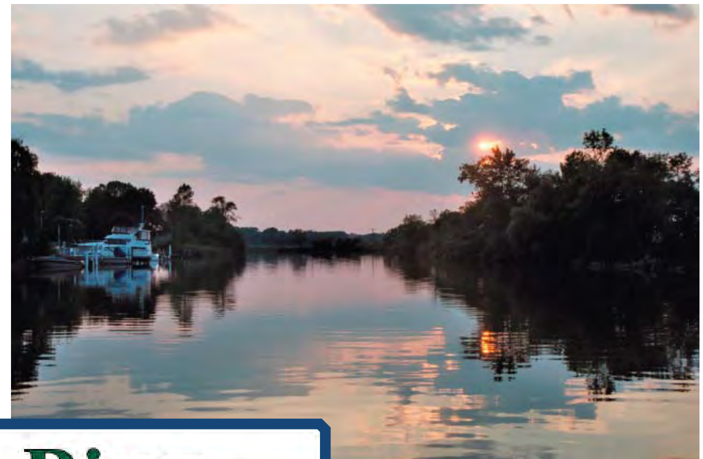
A CLINTON RIVER WATERSHED MANAGEMENT PLAN

CLINTON RIVER EAST SUBWATERSHED

for improving water quality in the Clinton River, Lake St. Clair, and the Great Lakes

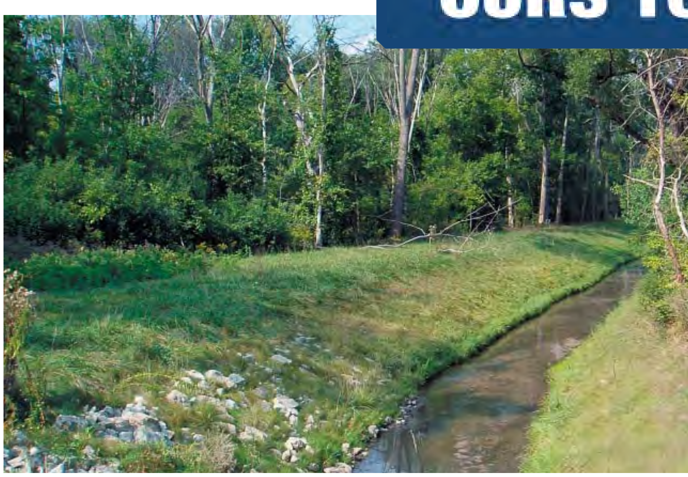
The Clinton River East Subwatershed

of Macomb County



Clinton River East Watershed

OURS TO PROTECT



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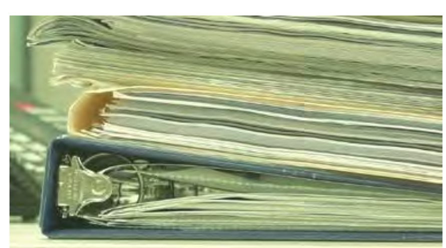

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Acknowledgements

This watershed management plan (WMP) represents the joint effort of and hard work of many dedicated people, especially the members of the Subwatershed Advisory Group (SWAG) for the Clinton River East Subwatershed (CREW). There are many individuals and organizations who contributed their time, expertise, and resources during the development of this WMP. Their tireless efforts will greatly benefit future protection of the Clinton River and its tributaries for years to come. There is great appreciation for the time and efforts of all of the private citizens as well. The following individuals and organizations are recognized for their contributions:

- Anderson, Eckstein & Westrick, Inc.
  - Jeff Bednar
  - Missy Madigan
- Clinton River Watershed Council
  - Tracie Beasley
  - Gary Morgan
  - Jessica Opfer
- Clinton Township
  - Mary Bednar
- Fraser, City of
  - Jeff Bremer
  - Thomas VanDamme
  - Bernard VanFleteren
- Fraser Public Schools
  - Jack Treaster
- Harrison Township
  - Randy McConnell
  - Adam Wit
- Hubbell, Roth & Clark
  - Ryan Higuchi
  - Margie Synk Kuhn
  - Keith McCormack
- L'Anse Creuse Public Schools
  - Gasper Vitale
- Macomb County Health Department
  - David Berry
  - Stephen Lichota
  - Stacey McFarlane
  - Cole Shoemaker
  - Gary White
- Macomb County Planning and Economic Development
  - Gerard Santoro
- Macomb County Prosecuting Attorney
  - Andrea Jacklyn
  - Mark Richardson
- Macomb County Soil Conservation District
  - Seth Hopkins
- Macomb Intermediate School District
  - Dave Puranen
- Michigan Department of Environmental Quality
  - Chris Ethridge
  - Bretton Joldersma
  - Stephanie Kammer
  - Carol Panagiotides
- Mt. Clemens, City of
  - Chuck Bellmore
- Romeo Community Schools
  - Don Gratton

- Shelby Township
    - Pat Kusiak
    - David Miller
- Southeast Michigan Council of Governments
    - Amy Mangus
    - Susan Stefanski
- Spalding DeDecker Associates, Inc.
    - Brian McKissen
- Utica, City of
    - William Lang
    - Jacqueline Noonan
- Utica Community Schools
    - John Goike
- Washington Township
    - Rob Mair

In addition to the SWAG members, the Macomb County Public Works Office (MCPWO) its contractor, Tetra Tech, and the United States Army Corps of Engineers (USACE) were instrumental in preparing this document.

Lynne Seymour and Lara Sucharski from the MCPWO chaired the SWAG and provided direction for the planning efforts. Their dedication was critical in procuring funding for the project, providing a cohesive voice for the SWAG and its various members, and fostering communication between the myriad stakeholders involved.

The USACE provided financial support through the Remedial Action Plan (RAP) program. Dedicated staff members such as Collete Luff, Dick Smit, and Mike Geiger, provided logistical support, technical support, and worked diligently within the USACE to ensure the maximum amount of resources available to the project were utilized.

At Tetra Tech, the project was initiated under the supervision of Jim Scholl. Upon Jim's departure, Dan Christian assumed all major project management responsibilities and was the main voice for Tetra Tech at SWAG meetings. Charlie MacPherson, Kevin Kratt, and Matt Rathsack provided additional management-level guidance and technical assistance.

Kyle Paulson was involved with the development of the workplan, the initial technical memos for the USACE, and the actual WMP document. His duties included coordinating the technical content of the plan, providing GIS support, drafting and laying out the documents, and editing the documents based on internal and external comments.

Kelly Dubay and Kathleen Herrmann were instrumental in planning and conducting the stakeholder meetings and community forums held during the development of the WMP. Kelly also contributed the majority of the Chapter 5 text, the technical content of which was developed by Elizabeth Hansen.

Steve Pennington, with assistance from Susan MacNeil, conducted the planning audit and developed the associated text presented in Chapter 3. Steve also performed a final overall check of the entire plan.

Other team members contributing to development of the WMP include: Brian Rubel (technical review), John Herrmann, Anne Thomas (Chapter 8), Natalie Trotter (GIS), Valerie Sanglier, Justin Voss, and Amanda Thelen.

All components of the WMP were reviewed and commented on extensively by members of the SWAG.

Organization of the Plan

This plan defines an approach that is to be taken to protect ecological, hydrological, and cultural resources of the subwatershed. It presents all of the data, analyses, public inputs, and conclusions used in developing the approach as well as components of the approach itself, including goals and objectives, actions to achieve the goals and objectives, plan evaluation and revision, and plan sustainability.

1. Introduction

This chapter introduces the reader to the subwatershed, describes its significance as portion of the Clinton River Watershed / Lake St. Clair Regional Sub-basin, and defines the drainage units, or catchments, that comprise the subwatershed and the municipal entities represented in it.

The chapter goes on to introduce the reader to some background information such as watershed science, water pollution control and its history, and other relevant plans that are supported by this watershed management plan (WMP).

Finally, the chapter discusses the partners that were involved in development of this WMP.

2. Inventory of the Subwatershed

This chapter walks the reader through the natural environment of the subwatershed, including coverage of each category in the watershed. A brief introduction to the hydrological processes, vegetation, habitat and wildlife provides the reader with a greater understanding of the valuable natural features.

The chapter goes on with details of the community profiles, population trends and statistics. Past, present and future land use data educates the reader about trends in development and infrastructure.

The chapter concludes with existing infrastructure and potential sources of pollution discharges.

3. Documented Subwatershed Conditions

This chapter begins with a discussion of the impacts on the environment caused by human activity and government defined water quality standards and indicators. An in-depth discussion of qualitative water chemistry conditions, biological conditions and hydrologic conditions supplies the reader with an overview of historic and current subwatershed conditions.

The chapter continues by providing the reader with results from road-stream crossing surveys, unified stream assessments and an analysis of impervious cover and the effect on stream quality.

There are several subwatershed protection practices already in place and are summarized for the reader. The chapter is closed out with a list of the existing waterbody impairments.

A vast amount of the information in this chapter provides a baseline for future chapters in this WMP and future planning efforts.

4. Community Outreach and Public Involvement


4. Community Outreach and Involvement

Chapter 4 begins with a discussion of the public involvement processes that were used to obtain input into the content of this WMP and comments on a draft version. This discussion includes details of the participants in the various mechanisms and lists the specific feedback received.

The chapter goes on to discuss the education that was done for benefit of the municipal officials and concludes with a detailing of the public education efforts that were conducted during development of and will continue after submittal of the WMP.

5. Problem Assessment and Stressor Summary


5. Problem Assessment & Stressor Summary

This chapter distills the information contained in Chapters 2, 3, and 4 into a number of significant stressors that impact water quality. It begins by listing the data sources, including a determination of the status of designated uses and a listing of general potential stressors.

The chapter then discusses the methodology employed to analyze the significant stressors and provides a section for each stressor that discusses topics associated with each: sources, impacts and impairment, indicators, water quality standards, load estimates and reduction goals, critical areas, monitoring progress, and improvement ideas.

The chapter finishes with a brief discussion of other known and suspected stressors in the subwatershed.

6. Goals and Objectives


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This chapter defines the goals and objectives of the plan.

First, the sources of information utilized in developing the goals and objectives (the information presented in the previous chapters) are detailed.

Then the goals are listed along with each of the objectives associated with them.

The chapter goes on to list the general decision-making principles that were used in distilling the goals and objectives.

The chapter ends with a reflection on how the goals of this WMP fit into goals of other WMPs that reflect larger management areas including the entire Clinton River, Southeast Michigan, and the entire Lake St. Clair Regional Sub-basin.

7. Watershed Protection

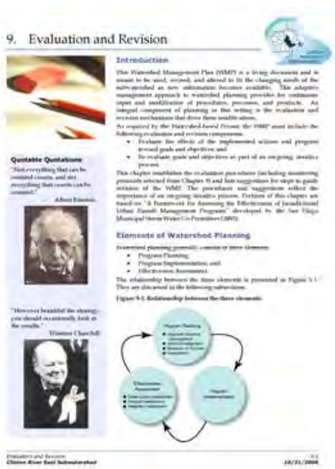
This chapter presents many tools and resources that are available to achieve the goals and objectives presented in the previous chapter. The tools are discussed in general groupings, in the following order: Watershed Planning, Institutionalization, and Implementation; Public Education and Participation; Ordinances, Zoning, and Development Standards; Good Housekeeping and Pollution Prevention; Storm Water Best Management Practices; Natural Features and Resources Management; Recreation Promotion and Enhancement; and Monitoring.

This chapter ends by introducing a methodology that will allow the implementing agencies to help select the most appropriate tools and resources.

8. Implementation Roadmap

This chapter details the roadmap that the implementing agencies will follow, utilizing the actions and resources presented in Chapter 7, to achieve the goals and objectives of the WMP (see Chapter 6). It details the steps that will be taken and includes: a textual description of each action, a table linking the actions to the appropriate goals and objectives, the lead implementing agency, a projected schedule, estimates of cost and time, financial and technical assistance needed, the authority related to each action, and Watershed-based Permit (NPDES Phase II) details such as SWPPI inclusion and level of commitment.

The chapter concludes with a discussion of how the actions will be implemented to achieve the loading reductions calculated and presented in Chapter 5.



9. Evaluation and Revision

Chapter 9 describes the iterative process of watershed planning and how evaluation and revision are an essential component of this.

The chapter also details potential evaluation mechanisms (or measures of success) and what options are available to assess them.

The bulk of the chapter lays out the evaluation and revision guidance (ERG) for this WMP, including: measures of activity completion, measures of usage, and measures of change; monitoring protocols and existing monitoring programs; and the specific actions involved in the plan with details such as lead implementing agency, timeline/schedule, and estimates of cost and time.

The chapter goes on to list out all of the interim milestones used to track implementation of the WMP actions and concludes with a table of specific evaluation questions that may be used to gauge success in achieving each of the goals and objectives of this WMP.

10. Plan Institutionalization

Chapter 10 presents some organizational structures and legal relationships that the subwatershed entities will consider to ensure that the actions of the WMP are implemented and the goals and objectives of the WMP are met.

Finally, the chapter defines a number of potential funding mechanisms that may be utilized when implementing the actions defined in the WMP.

Appendices

The appendices include products generated during the WMP-development process (e.g. fact sheets) contact lists, and other information not essential to the text of the WMP but important for those requiring additional information on selected topics.

WMP as a Planning Document

This WMP is a planning document only and it is fully expected that ongoing modifications will be necessary to reflect actual resources obtained and available for its implementation. The Permittee's individual SWPPI should be referenced to more clearly indicate commitments to programs and activities especially for those in multiple watersheds where the definitions of similar actions/activities is widely variable and the logistics of implementing so many variable activities are complex.

A Note about Photos

Photos with no reference have public domain usage rights.

WMP Contact Info:

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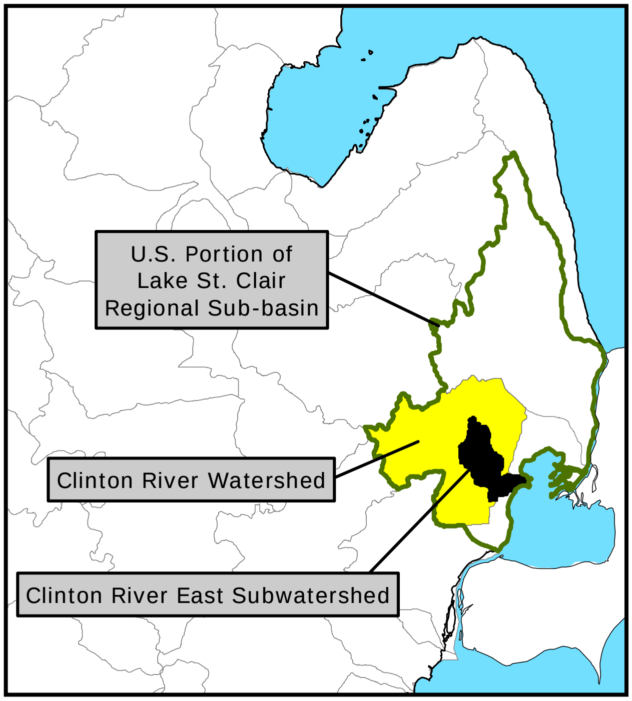
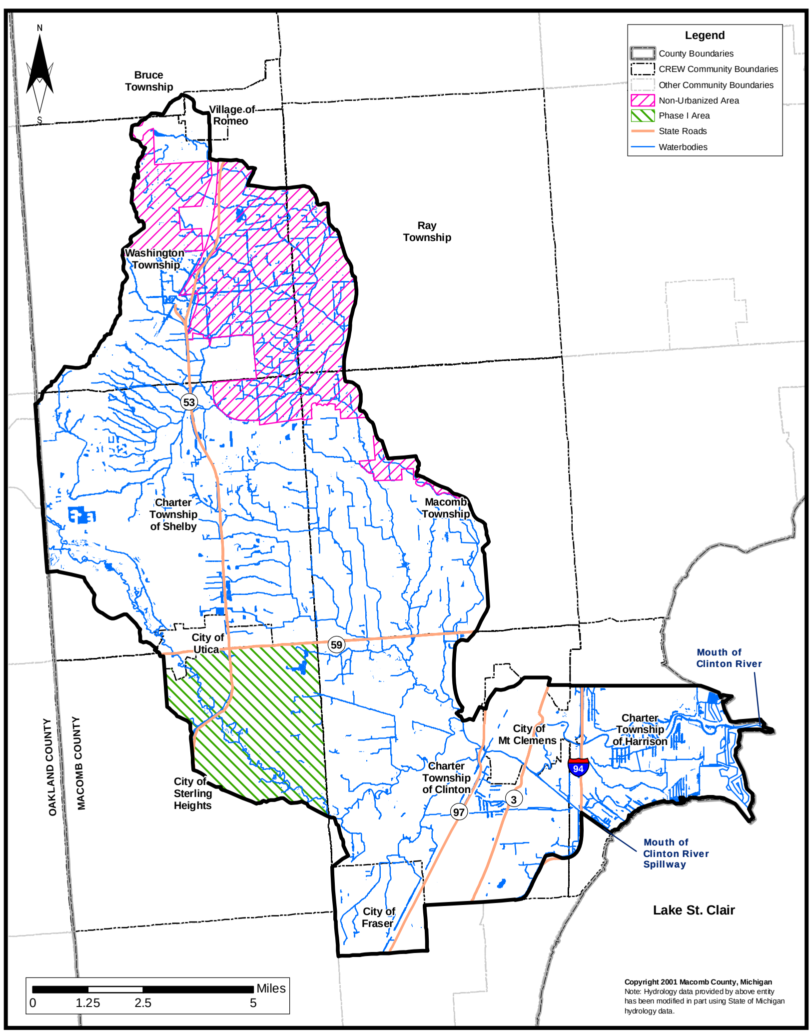
Executive Summary



The Clinton River Watershed encompasses approximately 760 square miles in four Southeast Michigan Counties and is home to over 1.4 million people. The headwaters of the Clinton River are in Independence and Springfield Townships of Oakland County, where the river water begins its meandering 80 mile trek, passing through Macomb County, then finally discharging into Lake St. Clair.

The Clinton River East Subwatershed (CREW), the focus of this watershed management plan (WMP), covers the final stretch of the river, from its discharge point in Harrison Township upstream to Shelby Township (where the river enters Macomb County). The CREW is a 132 square mile, Michigan Department of Environmental Quality (MDEQ)-approved basin that also incorporates the entire drainage area of the Middle Branch of the Clinton River and is home to 300,000 people.

This WMP was developed by the CREW Subwatershed Advisory Group (SWAG) to: 1) fulfill the National Pollutant Discharge Elimination System (NPDES) Phase II requirements (MDEQ's *General Permit No. MIG619000 for Coverage of Storm Water Discharges for Municipal Separate Storm Sewer Systems Subject to Watershed Plan Requirements*) for non-Phase I governmental units in the urbanized area; and 2) make all of the entities represented in the subwatershed eligible for various grant funding opportunities to implement actions for watershed improvement.



The contents of this plan, including the goals and objectives and the actions to meet them, were developed cooperatively by SWAG members with consideration of the input from community leaders, residents, environmental and citizen groups, local businesses, schools, and universities. This WMP was also developed to be consistent with other planning efforts affecting the subwatershed, including: the Lake St. Clair Comprehensive Management Plan (U.S. Army Corps of Engineers), the Clinton River Watershed Remedial and Preventative Action Plan (Clinton River Public Advisory Council), and the Water Quality Management Plan for Southeast Michigan (Southeast Michigan Council of Governments).

In the 1830s, the subwatershed was primarily forest land (100 square miles) and swamp/wetland (30 sq. miles). Since that time, permanent human settlement has transformed this land into developed types such as residential, commercial, and industrial (105 square miles) and agricultural uses (15 sq. miles). Although only 12 square miles of natural areas remain, it is mostly in protected areas and expected to remain intact through the year 2030.

This past and continuing development has been and will continue to be a major factor that impacts the quality of water in the subwatershed. This is because traditional development practices have dramatically increased impervious surfaces which subsequently increase runoff and pollutant transfer to nearby waterbodies. Other factors which have and continue to impact water quality in the subwatershed include: sewer systems and practices, riparian corridor and waterbody modifications, and point sources such as pollution control facilities.

The health of waterbodies in the subwatershed can be gauged from water quality standards (WQS), defined by the MDEQ, to: 1) protect health and public welfare, 2) enhance and maintain the quality of water, 3) protect the state's natural resources, and 4) meet the requirements of state and federal law. The WQS contain requirements for designated uses that the waters of the state must meet, including:

- Agricultural Water Supply;
- Public Water Supply;
- Other Aquatic Life/Wildlife;
- Industrial Water Supply;
- Navigation;
- Warmwater Fishery;
- Coldwater Fishery (specifically identified water bodies only);
- Total Body Contact (May 1st through October 31st); and
- Partial Body Contact.

Water quality monitoring has been and continues to be conducted by various organizations and agencies. While some historical data exist, the bulk of monitoring began in the 1970s, spurred by the passage of the Clean Water Act and other environmental initiatives. Analysis of this data tells a story of a severely impacted Clinton River that has improved over the past 30 years but still exhibits some problems. Impairments, as listed by the MDEQ in 2006 include: a Fish Consumption Advisory (FCA) for PCBs, the presence of pathogens, and excessive mercury levels in Mt. Clemens. Additionally, all other waterbodies in the subwatershed are impaired due to elevated PCB levels and Clear Spring Lake also has a FCA for PCBs.

The subwatershed, as part of the Clinton River Area of Concern, is affected by some beneficial use impairments that indicate other problems, including:

- Degradation of aesthetics;
- Beach closings and other "full body contact" restrictions;
- Degradation of benthos;
- Loss of fish/wildlife habitat;
- Restrictions on dredging activities;
- Eutrophication/undesirable algae populations;
- Degradation of fish/wildlife populations; and
- Restrictions on fish/wildlife consumption.

Phase II Permittees

The Phase II Permittees covered by this plan are:

- Bruce Township;
- Clinton Charter Township;
- Fraser, City of;
- Harrison Charter Township;
- Macomb County;
- Macomb Township;
- Mt. Clemens, City of;
- Romeo, Village of;
- Shelby Charter Township;
- Utica, City of; and
- Washington Township.

Nested Jurisdictions

The nested jurisdictions in the subwatershed are associated with county-level government (except where noted) and include:

- Chippewa Valley Schools;
- Clintondale Community Schools;
- Fraser Public Schools;
- L'Anse Creuse Public Schools;
- Macomb Intermediate School District;
- Mt. Clemens Community School District (the City of Mt. Clemens);
- New Haven Community Schools;
- Romeo Community Schools; and
- Utica Community Schools.

Detailed analysis of water quality data has led to the identification of four major stressors that impact the subwatershed. These stressors are: sediment, phosphorus, pathogens, and flow variability. They have been treated to detailed analysis in the plan that includes discussion of: impacts, indicators, standards, load estimates and reduction goals, critical areas, monitoring, and improvement ideas. The framework for discussion of these stressors makes the implementation of actions to improve their conditions potentially eligible for grant funding.

In addition to addressing the problems causing the waterbody impairments and beneficial use impairments, this WMP also seeks to address issues of public stakeholders. Various meetings were held during the planning process to allow the stakeholders to express their issues and concerns as well as their goals and visions for the subwatershed.

Consideration of the public input and the measurable water quality impairments led to the goals and objectives of the WMP, as well as the main principle:

> "To improve and protect ecological, hydrological, and cultural resources of the Clinton River East Subwatershed."

Specifically, the goals of the WMP are:

I. To protect, restore, and enhance water quality of the subwatershed;

II. To educate the public in how to protect, restore, and enhance water quality;

III. To protect and enhance recreational opportunities in the subwatershed;

IV. To appropriately manage suitable habitat for aquatic life, wildlife, and fisheries in the subwatershed;

V. To reduce runoff impacts through sustainable stormwater management;

VI. To seek out opportunities to sustain implementation of the plan; and

VII. To promote opportunities to preserve, protect, restore, and enhance natural features.

Meeting the goals and objectives of the plan in an economically responsible way requires the implementation of numerous actions over many years. As presented in the plan, there are many actions that address the goals and objectives of the WMP and even more resources that provide assistance relative to these actions.

The planned actions have been grouped into the following eight categories:

- Watershed Planning, Institutionalization, and Implementation – includes funding, plan revision, and reporting actions;
- Public Education and Participation – includes community education, employee training, demonstration projects, signage, and meetings;
- Ordinances, Zoning, and Development Standards – includes stormwater standards, managing development, preserving natural features, and pollution prevention ordinances;
- Good Housekeeping and Pollution Prevention – includes sewer operations and maintenance, waste management, municipal property practices, and spill preventions and response;
- Stormwater Best Management Practices: Non-Construction Related Soil Erosion and Sedimentation Control – includes soil and streambank repair, use exclusion, and structural controls;

- Stormwater Best Management Practices: Other Pollutant Load Reducing Controls – includes impervious surface mitigation, infiltration, filtration, vegetative buffers and conveyance, and retention / detention; and
- Natural Features and Resources Management – includes identification, protection, and restoration of natural features
- Recreation Promotion and Enhancement – includes program coordination and opportunity enhancement (parks, boat launches, trails, fishing spots).

The actions in these categories have specific details, including: the lead agency, the schedule, cost estimates, technical and financial assistance, the authority related to the action, any clarifying comments, permit requirement commitments (where appropriate), and applicability to the major stressors affecting the subwatershed.

As with any plan that is part of an adaptive management scheme, this WMP contains procedures for its evaluation and revision. Evaluation measures fall into six levels:

1. Compliance with Activity-Based Permit Requirements;
2. Changes in Knowledge/Awareness;
3. Behavioral Change / BMP Implementation;
4. Load Reductions;
5. Changes in Discharge Quality; and
6. Changes in Receiving Water Quality.

The evaluation measures in the six categories are also classified as: 1) a measure of activity completions (including milestones), 2) a measure of usage, or 3) a measure of change.

The data to drive the evaluations will come from various existing and additional volunteer programs. The assessment of the various measures (including checking achievement of goals and objectives) will drive the modifications and revisions to the WMP.

The implementation of the WMP (actions, evaluation, and revision) will be through the SWAG and its individual members. The SWAG will continue its current voluntary structure but will consider alternate organizational structures and funding mechanisms and will initiate them as appropriate for the most effective implementation.

Watershed planning is meant to be an iterative process that provides for continuous input and revision of procedures, processes, and products. It is 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.

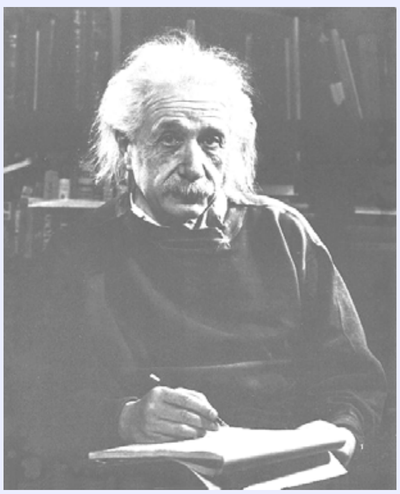
This WMP is a living document and is meant to be used, revised, and altered to fit the changing needs of the subwatershed as new information becomes available and new priorities arise.

1. Introduction

Quotable Quotation

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

- Albert Einstein



Clinton River Watershed

The Clinton River Watershed includes portions of Macomb, Oakland, St. Clair, and Lapeer Counties. Historic drainage areas in Wayne County no longer drain to the Clinton River.

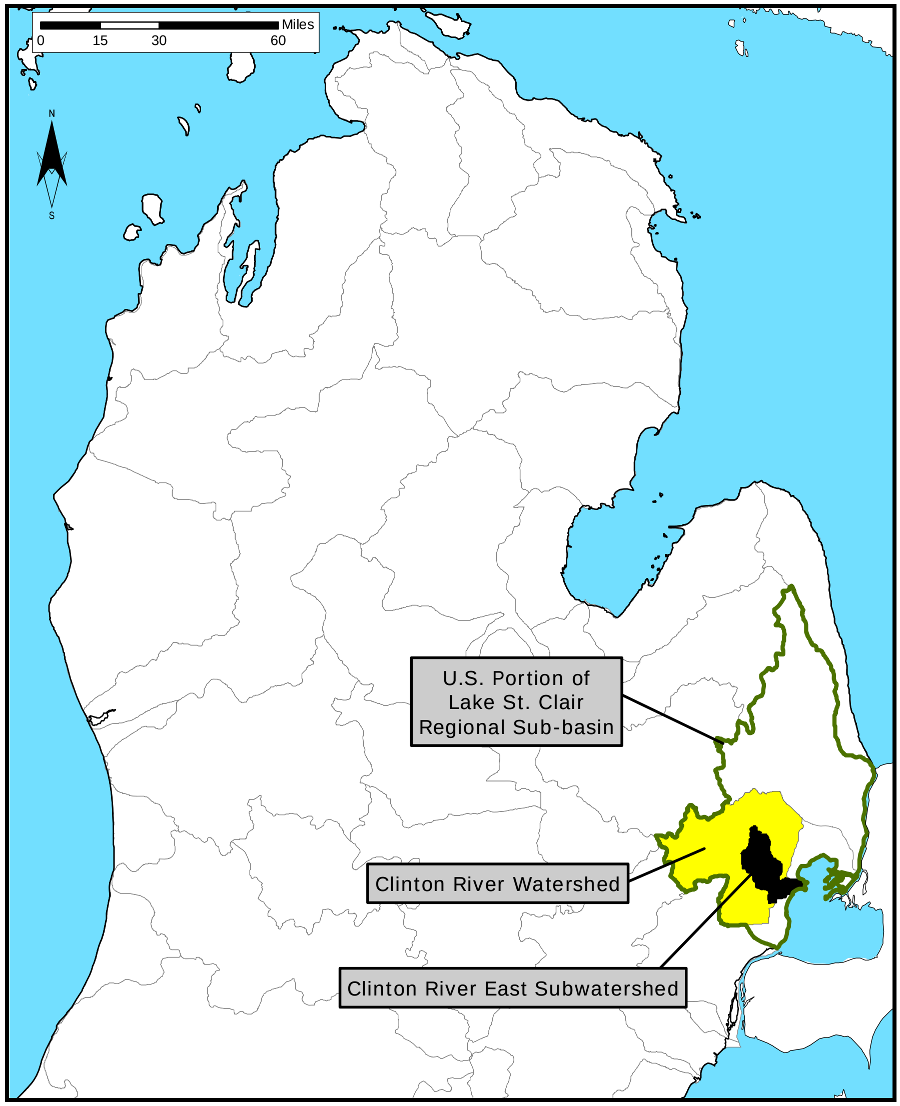
Acronyms and Terms

A complete list of acronyms and terms and their respective definitions can be found in Appendix A.

Geographic Scope

The Clinton River East Subwatershed (CREW), shown in Figure 1-1 is a hydrologically-based, Michigan Department of Environmental Quality (MDEQ)-approved basin of the Clinton River Watershed located in Southeast Michigan.

Figure 1-1. Location of Clinton River East Subwatershed.



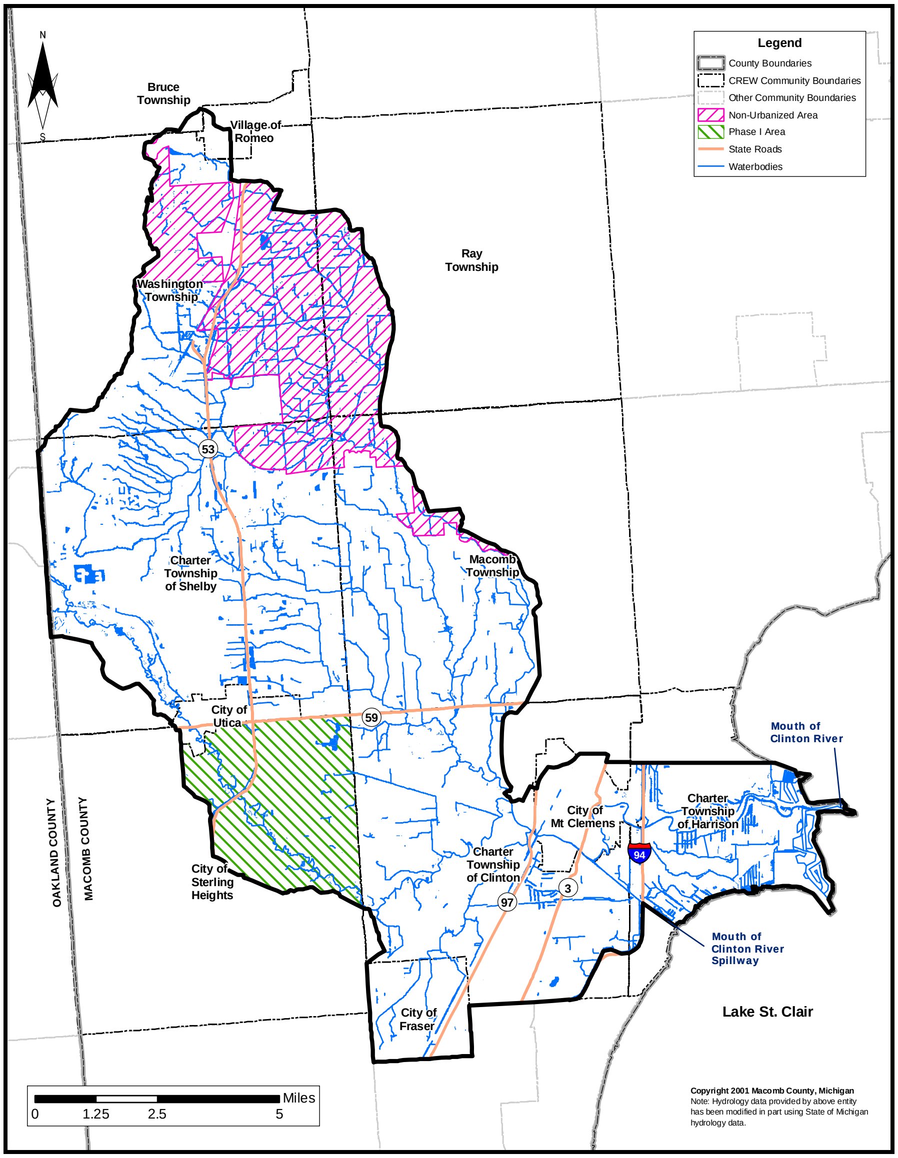
Communities

The CREW includes all or part of twelve Macomb County communities as shown in Figure 1-2. See Table 1-1 for characteristics of these communities.

Drainage Areas

The subwatershed covers approximately 132 square miles and consists of seven drainage areas that are based on the topographically-derived United States Geological Survey (USGS) / Natural Resources Conservation Service (NRCS) classification system (see additional discussion later in chapter). A map showing the drainage areas is presented in Figure 1-3.

Figure 1-2. Subwatershed communities.



Clinton River East Subwatershed

The CREW extends from the Lake St. Clair shore in the Charter Township of Harrison northwest to the Village of Romeo. Runoff from this area drains to the Clinton River and Clinton River Spillway; or directly into Lake St. Clair in the vicinity of the mouths of the Clinton River and Clinton River Spillway (see Figure 1-2).

Regulated Areas

The NPDES Phase II program, discussed later in this chapter, regulates all urbanized areas (as defined by the U.S. Census) operating a separate storm sewer system. This includes all areas of the subwatershed except for the following:

- Sterling Heights (covered under NPDES Phase I);
- Portions not considered 'urbanized area' (shown as 'Non-Urbanized Area' in Figure 1) - Tables 1 and 2 contain more detailed information; and
- A small portion of the City of Mt. Clemens, which is served by combined sewers (this area is not shown).

Table 1-1. Subwatershed communities.

Community	Community Size (sq. miles)	Percent of Community in Subwatershed	Total Area in Subwatershed (sq. miles)	Urbanized Area (sq. miles)	Non-Urbanized Area (sq. miles)
Bruce Township	36.40	0.5%	0.17	0.17	---
Clinton, Charter Township of	28.21	84.4%	23.80	23.80	---
Fraser, City of	4.17	100.0%	4.17	4.17	---
Harrison, Charter Township of	14.97	71.4%	10.69	10.69	---
Macomb Township	36.50	48.5%	17.72	15.82	1.90
Mt. Clemens, City of	4.21	91.0%	3.83	3.83	---
Ray Township	36.62	13.0%	4.78	---	4.78
Romeo, Village of	2.00	22.1%	0.44	0.44	---
Shelby, Charter Township of	35.18	91.6%	32.21	30.37	1.84
Sterling Heights, City of	36.69	29.3%	10.74	10.74	---
Utica, City of	1.72	100.0%	1.72	1.72	---
Washington Township	35.95	58.4%	21.00	9.37	11.63
Total	---	---	**131.27**	**111.12**	**20.15**

Source: SEMCOG, 2004.

Hydrologic Boundaries

As depicted in Figure 1-3 the CREW includes land area that does not drain through the mouth of the Clinton River. This land area either drains directly to Lake St. Clair or to Lake St. Clair through the Clinton River Spillway.

The southern boundary of the subwatershed has been modified slightly from the MDEQ provided boundary. The boundaries in the Charter Townships of Clinton and Harrison have been changed to coincide with I-94 and the Clinton River Spillway (as shown in Figure 1-3).

Municipality Names

The municipality names used in this chapter reflect the actual legal names of the entities. In the remaining chapters of the plan, the names have been truncated to more commonly used variations (where appropriate). For example, the 'Charter Township of Clinton' is referred to as 'Clinton Township' and the 'City of Fraser' is referred to as 'Fraser'.

Figure 1-3. Subwatershed drainage areas.

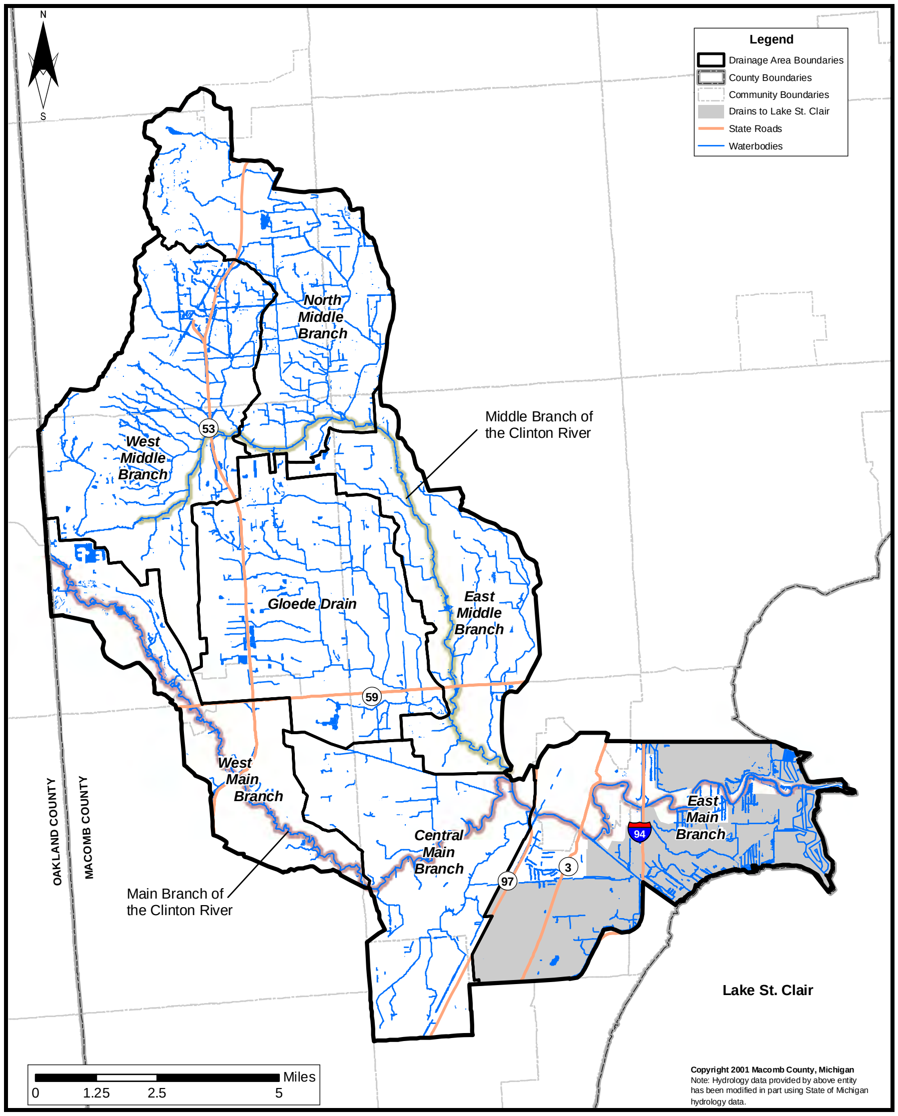


Table 1-2 presents a breakdown of the drainage areas with respect to the subwatershed and the communities.

Table 1-2. Subwatershed drainage areas.

Drainage Area	Bruce Township	Clinton, Charter Township of	Fraser, City of	Harrison, Charter Township of	Macomb Township	Mt. Clemens, City of	Ray Township	Romeo, Village of	Shelby, Charter Township of	Sterling Heights, City of	Utica, City of	Washington Township	Total Area (square miles)	Percent of Subwatershed
Gloede Drain	---	1.54	---	---	5.60	---	---	---	12.36	1.14	1.17	---	**21.81**	16.6%
Central Main Branch	---	11.26	4.17	---	---	---	---	---	---	2.27	---	---	**17.69**	13.6%
East Main Branch	---	7.88	---	10.69	---	3.83	---	---	---	---	---	---	**22.40**	17.1%
West Main Branch	---	0.04	---	---	---	---	---	---	5.03	7.33	0.55	---	**12.95**	9.9%
East Middle Branch	---	3.09	---	---	11.45	---	0.01	---	0.44	---	---	---	**14.99**	11.4%
North Middle Branch	0.17	---	---	---	0.66	---	4.76	0.44	2.08	---	---	11.29	**19.40**	14.8%
West Middle Branch	---	---	---	---	---	---	---	---	12.31	---	---	9.71	**22.02**	16.8%
Total (square miles)	**0.17**	**23.80**	**4.17**	**10.69**	**17.72**	**3.83**	**4.78**	**0.44**	**32.21**	**10.74**	**1.72**	**21.00**	**131.27**	**100.0%**
Percent of Subwatershed	0.1%	18.1%	3.2%	8.1%	13.5%	2.9%	3.6%	0.3%	24.5%	8.2%	1.3%	16.0%	**100.0%**	---

Congressional Districts

The people of the subwatershed are represented in the United States House of Representatives through Michigan's 10th and 12th Congressional Districts. A map showing the districts is presented as Figure 1-4.

Table 1-3 presents the district information on a community basis and includes state-level information (not pictured).

Figure 1-4. Congressional districts.

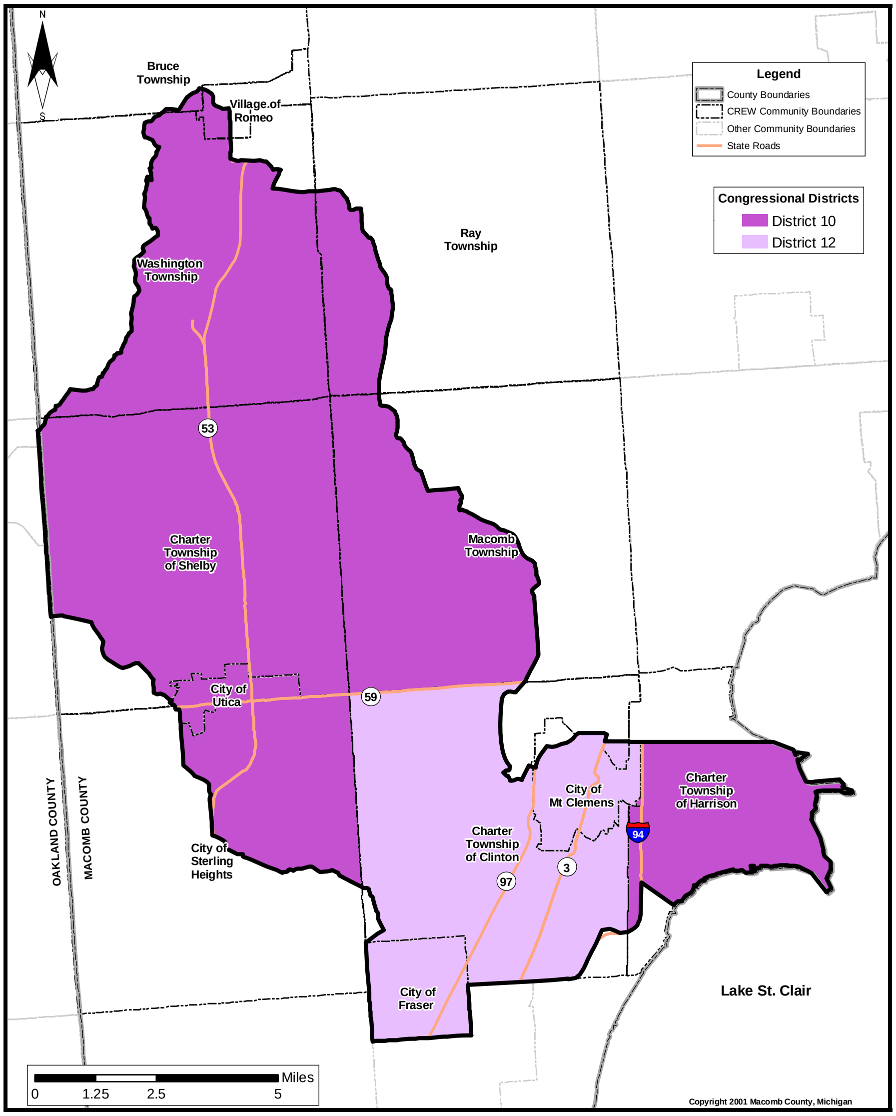


Table 1-3. Congressional districts by community.

Community	Congressional District	State House District	State Senate District
Bruce Township	12	36	11
Clinton, Charter Township of	10	31/33	10
Fraser, City of	10	31/42	9
Harrison, Charter Township of	12	24	11
Macomb Township	12	33	11
Mt. Clemens, City of	10	31	11
Ray Township	12	33	11
Romeo, Village of	12	36	11
Shelby, Charter Township of	12	36	11
Sterling Heights, City of	12	30	10
Utica, City of	12	25/30	10
Washington Township	12	36	11

U.S. Capitol Building – Washington D.C.

Michigan Capitol Building – Lansing, Michigan

Federal and State-Level Representatives (as of 10/06)

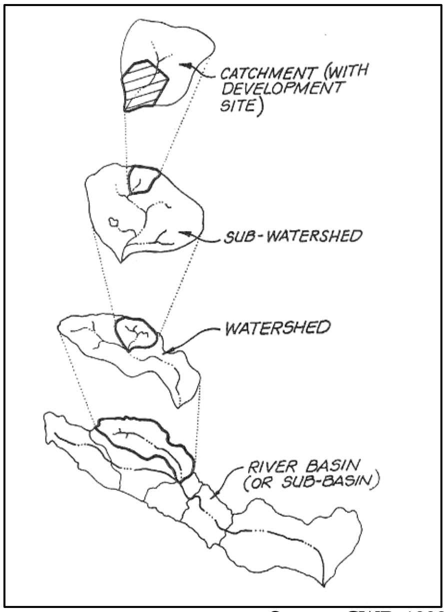
U.S. Senate
Carl Levin
Debbie Stabenow

U.S. House of Representatives
10th District – Candice Miller
12th District – Sander Levin

Michigan Senate
9th District – Dennis Olshove
10th District – Michael Switalski
11th District – Alan Sanborn

Mich. House of Representatives
24th District – Jack Brandenburg
25th District – Steve Bieda
30th District – Tory Rocca
31st District – Fred Miller
33rd District – Leon Drolet
36th District – Brian Palmer
42nd District – Frank Accavitti

Drainage Areas



Source: CWP, 1998.

The Great Lakes Basin

Watershed Science

A drainage area, commonly referred to as 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 document, a number of terms are used to describe the various classifications of drainage areas. The most commonly encountered system is the USGS / NRCS system. This system classifies drainage areas as follows (using the Hydrologic Unit Code [HUC] system):

USGS/NRCS Hydrologic Units	Local Example	Local HUC
Regional (2-digit code)	Great Lakes	(04)
Subregional (4-digit code)	St. Clair System	(0409)
Accounting (6-digit code)	*- same area as above -*	(040900)
Cataloging (8-digit code)	Clinton River	(04090003)
Watershed (10-digit code)	CREW*	(0409000312)
Subwatershed (12-digit code)	East Main Branch*	(040900031241)

* Note: *The areas delineated for this plan do not perfectly coincide with the boundaries defined by the USGS/NRCS HUC system. The 12-digit areas utilized in this plan have been modified to account for man-made changes to drainage patterns (e.g., storm sewer systems) and the 10-digit area has been defined by the MDEQ with management purposes in mind (eastern portions that drain directly to Lake St. Clair have been included).*

An example of how drainage systems nest within each other is shown in the 'Drainage Areas' figure on the left-hand side of the page.

The area commonly referred to as the 'Clinton River Watershed' is actually a 'Cataloging Unit'. However, for the purposes of this plan, the naming conventions have been modified to adhere to local customs and traditions. The adopted naming conventions to be used throughout this plan are:

USGS/NRCS	Local Naming Convention	Local Example
(2-digit code)	**Regional Basin**	Great Lakes Basin
(4-digit code)	**Regional Sub-basin**	Lake St. Clair Sub-basin
(6-digit code)	*-- not used as it covers the same area as above --*	
(8-digit code)	**Watershed**	Clinton River Watershed
(10-digit code)	**Subwatershed**	CREW
(12-digit code)	**Catchment**	East Main Branch
-- *none**	**Sub-catchment**	Subdivision

* Note: *14-digit codes exist and are in the process of being refined but have not been utilized during the development of this plan.*

Regional Basins are the largest drainage areas typically utilized for management type activities (examples include the Great Lakes and Mississippi River; larger areas such as ocean basins are not practical management areas). The **Regional Sub-basins** comprising these drain to major receiving waters such as a large river, estuary or lake (such as Lake Michigan or the Missouri River). Within each **Regional Sub-basin** are a group of **Watersheds**, that are a mosaic of many diverse land uses, including forest, agriculture, range and urban areas. **Watersheds** are composed of a group of **Subwatersheds**, which, in turn, are composed of a group of **Catchments**. Within **Catchments** are **Sub-catchments**, which are the smallest units in a watershed, defined as the area that drains an individual or group of parcels to the first intersection with a waterbody or storm sewer catch basin.

Current Approach to Control Water Pollution

National Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System (NPDES) is a cornerstone of environmental protection at the federal level. When the NPDES was established in 1972 (under the Clean Water Act), only one third of our rivers, lakes, and coastal waters were considered fishable and swimmable. Today, approximately two thirds of our waters are healthy. This is due in no small part to the regulation of more than 50 categories of industry (including several hundred thousand businesses) and the nation's network of more than 16,000 municipal sewage treatment systems. The NPDES permits that regulate discharges from these facilities have resulted in the prevention of billions of pounds of conventional pollutants (e.g. suspended solids) and millions of pounds of toxic pollutants (e.g. dissolved heavy metals) from being discharged into 'waters of the United States' (EPA, 2001).

In 1990, the Environmental Protection Agency (EPA) promulgated Phase I of the stormwater rules of the NPDES. This required municipal separate storm sewer systems (MS4s) in areas with 100,000 or more people to regulate the quality of stormwater discharges to waters of the United States. As previously noted, the City of Sterling Heights is regulated under Phase I.

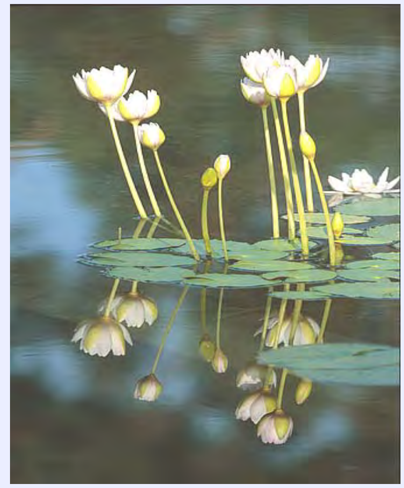
In 1999, the EPA promulgated Phase II of the NPDES stormwater rules. The Phase II requirements expand the coverage of MS4s to include those in urbanized areas (as defined by the U.S. Census) not previously covered under Phase I. The urbanized area of the CREW includes the entire subwatershed except for the area in Figure 1-2 denoted as 'Non-Urbanized Area'.

Michigan is one of forty-five states and territories authorized to implement the NPDES program. In implementing the Phase II requirements, the MDEQ has developed the NPDES General Permit No. MIG619000 for Coverage of Storm Water Discharges for Municipal Separate Storm Sewer Systems Subject to Watershed Plan Requirements (Appendix B). To date, this is the only instance of a watershed-based permitting approach under the NPDES program. The MDEQ has also developed a jurisdictional-based approach: NPDES General Permit No. MIS040000 for Coverage of Storm Water Discharges from Municipal Separate Storm Sewer Systems with Controls Based on Six Minimum Measures. This approach involves communities working independently to address stormwater discharges through: 1) Public Education and Outreach, 2) Public Participation / Involvement, 3) Illicit Discharge Detection and Elimination, 4) Construction Site Runoff Control, 5) Post- Construction Runoff Control, and 6) Pollution Prevention / Good Housekeeping.

Development of the Watershed Management Plan

By March 10, 2003 the CREW municipalities were required to submit an application to seek permit coverage. Acting as the CREW Subwatershed Advisory Group (SWAG), the communities filed to obtain coverage under General Permit No. MIG619000 requiring them to develop a watershed management plan (WMP). As such, the communities have all received Certificates of Coverage with stipulations for implementing various activities. The submittal due date for this WMP is November 1, 2006.

State of Michigan Symbol of Water Quality



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.

One Vision

Incorporating the numerous and diverse requirements of the various programs and permits, the resultant plan has this one main purpose:

"To improve and protect the ecological, hydrological, and cultural resources of the Clinton River East Subwatershed."

Additional WMP Elements

In attempting to make the WMP as robust as possible, this plan has been developed to meet the elements of a number of additional programs, including:

- the Clean Michigan Initiative (CMI) bond grant program (1998 Mich. Public Act 284);
- the EPA Section 319 National Nonpoint Source Monitoring Program grant requirements;
- the EPA Great Lakes National Program Office grant requirements; and
- other Federal and State requirements for implementing the Clinton River Remedial Action Plan.

Waters of the U.S.

The EPA defines these as:

- Navigable waters;
- Tributaries of navigable waters;
- Interstate waters; and
- Intrastate lakes, rivers, and streams which are:
  - Sources of fish or shellfish sold in interstate commerce;
  - Used by interstate travelers for recreation and other purposes; or
  - Utilized for industrial purposes by industries engaged in interstate commerce.

Source: EPA, no date.

Benefits of the Watershed Management Plan Approach

Some benefits of the watershed approach include: access to grant funding; sharing of resources, expenses, products, information, and techniques; expanded schedules for watershed management planning, and choices on how and when implementation will occur. A watershed approach involves coordinated efforts with both public and private sectors focusing efforts to address the highest priority problems.

Requirements of the Watershed Management Plan

As described in NPDES General Permit No. MIG619000, 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.

Water Pollution Control in Michigan and the U.S.

The first formal water pollution control efforts came at the state level with the passage of Public Act 98 of 1913 which established the Health Department and required large communities to: 1) control and treat sewage, and 2) treat and distribute drinking water. The Conservation Department (today's Department of Natural Resources) was created by Public Act 17 of 1921 to help deal with flagrant and gross pollution of water as well as to protect other natural resources (Sweet, 2006).

The state established the Stream Control Commission in 1929 (Public Act 245) as the official pollution control agency of the state. However, the agency had little influence and any progress made during the 1930s was generally in response to outcries from urban populations that had to deal with the conditions caused by rampant pollution and raw sewage discharge into nearby waterbodies. The Commission wasn't recognized as a strong force until it won two court orders for enforcement in 1939 and 1940. The Commission was renamed the 'Water Resources Commission' in 1949 by Public Act 245 which also expanded the definition of pollution and required approval for all new uses of state waters (Sweet, 2006).

At the federal level, water pollution control programs were initiated by the **1948 Water Pollution Control Act**, which focused on protection of human health, not the environment. The Act allotted funds to state and local governments for water pollution control, placing emphasis on the States' role in controlling and protecting water resources, with few, if any, federal goals, objectives, limits, or guidelines.

Congress became increasingly interested in water quality degradation from 1956 through 1966, and passed four laws to strengthen the federal role in water pollution control, including the **Water Pollution Control Act Amendments of 1956** and the **Federal Water Pollution Control Act Amendments of 1961**. These initiatives focused on giving additional funding to municipalities for constructing wastewater treatment works.

During this time, the State's Water Resources Commission instituted the first periodic water quality monitoring program. In addition, the Water Resources Commission was incorporated into the newly renamed Department of Natural Resources in 1965 and the legislature amended Act 245 to further regulate pollution and raw sewage discharge (Sweet, 2006).

The federal **Water Quality Act of 1965** represented a major regulatory advancement in water pollution control by requiring States to develop water quality standards for interstate waters by 1967. Michigan established minimum water quality standards for other state waters in 1968. The Water Quality Act also called for States to develop waste load allocations to quantify pollutant loadings that could be discharged without exceeding the water quality standards. Despite increasing public concern and increased public spending, only about half of the States developed water quality standards by 1971. Furthermore, enforcement of the federal legislation was minimal and there were no criminal or civil penalties to enforce the regulation.

The lack of success in developing adequate water quality standards programs, along with growing concern about the environment, prompted President Nixon to form the United States Environmental Protection Agency (EPA) in 1970 to enforce environmental compliance and consolidate federal pollution control activities. In 1972 (and again in 1978), the United States and Canada signed the Great Lakes Water Quality Agreement establishing the Great Lakes Water Quality Board and committing to 'restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem'. In November of 1972, Congress passed a comprehensive recodification and revision of federal water pollution control law, known as the **Federal Water Pollution Control Act Amendments of 1972** (more commonly known as the 'Clean Water Act' or CWA), marking a distinct change in the philosophy of water pollution control in the United States. The Amendments contained requirements for water quality-based controls, with an emphasis on technology-based, or end-of-pipe, control strategies (EPA, no date). Michigan updated its water quality standards in 1973 to fully reflect the requirements of the CWA (Sweet, 2006).

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.

Goals and Principles of the Clean Water Act

The ambitious goals of the Clean Water Act include:

- "it is the national goal that the discharge of pollutants into navigable waters be eliminated by 1985";
- "it is the national goal that wherever attainable an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983"; and
- "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited".

Other important principles include:

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

Source: EPA, no date.

Special Laws / Programs

Specific situations may invoke numerous other federal, state, and local programs that directly or indirectly relate to storm water issues, including:

- The National Environmental Policy Act sets national policy for the environment and requires impact statements;
- The federal Safe Drinking Water Act establishes wellhead protection provisions that are implemented at the state or local level (MDEQ Water Wellhead Protection program);
- Coastal / shoreline areas have numerous federal laws such as the Coastal Zone Act and the Shoreline Erosion Protection Act, and state laws / programs such as Coastal Management, Sand Dune Protection, and Shoreland Management;
- Commercial/industrial sites have numerous laws and regulations to minimize environmental impacts. Laws include: the Surface Mining Control & Reclamation Act, the Resource Conservation and Recovery Act, the Federal Insecticide, Fungicide, and Rodenticide Act, and the Toxic Substances Control Act;
- The control of excessive aquatic plants and algae is regulated the Michigan Public Health Code;
- The River and Harbor Act of 1899 sets protocols for structural modifications to navigable waters;
- The federal Clean Air Act establishes state-enforceable emission standards of pollutants (some of which can degrade water quality);
- The federal 'Superfund' deals with the cleanup of abandoned hazardous waste sites;

Changes in 1987 replaced the construction grants program with the State Water Pollution Control Revolving Fund, more commonly known as the SRF. This new funding strategy addressed water quality needs by building on EPA-State partnerships.

Since passage of the CWA, numerous International, Federal, State (e.g. water quality standard updates), Regional, and Local actions have enhanced the control of water pollution in the CREW. These specific actions are discussed more thoroughly in Chapter 4 (along with a discussion of water quality trends), but some important programs are discussed briefly in the following sections.

Relevant State Laws

Natural Resources and Environmental Protection Act

Act 451 of 1994, the Natural Resources and Environmental Protection Act (NREPA), is designed to protect the environment and natural resources of the state by: regulating pollutant discharges; regulating land, water, and resource use; and prescribing penalties and remedies for violations.

Notable parts of the act relating to stormwater include: Part 17 – Environmental Protection; 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; Part 305 – Natural Rivers Act; Part 307 – Inland Lake Levels; Part 309 – Inland Lake Improvement; Part 315 – Dam Safety; and Part 323 – Shorelands Protection and Management..

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). It should be noted that the Macomb County Public Works Office (MCPWO) contends that county drains established before 1973 are exempt from certain state permits even though they are waters of the state.

Relevant State Programs and Regulations

Water Quality Standards

Under the auspices of the CWA and NREPA, the MDEQ defines water quality standards "to protect the Great Lakes, the connecting waters, and all other surface waters of the state" (MDEQ, 2006). Water quality standards are discussed in greater detail in Chapter 4.

The Total Maximum Daily Load Program

MDEQ regulations (as authorized by the EPA under the CWA) require that "when a lake or stream does not meet water quality standards, a study must be completed to determine the amount of a pollutant that can be put in a waterbody from point sources and nonpoint sources and still meet water quality standards, including a margin of safety" (MDEQ, 2006). Any Total Maximum Daily Loads (TMDLs) relevant to this subwatershed are addressed in Chapter 8 (see Action 1-8).

Permits

Despite the NPDES permitting process that covers stormwater-specific issues, other permits may be required for a specific cases. Many state and federal permits are covered under the MDEQ/USACE Joint Permit Application package. The application 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 application include: the Sewerage System Construction Permit and the Groundwater Discharge Permit.

Other Programs

State programs that directly enforce and assist in compliance with federal and state stormwater 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 stormwater related projects include: the SRF, the Strategic Water Quality Initiative Fund, and the CMI.

Supported Plans and Programs

It is imperative to support the goals and objectives of other plans and programs affecting the CREW to ensure a cohesive management strategy and eventual progress in plan implementation.

St. Clair River and Lake St. Clair Comprehensive Management Plan

The comprehensive management plan was issued in 2004 by the USACE with assistance from the Great Lakes Commission. This joint effort between U.S. federal, state, and local, and Canadian federal and provincial authorities does four things with respect to the Lake St. Clair Regional Sub-basin:

- identifies the causes and sources of environmental degradation;
- addresses the continuous monitoring of contamination levels;
- provides for timely dissemination of information; and
- includes recommendations for potential restoration measures.

In providing cohesion between the two efforts, various elements of the plan influenced the content and structure of this document.

Clinton River Watershed Remedial & Preventative Action Plan

The Remedial Action Plan (RAP) for the Clinton River Watershed was first developed by the Michigan Department of Natural Resources (MDNR) in 1988 in response to the Clinton River being listed as an Area of Concern (AOC) by the Great Lakes Water Quality Board of the International Joint Commission in 1985.

In 1995, the RAP (now a Remedial and Preventative Action Plan) was updated (by the Clinton River Public Advisory Council) to include the entire Clinton River Watershed and the nearshore area of Lake St. Clair impacted by the Clinton River and the Clinton River Spillway. A plan (consisting of 84 actions) was also prepared to address impairments as identified in Annex 2 of the Great Lakes Water Quality Agreement.

The current version of the RAP, issued in 1998, documents changes in the watershed, an updated list of actions (100), progress towards

Special Laws / Programs (continued)

- The Oil Pollution Act authorizes federal response mechanisms designed to prevent catastrophic oil spills and requires submittal of plans to the Coast Guard and EPA; and
- The Water Resources Development Act provides for the conservation and development of water and related resources and authorizes studies and construction of improvement projects for navigation, flood damage reduction, dredging, ecosystem restoration, and water supply.

Clinton River Area of Concern Information

For more information about the Clinton River Area of Concern, refer to the following Web site: http://www.epa.gov/grtlakes/aoc/clintriv.html.

International Joint Commission

Established by the Boundary Waters Treaty of 1909, the commission investigates and monitors transboundary issues when requested to do so by the governments.

Names

The Clinton River was originally called Nottawasippee by French settlers and Native Americans or the Huron River of St. Clair by the English. It was renamed for New York Governor DeWitt Clinton (1817-1823; 1825-1828) who is often referred to as the 'Father of the Erie Canal'.

Source: Wikipedia, 2006.

Lake St. Clair was originally called 'Lac Sainte Claire' by French settlers who first discovered it in 1679 on the day of the feast of Sainte Claire of Assisi. The name was later changed by government officials and map makers, perhaps in honor of the first governor of the Northwest Territory, General Arthur St. Clair.

Source: Bolsenga, 1993.

implementing the actions, and a new set of education related goals and recommendations.

In 2005, Restoration Criteria for the Clinton River AOC were developed. These criteria describe a pathway that, when competed, will result in the delisting of the area as an AOC.

In developing this document, numerous elements of the various RAPs and associated restoration criteria were considered.

Water Quality Management Plan for Southeast Michigan

The Water Quality Management Plan (WQMP) for Southeast Michigan was first prepared by the Southeast Michigan Council of Governments (SEMCOG) in 1978 and subsequently amended in 1979, 1981, and 1999. SEMCOG is the designated Areawide Water Quality Planning Agency for Southeast Michigan under the CWA and prepared the WQMP to assist the agencies and organizations that have a role in the stewardship of the region's water resources. To this end, the plan contains water quality management policies on a broad range of issues, including: infrastructure, monitoring, management, non-point source pollution, stormwater, pollution prevention, and public education.

The plan also contains regional goals and includes a guide to implementation. Additional implementation guidance was provided in the 2000 document *Putting Southeast Michigan's Water Quality Plan into Action: Tools for Local Governments*.

The WQMP and follow-up guidance has been considered in the development of this plan, specifically the elements related to regional goals and implementation.

Developing the Watershed Management Plan

Watershed Partners

The CREW SWAG spearheaded the efforts involved in developing this WMP. The SWAG was chaired by representatives from the Macomb County Public Works Office (MCPWO) and included representatives from:

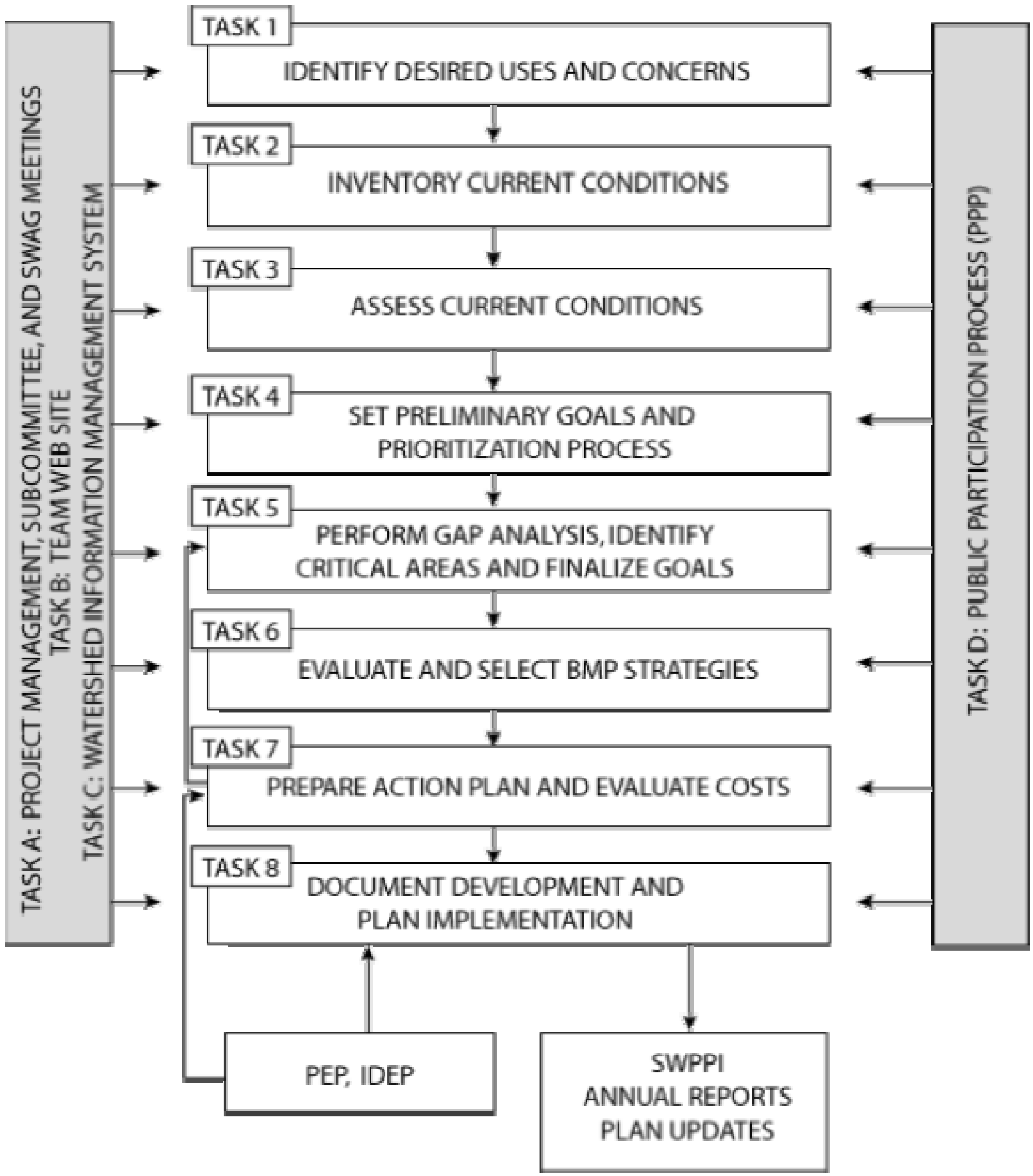
- each community in the subwatershed;
- each nested school district in the subwatershed (see the 'Nested Jurisdictions' sub-section);
- the Clinton River Watershed Council (CRWC);
- the Macomb County Health Department (MCHD);
- the Macomb County Department of Planning and Economic Development (MCPED);
- the Macomb County Soil Conservation District (MCSCD);
- the Road Commission of Macomb County (RCMC);
- the Southeast Michigan Council of Governments (SEMCOG);
- the MDEQ; and
- the USACE.

Refer to Appendix C for the contact list of the SWAG members.

Planning Process

The management plan was developed through an adaptive management process that had twelve distinct tasks (see Figure 1-5). Four of these tasks were continuous and denoted A, B, C, and D. The other eight were sequential and denoted 1, 2, 3, 4, 5, 6, 7, and 8. These tasks are discussed in the following topics.

Figure 1-5. Watershed management plan development.



Public Participation Process

The public participation process was designed to elicit input from the general public and subwatershed stakeholders through a series of meetings and workshops. The general public was invited to two 'Community Forums': one at the beginning of the planning process to help guide plan development and one near the end to gather feedback on the draft version of the plan. Other stakeholders, such as government representatives, were also invited to two 'Stakeholder Workshops': again, one at the beginning and one near the end. A 'Focus Group Meeting' was also held with local developers and builders to get their specific input into the planning process.

More detail on the meetings and workshops and the feedback received at each is documented in Chapter 4.

Important Feedback to be Considered: Combined Sewer Overflows

An important issue that came up at multiple public participation events is the impact of combined sewer overflows (CSOs) from upstream communities. It is important to note that although these communities are outside of the scope of this plan, they are involved in stormwater management which will play a role in controlling overflow events. Additionally, these CSO systems are closely regulated by the MDEQ and the communities are striving to ensure proper operation in accordance with appropriate regulations.

Task A: Meetings

This task consisted of monthly SWAG meetings, SWAG subcommittee meetings as necessary, and monthly project management meetings between representatives from the MCPWO, the consulting firm Tetra Tech, the USACE (until late 2005), and others as appropriate.

Task B: Website

Various websites were used to coordinate the planning process, disseminate information, and receive feedback. The EPA hosted the initial project management website. Tetra Tech hosted the website during the final year of the project. The CRWC website was used throughout the project for posting relevant public information and receiving comments.

Task C: Watershed Information Management System

A system for managing appropriate data for watershed planning was proposed and some work was initiated. However, this system was deemed more appropriate for development at the watershed level and has been incorporated in the Clinton River Watershed Initiative being executed through the Oakland County Drain Commissioner's Office with Tetra Tech as the primary contractor.

Task D: Public Participation Process

The public participation process (PPP) was extensive and essential to the development of the watershed management plan. The 'Public Participation Process' sidebar describes this task. Detailed information on the efforts to implement the PPP and the public comments received and used to craft this plan are detailed in Chapter 4.

Task 1: Identify Desired Uses and Concerns

This task involved evaluating the status of the State of Michigan's designated uses (see Chapters 3 and 5) and consolidating the information gathered during implementation of the PPP to identify desired uses for the subwatershed in addition to any specific concerns.

Task 2: Inventory Current Conditions

This task involved collecting and summarizing existing data about the subwatershed. This generally included information about the history, natural environment and water quality, the people, and the infrastructure. This information is presented in Chapters 1, 2 and 3.

Task 3: Assess Current Conditions

This task involved analyzing and presenting the data that was collected under Task 2 to facilitate planning decisions to be made throughout the project. This data is presented in Chapters 2, 3, and 5.

Task 4: Set Preliminary Goals and Prioritization Process

This task involved developing a list of preliminary goals for the watershed management plan based on the data, analyses, and public input generated through the previous tasks. Certain prioritization and decision-making processes were also developed (implicitly and explicitly) to assist in executing the remaining tasks. These processes are reported in various locations throughout the plan.

Task 5: Gap Analysis, Identify Critical Areas, and Finalize Goals

The gap analysis involved assessing the current level of watershed protection in the subwatershed and identifying the actions required to provide the necessary level of protection. This assessment is presented in Chapter 3. Additionally, current and future pollutant load calculations were performed and the areas of the watershed critical to controlling pollutant loads were identified. This information is presented in Chapter 5. Based on the preliminary goals developed under Task 4, the gap analysis, and critical area identification, the SWAG finalized the goals of the watershed management plan. The final goals of the plan, along with their associated objectives, are found in Chapter 6.

Task 6: Evaluate and Select BMP Strategies

The first step in performing this task was to develop a comprehensive list of the actions that could be implemented to achieve the goals and objectives of the watershed management plan. The contents of Chapter 7 were developed from this list. The next step was to select the appropriate actions presented in the comprehensive list as the ones which would actually be implemented by the entities in the subwatershed. This decision was made considering all of the information compiled and generated under the previous tasks.

Task 7: Prepare Action Plan and Evaluate Costs

Based on the actions that were selected for implementation, an action plan, or 'implementation roadmap', was developed. This roadmap is presented as Chapter 8 and includes such details as whether or not the action is a permit requirement, the schedule, milestones, the benefits of the actions, how the actions relate to the goals and objectives, cost estimates, implementation assistance required and potential sources, commitment levels, and the pollutant load reductions associated with the actions. This task also involved defining the evaluation mechanisms and revision procedures to update the plan in the future. This information is presented in Chapter 9.

Task 8: Document Development and Plan Implementation

This task involved assembling all of the information generated during the planning process into the various chapters previously mentioned, in addition to Chapter 10, which defines institutionalization mechanisms and funding options, and other components of the plan such as the appendices, the cover, and the front end items (e.g. table of contents). This task also included compliance with other permit requirements such as the public education plan and implementation, illicit discharge elimination plan and implementation, and stormwater pollution prevention initiative and annual report submittals. For logistical reasons, the implementation of the plan and future updates to the plan are considered to occur under this task.

A Critical Source of Sediment in the Subwatershed – Construction Site Runoff

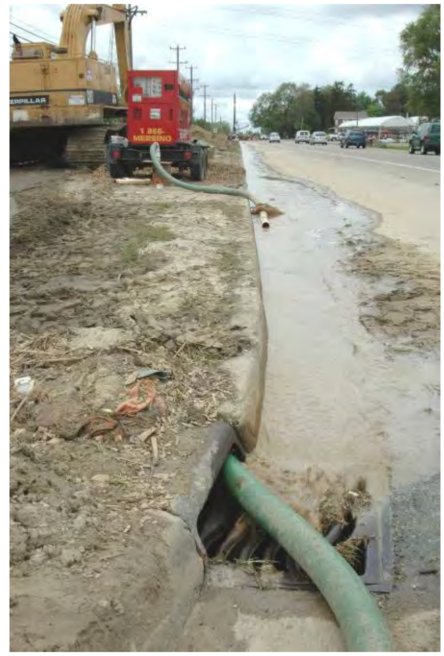


Photo courtesy of Tetra Tech.

The Planning Process in Action – A CREW SWAG Meeting

Photo courtesy of MCPWO.

Nested Jurisdictions

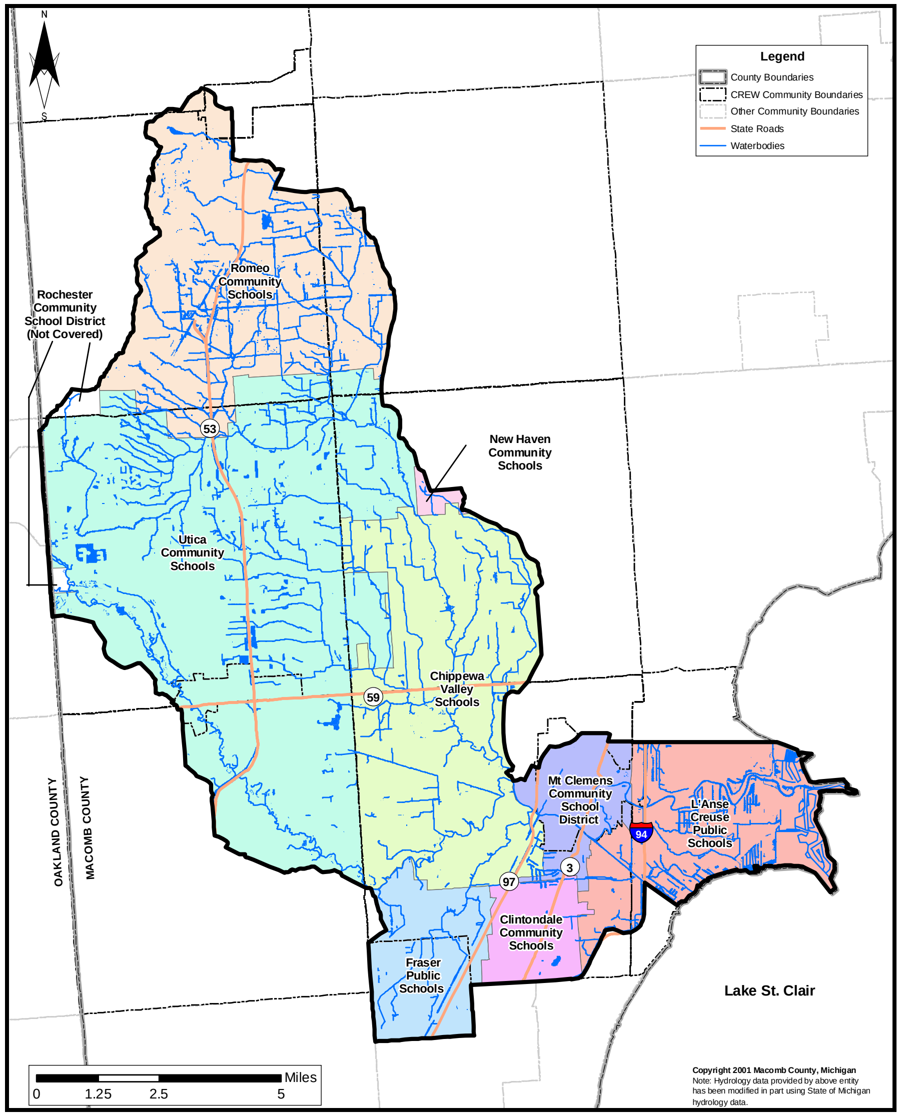
The nested jurisdictions in the subwatershed are associated with county-level government (except where noted) and include:

- Chippewa Valley Schools;
- Clintondale Community Schools;
- Fraser Public Schools;
- L'Anse Creuse Public Schools;
- Macomb Intermediate School District;
- Mt. Clemens Community School District (the City of Mt. Clemens);
- New Haven Community Schools;
- Romeo Community Schools; and
- Utica Community Schools.

Nested Jurisdictions

There exist additional facilities in the subwatershed that are covered by this plan (see the 'Nested Jurisdictions' sidebar). These facilities include those associated with the school districts that overlay the subwatershed (see Figure 1-6). The location of the actual schools can be seen in a figure in Chapter 2.

Figure 1-6. School districts in the subwatershed.



The Rochester Community School District is not covered by this plan as it has no facilities (and very little land area) in the subwatershed.

References

Bolsenga, S.J, and C.E. Herdendorf. 1993. "Lake Erie and Lake St. Clair Handbook." Wayne State University Press. Detroit, Michigan.

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

Environmental Protection Agency [EPA]. "Handbook for Developing Watershed Plans to Restore and Protect Our Waters." 2006.

Environmental Protection Agency [EPA]. "Protecting the Nations' Waters Through Effective NPDES Permits." June 2001. Washington, DC.

Environmental Protection Agency [EPA]. "Water Permitting 101." <no date>. Via: http://www.epa.gov/npdes/pubs/101pape.pdf.

Environmental Protection Agency [EPA]. "Water Quality Standards" website. Via: http://www.epa.gov/waterscience/standards/. Last accessed: March 22, 2005.

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

Michigan Department of Environmental Quality [MDEQ]. "TMDL Website." Via: www.michigan.gov. Last accessed: February 17, 2006.

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

Southeast Michigan Council of Governments [SEMCOG]. "Community Profiles". Via: http://www.semcog.org/cgi-bin/comprof/profiles.cfm. Last accessed: December 21st, 2004.

Sweet, Bob. Document provided at meeting. Starts with pg. 9 'Chapter Three: Summary of Water Quality Conditions and Pollution Control Efforts in Michigan – Past, Present, and Future'. 2006.

Wikipedia. Website. Via: http://en.wikipedia.org/wiki/DeWitt_Clinton. Last accessed: June 19th, 2006.

Pictures

U.S. Capitol Building
http://www.aoc.gov/cc/capitol/c_wf_1.cfm

Michigan Capitol Building
http://www.civics-online.org/library/formatted/images/micapitol.html

The Great Lakes Basin
http://www.great-lakes.net/lakes/basinMap2.gif

DeWitt Clinton
http://www.alexanderhamiltonexhibition.org/gallery/clinton_d.html

Arthur St. Clair
http://www.earlyamerica.com/portraits/images/stclair.jpg

2. Inventory of the Subwatershed

Introduction

This chapter provides pertinent background information about the natural environment, population demographics, and infrastructure in the subwatershed. This information is important in the adaptive management scheme of watershed planning. It defines the baseline conditions in the subwatershed and will be used in analyses presented in later chapters of this plan and to support implementation of this plan in the future.

The Natural Environment

The natural environment generally describes all living and non-living features that define a given place. In this section of the chapter, a discussion of the natural environment is presented that includes an introduction to many of these features.

Climate

Climate is defined as the meteorological conditions, including temperature, precipitation, and wind, which prevail in a region. The climate of the Clinton River East Subwatershed (CREW) is a temperate one that shows variations between summer and winter conditions.

Data Sources

Temperature and rainfall data is an aggregate from ten southeast Michigan counties for 1931-2000. Snowfall data is an average of 30-year means for stations in Mt. Clemens and Detroit. Extremes are taken from the Mid-west Regional Climate Center website. Wind data is from a station in Detroit from 1930-1996.

Temperature

The temperature in southeast Michigan is seasonal, with a difference of 49°F between the highest and lowest average monthly temperature.

Table 2-1 presents the low, mean, and high average monthly temperatures.

The record high temperature in the region is 105 °F on July 9th, 1936. The record low is -22 °F on February 9th, 1934 (MRCC, 2005).

In comparing the data from the last 30 years to the entire set (1931-2000), no major warming or cooling trends in temperature were identified.

Table 2-1. Climatic data for the subwatershed.

Month	Avg. Monthly Temperature (°F)			Avg. Monthly Precipitation* (inches)			Avg. Monthly Snowfall** (inches)			Prevailing Wind Direction	Average Wind Speed (mph)	Peak Gust Wind Speed*** (mph)
	Low	*Mean*	*High*	*Low*	*Mean*	*High*	*Mean*	*High*	*Day*			
January	12.8	23.7	35.5	0.12	1.83	4.44	11.3	34.2	14.7	WSW	12	66
February	13.4	25.2	36.7	0.09	1.71	5.14	8.9	28.5	12.0	SW	12	51
March	24.7	34.3	45.5	0.00	2.30	5.59	6.1	21.2	13.7	WNW	12	60
April	39.5	46.2	54.9	0.40	3.03	5.46	1.6	9.0	5.0	SW	12	64
May	50.0	57.8	67.1	0.33	3.12	7.66	trace	1.1	1.1	NE	10	58
June	61.8	67.6	73.3	0.22	3.38	8.15	0.0	0.0	0.0	SW	9	56
July	77.1	72.1	79.1	0.00	2.96	9.21	0.0	0.0	0.0	SW	9	59
August	65.3	70.2	77.2	0.37	3.15	10.43	0.0	0.0	0.0	SW	8	47
September	58.1	62.8	69.6	0.00	2.92	7.52	0.0	0.0	0.0	SW	9	54
October	45.7	51.6	62.7	0.00	2.42	8.54	0.2	0.8	2.7	SW	10	56
November	32.9	39.1	49.5	0.43	2.44	6.16	2.2	12.3	10.0	WSW	11	58
December	18.0	28.1	39.7	0.14	2.20	6.00	10.6	34.9	18.4	SW	11	59
Annual	---	---	---	**15.86**	**31.46**	**40.54**	**40.8**	**74.0**	---	---	---	---

* - Includes snowfall. ** - As a general rule, divide the snowfall amount by ten to convert to equivalent inches of rainfall. 'Day' indicates the maximum amount of snowfall ever recorded for one day in the month. *** - As recorded.

Source: NOAA; NCDC, 1998; NCDC, 2002; MRCC, 2005.

Precipitation

The average annual precipitation in southeast Michigan is 31.46 inches. It is distributed somewhat seasonally, with a difference of approximately 1.7 inches between the lowest and highest average monthly precipitation. A portion of this precipitation typically occurs as snowfall in October through April (and sometimes May).

Table 2-1 presents the low, mean, and high average monthly precipitation. The record 1-day rainfall in the region is 5.13 inches on July 19th, 1976.

The average yearly precipitation for the period of 1971-2000 is 1.4 inches greater than the 1931-2000 average with most of the increase occurring in the late summer months. This does not necessarily imply a trend in precipitation as it may merely be a statistical fluctuation.

Wind

In general, the wind in the region tends to come from the southwest. The average wind speed for the winter months is up to 4 mph faster than the summer months and the highest wind gusts also occur during the winter.

Table 2-1 presents this information, including prevailing direction, speed, and peak gust speed.

Geology, Topography, and Soils

Historical climatic conditions have been a driving force in defining the current geology of the CREW. In this plan, the discussion of geology includes a brief geologic history and the current topographical and soil characteristics of the subwatershed.

Geologic History

Michigan has been subjected to four glacial periods: Wisconsian, Illinoian, Nebraskan, and Kansian. The last of these, the Wisconsian, began 110,000 years ago, peaked 20,000 year ago and ended about 10,000 years ago (Smith, 2002). It is this glacial period that is responsible for much of the development of Michigan's underlying geology.

The CREW lies along the western edge of what is known as the "Maumee Lakeplain". This is a plain of fine sediments that were deposited over 11,000 years ago on the bottom of a series of glacial lakes that covered portions of Michigan, Ohio and Ontario. It is characterized by the presence of broad glacial drainage-ways of sandy soil, water-lain moraines (low-lying landforms where the glaciers and glacial lakes were in contact), and beach ridges of the former lakes that in some cases can still be identified inland of existing shorelines. Although difficult to identify today due to centuries of natural erosion, the Mt. Clemens water-lain moraine forms portions of the eastern edge of the subwatershed (Smith, 2002; GLC, 2005).

The highland areas in the northwest portion of the subwatershed are part of the "Fort Wayne – Defiance Moraines", a series of end moraines that formed at the stationary front of a glacier where till was continuously deposited.

The glacial activities in the region defined a diverse landscape through the erosion of existing landforms and the subsequent deposition of these eroded materials. The major depositional types include:

- Glacial till – poorly sorted and poorly rounded material ranging in size from pebbles to boulders;
- Glacial outwash – finer material deposited by glacial melt water; &

Effects of the Great Lakes

The lakes moderate the temperatures of the surrounding land, cooling the summers and warming the winters. This results in a milder climate compared to other locations of similar latitude. The lakes also act as a giant humidifier, increasing the moisture content of the air throughout the year.

Source: GLIN, 2005.

24-hour Storm Events

The percentages below are the chance that the given 24-hour rainfall will be exceeded in a 1-year period. For example, there is a 50% chance that it will rain at least 2.26 inches in one 24-hour period during any given year.

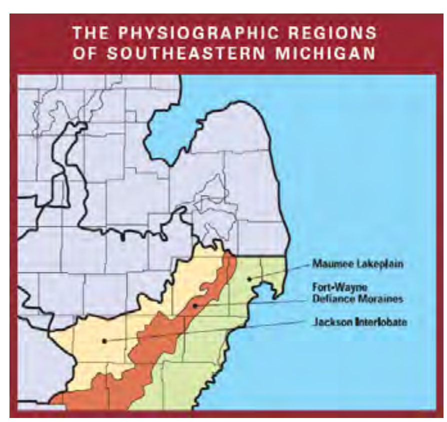
50% = 2.26 in.	4% = 3.60 in.
20% = 2.75 in.	2% = 3.98 in.
10% = 3.13 in.	1% = 4.38 in.

Source: Huff and Angel, 1992.

Average Annual Runoff

The average annual runoff in the subwatershed approximately ranges from 11 inches/year in the northwestern portion to 7 inches/year near the lake.

Source: USGS, 1986.



Source: Smith, 2002.

Soil Associations

Belleville-Pipestone-Wixom (BPW)

Nearly level to gently sloping, somewhat poorly drained soils that are coarse textured or moderately coarse textured throughout; on outwash plains and lake plains.

Cohoctah-Shoals-Sloan (CSS)

Nearly level, poorly drained and somewhat poorly drained soils that are moderately coarse textured or medium textured throughout; on flood plains.

Conover-Brookston-Parkhill (CBP)

Nearly level to gently sloping, somewhat poorly drained and poorly drained soils that have a moderately fine textured and medium-textured subsoil; on uplands.

Hoytville-Nappanee-Blount (HNB)

Nearly level to gently sloping, poorly drained and somewhat poorly drained soils that have a dominantly fine textured subsoil; on uplands.

Lenawee-Toledo-Fulton (LTF)

Nearly level, poorly drained soils that have a moderately fine textured to moderately coarse textured subsoil; on lake plains.

Marlette-Capac-Parkhill (MCP)

These soils are well drained to very poorly drained and are nearly level and gently sloping loams on till plains.*

Miami-Marlette-Lapeer (MML)

Gently sloping to rolling, well drained and moderately well drained soils that have a dominantly medium textured and moderately fine textured subsoil; on uplands.

Spinks-Houghton-Boyer (SHB)

Nearly level to hilly, well-drained soils that are coarse textured or moderately coarse textured throughout; on lake plains, beach ridges, and outwash plains.

Urbanland-Tedrow-Granby (UTG)

Similar to Belleville-Pipestone-Wixom but with significant portions of developed urban land.

Wasepi-Gilford-Boyer (WGB)

Nearly level to gently sloping, somewhat poorly drained soils that have a coarse-textured to moderately fine textured subsoil; on lake plains and glacial till plains.

Sources: NRCS, 2006; USDA, 1971.
* Alternate Source: DeWitt, 2006.

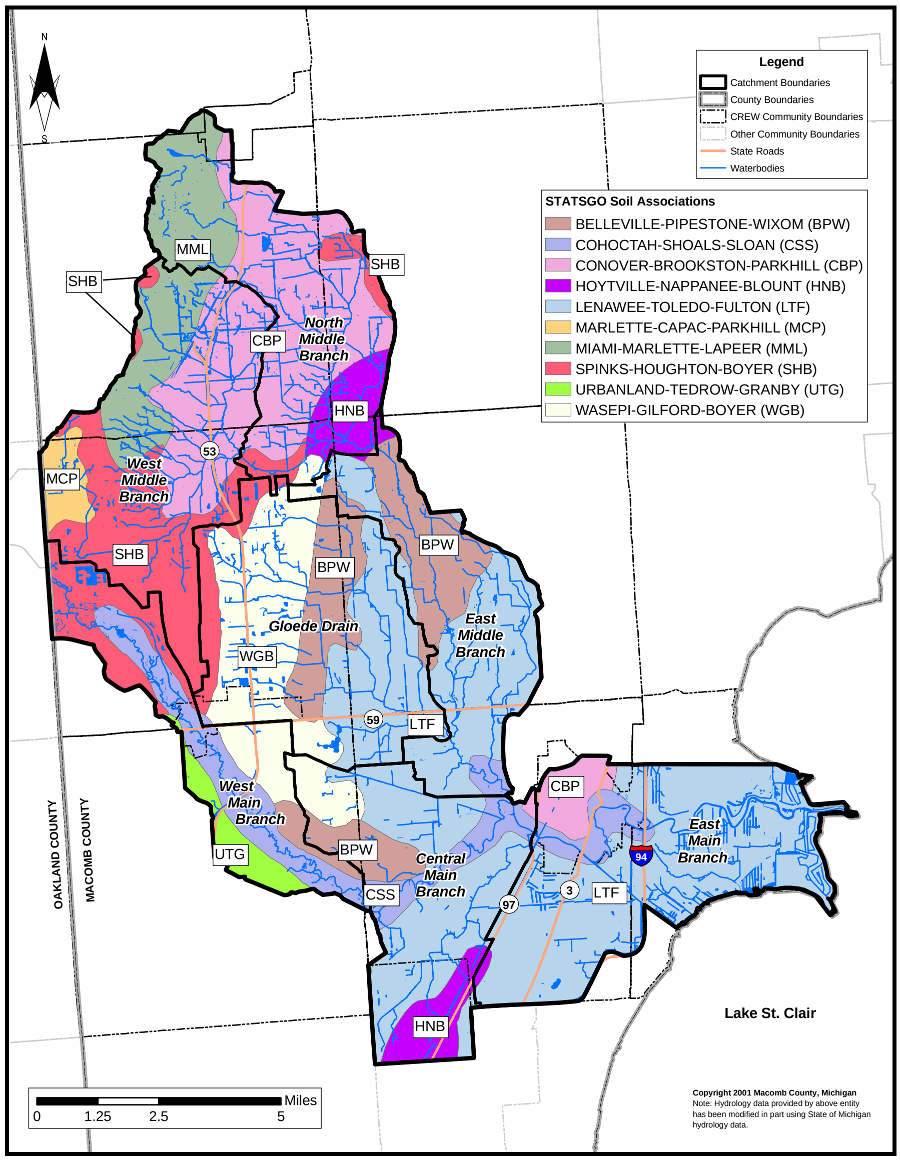
- Lacustrian material – fine materials deposited in still or ponded glacial meltwater.

These materials, and those recently deposited from local rivers and streams (alluvian material), are the parent materials of the soils that we find today.

Soils

The parent materials have combined to form more than 40 distinct soil types in Macomb County alone. For planning purposes, it is useful to group the types into *soil associations* which are landscapes that have distinctive proportional patterns of soils consisting of major soil groups with some minor components. The ten soil associations found in the subwatershed are discussed in the "Soil Associations" dialog box. The extent of these associations throughout the subwatershed is shown in Figure 2-1.

Figure 2-1. Soil associations in the subwatershed.

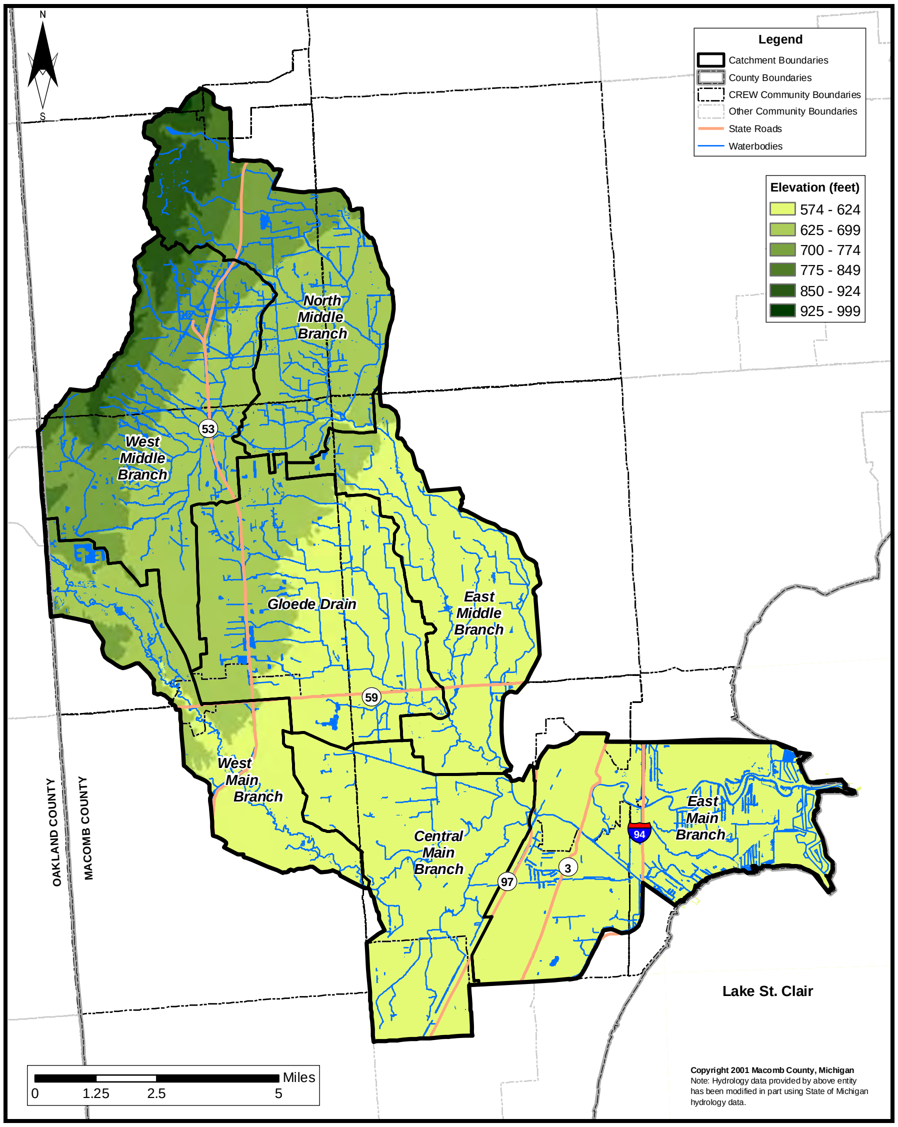


Source: NRCS, 2006.

Topography

As the soil association descriptions indicate, the topography of the landscape also influences the soil association classification. The elevation ranges from 574 ft to 984 ft above sea level. The maximum elevations occur in the northwest portion that is part of the Fort Wayne – Defiance Moraines while the rest of the subwatershed is generally flat with rolling plains. Figure 2-2 shows the elevations throughout the subwatershed.

Figure 2-2. Elevation in the subwatershed.



Hydrological Features

Hydrological features such as rivers, stream, lakes, and wetlands have developed over time as a result of climatic and geological conditions. It is these features, specifically Lake St. Clair, the Clinton River, and its tributaries, that this plan aims to protect.

Rivers, Streams, and Lakes

The CREW has approximately 422 miles of open channel waterways, a number of small lakes / ponds, and 7 miles of shoreline on Lake St. Clair. These waterbodies can be seen in figures throughout the plan.

Hydrologic Soil Groups

A useful classification of soil types in based on the soil's runoff potential. The four classifications utilized by the Natural Resources Conservation Service (NRCS) are:

A - sand, loamy sand or sandy loam types of soils; low runoff potential and high infiltration rates even when thoroughly wetted; chiefly consist of deep, well to excessively drained sands or gravels and have a high rate of water transmission;

B - silt loam or loam; moderate infiltration rate when thoroughly wetted; consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures;

C - sandy clay loam; have low infiltration rates when thoroughly wetted; consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure; and

D - clay loam, silty clay loam, sandy clay, silty clay or clay; has the highest runoff potential; very low infiltration rates when thoroughly wetted; consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

The hydrologic soil group classification for the soil types found in the subwatershed can be found in Appendix C of the MDEQ's 'Stormwater Management Guidebook' (MDEQ, 1999).

Source: NRCS, 1986.

Grades and Widths

The grade and width of streams and rivers change based on the terrain. The steepest and narrowest portions are found upstream while the flattest and widest portions are found nearest to the mouth. Grade and width influence temperature such that wide, low-grade reaches generally have higher temperatures. These physical features for the Main Branch of the Clinton River and the Middle Branch are given below as averages for each river segment.

The middle segment of the Clinton River is 19.3 miles from I-75 (outside of the subwatershed) to M-59 in Utica. The segment has cool summer temperatures because of the influence of upstream coldwater tributaries.

The lower segment is 13.7 miles from M-59 to the confluence with the North Branch of the Clinton River and has higher water temperatures.

The mouth segment is 11.1 miles from the confluence with the North Branch of the Clinton River to Lake St. Clair and also has higher water temperatures.

Segment	Grade	Width
Main Middle	12.4 ft/mile	55.7 ft
Main Lower	2.8 ft/mile	76.4 ft
Main Mouth	0.4 ft/mile	175.7 ft
Middle Br.	16.6 ft/mile	39.5 ft

Source: Francis, 2005.

Primary Producers

Not only do plants define the habitat available for the animals, they also are the basis for the food web. They are referred to as primary producers because they have the ability, through photosynthesis, to utilize sunlight in producing their own energy and growing. This plant biomass acts as an energy source for organisms that consume it.

There are also smaller waterways, or 'headwaters', that are intermittent in nature and will not show up on most maps. These waterways drain the 'headwater areas' which maintains the flow in larger waterbodies.

The waterways in these areas provide many of the benefits that scientists call "ecosystem services", including (Sierra Club, 2003):

- Natural flood control through:
  - dampening the effects of impervious cover; and
  - providing storage and slow release, evaporation, and/or percolation of water;
- Maintaining water supplies by:
  - Providing groundwater filtering and recharge; and
  - Maintaining surface water flow levels;
- Trapping excess sediment;
- Cleansing/transforming nutrients;
- Recycling organic matter; and
- Maintaining biological diversity by:
  - acting as habitat and spawning / mating grounds;
  - supporting nearly 50% of Michigan's threatened /endangered species; and
  - supporting populations that will later re-colonize impaired downstream waters as they improve.

Many of the waterbodies in the subwatershed have been modified such that they no longer exist in their 'natural state' and thus have decreased ecosystem services. Some of these changes are discussed later in this chapter. The implications of these changes are discussed in Chapter 3.

Wetlands

According to the MDEQ, wetlands are defined as "land characterized by the presence of water at a frequency and duration sufficient to support and that under normal circumstances does support wetland vegetation or aquatic life" (MDEQ, 2001). Generally, wetlands are lands where saturation with water is the dominant factor determining soil types, plant communities, and animal communities (Cowardin, 1979).

Wetlands are often found in headwater areas and provide the same ecosystem services as headwater streams. Wetlands and headwater streams are important areas of transition between water and land. Wetlands are extremely diverse and productive biological systems that typically support the primary producers of the aquatic food chain including free-floating and attached algae (phytoplankton and periphyton, respectively) and submerged aquatic plants (macrophytes).

Figure 2-3 shows the location of wetlands in the subwatershed based on 2001 National Wetlands Inventory data. Table 2-2 presents the wetland coverage for the catchments.

Currently, wetland coverage in the subwatershed is 5.7% of land area (down from the historical value of 22%). The West Main Branch catchment is 9.9% wetlands (mostly adjacent to the river) and accounts for 18.4% of the subwatershed total. The East Main Branch catchment is 7.2% wetlands (mostly in low lying areas near Lake St. Clair) and accounts for 21% of the subwatershed total. Other catchments accounting for greater than 15% of the wetland total include the North Middle Branch and West Middle Branch catchments where the wetland acreage can be attributed in part to less intense urban development.

Figure 2-3. Wetland locations and types in the subwatershed.

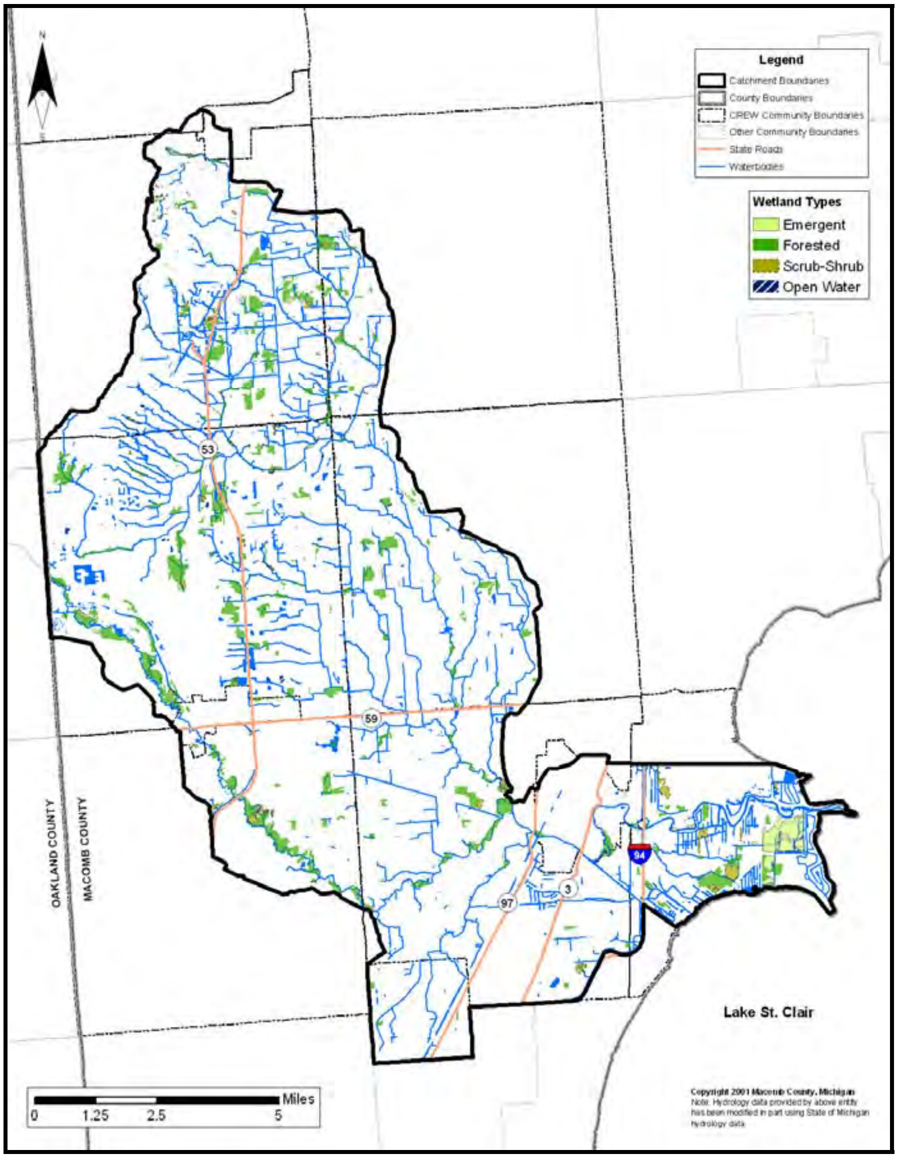


Table 2-2. Wetland coverage in the subwatershed.

Catchment	Wetland Acres	Wetland Coverage
Gloede Drain	580	3.9%
Central Main Branch	357	6.3%
East Main Branch	1,009	7.2%
West Main Branch	884	9.9%
East Middle Branch	315	3.3%
North Middle Branch	745	6.0%
West Middle Branch	917	6.7%
Total	**4,808**	**5.7%**

Emergent Wetland Types

Emergent Wetlands – include bogs, meadows, marshes, fens, and potholes. An important marsh type is the 'Great Lakes Marsh' that is hydrologically connected to the Great Lakes and rivals rainforests in terms of biological productivity. A protected Great Lakes Marsh exists at the Metropolitan Beach Metropark in Harrison Charter Township.

Open Water – Deeper, perennial pools within wetlands and shallow portions of lakes and rivers. The warmth of the water supports numerous aquatic organisms. Typically home to submerged plants (plants that grow underwater) which provide unique habitat resources such as substrates for macro-invertebrates, cover and forage for waterfowl, and spawning and nursing for fish. Forty-six types of submerged plants have been identified in Lake St. Clair alone (USACE, 1996) where they flourish due to the relative shallowness.

Forested Wetland Types

These are often referred to as 'Swamps'.

Forested – Forested swamps occur where trees grow in moist soils. They are often inundated with floodwater from nearby rivers and streams. Sub-classifications include: 'Conifer Swamps' and 'Hardwood Swamps'.

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

Source: Cwiekal, 2003; Smith, 2002.

Quotable Quotation

"The River itself has no beginning or end. In its beginning, it is not yet the River; in its end, it is no longer the River. What we call the headwaters is only a selection from among the innumerable sources which flow together to compose it. At what point in its course does the Mississippi become what the Mississippi means?"

- T.S. Eliot

Stream Banks and Shorelines

As with wetlands and headwater streams, stream banks and shorelines are transition zones between the water and land. Where stream banks define a river channel, a shoreline defines an impoundment such as a lake, reservoir, or pond. Natural, intact stream banks and shorelines are important because they reduce the potential for erosion and thus control migration of watercourses. Additionally, healthy stream banks and shorelines help filter pollutants before they reach the waterbodies, and provide habitat for benthic organisms.

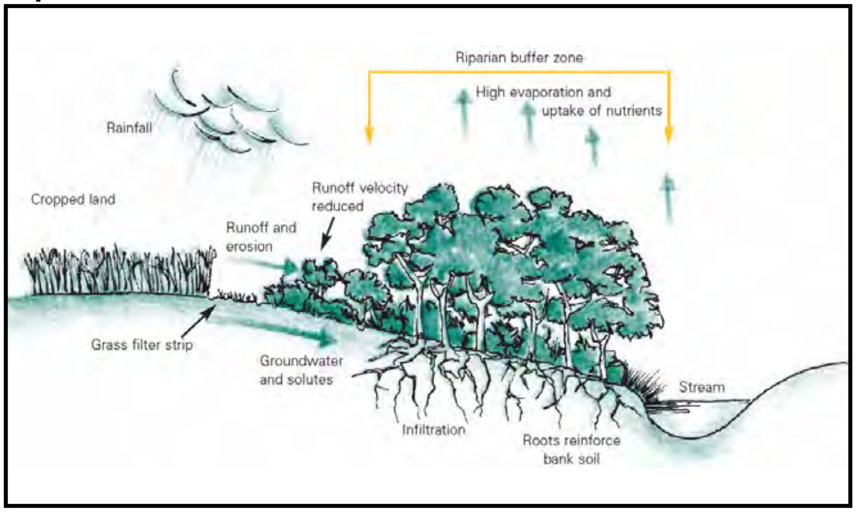
An examination of the importance of stream bank and shoreline health requires a discussion of certain concepts, which follows below.

Riparian Corridor

The riparian corridor includes the waterbody, the surrounding lowlands (floodplain), and the fringe areas between the lowlands and uplands (see the 'Riparian Corridor' figure, inset). This corridor benefits the stream in a number of ways:

- Leafy vegetation (trees, shrubs, grass, cropped land) protects the soil from the direct force of falling rain.
- The vegetation and detritus on the forest floor act to slow runoff and erosion, thus reducing scour and allowing sediments to settle out.
- Organic materials on the forest floor act to filter pollutants from runoff flowing into waterbodies.
- The root systems of stream bank and shoreline vegetation act to encourage infiltration (thereby reducing runoff volume) and reinforce the bank by retaining the soil.

Riparian Corridor



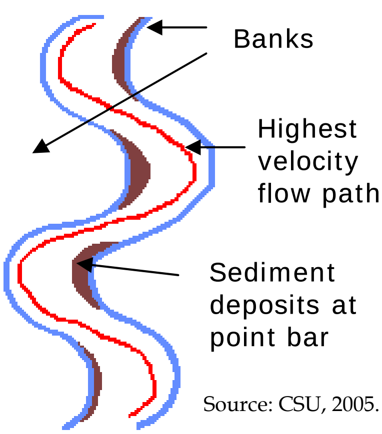
Source: LWA, 2005.

Stream Channel and Processes

The stream channel is defined by the stratum in which it is located (dependent on geology, soils, and vegetation), the flow rate of the water, and the slope of the land (FISRWG, 1998). These factors are directly related to the conditions in the riparian corridor.

While streams may exist in a straight or braided pattern, most natural channels in Michigan display a winding nature, exhibiting periodic bends (as shown in the 'Stream Meanders' figure). These bends develop over geologic periods of time as the water erodes and deposits sediment. In a bend, the force of the water erodes sediment along the outer bank. These sediments are then deposited where stream velocity is lowest (the brown areas in the 'Stream Meanders' figure inset), either: 1) on the inside bank (due to the screw-like path of water in the channel) or 2) further downstream along the point bars. In many urbanized areas, modifications to streams have resulted in them being straightened for maximum hydraulic capacity (see the 'Hydrologic / Hydraulic Infrastructure discussion in the 'Infrastructure' subsection of this chapter).

Stream Meanders



Source: CSU, 2005.

In this natural meandering state, the streams develop extensive storage along its path that function to attenuate flooding. Additionally, the meandering nature of streams provides a longer flow path as the water travels on its way, reducing the effective velocity of a stream and thus maintaining the erosion and deposition of sediments in a quasi-balance.

The bankfull discharge is defined as the flow that fills the channel from bank-to-bank before spilling onto the floodplain (Leopold, 1969). In streams with deep cut banks, the level associated with this flow may be lower than the bank level. In any case, this discharge, with an average recurrence interval of approximately 1.5 years, is the dominant flow rate that transports the abundance of sediments and thus defines the stream channel (Leopold, 1994). While more extreme flows, such as the 50- or 100-year rate, transport more sediments in a single event, it is the high relative erosion potential of the bankfull discharge, coupled with its frequency, that make it the controlling flow with respect to channel formation processes.

Flow rates greater than the bankfull discharge generally cause waters to overtop the banks and spill onto the floodplain. These floodplain waters still move significant amounts of sediment but have less erosion potential due to greatly decreased velocities (lower energy). While the waters in the bank during these events still have high erosion potential, the overall erosion potential of these events (relative to flow rate) is tempered by the floodplain waters.

Bank Slope Processes

There are numerous natural processes that affect the banks of streams and shorelines. The most basic process is the slow downhill movement of materials over time due to the constant stress of gravity. This movement ranges from a single rock rolling downhill to the slow, down slope movement of large sections of soil ("creep").

More dramatic mass movements are facilitated by the effects of water, including the erosive actions of waves and high velocities, and the added weight of slope materials when they become saturated (Hughes, 2005; TPE, 2005). These mass movements include "earthflow", "slump", "topple", and "subsidence". More information can be found in related scientific texts.

Vegetation, Habitat, and Wildlife

All of the previously discussed elements of the natural environment determine the type of vegetation, habitat, and wildlife that can be supported. This introductory discussion presents some of the particulars that may be encountered and some scientific background for understanding their interactions.

The subwatershed lies within the northern limits of the Eastern Deciduous Forest Region. It is considered part of the "Carolinian Life Zone" because of its link with forests located farther south. Many of the species found here are at the northern boundaries of their range.

Dominant Flora and Habitat

As part of an ancient glacial lakeplain, the poorly drained silts and clays of the subwatershed supported hardwood forests and swamps, with ancient beaches and sandy deposits supporting prairie and savanna. The land cover circa 1830 is shown in Figure 2-7 (page 2-19) and is described more thoroughly in the 'Land Cover and Use' portion of the 'The People and Infrastructure' section of this chapter.

Development, including logging, clearing for farming, and urbanization, has resulted in the loss of most of these habitats. Of the natural habitat remaining, the most abundant is the wooded area. In terms of water habitat, the subwatershed still has some swamps and wetlands, in addition to the river/stream habitat and that of the open water including inland lakes and Lake St. Clair. The present day land cover can be seen in Figure 2-8 (page 2-20). The historical and existing habitats, including human-modified lands, and the flora found in them are discussed.

Habitat Regions of the Eastern United States

Tree Canopy

Tree canopy is essential to environmental and economic health, providing additional cooling, reducing energy needs, increasing property values, improving air/water quality, reducing the cost of stormwater control, and contributing to a more beautiful, friendlier, and livable community. "The benefits represent hefty dollar amounts, many millions to big cities even after the costs of tree management, which average less than 1 percent of municipal budgets. Psychological benefits, too, are worth plenty. People simply feel better and kinder around trees. Trees bring birdsong. They provide privacy and a sense of protection. Hospital patients exposed to trees heal faster, feeling less pain."

Source: Plotnik, 2000.

Fish Habitat

Rivers and streams have many habitat types, including:

- Riffles – shallow areas where rocks break the surface and aerate the water (important areas for fish spawning);
- Runs – fast, deep areas where the water surface is turbulent due to the flow;
- Pools – wide, deep areas with slow currents that occur between riffles and runs and are favored habitats of fish; &
- Floodplains – land around a stream that is periodically covered with water.

Meanders in a stream enhance the quantity and quality of habitat by creating a longer stream that disperses flow energy (i.e., reduces velocity).

Wooded Areas

Historically, old-growth forests dominated the subwatershed and supported numerous tree species, wildflowers, and grasses, and had a deep organic forest floor that supported ferns, mosses, and vines, with plenty of standing and fallen deadwood.

The wooded areas that remain today are often disjointed, thus fragmenting the habitat, and some are artificially maintained, meaning organic matter that should enrich the forest floor is often removed. Additionally, fire suppression has resulted in the proliferation of fire-intolerant species. Wooded area subtypes include the 'Beech-Maple Forest', the 'Oak-Hickory Forest', and the 'Mixed Oak Forest'.

Oak Savanna

Oak Savannas are transition communities from woodland to prairie and are defined by widely spaced trees (typically oak and hickory), containing shrubs, grasses, sedges, ferns and wildflowers in the understory.

The edges of the Oak Savanna are known as 'Oak Barren' where trees grow in scattered clumps among prairie flowers / grasses.

Prairie

Prairies contain an abundance of species dominated by prairie flowers / grasses and sedges with few or no trees. They are an important habitat for many, supporting more biodiversity than any other type of terrestrial ecosystem. Prairies were the first to yield to and be drained for farming practices in the early 1800s. Some of the prairies that were not drained have disappeared as fire suppression has allowed woody species to invade and begin the succession to wooded habitat (Smith, 2002). In fact, in southeast Michigan, 122,245 acres of combined prairie and oak savanna existed prior to European settlement, but less than 800 total acres remain today (Smith, 2002).

Riparian Zones

Riparian zones are the areas along the banks of waterbodies that provide an important transition between water and land. This unique habitat includes diverse plant communities adapted to fluctuating water levels and provides an important migratory corridor for wildlife in an increasingly fragmented natural landscape. Approximately 70 percent of all terrestrial animal species use riparian zones at some point in their life cycle (GLC, 2005). The riparian zone also functions to protect water quality and mitigate such factors as temperature (which also affects dissolved oxygen levels) and flow rate flashiness.

Wetlands and Swamps

Refer to the 'Wetlands' discussion in the 'Hydrological Features' portion of this section for appropriate habitat-related discussion.

Developed Lands

Developed lands range from heavily built up urban centers to suburban residential neighborhoods. In general, constructed materials make up at least 50 percent of the surface area in developed lands. High intensity developed lands generally have little habitat value. Areas that do provide habitat can be particularly significant given the relative scarcity of alternatives. Natural areas in urban parks, especially those with forests, ponds or wetlands, can serve as critical ecological corridors when they link to larger patches of habitat outside the city core (GLC, 2005).

Cultivated Lands

Cultivated lands are lands that have been planted, tilled or harvested (i.e. orchards, groves, nurseries, and row crops such as soybeans, corn and wheat). Agriculture has been implicated in the decline of about 40% of endangered species, and historically, was the primary cause of habitat loss and fragmentation in the area. Fencerows along roads, windbreaks, shelter belts between fields, and vegetative buffers along stream corridors can provide both food and cover for birds, small mammals, some reptiles and amphibians, and insects, as well as vital linkages between larger habitat patches. Within these corridors, native plants which provide berries, nectar or seeds are particularly valuable for wildlife (GLC, 2005).

Dominant Fauna

The vegetative habitats previously described support distinct animal populations. However, most animals rely on multiple habitat types to sustain their lifecycles (i.e., birds may nest in trees but feed on prey from the water). Little data exists documenting the populations of wildlife in the subwatershed, but some of the general types of animals are discussed.

Mammals

Mammals are warm-blooded animals that give birth to live young and include such organisms as mice, squirrels, raccoons, and deer. Mammals are generally terrestrial but some obvious examples, such as beavers and otters, are highly dependent on aquatic habitat.

Birds

Birds are warm-blooded animals that lay eggs and have wings for flight. Birds occupy an abundance of habitats including terrestrial and water-reliant and often migrate between winter and summer locations. Terrestrial birds that may be encountered in the subwatershed include songbirds, raptors, owls, and woodpeckers. Others that tend to nest near water include waterfowl, shorebirds, blackbirds, wrens, cormorants, and herons. Heron rookeries have been identified along the Clinton River (MDN, 2006).

Reptiles

Reptiles are cold-blooded animals that typically lay eggs and have scaly coverings. They typically utilize both terrestrial and aquatic habitats and are very sensitive to habitat fragmentation (thus their scarcity in urban/suburban settings). Snakes and turtles are two examples that may be encountered in the subwatershed.

Amphibians

Amphibians are cold-blooded, smooth skinned animals that typically undergo an aquatic larval stage. Like reptiles, they utilize both terrestrial and aquatic habitats and are sensitive to habitat fragmentation. Amphibians that may be encountered in the subwatershed include: frogs, skinks, newts, and salamanders.

Fish

Fish are aquatic, cold-blooded animals that breathe oxygen through gills. Fish are commonly classified into two major groups:

- Bottom feeders that feed on most macro-invertebrates and substrate materials and, therefore, survive in most environments; and
- Fish that feed on select types of prey. This group ranges from small fish that feed on macro-invertebrates to large fish that feed on other fish. The presence of this group is often associated with clean water as this is where prey is available (MDNR, 1973).

Neither Plant nor Animal

Fungi - These decomposers decay organic matter, making nutrients from dead plants available for future plant growth.

Source: Smith, 2002.

Bacteria – single-celled organisms that exist in nearly all habitats in the world. They play important roles in the cycling of carbon, nitrogen, and sulfur in the environment. While many bacteria assist in the life cycles of humans, many have the potential to cause disease. These are of interest in terms of water quality.

Source: UCB, 2005.

An Example of a Reptile in the Subwatershed: A Snapping Turtle at Holland Ponds

Photo courtesy of Tetra Tech.

Zooplankton

Zooplankton comprises the animal portion of the plankton community. Zooplankters prey on phytoplankton and subsequently provide a food source to other organisms. In this manner, nutrients are transmitted to higher organisms including macro-invertebrates, and planktivorous fish.

A Creek Chub from the Harrington Drain – MDNR Fish Shocking Photo

Photo courtesy of MDNR.

Mayfly

Source: Fly Fish Michigan LLC, 2003.

Wavy-rayed Lampmussel

Source: MSUE, 2006.

Although many of the native fishes have been eliminated (because of overfishing, habitat destruction, invasive species effects, etc.), Lake St. Clair probably contains the most diverse fish community of any of the Great Lakes with 45 different species (GLC, 2005). The three most common species are the mimic shiner, rainbow smelt, and yellow perch. Populations of sturgeon and mooneye are also relatively healthy (LSC, 2000). There are numerous documented fish spawning sites in Lake St. Clair between the mouths of the Clinton River and Spillway (GLC, 2005).

Macroinvertebrates

Macroinvertebrates are backbone-less organisms that are large enough to see with the naked eye. Two examples are insects and benthic organisms.

Insects perform important functions in ecosystems such as pollination and organic matter decomposition. The larval stages of many are benthic.

Benthic macroinvertebrates are organisms which live at least part of their life cycles within or upon the substrate. The major taxonomic groups common to freshwaters include insects, worms, mollusks (e.g. shellfish), and crustaceans (e.g. crayfish) (MDNR, 1973).

An important example is the mayfly (also known as the fishfly), swarms of which can be seen around water during the summer. The burrowing mayfly nymph, which feeds on decaying organic plants, is an extremely important food for fish in open waters. The flying adult is eaten by birds. These insects, and others with similar life cycles, are important water quality indicators because they are highly sensitive to environmental pollutants and thus good indicators of water quality. Populations of these organisms are often documented and analyzed during water quality assessments.

Another intriguing example is the freshwater mussel. These organisms have limited mobility and breathe and feed by filtering water through their gills. The reproduction of most mussels involves a parasitic larval stage that requires host fish. Due to their limited mobility and reproductive cycle, they are highly sensitive to disturbances in flow, poor water quality, and fish populations. Virtually all of the species that are listed as endangered, threatened, or of special concern in Michigan are confined to the waters of southeast Michigan. Historically, Lake St. Clair and its tributaries have been home to large diverse populations of freshwater mussels (with over 30 species documented).

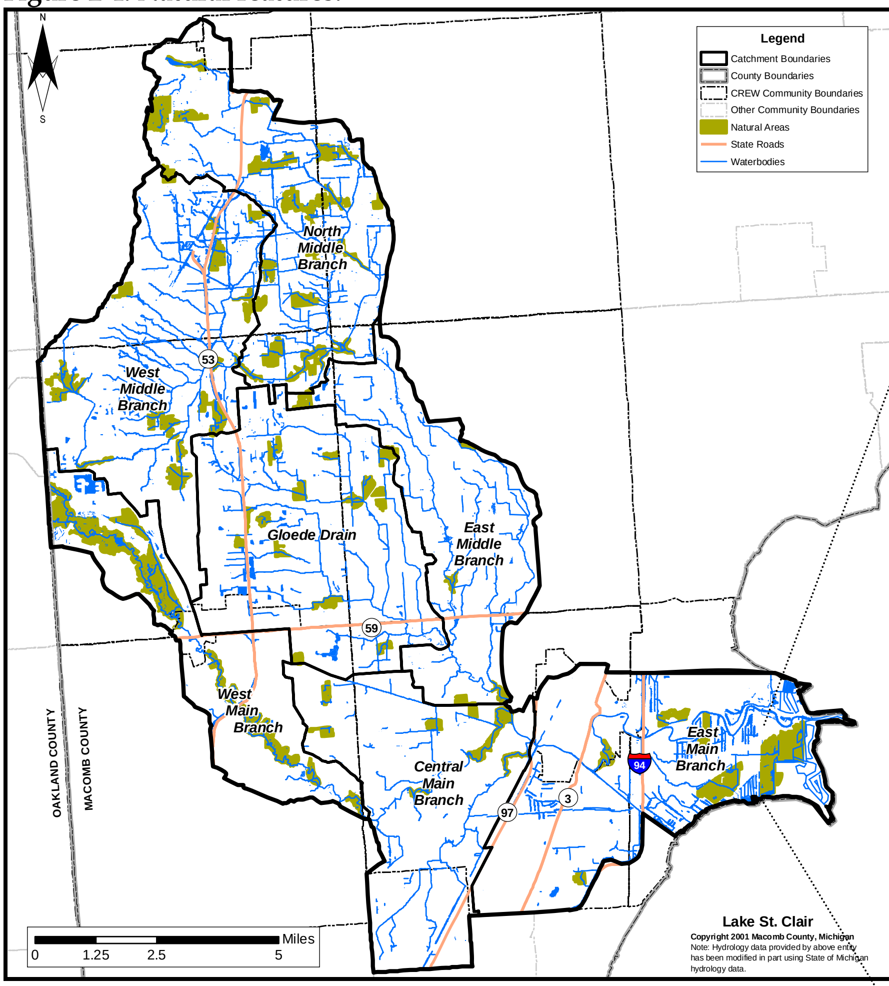
Recognized Valuable Natural Features

Natural features include elements of the natural environment that are recognized as valuable resources (i.e., wildlife populations, habitat, geological features, and waterbodies). This discussion focuses on those in which unique landscape features or environments exist.

Unique landscapes and environments provide an abundance of wildlife habitat and the protection of these areas has been directly linked to long-term water quality, especially in urban centers. In Macomb County, a study was done to delineate areas with a natural environment very similar to the one found 200 years ago (MCDPED, 2004). The locations of these features are shown in Figure 2-4. Table 2-3 shows a breakdown of these features based on the subwatershed catchments. Also included in the table are specific features that have been identified by the Michigan Natural Features Inventory (MNFI, 2005):

- Delta (D) – A plain underlain by sediments that accumulate where a stream flows into a body of standing water where its velocity and transporting power are suddenly reduced (NALMS, 2005);
- Great Lakes Marsh (GLM) – A non-forested wetland with multiple ecologic communities that is directly connected to a large freshwater lake;
- Hardwood-Conifer Swamp (HCS) – A groundwater-supplied swamp that is moderately saturated and dominated by a mixture of northern hardwoods and lowland conifers; and
- Mesic Southern Forest [Rich Forest, Central Midwest Type] (MSF) – A southern hardwood forest type on moist ground with little oak.

Figure 2-4. Natural features.

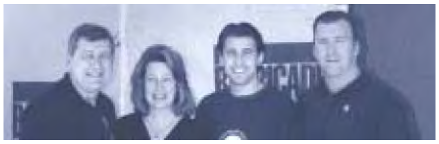


Satellite Image of Great Lakes Marsh Area in Harrison Township

Image obtained from maps.yahoo.com.

Table 2-3. Natural features.

Catchment	Natural Area (acres)	Natural Area as Percent of Total Area	MNFI Features *(refer to text on page 2-14 Sefor definitions)*
Gloede Drain	481.7	3.5%	D, MSF
Central Main Branch	341.9	2.4%	
East Main Branch	844.0	6.8%	GLM
West Main Branch	1,415.6	14.8%	D, HCS, MSF
East Middle Branch	147.0	1.0%	
North Middle Branch	1,204.9	10.6%	D
West Middle Branch	692.0	8.3%	D
Total	**5,127.1**	**6.1%**	---



Source: SEMCOG, 2004a.

Population Growth 2000 to 2005

Bruce Township	+ 10.7%
Clinton Township	+ 0.4%
Fraser	- 1.3%
Harrison Township	+ 4.1%
Macomb Township	+ 40.2%
Mt. Clemens	- 1.2%
Ray Township	+ 3.3%
Romeo	- 0.7%
Shelby Township	+ 8.5%
Sterling Heights	+ 2.4%
Utica	+ 2.5%
Washington Township	+ 23.4%

Source: SEMCOG, 2005.

Additional History

A more detailed history of the area can be found in "The Clinton River: An Historical Sketch", prepared by the Clinton River Watershed Council in 1987.

The People and Infrastructure

In the urban and suburban setting of the CREW, the influence of humans is the major driving force in modifying the natural environment. This section of the chapter summarizes the human population and the associated infrastructure that impacts the natural environment.

Community Profiles

The Southeast Michigan area was originally settled 10,000 years ago and became home to numerous Native American tribes including the Ojibwa, Chippewa, Ottawa, and Potawatomi (Oakland County, 2004). In 1701, the first European settlement of Fort Pontchartrain (now Detroit) marked the beginning of three-hundred-plus years of development and non-indigenous population growth (native populations declined due to the introduction of new diseases and other social upheaval). The first settlement on the Clinton River was in 1782, a German Moravian mission. The first known population data in the region indicates that there were 500 people in the City of Detroit in 1796. In 1840, the first population data for the region indicated a population of 103,064 in southeast Michigan (SEMCOG, 2001b).

As of 2000, the CREW alone was home to approximately 296,000 people (USCB, 2000). The "Population Growth 2000 to 2005" dialog box presents community-specific information concerning population trends between 2000 and the present day (trend data includes parts of the community outside of the CREW). Year 2000 data is the primary set referenced throughout this section.

Population by Community

Table 2-4 presents the population of each community and the portion of this population present in the subwatershed. A map of the population density is presented as Figure 2-5.

Table 2-4. Year 2000 community populations and densities.

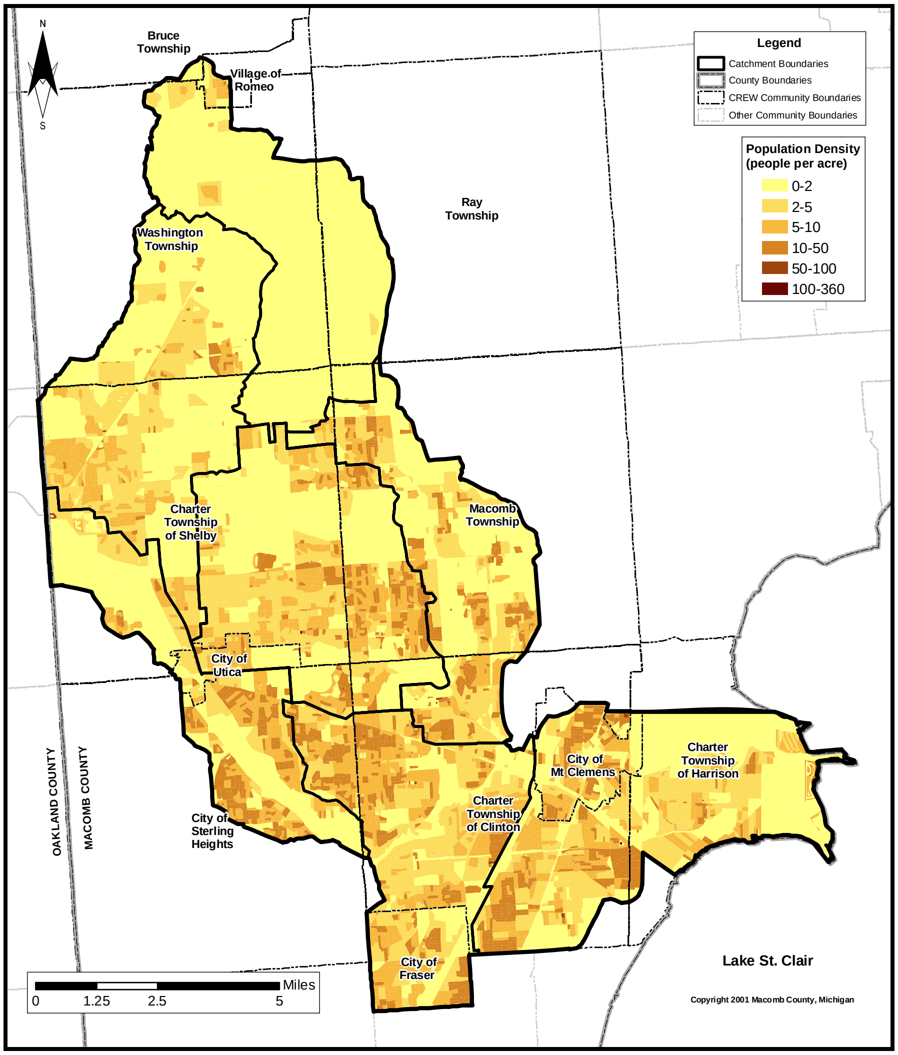
Community	Total Population	Percent of Population in Subwatershed	Total Population in Subwatershed	Percent of Total Subwatershed Populations	Average Population Density – for areas in subwatershed (people/acre)	Maximum Population Density* - for areas in subwatershed (people/acre)
Bruce Township	6,395	1.7%	107	0.0%	0.99	1.1
Clinton Township	95,648	89.8%	85,897	29.0%	5.64	216.2
Fraser	15,297	100.0%	15,297	5.2%	5.73	175.8
Harrison Township	24,461	74.9%	18,319	6.2%	2.68	85.7
Macomb Township	50,478	87.6%	44,215	14.9%	3.90	357.9
Mt. Clemens	17,122	85.7%	14,674	5.0%	5.99	62.2
Ray Township	3,740	19.7%	735	0.2%	0.24	4.4
Romeo	3,721	33.9%	1,261	0.4%	4.48	13.5
Shelby Township	65,159	84.8%	55,276	18.6%	2.68	118.0
Sterling Heights	124,471	33.3%	41,495	14.0%	6.04	62.2
Utica	4,577	100.0%	4,577	1.5%	4.16	24.7
Washington Township	17,122	84.9%	14,533	4.9%	1.08	53.0
Total	---	---	**296,386**	**100.0%**	**3.53**	---

Note: Block-level data was used to determine population numbers. Where blocks were truncated due to subwatershed boundaries, the population was prorated based on area.

* - the maximum population density is calculated on a census block basis.

Source: USCB, 2000; SEMCOG, 2004a.

Figure 2-5. Population densities in the subwatershed.



Source: USCB, 2000.

Development Trends

New residential and non-residential development is currently focused in the areas where the population density is near average. Over the next thirty years, the majority of growth is expected to occur in these areas. Growth will also occur in the sparsely populated areas, although at a lesser rate. This growth is expected to increase as the population densities in the currently developing areas rise. In the high population density areas, redevelopment will be predominant as existing facilities are refurbished and shifts occur between housing and commercial uses (SEMCOG, 2004b; 2001a; 2004c).

The largest contributors of population to the subwatershed are Clinton Township (29.0%), Shelby Township (18.6%), Macomb Township (14.9%), and Sterling Heights (14.0%). These communities (along with the Fraser, Utica, Mt. Clemens, and Romeo) also have higher population densities than the subwatershed average.

Population Trends

As shown in Table 2-5, Macomb Township was the fastest growing of the communities from 1970 to 2000 with 722.1% growth over this period. Other communities showing greater than 100% growth over this period include: Washington Township, Bruce Township, Shelby Township, and Sterling Heights. Only Mt. Clemens and Romeo experienced a population decline over this period. Over the 2000 to 2030 period, Macomb Township is forecasted to continue its growth at a rate of 120.4%. Other communities with greater than 50% growth forecasted over this period include Bruce Township, Washington Township, and Ray Township. Mt. Clemens is the only community predicted to show a population decline, with Fraser, Harrison Township, and Sterling Heights all showing growth of less than 3%.

In general, the sparsely populated townships have been and will continue to increase in population. The cities and villages in the area experienced modest growth in the past and will generally continue growing at a lesser rate. Overall, growth in the subwatershed communities was 99.2% for the 1970 to 2000 period but is expected to only be 29.6% for the 2000 to 2030 period.

Table 2-5. Community populations for 1970, 2000, and 2030.

Community	1970 Population	2000 Population	2030 Population (forecasted)	Percent Change from 1970-2000	Forecasted Change (%) from 2000-2030
Bruce Township	2,213	6,395	12,362	189.0%	93.3%
Clinton Township	48,865	95,648	108,040	95.7%	13.0%
Fraser	11,868	15,297	15,708	28.9%	2.7%
Harrison Township	18,755	24,461	24,881	30.4%	1.7%
Macomb Township	6,140	50,478	111,247	722.1%	120.4%
Mt. Clemens	20,476	17,122	15,763	-16.4%	-7.9%
Ray Township	2,683	3,740	6,055	39.4%	61.9%
Romeo	4,012	3,721	4,712	-7.3%	26.6%
Shelby Township	29,467	65,159	92,699	121.1%	42.3%
Sterling Heights	61,365	124,471	124,935	102.8%	0.4%
Utica	3,504	4,577	5,192	30.6%	13.4%
Washington Township	5,651	17,122	33,187	203.0%	93.8%
Total	**214,999**	**428,191**	**554,781**	**99.2%**	**29.6%**

Source: SEMCOG, 2002 & 2004a.

Population by Catchment

It is useful from a watershed planning perspective to aggregate populations on the subwatershed catchments. This data is presented in Table 2-6.

Table 2-6. Subwatershed community populations for 2000 presented on a catchment basis.

Community	Gloede Drain	Central Main Branch	East Main Branch	West Main Branch	East Middle Branch	North Middle Branch	West Middle Branch	Total
Bruce Township	---	---	---	---	---	107	---	107
Clinton Township	2,855	41,090	30,431	66	11,456	---	---	85,897
Fraser	---	15,297	---	---	---	---	---	15,297
Harrison Township	---	---	18,319	---	---	---	---	18,319
Macomb Township	19,495	---	---	---	24,555	165	---	44,215
Mt. Clemens	---	---	14,674	---	---	---	---	14,674
Ray Township	---	---	---	---	1	734	---	735
Romeo	---	---	---	---	---	1,261	---	1,261
Shelby Township	26,521	---	---	5,731	879	613	21,532	55,276
Sterling Heights	3,868	11,224	---	26,403	---	---	---	41,495
Utica	3,471	---	---	1,106	---	---	---	4,577
Washington Township	---	---	---	---	---	3,690	10,843	14,533
Total	**56,210**	**67,610**	**63,423**	**33,306**	**36,890**	**6,571**	**32,375**	**296,386**
Percentage	**19.0%**	**22.8%**	**21.4%**	**11.2%**	**12.4%**	**2.2%**	**10.9%**	**100.0%**
Average Population Density	4.03	7.81	4.42	3.04	3.85	0.53	2.30	3.53
Maximum Population Density*	357.9	216.2	136.8	118.0	138.5	13.5	58.4	---

* Note: given in people/acre and calculated on a census block basis. Source: USCB, 2000.

The largest contributors of population to the subwatershed are the Central Main Branch (22.8%), East Main Branch (21.4%), and Gloede Drain (19.0%). The North Middle Branch contributes only 2.2% with the rest of the catchments falling between 10.9% and 12.4%.

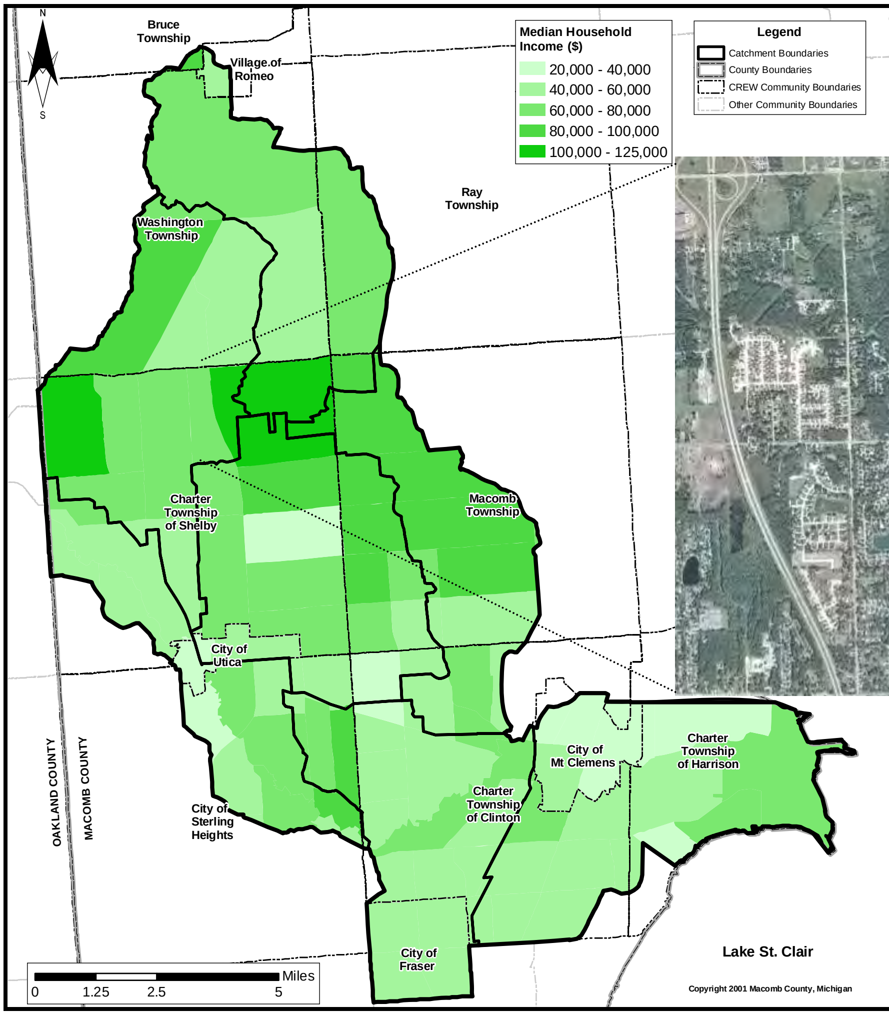
The highest population contributors have greater than average population densities of 7.81, 4.42 and 4.03 people per acre, respectively. The lowest population density occurs in the North Main Branch (0.53 people per acre), with the others falling between 2.30 and 3.85 people per acres. The subwatershed average population density is 3.53 people per acre.

Income and Education

In the watershed planning process, it is important to consider not only the affected population, but also the characteristics of that population. The characteristics help evaluate the potential for watershed planning success and involvement. Common characteristics used to describe the population include median household income and education level.

Median household incomes in the subwatershed are presented in Figure 2-6. Income and education information is presented in Table 2-7.

Figure 2-6. Median household incomes in the subwatershed.



Source: USCB, 2000.

The median household income data indicates that the wealthiest areas are the suburban ones: Washington Township, Macomb Township, Ray Township, and Bruce Township. Mt. Clemens and Utica have the lowest median household incomes. As expected, the communities that have the lowest median household incomes have the highest percentage of households living below the poverty level and generally show lower education levels while the communities with the highest median household incomes show the opposite.

Only Mt. Clemens and Utica have median household incomes that are significantly lower than Southeast Michigan as a whole.

Suburban Development Patterns in a Wealthy Portion of the Subwatershed

Image obtained from maps.yahoo.com.

New Development in a Suburban Area of the Subwatershed: Exhibiting Poor Construction Sediment Runoff Control

Photo courtesy of Tetra Tech.

Income Data

The data for the map is on a census tract basis. The data in the table is on a community basis. This may lead to perceived discrepancies, although both are correct.

Minority Percent of Community Populations

Bruce Township	2.6%
Clinton Township	8.9%
Fraser	3.3%
Harrison Township	5.5%
Macomb Township	3.9%
Mt. Clemens	24.2%
Ray Township	2.2%
Romeo	7.3%
Shelby Township	5.0%
Sterling Heights	9.3%
Utica	6.2%
Washington Township	2.5%

Source: USCB, 2000.

Minority Percent of Catchment Populations

Gloede Drain	5.9%
Central Main Branch	5.5%
East Main Branch	16.2%
West Main Branch	7.1%
East Middle Branch	6.1%
North Middle Branch	4.8%
West Middle Branch	4.5%
Total	**8.0%**

Source: USCB, 2000.

Median household income data is presented on a census tract basis, meaning it has less resolution than the census block level population information.

Table 2-7. Community income, poverty, and education levels.

Community	Median House-hold Income ($)	Households Below Poverty Level (%)	Population Receiving at least High Diploma (%)[1]	Population Receiving at least 4-yr College Degree(%)[1]
Bruce Township	$72,102	4%	89%	25%
Clinton Township	$50,067	6%	85%	18%
Fraser	$50,339	6%	82%	14%
Harrison Township	$51,892	5%	88%	20%
Macomb Township	$72,319	2%	89%	22%
Mt. Clemens	$37,856	13%	79%	13%
Ray Township	$70,081	2%	88%	18%
Romeo	$48,015	5%	84%	24%
Shelby Township	$65,291	4%	87%	26%
Sterling Heights	$60,494	5%	84%	23%
Utica	$38,683	10%	81%	18%
Washington Township	$71,823	3%	88%	23%
Southeast Michigan	**$49,979**	**10%**	**83%**	**25%**

1 – Includes only those individuals 25 years of age and older. Source: SEMCOG, 2004a.

Population Ethnicity

Another population characteristic to consider is the ethnic composition of the population. Approximately, 89% of the subwatershed population is Caucasian. The non-Caucasian segment of the population consists mainly of African-American, Hispanic, Asian, and mixed ethnicities. The dialog boxes present the minority population as a percentage of the total on a municipal and catchment basis.

Only one subwatershed community has a non-Caucasian population greater than 10% (Mt. Clemens at 24.2%). The same is true for the catchments, where the non-Caucasian population in the East Main Branch (in which Mt. Clemens exists) is 16.6%.

Environmental Justice

According to the Environmental Protection Agency's (EPA) website (http://www.epa.gov/compliance/environmentaljustice/)

> "Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or a socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Meaningful involvement means that: (1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; (2) the public's contribution can influence the regulatory agency's decision; (3) the concerns of all participants involved will be considered in

the decision making process; and (4) the decision makers seek out and facilitate the involvement of those potentially affected.

In summary, environmental justice is the goal to be achieved for all communities and persons across this Nation. Environmental justice is achieved when everyone, regardless of race, culture, or income, enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work."

Based on an examination of the economic and ethnicity information for the subwatershed, certain areas – low income and/or minority population centers - show potential to elicit environmental justice concerns. Because environmental justice requires and encourages these communities to be represented fairly by the WMP, the public involvement procedures, decision-making processes, and management decisions have been tailored to alleviate potential environmental justice concerns.

Swamp Land at Holland Ponds

Photo courtesy of Tetra Tech.

Land Cover and Use

As humans have settled the land, they have adapted it and altered it to suit their needs. This discussion documents how the land has changed over the last 170 years and how this impacts the subwatershed.

Historical Land Cover

Historically, much of the subwatershed was comprised of forests and swamps. The predominant ecosystem was the Beech-Sugar Maple Forest, while the Mixed Oak Forest and Mixed Hardwood Swamp were also present in considerable amounts. These productive natural land covers provided resources for settlers in the area and provided habitat for a diverse community of wildlife. Table 2-8 breaks down the land cover in 1830, when the land was part of the Michigan Territory. Figure 2-7 shows a map of the land cover (circa 1830) on a catchment basis.

Table 2-8. Land cover in the subwatershed circa 1830.

Land Cover	Gloede Drain	Central Main Branch	East Main Branch	West Main Branch	East Middle Branch	North Middle Branch	West Middle Branch	Total
Sand Dune	---	---	0.28	---	---	---	---	**0.28**
Prairie - Wet	---	0.07	---	0.06	---	0.12	0.11	**0.36**
Wetland – Open Water	---	0.03	0.51	---	---	---	---	**0.54**
Wetland – Scrub/Shrub & Marsh	0.36	0.71	3.00	---	0.06	0.07	0.01	**4.22**
Swamp – Conifer	0.02	0.28	---	0.16	---	---	0.16	**0.62**
Swamp – Hardwood	3.05	2.81	4.28	1.53	2.68	1.98	2.18	**18.51**
Swamp – Hardwood (Ash)	4.29	---	---	0.22	---	0.52	0.16	**5.19**
Wooded Area – Beech/Maple Forest	12.96	13.78	14.34	6.49	12.24	11.02	9.29	**80.13**
Wooded Area – Mixed Oak Forest	1.12	---	---	4.49	---	---	8.63	**14.24**
Wooded Area – Oak/Hickory Forest	---	---	---	---	---	5.01	0.43	**5.44**
Oak Barren	---	---	---	---	---	0.68	1.05	**1.73**
Total	**21.81**	**17.69**	**22.40**	**12.95**	**14.99**	**19.40**	**22.02**	**131.27**

Note: all units in square miles. Source: MIGDL, 2005.

Beech / Maple Forest

Source: Ellsworth, 2005.

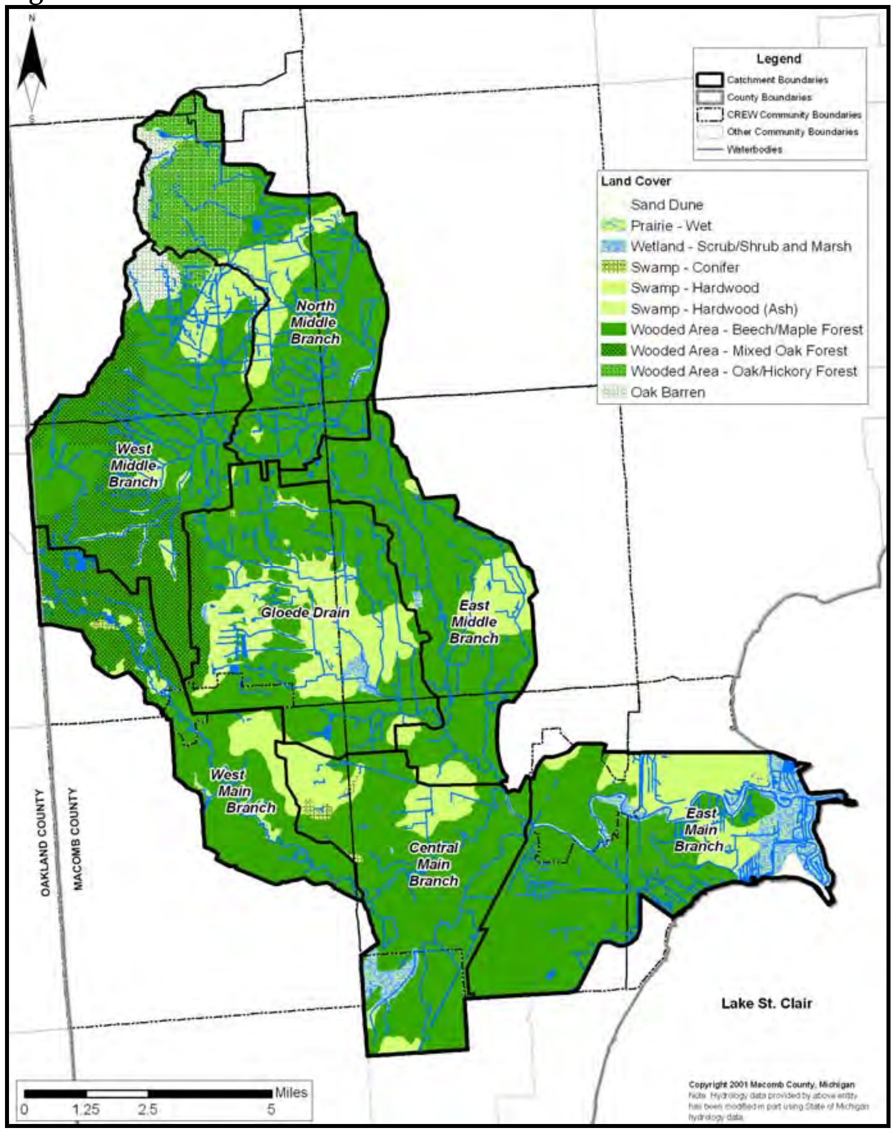
Mixed Oak Forest

Source: EKU, 2005.

Multiple Present Day Land Uses: Agricultural, Single Family Residential, & Utility

Photo courtesy of Tetra Tech.

Figure 2-7. Land cover in the subwatershed circa 1830.



Present Day Land Use

Permanent human settlement brought great change to the landscape as the land was altered for human benefit. Many of the forests were cleared and wetlands were drained to provide land for farming, settlement, and transportation. This and other changes such as urban development, dams, river relocation, channelization, and dredging significantly altered the landscape of the subwatershed to become what we now see today.

The landscape of today is vastly different from its pre-development conditions. Only 11.19 square miles of woodland and wetland exist; a mere 10 percent of the woodland and wetland areas that existed in 1830.

Today, 43 percent of the subwatershed is used for single-family residences. Agricultural use accounts for 12 percent and another 10 percent exists as grassland and shrub. Figure 2-8 shows these and other present day land uses throughout the subwatershed (note that to make the figure easier to interpret, the catchment boundaries are not shown). Table 2-9 breaks the land use down on a catchment basis.

Figure 2-8. Land use in the subwatershed – present day.

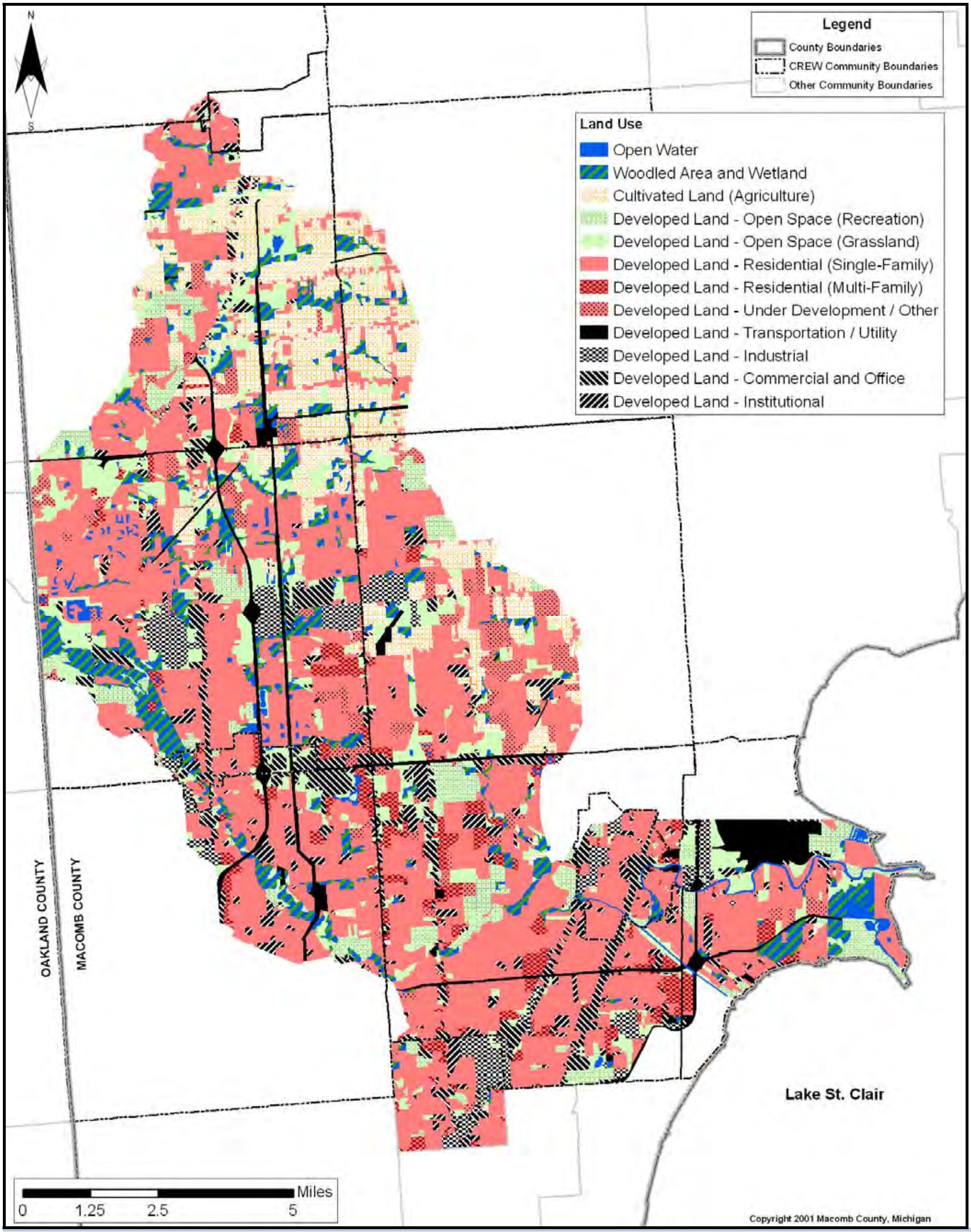


Table 2-9. Land use in the subwatershed – present day.

Land Cover	Gloede Drain	Central Main Branch	East Main Branch	West Main Branch	East Middle Branch	North Middle Branch	West Middle Branch	Total
Open Water (counted as wetland)	0.29	---	0.84	0.17	0.07	0.05	0.20	**1.62**
Woodland and Wetland	1.15	0.62	1.09	2.35	0.55	2.14	1.67	**9.57**
Cultivated Land (Agriculture)	0.94	0.11	0.04	0.03	2.78	9.17	2.12	**15.19**
Developed Land – Open Space (Recreation)	0.91	1.19	1.76	0.85	0.69	0.03	1.11	**6.54**
Developed Land – Open Space (Grassland)	2.35	0.82	1.60	1.32	1.06	2.11	3.33	**12.59**
Developed Land – Residential (Single-family)	9.80	10.25	9.93	5.41	6.47	4.87	9.60	**56.34**
Developed Land – Residential (Multi-family)	1.06	1.45	1.15	0.44	0.40	0.01	0.32	**4.83**
Developed Land – Under Development / Other	0.68	0.37	0.24	0.08	1.89	0.25	1.17	**4.68**
Developed Land – Transportation / Utility	0.92	0.22	2.15	0.54	0.11	0.36	0.68	**4.98**
Developed Land – Industrial	1.27	0.95	1.05	0.48	0.03	0.07	0.67	**4.51**
Developed Land – Commercial and Office	1.88	1.06	1.77	0.65	0.34	0.19	0.68	**6.58**
Developed Land – Institutional	0.56	0.65	0.78	0.61	0.60	0.17	0.47	**3.83**
Total	**21.81**	**17.69**	**22.40**	**12.95**	**14.99**	**19.40**	**22.02**	**131.27**

Note: all units in square miles. Source: SEMCOG, 2005.

Land Use Types - Present

NON-DEVELOPED TYPES

Open Water
Rivers, lakes, drains, etc.

Wooded Area and Wetland
Not currently developed wooded and wetland areas.

Cultivated Land (Agriculture)
Includes croplands, orchards, feeding operations, etc.

DEVELOPED TYPES

Open Space (Recreation)
Includes fields, facilities, pools, campgrounds, marinas, etc.

Open Space (Grassland)
Dominated by grasses / shrubs

Residential (Single-Family)
Housing units designed for less than two families (includes houses, trailers).

Residential (Multi-Family)
Housing units designed for three or more families (apartments, etc.).

Under Development / Other
Areas being developed or losing housing. Also: gravel pits, wells, beaches, dunes, etc.

Transportation / Utility
Roads, utilities, facilities, etc.

Industrial
Industrial parks, etc.

Commercial and Office
Offices, business districts, malls, etc.

Institutional
Includes religious, educational, government, etc.

Source: SEMCOG, 2004.

Residential development is the dominant land use in all but the North Middle Branch catchment where residential use accounts for only 25 percent. In the Central Main Branch catchment, residential use accounts for over 66 percent while the other catchments vary between 45 percent and 49 percent residential.

Agricultural use dominates the North Middle Branch catchment, accounting for 47 percent of the total. It also accounts for 18 percent of the land use in the East Middle Branch catchment, 10 percent in the West Middle Branch catchment, and 4 percent in the Gloede Drain catchment. The Main Branch catchments have less than 1 percent agricultural use, each.

Present Day Land Uses: Transportation & Commercial

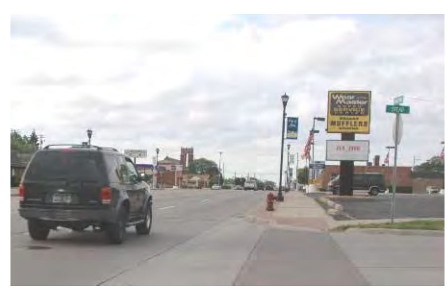


Photo courtesy of Tetra Tech.

Future Land Use

Figure 2-9 presents the projected future land use in the subwatershed based on community zoning and master plans, as compiled by SEMCOG (note that to make the figure easier to interpret, the catchment boundaries are not shown). Table 2-10 summarizes the project land use information.

Future Land Use

The projected future land use in the subwatershed is based on zoning ordinances and master plans for the various communities. The horizon date for this information is the year 2030.

Table 2-10. Land use in the subwatershed – future (year 2030).

Land Cover	Gloede Drain	Central Main Branch	East Main Branch	West Main Branch	East Middle Branch	North Middle Branch	West Middle Branch	Total
Open Water (counted as wetland)	0.33	---	0.91	0.17	0.06	0.05	0.21	**1.73**
Wooded Area / Wetland / Open Space	1.19	1.64	1.46	4.10	0.51	0.41	2.41	**11.71**
Cultivated Land (Agriculture) / Residential (Rural)	---	---	0.21	---	0.01	13.39	2.49	**9.25**
Developed Land – Residential (Low Density)	10.19	4.19	4.47	5.99	9.47	4.08	12.31	**50.70**
Developed Land - Residential (Medium Density)	1.85	7.14	4.61	0.28	3.41	0.40	0.71	**18.40**
Developed Land – Residential (High Density)	1.06	1.27	3.12	0.61	0.35	0.03	0.83	**7.28**
Developed Land – Transportation / Utility	0.32	0.12	0.74	0.24	---	---	0.34	**1.76**
Developed Land – Industrial	3.73	1.15	1.76	0.70	0.38	0.44	1.01	**9.17**
Developed Land – Commercial and Office	2.75	1.28	2.12	0.60	0.72	0.56	1.21	**7.28**
Developed Land – Institutional	0.38	0.90	3.00	0.25	0.09	0.05	0.49	**5.16**
Total	**21.81**	**17.69**	**22.40**	**12.95**	**14.99**	**19.40**	**22.02**	**131.27**

Note: all units in square miles. Source: SEMCOG, 2005.

The projected future land use (for 2030) indicates that residential land use in the subwatershed will increase to 62.4 percent. The East Middle Branch catchment is projected to have a residential land use of 88 percent (up from 46 percent). Residential land use in the North Middle Branch catchment is projected to remain relatively constant. The other catchments are projected to experience moderate increases with ultimate residential land use percentages of between 53 percent and 71 percent.

Appreciable amounts of agriculture are projected to be confined to the North Middle Branch and West Middle Branch catchments, with 69 percent and 11 percent coverage, respectively.

Wooded Area / Wetland / Open Space is projected to decrease throughout the subwatershed from 23.1 percent to 9.6 percent. However, a significant stretch along the Clinton River in the West Main Branch catchment has been set aside for conservation. If this is the case, the amount of open space in the catchment may actually increase.

Land Use Types - Future

NON-DEVELOPED TYPES

Open Water
Rivers, lakes, drains, etc.

MIXED TYPES

Wooded Area / Wetland / Open Space
Not currently developed wooded and wetland areas; grasses, shrubs; fields, camp-grounds, marinas.

Cultivated Land (Agriculture)
Croplands, orchards, feeding operations, and housing in rural areas.

DEVELOPED TYPES

Residential (Low Density)
Generally single-family dwellings constructed on large parcels.

Residential (Medium Density)
Generally single-family dwellings that are not high- or low-density.

Residential (High Density))
Generally includes urban multiple- and single-family dwellings.

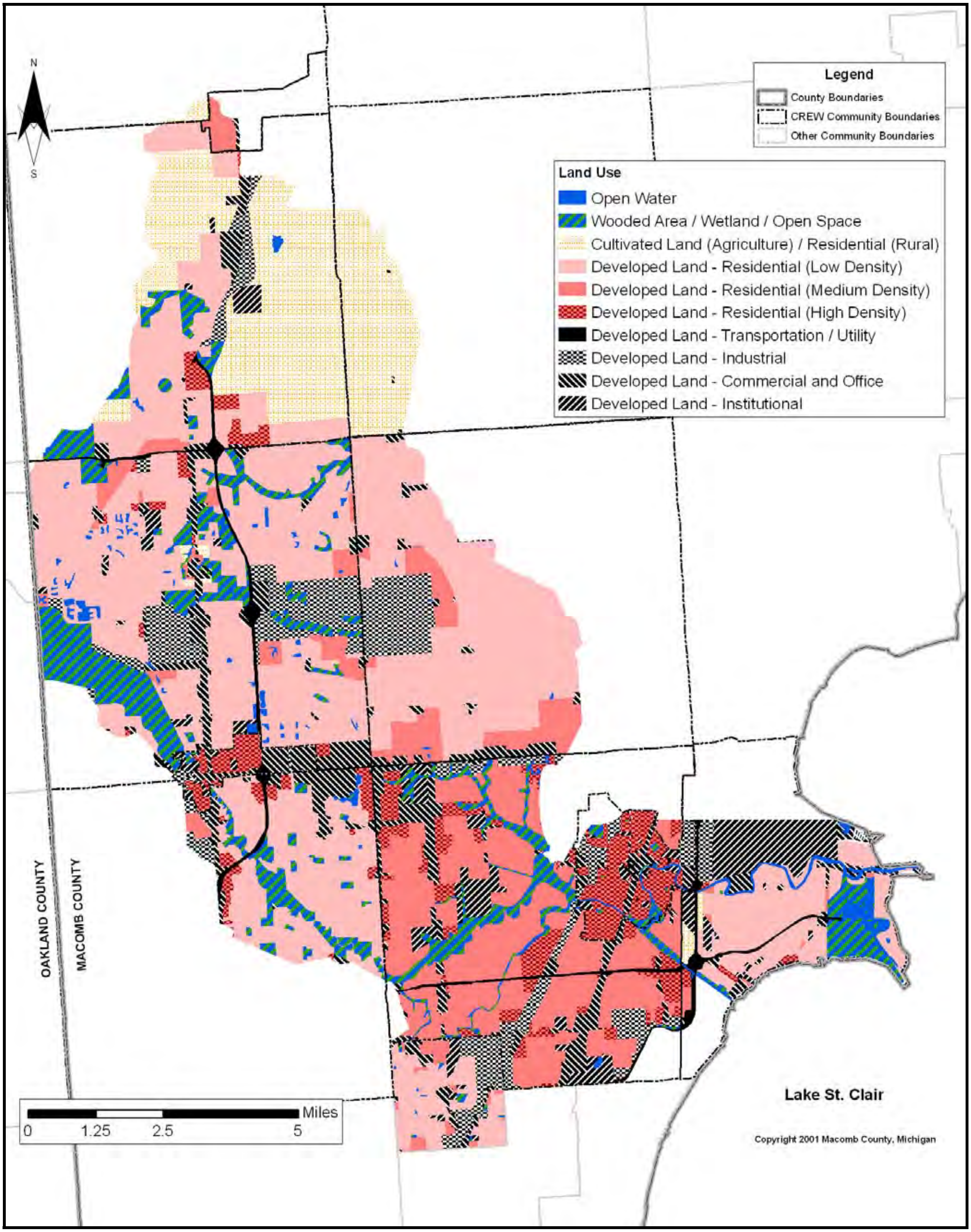
Transportation / Utility
Roads, utilities, facilities, etc.

Industrial
Industrial parks, etc.

Commercial and Office
Offices, business districts, malls, etc.

Institutional
Includes religious, educational, government, etc.

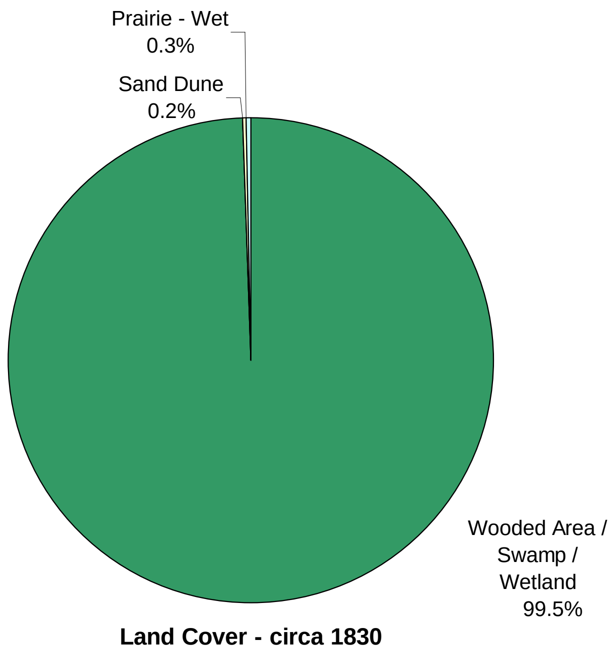
Figure 2-9. Land use in the subwatershed – future.

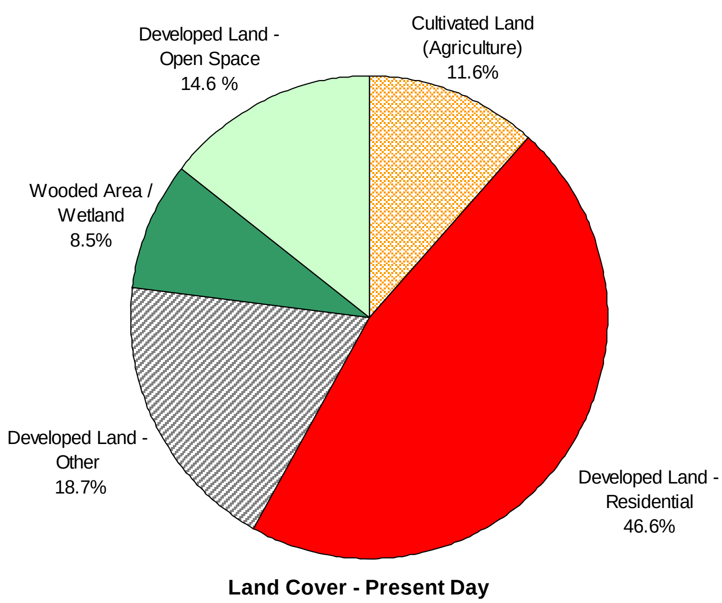


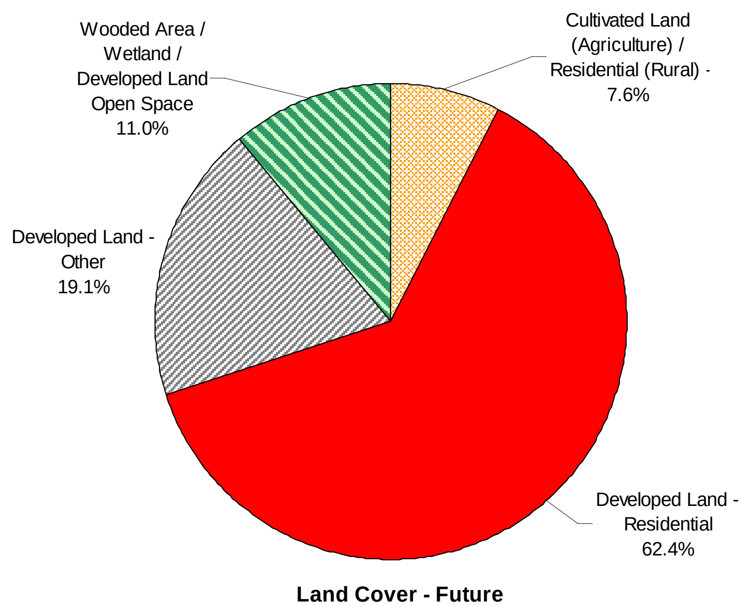
Land Cover / Use Trends

Figure 2-10 illustrates that the land comprising the subwatershed was covered almost entirely by forest and swamp only 170 years ago. Since then, conversion of the land to agriculture, residential, and other development has reduced the woodland/ wetland cover to only 8.5 percent. Continuing development in the subwatershed will result in the conversion of remaining woodlands, wetlands, and open spaces into residential development.

Figure 2-10. Land cover/use comparison.







Public Land

Public land is a valuable component of land use within the watershed as it provides for easier implementation of watershed management practices (such as stormwater retrofits) and procedures. Public land uses in the watershed include road rights-of-way, parks and recreation areas, educational facilities, and other government properties. Public land borders about 51 percent of the Clinton River downstream of I-75. Only 4 percent of the Middle Branch and its major tributaries are bordered by public land.

Source: Francis and Haas, 2005

Sanitary Sewer Overflows

In extreme circumstances, such as during heavy rainfall events where excess water enters the system, or when blockages in the system occur, the sanitary sewer system may overflow at a low point, causing untreated sewage to discharge to nearby waterbodies. Such occurrences are referred to as sanitary sewer overflows (SSOs). SSOs have not been permitted since 1977, but are often subject to MDEQ administrative consent orders. Current MDEQ policy is to work with communities to eliminate the occurrence of all SSO events.

There were 55 reported SSOs at 11 locations, releasing about 9.25 million gallons of raw or diluted sewage in the CREW between July 2000 and July 2006.

Source: MDEQ, 2000-2006

DWSD WWTP

Source: water-technology.net, 2005.

Romeo WWTP

Photo courtesy of Hubbell, Roth, and Clark.

Infrastructure

Associated with the people of the subwatershed and their inhabited land is an extensive infrastructure that supports the activities of human life. Those which have an impact on, or are impacted by, water and environmental quality are discussed.

Sewage Disposal

The collection and treatment of human waste is essential to protecting water quality. In the subwatershed, two distinct system types address this issue: sanitary sewer – to – waste water treatment plant (WWTP) systems and private on-site disposal systems (OSDS) – also known as 'septic' systems.

Sanitary Sewers

Sanitary sewers exist for the purpose of collecting wastewater generated by residences, businesses, and other facilities and routing it to a WWTP. The WWTP then treats the sewage to remove pollutants to regulatory levels before discharging the effluent into a nearby waterbody.

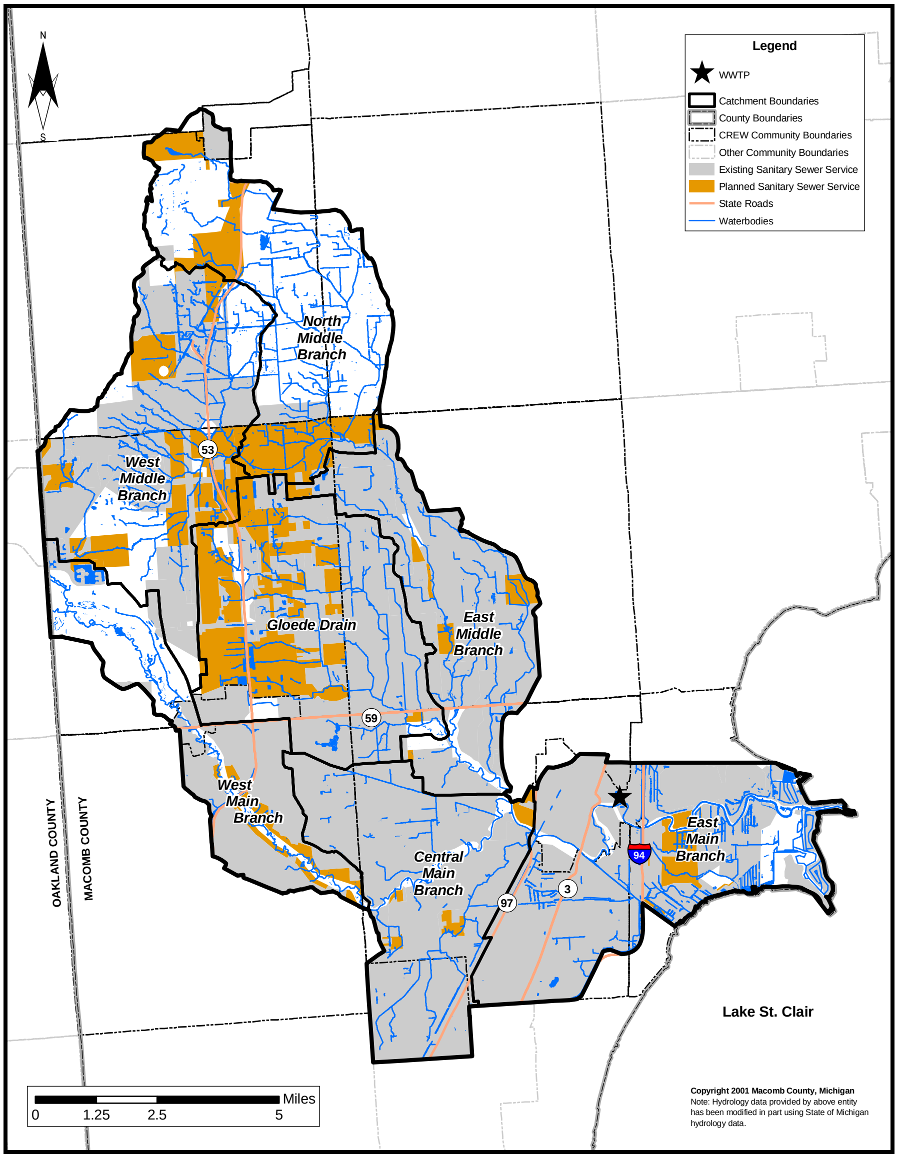
The bulk of the sanitary sewers in the subwatershed flow to the Detroit Water and Sewerage Department (DWSD) WWTP located in the City of Detroit, which discharges to the Detroit River and also to the River Rouge during high flow events. Romeo, a small portion of Bruce Township, and some future sewers in Washington Township, are or will flow to the Romeo WWTP which discharges into East Pond Creek outside of the subwatershed. The sanitary sewers in Mt. Clemens (and a small portion of Clinton Township) flow to the Mt. Clemens WWTP which discharges to the Clinton River (in the East Main Branch catchment). This is the only WWTP in the subwatershed. Its location, and the extent of current, and future (by the year 2030), sanitary sewer coverage in the subwatershed, can be seen in Figure 2-11. Table 2-11 summarizes this information on a catchment basis.

Table 2-11. Sewage disposal in the subwatershed, by catchment.

Catchment	Septic System (sq. mi.)		Sanitary Sewer Service (sq. mi.)		Total (sq. mi.)
	Current	*Future*	*Current*	*Future*	
Gloede Drain	7.63	0.99	14.17	20.81	21.81
Central Main Branch	1.11	0.61	16.58	17.08	17.69
East Main Branch	3.20	2.24	19.21	20.16	22.40
West Main Branch	5.98	5.00	6.97	7.95	12.95
East Middle Branch	1.74	0.79	13.24	14.20	14.99
North Middle Branch	17.98	13.61	1.44	5.81	19.40
West Middle Branch	9.83	5.18	12.19	16.83	22.02
Total	**47.47**	**28.43**	**83.80**	**102.84**	**131.27**

Source: GIS data courtesy of SEMCOG.

Figure 2-11. Sewer systems in the subwatershed.



Mt. Clemens WWTP

Courtesy of MCPWO

More on Combined Sewers and CSOs

In the subwatershed, there is approximately 100 acres served by combined sewers (all in Mt. Clemens). The sewers in this area flow to the Mt. Clemens Retention and Treatment Facility (RTF) – pictured below.

When flows in the system exceed the allowable discharge rate into the DWSD interceptor sewer, excess flow is stored in the facility. If the storage volume capacity is reached, additional flow is partially treated with chlorine before being discharged to the Clinton River. This facility is located across the river from the Mt. Clemens WWTP.

In 2004, the City of Mt. Clemens placed 1st nationally in the EPA's Combined Sewer Overflow Control Excellence Awards program for combined sewer separation work and improvements to the Mt. Clemens RTF.

Combined Sewers

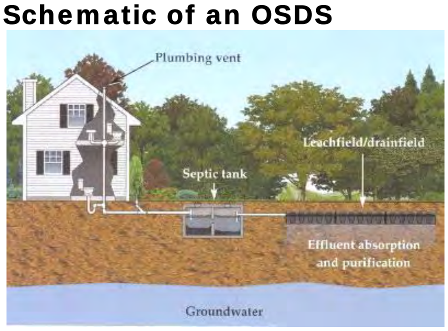
A variation of the sanitary sewer system which is common in older urban areas is the combined sewer system. This type of system is designed to convey both sanitary and stormwater for treatment at a WWTP. During dry weather, the flow in a combined sewer is composed entirely of sewage. During rain events, catch basins and downspout leads from buildings route stormwater runoff into the system which is then treated at a WWTP. However, these systems and the WWTPs are not sized to handle the flows generated by intense rain events. Flow from intense rain events may lead to a situation in which flow control devices in the system, or 'regulators', limit the flow to WWTP by allowing some of the mixed stormwater and sewage to overflow into nearby waterbodies (which is called a combined sewer overflow or 'CSO'). No CSOs have occurred in the subwatershed since April 2000 (MDEQ, 2006). Figure 2-12 (courtesy of Marist College) shows a schematic of this type of system.

Clinton River Factoid

On an average day, approximately half of the river flow seen at the mouth of the river is treated wastewater effluent from six municipal plants in the Clinton River watershed. While this effluent is of high quality and contains less sediment than the natural river water, there is a likely increase in nutrient levels such as phosphorus and nitrogen.

Source: USACE, 2005.

Schematic of an OSDS



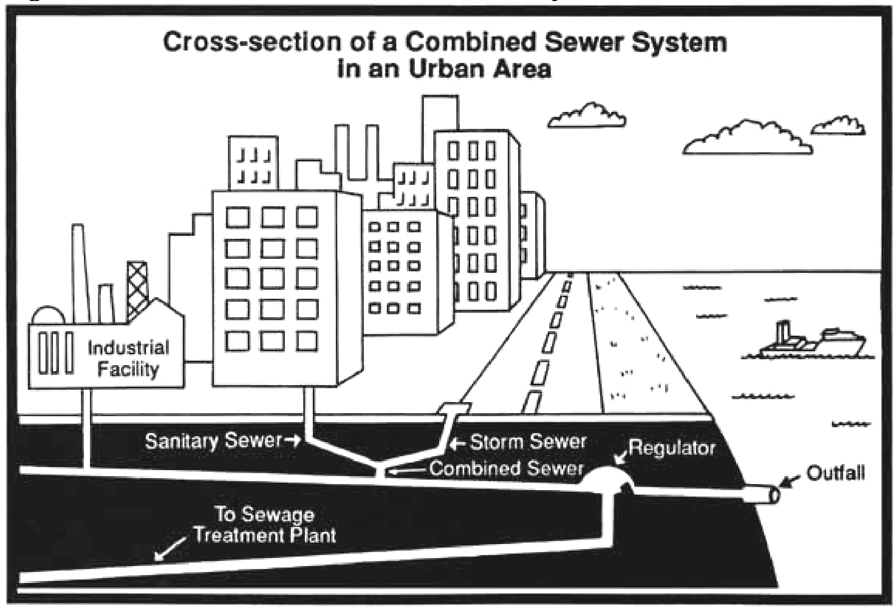
Source: Infiltrator Systems, 2005.

Sewage Disposal Summary

Currently, 64% of the land area in the subwatershed is served by sanitary sewers. The greatest coverage percentages are in the Central Main Branch, East Main Branch, and East Middle Branch catchments, with 94%, 86%, and 88% coverage, respectively. In the North Middle Branch catchment, only 7% is served by sanitary sewers.

By 2030, sanitary sewer coverage is expected to reach 78%. The additional sanitary sewers are planned to be constructed in the Gloede Drain, North Middle Branch, and West Middle Branch catchments.

Figure 2-12. Schematic of a combined sewer system.



On-site Sewage Disposal Systems

Where sanitary or combined sewer service is not available, facilities generally rely on OSDS to treat sewage. OSDS are small underground systems consisting of a tank which waste collection and treatment occurs and a drain field which disperse the effluent. OSDS systems typically serve one facility, but may serve more depending on size. These systems require routine maintenance to ensure proper functioning.

Failing systems have been documented to be a pollutant source in the Clinton River Watershed. A 1995 survey of septic systems in the Clinton River watershed (Ditschmann, 1995) showed that between 30% and 50% of certain near-water septic systems were failing between June 5th and July 6th, 1995. These failure rates are in-line with other studies in the area that documented septic system failures in the Rouge River watershed in 1994 and 1995 (Krinn, 1994; Petitt, 1995). Based on a recent survey of health departments in the state (Halverson, 2004), two key issues have been identified: 1) not enough sanitary sewer line extension will be occurring, and 2) there is a lack of authority on the local and state level to identify and remediate failing septic systems. The compounding effect of these two issues leads to the general conclusion that there will potentially be significant future problems related to septic systems.

In reference to Figure 2-11, all non-shaded areas are assumed to be served by septic systems (these non-shaded sections may also include areas that do not require sewers, e.g. natural areas). Table 2-11 summarizes this information on a catchment basis.

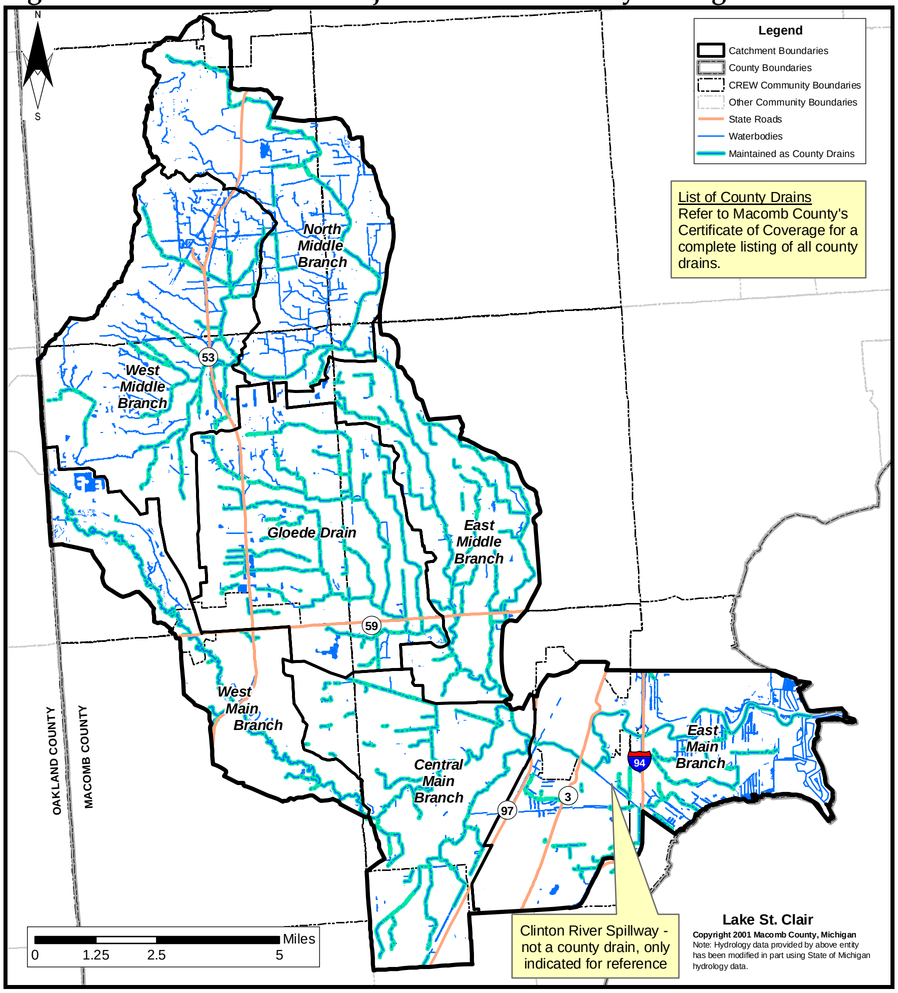
Hydrologic / Hydraulic Infrastructure

In order to best utilize the land and water, modifications are often made to drainage patterns and waterbodies. The following discussion addresses some of these issues.

Water Drainage

Water drainage alterations typically occur when open channel drains are modified and enclosed and when storm sewers are constructed. Under Michigan law, open-channel waterways fall under the jurisdiction of the county-level government if they are designated as 'county drains'. This jurisdiction includes existing as well as newly constructed waterways. The extent of county-level government jurisdiction over the waterways of the subwatershed is shown in Figure 2-13.

Figure 2-13. Waters under the jurisdiction of county-level government.



Maintained drains are 'cleaned' as needed to ensure proper hydraulic functioning. Many have also been modified to maximize hydraulic capacity (such as being widened or straightened), to pass under infrastructure (such as being routed through a culvert or enclosed), or to include protective measures (such as armored banks or check dams). MDEQ approval is not required for actions affecting drains established before 1972.

In locations where extensive open-channel drainage networks are not feasible (such as urbanized areas), storm sewers have been built. These exist for the purpose of collecting runoff from the land, utilizing catch basins and other devices, during precipitation and/or snowmelt events and routing it to waterbodies. In some cases, development may interrupt natural drainage to the point that pump stations are required to route water to its natural outlet. Because these sewers discharge directly to waterbodies, they have the potential to introduce a variety of untreated pollutants.

Inland Lake Levels

Under Michigan's Public Action No. 59 of 1995, the drain commissioner in each county is delegated to establish normal levels for inland lakes (when appropriate for flood control, recreational enhancement, and /or property protection) and maintain the levels for each lake that has a normal level defined.

Storm Sewer Catch Basin

Courtesy of MCPWO

Storm Sewer Coverage

While no comprehensive storm sewer coverage data is readily available for analysis, storm drainage systems typically cover areas where sanitary sewers exist. This includes urban areas and other residential suburban areas where surface drainage to natural waterbodies is not feasible. Storm sewers may also exist in some suburban areas serviced by individual septic systems, especially along major roads.

Storm Sewer Construction

Courtesy of MCPWO

Clinton River Flow Reversal

High lake levels (including wind-induced seiche events) have been noted to cause a condition that results in the Clinton River reversing its flow direction from its mouth where water flows upstream to the Clinton River Spillway weir, then discharging through the spillway with water flowing from the upstream areas (MDNR, 1973; USACE, 2005).

Lake St. Clair Flooding

Portions of the subwatershed on the shore of Lake St. Clair are susceptible to lake-related flooding related to strong winds and sudden barometric pressure changes (as opposed to river/stream flooding that is related to intense rain events). Flooding may also occur due to long-term hydrologic trends that cause fluctuations in lake levels. Nearly all of the shore and most canals are protected by either concrete/steel sheet piling or earthen and sandbag dikes constructed through assistance from the United States Army Corps of Engineers' 'Operation Foresight'. The Venter De Bueff Drain also has a control structures, installed under the 'Advanced Flood Protection Measures' program, for flood control when the lake levels are at flood stage. Noted problems with the dike system include: 1) areas where property owners have removed/ reduced dikes, and 2) the propensity for waters overtopping the system to be trapped when flooding recedes (FIA, 1980).

All of the communities in the subwatershed own and operate some type of storm sewer system. In addition to those directly operated by the municipalities, there are storm sewer systems associated with county- and state-owned roads under the jurisdiction of the county road commission or the Michigan Department of Transportation (MDOT). Also, there may exist other lands such as public school district, government, or condominium subdivision properties (e.g. homeowner associations) that are separate entities and have storm sewers that are within a community's system. Any separate storm sewer system within a community's system is called a 'nested system'. These nested systems and associated jurisdictional agreements are listed in Chapter 1. The National Pollutant Discharge Elimination System (NPDES) Phase II permit application submitted by each community contains a listing of all known storm sewer discharge points (outfalls) owned by the entity.

Waterbody Modifications

A number of structures exist throughout the subwatershed for flood control or other purposes. The principal structure is the 2.1-mile long Clinton River Spillway which allows flows at high river stages to bypass the main river channel (FIA, 1998). The spillway begins in Mt. Clemens, passes through Clinton Township and empties into Lake St. Clair in Harrison Township (see Figure 2-13). There are nine dams in the subwatershed, including: the Lakeside Mall Dam on the Utica Drain, the Crystal Creek Detention Dam #1, the Chestnut Lake Dam (on the Clinton River Middle Branch), the Huntington Lake control structure, the Cory Lake Dam (on a tributary to the Yates Drain), the Ford Motor Company Drain Dam, the Mather Dam on the Price Brook, the Lefever Dam (on a tributary to the Yates Drain), and Yates Dam on the Clinton River at the most upstream subwatershed location. The Selfridge Air National Guard Base, north of the Clinton River in Harrison Township, maintains its own system of drainage ditches and dikes for flooding protection.

Water Usage

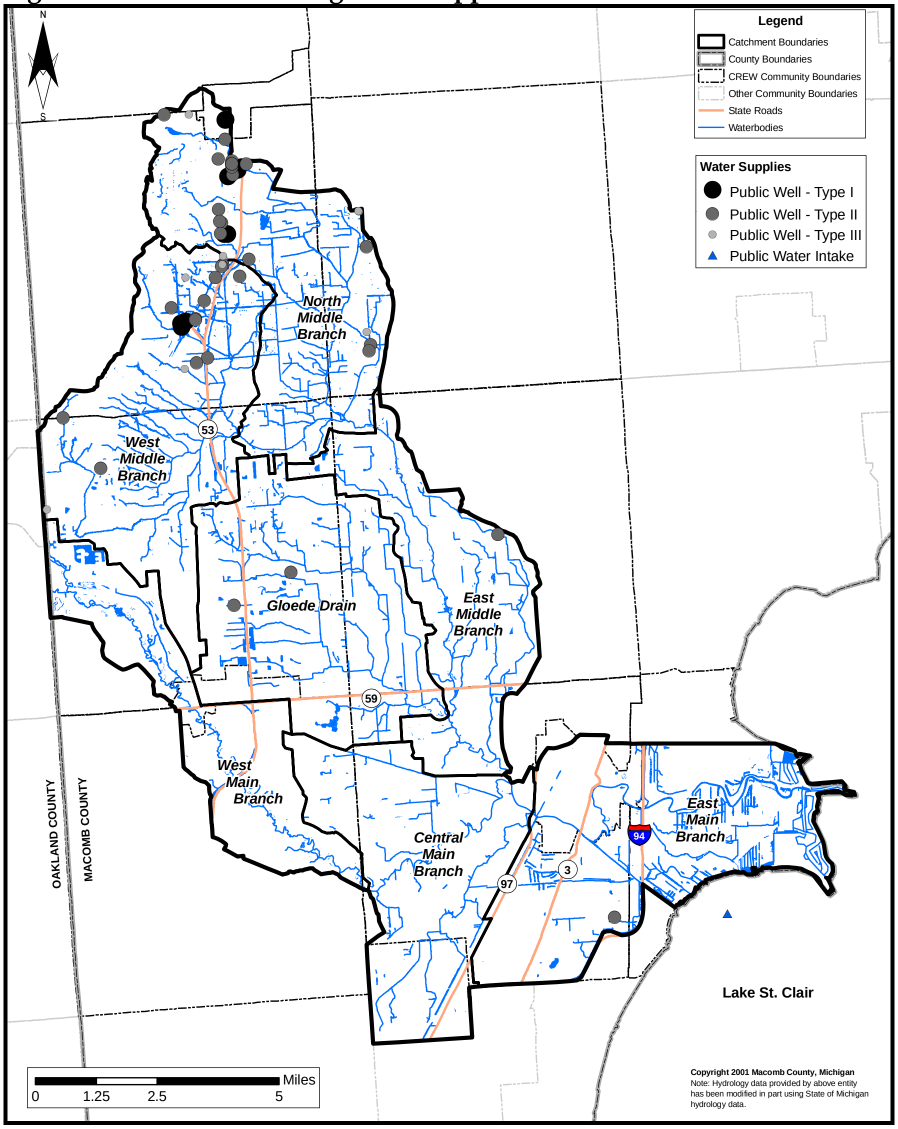
Modifications are not the only way that hydrology and hydraulics are affected. Direct water usage also has impact potential. Additionally, domestic water uses are also affected by the quality of the water.

There is one surface water supply intake in the subwatershed. It is the intake for the Mt. Clemens water treatment plant, which is a public water supply. The location of the intake can be seen in Figure 2-14. Although the water is treated before distribution, the quality of the water can be affected by the water quality in Lake St. Clair.

In addition to surface water, groundwater is also used for human purposes (including drinking and irrigation). Although often thought of as separate resources, groundwater and surface water are inextricably linked. As discussed previously, groundwater and surface water interface in most waterbodies and wetlands. As such, poor quality surface water can lead to poor quality groundwater, and vice-versa.

The most recent data indicates that there are 10 Type I public wells, 34 Type II public wells, 11 Type III public wells, and 2,767 private water wells (in addition to 79 that are defined as unknown in the State of Michigan well database). The public wells are shown in Figure 2-14. The private wells are shown in Figure 2-15. The majority of all wells in the watershed exist in the West Middle Branch and North Middle Branch catchments.

Figure 2-14. Public drinking water supplies.



Because the location data associated with the well database is of dubious accuracy, the location of many of the wells can only be taken as a general location (many show up on section/township lines if this is the only location data given; this generally places the well in the appropriate municipality).

Currently, no wellhead protection plans from communities within the subwatershed are on file with the State of Michigan. These plans are meant to minimize the potential for groundwater contamination. Romeo's wellhead protection plan is currently in the workplan stage.

For those areas of the subwatershed that are serviced through public water supplies, the majority of the communities are connected to the Detroit Water and Sewerage Department system. The exceptions include: Mt. Clemens and the part of Clinton Township bounded by the Clinton River Spillway, the Clinton River, Mt. Clemens, and Harrison Township, which are serviced by the Mt. Clemens system (Clinton Township, 2003); and the western half of Romeo and portions of Bruce Township, which are serviced by the Romeo system.

Water Supply / Well Types

Type I – Community Public Water Supply

Provides year-round service to not less than 25 residents or not less than 15 living units. Examples: municipalities, apartments.

Type II – Non-transient, Non-community Public Water Supply

Serves not less than 25 of the same people for at least six months per year. Examples: schools, industries.

Type II – Transient, Non-community Public Water Supply

Serves not less than 25 people or not less than 15 connections for at least 60 days per year. Examples: hotels, restaurants.

Type III – Public Water Supply

Anything not considered a Type I or Type II water supply; serves less than 25 people and 15 connections, or operates for less than 60 days per year. Examples: condominiums, duplexes.

Private Water Supply

Serves a single living unit. Example: single family home.

Source: MDEQ, 2005.

Typical Private Well Casing Cap

Photo source: wellaware.com, 2006.

Drinking Water Problems

A group of private wells in the Coral Avenue area of Clinton Township have been impacted by a problem that is potentially related to a collapsed sewer in 2004. Since then, these wells yield dark, sediment-laden water that tests positive for the presence of coliforms and has a distinct rotten-eggs odor.

Source: Hunt, 2006

Pollution Control / Discharge Data Sources

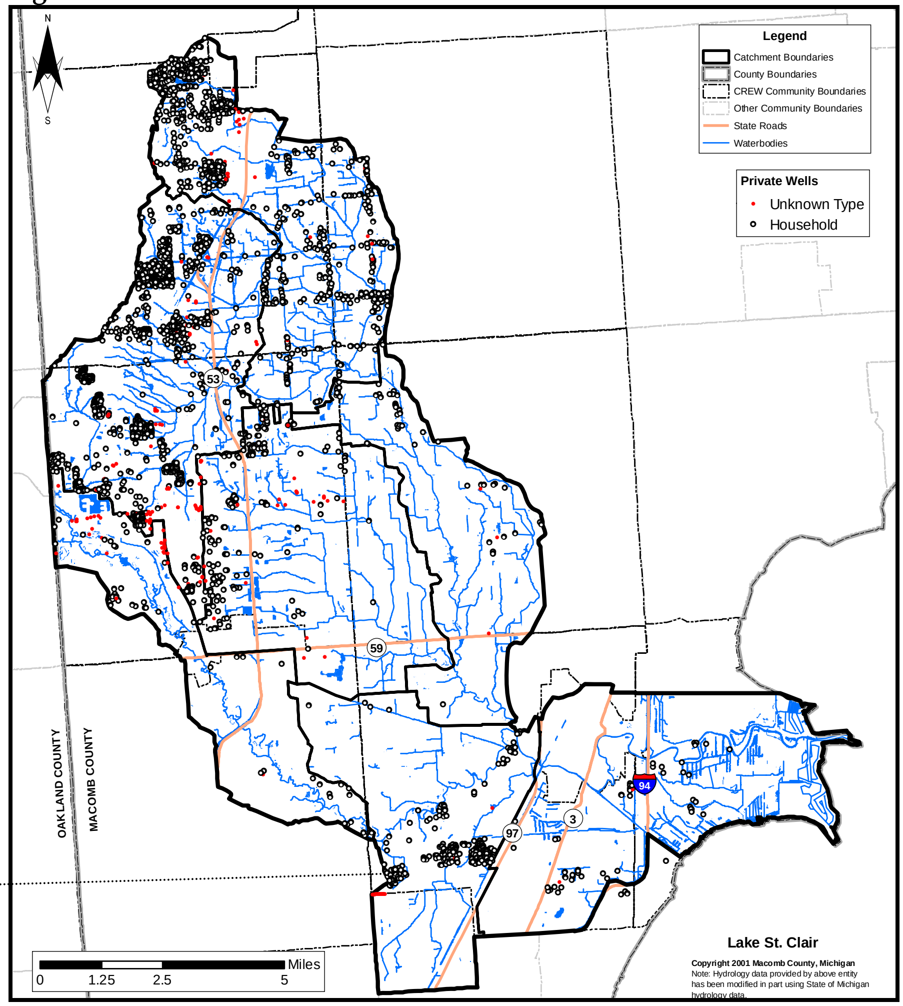
EPA NPDES
http://cfpub.epa.gov/npdes/

EPA NPL
http://www.epa.gov/superfund/sites/npl/mi.htm

MDEQ Brownfield/USTfield database
http://www.michigan.gov/deq/0,1607,7-135-3311_4110_23244--63468--,00.html

MDEQ Part 201Site Database
http://www.deq.state.mi.us/part201ss/

Figure 2-15. Private wells.



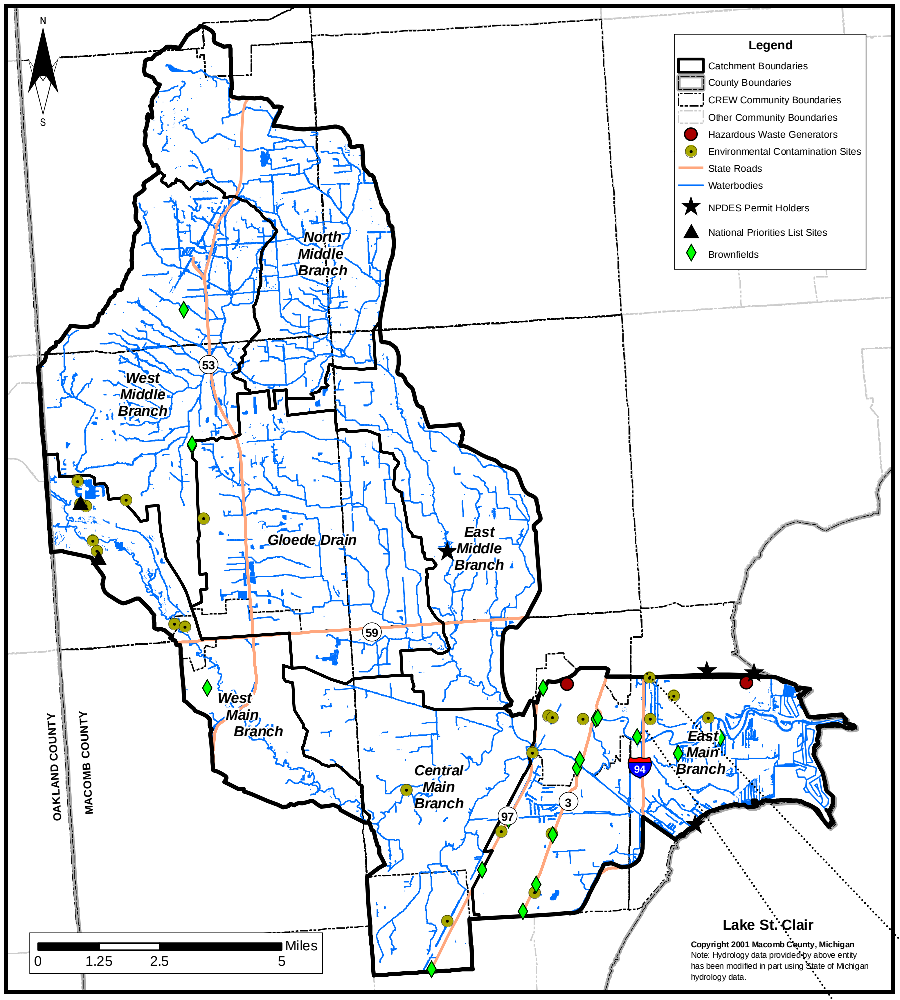
Pollution Control Facilities / Potential Discharge Points

Within the subwatershed, there are four facilities (in addition to the Mt. Clemens WWTP) that are permitted to discharge certain pollutants through the NPDES. These are the City of Mt. Clemens water filtration plant, the United States Department of Defense Selfridge ANGB facility, a Sunoco liquid petroleum pipeline, and the United States Army Tank Command facility at Selfridge ANGB. These are identified in Figure 2-16. CSO discharges may also occur from the Mt. Clemens RTF but this facility is covered under the same permit as the Mt. Clemens WWTP. There are also numerous industrial stormwater discharge permits in the subwatershed, but these are not mapped. Refer to the Clinton River Assessment (Francis, 2005) for a list of these.

There are an additional two sites in the subwatershed (both in the West Middle Branch catchment) that are included on the federal National Priorities List (NPL) as sites needing remediation: G&H Landfill (MDEQ status: remedial action in progress) and Liquid Disposal, Inc (MDEQ status: interim response in progress).

The MDEQ regulates hazardous waste generators (known as Part 111 sites). There are two of these in the subwatershed, Selfridge ANGB and the Ford Motor Company's Mt. Clemens Vinyl Plant, both in the Main Branch East catchment.

Figure 2-16. Pollution control facilities / potential discharge points.



Pollutants may be released from sites called "brownfields". These are typically abandoned facilities including gas stations, commercial business, and industrial sites. There are currently 18 of these sites in the subwatershed (12 in the East Main Branch; 2 in the Central Main Branch, 3 in the West Middle Branch, and 1 is the West Main Branch).

The MDEQ lists contaminated sites (known as Part 201 sites) where there has been a release of a hazardous substance in an amount that exceeds the established state cleanup standard for residential properties. There are currently 21 of these sites in the subwatershed (10 in the East Main Branch catchment, 8 in the West Main Branch catchment, 2 in the Central Main Branch catchment, and 1 in the Gloede Drain catchment).

The MDEQ is the permitting agency for above and below ground storage tanks. The locations of the 437 tanks in the subwatershed are shown in Figure 2-17.

Some of the tanks in the subwatershed have leaked in the past or are currently leaking. There are currently 85 open MDEQ inquiries into leaking underground storage tanks (LUSTs). Summarized by catchment, there are 52 in the East Main Branch, 10 in the Central Main Branch, 8 in the West Main Branch, 5 in the Gloede Drain, 5 in the North Middle Branch, 4 in the West Middle Branch, and 1 in the East Middle Branch.

Pollution Control Legislation

The MDEQ permits and monitors most pollution control facilities under authority given to them under Public Act 45 of 1994, specifically:

LUSTS – sections 211 and 213;

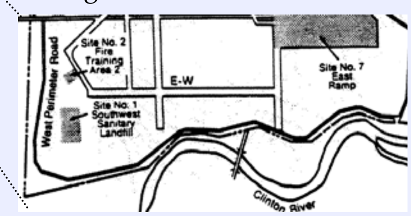
Solid Waste – section 115; and

Hazardous Waste – section 111;

in addition to numerous other sections which relate to these and other types of sites, including incentives for cleanup at contaminated locations (sections 193, 195, and 196).

Selfridge ANGB

The 1988 RAP discusses seven sites on the Selfridge ANGB that have released or have the potential for releasing pollutants (3 in the subwatershed). Groundwater was thought to be the most easily contaminated media, however, surface water contamination was also possible through runoff and baseflow.



Source: MDNR, 1988.

Dredge Spoils

A confined disposal facility exists at the mouth of the Clinton River that contains dredge spoils generated by the USACE when performing maintenance on the Clinton River channel to maintain recreational navigation.

Source: MDNR, 1988.

An Underground Storage Tank Site: Gas Station

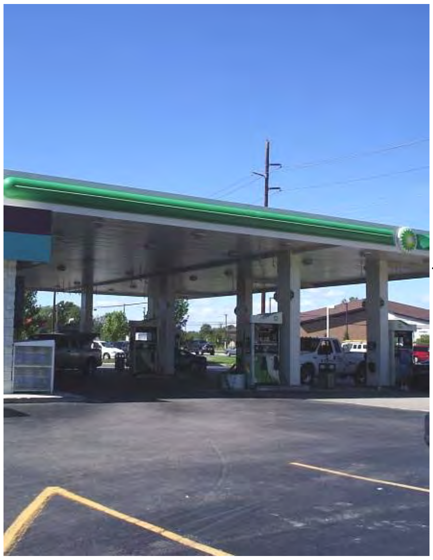
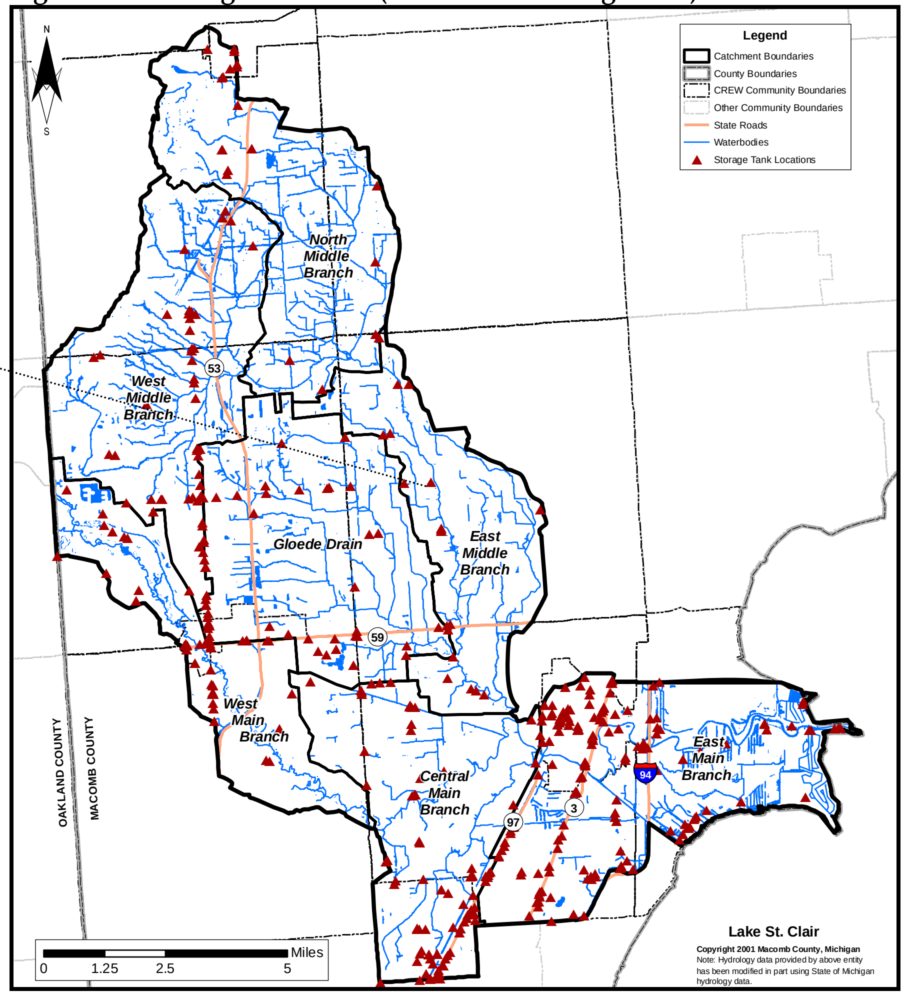


Photo courtesy of MCPWO.

Figure 2-17. Storage tank sites (above and below ground).



While not quantified here, there have also been numerous LUSTs in the past which have been satisfactorily remedied by MDEQ.

Based on the preceding pollutant source location information, point sources are of most concern in the East Main Branch catchment because it has the most identified point sources.

Transportation Infrastructure: Van Dyke Avenue in Shelby Township

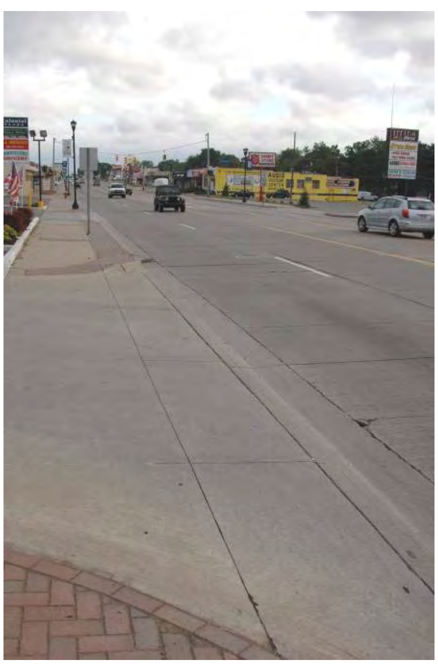


Photo courtesy of Tetra Tech.

Transportation Infrastructure

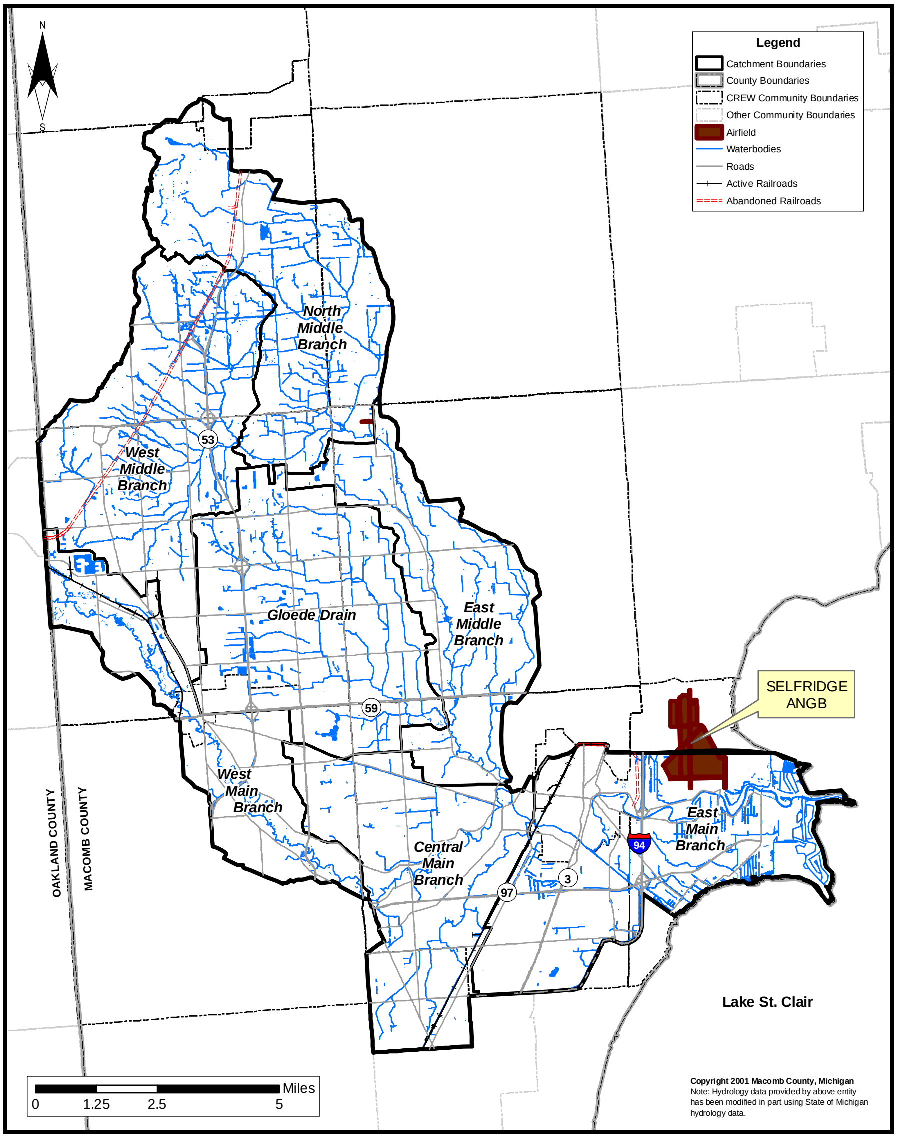
Transportation infrastructure has the potential to impact water resources through the effects of impervious surfaces and pollutant emissions/spills. This discussion is limited to facilities related to land, air, and sea travel. These facilities are mapped in Figure 2-18 and summarized in Table 2-12.

Table 2-12. Transportation infrastructure, by catchment.

Catchment	Road Miles*	Railroad Miles
Gloede Drain	247	0
Central Main Branch	260	4
East Main Branch	313	9
West Main Branch	145	7
East Middle Branch	152	0
North Middle Branch	69	0
West Middle Branch	210	< 1
Total	**1,396**	**20**

* - Each set of lanes for divided roads is counted in the total.
Source: GIS data obtained from State of Michigan: http://www.michigan.gov/cgi.

Figure 2-18. Transportation infrastructure.



By far the most numerous transportation facilities in the subwatershed are roads. There are over 1,396 miles of roads in the subwatershed. Road types range from property access roads to limited access Interstate highways. For clarity, only Interstate, U.S., and Michigan highways and arterial and collector roads are shown in Figure 2-17. I-94 is the only completely limited access highway passing through the subwatershed. Most of M-53 in the subwatershed is access limited but still provides one or two local exchanges. M-59, M-3 and M-97 are completely local access surface roads. Although not shown on the figure, there are numerous bridges/crossing structures in the subwatershed that make up an important component of transportation facilities because of their maintenance-intensive nature and the interface with waterbodies.

The other surface tranportation type of facility in the subwatershed are railroads of which there are approximately 20 miles. These include a Conrail (formerly Penn Central) line which runs through the Main Branch Clinton River – West catchment and a Canadian National line (formerly

Gratiot Ave. Bridge

Source: HB, 2005.

Mt. Clemens Train Depot

Source: MTM, 2005.

Selfridge ANGB

Source: www.air-sho.com, 2005.

Sundog Marina in Harrison Twp

Source: Sundog Marina, 2005.

Navigable Waters

The word 'navigable' is a legal term defining a waterbody as public. However, a waterbody being boat-able does not necessarily make it navigable.

The field of water law is complex and develops through both legislative and judicial action. There is a great deal of uncertainty regarding the public or private status of most of the state's streams, particularly the smaller ones.

In the subwatershed, action has only been taken to establish the navigability of certain portions of the Clinton River:

- Section 10, T2N, R12E – via Michigan Legislature in 1849;
- Upstream to Section 19, T3N, R12 – Michigan Supreme Court in 1898; and
- Mouth to Gratiot Avenue Bridge – U.S. Army Corps of Engineers in 1981.

Source: Francis, 2005.

Grand Trunk Western) which runs along the division between the Main Branch Clinton River – Central and – East catchments. Other facilities associated with railroads in the subwatershed (not on map) include depots and bridges. Additionally, numerous abandoned rights-of-way exist in the subwatershed, including a Grand Trunk Western/Conrail line between Utica and Romeo that is being turned into a trailway. Not all of the historically abandoned rights-of-way are shown in Figure 2-18.

In terms of air travel, a portion of the Selfridge Air National Guard Base (ANGB) facilities is situated in the subwatershed. Also, the Higgs Landing Strip is located in Macomb Township.

In terms of water travel, a number of marinas are situated along the banks of Lake St. Clair and the mouth area of the Clinton River. Many of the river, stream, and creek miles (although the actual number is undocumented) in the subwatershed are considered 'navigable'.

Recreation Resources

This final infrastructure category includes facilities where WMP-related education activities may be fruitful, includes places that should be preserved, and highlights locations where peopled interact with their environment.

Historical and Cultural Sites

Historical and cultural resources in the subwatershed define an essential component of the character of the people. They define traditional and current values and may present unique opportunities for watershed management planning activities. The designated historical facilities include government buildings, schools, religious buildings, residences, and libraries. The cultural resources include existing schools, markets, museums, shopping malls, and old fashioned downtowns.

These resources are summarized in Table 2-13. Figure 2-19 displays the location of these resources.

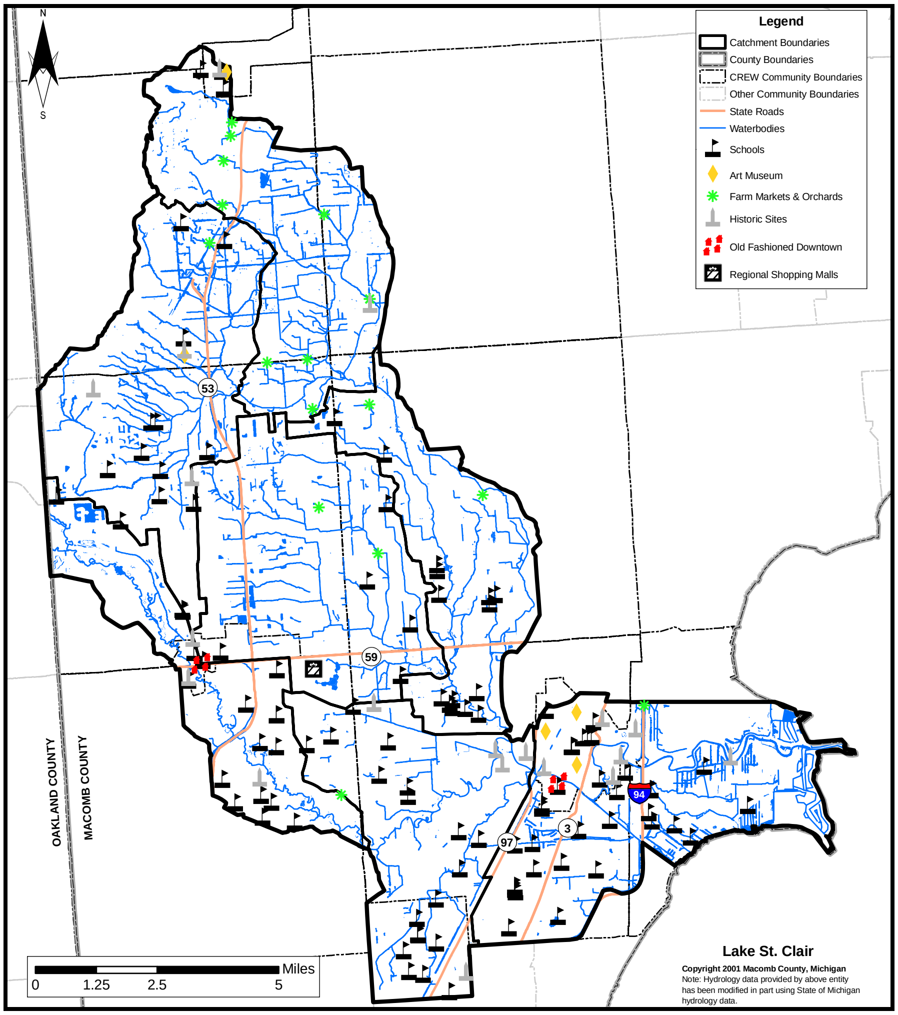
Table 2-13. Historical/cultural sites in the subwatershed, by catchment.

Catchment	Historical Sites	Cultural Sites	Public School Facilities
Gloede Drain	3	4	6
Central Main Branch	4	0	19
East Main Branch	6	5	37
West Main Branch	2	2	16
East Middle Branch	0	2	16
North Middle Branch	2	2	13
West Middle Branch	3	10	3
Total	**20**	**25**	**110**

Source: GIS data from Macomb County and SEMCOG.

There are 20 historical sites, 25 cultural sites, and 110 public school facilities in the subwatershed. The East Main Branch catchment has the most historical sites with 6 and the most public school facilities with 37. The West Middle Branch catchment has the most cultural sites with 10. Please contact the local or county government to obtain a list of specific sites and their addresses.

Figure 2-19. Historical/cultural sites in the subwatershed.



Nature Areas / Parks

Nature areas and parks allow citizens to interact with the natural environment. These recreation areas include parks and trails and are maintained by a number of organizations including: the Huron-Clinton Metropolitan Authority, local municipalities, and private groups. Table 2-14 provides a breakdown of these areas by catchment.

Table 2-14. Nature area / park summary.

Catchment	# of Areas[1]	Total Area[1,2]	Trail Miles
Gloede Drain	9	418	14
Central Main Branch	18	284	23
East Main Branch	21	903	46
West Main Branch	13	1,632	27
East Middle Branch	3	88	14
North Middle Branch	2	28	12
West Middle Branch	5	567	28
Total	**68**	**3,915**	**164**

1 - Number for each catchment includes portions of parks that cross boundaries. Total reflects total number in the subwatershed. 2 - Does not include trail miles.

The largest recreation areas in the subwatershed are listed in Table 2-15. Their locations are shown in Figure 2-20.

Historical Site – Carnegie Library, Mt. Clemens

Source: michmarkers.com, 2005.

Archaeological Sites

Although data was not available for mapping, there are approximately 90 archaeological sites in the subwatershed.

Source: Francis, 2005.

Memorial Park – St. Clair Shores

Courtesy of MCHD

Nature Areas and Parks

Given the public ownership of most recreation areas, they are ideal places to pursue the conservation of natural areas and implement other restoration or water quality protection measures.

Table 2-15. Largest nature areas / parks in the subwatershed.

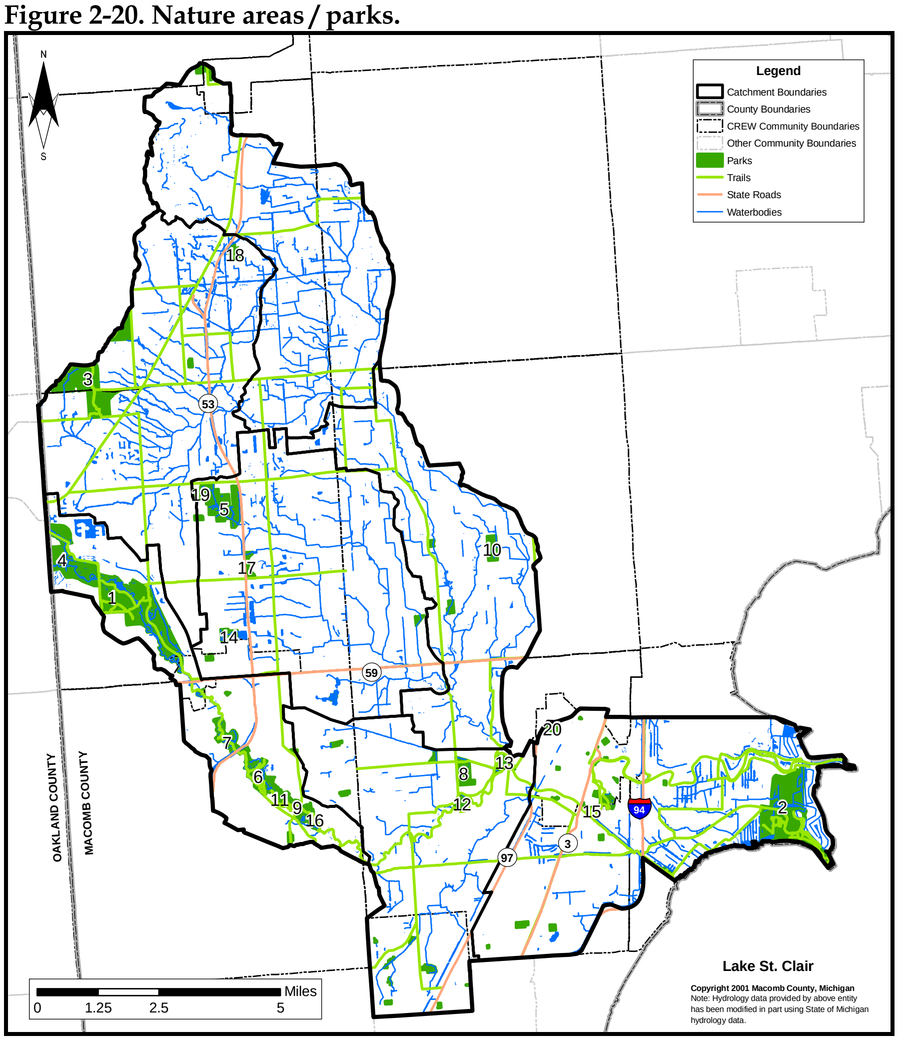
Recreation Area	Acres	Municipality	Catchment
1. River Bend/Woodall/Shadbush Park	769	Shelby Township	West Main Branch
2. Metro Beach Metropark	732	Harrison Township	East Middle Branch
3. Stony Creek Metropark	516	Shelby and Washington Township	West Middle Branch
4. Holland Ponds Park	385	Shelby Township	West Main Branch
5. Cherry Creek Golf Course	242	Shelby Township	Gloede Drain
6. Dodge Park	180	Sterling Heights	West Main Branch
7. North Clinton River Park	100	Sterling Heights	West Main Branch
8. Civic Center Park	97	Clinton Township	Central Main Branch
9. Kleino Property (South)	72	Sterling Heights	West Main Branch
10. MDOT Wetlands	60	Macomb Township	East Middle Branch
11. Connecting Property (Greenbelt)	49	Sterling Heights	West Main Branch
12. Frank H. Budd Park	48	Clinton Township	Central Main Branch
13. Mill Park	46	Clinton Township	Central Main Branch
14. Whispering Woods Park	46	Shelby Township	Gloede Drain
15. Shadyside Park	43	Mount Clemens	East Main Branch
16. Clinton River Park East	41	Sterling Heights	West Main Branch
17. Lombardo Park	40	Shelby Township	Gloede Drain
18. Barnabo Field	39	Washington Township	West Middle Branch
19. Heritage Gardens Municipal Center	35	Shelby Township	Gloede Drain
20. Memorial Park	30	Mount Clemens	East Main Branch

Recreational Use of Waters for Fishing

Most of the waterways in the subwatershed are open all year for fishing with an 8-inch minimum size limit and a 5 fish daily possession limit, no more than 3 of which may be 15 inches or longer. However, Brown trout, Brook trout, and Atlantic Salmon cannot be taken from the Clinton River after September 30th and before the last Saturday in April. The Clinton River also has length limits for Brown trout, Rainbow trout, Splake, and Coho, Chinook, and Pink salmon of 10"; for Atlantic salmon of 15"; and for Lake Trout of 24". Also, no more than 1 Atlantic salmon may be taken.

HURON-CLINTON METROPARKS

Figure 2-20. Nature areas / parks.



References

Charter Township of Clinton. “Drinking Water Quality Report” Via: http://www.clintontownship.com/w&s/drnkreport03.pdf#search='2003%20Clinton%20Township%20Drinking%20Water%20Quality%20Report'. Last accessed: June 23, 2006.

City of DeWitt. “Parks and Recreation – 5-year Master Plan” Via: http://www.dewittmi.org/web/documents/ATT109335_000.pdf. Last accessed: April 20th, 2006.

Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U. S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Online.Via: http://www.npwrc.usgs.gov/resource/1998/classwet/ classwet.htm (Version 04DEC98). Last accessed: April 20th, 2006.

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.

Ditschmann, E.P., et al. Clinton River Watershed On-Site Sewage Disposal System Survey. 1995.

Federal Insurance Agency [FIA] – Federal Emergency Management Agency. “Flood Insurance Study – Clinton Township.” August 1998.

Federal Insurance Agency [FIA]– Federal Emergency Management Agency. “Flood Insurance Study – Harrison Township.” November 1980.

Federal Interagency Stream Restoration Working Group [FISRWG]. “Stream Corridor Restoration: Principles, Processes, and Practices.” 1998.

Francis, J.T. and R.C. Haas. 2005. “DRAFT Clinton River Assessment.” Michigan Department of Natural Resources.

Great Lakes Commission [GLC]. “Lake St. Clair Coastal Habitat Assessment: With Recommendations for Conservation and Restoration Planning.” 2005.

Great Lakes Information Network [GLIN]. “Weather and Climate in the Great Lakes” website. Via: http://www.great-lakes.net/envt/refs/ weather.html. Last accessed: April 15th, 2005. Great Lakes Commission.

Halvorsen K.E, et al. “Strengths and Weaknesses of Great Lakes Onsite Sewage System Regulatory Programs.” 2004.

Historical Bridges [HB] of Michigan and Elsewhere. *Website*. Via: http://www.pcnate.com/bridges/b_c_mi_macomb.htm. Last accessed: July 20, 2005.

Huff, F.A. and Angel, J.R. “Rainfall Frequency Atlas of the Midwest.” 1992. Midwestern Climate Center.

Hughes, S. “Slope Failure.” Website. Via: http://geology.isu.edu/ wapi/envgeo/EG4_mass_wasting/EG4-MassWasting_large.pdf. Last accessed: September 14, 2005.

Hunt, A. “Stinky, dirty water irks Clinton Twp. Residents.” Detroit Free Press. October 13, 2006.

Krinn, Keith, L., et al. *1994 Rouge River headwaters on-site sewage disposal system survey*. Oakland County Health Division. 1994.

Lake St. Clair Conference Summary Report [LSCCSR]. “Lake St. Clair: It’s Current State and Future Prospects.” 2000.

Leopold, L.B. 1969. “Landscape esthetics: How to quantify the scenics of a river valley.’ Natural History 78 (8):36-45.

Leopold, L.B. 1994. “A View of the River.” Harvard University Press. Cambridge, Massachusetts.

Macomb County Department of Planning and Economic Development [MCPED]. “Potential Conservation/Natural Areas Report.” March 2004.

Macomb Daily News. “Great blue herons find Clinton River good spot to nest.” Published: May 9, 2006 via http://www.macombdaily.com/stories/050906/loc_herons001.shtml. Last accessed: June 27, 2006.

Michigan Department of Environmental Quality [MDEQ]. “Combined Sewer and Sanitary Sewer Overflow Information System.” Via: http://www.deq.state.mi.us/csosso/. Last Accessed: August 11, 2006.

Michigan Department of Environmental Quality [MDEQ]. “Sanitary Sewer Overflow (SSO) Summary Report.” Annual Report, 2000, 2001, 2002, 2003, 2004, and 2005.

Michigan Department of Environmental Quality [MDEQ]. “What is a community public water supply?” Via: http:// www.michigan.gov/deq/ 0,1607,7- 135-3313_3675_3691-9577--,00.html. Last accessed: January 10th, 2005.

Michigan Department of Environmental Quality [MDEQ]. “Wetland Identification Manual.” 2001. Via: http://www.michigan.gov/deq/. Last accessed: May 5th, 2005.

Michigan Department of Environmental Quality [MDEQ]. “Stormwater Management Guidebook.” 1999.

Michigan Department of Natural Resources [MDNR]. “Biological Survey of the Clinton River: Pontiac to Mouth.” 1973a.

Michigan Geographic Data Library. *1800 Land Cover Datasets*. Via: http://www.mcgi.state.mi.us/mgdl/. Last accessed: July 7th, 2005.

Michigan Historical Markers. Website. Via: http://www.michmarkers.com/. Last accessed: July 20, 2005.

Michigan Natural Features Inventory [MNFI]. Via: http://web4.msue.msu.edu/mnfi/home.cfm. Last accessed: February 24th, 2005.

Michigan Transit Museum [MTM]. Website. Via: http://www.alexxi.com/mtm/. Last accessed: July 20, 2005.

Midwest Regional Climate Center [MRCC]. Via: http://www.sws.uiuc.edu/. Last accessed: Jan. 12th, 2005.

National Climatic Data Center [NCDC]. “United States Climate Normals, 1971-2000: National Weather Service Snow Normals”. October 1, 2002.

National Climatic Data Center [NCDC]. “Climatic Wind Data for the United States”. November 1998.

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

Natural Resources Conservation Service [NRCS], Soil Survey Staff. United States Department of Agriculture. State Soil Geographic (STATSGO) Database for Michigan. Via: http://www.ncgc.nrcs.usda.gov/ products/datasets/statsgo/index.html. Last accessed: April 20th, 2006.

Natural Resources Conservation Service [NRCS]. “Urban Hydrology for Small Watersheds”. Technical Release 55. 1986.

North American Lake Management Society [NALMS]. Via: http://www.nalms.org/ glossary/lkword_d.htm. Last accessed: February 24th, 2005.

Oakland County. “Oakland County’s History and Heritage.” Via: http://www.co.oakland.mi.us/about/history. Last accessed: December 17th, 2004.

Petitt, Julie A., et al. 1995 Rouge River headwaters on-site sewage disposal system survey. Oakland County Health Division. 1995.

Plotnik, Arthur, "The Urban Tree Book: An Uncommon Field Guide For City and Town", Three Rivers Press, NY, 2000, 7-8.

Sierra Club. “Where Rivers are Born: The Scientific Imperative for Defending Small Streams and Wetlands.” 2003.

Smith, et al. “Explore Our Natural World: A Biodiversity Atlas of the Lake Huron to Lake Erie Corridor.” 2002.

Southeast Michigan Council of Governments [SEMCOG]. “Population and Households in Southeast Michigan, 2000-2005.” September 2005.

Southeast Michigan Council of Governments [SEMCOG]. “Population and Households in Southeast Michigan, 2000-2004.” September 2004a.

Southeast Michigan Council of Governments [SEMCOG]. "Nonresidential Development in Southeast Michigan, Summary 2003. April 2004b.

Southeast Michigan Council of Governments [SEMCOG]. "Residential Construction in Southeast Michigan, 2003". April 2004c.

Southeast Michigan Council of Governments [SEMCOG]. "Historical Population and Employment by Minor Civil Division, Southeast Michigan." June 2002.

Southeast Michigan Council of Governments [SEMCOG]. "2030 Regional Development Forecast for Southeast Michigan: Population, Households, and Jobs, for Cities, Villages, and Townships 1990-2030." October 2001a.

Southeast Michigan Council of Governments [SEMCOG]. "Detroit and 300 Years of Metropolitan Growth." June 2001b.

The Physical Environment [TPE]. Website. Via: http://www.uwsp.edu/geo/faculty/ritter/glossary/s_u/soil_creep.html. Last accessed: September14th, 2005.

United States Census Bureau [USCB]. "Year 2000 Census." 2000

United States Army Corps of Engineers [USACE]. "Clinton River Sediment Transport Modeling Study – DRAFT." 2005.

United States Army Corps of Engineers [USACE]. "Lake St. Clair, Michigan Aquatic Plant Management Investigation." September 1996.

United States Department of Agriculture [USDA]. "Soil Survey for Macomb County, Michigan." 1971.

United States Geological Survey [USGS]. "Average Annual Runoff, 1951-1980." 1986.

University of California-Berkeley. Website. Via: http://www.ucmp.berkeley.edu/bacteria/bacterialh.html. Last accessed: August 8th, 2005.

Pictures

AirSho. *Website*. Via: http://www.airsho.com/harisntp.htm. Last accessed: July 20, 2005.

Colorado State University [CSU]. "Meandering River Channels". Via: http://www.waterknowlege.colostate.edu/meander.htm Last Accessed: January 20th, 2005.

Eastern Kentucky University [EKU]. "Lilley Cornett Woods." Via: http://www.naturalareas.eku.edu/lcw/lcw13.jpg. Last accessed: July 7th, 2005.

Ellsworth, David. "About Plant Physiological Ecology." Via: http://wwwpersonal.umich.edu/~ellswor/About_Phys-Ecol.html. Last accessed: July 7, 2005.

Fly Fish Michigan LLC. "Fly Fish Michigan – Hex." Via: http://flyfishmichigan.com/hex.htm Last accessed: June 21, 2006.

Infiltrator Systems. *Website*. Via: http://www.infiltratorsystems.com/pix/g_onsitesystem.jpg. Last accessed: April 20th, 2006.

Land and Water Australia [LWA]. "Streambank Stability." 2004.

Marist College, 2005. "The Plan" Website. Via: http://library.marist.edu/diglib/EnvSci/archives/hudsmgmt/ny-njharborestuaryprogram/theplan.html. Last accessed: April 20th, 2006.

Michigan State University Extension [MSUE]. 2006. "Wavy-rayed Lampmussel." Via: http://web4.msue.msu.edu/mnfi/abstracts/aquatics/Lampsilis_fasciola.pdf . Last accessed: June 21, 2006.

Southeast Michigan Council of Governments [SEMCOG]. "Population and Households in Southeast Michigan, 2000-2004." September 2004.

Sundog Marina. *Website*. Via:http://www.sundogmarina.com/. Last accessed: July 20, 2005.

Washington Township. "Washington Township" *Website*. Via: http://www.washingtontownship.org/. Last accessed: March 24, 2005.

Water Technology. *Website*. Via: http://www.watertechnology.net/projects/detroit_waste2/detroit_waste21.html. Last accessed: July 20 2005.

3. Documented Subwatershed Conditions

Introduction

The previous chapter discussed the natural environment, the human population, and their infrastructure in the subwatershed. This chapter discusses how humans and their infrastructure impact the natural environment, by:

- Discussing, in general terms, what human activities impact the environment and what the effects are;
- Defining the indicators used to assess the health of the environment;
- Briefly discussing past pollution sources and trends;
- Summarizing historical and current reports of water quality;
- Presenting the results of some preliminary assessments used to quantify the health of the environment;
- Discussing the current environmental protection practices implemented by the communities comprising the subwatershed; and,
- Presenting the impairments to waterbodies based on the findings of the Michigan Department of Environmental Quality (MDEQ).

Infrastructure

The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons.

Source: American Heritage Dictionary.

Lakeside Mall Parking Lot in Sterling Heights

Courtesy of MCPWO

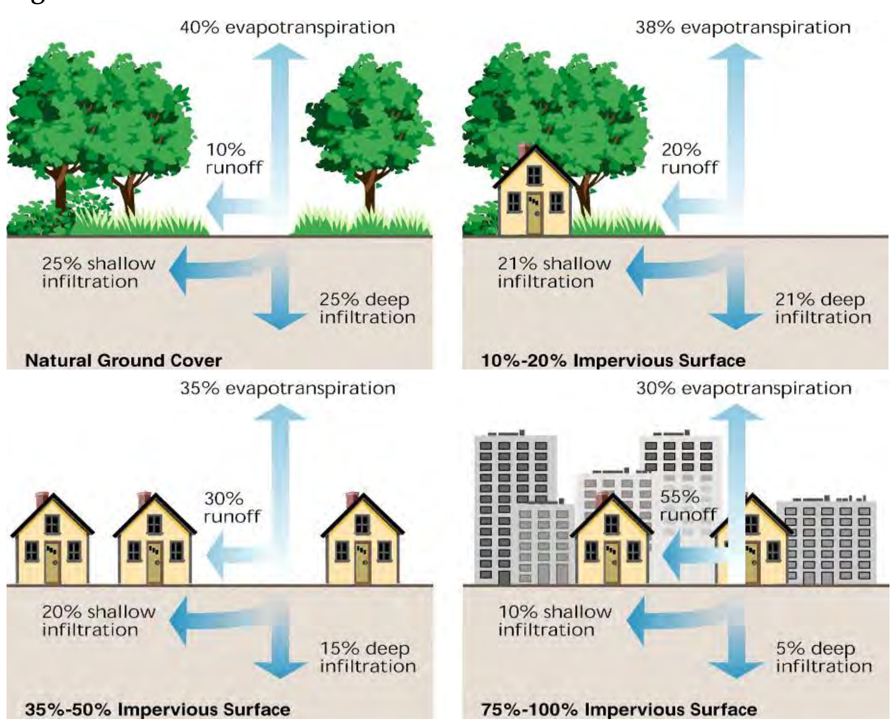
Environmental Impacts of Human Activity

There are numerous ways in which people and infrastructure influence the natural environment. This section presents a general discussion of these impacts. More detailed information can be found later in the chapter.

Impervious Surface

The conversion of natural landscapes into urban landscapes (i.e., rooftops, streets, parking facilities) results in surfaces impervious to the infiltration of stormwater. This causes increase in: 1) the frequency of rainwater runoff reaching waterbodies; 2) the total volume of runoff, and 3) the peak flow rate of runoff. This is illustrated in Figure 3-1.

Figure 3-1. Effects of urbanization on runoff.



Source: FISRWG, 1998.

Changes in runoff characteristics cause similar changes in the discharge of receiving waterbodies (e.g. increased flow volume, increased peak flows). Consequently, channels experience more bankfull flood events each year and are exposed to erosive velocities for longer intervals (which modify channels and increase sediment load). Since impervious cover prevents rainfall from infiltrating into the soil, less rainwater is available to recharge groundwater. Consequently, during extended periods without rainfall, baseflow levels are often reduced.

Impervious surfaces also generate runoff that carries increased sediments, nutrients, and other pollutants and cause additional water quality problems such as increased water temperature, excess plant and algal growth, and dissolved oxygen depletion.

Because of the effects of imperviousness, the percent of impervious surface coverage in a watershed, or subwatershed, can be used as an indicator to predict the severity of differences in the character of urban and natural basins. Generally speaking, higher levels of impervious surface coverage lead to adverse effects in the physical, chemical, and biological integrity of the waters (Schueler, 1994).

Impervious Surfaces and Storm Sewers

While impervious surfaces cause numerous hydrologic problems, these are often exacerbated by the presence of enclosed storm sewers which introduce additional hydraulic problems (see Chapter 2).

Alteration of the Riparian Corridor

Development that alters the riparian corridor (i.e. land adjacent to a waterbody) exacerbates the problems associated with impervious surfaces by reducing or removing the soil and vegetation that act to filter pollutants, mitigate temperatures, and slow runoff rates. Additional problems include:

- The removal of woody growth (which eventually dies and falls into the waterbody) eliminates an important microbiological food source and near-shore fish habitat;
- Development along streambanks and shorelines, which fragments riparian habitat; and
- Buildings and structures occupying volume that reduces the amount of flood storage available.

A Building in the Floodplain - Shelby Township near 21 Mile Rd

Courtesy of CRWC

Streambank / Shoreline / Waterbody Modifications

Modifications to streambanks, shorelines, and the waterbodies themselves range from passive actions that are inconsequential as isolated events and easily repairable to specific activities that are very serious in nature and hard to reverse. A range of activities is listed below (Waters, 1995):

- Ad hoc human trails down or along banks tend to kill vegetation and expose bare soils that can subsequently be more easily eroded. These include walking, biking, off-road vehicle (ORV) trails, and roads;
- Removing deep-rooted vegetation on or near the banks or shoreline makes the soil more prone to erosion from high flow rates or intense wave action;
- Livestock near or in waterbodies tend to trample and over-graze vegetation and their hooves cleave consolidated soils. These actions leave the soil more susceptible to erosion;
- Open pit mining and sand/gravel extraction operations in or near a waterbody alter the natural channel and banks resulting in increased erosive activity as the stream attempts to attain equilibrium;
- Meanders are important components of the energy balance in a stream, but historical practice has been to straighten channels to provide for quick removal of water to prevent flooding. Removing or reducing the bends of a stream shortens the effective flow length of

Straightened Section of the Middle Branch of the Clinton River in Macomb Township

Derived from images provided by MCPED.

Effects of Clinton River Spillway Weir

The construction of the Clinton River Spillway in 1952 has alleviated some flooding problems in the lower portion of the Clinton River but has resulted in sedimentation and water quality issues.

- The decreased velocities near the spillway weir result in sediment deposition and buildup.
- The occurrence of short-term Lake St. Clair water level fluctuations (lake seiches) results in reversals of flow in the Clinton River such that water flows from the natural mouth up to the spillway weir and back to Lake St. Clair through the spillway. Thus, the lower portion of the river often acts as an estuarine extension of Lake St. Clair resulting in pollutant buildup that is only flushed during wet weather. Additionally, contaminant plumes and sediment may migrate from the lake and move upstream.

Modifications to the weir in 1997 have attempted to alleviate this problem by making the weir height dependent on the Lake St. Clair water level, thus attempting to minimize flow reversal problems and route more dry-weather flow down the natural channel. However, under the right conditions, reverse flow can still occur, and may occur along the banks even when a moderate flow rate is being seen moving downstream in the natural channel.

Source: USACE, 2005.

the channel, thus increasing the slope. This causes water to flow faster and intensifies erosion in the channel near the modification and increases sedimentation further downstream, as the stream seeks to naturally create new meanders;

- Introducing bridges, culverts, break walls, hard-engineered shorelines, and armored streambanks serve both to eliminate terrestrial and aquatic habitat and deflect wave energies that may exacerbate erosion problems elsewhere. Problems are magnified when these type of structures are poorly designed, constructed and/or maintained;
- Altering the channel by installing concrete lining or enclosures removes all natural processes and protections, creating a reach that is inhospitable to life and unable to protect itself from pollution;
- Creating artificial drainage promotes sedimentation, contributes to the degradation of wetlands, reduces water storage, and alters drainage patterns (Francis, 2005);
- Constructing dams which alter flow regimes, block fish passage, fragment aquatic communities, and change temperature profiles in the water column (Francis, 2005); and
- Inadequate bank protection during in-stream construction activities leaves the banks susceptible to erosion.

Over-development

Development is an important component of human economic and cultural growth. However, unmanaged development (especially development in sensitive areas such as wetlands) has the potential to cause a number of locally irreversible situations (in addition to those discussed previously):

- Natural feature and wildlife habitat loss from land use changes;
- Creation of unnatural habitat that encourages concentrated populations (e.g. geese) and creates animal waste contamination;
- Vegetative cover / tree canopy loss leading to heat island effects;
- Loss of soils, due to poor construction practices and streambank erosion;
- Loss of aquatic habitat, due to poor water quality and enclosing open channel waterways; and
- Loss of groundwater services (e.g., recharge, pollutant removal).

Pollution Control Facilities

Pollution control facilities generally perform in ways to prevent environmental pollution. However, when these facilities do not function properly they tend to release elevated amounts of pollutants. Some examples include:

- Sanitary sewer systems which cannot handle excessive flow rates and discharge sewage to waterbodies (sanitary sewer overflows);
- Sanitary sewer leads from residences or businesses that are improperly connected to storm sewers (illicit connections);
- Landfills that do not properly control leachate and/or runoff and allow flow to reach nearby waterbodies (illicit discharges); and
- Failing septic systems that perform little or no treatment on sewage (illicit discharges).

Historical Policies and Practices

Practices and policies from earlier times continue to affect water quality, such as:

- The use of combined sewer systems that are designed to discharge diluted sewage into waterways during wet weather conditions;

- The unregulated discharge of industrial pollutants into waterways which pollute sediments and can linger for generations;
- The under-regulated discharge of airborne pollutants which can deposit themselves in waterways (e.g., mercury and acid rain); and
- The unregulated disposal of refuse in non-engineered 'dumps'.

Non-point Source Pollution

Non-point source pollution is typically generated from dispersed sources that can collectively create problems, such as: agricultural runoff (animal waste, fertilizers, pesticides); trash/debris (which tends to accumulate at specific locations); and runoff from roads (oils and grease, salt, sediments).

Intentional Actions

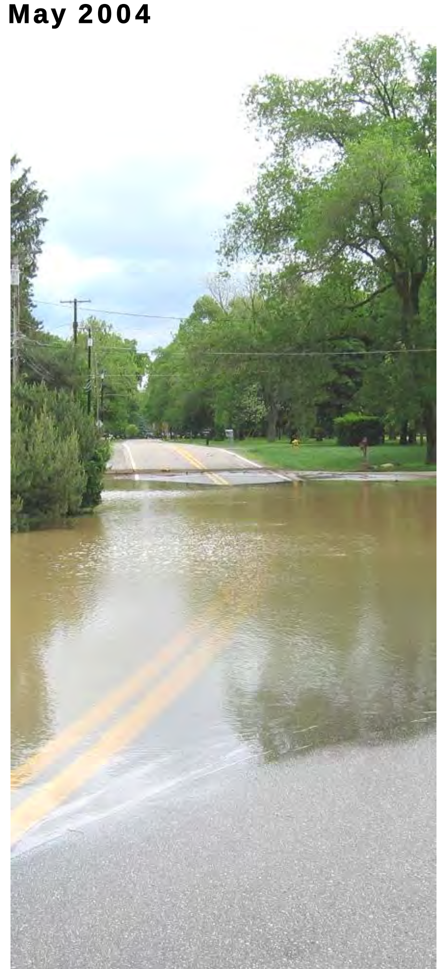
High levels of pollutants also can be intentionally introduced into the environment. For example, some residents may unlawfully discharge substances such as paint or motor oil into storm drains or unscrupulous businesses may discharge barrels or truckloads of pollutants into waterways to avoid the costs of proper disposal of the wastes.

Unintentional Consequences

Many of the previously discussed problems are unintended consequences of human activities. Some other unintentional consequences of human activity that have a detrimental environmental effect include:

- *The introduction of non-native species* - Ballast water from ships has been the source of many non-native species found in the Great Lakes. Also, people import plants or animals from other parts of the world and may accidentally or intentionally release them into the wild. Some of the non-native species may flourish in their new habitat and wreak havoc on local eco-systems. These are usually referred to as 'invasive' species;
- *Climate change* – This consequence of human activity results from mankind's dependence on fossil fuels in such things as automobiles and power plants. By-products of fuel consumption produce compounds that cumulatively trap heat in the earth's atmosphere resulting in changing weather patterns (temperature and precipitation) and altering habitats. Although there is scientific debate about the extent of climate change caused by human activity, its potential consequences require acknowledgement;
- *Extinct and endangered species* – While extinction is a process that occurs in the natural environment, activities such as over-development which destroy habitat and over-hunting or over-fishing certain species result in the endangerment, extirpation, or extinction of these species;
- *Flooding* – Any number of modifications to land cover or waterbodies may increase the potential for flooding frequency or magnitude. This includes many flood control measures which often have the effect of sparing flooding in one location for additional flooding in another; &
- *Other* – A complete list is impossible, but some examples include:
    - The use of motor boats may result in the discharge of pollutants into waters from engine exhaust;
    - The use of propellers in shallow areas can disrupt benthic habitat and organisms and may stir up settled pollutants; and
    - Dredging in waterbodies severely impacts benthic habitat and organisms and may impact hydraulic characteristics.

Clinton River Flooding – May 2004



Courtesy of MCPWO

Measuring Impacts: Water Quality Metrics

There are several methods available for assessing environmental impacts. An acceptable assessment practice involves comparing measured pollutant levels or other qualitative indicators against regulatory and other scientifically valid standards or values. This gives a glimpse into the relative health of a waterbody and this data, when compared over time, can be used to gauge trends in water quality. A number of quantifiable and qualitative standards and indicators are discussed in this section to provide a background against which to consider the water quality discussion presented later in the chapter. These have also been considered in the development of the short-term objectives and long-term goals for the subwatershed in addition to the methods for evaluating the effectiveness of the plan.

Water Quality Standards

Water quality standards are the foundation of the water quality-based pollution control program mandated by the Clean Water Act.

Water quality standards define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions to protect waterbodies from pollutants.

Source: EPA, 2005a.

Water Quality Standards

The Michigan Department of Environmental Quality (MDEQ) has defined a number of water quality standards (WQS) that define the minimum requirements to which the waters of the state are to be managed (Michigan, 2006). The general WQS[1], along with specifically regulated pollutants, are presented in Table 3-1[2].

The WQS are intended to:

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

Table 3-1. Water quality standards.

Rule #	WQS	Specific Pollutants
50	Physical Characteristics	Turbidity, Color, Oil films, Floating solids, Foams, Settleable solids, Suspended solids, Deposits
51	Dissolved Solids	General dissolved solids, Chlorides
53	Hydrogen Ions (pH)	Acids, Bases
55	Taste / Odor Producing Substances	
57	Toxic Substances	Arsenic, Cadmium, Chromium, Copper, Cyanide, Dieldrin, Endrin, Lindane, Mercury, Nickel, Parathion, Pentachlorophenol, Zinc, others as listed (including PCBs) or determined based on processes listed in rule
58	Radioactive Substances	
60	Plant Nutrients	Phosphorus, others as determined by rule
62	Microorganisms	*Escherichia coli*, Fecal coliforms, others as determined by rule
64, 65	Dissolved Oxygen	
69, 70, 72, 73, 75	Temperature	
100	Designated Uses	-- refer to following discussion

Source: Michigan, 2006. Note: The WQS are subject to change at any time.

[1] Only those directly related to pollutants are presented. There are also numerous procedural WQS (such as the anti-degradation policy) that define the applicability of standards and detail policies related to their interpretation.

[2] The regulated levels for each pollutant are defined in the appropriate rule. In some instances, the regulated level is not explicit and must be determined based upon a specified calculation method. Refer to the standards for more detailed information.

Designated Uses

Designated Uses are an important subset of MDEQ's WQS. They define recognized important uses for waterbodies that are regulated by the state. The Designated Uses are:

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

One of the first things to come to mind in terms of the quality of water is its use for drinking. This is an extremely important use because a clean source of drinking water, free from contaminants, is vital to human health.

Communities in the subwatershed use both surface water and groundwater for drinking water supplies. Even though the designated uses apply specifically to surface waters, the uses also help protect groundwater drinking supplies which are often affected by surface water conditions.

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

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 'Warmwater and Coldwater Fisheries' uses also ensure healthy fish populations, increase recreational enjoyment of fishing, and ensure a thriving fishing industry (which 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; and
- The 'Navigation' use ensures that the state's waterways are passable and the 'Body Contact' uses ensure that people can safely recreate (e.g. wade, swim). These uses contribute to the lure of many travelers vacationing during the summer.

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

Waterbody Status

In the framework of the WQS, those waterbodies with identifiable or foreseeable problems are classified as such:

- **Threatened** waterbodies currently meet all WQS, but there is reason to expect (e.g. declining water quality trends) that WQS will be violated in the future; and
- **Impaired** waterbodies do not fully meet WQS (i.e., do not fully support their designated uses).

Example Pollutants / Factors 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.

Additional Indicators

There are other indicators of water quality that are not necessarily defined as regulatory standards. These additional indicators also give insight to the health of a given waterbody and may be referenced in determining the status of designated uses (Rule 100). Additional indicators may include: alkalinity/hardness, conductivity, transparency, fecal streptococcus levels, physical obstructions, sediment conditions, contaminants in fish and other organisms, fish populations, fish taste, macroinvertebrate communities, habitat conditions, and chlorophyll/algae.

The U.S. Environmental Protection Agency's Areas of Concern (AOC) program references a number of beneficial uses, the status of which are used to gauge the quality of associated waters (EPA, 2005):

- Aesthetics;
- Acceptable fish /wildlife taste;
- Open beaches;
- Healthy benthos conditions;
- No fish tumors / deformities;
- Healthy fish / wildlife habitat;
- Healthy phytoplankton / zooplankton populations;
- No dredging-restrictive contaminants in sediment;
- No eutrophication / controlled algae populations;
- No taste / odor problems or other drinking water restrictions;
- Healthy fish / wildlife populations;
- No contaminants in fish / wildlife;
- No costs incurred for agriculture and industrial water usage; and
- No bird / animal deformities or reproductive problems.

Pollution Sources and Trends

Historically, the Clinton River has suffered from degraded water quality in the lower reaches due to unregulated discharges by industries and municipalities throughout the watershed. In fact, between 1940 and 1980 the number of industries in the watershed rose from about 60 to over 1,800 (Francis, 2005). Water quality reports in the years between 1940 and 1970 are sparse, but two notable reports are overviewed in the 'Early Water Quality Reports' sidebar.

The passage of the Clean Water Act in 1972 initiated municipal and industrial projects that have lead to point source pollution reduction over the past thirty years. All of the CREW communities, except Mt. Clemens, shut down WWTPs and connected to the Detroit Water and Sewerage District (DWSD) WWTP. Industry and municipalities also implemented improved treatment technologies and managerial practices. Today there are only 35 municipal and industrial process discharges to surface waters in the Clinton River Watershed (5 of which are in the CREW).

Pollution from point sources will continue to be reduced as municipal waste water treatment plants upgrade their facilities, and restrictions on industrial discharge permits are tightened. Unfortunately, many chemicals from prior industrial discharges persist in the sediments of the Clinton River (Francis, 2005).

With point sources becoming less of a problem, the focus of pollution control has been shifting to non-point source pollution, as alluded to in a

Non-Regulatory Programs

There are numerous non-regulatory programs that identify certain standards as metrics for judging their success. The Clinton River Coldwater Restoration project specifically aims to have a healthy trout population while the Clinton River Watershed Council's Cleanup and River Day activities aim to enhance streams by removing trash and debris (CRWC, 2005).

Early Water Quality Reports

- In a 1953 study documenting the water resources of the Clinton River basin, the Water Resources Commission provided a general assessment of some pollution sources to surface waters. While some communities were noted for good control of pollution through sewage treatment, others were noted for "moderate contamination", "no treatment" for sewered areas, "untreated", and "sewage from urban areas". It was also noted, long before significant focus was placed on stormwater runoff, that "surface runoff…at present…is of questionable quality due to pollution loading."
- A 1966 Federal Water Pollution Control Administration (FWPCA) study inventoried Waste Water Treatment Plants (WWTPs) in the area, including: two in Clinton Township, Mt. Clemens, Sterling Heights, Utica, and Selfridge Field. The study also noted some sewered areas and facilities that did not flow to a WWTP.

1975 report by the Clinton River Watershed Council (CRWC). In this report, it was acknowledged that "although in its infancy in terms of research and development…stormwater runoff, in conjunction with erosion and sedimentation, is becoming the most important water quality issue for the future."

An additional publication by the CRWC in the same year (CRWC, 1975b) noted the following pollution-related trends:

- Microbiological contamination is being reduced due to the elimination of septic systems due to increased sewer coverage; &
- Problems with nutrients, particularly phosphorus, continue to persist due to non-point runoff from agricultural areas (fertilizers).

In 1985, the International Joint Commission (IJC) designated the lower Clinton River Basin as an AOC – one of 43 in the Great Lakes basin. The reasons are presented in the associated dialog box.

In 1988, the MDNR prepared a Remedial Action Plan (RAP) that inventoried conditions in the AOC basin and the entire watershed. This document presented numerous data and assessments related to the IJC problems identified in 1985.

While not a constant pollution source, combined sewers also began to be recognized for the damage they cause when an overflow occurs resulting in raw sewage diluted with stormwater runoff being routed to nearby waterbodies. In 1994, the U.S. Environmental Protection Agency issued a combined sewer overflow (CSO) control policy aimed at reducing / preventing future pollution.

In 1995, the AOC was extended to include the entire Clinton River watershed and the nearshore area of Lake St. Clair impacted by the river and spillway (CRPAC, 1995).

In 1997, Macomb County established the Blue Ribbon Commission on Lake St. Clair. This commission determined four key elements that are required to manage water quality issues affecting Lake St. Clair. These include: monitoring, education, voluntary action, and regulation & enforcement. The commission also recommended various actions on watershed, local, state, national, and international levels that should be taken to support the four key elements (MCHD, 1997).

In the 1998 Clinton River Remedial and Preventive Action Plan – an update of the 1988 and 1995 RAPs – numerous pollution-related issues were discussed. Refer to the associated sidebar for details.

The MDNR's 2005 Clinton River Assessment (Francis) notes that nonpoint source pollution is the greatest factor that degrades water quality in the Clinton River Watershed today. This type of pollution generally consists of sediments, nutrients, bacteria, organic chemicals, and inorganic chemicals from agricultural fields, livestock feedlots, construction sites, parking lots, urban streets, septic seepage, illicit connections, and historical dumping grounds.

Water Chemistry Conditions – Historical & Current

This section offers a qualitative summary of numerous studies containing quantitative data and qualitative assessments which are relative to the time period in which the documents were written. Due to evolving data

IJC Concerns with Clinton River Basin

- Conventional pollutants including high fecal coliform bacteria and nutrients;
- High total dissolved solids;
- Contaminated sediments including heavy metals, PCBs, oil and grease; and
- Impacted biota (MCHD, 2002; CRPAC, 2000).

Pollution Related Discussion in the 1998 RAP

- There are no major industrial discharges to the river or its tributaries as most have instituted industrial pretreatment plans. Still, historical point sources are responsible for existing sediment contamination (e.g., heavy metals and organic compounds) in many waterbodies.
- Fecal contamination of waters has been greatly reduced especially with respect to CSOs and sanitary sewer overflows (SSOs). A notable project is the continued combined sewer separation in Mt. Clemens.
- Pollution problems remain with failing septic systems, illegal sanitary sewer connections to storm sewers (although progress is being made), and fecal contamination from animals/wildlife.
- Stormwater runoff is the most important pollution issue today as it carries pollutants from impervious surfaces and exacerbates erosion and sedimentation problems.

Source: CRPAC, 2000.

Water Quality Parameters

Secchi Transparency / Turbidity
Measure of opaqueness of water. Secchi Transparency is typically used to estimate the depth of the photic zone, defined as the uppermost layer in a body of water into which daylight penetrates in sufficient amounts to influence living organisms. Turbidity is typically indexed to the amount of suspended materials in water. It can be used to gauge the extent of possible primary production or the potential for suspended sediments to injure organisms and habitat.

Temperature
A measure of thermal energy. It affects the biological process of organisms and alters the behavior of nutrients and pollutants in water.

Dissolved Oxygen (DO)
A measure of the amount of oxygen dissolved in water. Generally, the most important chemical substance in supporting life and regulating chemical processes.

Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)
Indirect estimates of the amount of oxygen required to meet the demands from aerobic decomposition of organic matter. They indicate the rate at which dissolved oxygen will be depleted.

pH
The measure of acid-base equilibrium that directly affects organisms and influences behavior of other substances (such as the solubility of toxic metals).

Source: MDNR, 1973a.

(continued on following page)

collection methodologies and assessment criteria, interpretation of the documents was required (e.g. due to changing water quality standards, a value which may have been considered 'good' in 1960 may be considered 'poor' in 1990). To allow a comparison between different time periods, the water quality parameters have been assessed based on today's standards.

The discussion of conditions presented in this section is by no means comprehensive. Most studies referenced were those on-file or readily available from state agencies and regional/local groups and governments. The best effort has been made to identify and obtain those studies that were deemed relevant to the purposes of this plan.

1950s and Before

In 1947, an IJC study (FWPCA, 1966) documented Dissolved Oxygen (DO) levels on the Clinton River. DO levels were good at Hayes Road (upstream of the confluence with the Red Run Drain) and acceptable, but tending towards poor, at Moravian Drive and Bridgeview Road.

In a 1953 study, the Water Resources Commission (WRC) noted that Lake St. Clair was generally low in suspended solids and generally free from pollution. With respect to groundwater, the study indicated that "Groundwater supplies are available only in limited areas and then in rather limited quantities." Groundwater in the subwatershed was high in hardness with elevated iron and chloride in certain portions and occasional hydrogen sulfide.

A 1955 WRC study (Surber, 1955) documented acceptable DO levels in the Clinton River at the most upstream site in the subwatershed and good levels at M-59. Dense filamentous algae were noted near Dequindre Road and at Kleino Road, implying high nutrient concentrations.

In 1958, the WRC conducted a self-purification assessment of the Clinton River (WRC, 1959) that documented Biochemical Oxygen Demand (BOD) loads and DO levels over the entire span of the river in the subwatershed. The upstream DO levels in the middle segment of the Clinton River range were good and show the DO recovering from upstream BOD loadings. The DO levels for sites in the lower and upper mouth section gradually decline to poor status due in good part to BOD loading from the Utica WWTP and Mt. Clemens WWTP. The DO levels for the downstream mouth sites show the DO recovering to a good rating at the mouth.

1960s

Based on 1964 data gathered by the IJC, elevated coliform levels were detected in the Clinton River downstream of Moravian Drive (DNR, 1981b).

A 1966 report on water pollution by the Federal Water Pollution Control Administration (FWPCA) reports fair to poor DO levels for the entire stretch of the Clinton River in the subwatershed with very little oxygen recovery being shown before the water flowed into Lake St. Clair. BOD loadings were noted to be twice as high in the lower Clinton River as they were in the more pristine sections upstream from the City of Pontiac. Chlorides were considered generally high throughout the stretch of the river and ammonia concentrations ranged from 10 – 25 times greater than the concentrations upstream of Pontiac.

Additionally, phosphate concentrations were elevated 5 – 10 times greater than concentrations for upstream stretches of the river. Throughout the Clinton River, coliform levels were greatly elevated compared to today's regulatory standards.

Clinton River data gathered between 1963 and 1967 (WRC, 1968) noted a general trend of higher coliform levels downstream of high density population areas. These waters were also noted to be characterized by low DO and high BOD. Extreme DO variability was noted in the downstream portion of the lower section and the mouth section, with levels ranging from near depletion to supersaturation (due most likely to an overabundance of algae/macrophytes and their associated photosynthetic action during the day). DO recovery and lower coliform levels were noted near the mouth of the river (Jefferson Street and Clairpointe Street extended). The Middle Branch of the Clinton River at 21 Mile Road was noted to be quite healthy with respect to DO, coliforms, and BOD loading but exhibited slightly elevated levels of Total Suspended Solids (TSS).

1970s

With increased regulation of water quality, federal and state governments increased monitoring and assessment efforts, thus producing much more data and discussion on water quality and pollution sources.

Two 1973 studies, one by the MDNR (1973b) and one by the CRWC (1975c) documented similar DO conditions in the Clinton River. The middle section exhibited fair, tending towards good levels, and the lower section upstream of the Red Run Drain confluence had good levels. The DO levels were poor from the Red Run Drain confluence to I-94. DO recovery was noted near the mouth of the river (Bridgeview Road and Clairpointe Street extended). Extremely high BOD and phosphorus in the Red Run Drain results in excessive BOD loads and phosphorus in the Clinton River downstream of the confluence.

High coliform levels were noted on the Clinton River Spillway at Harper Road and on the Clinton River at Garfield Road and Groesbeck Highway with somewhat elevated levels at other sites in the lower section downstream of the confluence with the Red Run Drain. Fish from various sites throughout the Clinton River had significant levels of uptake of PCBs, DDT, and heavy metals. A downward trend in coliform levels was noted in the Clinton River at Bridgeview Road between 1967 and 1973 (MDNR, 1981b). Elevated levels of phosphorus were documented in the stretch of the river upstream of the confluence with the Red Run Drain.

A 1975 MDNR study of Lake St. Clair documented the overall conditions of the lake. The findings of the study include the following conditions:

- Moderate / high alkalinity
- DO levels good (some fair)
- Low TKN in sediments
- Low chlorophyll levels
- TSS levels elevated
- Low specific conductance / TDS
- Normal temperatures
- Open water BOD low
- Low hydrocarbons in sediments
- Good levels of silica dioxide

Based on these factors the lake was classified as mesotrophic (having moderate levels of nutrients and algae).

A localized area of the lake, near the Clinton River Spillway, was classified as eutrophic due to high phosphorus, nitrogen, and chlorophyll levels. The spillway was noted to be a significant source of dissolved materials

Water Quality Parameters

Total Dissolved Solids (TDS) and Specific Conductance
Measure of dissolved substances in water. Specific conductance is an indirect measure of TDS. TDS is a good indicator of the productivity of a waterbody (higher TDS means more productive).

Alkalinity
The measure of the buffering capacity to neutralize hydrogen ions and hence resist pH changes.

Hardness
A measure of the concentration of polyvalent metals (e.g. Ca^{2+}, Mg^{2+}). It is a similar concept to alkalinity

Nitrogen Compounds
Organic Nitrogen – This is nitrogen not available for use by plants and animals but may be transformed to usable forms.

Ammonia – This is a product of the first stage of microbiological oxidation. It is converted to nitrite by nitrifying bacteria and quickly oxidizes to nitrate in aerobic conditions.

Total Kjeldahl Nitrogen (TKN) – This is a measure of the total ammonia and organic nitrogen. Assesses total reservoir of possible nitrogen for primary production.

Nitrate – This is the form most easily taken up by green plants.

Phosphorus Compounds
Total Phosphorus – Phosphorus compounds that are available for eventual use or conversion to usable forms in plants.

Ortho-phosphorus – Phosphourus compounds that are readily available for use in plants.

Source: MDNR, 1973a.

(continued on following page)

Water Quality Parameters

Silica Dioxide
This is a critical nutrient for certain phytoplankton for use in their cellular structure. In its absence, less desirable communities become dominant.

Chlorophyll 'a'
This is the photosynthetic pigment found in all plants. It provides an estimate of the algal standing crop.

Organic Contaminants
These include pesticides (e.g., DDT, dieldrin) and industrial compounds (e.g., PCBs, phthalates). These generally interfere with the life cycles of organisms.

Heavy Metals
Metals occur naturally in the environment, but elevated levels may occur due to industrial pollution. Metals tend to be toxic to most organisms.

Oil and Grease
May coat benthic habitat and kill organisms, including diatoms, phytoplankton, zooplankton, fish larvae, fry and macroinvertebrates.

Source: MDNR, 1973a.

and the nearshore waters of the spillway area were of lower quality than other open lake waters for most water quality parameters. This area also had elevated levels of heavy metals, PCBs, and phthalates in the sediment. The shipping lane across the lake (from the St. Clair River to the Detroit River) also exhibited some sediment contamination.

A 1976 MDNR study noted elevated sediment levels throughout the entire Clinton River in the subwatershed. This was attributed in part to WWTP discharges and surface runoff via storm sewers. The Red Run Drain was noted to be a significant source of these sediments. Also:

- Oil levels in the Clinton River were high enough to inhibit macroinvertebrate growth;
- Metal levels were high on the Clinton River at Garfield Road and Moravian Drive; and
- Elevated PCBs were detected in the Clinton River at I-94 and downstream of the Mt. Clemens WWTP, and in the spillway at Harper Road.

Two SEMCOG studies in 1976 and 1977 (documented in a 1978 report), included sampling at five sites in the subwatershed: the Clinton River at Avon Road, at Van Dyke Road, at Garfield Road, and at Gratiot Avenue; and the Middle Branch at Heydenreich Road. All sites had elevated fecal coliform levels, elevated temperatures, excessive phosphorus, high turbidity, and elevated levels of iron. All sites except the Middle Branch location had elevated levels of nitrate/nitrite. All sites except the Avon Road location had elevated total suspended solids. The latter three sites exhibited low DO problems. The Garfield Road and Gratiot Avenue sites had elevated concentrations of lead. A ranking of the five sites based on the Water Quality Index (Collins, 1978) classified them all as 'poor'.

The report noted that phosphorus levels on the river upstream of the confluence with the Red Run Drain, although still elevated, were significantly lower than recorded during the MDNR's 1973 survey. The portion of the river downstream of the confluence also exhibited decreased levels of phosphorus, in addition to BOD and ammonia.

MDNR data from 1979 indicates that the Clinton River at Moravian Drive and Gratiot Avenue showed elevated coliform levels (MDNR, 1981).

1980s

A 1980 MDNR (1981b) bacterial pollution study of Lake St. Clair noted elevated levels in the vicinity of the Clinton River and excessive levels near the spillway. Metropolitan Beach was noted to be OK, but there was evidence that wind conditions could cause plumes from the spillway to affect the beach. In general, bacterial pollution is higher near shore waters, especially tributary outlets, and in embayments (i.e., formations resembling a bay). The spillway area was also noted to have elevated turbidity and TSS.

A 1981 MDNR study of the mouth area of the Clinton River noted that standards for Total Dissolved Solids (TDS), pH, DO, and temperature were good. DO was often supersaturated, indicating large communities of algae and macrophytes. This was especially true for the most downstream portions, nearest to Lake St. Clair, where high levels of chlorophyll-a were also detected. The supersaturated conditions mask problems in DO that may occur at night (when plants produce no oxygen), especially during drought flows.

Nitrates and phosphorus were found to be high at all points sampled. High ammonia was detected for the sites between Gratiot Avenue and the Crocker Street Bridge. Fecal coliform levels were elevated at Gratiot Avenue and on the spillway at Harper Road. Turbidity was also high at the spillway site.

A 1988 MDNR (1988b) sediment analysis for sites on the Clinton River downstream of the spillway shows the sediments to be classified as 'heavily polluted' (EPA standards) with respect to numerous metals. However, the sediments were shown to be not polluted enough to cause acute toxicity levels in the waters of the river if the sediments were to be dredged.

The 1988 MDNR RAP for the Clinton River discussed a demonstrable improvement in the water quality, including decreased phosphorus, BOD, metals, PCBs and other organic compounds, ammonia, fecal coliforms, suspended solids, and chlorophyll. Other improvements included increased DO levels, improved fish communities, and improved macroinvertebrate communities in the middle section of the river. It was noted that the portion of the river below the Red Run Drain confluence is still heavily impacted by municipal discharges, stormwater, sediment oxygen demand, and high BOD loadings.

1990s

A 1994 Environmental Protection Agency report (EPA, 2005b) documented beach closings due to pollution at Metropolitan Park in 1994.

Sediment sampling data from 1990 to 1997 in the downstream reaches of the mouth section of the Clinton River revealed 15 contaminants above their respective Probable Effect Levels (PELs), including: Mercury, Lead, Zinc, Cadmium, Arsenic, DDT, and other organic chemicals (Francis, 2005).

The 2001 USGS document "Areal Distribution and Concentrations of Contaminants of Concern in Surficial Streambed and Lakebed Sediments, Lake Erie-Lake Saint Clair Drainages, 1990-1997" (Rheaume) examines this sediment data, other data taken throughout the watershed, and data throughout the U.S. portion of the Lake St. Clair and Lake Erie drainage basin. The scale of the data precludes its detailed discussion in this plan, but the raw data, available through the National Water Quality Assessment (NAWQA) on-line data warehouse, has been utilized, where appropriate, in the analyses presented in Chapter 5. The same can be said for the 2000 USGS document "Water Quality in the Lake Erie – Lake Saint Clair Drainages, Michigan, Ohio, Indiana, New York, and Pennsylvania, 1996-98" (Myers), which looked at some similar and some additional data over the period from 1996 to 1998.

A 1995 MDNR report documented the results of water quality and sediment sampling in 1994 at Ryan Road on the Clinton River and on the Middle Branch of the Clinton River at 23 Mile Road and at Jewell Road.

No water quality standards were exceeded and TKN and TOC levels were normal, although phosphorus and nitrate levels were elevated at Ryan Road. All metals tested for in the water were either at or below the minimum detection limits.

A 1995 septic system survey done by the CRWC (Ditschmann) documented bacterial (*E. coli*) contamination at a number of sites

Upper Great Lakes Connecting Channels Study

This 1988 study concluded that water quality in Lake St. Clair was high and that the lake sediments were only lightly polluted (20% of sediments contamined with nickel, chromium, copper, and zinc; 5% by mercury). Sediments collected near the Clinton River were moderately to heavily polluted by phosphorus.

The reason for the high water quality, despite continual pollutant inputs (e.g. the Clinton River, which was identified as a major pollution source), was given as the massive inflow of clean water from Lake Huron which serves to dilute and flush pollutants from the lake.

The study did note that some pollutants were accumulating in high concentrations in fish and wildlife. Although the effects of such accumulations are largely unknown, an example of debilitated health was given as the unsightly growths (e.g. dermal sarcomas, tumors) on walleyes that have been observed in recent years and are likely caused by viruses that manifest themselves in contaminant-stressed environments.

The study also expressed concern over the potential for the contaiminats to pose risks to the human population that consumes the fish and wildlife.

Source: EPA & EC 1988 via Edsall, 1991.

Beach Closing Information

Current beach closing information can be obtained from the EPA at:

http://oaspub.epa.gov/beacon/beacon_national_page.main

or from the MCHD at:

http://macombcountymi.gov/publichealth/EH/BeachConditions.asp

Bacterial Contamination

A recent development in the tracking of bacterial contamination sources has been the discovery that *E. coli* may contaminate soils on the banks of waterbodies and especially the sand at beaches. It was largely believed that most bacterial contamination problems occurred from loadings to waterbodies, but this belief has been called into question. Research continues into this complex topic and has the potential to significantly change the paradigm for dealing with bacterial contamination in the future. For more information, refer to LSCSCR, 1998 and/or the Clean Beaches Council.

Antibiotic Resistant Bacteria

An emerging concern in the world is the evolution of antibiotic resistant bacteria. The USGS conducted a preliminary survey in 2003 (USGS, 2005b) which included a site where the Clinton River enters the subwatershed. The results documented some bacteria exhibiting resistance characteristics, but none that were resistant to all antibiotics tested. Please refer to the report for more detailed information.

throughout the subwatershed: at Jefferson Street in both the Murdock Ballard Drain and Vanter De Bueff Drain; the Clinton River immediately downstream of the spillway; the Middle Branch at Shelby Road, Mound Road, 24 Mile Road, and near Connies Road; the Dunn Drain at M-53; the Wilcox Drain at M-53; and in the Harrington Drain at Harrington Road.

A 2005 USGS report (Syed) examined trends in contaminants in the Clinton River at the Mt. Clemens stream gauging station (#04165500). The period of analysis was generally from 1973/1974 to 1995. Significant increasing trends were noted for pH, calcium, magnesium, chloride, and total hardness. Decreasing trends were noted for sulfate, fluoride, total ammonia, total organic nitrogen, total nitrogen, total nitrate/nitrite, and total phosphorus. Out of the ten state-wide locations sampled, the Mt. Clemens site exhibited the largest number of negative trends for nitrogen compounds and the only negative trend for phosphorus compounds. The report summary concluded that water quality in the Clinton River at the Mt. Clemens site showed an overall improvement.

Caged fish studies in the Clinton River throughout the 1990s and early 2000s (Francis, 2005; MDEQ, 1999) noted some PCB uptake at most locations, but high levels in the lower reaches of the river (with no significant trend over time). This suggests that the watershed is subject to numerous diffuse small sources of PCBs. Significant uptake of mercury, DDT, and other organic chemicals was noted at 5 of 6 stations in 1999, all 8 in 2000, and 1, 2, and 3 stations (out of 3), respectively, in 2001.

The 1998 Macomb County Surface Water Quality Report (1998b) documented *E. coli* levels at various locations throughout the subwatershed. All of the sites tested had numerous samples with excessive levels of *E. coli*, including: the Metz Drain near the confluence with the Middle Branch of the Clinton River; the Middle Branch of the Clinton River at 25 Mile Road, at 21 Mile Road, and at Heydenreich Road; the Clinton River at M-59, at Schoenherr Road, at Garfield Road, at Moravian Drive, at Gratiot Avenue, and at four other sites along the mouth segment; the Harrington Drain at Harrington Road; the Clinton River Spillway at Harper Road, at I-94, and at Jefferson; and the Canal Drain near the confluence with the Clinton River.

Beginning in 1998, the Macomb County Health Department (MCHD) has conducted extensive water and sediment sampling at numerous sites.

Information obtained from the MCHD Web site (2005) indicates that Metropolitan Park beach was closed at times during 1995, 1996, 1997, 1998, and 2000 due to excessive *E. coli* levels.

2000s

A 2000 MDEQ study (2002b) of mercury in the sediments of Lake St. Clair noted elevated levels along the main shipping channel from the St. Clair River to the Detroit River, but the documented concentrations were not alarming by U.S. standards.

A 2005 MDEQ report summarized data collected on the Middle Branch at 19 Mile Road and the Clinton River at Ryan Road and noted no WQS violations. .

A 2004 USGS report documented water quality conditions from 2001 to 2003 in the Clinton River where it enters the subwatershed. The nature of the data precludes its detailed discussion in this plan, but the appropriate raw data, available through NAWQA, has been utilized, where appropriate, in the analyses presented in Chapter 5.

A 2005 USGS report documented water quality trends between 1970 and 2003 in the Clinton River where it enters the subwatershed. The results showed that TDS, chlorides, and nitrates all increased as expected because of upstream urbanization. However, the levels of dissolved phosphorus and sulfates decreased during the same period most likely due to less deposition from decreased air emission in the case of sulfates and from improved WWTP practices in the case of phosphorus.

The MCHD sampling begun in 1998 has expanded over the years and now includes monitoring at 17 sites (11 with data in 2003 and 2004) in or immediately offshore of the subwatershed (in Lake St. Clair). Summarized results for sampling in 2005 and 2006 were not available as of the publication of this document (although raw data for 2005 was utilized in the analyses presented in Chapter 5).

Based on the MCHD sampling, the bulk of water quality problems in recent years have been demonstrated to be in the lower portion of the Clinton River including the spillway. Metal and COD concentrations in the sediment and nutrient concentrations in the water column are frequently above threshold levels. Aqueous mercury levels have been above threshold levels at times throughout the sampling period. Elevated turbidity levels have also been documented, frequently in these lower portions, but also on the Middle Branch at Heydenreich Road and at the mouths of the Murdock-Ballard and Venter de Bueff Drains. Bacterial contamination is more evident in those river and watershed locations further upstream from Lake St. Clair (as documented in previous studies and likely due to dilution with water from the lake which has much lower level of *E. coli* bacteria).

In general, the sites offshore from the coastline exhibit water/sediment quality that is better than the various waterbodies. Of these offshore sites, the spillway site exhibits the lowest sediment quality. The water quality is generally good at this site and exhibits significant improvements as compared to conditions reported in previous reports.

Biological Conditions – Historical and Current

The discussion of biological data presented in this section is by no means comprehensive. Most studies referenced were those on-file or readily available from state agencies and regional/local groups and governments. The best effort has been made to identify and obtain those studies that were deemed relevant to the purposes of this plan.

An important component documenting water quality in a specific area involves examining the biological conditions in various waterbodies. A number of reports, both historical and recent, are specific to waterbodies in the subwatershed and are discussed in this section. Figure 3-2 (page 3-16 and 3-17) shows the inventoried locations in the subwatershed and presents a brief summary of the habitat, macroinvertebrate communities, and fish communities in addition to any other appropriate information.

Sediment Transport and Delivery

A 2005 USACE study reports the following information related to sediment transport and delivery:

- Cultivated and grazed land elevates sediment supply above natural levels and is generally the greatest non-point source;
- Urban sediment comes from developed area storm sewer system outfalls and combined sewer system overflow events;
- Construction site runoff, which there is an abundance of in some Oakland and Macomb County areas, is a major source of sand and silt load; the need for stricter enforcement of control measures has been documented;
- Flow obstructions such as dams and the spillway weir cause sediment deposition in upstream areas;
- Low gradient areas, such as the stretch from Mt. Clemens to the mouth facilitate sediment deposition and sediments from these areas are typically only flushed during high flow events; and
- Road crossings are often sites of erosion (because of altered flow paths to accommodate man-made features) that add to the overall sediment load.

Source: USACE, 2005.

Biological Conditions Rankings

The rankings used in this section are based on the determinations presented in the appropriate references. No re-ranking of the data in a modern standard metric has been attempted. This is due in large part to a lack of usable raw data for such purposes and time constraints.

1800s

Investigations of plant and animal life in the region have been conducted since the 1870s (and probably earlier in the form of personal journals). Historical publications from this period provide some insight into the original fish community of Lake St. Clair and its productivity. These reports show us that 1) the majority of commercial catch was lake herring, yellow perch, and suckers; 2) the total catch during late 1800's reached nearly 4 million pounds at peak, 3) Michigan harvest post-1909 was harvest of "rough" fish under special permit, continuing at very low levels until about 1970, 4) commercial records show that herring and whitefish were heavily exploited by the fishery in the late 1880's, mainly during fall spawning migrations into Lake St. Clair from Lake Erie (LSCCSR, 2000).

1960s

In the 1960s, a U.S. Fish and Wildlife Service (FWS) survey of the Clinton River from Pontiac to Mt. Clemens found no living fish (Johnson, 1984).

A 1967 exercise by the MDNR (Francis, 2005) classified the Clinton River, the spillway, the Canal Drain, and a portion of the Roseville-Clinton Consolidated Drain as 2nd quality warmwater streams based on stream temperature, habitat quality, stream size, and riparian development. The Middle Branch and one upstream tributary were classified as top-quality warmwater streams.

1970s

A 1973 MDNR (1973c) study documented conditions in the Clinton River at a site just upstream of the subwatershed boundary noting the habitat was a cobble substrate with evident silt deposits and that both macroinvertebrate and fish populations exhibited reduced numbers of species and individuals.

A 1973 MDNR (1973a) study of the Clinton River noted vast areas of severe water quality degradation downstream of the confluence with the Red Run Drain. Some specific findings of the study include:

- The populations of phytoplankton and periphyton are elevated throughout the Clinton River. The areas of spiking populations are represented mostly by organisms that are tolerant of degraded water quality (e.g. Characium green algae);
- The 17-mile reach downstream from the Red Run Drain confluence to Lake St. Clair was 'utterly destroyed' with respect to macroinvertebrate populations with only sludgeworms and midges present. Similar conditions were noted in the Clinton River Spillway and the Roseville-Clinton Drain tributary to it; and
- Although habitat was present and acceptable, poor quality fish populations were evident throughout the Clinton River.

A 1975 MDNR report documenting the conditions of Lake St.Clair in 1973 classified the lake as mesotrophic (having moderate levels of nutrients and algae) and exhibiting a biota better than that of lower Lake Huron. Dissolved oxygen levels were noted to be near saturation levels at all points surveyed. High quality benthic and planktonic communities were present throughout the lake, and although populations were dominated by facultative (i.e. pollution tolerant) organisms, many intolerant types common to oligotrophic conditions were commonly found.

Historical Fish Species

A list of historical and current fish species found throughout Clinton River Watershed can be found in the Draft Clinton River Assessment issued in 2005 (to be finalized in 2006).

Source: Francis, 2005.

Earliest Data

The earliest comprehensive research dates to 1894, when Dr. Jacob Reighard, a prominent zoologist at the University of Michigan, conducted a study of the limnology of Lake St. Clair including a survey of the aquatic life, with a focus on clarifying the causes of decline in the commercial catch of whitefish.

Source: GLFC, 1985.

Freshwater Mussels

The Clinton River Watershed has historically been an area of rich mussel fauna. Data prior to the 1940s indicate the presence of diverse species and abundant numbers at most locations in the watershed. However, since that time, the mussel fauna in the portion of the Clinton River passing through the subwatershed has been eradicated. It is believed that pollution associated with urban development is the cause.

The Middle Branch and Healy Brook, which historically were on the low end with respect to species diversity, still had some living specimens. However, the conditions were still deteriorated when compared to past data.

Source: Strayer, 1980.

Figure 3-2. Biological study locations and summarized data.

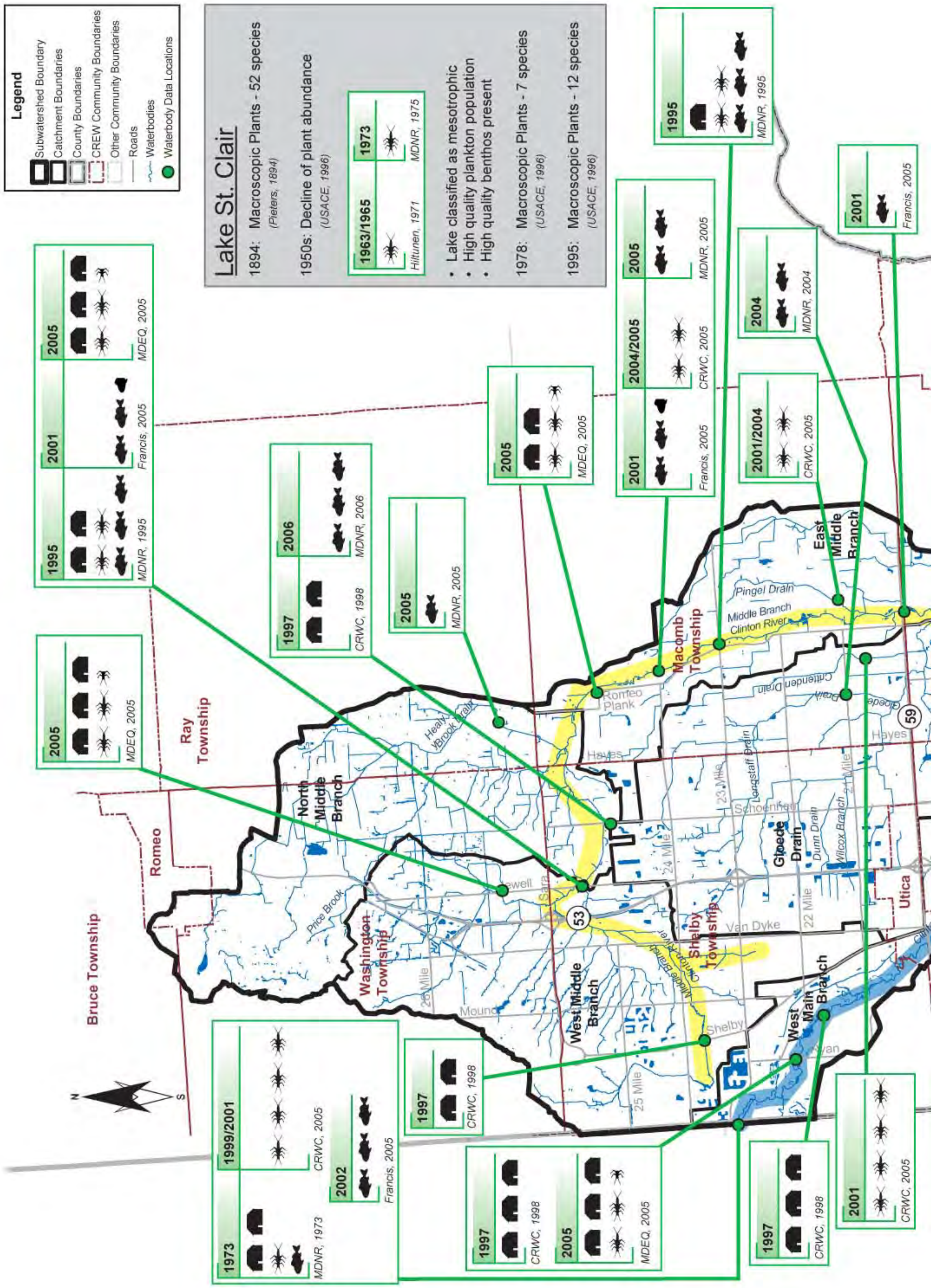
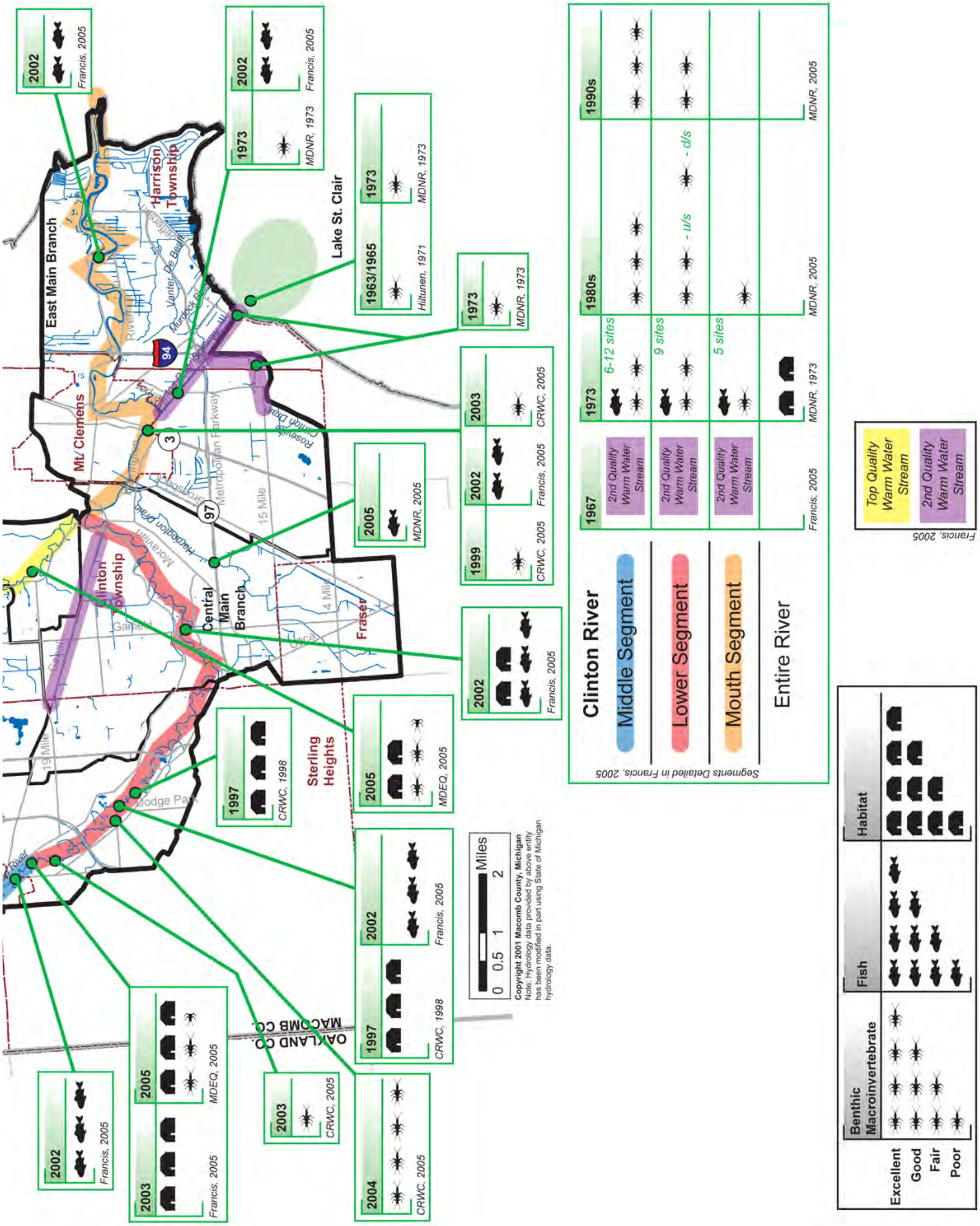


Figure 3-2. Biological study locations and summarized data (continued).



The Clinton River Spillway area of the lake was noted to have a severely degraded benthic organism population with few species (worms and midges) and low population densities. Algae communities were of a tolerant type and exhibited elevated density levels. Overall, it was compared in quality to western Lake Erie (noting that Lake Erie exhibited extremely poor water quality in the 1970s).

1980s

In contrast to the 1960s, the USFWS in 1980 found 33 species in the Clinton River between Pontiac and Mt. Clemens (Johnson, 1984). Tests by the MDNR (1988) in 1983 and 1985 also noted this improvement but explained it was localized to upstream of the confluence with the Red Run. Other tests in the 1980s documented improved conditions in the mouth stretch and spillway area.

1990s

A 1995 MDNR study surveyed the biological conditions at three points: the Clinton River at Ryan Road and the Middle Branch at Jewell Road and 23 Mile Road. The Clinton River site was noted to have "excellent" habitat, a "good" macroinvertebrate community, and an improved but still impaired fish community. The Middle Branch sites were given "fair" and "poor" ratings, respectively, for habitat, "fair" ratings for the macroinvertebrate community, and "good" fish communities.

In 1996, the United States Army Corps of Engineers (USACE) issued the results of an aquatic plant management investigation on Lake St. Clair.

Aquatic plants in Lake St. Clair numbered 158 total species (52 non-microscopic) in 1894 (Pieters). A decline in abundance was noticed in the 1950s with increased turbidity thought to be the influencing factor (USACE, 1996). A 1978 study found only 7 species in Lake St. Clair with plants occurring at only 16% of sampled sites. Between 1978 and 1994 an upward trend was noted, with the 1995 investigation documenting 12 species in Lake St. Clair and plants at 87% of sites sampled. The increase occurred along both the perimeter and in the open water with lakeward expansion most prominent along the western shore.

The positive trend in plant growth is thought to be a result of decreasing turbidity levels due to: soil erosion control in the basin, variations in water levels, sediment stabilization due to plant expansion, and the dramatic increase in zebra mussels which filter water for food and oxygen.

A 1998 CRWC report detailed documented fish habitat conditions in 1997 at 6 locations throughout the subwatershed. The four sites on the Clinton River (upstream of Ryan Road, in River Bends Park, and two in Dodge Park) all were rated "good". The two sites on the Middle Branch (Schoenherr Road and Shelby Road) were both considered "fair".

Monitoring through the CRWC's 'Stream Leaders' program documented the following macroinvertebrate community conditions in 1999 on the Clinton River: "excellent" at Dequindre Road and "poor" at Gratiot Ave

2000s

The following macroinvertebrate community conditions were noted by the CRWC's 'Stream Leaders' Program: in 2001 the Clinton River at Dequindre Road was rated "excellent", the Crittenden Drain at Fox Elementary was "excellent", and the Pingel Drain at 21 Mile Road was "fair"; in 2003 the Clinton River in Riverland Park and at Gratiot Avenue was "poor"; in 2004, the Clinton River in Dodge Park was "excellent", the

Lake St. Clair Fishing

Lake St. Clair supported commercial fishing from the days of the first settlers and was an important industry until the 1900s when overfishing caused the decline of fish populations and the close of the Michigan industry in 1908. The Canadian fishery closed in 1970 in response to mercury in fish.

Sport fishing on Lake St. Clair has been good since the early 1900s and has improved dramatically for many species, such as muskellunge, smallmouth bass, and yellow perch since the late 1980s. In fact, in 2000 and 2001 catch rates for walleye and muskellunge were the highest since 1996 while catch rates for smallmouth bass and yellow perch have remained relatively constant.

Sources: LSCCSR, 2000; MDNR, 2003; GLC, 2004.

Fish Stocking

The MDNR stocked 25,000 steelhead trout in the Clinton River in 2005 and stocked 15,000 young trout and 5,000 brown trout in 2004. Additionally, 30,000 8-inch steelhead finger-lings were planted in 2003. The MDNR plans on stocking 4,500 brown trout annually.

The continued and increased fish stocking is in response to growing sustainable fishery that is itself a testament to the improving quality of the river.

Source: Hunter, 2005.

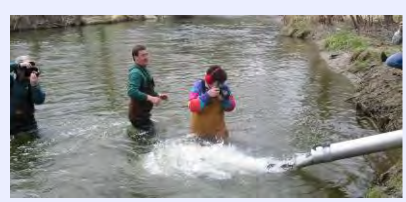


Photo courtesy of CRWC.

Pingel Drain at 21 Mile Road was "fair", and the Middle Branch at 24 Mile Road was "fair"; in 2005 the Middle Branch at 24 Mile Road was "fair".

In 2002, the MDNR conducted fish shocking on the Middle Branch at three locations: M-59, 24 Mile Road, and Jewell Road. The M-59 site had a very "poor" fish community with the others rated "fair". Shocking on the Main Branch documented an "excellent" condition at Dequindre Road; "good" conditions at Van Dyke Road, in Dodge Park, and at Garfield Road; and "fair" conditions at Gratiot Avenue, at Bridgeview Road, and on the spillway just downstream of the weir. "Fair" habitat conditions were noted at the Gratiot Avenue site (Francis, 2005).

In 2004, the Gloede Drain was sampled at 21 Mile Road and exhibited a "fair" (tending towards "poor") fish community (MDNR, 2004).

A 2005 MDEQ report documented habitat and macroinvertebrate conditions at six locations in the subwatershed. Habitat was "good" in the Taft Drain at Jewell Road, the Clinton River at Ryan Road and at Riverland Road, and the Middle Branch at Jewell Road. Habitat was "fair" in the Middle Branch at 25 Mile Road and at 19 Mile Road. Macroinvertebrate conditions were "good/fair" at all six locations.

The 2005 Clinton River Assessment (Francis) indicated hydraulic diversity-based habitat ratings (utilizing recent data up to 2003) of "good" for the Clinton River at the Sterling Heights USGS gauge and "fair" at the Fraser USGS gauge.

In 2005, the Harrington Drain was sampled at Metropolitan Parkway, the Healy Brook Drain was sampled at Romeo Plank Road, and the Middle Branch was sampled at 24 Mile Road. The fish communities were rated very "poor", "fair", and "fair", respectively (MDNR, 2005).

Preliminary data for fish sampling in 2006 on the Middle Branch at Schoenherr Road indicates a "good" fish community (Francis, 2006).

Threatened and Endangered Species Legislation

At the federal level, threatened and endangered species protection comes primarily from the Endangered Species Act of 1973.

At the state level, threatened and endangered species protection comes primarily from Part 365 of Public Act 451 of 1994.

Native Species

Every species has a home in some part of the world, where it has existed for thousands of years as a result of natural forces and influences. Over long periods of time, these and other physical and biological factors direct the distributions of organisms in nature (APWG, 2006). A native species is one that occurs in a particular region, ecosystem, and habitat without direct or indirect human actions (Kartesz and Morse, 1997). Species native to the subwatershed are as those occurring in the area prior to European settlement.

Threatened and Endangered Species

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

Table 3-2 identifies any plants or animals that are found in a subwatershed catchment and listed at the federal and/or state level. The classification schemes for the state and federal government are described in the sidebar.

In Lake St. Clair, the river darter, channel darter, eastern sand darter, lake sturgeon, and mooneye, are all listed as endangered.

Non-Native Species

Invasive non-native organisms are one of the greatest threats to the natural ecosystems of the U.S. Organisms are considered non-native when they are encountered beyond their known historical natural ranges. These species are transported from other parts of the world (including other parts of the U.S.) and disrupt the ecology of natural ecosystems, displacing native plant and animal species. Aggressive invaders reduce the amount of light, water, nutrients and space available to native species, alter hydrological patterns, soil chemistry, moisture-holding capacity, and erodibility, and change fire regimes (Randall 1996). Some exotics are capable of hybridizing with native plant relatives, resulting in unnatural changes to a plant's genetic makeup; others have been found to harbor plant pathogens (McElrone, et al., 1999). Still others contain toxins that may be lethal to certain animals.

Table 3-2. Threatened or endangered species in the subwatershed.

Name	Scientific Name	Federal Status	State Status	Gloede Drain	Central Main Branch	East Main Branch	West Main Branch	East Middle Branch	North Middle Branch	West Middle Branch
Animals										
American Burying Beetle	*Nicrophorus americanus*	LE	E				✓			✓
Black-crowned Night-heron	*Nycticorax nycticorac*		SC			✓				
Black Tern	*Chlidonias niger*	SC				✓				
Common Tern	*Sterna hirundo*		T			✓				
Cooper's Hawk	*Accipiter cooperii*		SC			✓				
Eastern Fox Snake	*Elaphe vulpina gloydi*		T			✓				
Forster's Tern	*Sterna forsteri*		SC			✓				
Long-eared Owl	*Asio otus*		T							✓
Northern Harrier	*Circus cyaneus*		SC			✓				
Sauger	*Stizostedion canadense*		T			✓				
Slippershell Mussel	*Alasmidonta viridas*		SC				✓			
Spotted Turtle	*Clemmys guttata*		T	✓		✓	✓			✓
Wavy-rayed lamp mussel	*Lampsilis fasciola*		T		✓	✓				
Plants										
Clinton's Bulrush	*Scirpus clintonii*		SC	✓			✓			
Downy Gentian	*Gentiana puberulenta*		E	✓			✓		✓	✓
False Hop Sedge	*Carex lupuliformis*		T	✓			✓			✓
Gattinger's Gerardia	*Agalinis gattingeri*		E	✓			✓			✓
Hill's Thistle	*Cirsium hillii*		SC	✓			✓			✓
Kentucky Coffee-Tree	*Gymnocladus dioicus*		SC				✓			
Lake Cress	*Armoracia*		T	✓				✓	✓	✓
Missouri Rock-cress	*Arabis missouriensis var. deamii*		SC				✓			✓
Panicled Hawkweed	*Hieracium paniculatum*		SC	✓			✓	✓	✓	✓
Richardson's Sedge	*Carex richardsonii*		SC	✓			✓	✓	✓	✓
Round Hickorynut	*Obovaria subrotunda*		E			✓				
Showy Orchis	*Galearis spectabilis*		T		✓	✓	✓	✓	✓	✓
Side-oats Grama Grass	*Bouteloua curtipendula*		T				✓			✓
Stiff Gentian	*Gentianella quinquefolia*		T	✓			✓			✓
Tall Nut-rush	*Scleria triglomerata*		SC		✓	✓				
Wild-Rice	*Zizania aquatica var. aquatica*		T		✓	✓				

Source: MNFI, 2005

Species Classifications

Endangered (E) - near extinction throughout all or a significant portion of its range in Michigan.
Threatened (T) - likely to become classified as endangered within the foreseeable future.
Special Concern (SC) - very uncommon in Michigan or has a unique habitat requirement and deserves careful monitoring.
Extirpated (X) - once existed in Michigan, but does not anymore.

The U.S. Fish & Wildlife Service also lists species as **threatened (LT)** or **endangered (LE)**.

There are a many invasive species which have been documented in or near the subwatershed. Examples from the Lake St. Clair Coastal Habitat Assessment (GLC, 2004) are presented in the following text.

Purple Loosestrife

Photo Source: UMN, 2005.

Eurasian Water-milfoil

Photo Source: Echo, 2006.

Spiny Water Flea

Picture Source: IDNR, 2005.

Zebra Mussel

Picture Source: Starfish, 2006.

Lake Water Levels – Impacts on Biota

Due to the large, shallow characteristic of Lake St. Clair small changes in water depth can drastically change the surface are of the lake available for submersed aquatic plant communities – vital habitat for fish and migrating waterfowl (LSCSCR, 1998). Negative impacts on all of these communities may occur when water levels decrease, as was experienced over the last decade.

Invasive Plant Species

Purple loosestrife

Purple loosestrife is a widespread and serious problem that continues to invade and thrive in wetlands in southeast Michigan. It has the ability to quickly displace native vegetation as a single plant can produce up to one million seeds.

Eurasian water-milfoil

Eurasian water-milfoil is a rooted aquatic plant that can grow in a wide variety of habitats. Its long stems that branch near the surface of the water create a cover of floating foliage that blocks out native vegetation, affects macroinvertebrate communities, and impairs fish spawning. It is becoming common in Lake St. Clair with its frequency of occurrence at sampling sites doubling between 1978 and 1995 (LSCSCR, 1998).

A list of other known and potential invasive plant species (both aquatic and terrestrial) includes: common buckthorn, common reed, honeysuckle, garlic mustard, privet, autumn olive, sweetclover, spotted knapweed, European frogbit, flowering rush, hydrilla, reed canary grass, cheatgrass, Japanese knotweed, leafy spurge, multiflora rose, smooth brome, and tree-of-heaven (GLC, 2004).

Invasive Animal Species

Spiny water flea

The spiny water flea is a tiny crustacean with long, sharp, barbed tail spines. It is poised to invade Lake St. Clair and from there could colonize water in the Clinton River basin.

Zebra mussel

This invasive from the Caspian Sea region was first discovered in Lake St. Clair in 1988. They aggressively compete with indigenous species, which has resulted in the extirpation of the 18 native species from the open waters of Lake St. Clair. The zebra mussel also aggressively colonizes submerged infrastructure such as water intake screens at treatment plants, creating extensive problems for industry and municipalities.

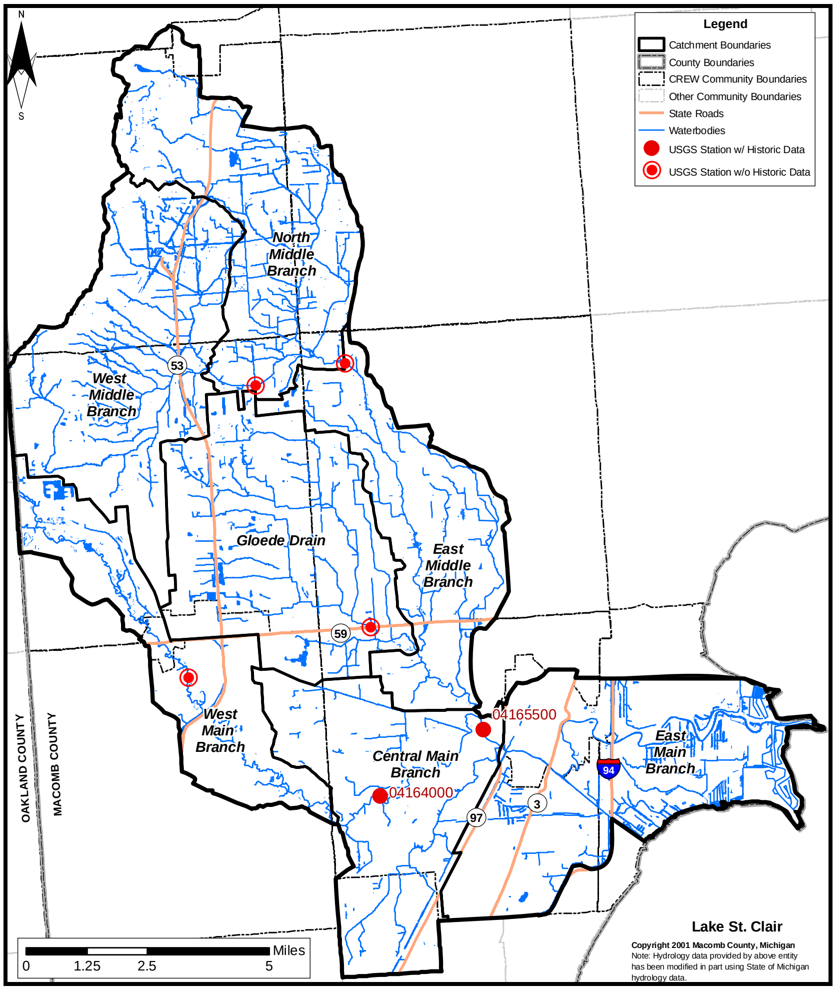
A list of other known and potential invasive species includes: emerald ash borer, Asian long-horned beetle, sea lamprey, round and tubenose goby, ruffe, Asian carp, and northern snakehead.

Hydrologic Conditions – Historical & Current

In addition to water chemistry and biological conditions, hydrologic conditions – how water moves on the land, in the soil, through bedrock, and in the atmosphere - are important in assessing the relative health of water-based environments. As discussed in the first section of the chapter, impervious surfaces can dramatically affect runoff volumes and rates. These changes then translate into alterations of the flow patterns in nearby waterways. An analysis of some data related to this phenomenon is presented in this section.

In the subwatershed there are two locations where sufficient stream flow data exist to conduct a meaningful analysis. These sites and others without sufficient data, maintained by the United States Geological Survey (USGS), are detailed in the sidebar and shown in Figure 3-3.

Figure 3-3. USGS streamflow gages.



The flow data presented in the sidebar graphs is the monthly mean stream flows for the entire data span 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. This is meant to illustrate the flow variability within each month and also between the months.

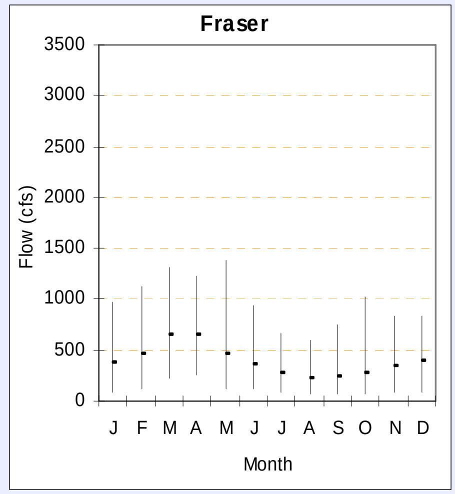
The flow data shows the yearly variance in flow from January, increasing until its peak in March/April, decreasing to its lowest in August, then increasing again.

As one would expect, the downstream gage exhibits greater mean flows and greater variances in flows. For example, the stream flow at the Fraser gauge had a maximum annual mean of 563 cfs in 1985 with a monthly variation from 72 cfs in October 1953 to 1,352 cfs in May of 1956. The Mt. Clemens gauge had a maximum annual mean of 1,959 in 1975 with a monthly variation from a 51 cfs in July 1934 to a high of 3,090 cfs in April 1947.

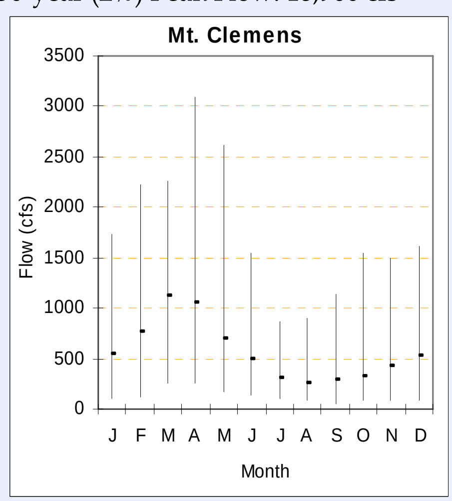
Some data is available for other current and defunct stations throughout the subwatershed, but these do not have sufficient historical flow data to be used for the purposes of this discussion.

USGS Gages

04164000 - Fraser at Garfield Road
Catchment: MBCR – W (near outlet)
Drainage Area: 444 square miles, including the Red Run
Data spans: 55+ years.
Maximum Recorded Flow: 9,000 cfs
Average Annual Peak Flow: 4,000 cfs
10-year (10%) Peak Flow: 6,500 cfs
50-year (2%) Peak Flow: 8,400 cfs



04165500 - Mt. Clemens at Moravian Dr
Catchment: MBCR – E
Drainage area: 734 square miles, including the Middle and North Branches of the Clinton River.
Data spans: 70+ years
Maximum Recorded Flow: 21,200 cfs
Average Annual Peak Flow: 6,000 cfs
10-year (10%) Peak Flow: 12,000 cfs
50-year (2%) Peak Flow: 18,900 cfs



Flashiness Index

The Richards-Baker, or "RB" index is a ratio of the absolute value of the sum of the daily flow changes to the sum of the total daily flows. Although this index may vary spatially for a particular year, the temporal trend of this index is a relative indication of basin response to rainfall and is a good indicator of hydrologic changes in the watershed.

Source: Baker, et al., 2004.

Water Budget Issues

Analyzing flow trends is complicated by the changing water budget of the subwatershed over the years. Some facts to note include:

The George W. Kuhn combined sewers in the Red Run Subwatershed drains a significant portion of land tributary to the Clinton River USGS gauges. This flow is routed out of the watershed to the DWSD WWTP except during overflow conditions.

In 1964, the portion of the watershed in Detroit was excised by the construction of combined sewers tributary to the DWSD WWTP. Unlike the George W. Kuhn system, flows from this area will not discharge to the watershed even in CSO conditions.

Most sanitary sewers transport water out of the watershed to be treated at the DWSD WWTP.

Some of the water supplied to households is from outside of the watershed as the DWSD water supply system utilizes numerous intakes, including Lake Huron (Francis, 2005).

The preceding analysis only addresses flow variability. One common metric used to characterize the change in basin response is a stream flashiness index. Flashiness is a characterization that quantifies the time response of a river to a rainfall event. In this analysis, the flashiness index used was based on a method described in a paper by researchers from Heidelberg University (Baker, et al, 2004) in the Journal of American Water Resources Association (see 'Flashiness Index' sidebar for additional information).

Figure 3-4 and Figure 3-5 present the results for such an analysis at the two gages of interest in the subwatershed (USACE, 2005).

Figure 3-4. Flashiness indices and trend at the Fraser gage.

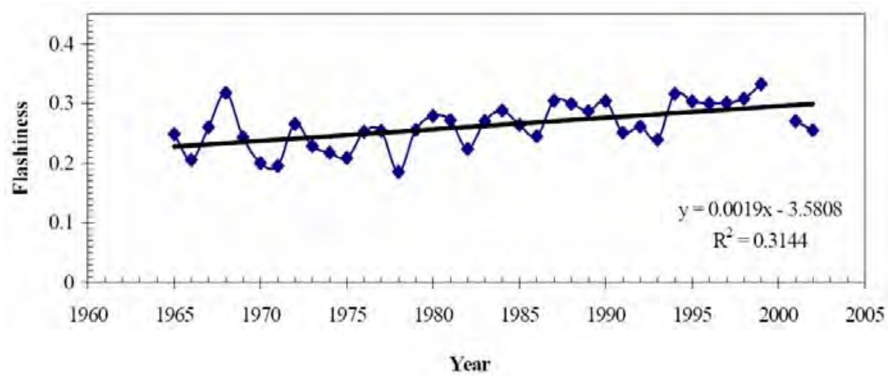


Figure 3-5. Flashiness indices and trend at the Mt. Clemens gage.

As can be seen in the figures, the flashiness index shows an increasing trend over the last 35 years. As any rainfall deviation over this period was statistically insignificant, this indicates that the Clinton River is generally becoming more responsive (exhibiting higher peak flow rates) most likely due to increasing impervious surfaces in the river's headwater areas.

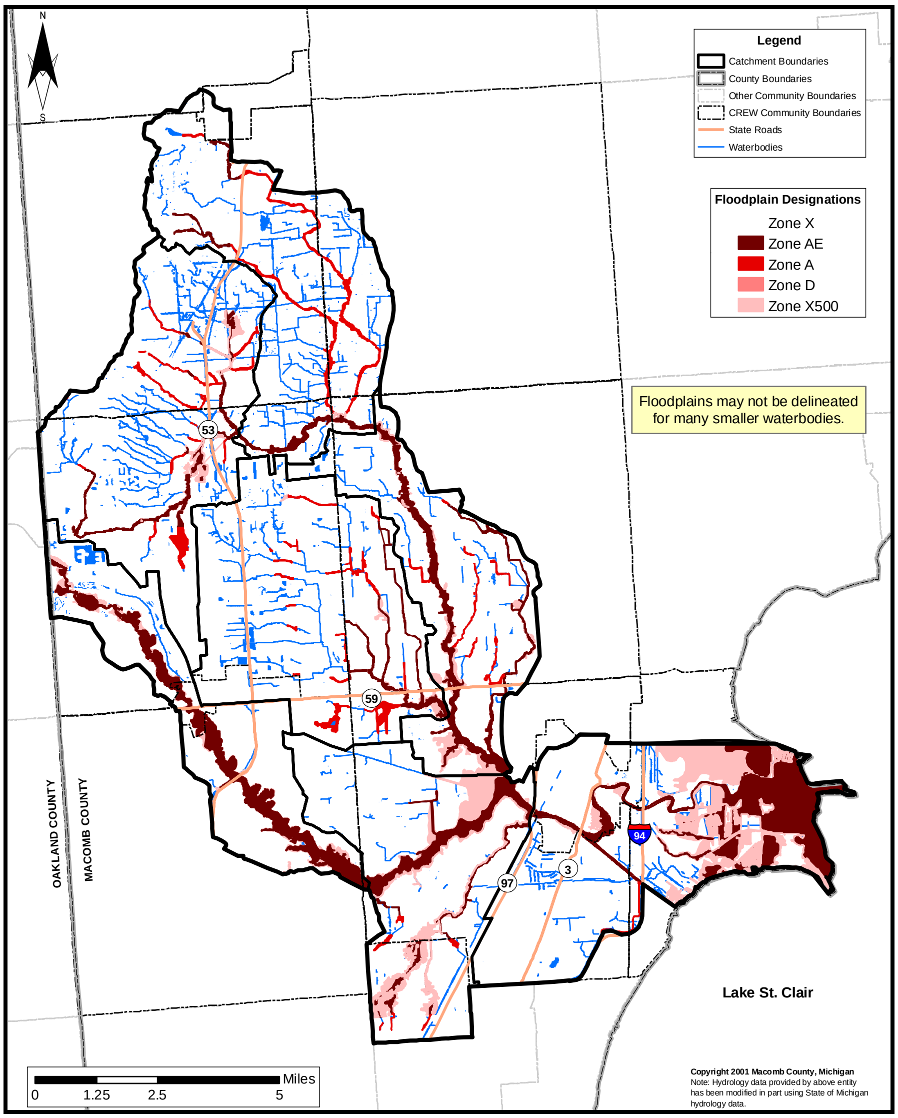
A 2005 report prepared for the Macomb County Public Works Office and the MDEQ (ECT, 2005) reported flow trends at the two USGS gauges on the Clinton River and on another on the Middle Branch at Romeo Plank Road (04164800). Between 1949 and 2001, the flow at the Fraser gauge increased in peak flow by 44%, increased in annual mean flow by 41%, and increased in bankfull flow by 15%. Between 1935 and 2000, the numbers for the Mt. Clemens gauge are -33%, 63%, and 0%, respectively. Between 1960 and 2000, the numbers for the Middle Branch gauge are 30%, 88%, and 57%, respectively.

Floodplains

While waterbodies naturally are associated with areas that will flood under various conditions, man-made changes that affect the hydrology of water flowing to them and the hydraulics of water flowing in them can exacerbate flooding problems.

As part of the National Flood Insurance Program, the Federal Emergency Management Agency (FEMA) has delineated floodplains for many waterbodies throughout the subwatershed. Floodplains may not be delineated for many smaller streams and creeks. The floodplain areas that have been delineated in the subwatershed are presented in Figure 3-6.

Figure 3-6. Floodplains.



These floodplains reflect recent updates undertaken by FEMA in response to extensive flooding in May 2004 that caused more than ten million dollars of public property damage throughout Macomb County.

The largest potential flood problems are shown to be in Harrison Township (due to potential Lake St. Clair-related flooding) and along the Clinton River and Middle Branch of the Clinton River.

Low Flow Conditions

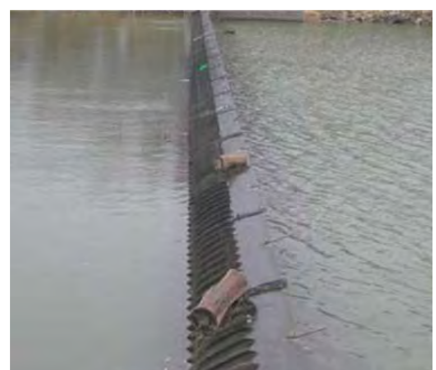
In April, when lake level and other control structures are put into operation, the flow in the Clinton River downstream of these structures drops up to 90%. These are mostly in upstream subwatersheds, but the impacts (e.g. loss of active channel and associated wildlife and fish habitat) extend downstream into the CREW.

Source: CRWC, 2005c.

FEMA Floodplain Categories

- **Zone AE –** 100-yr floodplain determined by calculation
- **Zone A –** 100-yr floodplain determined by estimation
- **Zone D –** Possible flooding; no analysis conducted
- **Zone X500 –** 500-yr floodplain
- **Zone X –**All areas not in other categories

Clinton River Spillway Weir – Normal Conditions



Source: USACE, 2005.

Clinton River Spillway Weir – During May 2004 Flooding

Courtesy of MCPWO

Volunteers

Several Subwatershed Advisory Group (SWAG) members volunteered to conduct the visual assessment surveys.

The volunteers conducting the surveys completed a training session before engaging in actual field work.

Current Data for Planning: Visual Assessment

A visual assessment was conducted in the subwatershed to obtain current data to utilize in the assessment of problems, their causes, pollutant sources, and critical areas. The assessment was comprised of three surveys that involved documenting problems or problem indicators in targeted waterbodies and upland areas. The surveyed locations were selected to provide a representative cross-section of the subwatershed.

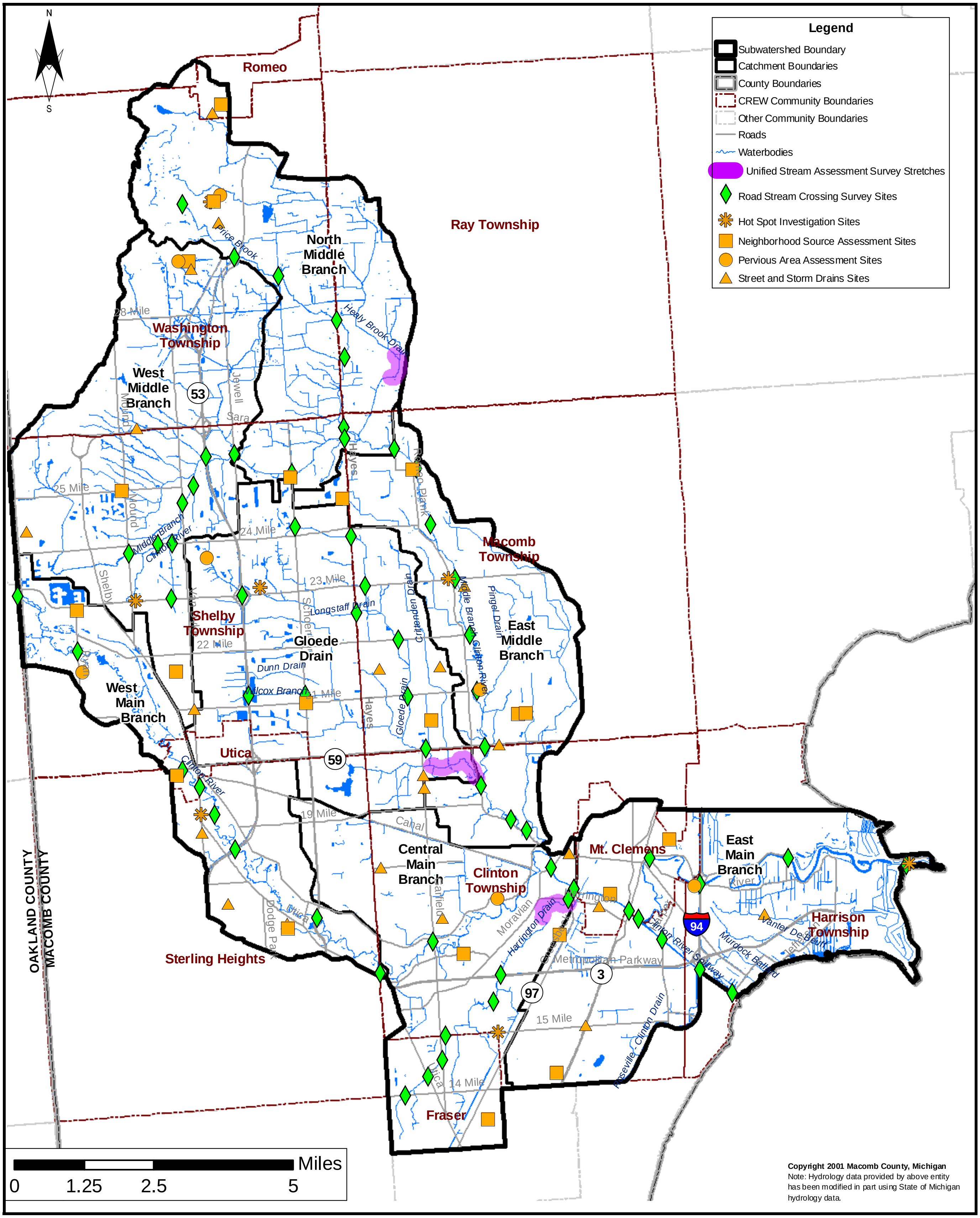
The three different types of surveys conducted are detailed below:

- Road-Stream Crossing Surveys - This survey looked at physical characteristics, substrate, shade cover, morphology, adjacent land uses and potential pollution sources. The survey was conducted using the MDEQ's Stream Crossing Watershed Survey (2000b) procedure. This procedure was selected to provide consistency with existing information throughout the State of Michigan and with existing data in the subwatershed that is being collected by the CRWC;
- Unified Stream Assessments (USA) – This survey, developed in 2005 by the Center for Watershed Protection (CWP), involves looking for and documenting issues that potentially impact each waterbody. Each stream assessment involved documenting and evaluating specific impacts as they were encountered (i.e., stormwater outfalls, severe bank erosion, impacted buffers, stream crossings, channel modifications, trash and debris, utility impacts, and miscellaneous). Additionally, a general assessment for the entire reach was performed upon completion of all other evaluations. This survey was conducted by Macomb County Public Works Office (MCPWO) staff; and
- Unified Subwatershed and Site Reconnaissance (USSR) – This survey, also developed by the CWP (2005), involved conducting quick but thorough characterizations of upland areas. The goal of the USSR was to identify major source types and areas that potentially contribute pollutants to waterbodies. The four major components of this survey include: neighborhood source assessments, hotspot site investigations, pervious area assessments, and street and storm drains assessments. This survey was conducted by MCPWO staff.

The locations visited by the surveyors are presented in Figure 3-7.

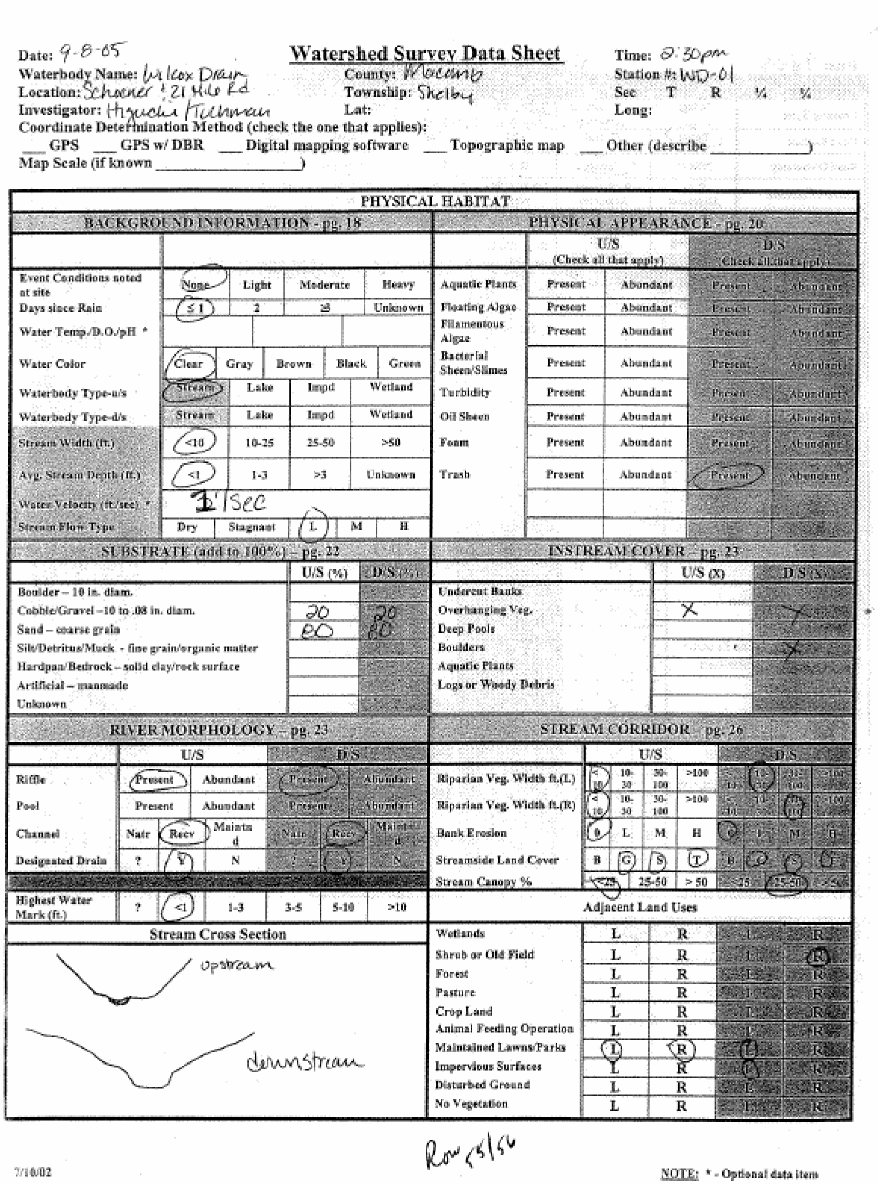
The data and assessments presented in this section provide a baseline for more specific analyses regarding problems in the subwatershed. Further investigation of the sites will be required prior to taking corrective action to more accurately assess the nature and extent of the problem and determine the appropriate solution.

Figure 3-7. Survey locations.



Road-Stream Crossings Survey

In all, 64 road-stream crossings in the subwatershed (35% of the total) were surveyed. The data sheet associated with this procedure is inset.



Watershed Survey Data Sheet

Date: 9-8-05
Waterbody Name: Wilcox Drain
Location: Schoener & 21 Mile Rd
Investigator: Higuchi / Tichman
County: Macomb
Township: Shelby
Lat:
Time: 2:30pm
Station #: WD-01
Sec T R ¼ ¼
Long:
Coordinate Determination Method (check the one that applies):
___ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe ____________)
Map Scale (if known ________________)

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None	Light	Moderate	Heavy	
Days since Rain	≤1	2	≥3	Unknown	
Water Temp./D.O./pH *					
Water Color	Clear	Gray	Brown	Black	Green
Waterbody Type-u/s	Stream	Lake	Impd	Wetland	
Waterbody Type-d/s	Stream	Lake	Impd	Wetland	
Stream Width (ft.)	<10	10-25	25-50	>50	
Avg. Stream Depth (ft.)	<1	1-3	>3	Unknown	
Water Velocity (ft./sec) *	1'/sec				
Stream Flow Type	Dry	Stagnant	L	M	H

PHYSICAL APPEARANCE - pg. 20

	U/S (Check all that apply)		D/S (Check all that apply)	
Aquatic Plants	Present	Abundant	Present	Abundant
Floating Algae	Present	Abundant	Present	Abundant
Filamentous Algae	Present	Abundant	Present	Abundant
Bacterial Sheen/Slimes	Present	Abundant	Present	Abundant
Turbidity	Present	Abundant	Present	Abundant
Oil Sheen	Present	Abundant	Present	Abundant
Foam	Present	Abundant	Present	Abundant
Trash	Present	Abundant	Present	Abundant

SUBSTRATE (add to 100%) – pg. 22

	U/S (%)	D/S (%)
Boulder – 10 in. diam.		
Cobble/Gravel –10 to .08 in. diam.	20	20
Sand – coarse grain	80	80
Silt/Detritus/Muck - fine grain/organic matter		
Hardpan/Bedrock – solid clay/rock surface		
Artificial – manmade		
Unknown		

INSTREAM COVER – pg. 23

	U/S (X)	D/S (X)
Undercut Banks		
Overhanging Veg.	X	X
Deep Pools		
Boulders		X
Aquatic Plants		
Logs or Woody Debris		

RIVER MORPHOLOGY – pg. 23

	U/S			D/S		
Riffle	Present	Abundant		Present	Abundant	
Pool	Present	Abundant		Present	Abundant	
Channel	Natr	Recv	Maintained	Natr	Recv	Maintained
Designated Drain	?	Y	N	?	Y	N

Highest Water Mark (ft.)	?	<1	1-3	3-5	5-10	>10

STREAM CORRIDOR – pg. 26

	U/S				D/S			
Riparian Veg. Width ft.(L)	< 10	10-30	30-100	>100	< 10	10-30	30-100	>100
Riparian Veg. Width ft.(R)	< 10	10-30	30-100	>100	< 10	10-30	30-100	>100
Bank Erosion	0	L	M	H	0	L	M	H
Streamside Land Cover	B	G	S	T	B	G	S	T
Stream Canopy %	<25	25-50	> 50		<25	25-50	>50	

Adjacent Land Uses

	U/S		D/S	
Wetlands	L	R	L	R
Shrub or Old Field	L	R	L	R
Forest	L	R	L	R
Pasture	L	R	L	R
Crop Land	L	R	L	R
Animal Feeding Operation	L	R	L	R
Maintained Lawns/Parks	L	R	L	R
Impervious Surfaces	L	R	L	R
Disturbed Ground	L	R	L	R
No Vegetation	L	R	L	R

Stream Cross Section

upstream

downstream

Row 55/56

7/10/02

NOTE: * - Optional data item

The general results of the road-stream crossing survey are shown in Figure 3-8. The symbols indicating the locations indicate the number of potential problems identified by the survey. See the legend on the map for details. Table 3-3 presents more detailed information about the problems identified at each site. All photos are courtesy of the volunteers.

Clinton River at Ryan Road

Longstaff Drain at Hayes Road

Harrington Drain at 14 Mile Rd

Clinton River - Bridgeview Rd

Gloede Drain at 22 Mile Rd

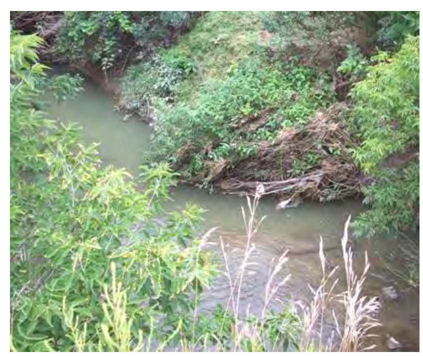
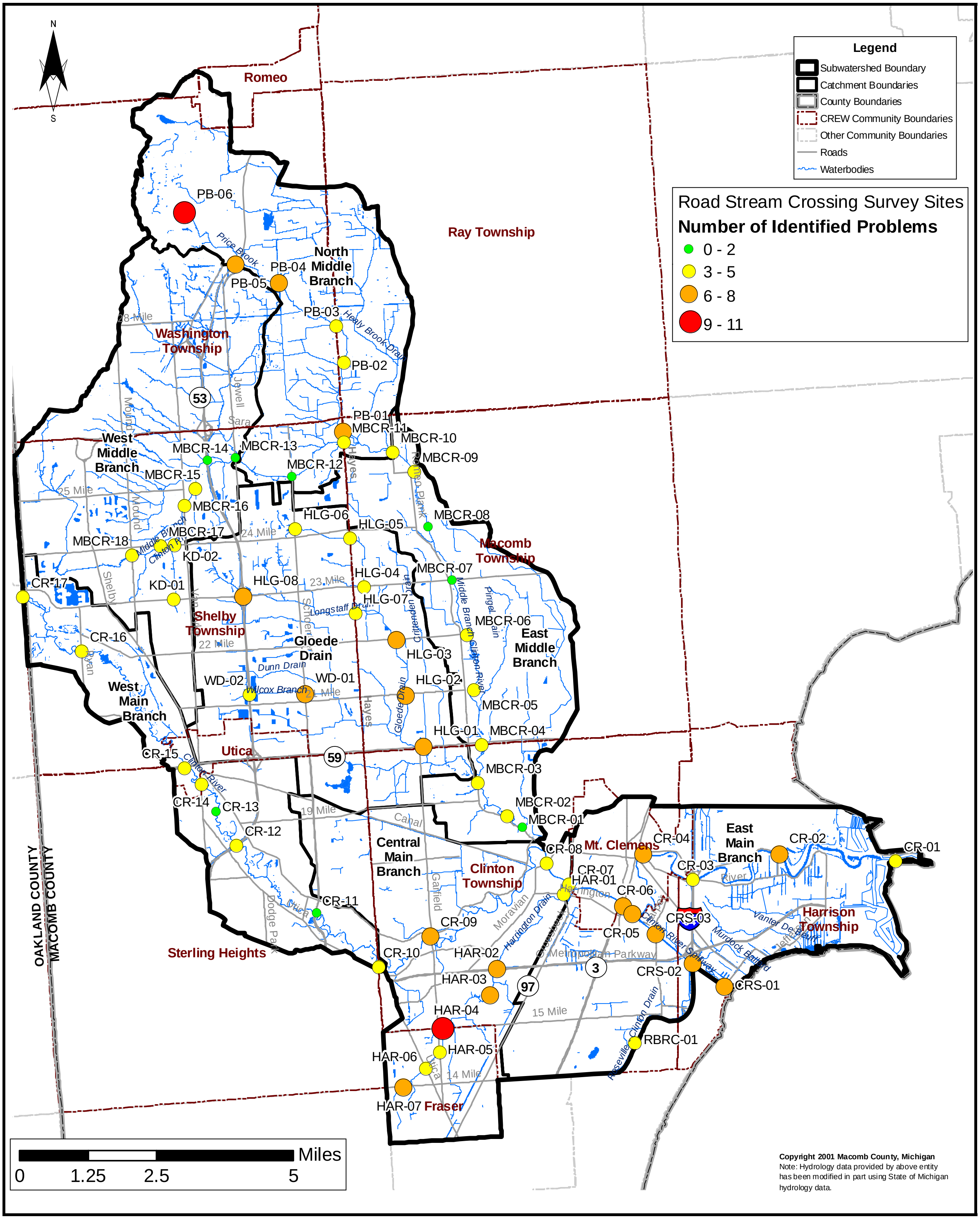


Figure 3-8. Identified problems.



Road-Stream Crossing Potential Problem Descriptions

Trash / Debris
Trash present near the waterbody or debris in the waterbody.

Illicit Discharge
The presence of an oil sheen or foam or the abundance of aquatic plants, floating or filamentous algae, bacterial slime, or turbidity or the specific identification of septic, industrial, or municipal pollution sources (of at least moderate priority).

Recreation
For waterbodies greater than 10 feet wide – the presence of woody debris or a depth of less than 3 feet.

Shade Cover
Vegetation covers less than 25% of water surface and there is no overhanging vegetation or aquatic plant cover.

Riparian Conditions
Riparian buffers on either bank of less than 100 feet or noted removal of riparian vegetation.

Substrate
Substrate greater than 80% sand or silt/detritus/muck or greater than 40% artificial.

Imperviousness
The presence of impervious surfaces adjacent to the waterbody.

Turf / Lawns
The presence of turf surfaces adjacent to the waterbody including parks, golf courses, and urban residential areas.

Agriculture
The presence of agriculture areas adjacent to the waterbody.

Hydrology
Problems with culverts such as poor alignment or obstruction, impoundments, channelization, or flow flashiness.

Other Sources
Potential pollution from other sources including transportation, recreational uses, construction, disturbed ground, dredging, natural sources or unknown sources.

Streambank erosion problems are presented in a separate section.

Table 3-3. Detailed road-stream crossing survey results.

Waterbody	Station#	Trash / Debris	Illicit Discharge	Recreation	Shade Cover	Riparian Buffer	Substrate	Imperviousness	Turf / Lawns	Agriculture	Hydrology	Other Sources
Clinton River	CR-01		X			X		X	X			X
	CR-02		X			X		X	X		X	X
	CR-03	X				X		X				X
	CR-04	X			X	X		X	X			X
	CR-05	X				X		X	X		X	X
	CR-06	X	X			X		X	X			X
	CR-07	X				X			X		X	X
	CR-08	X				X			X			X
	CR-09	X				X	X	X	X			X
	CR-10					X		X	X			
	CR-11				X							
	CR-12	X		X		X			X			X
	CR-13					X			X			
	CR-14	X				X	X	X	X			
	CR-15			X	X	X	X		X			
	CR-16					X	X	X	X			
	CR-17				X	X		X	X			X
Clinton River Spillway	CRS-01		X			X	X		X		X	X
	CRS-02		X			X	X		X		X	X
	CRS-03	X	X			X	X		X		X	X
Harrington Drain	HAR-01			X		X		X	X			X
	HAR-02			X		X	X		X		X	X
	HAR-03			X		X	X		X		X	X
	HAR-04	X	X	X		X	X	X	X		X	X
	HAR-05	X				X	X		X			
	HAR-06	X			X	X	X		X			
	HAR-07	X	X		X	X			X			X
Price Brook	PB-01		X		X	X		X	X		X	X
	PB-02		X		X	X			X			X
	PB-03		X			X			X	X		X
	PB-04		X			X	X		X	X		X
	PB-05		X		X	X		X	X			X
	PB-06		X		X	X	X	X	X	X	X	X
Gloede Drain	HLG-01		X		X	X		X	X		X	X
	HLG-02		X		X	X		X	X			X
	HLG-03		X		X	X			X	X		X
	HLG-04		X			X	X			X		X
Harris Drain	HLG-05		X			X	X		X		X	
	HLG-06		X			X	X		X			X
Longstaff Drain	HLG-07		X		X	X	X		X			
	HLG-08		X			X	X		X		X	X
Kingsbury Drain	KD-01				X	X	X				X	X
	KD-02					X	X	X	X			X
Middle Branch of the Clinton River	MBCR-01					X			X			
	MBCR-02	X		X		X		X				X
	MBCR-03					X		X	X			X
	MBCR-04			X		X		X	X			X
	MBCR-05			X		X		X	X			X
	MBCR-06			X		X			X			
	MBCR-07			X		X						
	MBCR-08					X			X			
	MBCR-09			X		X			X			X
	MBCR-10			X		X			X			
	MBCR-11			X		X			X			
	MBCR-12			X						X		
	MBCR-13			X								
	MBCR-14			X								
	MBCR-15					X			X			X
	MBCR-16					X			X		X	X
	MBCR-17					X	X		X		X	
	MBCR-18					X	X		X			
Roseville-Clinton Drain	RBRC-01			X		X			X			X
Wilcox Drain	WD-01	X				X	X	X	X			X
	WD-02					X	X					X

The most common potential problem in the subwatershed is the lack of a 100-foot buffer on each side for the waterbodies. In fact only four sites (one on the Clinton River and three on the Middle Branch of the Clinton River) provide this amount. Additional observations of the data include:

- Imperviousness was identified as a potential problem for at least one site;
- The substrate was also identified as a problem for at least one site;
- A common potential problem is the proximity of the waterbodies to managed lawns or other urban residential neighborhoods;
- Trash and debris issues are most pronounced for the Clinton River and Harrington Drain;
- Illicit discharges were identified as potential problems for all sites on the Healy Brook Drain, Gloede Drain, and Harris Drain;
- Recreation was an issue at many sites on the Middle Branch of the Clinton River;
- Agriculture is only an issue at sites on the Healy Brook Drain, Gloede Drain, and the Middle Branch of the Clinton River; and
- Shade cover, hydrology, and other sources were identified as problems at various sites throughout the subwatershed.

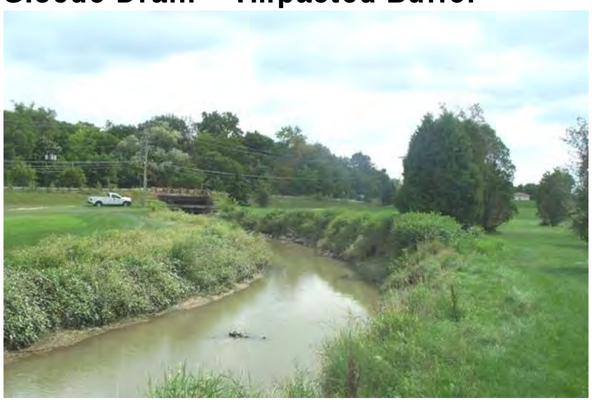
Middle Branch of the Clinton River at Heydenreich Rd

Kingsbury Drain at 23 Mile Road

Healy Brook Drain at Hayes

Gloede Drain – Wood Debris

Gloede Drain – Impacted Buffer



Gloede Drain – Turbid Water

Gloede Drain – Evidence of Erosion

Unified Stream Assessments

Unified stream assessments (of approximately ½ mile) were conducted at three different locations in the subwatershed: the Gloede Drain near its confluence with the Middle Branch of the Clinton River, the Healy Brook Drain near Romeo Plank Road, and the Harrington Drain near its confluence with the Clinton River. These reaches are highlighted in Figure 3-7. The surveys are summarized in the following text.

Gloede Drain

The assessed Gloede Drain reach is located between Garfield Road and Romeo Plank Road and is a highly accessible stream reach. The stream is not deeply entrenched and is able to enter the floodplain. However, moderate amounts of floodplain encroachment exist in the form of development and structures. The surrounding land use is residential and golf course. Log jams and soil erosion were identified to be the most substantial problems in this reach.

Additional observations include the following:

- Two stream crossings. One in poor condition, not aligned with dominant flow path, and totally blocked; the other new and not obstructing flow;
- One impacted buffer of less than 10 feet. Managed turf from a nearby golf course encroaches to the streambank;
- Two instances of massive log jams that will require heavy equipment to remove;
- One instance of steep-slope bank failure;
- One stormwater outfall with a trickle of flow but no evidence of illicit connections or discharges;
- Suboptimal in-stream habitat due in part to silt/clay and sand substrate and elevated turbidity. Evidence of fish was noted;
- Suboptimal vegetative protection (less than 50% stream shading);
- Suboptimal buffer width of 25-50 feet; and
- Marginal floodplain vegetation/habitat dominated by shrub or old fields. Evidence of deer and other wildlife was noted.

Healy Brook Drain

The assessed Healy Brook Drain reach is located between 27 Mile Road and Romeo Plank Road and is a fairly accessible stream reach with a suboptimal buffer width of 25-50 feet. The surrounding land use is residential and cropland. Deer, fish, and snails were sighted in the area. Further investigation of possible sewer outfalls is recommended.

Additional observations include the following:

- Two stream crossings. One consists of twin barrels partially blocked by brush; the other is a bridge containing rip rap and having stable banks;
- One impacted buffer of 40 feet. A channel extends from an agricultural field to the drain with plenty of area available for reforestation;
- Two instances of log/tree jams in the stream. One involves fallen trees which partially impact flows and require heavy equipment to remove; the other is a pickup load of cut logs which may be removed using saws;
- Fallen trees are also causing channel modification and sediment deposits downstream;
- Two instances of utility impacts by possible septic tank overflow pipes or illicit connections to storm sewers. Observations include dark brown discharge from one pipe and stains on the other;
- Two instances of bank failure with evidence of stream widening and scouring. Both locations have access for heavy equipment;
- Five stormwater outfalls ranging from 12 inch to 24 inch pipe with no observed dry weather discharges or excessive bank erosion; and
- One instance of channel modification due to bank armoring and check dams causing sediment deposition and fish barriers.

Healy Brook Drain – Obstructed Culvert

Healy Brook Drain – Wood Debris

Healy Brook Drain – Check Dam of Rocks

Harrington Drain – Outfall with Sediment

Harrington Drain – Trash in Stream

Harrington Drain – Erosion Under Outfall

Harrington Drain

The assessed Harrington Drain reach is located between Harrington Road and Miles Street extended and is a fairly accessible stream reach with a suboptimal buffer width of 25-50 feet. The surrounding land use is residential with the predominant floodplain vegetation being mature forest. Deer and fish were sighted during the assessment. Further investigation of sewer outfalls and bank erosion is recommended.

Additional observations include the following:

- One impacted buffer of 300 feet. The area lacks vegetation and has bare ground. There is no stream shade provided. Plenty of area is available for planting;
- Three instances of illegal dumping including plastic, metal, tires, and small man-made debris (i.e. Styrofoam, beach balls, garbage bags);
- Three instances of log jams in the stream causing flooding and turbidity downstream of logs. Possible to remove logs using saws;
- Three instances of utility impacts by probable septic system overflows or illicit connections to storm sewers (reported to Macomb County Health Department for follow-up action). Observations include dark brown discharge, sewage odor, toilet paper, and stains. Pipe testing is recommended;
- Five instances of bank failure with evidence of stream widening and scouring. All locations are candidates for bank stabilization;
- Seven stormwater outfalls ranging from 12 inch to 24 inch pipe as well as one earthen open channel were found. Five outfalls were clean with no further investigation needed. One outfall was a candidate for a rip rap base and another was in need of repair due to an exposed metal pipe and clogging due to silt; and
- Three instances of channel modification. Two are due to bank armoring where no sediment deposition is occurring and the channel is stable. One is due to channelization where sediment deposition is occurring and structural repair is needed.

Road Stream Crossings Survey, Unified Stream Assessment, and Historical Data – Focus on Streambank and Shoreline Conditions

An examination of the conditions of the streambanks and shorelines can give us an insight into the health of the associated waters. A summary of existing data for bank conditions in the subwatershed is shown in Figure 3-9. The bank conditions are classified as “good”, “fair”, or “poor” based on ratings from previous and recently collected data.

A 1995 MDNR study commented on the conditions at some locations in the subwatershed. Fair conditions were noted on the Middle Branch of the Clinton River at 23 Mile Road and at Jewell Road. "Good" conditions were noted on the Clinton River at Ryan Road.

In 1997, the CRWC (1998) recorded "poor" streambank conditions on the Middle Branch at Schoenherr Road.

In 2000, the MCPWO documented streambank conditions on the Middle Branch of "poor" near the mouth and at Van Dyke Road (MCPWO, 2000). "Fair" conditions were noted at M-59 and near Romeo Plank Road south of 19 Mile Road. "Fair" conditions were also noted on the Yates Drain at Jewell Road while "good" conditions were noted on the Taft Drain at Jewell Road and the Price Brook at Hayes Road. Road and ditch erosion conditions were also noted at numerous locations but not summarized in this WMP.

Data from the Clinton River Watershed Council (CRWC, 2005b) from 1999 to 2004 noted "fair" conditions on the Clinton River near the spillway, near Dodge Park, near 19 Mile Road extended, at Ryan Road, and at Dequindre Road. "Good" conditions were noted on the Crittenden Drain south of 21 Mile Road, and on the Middle Branch of the Clinton River at 21 Mile Road and at 24 Mile Road.

A 2005 USACE study documented "poor" conditions on the Clinton River near Dodge Park.

A 2005 study prepared for the Macomb County Public Works Office and the MDEQ (ECT, 2006) documented "high to very high" streambank erosion potential on the Middle Branch of the Clinton River from its point of beginning to Romeo Plank Road. These potentials are functions of the shear stresses on the streambanks, the geometry of the cross-section, and the amount and type of material that is available to be eroded. The study also noted "overall, a noticeable change in the sinuosity of many of the river reaches and drains was observed throughout the watershed." Additional general findings of the report are discussed in the 'Additional Findings…' sidebar. Refer to the report for numerous photographs of erosion problems.

In 2005, field data collected by the MCPWO and volunteers documented "good" conditions at all locations on the Clinton River, the spillway, Wilcox Drain, Kingsbury Drain, Harris Drain, and most locations on the Middle Branch and Harrington Drain. The Price Brook had three "good" and three "fair" locations. The Gloede Drain had two "poor" locations, the Longstaff Drain had a "fair" and "poor" location, the Harrington Drain had a "poor" location, the Healy Brook had a "poor" location, and the Middle Branch had two "fair" locations.

The Clinton River downstream of Bridgeview Street (to the mouth) has artificial banks consisting of either retaining walls or rip rap. Additionally, almost the entire shoreline on Lake St. Clair is armored or rip rap, with one beach area, and four scattered vegetated areas, only two of which are large enough to be significant (GLC, 2004).

While no extensive data exists in the subwatershed documenting the extent of channelization of the waterways, it is recommended in the future to extract this data from existing sources such as aerial photography or USGS topographic quadrangles.

Additional Findings of the Hydrologic Project on the Middle Branch of the Clinton River

The following ranges are applicable for the Middle Branch of the Clinton River from its point of beginning to Romeo Plank Road:

- Sensitivity to Disturbance – Consistently 'Very High' with some reaches 'Extreme'. This measures the susceptibility to alterations caused by changes in flow, sediment discharge, bank characteristics, or other factors;
- Stream Recovery Potential – 'Good' to 'Very Poor' with upstream reaches generally 'Good' and downstream generally 'Poor'. This identifies a stream's ability to naturally recover to an equilibrium condition after a disturbance;
- Sediment Supply – Generally 'Moderate' upstream and 'Very High' downstream. This is the amount of sediment that is available for erosion;
- Vegetation Controlling Influence – 'High' to 'Very High' except for depositional areas which have 'Moderate' values. This refers to the ability of using vegetation as a stabilization technique; and
- Bank Erosion Hazard Index – 'High' downstream, 'Moderate' and 'High' for most other reaches, and one 'Low' rating. This quantifies the existing erosion potential.

The study site was chosen due to it being representative of the entire Clinton River Watershed.

Source: ECT, 2006.

Unified Subwatershed and Site Reconnaissance

At least one of each type of USSR assessment was conducted in each catchment of the subwatershed.

The hotspot sites and pervious areas that were assessed were selected based on their being typical of those in the subwatershed.

The streets/storm drains and neighborhoods assessed were selected to provide a representative cross-section of 'typical' high, middle, and low-income areas in the subwatershed.

Typical House in the Moross Street / Wilson Street Neighborhood in Mt. Clemens

Apartments on Clara Street in Mt. Clemens – High Imperviousness and Stained Parking Lot

Unified Subwatershed and Site Reconnaissance

The number of USSR surveys conducted throughout the subwatershed is as follows:

- Neighborhood Source Assessment (NSA) – 21;
- Streets and Storm Drains (SSD) – 21;
- Hotspot Site Investigation (HSI) – 7; and
- Pervious Area Assessment (PAA) – 7.

The surveys are summarized in the following text.

Neighborhood Source Assessment

The neighborhood source assessment involved selecting a representative area in the neighborhood and gauging pollution source potential with respect to four main categories: 'Yards and Lawns', 'Driveways, Sidewalks, and Curbs', 'Rooftops', and 'Common Areas'.

The sites surveyed were characterized by relatively small parcels with a relatively large amount of impervious areas. Most lots are less than one-half acre, with 40% of the neighborhoods having lots one-quarter acre or smaller. Of the 21 neighborhoods assessed, all had impervious cover greater than 40% and 53% of neighborhoods contained impervious cover greater than 60%. Two-thirds of the neighborhoods had sidewalks, which contribute to the amount of impervious area. Larger impervious areas increase the volume and peak flow rate of stormwater runoff that will occur. Impervious surfaces also play a critical role in transporting pollutants to storm sewers.

In three-fourths of the neighborhoods assessed at least 80% of lots had moderately to highly maintained turf grass. Highly managed turf grass is often the source of nutrients from fertilizer, grass clippings, and other yard waste. It is also a source of pesticides and herbicides.

Seventy-one percent (71%) of the neighborhoods had curb and gutter. Of those, 50% of the neighborhoods were assessed as having 'clean and dry' curb and gutter. Sediment and organic material, such as leaves and lawn clippings had the largest pollution source potential in the curb and gutter.

In 33% of the neighborhoods, a majority of rooftops were directly connected to sewers or impervious surfaces that are directly connected to the sewers. Directly discharging roof drains increase the volume and peak flow rate of water in the sewer.

Seven assessed neighborhoods had open spaces, and six neighborhoods had stormwater ponds.

Figure 3-9. Streambank conditions in the subwatershed.

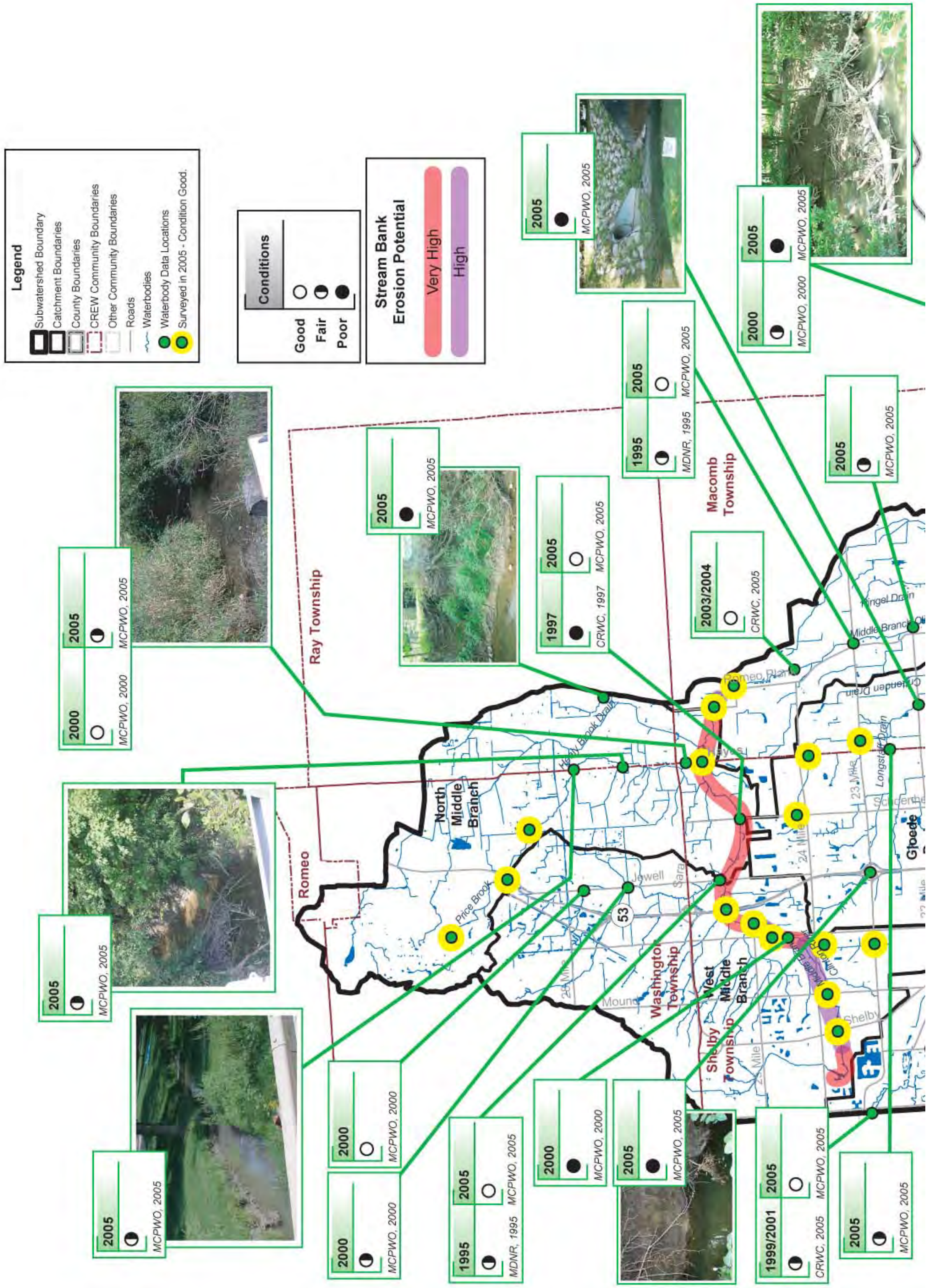
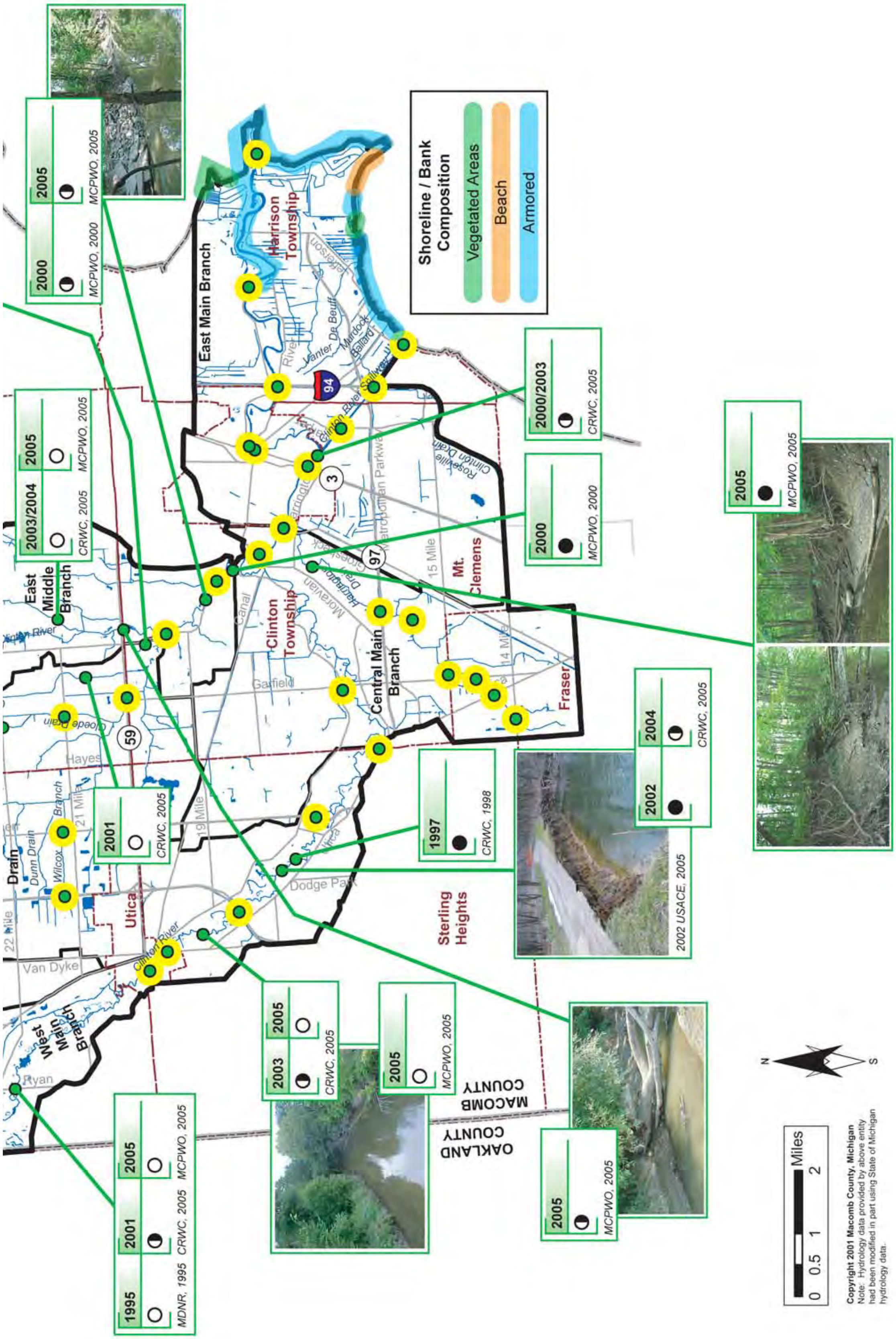


Figure 3-9. Streambank conditions in the subwatershed.



Based on field observations, 90% of neighborhoods showed indicators for excessive nutrients and 52% of neighborhoods were also assessed as having significant sediment pollution potential. Forty-eight percent (48%) were identified as having oil and grease, but only 14% of the neighborhoods were identified as having significant litter. Better lawn and landscaping practices were determined to be feasible in all of the locations. Better management of common spaces is possible in about 20% of the neighborhoods.

Streets and Storm Drains Assessment

The streets and storm drains assessment involved selecting a street area and gauging pollution source potential with respect to three main categories: 'Street Conditions', 'Storm Drain Inlets and Catch Basins', and 'Non-Residential Parking Lot'.

Of the twenty-one streets and storm drain assessments conducted in the subwatershed, 58% were in residential areas, 33% in commercial areas, and the remaining 8% in industrial/institutional areas. The street types surveyed break down as follows: collectors – 38%, local – 33%, and arterial – 29%. More than 90% of the sites utilize enclosed storm drainage infrastructure.

At 30% of the locations, the roads were noted to be cracked. This condition may allow more sediment to be introduced into runoff as a result of the deteriorating concrete. Forty percent (40%) of the street areas allowed on-street parking which requires more impervious area than streets without parking and also may interfere with street sweeping efforts, resulting in increased sediment loads in runoff. Imperviousness is also usually increased by the presence of cul-de-sacs which were present at 26% of the visited locations.

The presence of pollutants on the road surfaces was generally low with over 70% of the sites receiving 'clean' scores with respect to the presence of sediment, organic matter, and/or litter. Only one site received a 'filthy' score.

Obstructed catch basin inlets were noted at three sites, oil and grease at eight sites, and a sulfur smell at one.

Street sweeping and catch basin cleaning were gauged to be highly feasible pollution reduction strategies at these locations. Storm-drain stenciling was gauged to be feasible at about 60% of the locations, while parking lot retrofits were gauged feasible at only 10% of the locations.

Sediment on Gratiot Avenue near 15 Mile Road in Clinton Township

Debris in Catch Basin on Gratiot Avenue near 15 Mile Road in Clinton Township

SSD Terms

Local Streets
Streets with no through traffic function; access to property only.

Collector Streets
Streets that take traffic between local streets and arterial streets.

Arterial Streets
State designated routes and other major streets.

Turf Sports Field Surrounded by Wooded Areas at Budd Park in Clinton Township

Pervious Area Assessment

The pervious area assessment involved selecting an area and assessing its conditions and potential with respect to three main categories: 'Natural Area Vegetative Cover and Impacts', 'Open Area Vegetation and Impacts', and 'Open Area Reforestation Constraints'.

The pervious area assessment was completed for seven locations in the subwatershed, including schools, parks, a golf course, and an orchard.

Invasive species were found at five of the locations, animal impacts at one, trash and dumping at one, hydrologic impacts at two, and stormwater runoff had impacts at two locations.

Of the non-cropland sites, two were nearly 100% turf, two were around 50%, and the other two around 20%. The remaining coverage was typically trees with some shrubs. Soil compaction and erosion were found at four of the sites, and poor vegetative health at one. Compaction and poor vegetative health can cause less infiltration of water into the ground and more runoff (that can carry eroded sediments), which contributes to negative stormwater effects.

Reforestation is one method to reduce stormwater volume, peak flow, and erosion. Underground utilities, pavements, and buildings represented constraints to reforestation. Two of the sites were indicated to be poor candidates for reforestation and the others were not assessed.

Boat Washing on Impervious Surface at a Marina in Harrison Township

Hotspot Site Investigation

The hotspot site investigation involved selecting a common type of establishment and gauging pollution source potential with respect to six main categories: 'Vehicle Operations', 'Outdoor Materials', 'Waste Management', 'Physical Plant', 'Turf/Landscaping Areas', and 'Stormwater Infrastructure'.

Seven hotspots were assessed for pollution potential in the subwatershed. Of those seven, three were commercial properties, two were municipal properties, one site was transportation-related, and one site was a marina.

Fifty-seven percent (57%) of the sites contained vehicles that were maintained, repaired, and washed on site. Half of those locations performed at least some of this work outside. Fueling areas were directly connected to storm drains at 71% of the sites, and uncovered, outdoor fueling areas were located at 42% of the sites. Uncovered, outdoor fueling areas are potential sources of fuel pollution, especially when the fueling areas are directly connected to the sewer. Spills and leaks from vehicles were identified at 29% of the sites.

Materials were stored outside, without a cover at 57% of the locations assessed. Materials stored outside, without cover are more likely to be sources of pollution than those stored in protected locations.

Fifty-seven percent (57%) of assessed locations had dumpsters unprotected from rainfall or in damaged condition. Over half of the sites, had dumpsters that were located near a storm drain inlet. Leaky dumpsters or trash around them has the potential to contaminate runoff that will eventually enter the storm drain.

The building and parking lots at these locations ranged in age from five to 30 years. Only two of the sites had buildings and parking lots classified as 'clean', while there were two additional sites with only parking lots classified as 'clean.' Seventy-one percent (71%) of locations had downspouts that directly discharge to the sewer or to impervious areas drained by the sewer. Downspout connections contribute significantly to the volume and peak flow of water in sanitary and storm sewers.

Dumpster Area on Impervious Surface with Debris on the Ground – Gas Station in Macomb Township

Grass constituted the largest percent of turf and landscape area at all sites. Over half of the locations were considered to have moderate to highly maintained turf. Moderate to highly maintained turf is often a source of pollution from nutrients (fertilizers, grass clippings, leaves), pesticides, and herbicides.

Stormwater treatment practices were only found on 14% of the sites, but all sites were still assessed as moderately clean to clean in the areas of sediment, organic material, and litter.

Education was determined to be a feasible solution for about 70% of the sites. Better sweeping and storage practices were also identified as feasible solutions at about 30% of the sites.

Summary

The Road-Stream Crossing and USA surveys looked at waterbodies throughout the subwatershed and identified potential and actual problems of various magnitudes. The most common issues within the subwatershed were trash/debris in waterbodies, impacted/inadequate riparian buffers, bank erosion, and proximity to problematic land use types.

The USSR looked at upland areas throughout the subwatershed and characterized pollution potential for neighborhoods, streets, and hotspots, and assessed restoration potential for pervious areas. Common potential sources of pollution in the subwatershed included nutrients from lawn maintenance, sediment, and lack of pollution control at some hotspots. These sources have an increased pollution potential when there is increased imperviousness. Education, maintenance of streets and catch

Impervious Surfaces – Rooftops and Concrete – at the Department of Public Works in Shelby Township

Courtesy of MCPWO

basins, better lawn maintenance practices, and reforestation of pervious areas were all cited as some of the potential solutions to reduce the pollution potential of the subwatershed.

While the information presented in this section is specific to the sites visited, at the time they were visited, it can be extrapolated to estimate the extent of the identified problems throughout the subwatershed. Correlations can also be made between the pollutant sources surveyed in the USSR and the problems identified in the waterbodies. Additionally, this data is useful in estimating pollutant load reductions to waterbodies as a result of correcting the documented problems. These types of analyses are documented and discussed in Chapter 5 of the plan.

Analysis of Imperviousness

As explained in the first section and illustrated throughout the preceding section of this chapter, impervious surfaces play an integral role in contributing to water quality and hydrological problems.

There are a number of ways to estimate the extent of impervious coverage in the subwatershed. For the purposes of this plan, two methods utilizing available data have been selected. The first estimates impervious surface coverage based on land use (see Chapter 2) and SEMCOG impervious cover values for each type of land use (Table 3-4).

Table 3-4. Assumed percent impervious values.

Land Cover	Impervious Percentage
Open Water	0.0
Woodland and Wetland	0.0
Cultivated Land (Agriculture)	2.0
Open Space (Recreation)	10.9
Open Space (Grassland)	2.0
Developed Land - Residential (Single-family)	18.8
Developed Land - Residential (Multi-family)	51.4
Developed Land - Under Development / Other*	18.8
Developed Land - Transportation / Utility	52.9
Developed Land - Industrial	75.9
Developed Land - Commercial and Office	76.3
Developed Land - Institutional	28.0

* includes a very small amount of 'Extractive / Barren' land which has an impervious percentage of 10.0. Source: Perry and Hamann, 1998.

Imperviousness of Open Water

Often, especially when estimating the peak flow rates for ungaged streams, open water is considered to be 100 percent impervious because one inch of rainfall produce one inch of runoff volume over the area of the waterbody (i.e. no infiltration occurs).

SEMCOG (as in Table 3-2) defines open water as having zero percent impervious area. This is appropriate for identifying human influenced imperviousness through development.

However, for the calculation of peak runoff, it is typical to use one-hundred percent to account for all of the rainfall being converted to runoff.

The second method utilizes National Land Cover Data (NLCD) based on satellite imagery for the year 2000 (MRLC, 2001).

As Table 3-5 shows, the trends in impervious cover for each of the subwatershed catchments is similar between the two methods, however the actual values vary significantly.

Table 3-5. Impervious cover percentages.

Catchment	Impervious Cover from Land Use	Impervious Cover from NLCD
Gloede Drain	26.2%	35.8%
Central Main Branch	26.7%	41.6%
East Main Branch	27.8%	38.7%
West Main Branch	20.8%	29.5%
East Middle Branch	16.3%	34.9%
North Middle Branch	8.4%	6.2%
West Middle Branch	17.9%	21.1%
Subwatershed Average	**20.9%**	**29.5%**

The comparison of the results of the two methods is primarily shown to illustrate the documented variability in the differing methods utilized to estimate impervious cover (Moglen, 2006). A visual representation of the impervious cover from the land use data is shown in Figure 3-10. The remaining discussion is based on this data as the impervious percentage coefficients were derived based on regional information.

The impervious cover for the subwatershed as a whole is 20.9%. The Gloede Drain, Central Main Branch and East Main Branch catchments have the greatest percentages of impervious surface, with over 26% each. The North Middle Branch catchment has the lowest impervious percentage at 8.4%. The other catchments have impervious percentages between 16.3% and 20.8%.

Analysis of stream systems across the country seems to indicate that there are thresholds at which watershed imperviousness results in measurable degradation of waters. The Impervious Cover Model (Schueler, 1994) describes this relationship, some threshold values of imperviousness, the characteristics of streams impacted by imperviousness, and recommended actions to address issues in these streams. The ICM relationship is displayed in Figure 3-11.

Figure 3-10. Impervious cover based on land use type.

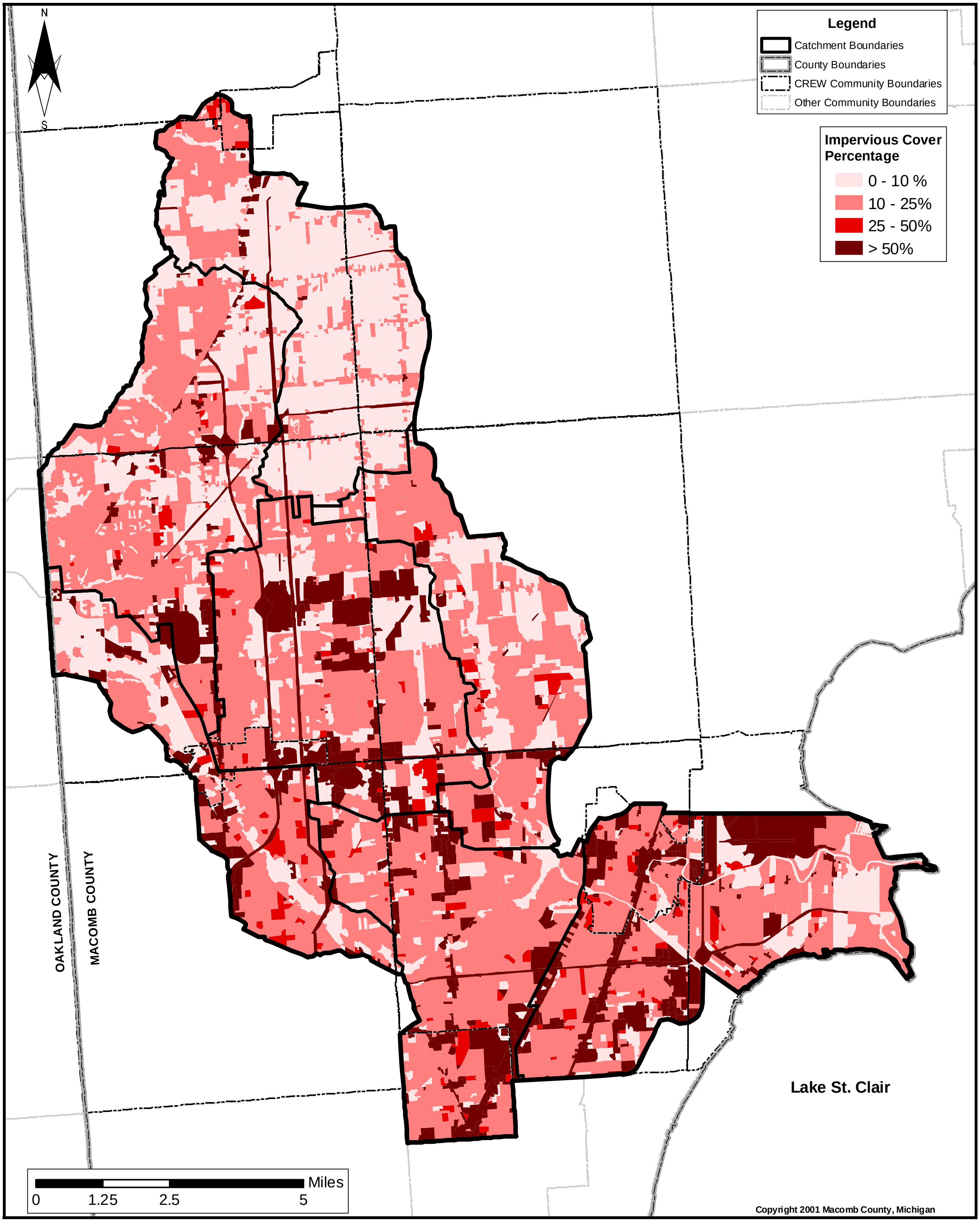
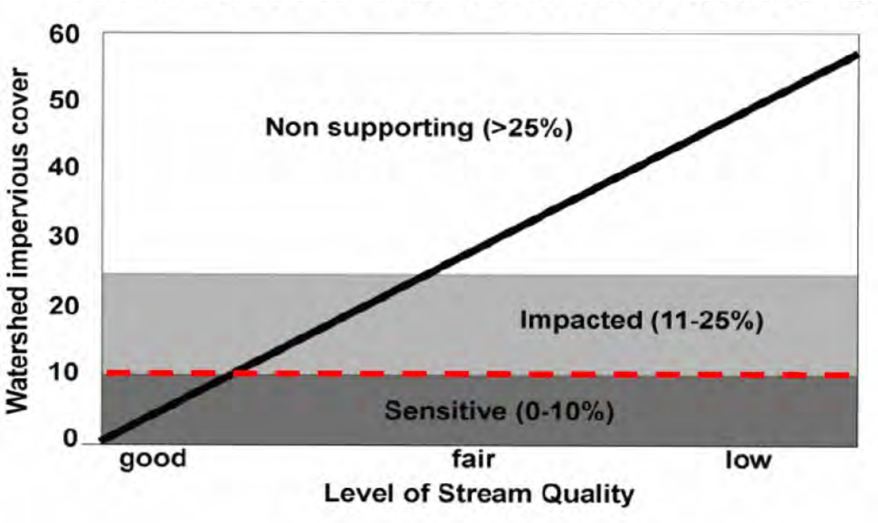


Figure 3-11. Relationship between impervious cover and stream quality.



Source: Moglen, 2006 – derived from Schueler, 1994.

Additional information is presented in the 'Impervious Cover Model' sidebar. The ICM, although a powerful tool to predict the quality of streams based on impervious cover change, has limitations and is not an absolute indicator. It is not generally applicable at scales greater than 10 miles and is based primarily on data from the northwest portion of the U.S. It is important to understand that the ICM is applicable at a single point along a waterbody; the analysis of imperviousness must consider the entire area of land tributary to that point. From the information presented above, it can be said that the Middle Branch of the Clinton River at the outlet of the West Middle Branch catchment has a tributary area that is 20.8% impervious and therefore falls within the impacted category. While the North Middle Branch catchment has an impervious area of only 8.4%, the ICM classification of the Middle Branch of the Clinton River at the outlet of the North Middle Branch catchment must include the total tributary area, which includes the West Middle Branch. This total area is then approximately 15% impervious and the river is classified as impacted at that location.

While outside the scope of this plan, it is recommended, in the future, to properly analyze the streams in the subwatershed in the context of the ICM. This involves defining drainage areas for numerous points along each stream to be analyzed and conducting the impervious analysis as described in the beginning of this section. At this point, it can be said, based on the catchment-aggregated data, that the impervious coverage for a given catchment can be compared to the ICM values to determine the likely classification of the small streams in that catchment. The remaining discussion in this section approaches the topic in such a manner.

Only one catchment, the North Middle Branch, falls in the 'Sensitive' category. One would expect that the waterbodies in this catchment will be the least impacted. Watershed protection activities in this catchment should focus on protecting the high quality elements of the waterbodies. The other two Middle Branch catchments (East and West), fall within the 'Impacted' category. Waterbodies in these catchments are expected to

Impervious Cover Model

The line in Figure 3-11 represents the trend line for the data actually collected in developing this model.

The table below presents the thresholds, the associated Impervious Cover Model (ICM) classifications of the waterbodies, noted characteristics exhibited by the waterbodies, and some action suggestions.

Cover	Class	Characteristics / Suggestions
0-10%	Sensitive	Stable Channel Good Water Quality Excellent-Good Biodiversity Maximum Protection Efforts Limit Future Imperviousness
11-25%	Impacted	Unstable Channel Fair Water Quality Good-Fair Biodiversity Protect Critical Elements Select Load Reducing BMPs
26-100%	Non-supporting	Highly Unstable Channel Fair-Poor Water Quality Poor Stream Biodiversity Control Bacteria Select Load Reducing BMPs

Source: Schueler, 1994.

show some signs of degradation. Watershed protection activities in these catchments should focus on protecting the critical elements of water quality and implementing protection strategies that focus on reducing pollutant loads from existing impervious areas. It is important to recognize that the aforementioned catchments are 'headwater areas' for the Middle Branch of the Clinton River and the fact that they are not dominated by impervious impacts is a positive in terms of future water quality potential. Refer to Chapter 2 for additional discussion concerning headwater areas.

Aerial of a Portion of the Sensitive North Middle Branch Catchment

Image derived from maps.yahoo.com

The Gloede Drain catchment falls into the category of 'Non-supporting' implying that many waterbodies in the catchment may be affected by impervious cover such that they show impacted water quality, low biodiversity, and have unstable channel banks. Watershed protection activities in this catchment should focus on reducing bacterial contamination and implementing pollutant load reducing BMPs.

The West Main Branch catchment falls within the 'Impacted' category. Despite heavy build-out on the downstream end, the amount of imperviousness is mitigated by a large conservation area on the upstream end. As such, the downstream portion can be classified as 'Non-supporting'. This catchment is land that drains essentially directly to the Clinton River as part of its corridor. Thus pollutants draining from impervious areas have a direct loading into the river.

Portions of the Central Main Branch and East Main Branch catchments also include the Clinton River corridor. Portions of the East Main Branch catchment drain to Lake St. Clair directly or through canals. Both of the catchments are classified in the 'Non-supporting' category and thus waterbodies within them are expected to show effects similar to those described for the Gloede Drain catchment.

Aerial of a Portion of the Non-supporting Central Main Branch Catchment

Image derived from maps.yahoo.com

As a whole, the subwatershed is affected by the high percentage of imperviousness. While some areas are expected to exhibit serious problems, others have impervious levels that imply the possibility to maintain high levels of water quality and general waterbody health.

While short-term actions for areas most affected by impervious surfaces are related to minimizing existing problems, the long-term outlook for these areas can be geared towards restoration if the right steps are taken. However, one of the purposes of the ICM is to identify streams that are outside of the severe impacts of imperviousness, so that limited resources can be funneled towards the protection of these resources. This approach is much more cost-effective than trying to restore streams severely degraded by high levels of imperviousness.

Current Subwatershed Protection Practices

The subwatershed conditions discussed in the previous sections of this chapter are in large part a result of local/county/regional plans, programs, projects, and ordinances. As such, an audit was performed to identify and critique the elements of these various documents that impact water quality (excluding those documents that were not publicly available). Based on the results of the audit, the communities were classified into groups summarizing their current level of watershed protection.

Audit Details

The audit is based on the evaluation mechanisms created by the SEMCOG and the CWP. The over 300 questions contained in the SEMCOG *Opportunities for Water Resource Protection in Local Plans, Ordinances, and Programs* (2002) were grouped using the CWP's Eight Tools of Watershed Protection (2002):

- Watershed Planning - The application of regulatory measures and/or planning techniques that are designed to maintain or limit future impervious cover, redirect development, and protect sensitive areas;
- Land Conservation - Programs or efforts to conserve undeveloped, sensitive areas or areas of particular historical or cultural value;
- Aquatic Buffers - The protection, restoration, creation, or reforestation of stream, wetland, and urban lake buffers. *Aquatic Buffers and Better Site Design were combined for this analysis;*
- Better Site Design - Local ordinances and codes to incorporate techniques to reduce impervious cover and/or redirect runoff onto pervious surfaces in the design of new development and redevelopment projects. *Aquatic Buffers and Better Site Design were combined for this analysis;*
- Erosion and Sediment Control - The use of erosion control, sediment control, and dewatering practices at all new development and redevelopment sites;
- Stormwater Management - The incorporation of structural practices into new development, redevelopment, or the existing landscape to help mitigate the impacts of stormwater runoff on receiving waters;
- Non-Stormwater Discharges - Locating, quantifying, and controlling non-stormwater pollutant sources in the watershed. May also include operation and maintenance practices that prevent / reduce pollutants from entering the natural/municipal drainage system; and
- Watershed Stewardship Programs - Stormwater and watershed education or outreach programs targeted towards fostering human behavior that prevents or reduces pollution over a range of land uses and activities.

Audit Methodology

Each community's planning and regulatory documents were evaluated and scored based on the number of question responses that indicated the community was performing a protection activity (which gauges the level of protection afforded by the plans, etc.). The communities were then grouped based on the 'scores'.

Audit Limitations

- The grouping of communities allows for manageable assessment but reduces the resolution of the analyses.
- Only verifiable and enforceable standards were given scoring credit.
- Communities may not have received credit for work the county is doing on their behalf.
- Credit was only given for soil erosion control if mention of compliance with state programs was included.

Communities not Included in Audit Results

- Grosse Pointe Farms (Lake St. Clair Direct Drainage Subwatershed)
- Harper Woods (Lake St. Clair Direct Drainage Subwatershed)
- Pleasant Ridge (Red Run Subwatershed)
- Royal Oak Township (Red Run Subwatershed)

Group 1 Synopsis

The Group 1 communities do not have all of the needed practices to protect local waterways from the impacts of stormwater. Significant effort will be needed to elevate local planning documents to a level necessary to implement the measures recommended by SEMCOG and the CWP and to be compliant with the Phase II stormwater requirements.

Audit Results

The general results of the audit indicate that none of the communities have all the recommended stormwater policies and procedures in place. This means that local rivers and streams are currently vulnerable to activities, especially those surrounding development. In fact, there is not a single community that currently is requiring half of the actions as prescribed by the SEMCOG or the CWP.

The communities were grouped into three classes that briefly summarize the level of protection afforded to the subwatershed[3].

Group 1

The planning documents for Group 1 communities indicate that there is little attention paid to watershed management under the current formal practices. The audit elicited the following characteristics of the Group 1 communities:

- Only one community had a Community Master Plan that addressed the impacts of stormwater;
- Ordinances, including zoning ordinances accounted for 80% of the communities' scores and were dated. Typically, ordinances are based on a template created in the 1970s and have been only updated on an as-needed-basis;
- They have not adopted overlay zoning districts for riparian areas and greenways even if they may be available at the county level;
- In general, the only reference made to stormwater in the ordinances is that buildings within 200 feet of the stormwater sewer system must be hooked into it (70% of the communities);
- Sixty percent (60%) of the communities did not allow septic systems within urban areas and 60% had a tree ordinance; and
- Only 50% of Group 1 communities regulated soil erosion and sediment control while 40% had provisions for cluster/open space developments.

Communities may be implementing some protection during the site plan review process. Communities may be requiring developers to undertake stormwater best management practices such as preserving natural features and establishing buffers along riparian corridors, along with a host of other protection measures. However, these ad hoc methods are not defensible in court and must be codified to provide true watershed protection.

Group 1 is comprised of communities scoring between 1 and 7 (out of 44) and includes: Macomb Township, Mount Clemens, Ray Township, Romeo, and Utica.

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[3] The classifications and discussion of each is based on results of not only the CREW, but also the Red Run Subwatershed (R2W) and Lake St. Clair Direct Drainage Subwatershed (LSCW). The analysis included 35 of the 39 communities comprising these three subwatersheds and also included Macomb, Oakland, and Wayne counties.

Group 2

What differentiates Group 2 from Group 1 is primarily the specific reference to stormwater in community planning documents. The audit elicited the following characteristics of the Group 2 communities:

- Twenty percent (20%) of the communities had a Community Master Plan that addressed the impacts of stormwater although a majority of these were out-of-date (> 5 years old);
- Sixty-five (65%) percent of the scores that communities received were from their ordinances;
- In Group 2 communities, the categories that showed significant improvement over Group 1 were provisions for clustering/open space (90%), recognition of floodplains and/or stream corridors (80%), wetlands (50%), and natural area/greenway preservation (30%);
- There is marked improvement in Group 2's efforts to manage stormwater over Group 1, especially if one considers the unaccounted for activities occurring at the site plan review level; and
- Group 2 communities have made strides at integrating state requirements, county initiatives, and other planning initiatives into planning documents.

The Group 2 communities offer some protection of local waterways from the impacts of stormwater. The biggest drawback is the inability of communities to strictly and uniformly enforce standards due to not having formally adopted them. Communities could close this gap by adopting ordinances that are coordinated with the county and are applicable throughout their jurisdictions. Generally, extensive work will be needed to upgrade the planning documents of Group 2 communities to implement the measures recommended by SEMCOG and the CWP to be compliant with the Phase II stormwater requirements.

Group 2 is comprised of communities scoring between 8 and 14 (out of 44) and includes: Bruce Township, Clinton Township, Fraser, Harrison Township and Sterling Heights.

Group 2 Synopsis

In general, these communities lack a comprehensive approach toward land management and, in particular, environmental management (including stormwater). This patchwork approach primarily stems from updating an out-of-date ordinance model on an as-needed-basis as opposed to integrating communities' ordinances with their Master Plan.

Group 3

Group 3 communities have the most stormwater practices of those reviewed. Still, the protection afforded to waterways by these communities is not as comprehensive as it could be. The audit elicited the following characteristics of the Group 3 communities:

- Forty percent (40%) of the communities had Master Plans that addressed the impacts of stormwater and 100 percent of the communities addressed floodplains, stormwater, soil erosion and public education in their planning documents;
- Eighty-five percent (85%) of the communities addressed wetlands and woodlands; and
- Sixty percent (60%) of the communities addressed cluster/open space development and natural area preservation.

Group 3 is comprised of communities scoring 15 or greater (out of 44) and includes: Macomb County, Shelby Township, and Washington Township.

Group 3 Synopsis

The communities of Group 3 have been making a conscious effort to improve their Master Plan and ordinances to include environmental considerations, including stormwater. For the most part, they are currently instituting about half of SEMCOG's prescribed stormwater measures. There is still some work that the Group 3 communities need to do to comply with the Phase II stormwater requirements but they are well ahead of the majority of communities.

Identified Waterbody Problems

MDEQ-defined Impairments

Waterbody impairments involve non-attainment of water quality standards and are based on data and research. The primary reference for determining impairments is MDEQ's biannual water quality report (MDEQ-WD, 2006). This report lists the following impairments:

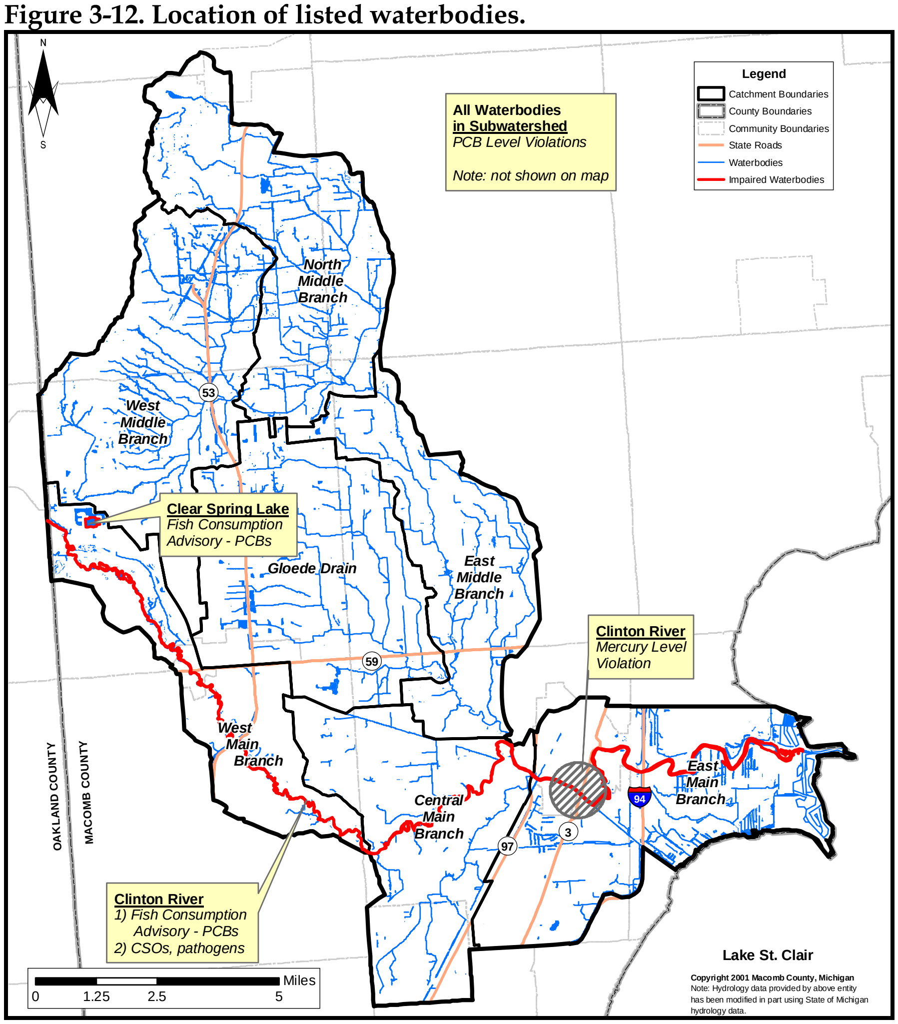
<u>All Waterbodies in Subwatershed</u>
- PCB levels

<u>Clinton River</u>
- Fish Consumption Advisory – PCBs
- Pathogens[4]
- Mercury levels (one mile stretch in Mt. Clemens)

<u>Clear Spring Lake</u>
- Fish Consumption Advisory – PCBs

Figure 3-12 shows the location of the listed waterbodies.

Figure 3-12. Location of listed waterbodies.



Fish Consumption Advisories

In addition to specific waterbodies, the Michigan Department of Community Health also has a general fish consumption advisory for all inland lakes, reservoirs, and impoundments for mercury contamination in Crappie, Bass (Large- & Smallmouth, and Rock), Muskellunge, Northern Pike, Walleye, and Yellow Perch.

Lake St. Clair

Although not within the subwatershed boundaries, Lake St. Clair is the receiving water for the subwatershed. The lake is listed as an impaired waterbody due to the following:

- Fish Consumption Advisory – PCBs; and
- Mercury in fish tissue.

Additionally, the subwatershed shares some shoreline with the lake including Metropolitan Beach in Harrison Township which is associated with an impairment for pathogens[1].

Metro Beach Metropark

Source: MEDC, 2005.

[4] Pathogen impairments in the subwatershed are specifically linked to the presence of Combined Sewer Overflows (CSOs) as referenced in the Michigan Water Quality Standards: "Total body contact recreation immediately downstream of … combined sewer overflows… is contrary to prudent public health and safety practices, even though water quality standards may be met."

Clear Spring Lake is in the West Main Branch catchment while the Clinton River runs through the West Main Branch, Central Main Branch, and East Main Branch catchments.

Beneficial Use Impairments

Because the subwatershed is located in the Clinton River AOC, it has the following BUIs:

- Degradation of aesthetics;
- Beach closings and other "full body contact" restrictions;
- Degradation of benthos;
- Loss of fish / wildlife habitat;
- Restrictions on dredging activities;
- Eutrophication / undesirable algae populations;
- Degradation of fish / wildlife populations; and
- Restriction on fish / wildlife consumption.

The BUIs do not have regulatory significance at the state level, but do provide insight into the types of problems encountered throughout the subwatershed.

Other Problems

Information provided by the CRWC indicates a possible tree blockage problem in the Clinton River in the West Main Branch catchment (CRWC, 2004).

Interpretation of Subwatershed Conditions

This chapter was intended to present the conditions of the subwatershed that can be used to concretely identify the problems in the subwatershed, the causes of the problems, and the sources of the causes of the problems. The continuing analysis of problems, causes, and sources is presented in Chapter 5. This follows Chapter 4: Community Outreach and Involvement because the public input that was obtained throughout the planning process was also used to define the problems, causes, and sources in the subwatershed, in addition helping define the targets to which the resources of the subwatershed should be managed.

Adaptive Management

This chapter represents the first effort by the watershed planners to document as much existing information as possible about the subwatershed conditions. This was done to provide a solid foundation for decisions related to plan development and implementation. As adaptive management is utilized to implement and update this plan in the future, it is likely that the content of this chapter will change to reflect additional information and will also be streamlined to more specifically address the issues upon which the plan is focused.

References

Alien Plant Working Group [APWG]. http://www.nps.gov/plants/alien/bkgd.htm. Last accessed: June 7th, 2006.

American Heritage® Dictionary [AHD] of the English Language, Fourth Edition. Houghton Mifflin Company, 2004. 26 Aug. 2006. Via: http://dictionary.reference.com/search?q=infrastructure

Baker, D.B. et al. "A New Flashiness Index: Characteristics and Applications to Midwestern Rivers and Streams." 2004.

Center for Watershed Protection [CWP], "The Practice of Watershed Protection". 2002.

Center for Watershed Protection [CWP]. "Unified Stream Assessment: A User's Manual." 2005.

Center for Watershed Protection [CWP]. "Unified Subwatershed and Site Reconnaissance: A User's Manual." 2005.

Clinton River Public Advisory Council [CRPAC]. 2000. "Clinton River Watershed Remedial and Preventative Action Plan: 1998 Update and Progress Report."

Clinton River Public Advisory Council [CRPAC]. 1995. "Clinton River Watershed Remedial and Preventative Action Plan: 1995 Update and Progress Report."

Clinton River Watershed Council [CRWC]. "Clinton River Watershed Council" web site. Via: http://www.crwc.org/. Last accessed: March 22, 2005.
Clinton River Watershed Council [CRWC]. "Stream Leaders Data, 1999-2004." 2005b.
Clinton River Watershed Council [CRWC]. "Communication from Dan Keifer concerning low flows on the river and supporting data". 2005c.
Clinton River Watershed Council [CRWC]. "E-mail communication with Jessica Pitelka Opfer concerning navigation in Clinton River watershed". November 18, 2004.
Clinton River Watershed Council [CRWC]. "1997 Aquatic Habitat Survey of the Clinton River Watershed with Recommended Management Actions." 1998.
Clinton River Watershed Council [CRWC]. "Clinton River: Water Quality Management Issues." 1975.
Clinton River Watershed Council [CRWC]. "Urban River: Water Quality Problems in the Clinton River Basin." 1975b.
Clinton River Watershed Council [CRWC]. "Water Quality in the Clinton River Basin." 1975c.
Collins, P.G. "Water Quality in Southeast Michigan: Introduction." Southeast Michigan Council of Governments. 1978.
Ditschmann, E.P., et al. Clinton River Watershed On-Site Sewage Disposal System Survey. 1995.
Edsall, T.A. and Gannon, J.E. "A Profile of Lake St. Clair". U.S. Fish and Wildlife Service. Ann Arbor, Michigan. 1991.
Environmental Consulting and Technology [ECT], Inc. "Hydrologic and Geomorphic Analysis of the Clinton River Watershed: Final Report." 2006.
Environmental Protection Agency [EPA]. "Clinton River Areas of Concern" web site. Via: http://www.epa.gov/glnpo/aoc/clintriv.html. Last accessed March 22, 2005.
Environmental Protection Agency [EPA]. "Water Quality Standards" website. Via: http://www.epa.gov/waterscience/standards/. Last accessed: March 22, 2005a.
Environmental Protection Agency. [EPA] "Summary of Great Lakes Beach Closings, 1981-1994." Via: http://www.epa.gov/glnpo/beach/. Last accessed: January 20th, 2005b.
Environmental Protection Agency [EPA] and Environment Canada [EC]. "Upper Great Lakes Connecting Channels Study. Volume 1. Executive Summary. 50pp. 1988.
Federal Water Pollution Control Administration [FWPCA]. "Report on Water Pollution in the Lake Erie Basin: Clinton River Area, Part I – Water Quality." 1966.
Francis, J.T., and R.C. Haas. Draft Clinton River Assessment. Michigan Department of Natural Resources, Fisheries Division, Ann Arbor. 2005.
Francis, J.T. Transmittal to Macomb County, untitled, 2006.
Great Lakes Commission [GLC]. "Lake St. Clair Coastal Habitat Assessment.". 2004.
Great Lakes Fishery Commission [GLFC]. Technical Release No. 41. "Overfishing or Pollution? Case History of a Controversy on the Great Lakes." 1985.
Hiltunen, J.K. "Limnological Data from Lake St. Clair, 1963 and 1965." 1971.
Hunter, G. "Steelhead release cast the Clinton in new light." Detroit News. April 20, 2005.

Johnson, P. The Advisor Newspaper. Referenced in MDNR, 1988.
Kartesz J. and L. Morse, The Nature Conservancy. 1997. Obtained from APWG web site (see associated reference).
Lake St. Clair Conference Summary Report [LSCCSR]. "Lake St. Clair: It's Current State and Future Prospects." 2000.
Macomb County Health Department [MCHD]. "Developing a Bathing Beach Monitoring Program." Via: http://www.macombcountymi.gov/publichealth/Beach_Presentation_Manual.asp. Last accessed: January 20th, 2005.
Macomb County Health Department [MCHD]. Raw data for "2005 Lake St. Clair Water Quality Assessment." 2005.
Macomb County Health Department [MCHD]. "2004 Lake St. Clair Water Quality Assessment." 2004.
Macomb County Health Department [MCHD]. "2003 Lake St. Clair Water Quality Assessment." 2003.
Macomb County Health Department [MCHD]. "2002 Lake St. Clair Water Quality Assessment." 2002.
Macomb County Health Department [MCHD]. "2001 Lake St. Clair Water Quality Assessment." 2001.
Macomb County Health Department [MCHD]. "2000 Lake St. Clair Water Quality Assessment." 2000.
Macomb County Health Department [MCHD]. "1999 Lake St. Clair Water Quality Assessment." 1999.
Macomb County Health Department [MCHD]. "1998 Lake St. Clair Water Quality Assessment." 1998.
Macomb County Health Department [MCHD]. "The 1998 Surface Water Quality Report." 1998b.
Macomb County Health Department [MCHD]. "Macomb County Blue Ribbon Commission on Lake St. Clair." 1997.
Macomb County Public Works Office [MCPWO]. *Road Stream Crossing Data.* 2005.
Macomb County Public Works Office [MCPWO]. *Middle Branch of the Clinton River Road Crossing & Streambank Inventory Report*. 2000.
McElrone, A., Sherald, J. L. and Pooler, M. R. 1999. Identification of alternative hosts of *Xylella fastidiosa* in the Washington, DC area using nested polymerase chain reaction (PCR). J. Arboric.
Michigan Department of Environmental Quality [MDEQ] – Water Division. "DRAFT Water Quality and Pollution Control in Michigan: 2006 Sections 303(d) and 305(b) Integrated Report". April 2006.
Michigan Department of Environmental Quality [MDEQ]. "Biological Assessment of the Clinton River Watershed, Lapeer, Macomb, and Oakland Counties, Michigan, July – September 2004, July 2005. 2005.
Michigan Department of Environmental Quality [MDEQ]. "Mercury Levels in Lake St. Clair Sediments, September 2000." 2002b.
Michigan Department of Environmental Quality [MDEQ]. "Developing a Watershed Management Plan for Water Quality: An Introductory Guide." 2000.
Michigan Department of Environmental Quality [MDEQ]. "Stream Crossing Watershed Survey Procedure." 2000b.
Michigan Department of Environmental Quality [MDEQ]. "A Caged Fish Study of The Clinton River, August 20 – September 17, 1997." 1999
Michigan Department of Natural Resources [MDNR]. Transmittal to Macomb County, untitled. 2005.
Michigan Department of Natural Resources [MDNR]. Transmittal to Macomb County entitled: *Stream Sampling – Macomb County – 2004*. 2004.
Michigan Department of Natural Resources [MDNR]. "Study Performance Report: F-81-R-4." 2003.

Michigan Department of Natural Resources [MDNR]. “A Biological Survey of sites in the Clinton River Watershed, Macomb and Oakland Counties, Michigan.” 1995.

Michigan Department of Natural Resources [MDNR]. “Remedial Action Plan for Clinton River Area of Concern.” 1988.

Michigan Department of Natural Resources [MDNR]. “Results of Bulk Sediment, EP Toxic and Elutriate Tests Performed on Clinton River Sediments Downstream of Mt. Clemens, Macomb County, Michigan Between 1981 and 1987 and Their Respective Purposes.” 1988b.

Michigan Department of Natural Resources. “Clinton River Study at Mt. Clemens.” 1981

Michigan Department of Natural Resources [MDNR]. “An Evaluation of Bacterial Pollution in Lake St. Clair in the Vicinity of the Clinton River.” 1981b.

Michigan Department of Natural Resources [MDNR]. “A Sediment Survey of the Clinton River, Pontiac to Mouth, September 9, 1976.” 1976

Michigan Department of Natural Resources [MDNR]. “Limnological Survey of the Michigan Portion of Lake St. Clair, 1973.” 1975.

Michigan Department of Natural Resources [MDNR]. “Biological Survey of the Clinton River: Pontiac to Mouth.” 1973a.

Michigan Department of Natural Resources [MDNR]. “Clinton River Survey: Rochester to Mouth.” 1973b.

Michigan Department of Natural Resources [MDNR]. “Biological Survey of the Clinton River: Vicinity of the Rochester Paper Company.” 1973c.

Michigan Natural Features Inventory [MNFI]. Web site. Via: http://web4.msue.msu.edu/mnfi/. Last accessed: August 1st, 2005.

Michigan, State of. “Michigan Administrative Code.” Part 4. Last Revised: Janurary 13th, 2006.

Moglen, G.E. “Impervious Area Limits are Trickier than You’d Think”. Presentation to the AWRA GIS and Water Resources Specialty Conference, May 8th, 2006.

Multi-Resolution Land Characteristics Consortium [MRLCC]. 2001 NLCD Data. “MRLC Consortium” Web site. Via: http://www.mrlc.gov/index.asp. Last accessed: June 7th, 2005.

Myers, D.N. et al. “Water Quality in the Lake Erie – Lake Saint Clair Drainages, Michigan, Ohio, Indiana, New York, and Pennsylvania, 1996-98.” United States Geological Survey Circular 1203. 2000.

Perry, S., and Hamann, A. “Utilizing GIS as a Tool in Mapping Impervious Surfaces and Protecting Southeast Michigan’s Headwaters.” 1998.

Pieters, A.J. “The Plants of Lake St. Clair.” Bulleting of the Michigan Fish Commision, No.2: pp. 1-14. Robert Smith & Co. State Printers and Binders. 1894.

Randall, J. and J. Marinelli. 1996. Invasive plants: weeds of the global garden. Brooklyn Botanic Garden Club, Inc. Handbook No. 149. 111 pp.

Rheaume S.J., et al, . “Areal Distribution and Concentrations of Contaminants of Concern in Surficial Streambed and Lakebed Sediments, Lake Erie – Lake Saint Clair Drainages, 1990-1997” United States Geological Survey, Water Resources Investigations Report 00-4200. 2001.

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

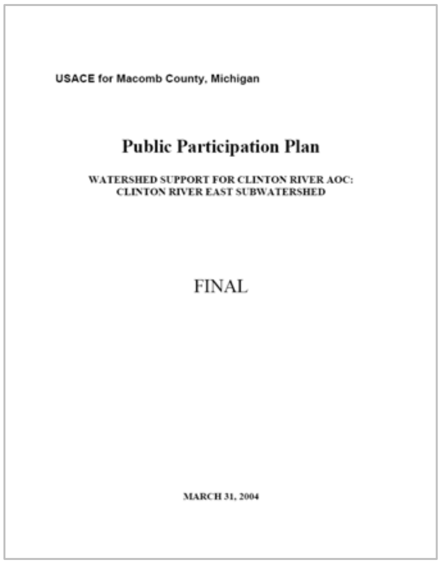
Southeast Michigan Council of Governments [SEMCOG], (August 2002). *Opportunities for Water Resource Protection in Local Plans, Ordinances, and Programs: A Workbook for Local Governments.* Available at: http://www.semcog.org/ cgi-bin/products/publications.cfm

Southeast Michigan Council of Governments [SEMCOG]. "Water Quality in Southeast Michigan: Clinton River Basin." 1978.
Strayer, D. The Freshwater Mussels (Bivalvia: Unionidae) of the the Clinton River, Michigan, with Comments on Man's Impact on the Fauna, 1870-1978. The Nautilus. 1980.
Syed, A.U., and L.R. Fogarty. "Trends in Surface-Water Quality at Selected National Stream Quality Network (NASQAN) Stations, in Michigan." United States Geological Survey, Scientific Investigations Report 2005-5158. 2005
Surber, E.W. "Results of a Biological Survey of the Clinton River in the Vicinity of Pontiac, Rochester, and Utica, Michigan, October, 4, 1955." 1955.
United States Army Corps of Engineers [USACE]. "Clinton River Sediment Transport Modeling Study." 2005.
United States Army Corps of Engineers [USACE]. "Lake St. Clair, Michigan Aquatic Plant Management Investigation." September 1996.
United States Geological Survey [USGS]. "USGS 04164000 Clinton River near Fraser, MI." Via: http://waterdata.usgs.gov/nwis. Last accessed: August 1st, 2006.
United States Geological Survey [USGS]. "USGS 04165500 Clinton River at Morovian Drive at Mt. Clemens, MI." Via: http://waterdata.usgs.gov/nwis. Last accessed: August 1st, 2006.
United States Geological Survey [USGS]. "Effects of Urban Land-Use Change on Streamflow and Water Quality in Oakland County, Michigan, 1970-2003, as Inferred from Urban Gradient and Temporal Analysis." 2005.
United States Geological Survey [USGS]. "Preliminary Survey of Antibiotic-Resistant Fecal Indicator Bacteria and Pathogenic Escherichia coli from River-Water Samples Collected in Oakland County, Mich. 2003." Scientific Investigations Report 2005-5058. 2005b.
United States Geological Survey [USGS]. "Water Resources Data, Oakland County, Michigan 2001-2004." Scientific Investigations Report 2004-1417. 2004.
Waters, T.F. "Sediments in Streams: Sources, Biological Effects, and Control." American Fisheries Society. Bethesda, Maryland. 1995.
Water Resources Commission [WRC]. "Physical Characteristics of the Clinton River Basin." 1968.
Water Resources Commission [WRC]. "Report on Self Purification Capacities – Clinton River, 1958 Survey: Pontiac to Rochester." 1959.
Water Resources Commission [WRC]. "Report on the Water Resources of the Clinton River Basin." 1953.

Pictures

ECHO. Web site. Via: http://www.echovermont.org/media/photos.html. Last accessed: June 7th, 2006.
Federal Interagency Stream Restoration Working Group [FISRWG]. "Stream Corridor Restoration: Principles, Processes, and Practices." 1998.
Iowa Department of Natural Resources [IDNR]. Web site. Via: http://www.iowadnr.com/fish/news/exotics/images/wtrflea.gif. Last accessed: June 7th, 2005.
Michigan Economic Development Corporation [MEDC]. Via: travel.michigan.org/attachments/G13104/Metro_Beach09.jpg. Last accessed: January 13th, 2005.
Starfish. Web site. Via: http://www.starfish.govt.nz/science/facts/fact-marine-biodiversity2.htm. Last accessed: June 7th, 2005.
University of Minnesota [UM]. Web site. Via: http://www.extension.umn.edu/projects/yardandgarden/ygbriefs/images/horticulture/colorslide/purpleloose.jpg. Last accessed: August 8th, 2005.
Wisconsin Department of Natural Resources [WDNR]. Web site. Via: http://www.dnr.state.wi.us/org/water/wm/nps/images/cowsinstream.gif. Last accessed: September 14th, 2005.

4. Community Outreach and Involvement



USACE for Macomb County, Michigan

Public Participation Plan

WATERSHED SUPPORT FOR CLINTON RIVER AOC:
CLINTON RIVER EAST SUBWATERSHED

FINAL

MARCH 31, 2004

Public Input Processes

Public involvement played a key role in the development of this watershed management plan (WMP). Throughout the development process, members of the general public and specific groups of stakeholders had the opportunity to actively participate. A Public Participation Plan (PPP) crafted for the subwatershed guided the opportunities for public participation. The goal of the PPP, which was submitted to MDEQ on March 31, 2004 and subsequently approved, is to effectively involve stakeholders throughout the WMP development process so that they would contribute during the process, understand the WMP recommendations, and ultimately support its implementation. To achieve this goal, the PPP identified the following objectives:

- Identify key stakeholders in the subwatershed;
- Include a wide variety of agencies and interests;
- Develop a process for effective stakeholder involvement;
- Develop materials to educate stakeholders and constituents; and
- Gather useful, measurable social feedback.

The PPP contains an adaptive management approach, allowing the Subwatershed Advisory Group (SWAG) to have the necessary flexibility to adjust the process during WMP development. While the PPP outlined specific activities for the SWAG to complete, the SWAG was able to modify these activities based on a better understanding of how to obtain local public input.

To ensure broad public participation, the WMP development process incorporated several activities for obtaining public input. The public participation activities included:

- SWAG meetings • Stakeholder workshops • Focus group meetings
- Community Forums with follow-up comments via website

These activities, and the feedback obtained, are summarized below, in chronological order.

SWAG Meeting

Courtesy of Tetra Tech

SWAG Meetings

The SWAG consists of representatives from each community, as well as Macomb County and other local agencies (see Chapter 1 for a complete list). This group met monthly and served as the core decision-making body throughout the WMP development process. The members regularly provided data, opinions, comments, and other information that formed the core of the WMP and guided it into this final form.

Stakeholder Workshop

Courtesy of MCPWO

Stakeholder Workshop

Representatives from the communities, institutions, and businesses in the subwatershed gathered at the Macomb Intermediate School District building on January 19, 2005, to participate in a stakeholder workshop. Over 47 invited individuals attended the workshop hosted by Macomb County Public Works Office (MCPWO) and other SWAG partners. Participants represented the following interests:

- Churches • Federal government • Local businesses
- Recreation • Regional planning • Schools/ universities
- Development • Environmental / conservation groups
- Technical consultants • County and municipal government
- Community residents

The workshop consisted of the following:

- A presentation on the watershed planning process that included information on how the public could continue to participate;
- A facilitated brainstorming session where participants formed small groups and identified a list of watershed visions and desired uses. Each group then shared their input as facilitators compiled a single comprehensive list;
- A voting session where each participant had the opportunity to cast three votes as a way to narrow and prioritize the list;
- Another brainstorming session to develop a list of watershed issues and concerns; and
- Another voting session to narrow and prioritize the list of issues and concerns.

The ranked results of the brainstorming and voting process follow. The top five (including ties) in each list show a number indicating the percentage of votes cast for that item (out of the total number of votes).

Stakeholder Workshop

Courtesy of MCPWO

Stakeholder Workshop Visions and Desired Uses

1. Public education/awareness (30%)
   - Daily activities/watershed definition
   - Household Hazardous Waste
   - Erosion Control
   - Alternative Landscape
   - Economic Benefits
   - Developer Education
2. Identify & provide public access (11%)
   - Increase recreational opportunities
3. River should meet water quality standards - total and partial body contact (11%)
4. Wetland protection and preservation (10%)
5. Construction site enforcement (10%)
6. Create Buffer (Riparian) zones
   - Native vegetation
   - Stream bank protection: restoration
   - Wildlife corridor
7. Manage water quantity/reduce flooding
8. Manage river for fish habitat
9. Septic system maintenance
10. Clean/clear open channel maintenance
11. Eliminate sanitary sewer overflows (SSO)
12. Preservation of natural systems & hydrology
13. Watershed signage and maps
14. Protect floodplains from development
15. Regulators provide solutions - not just fines
16. Managing Soil Erosion to protect water quality – between Yates Cider Mill and Lake St. Clair
17. Decrease imperviousness and parking lot size
18. Education of municipal salt applicators
19. Business community watershed stewardship
20. Smart development
21. Return river to prior historical water quality

Stakeholder Workshop Issues and Concerns

1. Lack of funding for watershed (29%)
2. Lack of / outdated ordinances to protect water resources (Reserved parking, onsite water retention, landscaping for water quality, site management - construction, flood plain, wetlands) (23%)
3. Lack of incentives and recognition for smart, environmentally friendly design (15%)
4. Need for significantly more public awareness to combat apathy (6%)
5. Barriers (4%)
   - Lack of agency and state support
   - No single source of accountability
   - Interagency/regional communication
6. Street sweeping coordination amongst communities-subdivisions (4%)
7. Politics- permitting & program bureaucracy
8. Training needs and time issues for staff
9. Sewer overflows, overwhelmed infrastructure
10. Time and lifestyle changes -individual & families / lack of ability to get involved
11. Treating symptoms instead of causes
12. Partnership between developers and homeowners
13. Lack of Best Management Practices maintenance
14. Environmental cleanup of Stramaglia superfund site in Mt. Clemens
15. Log jams – Mid. & Main Branch of Clinton River
16. Changing laws / removing phys. barriers to public access
17. Changing development practices
18. Address problems over time & geography
19. Stakeholder input as WMP solutions developed
20. Provide useful list on resources
21. Connect people with solutions
22. Lack of enforcement of laws, including wetlands
23. Farm runoff
24. Need park land & riparian acquisition for purchasing/granting/easements
25. Negative public perception of water resource
26. No design of stormwater controls for smaller (e.g. homeowner) scales

Community Forum

Courtesy of MCPWO

Meeting Fact Sheets

Meeting fact sheets were developed for the stakeholder workshops and the community forums. The fact sheets served as a meeting summary as well as an educational tool. Fact sheets were provided to municipal officials and stakeholders to demonstrate what the public view as critical water resource issues in the watershed. Each fact sheet contained a schedule of upcoming meetings to promote participation and input during the planning process. Copies of the fact sheets can be found in Appendix D.

Community Forum #1

Interested residents from the communities in the subwatershed met at the Macomb Intermediate School District building on February 2, 2005, to participate in a Community Forum. Over 30 individuals attended the forum hosted by MCPWO and other community partners participating on the SWAG. Although all participants were local residents, they also represented specific interests within their community, including:

- Churches
- County and municipal government
- Recreation
- Environmental / conservation groups
- Civil organizations (e.g., a scouting group)
- Public institutions
- Development
- Schools
- Local businesses

The forum consisted of the following:

- Educational displays and activities for children, including a demonstration of how a watershed works using an EnviroScape® model;
- Informational displays for adults, provided by SWAG members;
- A session where attendees had the opportunity to share their ideas on the development of the WMP, including their visions and desired uses and the issues and concerns for the subwatershed;
- A voting session where each participant had the opportunity to cast three votes as a way to narrow and prioritize the comprehensive list of watershed visions and desired uses; and
- A watershed scavenger hunt, which also served as a raffle for assorted prizes provided by SWAG members and other watershed partners, such as the Huron-Clinton Metropolitan Authority.

The ranked results of the brainstorming and voting process follow. The top five in the Visions and Desired Uses list shows a number indicating the percentage of votes cast for that item (out of the total number of votes).

Community Forum Visions and Desired Uses

1. Public education (15%)
2. Allow for canoeing and provide an interpretive water trail across the county - including maps & signs (15%)
3. Identify & provide public access, increase recreation such as bike paths (14%)
4. Develop greenbelt along the Clinton River (9%)
5. Fishable and swimmable Harrison Township at the most downstream point (6%)
6. Development demonstration sites for Best Management Practices (native plantings, rain barrels, and buffer strips)
7. Streambank protection to prevent erosion
8. Promote green building practices
9. More publicly available monitoring data – Health Dept. and real time data
10. Financial incentives for residents and developers
11. Create wetlands to improve water quality
12. Removal of major obstructions in the river to restore flow
13. Label storm drains
14. Preserve current wetlands
15. Enforce existing ordinances
16. Funding accountability/reporting
17. More positive press
18. Remediation of contaminated sediments
19. Remove fish advisories
20. Install biofilters at outfalls

Community Forum Issues and Concerns

- Clean Boat Areas along Harrison Township
- Why are the Mount Clemens docks closed?

Focus Group

The SWAG planned a targeted focus group to obtain input from and the participation of developers and builders, a key stakeholder group in the subwatershed. According to the SWAG, developers and builders are important stakeholders because of the potential impact of their activities on the watershed. The focus group served as a mechanism for gaining meaningful input and buy-in for the WMP development process and future implementation. Without the buy-in from developers and builders, some goals of the WMP may be difficult to achieve.

The focus group meeting was held on June 22, 2005 at the Clinton Township library. The six invited participants received an introduction to the project and answered questions on how members of this key stakeholder group communicate, where they get their information, what factors influence their services and activities, and what practices they use to protect water quality. The overarching purpose of the meeting was to identify issues specific to this group for consideration in development of the WMP. The issues raised by the focus group participants are presented below:

- Streamline the permitting process (i.e., make the county and state regulations consistent). State, county and local requirements tend to conflict with each other;
- Regulations should not be retroactive because it causes a financial burden for the developer. Grandfather existing projects in the "pipeline";
- The watershed management plan should be a workable, user-friendly document. The standards and specifications should be realistic and practical and offer flexible solutions; and
- Municipalities should take a more active part in the planning aspect. Developers are not opposed to smaller lot sizes with more open space; however, a majority of the municipal planners are resistant.

The group discussion indicated that some issues are important to raise not only with the building community, but also with the planning community. Issues for discussion by both the building community and the planning community include:

- The goals of the watershed plan must be economically feasible as well as improve water quality;
- Wetland preservation should be consistent throughout the area;
- Planners need to look at non-traditional Low Impact Development (LID); and
- The plan shouldn't be restrictive, goals should be broad.

Community Forum #2 and Follow-up Comments

A second Community Forum took place at the Clinton-Macomb Library on September 19, 2006 for interested residents from the communities in the subwatershed. The structure of the forum was similar to the first held in February 2005. Macomb County provided activities for children and SWAG members provided informational displays for adults. SWAG members conducted a watershed scavenger hunt and raffle for various prizes. Participants also received pizza during the open house portion of

Desired Uses

The public's desired uses for the watershed have been elicited and summarized for the purposes of meeting Clean Michigan Initiative (CMI) grant funding requirements and assisting in development of the goals and objectives listed in Chapter 6. Note that the desired uses include, either explicitly or implicitly, the restoration and protection of designated uses (as defined in Chapter 3).

20 Years Ago

In 1986, a public meeting was held to seek public comments to facilitate the development of the first Clinton River Remedial Action Plan (MDNR, 1988). It is interesting to note: 1) some of the concerns raised as a gauge of how long certain problems have been around; and 2) some of the approaches suggested for pollution control as a gauge of how much progress has been made.

The following categories summarize the comments:

- The need for watershed-based permitting and modeling;
- Sedimentation;
- Cooperative approach between governmental entities and other stakeholders;
- Stormwater runoff issues – quality and quantity;
- High and low flow issues in the Clinton River;
- Floodplain development;
- Polluted lands and other historic pollution sources;
- Sewer overflows;
- Wetland protection;
- Fish contaminants and health; and
- Other pollutants.

Community Forum #2

Photo courtesy of MCPWO.

CRWC Website: Utilized for Draft Plan Distribution and Receiving Public Comments

Image courtesy of CRWC.

Stakeholder Workshop #2

Photo courtesy of MCPWO.

the forum. The agenda for the forum consisted of a brief presentation on the status and content of the WMP, including an overview of how stakeholder input from the first Community Forum affected the development of subwatershed goals and objectives. The presentation also described the action items that communities in the subwatershed included in the WMP to fulfill their Phase II NPDES permit requirements and to obtain future grant money for implementation activities. Forum attendees then had the opportunity to provide feedback on the planned actions, the overall WMP, and voice their opinions on subwatershed issues. Approximately 37 individuals attended the forum hosted by SWAG members, of which 23 represented local residents and were not affiliated with the SWAG.

During the meeting, participants asked questions about stormwater management related to new developments, impacts from combined sewer overflows occurring upstream in the Red Run subwatershed, appropriate management practices for riparian landowners along drains in the subwatershed, and opportunities for improving recreation (e.g., camping) in the subwatershed.

Stakeholder Workshop #2

To obtain stakeholder input toward the end of the WMP development process, SWAG members hosted a second stakeholder workshop on September 27, 2006 at the Macomb Intermediate School District Educational Service Center Facility. The workshop, referred to as the Joint Community and Business Forum, brought together representatives from the communities and institutions in the subwatershed, as well as the Red Run and Lake St. Clair Direct Drainage subwatersheds. Approximately 70 individuals attended the workshop. Participants represented the following interests:

- Recreation
- Regional planning
- Community residents
- County and municipal government
- State and Federal government
- Schools/ universities
- Environmental / conservation groups

The workshop consisted of the following:

- A presentation on the nearly final content of the WMPs for each subwatershed. The presentation gave an overview of the goals and objectives developed using stakeholder input from stakeholder meetings conducted in 2005, as well as the pollutants of concern for each subwatershed and specific actions proposed to address each pollutant; and
- A facilitated session where participants had the opportunity to discuss the type of support necessary to ensure successful WMP implementation, the type of technical assistance needed to implement specific actions, and the type of tools to support successful implementation.

The facilitated discussion on technical assistance and tools necessary to promote successful WMP implementation generated the following feedback:

- Focus on public education regarding phosphorus-based fertilizer use and impacts;
- Identify opportunities for additional funding to conduct activities required under the Phase II NPDES permit;
- Create a mechanism that will provide a direct line of communication to exchange information at all levels of government;
- Create opportunities for local communities to exchange information on BMP successes and challenges;
- Identify and implement sustainable mechanisms to foster participation and information exchange by all communities;
- Focus on enforcing existing ordinances first, then identify where new or modified ordinances are necessary;
- Provide workshops on phosphorus reduction solutions; and
- Provide focused training for municipal employees on how to spot real problems in the watershed and what specific actions to take as a result.

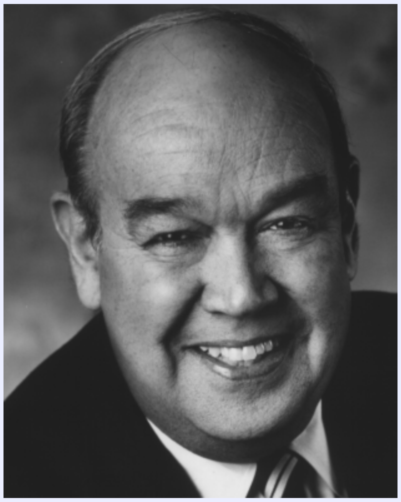
In addition to the facilitated discussion, participants had the opportunity to provide input on the types of technical assistance necessary to implement WMP actions using a feedback form. The participants indicated that they anticipated needing assistance with several implementation actions and provided specific ideas on the type of assistance that would benefit their community. Results from the feedback form are provided in Table 4-1.

Table 4-1. Results from feedback forms.

Action	Anticipate Needing Assistance?	What Type of Assistance Would Benefit Your Community or Business?
Update Storm Water Pollution Prevention Initiatives	Yes (5)	General info (2), public seminars, samples; technical assistance
Develop Annual Reports	Yes (5)	Guidance, funding, subwatershed summary information
Implement Public Education Plan	Yes (8)	Guidance (examples/samples); help in talking to the public; information; funding; provide technical assistance
Train Municipal Employees	Yes (3), No (1)	General info – displays; train the trainer; any training materials
Develop and Implement Storm-water Management Standards	Yes (6)	Models; post suggested standard
Manage Development Patterns	Yes (3), No (1)	(re)development; too late
Preserve Natural Features	Yes (4), No (1)	Fundraising/easements/land purchase; post natural features inventory; assist with preservation activities
Maintain Storm Sewer Systems	Yes (3), No (1)	Guidelines (schedule); funding; identify county drains
Minimize Pollution from Roads, Parking Lots, Municipal Garages	Yes (3), No (1)	Guidelines (schedule); funding; any and all technical assistance
Implement Turf Management	Yes (3), No (1)	Any and all technical assistance
Implement Flood Control Water Quality Considerations	Yes (3)	Funding; any and all technical assistance
Correct Illicit Discharges	Yes (5)	Funding (3)

Quotable Quotation

"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

Participants assigned priority rankings to voluntary implementation actions (i.e., activities not required under the Phase II stormwater permit). Activities ranked as having the highest priority in LSCW are listed below.

Activities ranked as having the highest priority:

- Develop pollution prevention ordinances;
- Stream bank, road, and ditch stabilization;
- Promote infiltration and filtration;
- Remediate contaminated sediments; and
- Restore fishing opportunities.

Activities ranked as having the second highest priority:

- Post signage;
- Support public involvement activities;
- Educate and involve municipal officials;
- Repair bare soil;
- Use structural controls where necessary;
- Address existing impervious surfaces;
- Minimize failing septic systems;
- Identify, protect, and restore natural features; and
- Promote natural buffers.

Activities ranked as having the third highest priority:

- Continue community forums and stakeholder workshops;
- Identify and protect sensitive sites;
- Manage solid and animal waste;
- Develop marine pollution prevention program;
- Identify and protect sensitive sites;
- Coordinate with existing recreation programs; and
- Add and enhance boat access sites.

Participants also suggested project ideas that should be considered for implementation funding. Project ideas included:

1. Purchase natural areas to provide stormwater filtration and retention. Assist owners with easements;
2. Need low phosphorus fertilizer ID in garden stores countywide;
3. Native plants for stormwater control;
4. Urban parking lot stormwater management demonstration; use an average parking lot that does not have any BMPs; show what must be done to maintain (e.g., sump cleaning); and
5. Educate children and homeowners.

Presentations 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 helps 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.

Members of the SWAG and other key stakeholders have made presentations to municipal officials throughout the watershed management planning process. These presentations are given during regular City Council, Township Board, and County Commissioner meetings. These meetings are a 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. SWAG members received a PowerPoint presentation to use at these types of meetings with municipal officials.

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. A Public Education Plan (PEP) is designed to promote, publicize, and facilitate education to help raise the public's awareness and motivate positive behavior in the watershed. Public support for watershed management programs will help to achieve the goals of the WMP.

In complying with the requirements of *NPDES General Permit No. MIG619000 for Coverage of Storm Water Discharges for Municipal Separate Storm Sewer Systems Subject to Watershed Plan Requirements* (or 'Watershed-based Permit'), each community in the subwatershed prepared and submitted a PEP to the MDEQ.

The MDEQ 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 Clinton River Watershed Council (CRWC) provided assistance in the design and implementation of educational activities undertaken as part of each community's PEP. Each PEP identifies activities that the communities will implement, or assist with, to provide public education. These activities optimize existing programs and materials from regional organizations currently conducting public education such as the CRWC, the Southeast Michigan Council of Governments (SEMCOG), and the Michigan State University Cooperative Extension (MSUE) Program. By using and adapting existing outreach opportunities and materials, the communities are able to cost-effectively reach a broad audience with a consistent watershed protection message. Specific details concerning each community's activities are available in their respective PEP, but some common elements include:

CRWC Display at Home and Garden Show – Detroit, MI

Courtesy of CRWC

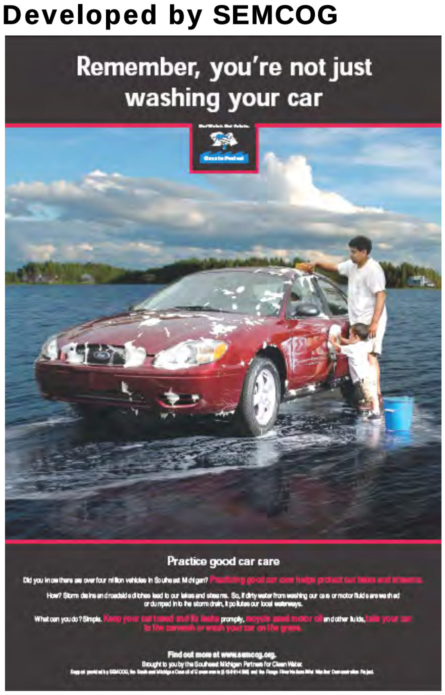
Information Displays

Meeting announcements, contact information, and brochures were and continue to be distributed to SWAG members and interested governmental and community organizations for display in public buildings such as municipal facilities, schools, and libraries.

Information Display at Bruce Township Offices

Courtesy of Bruce Township

An Example of Public Education Materials Developed by SEMCOG



- A 'Personal Watershed Stewardship Program' with the following key messages:
  - Definition of a watershed;
  - Knowledge of what watershed an individual lives in and has an impact on;
  - Importance of protecting watersheds; and,
  - Ways that individuals can impact the watershed through their activities;
- An 'Ultimate Storm Water Discharge Location and Potential Impacts' program with the following key messages:
  - Storm drains discharge to waterbodies;
  - Stormwater discharged from separate storm sewer systems does not receive treatment prior to discharge;
  - The environmental impacts of stormwater pollutants in the watershed; and,
  - Knowledge of the separate stormwater drainage system in an individual's neighborhood and the waterbody to which the stormwater is discharged;
- A 'Reporting of Illicit Discharges' program with the following key messages:
  - Definition of an illicit discharge and what to look for;
  - Promotion of the illicit discharge reporting system and how to report an illicit discharge;
  - Water quality impacts associated with illicit discharges and improper waste disposal;
  - Identification of failing on-site sewage disposal systems – physical symptoms to watch for; and,
  - Consequences/penalties associated with illicit discharges and improper waste disposal;
- A 'Personal Actions that Can Impact the Watershed' program with the following key message:
  - Best management practices for each of the following actions:
    - Car, pavement, and/or power washing (preferred cleaning materials and practices);
    - Pesticide use, fertilizer use, and their disposal;
    - Management of grass clippings, leaf litter, and animal wastes;
    - Residential de-icer use; and
    - Native vegetation on residential properties as an alternative to turf grass. The impacts of residential car, pavement, and power washing on water quality; and
  - Effects of residential wastes on our water bodies;
- A 'Waste Management Assistance' program with the following key messages:
  - Identification of household hazardous wastes and available alternatives; and
  - Disposal locations, requirements, and availability for household hazardous wastes and other chemicals, including motor vehicle fluids, travel trailer sanitary wastes, recreational boating sanitary wastes, and yard wastes; and

- A 'Management of Riparian Lands' program with the following key messages:
  - Importance of riparian corridors; and
  - Best management practices for riparian lands, including:
    - Protection through use of conservation easements;
    - Lawn maintenance for water quality (no-mow and no-chemical application areas);
    - Landscaping for water quality;
    - Shoreline stabilization techniques;
    - Proper septic system maintenance; and
    - Proper management of grass clippings, leaf litter, animal wastes, and other wastes.

Each community and its partners (e.g., CRWC) will use a variety of mechanisms to implement the PEP, including: programs, presentations, education materials/guides, displays/signs, workshops/forums/ trainings, volunteer monitoring/clean-ups/marking, mass media content, hotlines and a website.

Many other programs currently exist to educate the public and to help foster public involvement with watershed awareness, stormwater management, and water quality protection. Chapter 7 describes these programs in detail.

School Districts

The school districts in Macomb County that are participating in the SWAG (see Chapter 1) have been coordinating with the MCPWO to implement PEP activities.

Future Public Education and Involvement

Those entities that have PEPs will continue to implement them with a cooperative subwatershed-based approach. Additional public education and involvement activities have been included as actions in this plan and are discussed in Chapter 8. A discussion of resources available for public education and involvement is presented in Chapter 7.

Summary

Public involvement and participation was actively sought throughout the development process of the watershed management plan through various meetings, workshops, and forums. This input, along with data obtained and presented in Chapters 2 and 3, was used to focus the analysis of watershed problems for Chapter 5. In addition, the public input concerning visions, desired uses, issues, and concerns along with the analytical results presented in Chapter 5 was used to formulate the goals and objectives that are presented in Chapter 6.

References

Michigan Department of Natural Resources [MDNR]. "Remedial Action Plan for Clinton River Area of Concern." 1988.

Volunteers Participating in Cleanup Activities in Fraser: an Example of a Currently Implemented Action that will Continue into the Future

Photo courtesy of MCPWO.

5. Problem Assessment & Stressor Summary

What are stressors?

The term "stressor" refers to the pollutants and other undesirable factors that degrade water quality conditions. Stressors affecting a watershed might include pathogens, nutrients, trash and debris, sediment, and contaminated sediments. In addition to pollutants, other stressors might also come in the form of undesirable changes to the natural features of a watershed, such as changes to habitat and natural hydrology.

Purpose of this Chapter

This chapter is provided to meet the requirements of the Environmental Protection Agency's 319 grant funding program. The analyses and discussions presented herein are intended only to act as a part of a pollutant load reduction framework and are not meant to imply commitments towards the Phase II permit.

Introduction

Watershed management planning requires an understanding of the causes and sources of pollutants and other stressors (e.g., hydromodification) in the watershed, a quantifiable measurement of the pollutants and other stressors affecting the watershed, and a comparison of the current levels of pollutants and stressors against required water quality metrics (i.e., water quality standards). This information will indicate how much a pollutant or stressor must decrease to generate improvements in watershed conditions, as indicated by water quality standards and other types of water quality metrics.

This chapter presents significant information that is sometimes redundant with other chapters. This is because the analyses presented herein are best understood if all pertinent information is presented. Chapter 3 presented a detailed description of the causes and sources affecting conditions in the subwatershed, as well as the water quality metrics used to assess watershed conditions. Each of the causes and sources described in Chapter 3 result in one or more types of pollutants or stressors that adversely impact the watershed. This chapter provides a more detailed look at the primary pollutants and stressors generated by those causes and sources. This chapter also describes the analysis conducted to determine the percent reductions of specific pollutants and stressors necessary to improve water quality conditions, using water quality standards as the benchmark for measuring improvements.

It is important to note that the problem assessment and stressor summary for the subwatershed reflects the best sources of data available at the time of analysis. The analysis will change over time as a result of new data collected through the implementation of recent projects, such as the Clinton River Basin Watershed Initiative, and changes in the metrics used to assess water quality data, such as the adoption of new numeric nutrient criteria or improved indicators to assess pathogens. Watershed management planning is an iterative and dynamic process that requires the use of adaptive management, allowing strategies to evolve as new information becomes available. The analysis contained in this chapter will require regular re-assessment and re-evaluation as new data become available to ensure that strategies and priorities reflect the most accurate and most recent information.

Status of Water Quality

To determine the status of water quality in the subwatershed, it is necessary to have 1) water quality monitoring data and 2) the applicable water quality standards. Water quality standards are the measuring stick to determine if water quality is good, fair, or declining. Water quality standards consist of three components: designated uses, criteria, and an antidegradation policy. The first components, designated uses and criteria, are essential for measuring water quality in the subwatershed.

Where water quality does not support these designated uses, water quality is considered to be impaired. To determine if water quality supports the three designated uses, it is necessary to compare water quality monitoring data from the subwatershed with numeric and narrative criteria — the second component of water quality standards.

As illustrated in the previous sections, a significant amount of water quality data and information have been collected at various locations since the early 1970s. Water quality has been sampled within the subwatershed at various locations since the early 1970s by a variety of agencies and organizations, including the Michigan Department of Environmental Quality (MDEQ) during their regular assessments of water quality throughout the State of Michigan. These monitoring data compared to water quality standards show that current water quality conditions in the subwatershed do not support designated uses. As a result, water quality in the subwatershed is impaired.

Status of Designated Uses

Based on the MDEQ-defined waterbody impairments and other information in Chapter 3, as well as the input summarized in Chapter 4, the designated uses that are threatened, impaired, or of indeterminate status have been identified and are presented in Table 5-1[1].

General Stressors

In addition to designated use impairments, the subwatershed also has beneficial use impairments that apply because it located in the overall Clinton River Area of Concern (AOC) in the Great Lakes basin. To address these beneficial use impairments, stakeholders within the Clinton River Watershed are working together to develop an updated Remedial Action Plan (RAP). The updated RAP will describe the activities underway to restore the impaired beneficial uses and include the restoration criteria necessary to demonstrate when the beneficial use has been adequately restored. Currently, eight beneficial uses are considered impaired including: restrictions on fish and wildlife consumption, degradation of fish and wildlife populations, degradation of benthos, restrictions on dredging activities, eutrophication or undesirable algae, beach closings, degradation of aesthetics and loss of fish and wildlife habitat. While restoration of these beneficial uses is an important goal for the subwatershed, the restoration criteria do not have the same regulatory significance as Michigan's water quality standards.

The Lake St. Clair Environmental Characterization defines a broad set of stressors that affect lands tributary to the lake. These stressors include:

- Land Development and Urban Expansion
  - Stormwater
  - Habitat Fragmentation and Destruction
  - Fire Suppression
  - Agriculture
  - Soil Erosion and Sedimentation
- Altered Hydrology
  - Water Level Changes
  - Draining of Wetlands
  - Filling Wetlands and Dredging Waterbodies
  - Diking and Breakwalls

Water Quality Classifications

Impaired
When water quality does not meet water quality standards, determined by comparing water quality monitoring data with numeric and narrative criteria that water quality must meet to support designated uses.

Threatened
When water quality currently meets water quality standards, but current conditions exhibit a declining trend that could result in a water quality impairment without corrective action.

1988 RAP Designated Use Impairments

The 1988 RAP listed the Clinton River downstream of the Red Run and the Spillway with the following impairments:

- Agriculture – due to TDS in excess of 500 mg/L (in large part due to soil types found in the basin);
- Warmwater fishery – due to degraded populations;
- Other aquatic life / wildlife – due to impacted communities and low dissolved oxygen; and
- Total Body Contact – due to presence of fecal coliform from sewer overflows.

Source: MDNR, 1988.

[1] The assessments presented herein are subject to change. New pollution sources, additional data, and updated water quality standards all might affect the status of the designated uses.

Table 5-1. Status of designated uses.

Designated Use	Waterbody / Reach	Status	Stressor
Agricultural Water Supply	All in the agricultural portion of the subwatershed	Threatened	Elevated PCB levels
Industrial Water Supply	Indeterminate	In-determinate	Elevated PCB levels; unknown distribution of industrial uses
Industrial Water Supply	Clinton River – East Main Branch (in Mt. Clemens)	In-determinate	Elevated Mercury levels; unknown distribution of industrial uses
Public Water Supply	All in the subwatershed near public water supplies	Threatened	Elevated PCB levels; cross contamination concerns between surface and groundwater
Navigation	Clinton River – West Main Branch	Threatened	Tree blockages inhibiting navigational use of the river (information from CRWC)
Other Aquatic Life / Wildlife	Clinton River – Central and East Main Branch	Impaired	Sediment
Other Aquatic Life / Wildlife	Clinton River	Threatened	PCBs and Mercury in fish tissue (implied impacts to other aquatic life)
Other Aquatic Life / Wildlife	Clear Spring Lake	Threatened	PCBs in fish tissue (implied impacts to other aquatic life)
Other Aquatic Life / Wildlife	All other inland lakes, reservoirs, impoundments	Threatened	Mercury in fish tissue (implied impacts to other aquatic life)
Other Aquatic Life / Wildlife	Lake St. Clair	Threatened	PCBs and Mercury in fish tissue (implied impacts to other aquatic life)
Other Aquatic Life / Wildlife	All waterbodies	Threatened	Elevated PCB levels
Warmwater Fishery	Clinton River – Central and East Main Branch	Impaired	Sediment
Warmwater Fishery	Clinton River – Central and East Main Branch	Threatened	Low dissolved oxygen (due to algae from nutrient elevation)
Warmwater Fishery	Clinton River	Threatened	Hydrology (flow variability)
Warmwater Fishery	Clinton River	Threatened	PCBs and Mercury in fish tissue (implied impacts to other aquatic life)
Warmwater Fishery	Clear Spring Lake	Threatened	PCBs in fish tissue (implied impacts to other aquatic life)
Warmwater Fishery	All other inland lakes, reservoirs, impoundments	Threatened	Mercury in fish tissue (implied impacts to other aquatic life)
Warmwater Fishery	Lake St. Clair	Threatened	PCBs and Mercury in fish tissue (implied impacts to other aquatic life)
Warmwater Fishery	All waterbodies	Threatened	Elevated PCB levels
Total Body Contact	Clinton River	Impaired	Pathogens
Total Body Contact	Clinton River – Central and East Main Branch	Threatened	Presence of algae from nutrient elevation
Total Body Contact	Lake St. Clair (Metropolitan Beach)	Impaired	Pathogens
Partial Body Contact	Clinton River	Impaired	Pathogens
Partial Body Contact	Clinton River – Central and East Main Branch	Threatened	Presence of algae from nutrient elevation
Partial Body Contact	Lake St. Clair (Metropolitan Beach)	Impaired	Pathogens

- Contaminants
    - Nutrient Loading
    - Toxic Contamination
    - Sediment Contamination
- Shoreline Modification, Shipping, and Boating
    - Vegetation Removal
    - Shoreline Hardening
    - Vessel Activity and Marina Development
- Invasive Species
    - Aquatic and Wetland Invasives
    - Terrestrial Invasives
    - Potential Invasives
- Natural Disturbances
    - Ice Storms
    - Windthrow

Obviously, not all of these stressors impact the subwatershed, nor are they necessarily at a scale appropriate for subwatershed planning. However, defining this framework allows one to see how this WMP fits into the bigger picture.

Determining Significant Stressors

A wide range of data and information are available on the Clinton River watershed. Review and analysis of recent data from studies and reports, also summarized in Chapter 3, helped to determine the most significant pollutants and stressors specifically in the subwatershed. Data and reports containing information on stressors used in this analysis include the following:

- Federal and state water quality monitoring data;
- Michigan Department of Environmental Quality's 2006 Sections 303(d) and 305(b) Integrated Report containing the Water Quality Standards Nonattaiment List for Water Bodies Requiring TMDLs;
- State biological monitoring data for fish and macroinvertebrates;
- Development of Restoration Criteria in the Clinton River Area of Concern (Draft Final 2005);
- Lake St. Clair Environmental Characterization (2004); and
- Clinton River Assessment (DRAFT 2005).

Based on all of the data analyzed, the status of designated uses and related stressors, and the general stressor list, it has been determined that the most significant stressors in the subwatershed (and the most appropriate to address at this scale) include the following:

- Sediment;
- Phosphorus;
- Pathogens;
- Flow alterations;
- Contaminated sediments; and
- Habitat alterations.

Based on this list, the Subwatershed Advisory Group (SWAG) identified **sediment**, **phosphorus**, **pathogens**, and **flow alterations** as the top priorities to address in this plan, especially with respect to developing loading estimates and reduction targets.

Method for Quantifying Stressors and Establishing Reduction Targets

Significant stressors identified in the subwatershed will require strategic actions to reduce their impact on water quality and overall watershed health. To enable the selection and implementation of effective actions, it is important to first undertake an analysis that quantifies the stressor, identifies a numeric target, and determines if a reduction in the stressor is necessary to achieve the target. Quantifying the stressor for pollutants such as sediment, phosphorus, and pathogens, requires a way to determine how much of the pollutant is coming from particular sources in the subwatershed. The amount contributed by sources is referred to as the current pollutant load. The amount that sources should not exceed to achieve the numeric target is referred to as the target load. The method used to estimate the current and target pollutant loads in the subwatershed is called a load duration curve approach.

Estimating Pollutant Loads: The Load Duration Curve

The load duration curve approach involves calculating the target loadings of a pollutant over the range of flow conditions expected to occur in the water body. The load reduction approach also considers critical conditions and seasonal variation. Because the approach establishes loads based on a representative flow regime, it inherently considers seasonal variations and critical conditions attributed to flow conditions. The flow regimes are categorized into the following five "hydrologic zones" (Cleland, 2005):

- High flow zone: flows that plot in the 0 to 10-percentile range, related to flood flows.
- Moist zone: flows in the 10 to 40-percentile range, related to wet weather conditions.
- Mid-range zone: flows in the 40 to 50 percentile range, median stream flow conditions;
- Dry zone: flows in the 60 to 90-percentile range, related to dry weather flows.
- Low flow zone: flows in the 90 to 100-percentile range, related to drought conditions.

The Clinton River at Moravian Drive at Mt. Clemens, Michigan gage (USGS gage 04105500) and the Clinton River near Fraser, Michigan gage (USGS gage 04164000) were used to estimate flows in the watershed. Flow at other points in the watershed was estimated using a unit-area approach. Continuous stream flow data are available from the USGS NWIS online database.

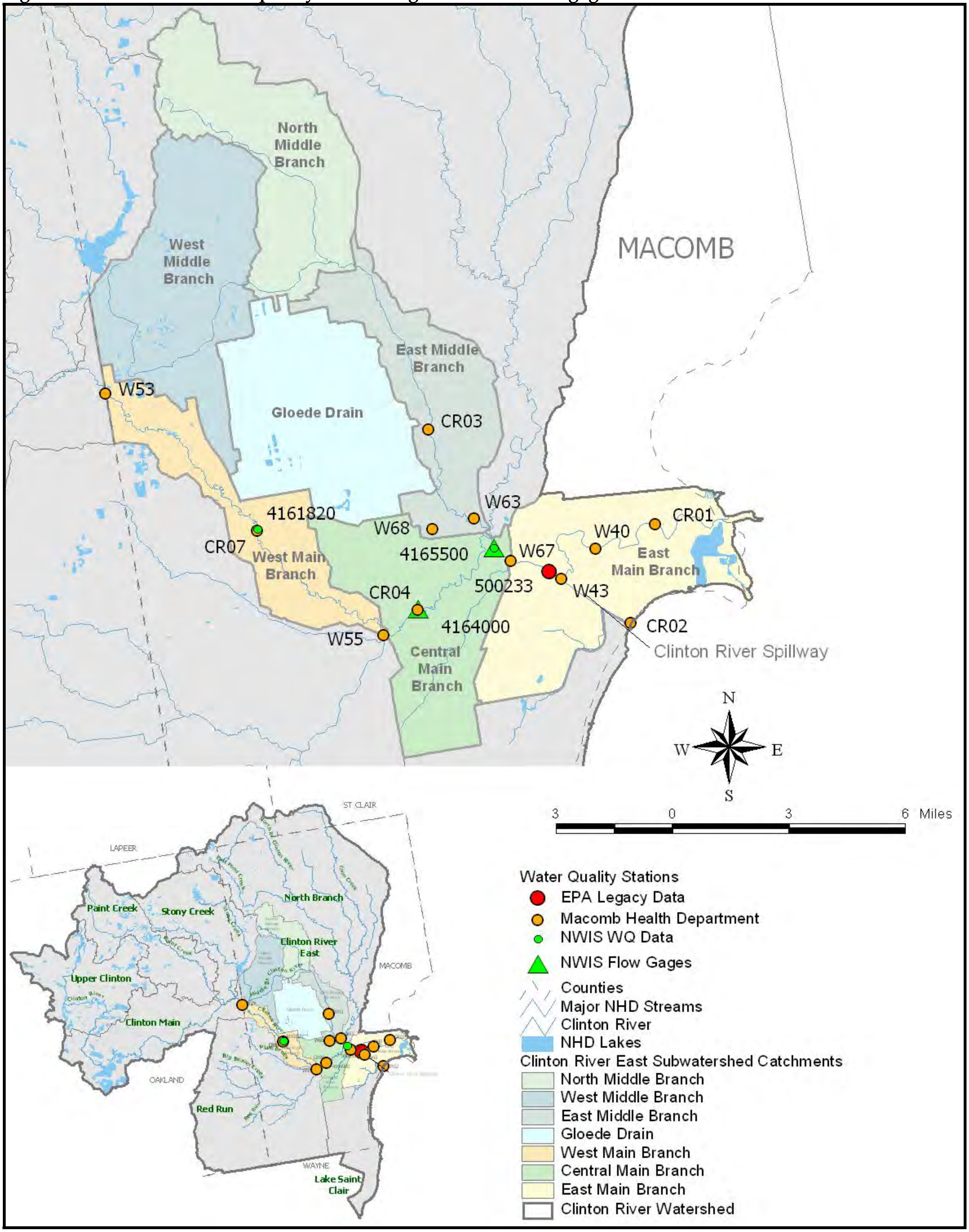
Water quality monitoring data used to determine the current and target pollutant loads in the subwatershed originate from several water quality monitoring stations. Figure 5-1 shows the locations of water quality monitoring stations in the subwatershed. Water quality monitoring stations are not located throughout the subwatershed; therefore, specific water quality monitoring stations are identified and used as representative stations. Table 5-2 lists the catchments and other geographic areas (i.e., subwatersheds) represented affecting water quality data at each water quality monitoring station.

Steps in the Load Duration Curve Approach

A load duration curve approach helps to identify the issues surrounding the impairment and to differentiate between pollutant sources. Steps for this approach are as follows:

1. Develop a flow duration curve for the stream by generating a flow frequency table and plotting the data points.
2. Translate the flow curve into a load duration curve. To accomplish this, multiply each flow value by the water quality target and by a conversion factor. Graph the resulting points.
3. Convert each water quality sample to a load by multiplying the water quality target concentration by the average daily flow corresponding to the day of sample collection and a conversion factor. Plot the individual loads on the graph.
4. Anaylze location of data points with respect to the load duration curve. Points plotting above the curve represent deviations from the water quality target and the daily target load. Those plotting below the curve represent compliance with targets and the daily target load.
5. Interpret the final curves. The area beneath the load duration curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions is the load that must be reduced to meet water quality targets.

Figure 5-1. Location of water quality monitoring and stream flow gages.



Extrapolating Stream Flows

When extensive flow data are not available, it is necessary to devise an approach for estimating flow at other points in the watershed. For purposes of estimating current pollutant loads, stream flows were extrapolated from the Clinton River stream flow record by using a multiplier based upon a comparison of the drainage areas.

Table 5-2. Representative water quality monitoring stations and associated catchments and subwatersheds.

Station ID	Primary Catchment	Other Catchments and Subwatersheds
CR03	East Middle Branch	North Middle Branch; West Middle Branch
4161820/ CR07	West Middle Branch	Clinton Main; Upper Clinton; Paint Creek; Stony Creek; Gloede Drain
4164000/ CR04	Central Main Branch (upper)	West Main Branch (downstream from 4161820/CR07); Red Run
4165500	Central Main Branch (lower)	Central Main Branch (downstream of 4164000); North Branch; East Main Branch (downstream of CR03)
500233	East Main Branch	Central Main Branch (downstream of 4165500)

Water quality station CR03 is located in the mid-section of the East Middle Branch catchment. Data from CR03 are representative of the water quality conditions not only in the upper portions of the East Middle Branch catchment, but also the upstream catchments: West Middle Branch, and North Middle Branch.

Water quality station 4161820/CR07 is located in the mid-section of the West Main Branch catchment. Data from 4161820/CR07 are representative of the water quality conditions in the upper portions of the West Main Branch catchment, but also of other subwatersheds located upstream: Clinton Main, Upper Clinton, Paint Creek and Stony Creek. Given there is no water quality monitoring station in the Gloede Drain catchment, the data from 4161820 are considered representative for Gloede Drain.

Water quality station 4164000/CR04 is located in the Central Main Branch, relatively close to the confluence of the tributaries draining the Red Run subwatershed and the mainstem of the Clinton River. As a result, data from these stations reflect the water quality contributions of the Red Run subwatershed, as well as the lower portions of the West Main Branch catchment located downstream from 4161820/CR07.

Water quality station 4165500 is also located in the Central Main Branch catchment, measuring the water quality conditions downstream of 4164000 in the Central Main Branch and CR03 in the East Main Branch catchments. Data from this water quality monitoring station also reflect water quality contributions from the North Branch subwatershed.

Water quality station 500233 is located in the East Main Branch catchment. Data from this station reflects water quality contributions from the downstream portions of the Central Main Branch catchment and a portion of the East Main Branch catchment downstream of 4165500.

There are other water quality monitoring stations located within the subwatershed; however, data from these stations were not used for purposes of this analysis because the data set is too limited or the data are not recent.

The remainder of this chapter examines the significant stressors in the subwatershed – sediment, phosphorus, pathogens, and hydrologic flow. Information provided for each significant stressor provides a summary of the sources, impacts, impairments, indicators, water quality standards, available data, pollutant load estimates and target reductions, critical areas, how to monitor progress and ideas for improvement.

Sediment

Sediment in urban watersheds is an important pollutant; causing problems and negative impacts while also transporting other pollutants that bind to sediment particles, including phosphorus. 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).

Sediment transported by moving water is described by the terms "suspended load" and "bedload." The suspended load is comprised by the fraction of material that is mixed intimately with the flowing water and tends to make the water appear muddy. The suspended load may be further segregated to include the suspended solids and the dissolved solids. Suspended solids will settle through the water based on their own density given an opportunity; however, solids are often sporadically and repeatedly caught in local turbulent eddies and remain suspended. The bedload is comprised of the larger particles too heavy to be suspended, but rather pushed along near the streambed (Leopold, 1994).

All streams require a degree of bedload transport to maintain their pools, riffles, and meanders. Some substrate movement is beneficial because it allows fine sediment to be flushed out of the spaces between larger particles and ultimately downstream. However, if there is too much substrate movement, the channel may be too unstable to support healthy fish and invertebrate populations.

Sources

The main sources of sediment are the erosion of uplands, lateral movement of channels into streambanks, and down cutting of streambeds. Natural erosion is present almost everywhere and results from wind and water passing over land surfaces. Table 5-3 identifies some general sources and causes of sediment based on human activities. Not all of these sources are present in the subwatershed. Some, such as agricultural runoff, might be present in upstream subwatersheds and have an eventual impact on the subwatershed.

In the subwatershed, the likely predominant sources of sediment include stormwater runoff from urbanized areas and agricultural land.

Chapter 3 of this WMP presents information gathered through the visual assessment process on subwatershed conditions that could contribute to sediment loads. The road-stream crossing survey results presented in Table 3-3 show that a majority of assessment sites lack a 100-foot riparian buffer along all waterbodies. In fact only four sites (one on the Clinton River and three on the Middle Branch of the Clinton River) provide this amount. The unified stream assessment conducted at three locations in the subwatershed revealed bank failure, channel modification, and impacted buffers contributing to sediment loading. The assessed reach of the Gloede Drain contains one instance of steep-slope bank failure. The

Distinguishing Between Sources and Causes of Impairment

<u>Sources</u>
Description of where pollutants or stressors are coming from. These sources of impairment are the activities, facilities, or conditions that generate the pollutants that keep waters from meeting the criteria adopted by the states to protect designated uses, such as municipal sewage treatment plants, storm sewers, and modification of hydrology.

<u>Causes</u>
The reason a particular source contributes pollutants or other stressors that cause water quality impairments. Causes help to define how an activity introduces a pollutant or other stressor into the watershed and highlights the type of management strategy necessary to address contributions from a particular source.

assessed reach of the Healy Brook Drain contains two instances of bank failure and channel modification due to fallen trees, bank armoring, and check dams. The assessed Harrington Drain reach contains an impacted buffer with bare ground; log jams; five instances of bank failure; and one instance of channel modification requiring structural repair.

A 2005 study prepared for the Macomb County Public Works Office and the MDEQ (ECT, 2006) documented high to very high streambank erosion potential on the Middle Branch of the Clinton River from its point of beginning to Romeo Plank Road. These potentials are functions of the shear stresses on the streambanks, the geometry of the cross-section, and the amount and type of material that is available to be eroded.

In 2005, the MCPWO and volunteers collected field data on streambank conditions in the subwatershed. MCPWO and volunteers documented good conditions at all locations on the Clinton River, the spillway, Wilcox Drain, Kingsbury Drain, Harris Drain, and most locations on the Middle Branch and Harrington Drain. The Price Brook had three good and three fair locations. The Gloede Drain had two poor locations, the Longstaff Drain had a fair and poor location, the Harrington Drain had a poor location, the Healy Brook had a poor location, and the Middle Branch had two fair locations. Figure 3-9 in this WMP illustrates streambank conditions and locations requiring attention throughout the subwatershed.

In addition, streambank erosion, construction activities, and hydrological impacts to the subwatershed are also suspected sources of sediment. Other urban and agricultural sources of sediment located in upstream subwatersheds, including the North Branch, Stony Creek, Paint Creek, Upper Clinton, Clinton Main, and Red Run, also contribute sediment to the subwatershed.

As part of the visual assessment process, volunteers conducted Unified Subwatershed and Site Reconnaissance (USSR) surveys that examined potential pollutant sources in neighborhoods, streets, and storm drains. The USSR surveys also examined hot spots and pervious areas. Chapter 3 presents the overall results of the USSR surveys. The neighborhood source assessment and the street and storm drain survey examined 21 locations in the subwatershed. Of those assessed, 71% of the neighborhoods had curb and gutter and 50% of those were assessed as having 'clean and dry' curb and gutter. Sediment and organic material, such as leaves and lawn clippings had the largest pollution source potential in the curb and gutter. Through the neighborhood source assessment, 52% of neighborhoods were assessed as having significant sediment pollution potential. The street and storm drain survey revealed cracked roads at 30% of the locations. This condition may allow more sediment to be introduced into runoff as a result of the deteriorating concrete. On-street parking is permitted on 40% of the street areas, which requires more impervious area than streets without parking and also may interfere with street sweeping efforts, resulting in increased sediment loads in runoff. Of the seven areas included in the pervious area assessment, four sites displayed soil compaction and erosion.

Table 5-3. General sources of sediment.

Sources	Causes
Agricultural Runoff	Lack of Buffer Poor Conservation Practices Over Grazing of Livestock
Streambanks	Flow Fluctuations (see Hydrologic Flow) Livestock Access Human Access
Livestock in Stream	Unrestricted Access
Off-Road Vehicles	Unrestricted Access Lack of Buffer
Construction Site Runoff	Inadequate Soil Erosion and Sedimentation Controls
Road-Stream Crossings	Poor Maintenance Poor Construction Poor Design Human Access
Drainage Ditches	Ditch Cleanout without Soil Stabilization Flow Fluctuations (see Hydrologic Flow) Livestock Access Human Access
Sand for 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
Mining Operations/Gravel Pits	Inadequate Soil Erosion and Sedimentation Controls

Impact and Impairment

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. Embeddedness refers to the extent to which gravel and cobbles are surrounded or covered by fine sediment. Decay of deposited organic sediments can also negatively affect in-stream dissolved oxygen concentrations. This is known as the sediment oxygen demand (SOD).

Indicators

Direct measurement of the amount of sediment moving in the watercourse may be measured as the total suspended solids (TSS), total dissolved solids (TDS) and the bedload. Turbidity indirectly measures the amount of sediment by considering the amount of light passable through the water column. Conductivity may also be used to indirectly measure the dissolved solids.

In addition, indicators such as the embeddedness and fish and benthic macroinvertebrate population and diversity may also be used as indicators of sediment.

Water Quality Standards

The water quality standards in Michigan pertaining to sediment do not include any numeric values to serve as a benchmark for assessing the amount of sediment in a water body. As a result, it is necessary to develop a numeric target for sediment. For purposes of the CREW watershed management plan, a preliminary numeric target for sediment was selected by evaluating data from Ohio reference sites within the same ecoregion as the Clinton River watershed (OEPA, 1999). This preliminary numeric target uses TSS as the indicator because suspended solids provide an estimate of the potential magnitude of sediment as a stressor and the primary sediment sources. The Clinton River watershed is located in the Huron-Erie Lake Plain ecoregion and the 90th percentile TSS values of reference sites within this ecoregion are approximately:

- Headwaters (< 20 square miles): 50 mg/L
- Wadeable (20 < 200 square miles): 65 mg/L
- Small Rivers (200 < 1000 square miles): 75 mg/L

The TSS value for small rivers applies to the CREW and is used as the benchmark to determine if current sediment loads meet water quality standards.

Current and Target Load Estimates to Calculate Load Reduction Percentages

The TSS target value presented above serves as the numeric goal for suspended solids in the subwatershed. To determine if the current amount of sediment entering the subwatershed will meet or exceed the TSS target value, it is necessary to estimate the current amount of sediment entering the subwatershed from a variety of sources. This amount is referred to as the current sediment load. In addition to determining the current load, it is also necessary to identify the target load – the amount of sediment that sources can contribute without exceeding the TSS target value for the subwatershed. If the current load is greater than the target load, management activities are necessary to reduce the sediment load entering the subwatershed.

This section presents the estimated current and target sediment load at each representative water quality monitoring station and the associated percent reduction in sediment loads necessary to meet the TSS target value in the subwatershed.

The load duration curve approach estimated current and target sediment loads using monitoring data for total suspended solids and a combination of recent and extrapolated flow data. Available total suspended solids sampling data originate from U.S. Geological Survey's (USGS) National Water Information System (NWIS) and the Macomb County Health Department. Table 5-4 presents the available TSS data.

Table 5-5 presents the existing and target annual TSS load (metric tons per year) for the in-stream sampling locations in the subwatershed. In addition, Table 5-5 states the percent annual load reduction necessary to achieve the TSS target value of 75 mg/L.

Table 5-4. TSS data used to estimate current and target loads.

Station ID	Period of Record	Count	Avg. (mg /L)	Min. (mg /L)	Max. (mg /L)
CR03	9/20/2004 - 11/2/2005	26	72	1	620
4161820/CR07	9/16/2004 - 10/21/2005	27	43	1	280
4164000/CR04	9/20/2004 - 10/21/2005	26	86	1	296
500233	1/29/1990 – 10/8/1998	70	37	4	470

Table 5-5. Estimated existing annual loads and associated reductions by representative monitoring station.

Station ID	Existing Load (t/yr)	Target Load (t/yr)	Load Reduction (t/yr)
CR03	4,176	2,464	1,712 (-40%)
4161820/CR07	25,725	20,464	5,261 (-20%)
4164000/CR04	65,837	29,404	36,433 (-55%)
500233	25,483	44,748	n/a (0%)

The load duration curve approach to estimate TSS loads in the subwatershed indicates that three areas require significant TSS load reductions to achieve the 75 mg/L TSS target value. At all three locations, the existing loads were most likely to exceed target loads during high flow conditions.

Data from water quality monitoring station CR03 show that the existing TSS loads from the North, West, and East Middle Branch catchments require a 40 percent reduction to achieve the target load that will meet the TSS target value.

Data from water quality monitoring station 4164000 show that a 55 percent reduction in TSS loads from the Central and West Main Branch catchments is necessary to achieve the target load and the TSS target value; however, it is important to keep in mind that the Red Run Subwatershed also influences TSS loads at this point.

Data from water quality monitoring station 4161820/CR07 show that existing TSS loads from the West Main Branch catchment, which include contributions from the four upstream subwatersheds, require a 20 percent reduction to achieve the target TSS load that will meet the 75 mg/L TSS target value. Since data from 4161820 are considered representative of Gloede Drain for purposes of this analysis, the 20 percent reduction also applies to the load from the Gloede Drain catchment. Tributaries from the North Branch Subwatershed converge with the Clinton River downstream of the water quality monitoring stations that indicate the need for significant TSS load reductions; data from water quality monitoring station 500233 show that no TSS loads decrease and that no reductions are necessary at this point to achieve the TSS target value. It is unclear at this time if TSS load reductions are necessary downstream of water quality monitoring station 500233 in the East Main Branch catchment due to a lack of sufficient accurate water quality and flow data.

Load Reduction Goals by Catchment

To calculate the sediment load reduction goals by catchment, it is necessary to have an estimate of the sediment loading from the sources in each catchment. Using readily available information such as land use and precipitation data, the Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) model, is able to provide an estimated sediment load for each catchment. It is important to keep in mind that the STEPL model does not estimate sediment loads from streambank erosion or account for upstream sediment load contributions (Tetra Tech 2004); therefore, the estimated loads are likely to be less than the actual sediment load from each catchment – particularly those experiencing streambank erosion or significant contributions from upstream sources.

The total estimated sediment load for each catchment and the applicable percent load reduction provide the total estimated load reduction for each catchment. Given that the STEPL model does not account for streambank erosion, an additional 10 percent is added on to the estimated load. The additional 10 percent is an estimated number and may be higher or lower than the amount contributed by actual streambank erosion. This percentage will be updated if and when better data on contributions from streambank erosion become available. The additional 10 percent was not applied to the Middle Branch catchments because there are actual measured TSS data for these three catchments combined. Table 5-6 presents the estimated total sediment load from each catchment, including the additional 10 percent of the original estimated load to account for streambank erosion. Table 5-7 presents the estimated load reduction by catchment.

Table 5-6. Estimated annual TSS load and additional load to account for streambank erosion by catchment

Catchment	Estimated Sediment Load (ton/year)	Additional Load to Account for Streambank Erosion (10%) (ton/year)	Total Estimated Sediment Load (ton/year)
Gloede Drain	708	71	779
Central Main Branch	409	41	450
East Main Branch	933	94	1027
West Main Branch	320	32	352
East Middle Branch North Middle Branch West Middle Branch	4,176	(Actual water quality monitoring data used from CR03 representing all three catchments)	4,176

Table 5-7. Estimated TSS load reduction needed by catchment

Catchment	Estimated Sediment Load Reduction Needed (tons/year)	
Gloede Drain	156	20% reduction estimated at 4161820 applied to total estimated sediment load of 779 t/yr
Central Main Br.	90	20% reduction estimated at 4161820 applied to total estimated load of 450 t/yr
East Main Br.	205	20% reduction estimated at 4161820 applied to total estimated load 1027 t/yr
West Main Br.	70	20% reduction estimated at 416820 applied to total estimated load of 352 t/yr
East Middle Br.	1,712	40% reduction from current load of 4,176
North Middle Br.		
West Middle Br.		

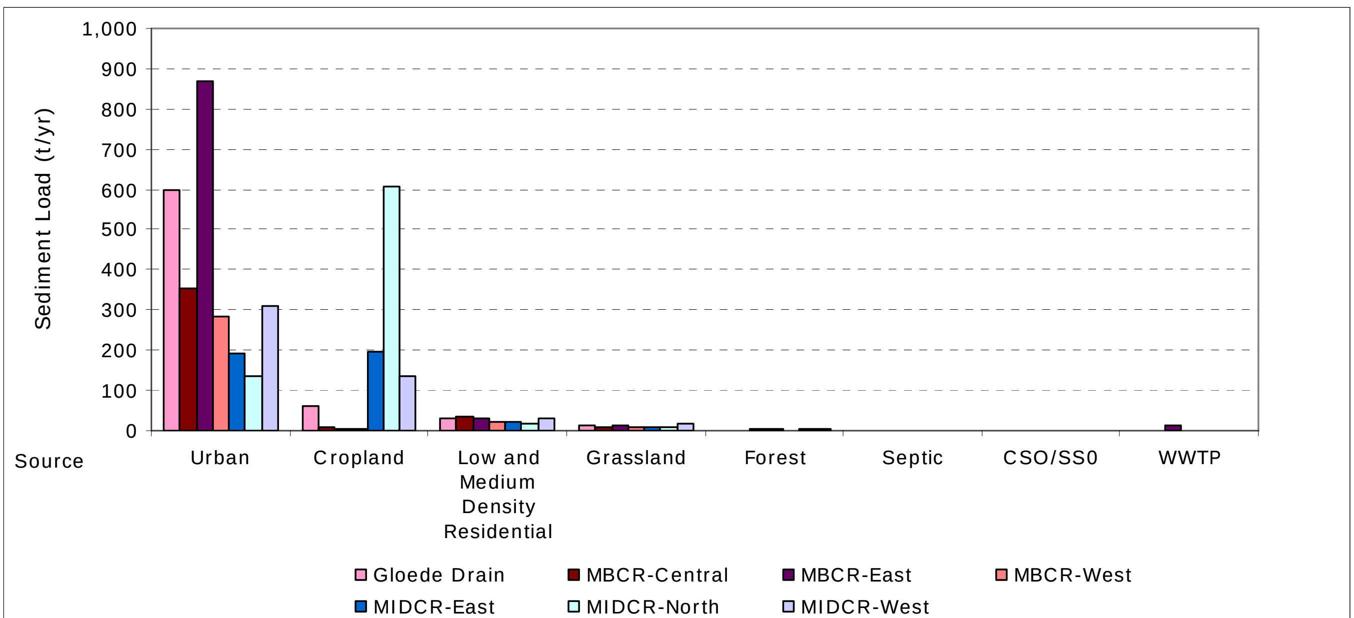
Critical Areas

Critical areas are the geographic portions of a watershed that contribute the greatest amount of a pollutant and have the most significant impact on the watershed. Identifying critical areas is an important step when determining how to achieve the TSS load reductions necessary to meet the TSS target value. The most significant sources of sediment loading in the subwatershed are stormwater runoff from urban land uses (e.g., commercial, industrial, institutional, transportation, multi-family dwellings, vacant developed land, and open space) and croplands, according to the analysis conducted using the STEPL model. Figure 5-2 presents a comparison of the relative contributions of sediment loading from different sources by catchment.

What is a critical area?

A critical area is the geographic portion of the watershed that is contributing a majority of the pollutants and is having a significant impact on the waterbody (MDEQ 2000).

Figure 5-2. Estimated sediment load by source and catchment.



Although the STEPL model results provide only an estimate, the information is helpful in understanding the relative contributions of sediment loading from sources within the subwatershed and how to prioritize these sources when selecting management practices to achieve load reductions.

Within the urbanized areas, sediment picked up by the surface runoff is readily conveyed to a gutter (an impervious channelized flow path) which runs along most streets and washes into a traditional storm sewer drainage system, which quickly discharges the sediment to the nearby water courses. The traditional catch basin sumps offer some limited opportunity to remove sediment.

Within the rural and agricultural areas, controlling sediment in the adjacent stream corridor is generally more important than controlling exposed soil away from the river. This is because the primary mode of transportation in rural areas is by way of a ditch or a swale; overland sheet flow rarely occurs for distances longer than about 300 feet before the flow becomes channelized in some form. The ditches and swales are generally vegetated which serves to slow the water down and tends to offer some filtering.

Defining critical areas for sediment in the subwatershed requires consideration of the results from both the load duration curve analysis approach and the STEPL model. These results represent both measured and estimated data. Based on TSS load reductions and estimated source contributions of the sediment load, the critical areas to address in the subwatershed include those described below.

Those sources include those which contribute to the sediment loads that were estimated using monitoring data from the water quality monitoring stations that indicate the need for an annual TSS load reduction.

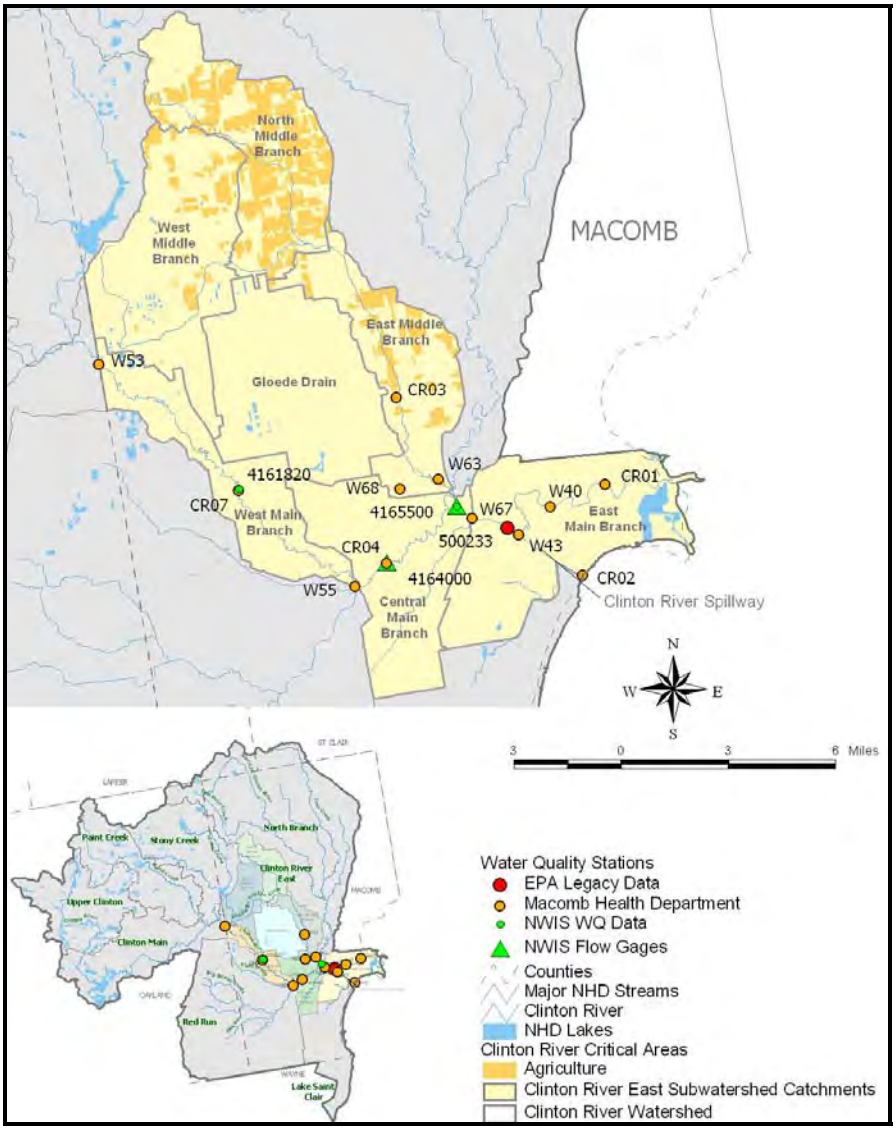
1 Agricultural Sources in the Middle Branch

Reductions of cropland sources of sediment in the East, North, and West catchments of the Middle Branch are necessary to achieve the estimated 40 percent reduction from the annual TSS load calculated for water quality monitoring station CR03. This equates a sediment load reduction of approximately 1,712 tons per year. Based on STEPL modeling results, urban and cropland sources in these three catchments contribute approximately 1,600 tons per year of sediment. The STEPL modeling results indicate that the North Middle Branch catchment contributes the greatest sediment loading from cropland, while the West Middle Branch contributes the least. Figure 5-3 illustrates the location of agricultural land uses in the Middle Branch.

2 Urban Sources in All Catchments

Results from STEPL clearly indicate that urban runoff is estimated to be the most significant source of sediment load in the subwatershed. Although there are some catchments that clearly contribute more of the load from urban sources than others, it is essential that all catchments in the subwatershed consider their urban sources as a critical area. By identifying all urban sources in the subwatershed as a critical area, each community in every catchment will share the responsibility to achieve their sediment load reduction targets. Figure 5-4 shows the location of urban areas in each of the catchments. Detailed information from the USSR surveys, particularly the neighborhood assessment and the street and storm drain surveys, will provide detailed locations of how to prioritize efforts in these catchments. Similar assessments in other areas of these catchments are likely needed to determine the potential for sediment pollution from curb and gutter, cracked streets, and other related urban land uses.

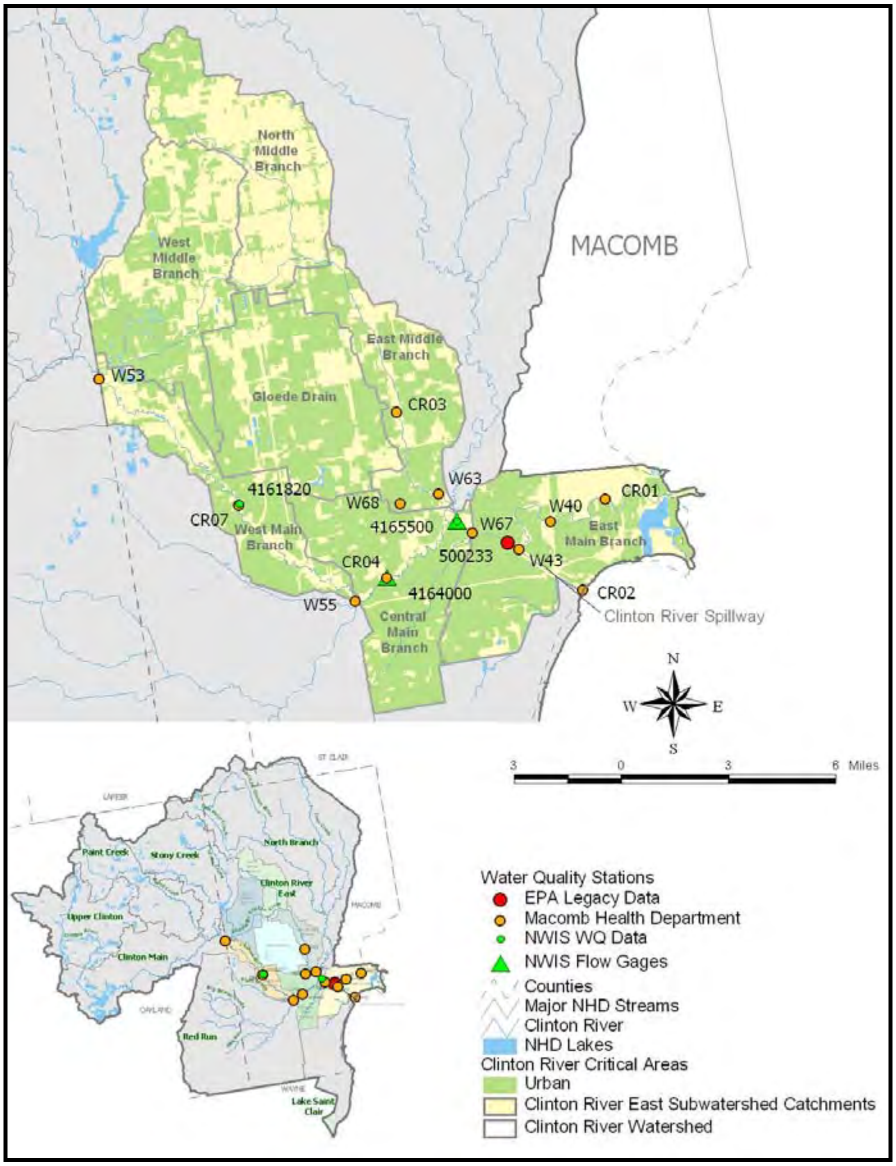
Figure 5-3. Agricultural land uses in the Middle Branch catchments identified as critical areas for sediment load reductions.



3 Known Areas of Exposed Soil

It is clear that other sources of sediment load exist in the subwatershed than those accounted for in STEPL. Since STEPL does not estimate sediment load from streambank erosion, it is likely that sediment load estimates for many catchments are underestimated. For example, the total estimated sediment load from the Middle Branch is approximately 4,172 tons/year according to estimates made using actual water quality monitoring data. The estimated amount from STEPL for the Middle Branch, however, is only 1,692 tons per year. The increased sediment load measured at CR03 is likely due to the significant amount of streambank erosion documented in the Middle Branch. Field data and recent studies mentioned in Chapter 3 and repeated above in the "Sources" subsection should help to pinpoint areas of exposed soil and prioritize restoration and stabilization activities. Based on known information, the Middle Branch should receive the highest priority for streambank restoration activities.

Figure 5-4. Urban land uses in all catchments identified as critical areas for sediment load reductions.



4 Soil Erosion from Construction Related Activities

Construction related activities are problems particularly when they are immediately adjacent to a water course or in an urbanized area with direct access to a storm sewer system and lacks the proper sediment controls. Although these areas were not considered in the STEPL model, it is well documented that soil erosion from construction related activities is a severe problem in rapidly developing areas and contributes significant sediment loads to the waterways. Portions of the CREW are rapidly developing. As mentioned in Chapter 2, the East Middle Branch catchment is projected to have a residential land use of 88 percent (up from 46 percent) by the year 2030. It is important to note that construction-related soil erosion control is addressed through a permitting program discussed in more detail in Chapter 7, and does not fall under the scope of this plan.

Monitoring Progress

Monitoring the reductions in the sediment load requires continued monitoring of TSS, as well as other indicators of sediment (e.g., turbidity, conductivity, benthic macroinvertebrates, pebble counts). The Macomb County Health Department conducts ongoing monitoring through its Surface Water Sampling Program, which includes TSS monitoring. The Clinton River Watershed Council's Stream Leaders student water quality monitoring program monitors turbidity and benthic macroinvertebrates.

Monitoring is recommended to include TSS to establish trends that build on the existing dataset that serves as baseline data. In addition to monitoring for purposes of trend analysis, monitoring plans should also measure management practice effectiveness to determine if management practice implementation is successfully reducing sediment loading from sources in the subwatershed.

Future monitoring needs include developing a better flow and water quality data set downstream of water quality monitoring station 500233 in the East Main Branch Clinton River catchment. There is also a need for both a flow and a water quality monitoring site in the Gloede Drain catchment.

Chapter 9 presents the specific monitoring protocols to be implemented in support of this plan.

Improvement Ideas

In the urban areas, good housekeeping practices such as street sweeping and catch basin cleaning will help to reduce sediment loads. In addition, management practices that promote infiltration while reducing the direct connection of impervious areas to the storm sewer drainage system will decrease sediment loads. These types of management practices include porous pavement, green roofs, bioinfiltration, retention, detention and other low impact development techniques. In addition, the use of swirl separators or sediment traps is another alternative.

Where agricultural areas contribute to sediment loads, animal access to the river should be limited and a buffer of ideally 100-feet or wider should be constructed. Where possible direct discharge of tile drains to the watercourses should be avoided. In addition, various conservation practices to minimize soil erosion should be employed. Participation in the Conservation Reserve Enhancement Program and making the rental rates for the land more appealing may be considered.

Stabilizing exposed soil adjacent to the streambanks and eroding streambanks may typically be accomplished with a vegetative approach (bioengineering). Some streambanks with extremely fast moving water next to it may require the use of hard armoring but in most cases other bioengineering techniques are available to divert or stabilize the forces from the moving water.

Findings from the road-stream crossing survey indicate areas in the CREW with potential problems related to hydrology, such as channelization and flashiness. Known hydrological problems exist in the lower portion of the subwatershed near the Clinton River Spillway, including decreased velocity and reverse flow, causing sediment deposition and build-up. Channel modifications and selective removal of logjams, such as those identified at Gloede Drain, Healy Brook Drain, and Harrington Drain may be used to change the flow profile such that the movement of sediment deposition may be achieved.

Chapter 8 presents the specific actions to be taken towards achieving loading reductions for sediment, as well as other significant stressors.

Phosphorus

Nutrients, both nitrogen and phosphorus, are essential to aquatic ecosystems. However, high levels of nutrients can have a negative impact on water quality. Of the two nutrients, phosphorus is typically in short supply in fresh water and has the greatest potential for adversely impacting water quality. Phosphorus stimulates the growth of plankton and other aquatic plants consumed by fish and other animals. Thus, phosphorus is necessary for a productive and diverse aquatic ecosystem. However, elevated levels of phosphorus can lead to excessive aquatic plant growth and throw off the balance of ecosystem production and consumption. Too many aquatic plants with too few consumers means that plants start to decompose, dissolved oxygen levels needed to support aquatic life begin to drop, and fish and aquatic animal populations begin to decline.

Phosphorus usually exists in nature as part of a phosphate molecule. In a watershed, phosphorus is found as either organic or inorganic phosphate and can either be dissolved in water or suspended in water by attaching to particulate matter (e.g., sediment). Phosphorus cycles through a watershed and is constantly changing form. As it cycles, phosphorus usually moves downstream, dissolved in water and suspended in the water as decomposing plant and animal tissue. Phosphorus attached to particulate matter settles in bottom sediment, where it is used by some benthic macroinvertebrates or covered by additional sediment; when the bottom is stirred, phosphorus re-enters the water column and becomes available again to aquatic plants.

Sources

Phosphorus enters a watershed through both human and natural sources, although contributions from human sources are typically far greater than contributions from phosphate deposits and phosphate rich-rocks. The main sources of phosphorus in a watershed are usually from wastewater treatment plants, fertilizer from residential lawns, fertilizer and animal manure from agricultural lands, failing septic systems, soil erosion from streambanks and construction sites, and stormwater runoff from urban areas. Table 5-8**Error! Reference source not found.** identifies some general sources and causes of phosphorus based on anthropogenic influences. Not all of these sources are present in the subwatershed. Some might be present in upstream subwatersheds and impact the Clinton River in this subwatershed.

Table 5-8. General sources of phosphorus.

Sources	Cause
Livestock	Unrestricted Access Lack of Buffer
Potential Illicit Connections	Function of Design Criteria Unnecessary Inflow Poor Maintenance Increased Development with Poor Stormwater Planning
Manure Storage	Poor Design Poor Construction Increased Development
Agricultural Runoff	Poor Nutrient Management Lack of Buffer
Animal Waste (Non-Agricultural)	Pet Owners Not Picking Up Waste Lack of Buffer Wildlife
Failing Septic Systems	Poor Maintenance Poor Construction Poor Design Overloaded Used beyond design life
Leaky Sanitary Sewer	Poor Design Poor Construction Poor Maintenance
Sanitary Sewer Overflows (SSOs)	Excessive Infiltration Stormwater Inflow Increased Development Inadequate storm drainage
Fertilizer Use (Non-Agricultural)	Fertilizer Application Lack of Buffer
Atmospheric Deposition	Causes Not Appropriate for this Plan but Education Needed
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
Combined Sewer Overflows (CSOs)	Limited Treatment Capacity Increased Stormwater Runoff from Impervious Surfaces Increased Development

In the subwatershed, the likely predominant sources of phosphorus include stormwater runoff from urban areas, failing septic systems and runoff from agricultural areas. The results from the Road-Stream Crossing Survey discussed in Chapter 3 found that proximity of the waterbodies to managed lawns or other urban residential neighborhoods is a common problem in the subwatershed. Managed lawns are potential sources of phosphorus in the subwatershed. In addition, results showed that almost all sites lacked a 100-foot riparian buffer. The results from the Unified Stream Assessment, also discussed in Chapter 3, indicates that the three assessed sites contain potential sources of phosphorus loading. For example, the Gloede Drain site contains an impacted buffer of less than 10 feet with managed turf from a nearby golf course that encroaches to the streambank. The Healy Brook site also contains an impacted buffer of 40 feet and a channel extends from an agricultural field to the drain with plenty of area available for reforestation. The Harrington Drain site contained three instances of utility impacts by probable septic system overflows or illicit connections to storm sewers, identified through evidence of dark brown discharge, sewage odor, toilet paper, and stains.

The neighborhood site assessments revealed that in three-fourths of assess neighborhoods, at least 80% of lots had moderately to highly maintained turf grass. Highly managed turf grass is often the source of nutrients from fertilizer, grass clippings, and other yard waste. Based on field observations, 90% of neighborhoods showed indicators for excessive nutrients.

Due to the relationship of phosphorus to sediment, sources of sediment discussed in the previous section are also likely sources of phosphorus. These include streambank erosion, construction activities, and hydrological impacts that affect both erosion and stirring of bottom sediments. The Mt. Clemens wastewater treatment plant (WWTP) is also a potential source of phosphorus; however, it is subject to a regulatory program and is required to meet effluent limitations for phosphorus as a condition of its permit coverage. Other sources of phosphorus are located in upstream subwatersheds, including the North Branch, Stony Creek, Paint Creek, Upper Clinton, Clinton Main, and Red Run.

Impact and Impairment

Excessive levels of phosphorus can cause accelerated plant growth and algae blooms that can interfere with aesthetic and recreational uses of water. Decay of algae blooms and aquatic plants can cause odors and the suspended particulate matter can lead to increased turbidity, which reduces light penetration and increases water temperature. Decaying plant and animal tissue requires oxygen, resulting in decreased in-stream dissolved oxygen (DO) concentrations. Low DO levels can negatively impact fish and other important aquatic animals (e.g., benthic macroinvertebrates).

Indicators

Direct measuremenst of the amount of phosphorus in the watercourse typically focus on measuring orthophosphate using tests that measure total orthophosphate, total phosphorus, dissolved phosphorus, soluble reactive phosphorus, or insoluble phosphorus. Total phosphorus and soluble reactive phosphorus are most commonly used to measure phosphorus in lake and river systems, respectively.

Indirect indicators of phosphorus vary depending on the type of impacts the indicator is intended to measure. For example, if the concern is impact to aquatic life, the indirect indicators for phosphorus could include biological indicators such as fish and benthic macroinvertebrates; periphyton biomass; dissolved oxygen levels; or pH. When concerned about impacts to recreation, appropriate indirect indicators of phosphorus might include periphyton biomass or water quality (EPA 1999).

Water Quality Standards

The water quality standards in Michigan pertaining to phosphorus do not include any numeric values to serve as a benchmark for assessing the amount of phosphorus in a water body. As a result, it is necessary to develop a numeric target for phosphorus. The Macomb County Health Department uses a numeric target of 0.05 mg/L for total phosphorus (TP) (Macomb County Health Department, 2002). Until MDEQ develops and adopts new numeric nutrient criteria, this analysis applied the numeric target value for TP used by Macomb County at this time.

Current and Target Load Estimates to Calculate Load Reduction Percentages

The TP target value presented above serves as the numeric goal for phosphorus levels in the subwatershed. To determine if the current amount of phosphorus entering the subwatershed will meet or exceed the TP target value, it is necessary to estimate the current phosphorus load entering from a variety of sources. In addition to determining the current load, it is also necessary to identify the target load – the amount of phosphorus that sources can contribute without exceeding the TP target value. If the current load is greater than the target load, management activities are necessary to reduce the phosphorus load.

This section presents the estimated current and target phosphorus load at each representative water quality monitoring station and the associated percent reduction in phosphorus loads necessary to meet the TP target value in the CREW.

The load duration curve approach estimated current and target sediment loads using monitoring data for TP and a combination of recent and extrapolated flow data. Available total suspended solids sampling data originate from U.S. Geological Survey's (USGS) National Water Information System (NWIS) and the Macomb County Health Department. Table 5-9 presents the available TP data. Rows displayed in boldface type illustrate where the average exceeds the target value of 0.05 mg/L.

Table 5-9. TP data used to estimate current and target loads.

Station ID	Period of Record	Count	Avg. (mg/L)	Min. (mg/L)	Max. (mg/L)
4161820/CR07	**4/4/1996 - 10/21/2005**	**70**	**0.08**	**0.01**	**0.24**
4165500	**4/3/1990 - 8/24/1995**	**23**	**0.14**	**0.01**	**0.35**
500233	**1/29/1990 - 10/8/1998**	**60**	**0.17**	**0.06**	**0.87**
CR03	**9/20/2004 - 11/2/2005**	**26**	**0.20**	**0.03**	**1.02**
416400/CR04	**9/20/2004 - 10/21/2005**	**26**	**0.29**	**0.03**	**0.63**

Table 5-9 presents the existing and target annual TP load (tons per year) for the in-stream sampling locations in the CREW. In addition, Figure 5-10 states the percent annual load reduction necessary to achieve the TP target value of 0.05 mg/L.

Table 5-10. Estimated existing annual TP loads and associated reductions.

Station ID	Existing Load (t/yr)	Target Load (t/yr)	Load Reduction (%)
4161820/CR07	16	46	0%
4165500	80	101	0%
500233	86	101	0%
CR03	11	4	-65%
4164000/CR04	123	67	-45%

The load duration curve approach to estimate TP loads in the subwatershed indicates that two areas require significant TP load reductions to achieve the 0.05 mg/L TP target value. Data from water quality monitoring station CR03 show that the existing TP loads from the North, West, and East Middle Branch catchments require a 65 percent reduction to achieve the target load that will meet the TP target value. Data from water quality monitoring station 4164000 show that a 45 percent reduction in TP loads from the Central and West Main Branch catchments is necessary to achieve the target load and the TP target value; however, it is important to keep in mind that the Red Run Subwatershed also influences TP loads at this point. Data from water quality monitoring station 4161820/CR07, upstream from 4164000, show that existing TP loads from the West Main Branch catchment and the four upstream subwatersheds do not appear to require a reduction in TP to achieve the TP target value. This seems to indicate that a majority of the TP load measured at 416400 is likely from the Red Run subwatershed.

Tributaries from the North Branch Subwatershed converge with the Clinton River in the subwatershed downstream of the water quality monitoring stations that indicate the need for significant TP load reductions; data from water quality monitoring station 500233 show that TP loads decrease and that no reductions are necessary at this point to achieve the TP target value. It is unclear at this time if TP load reductions are necessary downstream of water quality monitoring station 500233 in the East Main Branch catchment due to a lack of flow data.

Load Reduction Goals by Catchment

To calculate the phosphorus load reduction goals by catchment, it is necessary to have an estimate of the phosphorus loading from the sources in each catchment. Using readily available information, such as land use and precipitation data, STEPL is able to provide an estimated phosphorus load for each catchment. As mentioned during the discussion of sediment loading, STEPL does not estimate loads from streambank erosion or account for upstream load contributions. Given the relationship between soil and phosphorus, it is likely that the estimated loads for both sediment and phosphorus will be less than actual loads from each catchment – particularly those experiencing streambank erosion or significant contributions from upstream sources.

The total estimated phosphorus load for each catchment and the applicable percent load reduction provide the total estimated load reduction for each catchment. Given that the STEPL model does not account for streambank erosion, and there is a strong connection between sediment and phosphorus, an additional load that estimates the amount of phosphorus associated with streambank erosion is added on to the estimated load. The additional phosphorus load associated with streambank erosion is estimated by using the 10% additional sediment load estimated to account for streambank erosion and multiplying that number by a factor of 0.0005. MDEQ uses this factor when estimating the amount of sediment associated with a ton of sediment erosion. The additional estimated phosphorus load was not applied to the Middle Branch catchments because there are actual measured TP data for these three catchments combined. Table 5-11 presents the estimated total phosphorus load from each catchment, including the additional estimated load to account for streambank erosion.

Table 5-12 presents the estimated load reduction needed by catchment.

Table 5-11. Estimated phosphorus load by catchment.

Catchment	Estimated Phosphorus Load (ton/year)	Additional Load to Account for Streambank Erosion (0.0005 * 10% additional load for sediment)	Total Estimated Sediment Load (ton/year)
Gloede Drain	4.71	0.04 (0.0005*71)	5.11
Central Main Branch	2.94	0.02 (0.0005*41)	2.96
East Main Branch	5.72	0.05 (0.0005*94)	5.77
West Main Branch	2.68	0.02 (0.0005*32)	2.7
East Middle Branch	11	N/A	11
North Middle Branch			
West Middle Branch			

Table 5-12. Estimated TP load reduction needed by catchment.

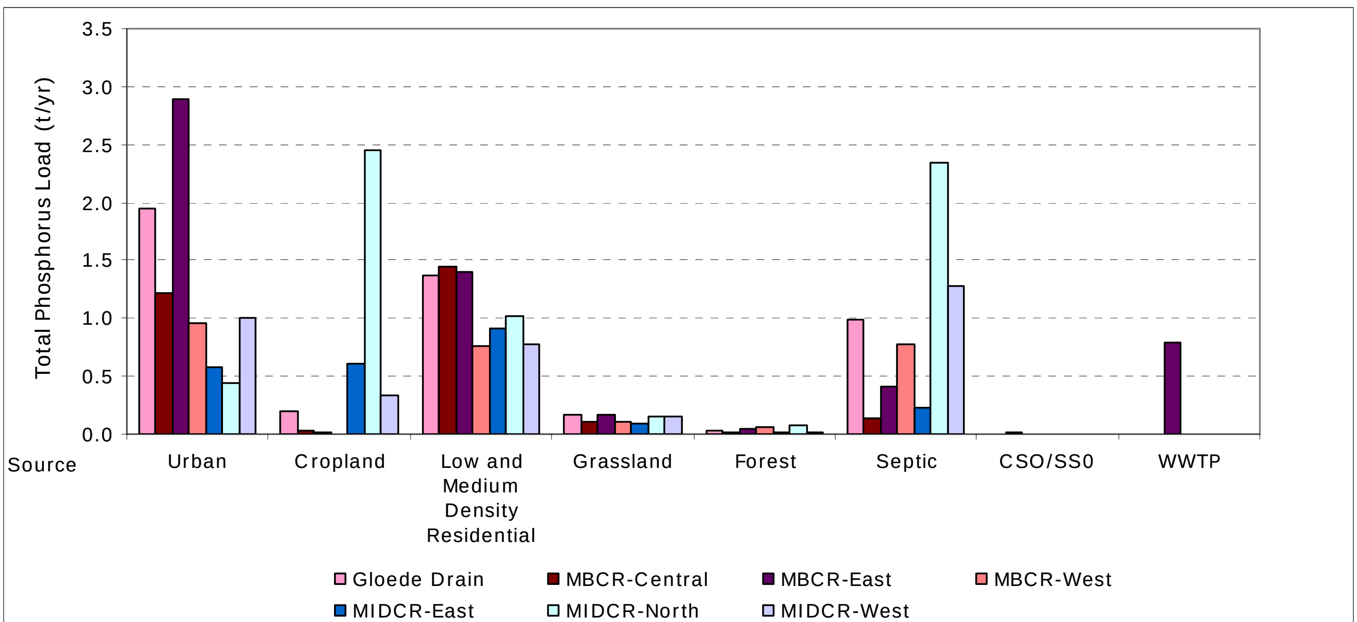
Catchment	Estimated Phosphorus Load Reduction Needed (tons/year)	
Gloede Drain	.72	14% reduction estimated at 4161820 applied to STEPL estimated load of 5.11 t/yr
Central Main Branch	.41	14% reduction estimated at 416820 applied to STEPL estimated load of 2.96 t/yr
East Main Branch	.81	14% reduction from STEPL estimated load 5.77 t/yr
West Main Branch	.38	14% reduction estimated at 416820 applied to STEPL estimated load of 2.7 t/yr
East Middle Br.	9	83% reduction from current load of 11 t/yr
North Middle Br.		
West Middle Br.		

Critical Areas

Critical areas are the geographic portions of a watershed that contribute the greatest amount of a pollutant and have the most significant impact on the watershed. Identifying critical areas is an important step when determining how to achieve the TP load reductions necessary to meet the TP target value. The most significant sources of phosphorus loading in the subwatershed are runoff from croplands, septic systems, and stormwater runoff from urbanized areas, according to the analysis conducted using the STEPL model. Figure 5-5 presents a comparison of the relative contributions of phosphorus loading from different sources by catchment. The STEPL model does not take into account streambank erosion or upstream load contributions. Therefore, the STEPL results do not reflect phosphorus loads associated with streambank erosion or contributions from the Warren WWTP in the Red Run Subwatershed. As a result, the TP loading from the STEPL analysis is less than the estimated annual load of TP presented in Table 5-11.

Although the STEPL model results provide only an estimate, the information is helpful in understanding the relative contributions of phosphorus loading from sources within the subwatershed and how to prioritize these sources when selecting management practices to achieve load reductions.

Figure 5-5. Estimated phosphorus load by source and catchment.



Results from the STEPL model indicate that urban sources of phosphorus, including those from low and medium density residential areas, are the most significant in the subwatershed. Urban sources of phosphorus can include fertilizer use, yard waste, pet waste, and automotive products deposited on roads and parking lots. Given the relationship of phosphorus to sediment (i.e., particulate phosphorus binds to sediment), surface runoff containing sediment is of concern. Within the urbanized areas, sediment picked up by the surface runoff is readily conveyed to a gutter (an impervious channelized flow path) which runs along most streets and washes into a traditional storm sewer drainage system, which quickly discharges to the sediment to the nearby water courses. The traditional catch basin sumps offer some limited opportunity to remove sediment (and thus phosphorus).

Results from the STEPL model indicate that phosphorus loads from septic systems are the second most significant source. The North and West Middle Branch catchments contribute the highest phosphorus loading from septic systems. Septic systems, or on-site sewage disposal systems (OSDS) require proper siting and design, as well as routine inspection and maintenance to ensure proper functioning. Past studies in the Clinton River watershed indicate a 30 – 50 percent septic system failure rate (Ditschmann, 1995). A variety of factors can lead to failing septic systems, including soil wetness or seasonally high water tables, undersized systems, system age, limited space for the soil absorption field (Lee, 2005). Failing septic systems are not always obvious and are, therefore, difficult to detect and measure. An obvious sign of a failing septic system is sewage surfacing on a nearby lawn or over the drain field. In some instances, the soil over the drain field may appear soggy or the vegetation will appear lush. Transport of phosphorus from leaking septic systems depend on the location of the system, the type of soil, the amount and concentration of sewage, and the age of the system. Phosphorus that encounters soil saturated with water can move as much as several hundred feet (Solomon, 1993).

In addition to septic systems, the most significant source of phosphorus from agricultural land is located in the North Middle Branch catchment. The movement of phosphorus from agricultural land to surface water depends on site and management factors, as well as transport factors. Site and management factors include soil phosphorus levels, fertilizer application practices, and field management practices. Transport factors include erosion, distance between field and surface water or water flow. Erosion is the primary contributor to phosphorus loss on many fields, particularly tilled fields (Wortmann, 2005). Considerations for controlling sediment in agricultural areas are applicable to controlling phosphorus associated with erosion in agricultural areas. Critical areas for phosphorus loading from agricultural areas are fields adjacent to the stream corridor. A greater proportion of overland flow occurs within 100 feet of a channel. Overland sheet flow rarely occurs for distances longer than about 300 feet before the flow becomes channelized in some form. Phosphorus concentrations in runoff are likely to decrease as distance increases between the field and the adjacent channel (Wortmann, 2005).

Defining critical areas for phosphorus in the subwatershed requires consideration of the results from both the load duration curve analysis approach and the STEPL model. These results represent both measured and estimated data. Based on TP load reductions and estimated source contributions of the phosphorus load, the critical areas to address in the subwatershed include those described below.

Those sources include those which contribute to the sediment loads that were estimated using monitoring data from the water quality monitoring stations that indicate the need for an annual TSS load reduction. These areas are shown in Figure 5-6 labeled according to the discussion following the figure.

Based on TP load reductions and estimated source contributions of the phosphorus load, the critical areas to address are discussed below.

1 Urban Sources in All Catchments

Urban sources in all catchments contribute an estimated 16.7 tons per year of phosphorus to the subwatershed, which is approximately 59 percent of the overall estimated phosphorus load from all sources. Results from STEPL clearly indicate that urban runoff is estimated to be the most significant source of phosphorus load in the subwatershed. Although STEPL estimates that some catchments contribute more of the load from urban sources than others (e.g., East Main Branch of the Clinton River and Gloede Drain), it is essential that all catchments in the subwatershed consider their urban sources as a critical area. By identifying all urban sources in the subwatershed as a critical area, each community in every catchment will share the responsibility to achieve their sediment load reduction targets. Urban sources in all catchments are also critical areas for sediment; many of the measures taken to reduce sediment loads are likely to help reduce phosphorus loads simultaneously. Figure 5-4 shows the location of urban land uses in all catchments.

2 Agricultural Sources and Septic Systems in the Middle Branch

The three catchments of the Middle Branch contribute an estimated 11 tons per year of phosphorus to the subwatershed. Agricultural sources and septic systems are the two most significant sources of phosphorus in the Middle Branch, contributing an estimated 7.3 tons per year to the subwatershed – approximately 81 percent of the phosphorus load reduction needed to achieve the target value. Load reductions from these sources, coupled with reductions from urban sources, will help to achieve the reduction of 9 tons per year. Figure 5-6 shows the location of agricultural sources and septic systems in the Middle Branch.

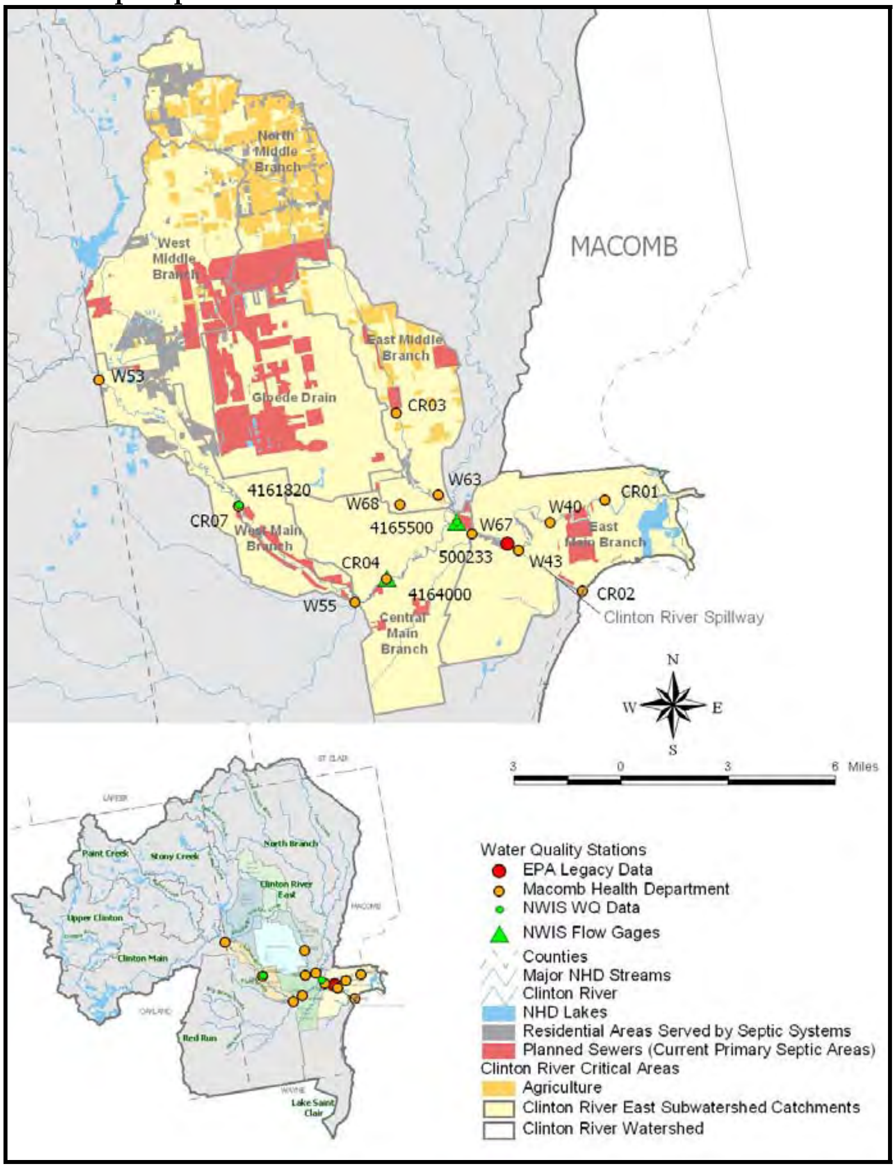
3 Known Areas of Exposed Soil

Field data and recent studies mentioned in Chapter 3 and repeated in this chapter under “Sediment” should help to pinpoint areas of exposed soil and prioritize restoration and stabilization activities. Based on known information, the Middle Branch should receive the highest priority for streambank restoration activities.

4 Soil Erosion from Construction Related Activities

These areas are problems particularly when immediately adjacent to a watercourse or in an urbanized area with direct access to a storm sewer system. Given the relationship of phosphorus to soil, controlling soil erosion from construction related activities will assist in reducing phosphorus loading in the subwatershed. Although these areas were not considered in the STEPL model, it is well documented that soil erosion from construction related activities is a severe problem in rapidly developing areas and contributes significant sediment loads to the waterways. Portions of the CREW are rapidly developing. As mentioned in Chapter 2, the East Middle Branch catchment is projected to have a residential land use of 88 percent (up from 46 percent) by the year 2030. It is important to note that construction-related soil erosion control is addressed through a permitting program discussed in more detail in Chapter 7, and does not fall under the scope of this plan.

Figure 5-6. Agricultural and septic system land uses identified as critical areas for phosphorus load reductions.



Monitoring Progress

Monitoring the reductions in the phosphorus load requires continued monitoring of total phosphorus, as well as other indicators of phosphorus (e.g., water clarity, dissolved oxygen). The Macomb County Health Department conducts ongoing monitoring through its Surface Water Sampling Program, which includes TP monitoring. The Clinton River Watershed Council's Stream Leaders student water quality monitoring program monitors for phosphates.

Monitoring is recommended to include total phosphorus to establish trends that build off of the existing dataset that serves as baseline data. In addition to monitoring for purposes of trend analysis, monitoring plans should also measure management practice effectiveness to determine if management practice implementation is successfully reducing phosphorus loading from sources in the subwatershed.

Future monitoring needs include developing a better flow and water quality data set downstream of water quality monitoring station 500233 in the East Main Branch catchment. There is also a need for both a flow and a water quality monitoring site in the Gloede Drain catchment.

The specific monitoring protocols to be implemented in support of this plan are presented in Chapter 9.

Improvement Ideas

In the urban areas, efforts to reduce the amount of phosphorus entering the storm sewer system will help to reduce the phosphorus load from urban runoff. This includes first taking action to reduce the source of phosphorus, such as amount of fertilizer leaving residential, commercial, industrial areas, as well as roadsides. In addition, management practices that promote infiltration while reducing the direct connection of impervious areas to the storm sewer system will also help to decrease phosphorus loads – less stormwater carrying phosphorus will travel through the system. These types of management practices include porous pavement, green roofs, bioinfiltration, retention, detention and other low impact development techniques. In addition to reducing fertilizer use or promoting the use of phosphorus-free fertilizer, good housekeeping practices such as street sweeping and catch basin cleaning will help to reduce sediment loads that likely contain elevated levels of phosphorus.

To address phosphorus loads from failing septic systems, development and implementation of an effective performance-based on-site system management approach is key. As stated in Chapter 2, there is a documented lack of authority at the state and local levels to identify and remediate failing septic systems. Performance-based on-site programs include rigorous and ongoing system management, such as periodic inspections and required maintenance. The assumed failure rate is likely to decrease using this type of management approach, resulting in a reduced phosphorus loading.

The number of septic systems in the subwatershed is likely to change over time as population increases and more households are connected to sewer systems. SEMCOG predicts that the population of Macomb County will rise by 17.5 percent by the year 2030 and the number of households will increase by 32.6 percent. The area in the subwatershed that is treated by sewer systems is also predicted to increase from 64 percent to 78 percent. Using this information, in addition to the information about septic systems, loads from wastewater treatment plans are estimated to increase by 60 percent (largely due to serving a larger population). The number of future septic systems was based on predictions from SEMCOG that the area served by septic systems would drop from 47.47 square miles to 28.43 square miles. The failure rate was also assumed to decrease from 40 percent to 30 percent. However, until households currently served by septic systems are transferred to sewer systems, it is important to develop and implement performance-based on-site management programs.

Improvement ideas to reduce phosphorus loads from agricultural areas focus reducing the sources of phosphorus and limiting the transport of phosphorus. Management practices to reduce the sources of phosphorus include reducing the use of fertilizer or improving fertilizer application. Management practices related to sediment and erosion control on agricultural lands, such as conservation tillage or installation of vegetative buffers, not only limit the transport of sediment, but also the transport of attached phosphorus particles. Where agricultural areas contribute to sediment loads, construction of 100-feet or wider vegetative buffers animal access to the river should be limited and a buffer of ideally 100-feet or wider should be constructed. Where possible, direct discharge of tile drains to the watercourses should be avoided. In addition various conservation practices to minimize soil erosion should be employed. Participation in the Conservation Reserve Enhancement Program and making the rental rates for the land more appealing may be considered.

Other actions to address erosion and sediment control have the potential to also reduce phosphorus loading. This includes stabilizing exposed soil adjacent to the streambanks and eroding streambanks using a vegetative approach (bioengineering). Some streambanks with extremely fast moving water next to it may require the use of hard armoring, but in most cases other bioengineering techniques are available to divert or stabilize the forces from the moving water. Addressing areas experiencing hydrologic modification could also reduce sedimentation and associated increased phosphorus loads.

The specific actions to be taken towards achieving loading reductions for sediment are presented in Chapter 8.

Pathogens

Pathogens are disease-causing microorganisms that are readily transported in stormwater runoff to streams and rivers. Three general categories of pathogens include bacteria, protozoans, and viruses. When found in water at elevated levels, pathogens can pose a serious health concern, potentially affecting water-based recreation and drinking water supplies. Illnesses associated with pathogens range from vomiting to death in sensitive populations. Risks to human health may vary depending on factors that influence the survival and reproduction of water-borne pathogens. Factors include temperature, sunlight, moisture, soil conditions, and settling in sediment (EPA, 2001).

Sources

Given the size and variability of pathogens, it is difficult to identify their sources and track their movement. Pathogens can enter watersheds from both point and nonpoint sources. Wastewater treatment plants and combined sewer overflows are typically the most significant point sources of pathogens. Nonpoint sources of pathogens in urban areas include failing sewer lines, pet waste, wildlife, and urban litter (EPA, 2001). In agricultural and rural areas, pathogens can originate from failing septic systems, uncontrolled manure storage areas, and land application of manure. Pathogens settle in bottom sediment and are prone to resuspension during storm events or from recreational activity. Table 5-13 identifies some general sources and causes of pathogens based on human activities. Not all of these sources are present in the subwatershed. Some, might be present in upstream subwatersheds and have an eventual impact in the subwatershed.

The likely sources of pathogens in the subwatershed include stormwater runoff from urban areas, failing septic systems, sediment resuspension related to altered hydrology, sanitary sewer overflows, wildlife, pet waste, and illegal dumping and illicit connections into the storm sewer system. Chapter 2 documents past instances of sanitary sewer overflows in the subwatershed. Other sources of pathogens are located in upstream subwatersheds, particularly in the Red Run.

Impact and Impairment

The presence of pathogens in water has the potential to negatively affect public health and can impair recreational and drinking water uses. Primary and secondary contact with recreational water contaminated by pathogens presents an elevated risk for gastrointestinal, respiratory, eye, ear, nose, throat, and skin diseases. As mentioned in Chapter 3, information obtained from the Macomb County Health Department Website (2005) indicates that Metropolitan Park beach was closed at times during 1995, 1996, 1997, 1998, and 2000 due to excessive *Escherichia coli* (*E. coli*) levels.

Table 5-13. General sources of pathogens.

Sources	Cause
Illicit Connections	Poor Construction Practices Function of Design Criteria Unnecessary Inflow (e.g. connected downspouts and footing drains) Increased Development with Poor Stormwater Planning
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
Failed Septic Systems	Poor Design Poor Construction Poor Maintenance Overloaded Used beyond design life
Leaky Sanitary Sewer	Poor Design Poor Construction Poor Maintenance
Sanitary Sewer Overflows (SSOs)	Excessive Infiltration Stormwater Inflow Increased Development with Poor Stormwater Planning Inadequate storm drainage
Dumping	Lack of Adequate Disposal Facilities
Combined Sewer Overflows (CSOs)	Limited Transport and/or Treatment Capacity Increased Stormwater Runoff from Impervious Surfaces Increased Development

Indicators

Directly measuring pathogens in water presents a variety of challenges. As a result, bacteria associated with pathogens are measured as an indicator of the presence of pathogens. Fecal indicators, such as total coliform, fecal coliform, and *E. coli*, are commonly used indicator organisms. Although there is scientific support for the use of *E. coli* and other fecal indicators in determining the presence of pathogens, concerns exist about the correlation between the indicator, the presence of pathogens, and the incidence of disease (EPA, 2001). However, despite these concerns, *E. coli* is one of the most frequently used and publicly recognized indicators for pathogens, particularly for purposes of beach health reporting.

Water Quality Standards

Water quality standards in Michigan contain numeric criteria for E. coli to protect total body contact recreation and partial body contact recreation designated uses. To protect total body contact recreation, in-stream water quality is not to exceed 300 *E. coli* per 100 milliliters. For partial body contact recreation, in-stream water quality is not to exceed a maximum of 1000 *E. coli* per 100 milliliters.

The component of the standard that applies to total body contact recreation (maximum of 300 counts/100 mL) was used to determine the extent of water quality exceedances in the subwatershed and identify critical areas.

Comparison of Current Concentration Data to the Water Quality Standard

The water quality standard for total body contact recreation presented above serves as the numeric goal for *E. coli*, a pathogen indicator organism. Rather than looking at *E. coli* loads from sources in the subwatershed, this section presents an analysis of the existing *E. coli* concentration data and directly compares these data to the water quality standard to indicate where a critical area might exist. Previous load reduction analysis conducted for the planning process indicates that significant load reductions throughout the subwatershed are necessary to achieve the water quality standard. Using a concentration-based approach is consistent both with the Macomb County Health Department's beach health reporting approach and the Michigan Department of Environmental Quality's approach for developing the pathogen Total Maximum Daily Load (TMDL) for the Red Run subwatershed upstream of the CREW. The nature of pathogens and *E. coli* as an indicator organism make it significantly challenging to estimate relative source contributions without the use of sophisticated and resource-intensive techniques (e.g., *E. coli* source tracking using DNA fingerprinting). It is appropriate to assume that all known and suspected sources of pathogens require significant attention to reduce pathogen loads to the subwatershed.

Table 5-14 presents the available *E. coli* data used to determine recent concentrations. These data are generated through Macomb County Health Department surface water quality monitoring programs. The geometric mean provides information on the average number of E. coli counts per 100 milliliters; counts above 300 indicate exceedances of the pathogen water quality standard. The percent reduction indicates how far the average concentration must drop to meet water quality standards – this is not a percent reduction in pathogen loads from sources. The number of samples exceeding the water quality standard out of the total number of samples (i.e., count) provides a percentage of samples that exceed the water quality standard. To determine where E. coli concentrations are of relatively greater concern, stations with monitoring data that demonstrate more than 60 percent of samples exceeding the water quality standard with a geometric mean greater than 60 percent above the standard have been flagged.

Table 5-14. ***E. coli*** **data used to estimate current and target loads.**

Station ID	Period of Record	Count	Geometric Mean (#/100mL)	Reduction %	# of Samples Exceeding 300 counts/mL	% of Samples Exceeding 300 counts/mL
4161820	4/4/1996 - 2/11/1998	41	150		7	17%
CR01	9/20/2004 - 10/21/2005	61	202		22	36%
CR02	9/20/2004 - 10/21/2005	56	103		14	25%
CR03	9/20/2004 - 10/21/2005	62	1641	-81.72%	49	79%
CR04	9/20/2004 - 10/21/2005	56	2162	-86.12%	52	93%
CR07	9/16/2004 - 10/21/2005	60	835	-64.05%	42	70%
W40	5/23/2000 - 9/16/2003	11	664	-54.85%	8	73%
W43	5/23/2000 - 9/16/2003	11	88		3	27%
W53	5/23/2000 - 9/16/2003	11	510	-41.12%	6	55%
W55	5/23/2000 - 9/16/2003	11	1097	-72.65%	9	82%
W63	5/23/2000 - 9/16/2003	11	975	-69.23%	10	91%
W67	5/23/2000 - 9/16/2003	11	1016	-70.47%	9	82%
W68	5/23/2000 - 9/16/2003	11	461	-34.97%	6	55%

Table 5-15 presents the existing and target annual *E. coli* load (billion cells per year) for the in-stream sampling locations in the CREW. In addition, Table 5-15 states the percent annual load reduction necessary to achieve the water quality standard for total body contact recreation of 300 *E. coli*/100 mL.

Table 5-15. Existing annual loads and associated needed reductions.

Station ID	Existing Load (10^9 cells/yr)	Target Load (10^9 cells/yr)	Needed Load Reduction (%)
4161820/CR07	522,538	742,588	0%
4164000/CR04	34,955,959	1,067,019	97%
CR03	2,250,858	103,173	95%
W43	9,292,872	1,623,808	82%

Critical Areas

For other stressors, critical areas are defined as the geographic portions of a watershed that contribute the greatest amount of a pollutant and have the most significant impact on the watershed. For E. coli, the analysis focuses on concentration data rather than loading data. Therefore, it is difficult to estimate the geographic portions of the watershed that contribute the greatest amount of pathogens. Concentration data can provide an understanding of what portions of the subwatershed have relatively higher or lower levels of pathogens; this provides an indication of which catchments might contribute a relatively greater pathogen load. Recommended critical areas for *E. coli* include those catchments represented at water quality monitoring stations with a geometric mean exceeding the water quality standard by more than 60 percent and more than 60 percent of samples exceeding the water quality standard. The prioritized critical areas associated with these water quality monitoring stations are described below in more detail.

1 Middle Branch

Monitoring data from two water quality monitoring stations, CR03 and W63, show *E. coli* concentrations exceeded water quality standards at the time of sampling. Without estimated load contributions by source category, information about land uses in these catchments (see Chapter 2) can help determine the potential sources of *E. coli*.

Predominant land uses in the Middle Branch catchments include residential (38 percent) and agriculture (25 percent). Of the three catchments, the North Middle Branch contains the highest percentage of agricultural lands. In addition, 93 percent of the land area in the North Middle Branch relies on septic systems – estimated to have a potential 30% to 50% failure rate. Within this critical area comprised of the three Middle Branch catchments, it is recommended that potential agricultural sources (e.g., uncontrolled manure storage areas, land application of manure and sewage sludge) and failing septic systems take first priority. Runoff from urbanized areas in all three catchments should also receive attention in an effort to reduce *E. coli* loads.

2 Central Main Branch Catchment

Three of the highlighted water quality monitoring stations – CR04, W55, W67 -- are located in the Central Main Branch catchment. This catchment is adjacent to the Red Run subwatershed; therefore, the *E. coli* concentrations in this catchment likely reflect upstream contributions and illustrates the need to work with the Red Run subwatershed to address *E. coli* loads.

3 West Main Branch Catchment

E. coli monitoring data from the water quality monitoring station CR07 represents conditions from the mid-portion of the West Main Branch catchment. Potential sources from this catchment might include septic systems, runoff from agricultural sources, as well as runoff from urban sources.

Monitoring Progress

Monitoring the progress of reducing pathogens will rely on existing *E. coli* monitoring efforts by the Macomb County Health Department. The Macomb County Health Department monitors for *E. coli* on a regular basis through the Macomb County Bathing Beach and Surface Water Quality Program. In addition, the Department conducts initial investigations of stormwater outfalls through the Illicit Discharge Elimination Program, which includes sampling for *E. coli*.

Another indicator of pathogens, fecal coliform bacteria, is monitored through the Clinton River Watershed Council's Stream Leaders student water quality monitoring program.

Continued *E. coli* monitoring will establish trends that build off of the existing dataset that serves as baseline data. In addition to monitoring for purposes of trend analysis, monitoring should also measure management practice effectiveness to determine if management practice implementation is successfully reducing *E. coli* loads from sources in the subwatershed. The issue of pathogen source identification is an important and challenging topic; as progress is made in this arena, it would be beneficial to incorporate source identification monitoring to help distinguish the sources of *E. coli* in the subwatershed.

Given the challenges associated with using *E. coli* as an indicator organism for pathogens, future monitoring needs include identifying an alternative indicator for pathogens. Future monitoring needs for E. coli also include the identification and use of acceptable source tracking techniques to aid in distinguishing anthropogenic sources of pathogens from wildlife and other natural sources.

The specific monitoring protocols to be implemented in support of this plan are presented in Chapter 9.

Improvement Ideas

In the urban areas, efforts to properly manage domestic pet waste and limit the populations of anthropogenic wildlife, such as geese, pigeons, raccoons, and rats, are likely to help reduce *E. coli* loads associated with urban runoff. In addition, management practices that promote infiltration while reducing the direct connection of impervious areas to the storm sewer drainage system will decrease *E. coli* loads. These types of management practices include porous pavement, green roofs, bioinfiltration, retention, detention and other low impact development techniques. Reducing the amount of stormwater runoff from urban areas will also help to alleviate the stress placed on separate and combined sanitary sewers that might have illicit connections to the storm sewer system or inflow/infiltration problems due to age or lack of adequate maintenance.

To address *E. coli* loads from failing septic systems, development and implementation of an effective performance-based on-site system management approach is key. As stated in Chapter 2, there is a documented lack of authority at the state and local levels to identify and remediate failing septic systems. Performance-based on-site programs include rigorous and ongoing system management, such as periodic inspections and required maintenance. The assumed failure rate is likely to decrease using this type of management approach, resulting in a reduced phosphorus loading.

Achieving *E. coli* load reductions in agricultural areas will likely necessitate the use of effective manure management techniques, including adequate manure storage, strategic land application of manure and sewage sludge, as well as restricted livestock stream access. Vegetated buffers previously discussed for other stressors will also aid in reducing the transport of *E. coli* to nearby streams and rivers.

The specific actions to be taken towards achieving loading reductions for sediment are presented in Chapter 8.

Hydrologic Flow

Stream flows vary in characteristic ways over time frames ranging from hours and days to seasons and years. The flow regime includes such factors as the magnitude and frequency of floods and low flow periods, the seasonal occurrence of various flow rates, and the rates of change of flow. The flow regime of a stream reflects the operation of the hydrologic cycle within its watershed. Climate, topography, geology, soils, vegetation, watershed size and shape, stream pattern, land use, water use, and dams all impact the timing and pathways of water movement to and through stream and hence the stream's flow regime.

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 may cause streambank erosion, sedimentation, and poor conditions for plants, fish and macroinvertebrates. In addition the surface runoff from precipitation collects and transports various pollutants to the receiving waters thus not only affecting the flow characteristics in the receiving water but also the pollutant concentrations.

Sources

Hydrologic flow changes in receiving water courses are due to a loss of infiltration into the soil, a loss of evaporation, loss of storage or increased flow channelization. These occurrences are typical of development regardless of the new land use. For example in urban areas loss of infiltration, storage and evaporation result as impervious surfaces are created and the soil is compacted due to construction operations. Refer to the discussion on the relevance of impervious cover in Chapter 2 for additional information.

Another key cause of changes in hydrologic flow is the loss of storage from wetlands and floodplains. As discussed in Chapter 2, wetland coverage in the subwatershed is currently 5.7 percent of land area. The West Main Branch catchment is 9.9 percent wetlands (mostly adjacent to the river) and accounts for 18.4 percent of the subwatershed total. The East Main Branch catchment is 7.2 percent wetlands (mostly in low lying areas near Lake St. Clair) and accounts for 21 percent of the subwatershed total. Other catchments accounting for greater than 15 percent of the wetland total include the North Middle Branch and West Middle Branch catchments where the wetland acreage can be attributed in part to less intense urban development.

Table 5-16 summarizes various sources of changes to the hydrologic flows.

Table 5-16. Hydrologic flow change sources.

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

Impact and Impairment

The typical changes in hydrologic flow due to development in the surrounding watershed include an increase in the flashiness of the watercourse, an increased peak flow, a reduction in the base flow due to loss of interflow and groundwater flow through the soil, and an increase in the total volume of water transported. A decrease of water is also possible if significant water withdrawals are occurring, however this is not the case in this watershed.

Increases in peak flow rates may literally wash benthic macroinvertebrates, fish, amphibians and vegetation downstream if the peak velocities and shear forces are great enough. With the increased flow rates and occurrence comes an increase in the erosion potential within the watershed. The impacts and impairment of this are discussed under sediment as a stressor.

The increased runoff from developed areas also has the potential to carry with it pollutants that would not otherwise enter the watercourse. For example in a residential development fertilizers may be carried by rainwater through the engineered stormwater conveyance system and be discharged to a river. Hence if the increased runoff were controlled not only would the stream experience less impact due to changes in hydrologic flow but would also not receive the fertilizer applied to the yard, in the above example.

A good discussion of the impacts of hydrologic flow may be found in "Hydrologic Impacts Due to Development: The Need for Adequate Runoff Detention and Stream Protection" by the MDEQ May 2002.

The loss of wetlands and connected floodplains in the watershed results in the same hydrologic changes as discussed above. In addition, the loss of storage areas help prevent the movement of sediment, filter pollutants, provide habitat and support a wide diversity of plants and animals.

Indicators

Many different indicators may be used for hydrologic flow. The most obvious indicator is that of the flow profile itself monitored throughout the day as it is at a USGS gauging station. The challenge with gauging station data is in interpretation based on all of the other variables affecting flow, for example precipitation, temperature, wind, length of records, etc. Flashiness indices are one method of analyzing flow records. The term flashiness reflects the frequency and rapidity of short term changes in stream flow, especially during runoff events. A variety of indices have been developed to describe natural flow regimes, their degree of alteration, and progress in their remediation.

Other indicators of changes in hydrologic flow look at the impact left behind such as streambank erosion, embeddedness, and population and biodiversity of organisms.

Erosion of streambanks is a natural process; severely eroding streambanks may be an indicator of changes in the hydrologic flow regime. Various methods are available to monitor the rate of eroding streambanks; these typically center around some type of reference marks or pins. Photographic monitoring also provides some reference framework for this. Fallen trees into the river may be an indicator of active erosion although this may be difficult to tell. The presence of exposed roots on the riverbanks with the fine roots in tack (looks like the roots are hairy) may indicate eroding streambanks.

The loss of storage may be calculated based on mapping, survey data, and perhaps modeling and used as an indirect measurement of the hydrologic change.

Water Quality Standards

Water quality standards specific to hydrologic flow are not available. The water quality rules discussed under the MDEQ's administrative rules focus on chemical composition, taste or odor producing substances, radioactive substances, plant nutrients, microorganisms, dissolved oxygen, and temperature. The rules surrounding floodplain also do not address hydrologic flow specifically but rather look to net increases to the floodplain, typically the one percent probability floodplain (100-year). Since hydrologic flow variations are in and of themselves not regulated, attention must be focused on the impacts associated with the changes of hydrologic flow.

Available Data

As discussed in Chapter 3, stream flow data are available at USGS gauging stations. In the subwatershed, there are two locations where sufficient stream flow data exist to conduct a meaningful analysis. These sites (#04164000 on the Clinton River near Fraser at Garfield Road; and # 0416550 on the Clinton River in Mt. Clemens at Moravian Drive) are detailed in Chapter 3.

Land use data and aerial mapping are available to estimate the percent of imperviousness, discussed in Chapter 3. Soil mapping information is available from the NRCS which is used in hydrologic flow computations. Flow conveyance information is available from the respective County Drain Commissioner's offices as well as from some municipalities.

Information on indicators is available in the form of organism biodiversity and population data (discussed in Chapter 3), and physical characteristics as observed from the various inventory and screening efforts previously discussed.

Load Estimates

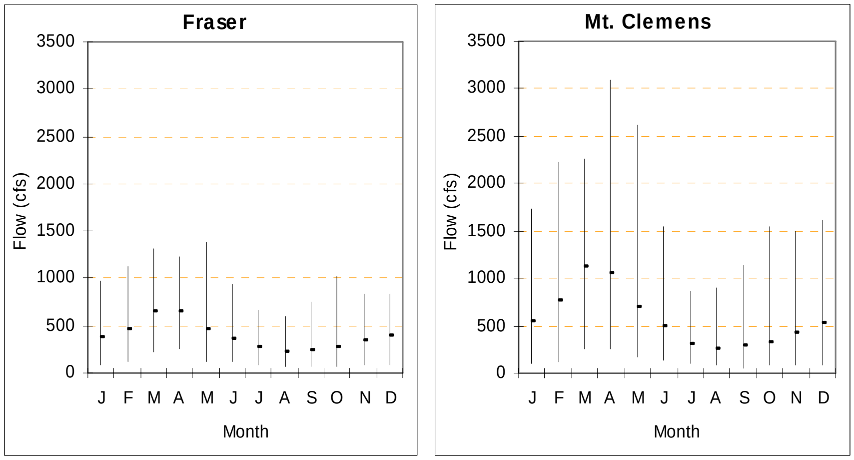
Load estimates for hydrologic flow are not specifically available rather surrogate estimates are used, namely the stream flow variations, flashiness indices and the amount of imperviousness within the watershed.

Figure 5-7 shows the monthly mean stream flows (in cfs) for the entire data span at the two USGS stations.

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. This is meant to illustrate the flow variability within each month and also between the months.

The flow data show the yearly variance in flow from January, increasing until its peak in March/April, decreasing to its lowest in August, then increasing again.

Figure 5-7. Monthly mean stream flows.

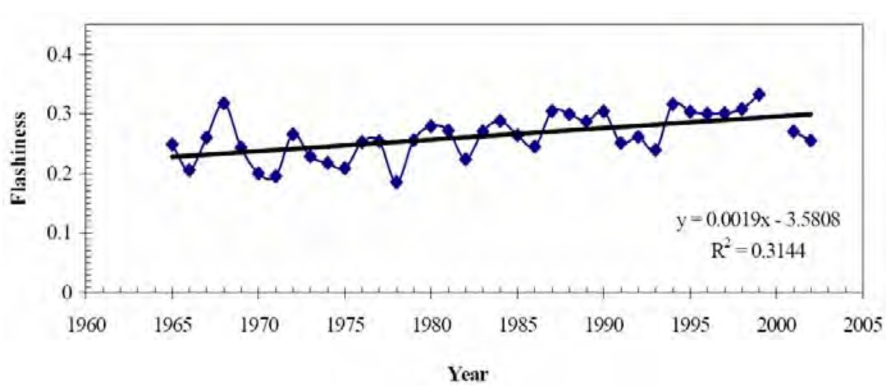


As one would expect, the downstream gage exhibits greater mean flows and greater variances in flows. For example, the stream flow at the Fraser gauge had a maximum annual mean of 563 cfs in 1985 with a monthly variation from 72 cfs in October 1953 to 1,352 cfs in May of 1956. The Mt. Clemens gauge had a maximum annual mean of 1,959 in 1975 with a monthly variation from a 51 cfs in July 1934 to a high of 3,090 cfs in April 1947.

The preceding analysis only addresses flow variability. One common metric used to characterize the change in basin response is a stream flashiness index. Flashiness is a characterization that quantifies the time response of a river to a rainfall event. In this analysis, the flashiness index used was based on a method described in a paper by researchers from Heidelberg University (Baker, et al, 2004) in the Journal of American Water Resources Association (see 'Flashiness Index' sidebar for additional information).

Figure 5-8 and 5-9 present the results for such an analysis at the two gages of interest in the subwatershed (USACE, 2005).

Figure 5-8. Flashiness indices and trend at the Fraser gage.



R-B Index to Track Changes in Flashiness

The Richards-Baker, or "RB" index is a ratio of the absolute value of the sum of the daily flow changes to the sum of the total daily flows. Although this index may vary spatially for a particular year, the temporal trend of this index is a relative indication of basin response to rainfall and is a good indicator of hydrologic changes in the watershed.

Figure 5-9. Flashiness indices and trend at the Mt. Clemens gage.

As can be seen in the figures, the flashiness index shows an increasing trend over the last 35 years. As any rainfall deviation over this period was statistically insignificant, this indicates that the Clinton River is generally becoming more responsive (exhibiting higher peak flow rates) most likely due to increasing impervious surfaces in the river's headwater areas.

A visual representation of the impervious cover from the land use data can be found in Chapter 2. The remaining discussion is based on this data as the impervious percentage coefficients were derived based on regional information.

The impervious cover for the subwatershed as a whole is 20.9 percent. The Gloede Drain, Central Main Branch and East Main Branch catchments have the greatest percentages of impervious surface, with over 26 percent each. The North Middle Branch catchment has the lowest impervious percentage at 8.4 percent. The other catchments have impervious percentages between 16.3 percent and 20.8 percent.

Analysis of stream systems across the country seems to indicate that there are thresholds at which watershed imperviousness results in measurable degradation of waters. The Impervious Cover Model (ICM) (Schueler, 1994) describes this relationship, some threshold values of imperviousness, the characteristics of streams impacted by imperviousness, and recommended actions to address issues in these streams.

The ICM, although a powerful tool to predict the quality of streams based on impervious cover change, has limitations and is not an absolute indicator. It is not generally applicable at scales greater than 10 miles and is based primarily on data from the northwest portion of the U.S. It is important to understand that the ICM is applicable at a single point along a waterbody; the analysis of imperviousness must consider the entire area of land tributary to that point. From the information presented above, it can be said that the Middle Branch of the Clinton River at the outlet of the West Middle Branch catchment has a tributary area that is 20.8 percent impervious and therefore falls within the impacted category. While the North Middle Branch catchment has an impervious area of only 8.4 percent, the ICM classification of the Middle Branch of the Clinton River at the outlet of the North Middle Branch catchment must include the total tributary area, which includes the West Middle Branch. This total area is then approximately 15 percent impervious and the river is classified as impacted at that location.

While outside the scope of this plan, it is recommended, in the future, to properly analyze the streams in the subwatershed in the context of the ICM. This involves defining drainage areas for numerous points along each stream to be analyzed and conducting the impervious analysis as described in the beginning of this section. At this point, it can be said, based on the catchment-aggregated data, that the impervious coverage for a given catchment can be compared to the ICM values to determine the likely classification of the small streams in that catchment. The remaining discussion in this section approaches the topic in such a manner.

As a whole, the subwatershed is affected by the high percentage of imperviousness. While some areas are expected to exhibit serious problems, others have impervious levels that imply the possibility to maintain high levels of water quality and general waterbody health.

While short-term actions for areas most affected by impervious surfaces are related to minimizing existing problems, the long-term outlook for these areas can be geared towards restoration if the right steps are taken. However, one of the purposes of the ICM is to identify streams that are outside of the severe impacts of imperviousness, so that limited resources can be funneled towards the protection of these resources. This approach is much more cost-effective than trying to restore streams severely degraded by high levels of imperviousness.

It should also be noted that the suggested relationship between impervious cover and the expected stream quality was developed for urban subwatersheds (typically with a drainage area less than 10 square miles) and may not accurately reflect conditions for agricultural areas.

Critical Areas

The critical areas for hydrologic flow are the highest developed areas as estimated by the impervious cover analysis. The more imperviousness associated with a given site, the higher the flashiness, the greater the peak flows will be increased, and the greater the total runoff volume due to the reduction in evaporation, transpiration, infiltration and storage.

All impervious areas which are directly connected to a stormwater conveyance system (often referred to as DCIA or directly connected impervious areas) should be considered for restoration potential. The areas with a higher percent impervious may be given higher priority based on their potential to more adversely affect the receiving water body. Likewise impervious areas which have a high potential for containing other pollutants should also be given a higher priority over impervious surfaces with no other pollutants.

When considered on the subwatersheds level those subwatersheds which have a percent imperviousness greater than or equal to 10 percent are considered the critical areas. Three categories are provided:

1 Urban Drainage Catchments

These areas are comprised of those with impervious cover greater than 60 percent. No catchments fall into this classification.

2 Non-Supporting Catchments

These areas are comprised of those with impervious cover between 26 and 60 percent. The Gloede Drain catchment falls into the category of 'Non-supporting' implying that many waterbodies in the catchment may be affected by impervious cover such that they show impacted water quality, low biodiversity, and have unstable channel banks. Portions of the Central Main Branch and East Main Branch catchments also include the Clinton River corridor. Portions of the East Main Branch catchment drain to Lake St. Clair directly or through canals. Both of the catchments are classified in the 'Non-supporting' category and thus waterbodies within them are expected to show effects similar to those described for the Gloede Drain catchment. The downstream portion of the West Main Branch catchment can be classified as 'Non-supporting'. This catchment is land that drains essentially directly to the Clinton River as part of its corridor. Thus pollutants draining from impervious areas have a direct loading into the river.

3 Impacted Catchments

These areas are comprised of those with impervious cover between 11 and 25 percent. The West Main Branch catchment falls within the 'Impacted' category. Despite heavy build-out on the downstream end, the amount of imperviousness is mitigated by a large conservation area on the upstream end. The East and West Middle Branch catchments fall within the 'Impacted' category. Waterbodies in these catchments are expected to show some signs of degradation. Watershed protection activities in these catchments should focus on protecting the critical elements of water quality and implementing protection strategies that focus on reducing pollutant loads from existing impervious areas. It is important to recognize that the aforementioned catchments are 'headwater areas' for the Middle Branch of the Clinton River and the fact that they are not dominated by impervious impacts is a positive in terms of future water quality potential. Refer to Chapter 2 for additional discussion concerning headwater areas.

Keep in mind that regardless of the overall subwatershed area weighted percent impervious, all directly connected impervious areas are good candidates for restoration potential.

For protection consideration, critical areas are considered those that have an impervious cover less than 10 percent in the category of "Sensitive." These are generally the undeveloped parcels or parcels with open green space included. The highest priority is given to the undisturbed tracks of land. Only one catchment, the North Middle Branch, falls in the 'Sensitive' category. One would expect that the waterbodies in this catchment will be the least impacted. Watershed protection activities in this catchment should focus on protecting the high quality elements of the waterbodies.

Load Reduction Targets

No specific load reduction is targeted for hydrologic flow. Rather the target is to see no effective upward trend for the R-B Index. Trending of the Index should be looked at on no less than a five year basis.

No specific target is set for the impervious cover analysis. The desire is to see no "effective" increase in hydraulically significant percent impervious. Hydraulically significant impervious areas are those impervious areas directly connected to the receiving water. The intent is not to limit development and consequently the impervious area, but rather when development occurs to do so in an environmentally friendly manner such as the premise of low impact development techniques.

The target for the wetlands and floodplains is to see no net loss of additional storage within the watershed.

Monitoring Progress

Use of the R-B Index will be used at the two USGS gauging stations to monitoring progress over time. Trending of the Index should be looked at on no less than a 5 year basis and not annually.

Progress will also be monitored through the other indicator parameters as identified in the *Indicator* section.

Improvement Ideas

To reduce the flashiness of a stream the high impervious cover areas may be retrofitted to slow down the runoff discharge and promote the use of infiltration and evapotranspiration. This may be accomplished through the use of bioretention and infiltration practices such as rain gardens, green roofs, porous pavement and vegetated swales. The use of detention facilities is appropriate to reduce the peak discharge however these types of facilities do not generally reduce the total volume of runoff discharged and therefore are not as effective as some other means.

For new development and significant redevelopment areas development standards should be put into place promoting the use of low impact development techniques. Public education and input should be included in formulating development standards.

Directly related to the flow regime stemming from high impervious areas is the ability and tendency of the runoff to pick up other pollutants and discharge them to the receiving waters. In order to minimize the impact of this any retrofit projects undertaken to reduce the discharge should also include best management practices to reduce the pollutants carried by the stormwater. In addition, good housekeeping practices and education should be included to reduce the opportunity for the pollutants to come in contact with the stormwater.

The degradation and loss of storage should also be thwarted by first completing inventories and assessments of the existing wetlands and floodplains and then providing protection measures. In addition, those areas capable of being restored should be prioritized and worked on as possible.

Critical Area Summary

Based on the critical area analyses presented in the previous sections, BMPs applied in urban areas have the potential to mitigate numerous stressors. Additionally, BMPs applied in agricultural area may do the same.

Other Stressors

Aside from the stressors discussed above in detail, other known stressors are present in the watershed. For each of these stressors, the sources and causes are identified.

Contaminated Sediments

Chemicals such as PCBs, metals (e.g., mercury, lead, zinc), and pesticides tend to bind to particles and collect in bottom sediments. Elevated concentrations of these chemicals have been documented over several decades in a number of locations along the Clinton River from Pontiac to the mouths of both the river and the spillway (EPA, 2003). According to studies conducted during the last decade, the subwatershed contains some of the most contaminated areas within the Clinton River AOC (ECT, 2005). Table 5-17 presents the potential sources and causes of contaminated sediments in the subwatershed. The sources of these contaminants include historical point source discharges, as well as existing nonpoint sources. Contaminated sites, such as landfills and leaking underground storage tanks, might also contribute pollutants contaminating sediments. More work is necessary to understand the sources and causes of contaminated sediments, including the mixing and transport of sediments. When present at elevated levels in sediments, chemicals can kill or harm bottom-dwelling organisms and can also accumulate in aquatic organisms and move up the food chain to fish, shellfish and eventually humans. Contaminated sediments have also resulted in a restriction to dredging activities because of the concern for re-suspending chemicals currently buried.

Table 5-17. Contaminated Sediments - Sources and Causes

Sources	Cause
Resuspension of buried contaminated sediments	Disturbance from storm events Disturbance from recreational and navigational activities
Contaminated sites (landfills and underground storage tanks)	Age of materials Lack of maintenance and monitoring
Stormwater runoff	Automotive fluids and by-products on impervious surfaces Improper disposal of hazardous materials Improper materials storage and good housekeeping practices

Polychlorinated Biphenyls

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. Table 5-18 lists potential sources and causes of elevated PCB levels in the subwatershed. The Clinton River Spillway is noted for having elevated levels of PCBs. 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, 2006).

Table 5-18. 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

Habitat Alteration

Habitat alteration is affecting the fisheries, other aquatic life, and wildlife. Habitat loss has resulted from the urbanization of the watershed and the conversion of the natural land cover to parking lots, buildings, homes, and lawns. In addition to the direct loss of stream habitat, the increased imperviousness has also resulted in a significant modification to the natural flow regime. High quality stream habitats with intact riparian zones and natural channel morphology are essential to a healthy aquatic community because they provide shelter, spawning areas, and can help filter excess pollutants such as nutrients and sediment.

References

Baker, D., R. Richards, T. Loftus, and J. Kramer. "A New Flashiness Index: Characteristics and Applications to Midwestern Rivers and Streams." Journal of the American Water Resources Association, April 2004.

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

Ditschmann, E.P., et al. 1995. Clinton River Watershed On-Site Sewage Disposal System Survey. 1995.

Environmental Consulting & Technology [ECT]. 2005. Development of Restoration Criteria in the Clinton River Area of Concern, Draft Final Report. Brighton, Michigan.

Environmental Protection Agency [EPA]. 2006. Polychlorinated Biphenyls (PCBs). Website via: http://www.epa.gov/opptintr/pcb/. Last Accessed August 2006.

Environmental Protection Agency [EPA]. 2003. *Clinton River Area of Concern.* Available at: http://www.epa.gov/glnpo/aoc/clintriv.html. Last Accessed 2006.

Environmental Protection Agency [EPA]. 2001. Protocol for Developing Pathogen TMDLs, First Edition. United States Environmental Protection Agency, Washington D.C.

Environmental Protection Agency [EPA]. 1999. Protocol for Developing Nutrient TMDLs, First Edition. United States Environmental Protection Agency, Washington D.C.

Lee, B., D. Jones, and H. Peterson. 2005. "Septic System Failure." Home & Environment. Purdue University, West Lafayette, IN. Available at: http://www.ces.purdue.edu/extmedia/HENV/HENV-1-W.pdf. Las Accessed September 2006.

Leopold, Luna. 1994. A View of the River. Harvard University Press, Cambridge, MA.

Macomb County Health Department [MCHD]. 2002. 2002 Lake St. Clair Water Quality Assessment.

Michigan Department of Natural Resources. "Clinton River Remedial Action Plan". 1988.

Ohio Environmental Protection Agency [OEPA]. 1999. Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams. Ohio EPA Technical Bulletin MAS/1999-1-1. Ohio Environmental Protection Agency, Columbus, Ohio.

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

Solomon, D. and E. Dersch. 1993. "Maintaining Your Septic System: Special Considerations for Shoreline Property." Michigan State University Extension Bulletin. July 1993. East Lansing, Michigan.

Southeast Michigan Council of Governments [SEMCOG]. 2005. *Land Use Datasets*. Via: ftp://ftp.semcog.org as instructed by Amanda Polanco. 2005.

Tetra Tech. 2004. *User's Guide: Spreadsheet Tool for the Estimation of Pollutant Load (STEPL), Version 3.0*. U.S. Environmental Protection Agency. Tetra Tech, Inc. Fairfax, VA. September, 2004.

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

Wortmann, C. 2005. Agricultural Phosphorus Management and Water Quality Protection in the Midwest.

6. Goals and Objectives

Quotable Quotation

"Our goals can only be reached through a vehicle of a plan, in which we must fervently believe, and upon which we must vigorously act. There is no other route to success."

--Stephen A. Brennan

Algae on the Clinton River: Goal I, Objective B Aims to Address This Issue

Photo courtesy of MCPWO.

Illicit Discharge Elimination Plans

Permittees are striving to eliminate pathogens discharging to waterbodies through their Illicit Discharge Elimination Plans (IDEP). These plans describe activities undertaken to ensure that no illegal pollution sources, such as cross-connected sanitary sewers, are discharging from storm sewer outfalls. Development and implementation of an IDEP is a separate requirement of the Watershed-based Permit.

Introduction

As noted in Chapter 1, the main purpose of this plan is:

> "**To improve and protect the ecological, hydrological, and cultural resources of the Clinton River East Subwatershed.**"

The long-term goals and short-term objectives defined in this section reflect this purpose. They also reflect:

- The natural and human environments of the subwatershed;
- The current conditions in the subwatershed;
- The desires and concerns of subwatershed stakeholders and the general public;
- The analysis of stressors in the subwatershed;
- The requirements of National Pollutant Discharge Elimination System (NPDES) General Permit No. MIG619000 ('Watershed-based Permit') and other programs for which the plan is compliant; and
- Support for the Clinton River Remedial Action Plan (RAP), the Lake St. Clair Comprehensive Management Plan, and the Water Quality Management Plan (WQMP) for Southeast Michigan.

The goals and objectives are important as they will drive future decisions with respect to appropriate management strategies and evaluation of progress toward improving the health of the subwatershed.

Goals and Objectives

The details of each goal, including objectives are presented in this section. The order of the goals and objectives does not reflect their importance.

Goal I: To protect, restore, and enhance water quality of the subwatershed

The aim of Goal I is to directly address known water quality issues and protect designated uses including "Agricultural Water Supply", "Industrial Water Supply", and "Public Water Supply". This goal is also intended to support actions for compliance with any Total Maximum Daily Loads (TMDLs) established within the subwatershed. The objectives include:

Goal I – Objectives	
A. Address existing and future contaminated sediments.	i. Identify feasible actions to remediate existing contaminated sediments.
	ii. Identify and implement pollution prevention activities for current and future sources.
B. Reduce the amount of nutrients and excessive algae to improve dissolved oxygen levels.	i. Identify sources of nutrients and BOD.
	ii. Identify and implement management practices to limit nutrient and BOD loadings.
C. Reduce the amount of sediment.	i. Identify sources of sediment.
	ii. Identify and implement management practices to limit sediment loadings.
D. Reduce amount of pathogens.	i. Identify and address failing septic systems.
	ii. Identify and address illicit connections.
	iii. Identify stormwater management techniques to reduce other nonpoint source pathogen loadings and implement techniques where practical.

Goal II: To educate the public on how to protect, restore, and enhance water quality

The aim of Goal II is to develop an aggressive multi-media public education and participation campaign to define watersheds and stormwater, foster a watershed stewardship ethic, and advertise watershed events targeted at the general public, stakeholders, municipal officials and planning boards. The objective language is presented below:

Goal II – Objectives	
A. Increase the public's level of awareness about watershed problems and management activities.	i. Develop and utilize existing outreach materials using messages and formats tailored to specific target audiences.
	ii. Provide hands-on, interactive learning opportunities focused on watershed concepts tailored to specific target audiences.
B. Increase the public's understanding of steps to take to improve water quality.	i. Ensure existing outreach materials focused on positive actions to improve water quality reach key target audiences.
	ii. Provide hands-on learning opportunities for key target audiences that address specific behaviors and pollutants of concern.
C. Produce measurable changes in the public's behaviors that negatively impact water quality.	i. Develop and utilize existing social marketing programs that target specific polluting behaviors in specific target audiences.
	ii. Conducting evaluations of outreach and social marketing activities to assess effectiveness over time.

Goal III: To promote and enhance recreational opportunities in the subwatershed

During the stakeholder workshops and community forums, 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", "Total Body Contact Recreation between May 1 and October 31", and "Navigation" are designated uses of surface waters that the MDEQ manages water resources to support. The communities would like to promote and enhance sustainable recreation in their watershed as much as practicable, but they recognize that this is a long-term goal that involves the implementation of this watershed management plan (WMP) as a whole.

The objectives for Goal III are:

Goal III – Objectives	
A. Increase opportunities for water-based recreation.	i. Educate the public about the potential dangers and health risks associated with water-based recreational activities.
	ii. Educate the public on watershed-based recreational opportunities in the subwatershed.
	iii. Increase recreational opportunities through additional programs / facilities and enhance public access to existing facilities.

Clinton River RAP Public Education Goals

Goal II and its associated objectives support the public education goals outlined in the 1998 Clinton River RAP, summarized below:

1: Ensure that information is accessible to the public;

2: Everybody should understand the watershed concept;

3: Educate the public about the positive and negative impacts that their actions have on the river;

4: The public will have a positive regard for the Clinton River, and understand progress in dealing with its problems;

5: Educate businesses about how they can become stewards of the river and the associated benefits;

6: Educate local government officials about what they can do to protect the watershed; and

7: Coordinate efforts to cleanup and enhance the watershed.

Social Marketing

Social marketing is the planning and implementation of programs designed to bring about social change using concepts from commercial marketing.

Source: SMI, 2006.

Fishing on the Clinton River: Goal III Aims to Promote This and Other Opportunities

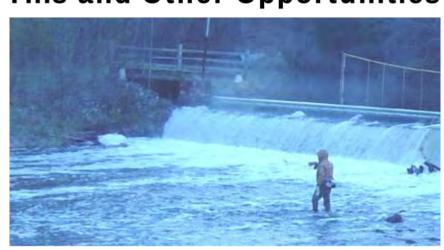


Photo courtesy of CRWC.

Creek Chub from the Healy Brook: Goal IV Aims to Protect Habitat for These and Many Other Organisms

Photo courtesy of CRWC.

Goal IV: To appropriately manage suitable habitat for aquatic life, wildlife, and fisheries in the subwatershed

During the stakeholder workshops and community forums, many people expressed a desire to protect and enhance terrestrial and aquatic wildlife populations. “Warm Water Fisheries” and “Other Indigenous Aquatic Life and Wildlife” are designated uses of surface waters that the MDEQ manages water resources to support. The communities rely on the successful implementation of this WMP to protect these designated uses. The objectives are:

Goal IV – Objectives	
A. Increase the amount of desired suitable habitat to support aquatic life, wildlife, and fisheries.	i. Identify high-quality habitat in need of protection.
	ii. Identify areas with habitat in need of restoration.

Combined and Sanitary Sewer Overflows

Minimization and/or management of sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) is a recognized problem and also a concern of the public. CSO and SSO control is not a part of this plan as these are addressed through other state permits and programs.

Goal V: To reduce runoff impacts through sustainable stormwater management

Based on historical and recent water quality and biological data, the communities recognize the contribution that stormwater runoff plays in deteriorating water quality. To address stormwater runoff the communities have established the following objectives:

Goal V – Objectives	
A. Reduce impacts from urban stormwater runoff.	i. Identify and implement best management practices to effectively manage quantity and quality of urban stormwater.
B. Reduce urban storm-water contributions leading to CSOs and SSOs.	i. Identify and implement best management practices to effectively manage quantity and quality of urban stormwater that will promote reduction of CSO and SSO frequency.

A Subwatershed Advisory Group Meeting: Continued Meetings and Action (Goal VI, Objective B) is a Key Making this Plan a Success

Photo courtesy of MCPWO.

Goal VI: To seek out opportunities to sustain implementation of the plan

For any plan to be fully implemented and sustained for the long-term, a funding source must be identified and the plan institutionalized. The objectives supporting this goal are:

Goal VI – Objectives	
A. Increase funding available for implementation.	i. Identify existing federal, state, and local funding opportunities.
	ii. Coordinate the development of grant proposals.
	iii. Create new opportunities for funding.
B. Institutionalize the plan and the advisory group.	i. Identify and adopt a mechanism for ensuring the advisory group continues its activities in the future.
	ii. Identify and adopt a mechanism for ensuring the plan is implemented, updated, and revised in the future.

Goal VII: To promote opportunities to preserve, protect, restore, and enhance natural features

Permittees would like to preserve, protect, restore, and enhance natural features as much as practicable through the implementation of sustainable land use practices and mitigation strategies. The permittees recognize that successful implementation of the WMP is needed to do this. The objectives associated with this goal are:

Goal VII – Objectives	
A. Protect existing high-quality natural features.	i. Compile an inventory of existing high-quality natural features for protection.
	ii. Identify and implement tools to protect inventoried natural features, such as ordinances and programs for managing natural features to benefit stormwater quality and quantity.
B. Restore important natural features.	i. Compile an inventory of natural features in need of restoration.
	ii. Develop plans and tools for restoration of natural features.
C. Enhance existing natural features.	i. Participate in local and regional efforts to promote green infrastructure.
	ii. Where feasible, stabilize stream banks where erosion is occurring and prevent stream bank failure in susceptible locations.

The Clinton River, its Streambanks, Riparian Corridor, and Associated Habitat: Examples of Natural Features to be Addressed through Goal VII

Photo courtesy of Tetra Tech.

Decision-making Principles

While there were numerous factors in play when developing the goals and objectives, a few of the important principles are summarized:

- Addressing permit requirements;
- Addressing other funding requirements;
- Addressing known water quality issues;
- Addressing the desires of the public;
- Addressing public concerns; and
- Supporting the goals and objectives of related plans.

Neither the goals nor the objectives have been prioritized. As the goals and objectives will be met through a wide variety of actions, the prioritization has been couched in the action plan presented in Chapter 8.

Supported Plans

As noted in Chapter 1 and reiterated in the 'Introduction' section of this chapter, this plan has been developed to be consistent with and support the Clinton River RAP, the Lake St. Clair Comprehensive Management Plan, and the WQMP for Southeast Michigan. Table 6-1 details the relationship of the goals of this plan to the Beneficial Use Impairments (BUIs) in the RAP (as determined by the Subwatershed Advisory Group – SWAG). Table 6-2 details the relationship of the goals of this plan to the goals of the Lake St. Clair Comprehensive Management Plan (as determined by the SWAG). The goals of the WQMP are too numerous to list here, but there is consensus among SWAG members that this plan supports the major themes present throughout the WQMP goals: protecting water quality; controlling pollution; the need for watershed-based, sustainable resource decisions; and public participation and education.

A Community Forum: Public Involvement and Education is a Tool that Can be Used to Address Many of the Goals and Objectives of this Plan

Photo courtesy of MCPWO.

Epilogue

This chapter defines the progress (in terms of goals and objectives) the SWAG would like to make towards improving their subwatershed. The information presented in the previous chapters has informed these choices through an adaptive management process (described in Chapter 1). If this process is continued throughout future planning efforts (e.g. plan updates), it is almost certain that the goals and objectives will change based on new data, completed actions, achievements, and other information.

The next chapter (7) lists a wide variety of the potential watershed protection tools, or actions, that can be implemented to realize the desired progress or, in other words, to achieve the goals and objectives.

Chapter 8 then presents the specific actions that have been chosen, indicates how these actions relate to achieving the goals and objectives, and defines the schedule for implementing the actions.

References

Social Marketing Institute [SMI]. Website. Via: http://www.social-marketing.org/. Last accessed: July 18, 2006.

Table 6-1. Relationship of WMP goals to RAP BUIs.

WMP GOAL	Clinton River RAP Beneficial Use Impairments							
	Degraded Fish and Wildlife Populations	Beach closings and other "full body contact" restrictions	Loss of fish and wildlife habitat	Restrictions on fish and wildlife consumption	Eutrophication or undesirable algae	Degradation of benthos	Degradation of aesthetics	Restrictions on dredging activities
I. To protect, restore, and enhance water quality of the subwatershed.	I	I	I	I	I	I	I	I
II. To educate the public on how to protect, restores, and enhance water quality.	I	I	I	I	I	I	I	
III. To promote and enhance recreational opportunities in the subwatershed.		I						
IV. To appropriately manage suitable habitat for aquatic life, wildlife, and fisheries in the subwatershed	I		D			I		
V. To reduce runoff impacts through sustainable stormwater management.	I	I	I	I	I	I	I	
VI. To seek out opportunities to sustain implementation of the WMP.								
VII. To promote opportunities to preserve, protect, restore, and enhance natural features	I		I			I	D	

D = WMP goal *directly* supports elimination of BUI; I = WMP goal *indirectly* supports elimination of BUI

Table 6-2. Relationship of WMP goals to Lake St. Clair Comprehensive Management Plan goals.

<table>
<tr><th rowspan="2">WMP GOAL</th><th colspan="10">Lake St. Clair Comprehensive Management Plan Goals*</th></tr>
<tr><th>1 – Pollution and Public Health</th><th>2 – Healthy Biological Conditions</th><th>3 – Water is safe for drinking</th><th>4 – Water is safe for swimming</th><th>5 - Fish and wildlife are safe to consume</th><th>6 – Sustainable Land Use</th><th>7 – Sustainable Recreation and Economic Activity</th><th>8 – Readily Available Information</th><th>9 – Collaborative Environ-metnal Protection</th><th>10 – Informed Public</th></tr>
<tr><td>I. To protect, restore, and enhance water quality of the subwatershed.</td><td>I</td><td>I</td><td>I</td><td>I</td><td>I</td><td></td><td></td><td rowspan="7">D - The required monitoring component of this plan , which is not a goal in and of itself, will generate data that will inform management decisions.</td><td rowspan="7">D - The purpose of this plan is to promote collaborative natural resource and environmental protection between all entities in the subwatershed.</td><td></td></tr>
<tr><td>II. To educate the public on how to protect, restores, and enhance water quality.</td><td>I</td><td>I</td><td>I</td><td>I</td><td>I</td><td>I</td><td>I</td><td>D</td></tr>
<tr><td>III. To promote and enhance recreational opportunities in the subwatershed.</td><td></td><td></td><td></td><td>I</td><td></td><td></td><td>I</td><td></td></tr>
<tr><td>IV. To appropriately manage suitable habitat for aquatic life, wildlife, and fisheries in the subwatershed.</td><td></td><td>D</td><td></td><td></td><td>I</td><td></td><td></td><td></td></tr>
<tr><td>V. To reduce runoff impacts through sustainable stormwater management.</td><td>I</td><td>I</td><td>I</td><td>I</td><td>I</td><td></td><td></td><td></td></tr>
<tr><td>VI. To seek out opportunities to sustain implementation of the WMP.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>VII. To promote opportunities to preserve, protect, restore, and enhance natural features.</td><td>I</td><td>I</td><td></td><td></td><td>I</td><td>D</td><td>I</td><td></td></tr>
</table>

* - full text of goals listed below
1 - Pollution does not threaten public health and the health of the watershed
2 - All biological communities and habitats are healthy, diverse, and self-sustaining.
3 - <complete>
4 - <complete>
5 - <complete>
6 - Land use activities are sustainable and support a healthy watershed.
7 - Recreations and economic activities impacting the lake are sustainable and support a healthy watershed.
8 - Data and information are available to ensure informed management decisions.
9 - All entities responsible for natural resources and environmental protection within the watershed are working together in a collaborative manner to protect and enhance the watershed.
10 - The public is informed about environmental issues and engaged in activities to restore and protect the lake.

D = WMP goal *directly* supports Lake St. Clair Comprehensive Management Plan goal
I = WMP goal *indirectly* supports Lake St. Clair Comprehensive Management Plan goal

7. Watershed Protection

Quotable Quotation

"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

SEMCOG Three-tiered Planning Approach

Tier I – those activities which can best be accomplished by local governments or other organizations.

Tier II – those activities which require groups of communities and agencies working together.

Tier III – those activities which require various subwatershed groups working together, including:

- Making subwatershed plans consistent;
- Coordinating and sharing information;
- Advising on funds distribution;
- Dispute resolution; and
- New mechanisms to address unresolved issues.

Source: SEMCOG, 1999.

Some of the action items in Chapter 8 can be classified as Tier I, but the development of this plan and most action items can be classified as Tier II.

Introduction

Achieving the goals and objectives presented in Chapter 6 requires many different tools. Primary tools focus on the protection and restoration of aquatic resources and include:

- Watershed Planning, Institutionalization, and Implementation;
- Public Education and Participation;
- Ordinances, Zoning, and Development Standards;
- Good Housekeeping and Pollution Prevention; and
- Stormwater Best Management Practices.

Additional tools necessary to meet the goals and objectives include:

- Natural Features and Resources Management; and
- Recreation Promotion and Enhancement.

Also, watershed protection requires monitoring of implementation and results to determine program effectiveness and guide changes to the plan. All of these aforementioned tools are discussed in the following sections.

Watershed Planning, Institutionalization, and Implementation

Watershed planning is a comprehensive tool that 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:

- Identification of problems, including a prediction of how water resources will react to future land use changes;
- Public input on desired uses within the watershed, including such topics as natural feature preservation and recreational opportunities enhancement;
- Goals and objectives, including meeting the designated and desired uses in the watershed;
- A plan to reduce or abate current and future problems;
- An action plan to select combinations of watershed protection tools for subwatersheds;
- Identification of the implementation and funding agents; and
- The framework for sustainable watershed management, including plan revision procedures (which rely on water quality monitoring)

Effectively implementing a plan requires a mechanism by which its actions are institutionalized and considered by all of the involved entities. This first tool, watershed planning, defines the actions which need to be institutionalized, including: public education and participation; ordinances, zoning, and development standards; good housekeeping and pollution prevention, and stormwater best management practices. Other actions to be defined during the planning process include those related to natural features and those targeting recreation.

The actions defined in a watershed management plan (WMP) need to be closely coordinated with other community programs. This ensures that changes to regulations and rules that impact watershed plan elements are supportive of the goals and objectives of the plan (SEMCOG, 2002).

Because watersheds are generally diverse in nature, and because the communities comprising the watershed have independent regulatory authority, these communities will determine which tools are appropriate for them (based on current water quality and land development levels) and apply them in ways consistent with their current regulatory structure.

Clinton River Basin Watershed Initiative

The Clinton River Basin Watershed Initiative (CRBWI) is a two-year effort intended to integrate existing Clinton River watershed information and generate easy-to-use tools that will promote coordinated decision-making and action. The goal of the CRWI is to give watershed stakeholders access to the information they need to identify and implement solutions that will improve, restore, and protect the Clinton River watershed. The CRWI will also produce an updated Remedial and Preventative Action Plan (RAP) for the Clinton River Public Advisory Council. The CRB-WI website is http://www.crwc.org/programs/watershedmgmt/crbwi/crbwi.html.

Public Education and Participation

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 participation in meaningful activities. Many programs are available to consider when selecting a method to promote watershed stewardship. The main targets for education and participation include: businesses, municipal employees, and the general public. Some agencies and programs that can provide assistance in this area are discussed below.

Agencies and Programs

Clinton River Watershed Council

The Clinton River Watershed Council (CRWC) is a non-profit organization dedicated to protecting, enhancing and celebrating the Clinton River, its watershed and Lake St. Clair. The council was formed in 1972 as an association of local governments under the authority of the Michigan Local Rivers Management Act of 1964. For more than 30 years, CRWC has served to coordinate the efforts of local governments, businesses, community groups and individuals in improving water quality, promoting innovative watershed management techniques, and celebrating the river as a natural and recreational resource. The CRWC wrote and is implementing the Public Education Plans (PEPs) for most of the communities in the subwatershed. The council's website can be found at http://www.crwc.org/.

Southeast Michigan Council of Governments

The Southeast Michigan Council of Governments (SEMCOG) is a regional planning agency in Southeast Michigan. SEMCOG plans in areas that cross jurisdictional boundaries in the Southeast Michigan region that encompasses Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne counties. SEMCOG supports local government planning in the areas of transportation, environment, community and economic development, and education. The council's website can be found at http://www.semcog.org/.

SEMCOG, partnering with other organizations through the 'Southeast Michigan Partners for Clean Water' program, conducts municipal training and heads up the 'Our Water. Our Future. Ours to Protect' campaign which includes: the 'Seven Simple Steps to Clean Water' materials, community involvement activities, and informational materials.

Clinton River Basin Watershed Initiative

Important products that will be developed through the CRBWI include:

- A Watershed Information Management System;
- A Clinton River Watershed Model; and
- A Site Evaluation Tool.

Important CRWC Programs

<u>Adopt-A-Stream</u>
A volunteer-based program that empowers community members to protect local streams and rivers by monitoring their health. Volunteers are teamed up, assigned sites, given equipment, data sheets and protocols, and sent out to gather information on streamside habitat and macroinvertebrate populations.

<u>River Day / Clinton Clean Up</u>
Days intended for river cleanup, celebration, recreation, and education throughout the entire Clinton River watershed.

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 at http://www.mtesp.org/.

Michigan Audubon Society

The mission of Michigan Audubon Society and local chapters is to instill in people an interest, knowledge, and appreciation of birds and other wildlife. The Audubon Society promotes sound conservation methods by helping restore wildlife habitat, helping prevent pollution, preserving outstanding wildlife areas, and educating the public. The society's website is http://www.michiganaudubon.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, 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/.

Southeast Michigan Sustainable Business Forum

The Southeast Michigan Sustainable Business Forum (SMSBF) is a resource for the development and implementation of sustainable business practices. It will promote practices through awareness of global trends, identification of best environmental practices, education and mentoring. The forum's website is available at http://www.smsbf.org/.

The Michigan Department of Agriculture

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

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.

Michigan's Biosolids Program

When treated and processed, sewage sludge ('biosolids') can be safely recycled and applied as fertilizer to sustain, improve, and maintain productive soils and stimulate plant growth. This 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.

Generally Accepted Agricultural and Management Practices

The various GAAMPs that have been developed can be accessed from the MDA's website by selecting 'Farming' → 'Environment' → 'GAAMPs' in the link list on the left-hand side of the page.

Silviculture

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

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. It is a restorative, sustainable management system that emphasizes a partnership with, rather than control over, nature. In organic farming the use of synthetic chemicals, genetically modified organisms, and ionizing radiation is prohibited. Such an approach enhances biodiversity, biological cycles, and soil biological activity to produce healthy plants and animals and foster human and environmental health. 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 organic products 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/deq/:

- Environmental Education - This section hosts and links to a variety of simple and dynamic information about the environment; and
- Surface Water: Nonpoint Source Program (NSP) - The NSP offers grants and technical assistance and develops information and educational materials to help protect and improve Michigan's water.

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/.

Specialized Programs: Youth Education

It is especially important to start educational activities when people are young so as to pave the way for watershed protection to become a societal value. Some sources of environmental curriculum schools are listed below Additional programs are presented in the sidebar.

Clinton River Watershed Council – 'Stream Leaders' Program

The Stream Leaders program is intended to provide students with an educational experience in water quality monitoring, data interpretation, and citizen action, as well as provide general information to local officials concerning water quality. First, students and teachers get in the river and examine the chemical constituents of the river, inventory physical stream-side conditions and land uses that may affect water quality, and sample the aquatic biological communities to evaluate the health of the river. Second, students and teachers analyze their data to locate any possible sources of pollution problems within the river. In the final part of the

Public Education Vehicles

The numerous potential public education messages can be disseminated in myriad ways. Some possibilities include: brochures, door hangers, maps, Websites, newsletters, kiosks, signs, posters, and point-of-sale education.

Additional considerations include: disseminating materials with municipal services (e.g. recycling bins, building permits), utilizing the Retired Engineer Technical Assistance Program (RETAP), and providing multi-lingual materials to capture the broadest possible audience.

Other Youth Education Programs

Macomb County – offers three programs for teachers

The Center for Improved Engineering and Science Education

Freshwater Wetlands Teaching Guide

Enviroscapes®

Izaak Walton League – American Wetlands Campaign and Save Our Stream Curriculum

North American Association for Environmental Education

USGS Water Resources Outreach Program

Yahara Watershed Education Network

Stream Leaders, students and teachers identify and complete a civic action project such as collecting and cataloging river, lake and beach debris, restoring degraded habitats, or making community presentations.

Adopt-A-Watershed

Adopt-A-Watershed (AAW) is a non-profit organization that promotes educational enhancement, environmental stewardship, and community development. AAW works with schools, youth education programs, community groups, and environmental organizations, guiding them through 'The 5-Steps to Leadership in Place-Based Learning'. The website is http://www.adopt-a-watershed.org/.

Center for Global Environmental Education

For over a decade, teachers, students, community leaders, and concerned citizens have come to Center for Global Environmental Education (CGEE) for inspired instruction and outstanding educational resources. CGEE's pioneering work in environmental education is grounded in the tradition of progressive learning that has been a hallmark of Hamline University's Graduate School of Education. The Center's strategic use of technology creates and supports global communities of learners committed to the stewardship of local environments. The center's website can be accessed at: http://cgee.hamline.edu/about_cgee/index.html.

Environmental Protection Agency – Office of Wetlands, Oceans, and Watersheds

This Environmental Protection Agency (EPA) office provides activities, projects, information magazines, and curricula on wetlands, water resources, ecosystems, watersheds, wildlife, and more. Links to educational resources produced by other organizations are also provided. The office's website can be found at http://www.epa.gov/owow/.

Earthforce Global Rivers Environmental Education Network

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

Michigan Department of Environmental Quality

The Michigan Department of Environmental Quality (MDEQ) has spent $1 million of the Clean Michigan Initiative funds 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 include: Air Quality, Ecosystems, Energy and Resources, Individuals' Impact on the Land, and Water Quality.

Additional information (classroom resources, grant opportunities, and speaker request forms) can be found at http://www.michigan.gov/deq/ under "Key Topics" → "Environmental Education".

United States Department of Agriculture

This website features links to wetlands information for middle and high school students. Links to education programs used in different states and programs produced by the EPA are also available. The website can be accessed by visiting http://www.usda.gov/ and selecting "Education and Outreach" from the 'Browse by Subject' menu.

Ordinances, Zoning, and Development Standards

Watershed protection requires employing a broad range of environmental protection planning and regulatory options at the local government level. The techniques, designed to minimize negative impacts of land use decision, can be used separately or in most cases together, to establish the amount of protection and effort a community is comfortable with. This effort can range from simply targeting peak flow reduction of stormwater runoff into waterbodies to attempting total watershed protection. The techniques that are selected need to be crafted with professional planning and legal assistance to fit each community and its natural resources.

The remainder of this section presents three levels of planning that need to be considered in watershed protection: 'Coordinated Planning', 'Zoning', and 'Advanced Regulation'. Coordinated Planning and Zoning are the most familiar options, but Advanced Regulation tends to provide the most powerful protection authority. These three levels are discussed in the following subsections, along with some additional considerations.

Coordinated Planning

The first step for a local government to protect its watershed is to prepare a future land use plan in cooperation with neighboring jurisdictions. Future land use plans (also known as Comprehensive Plans or Master Plans) should be based on a comprehensive inventory of natural resources and environmental features. Because the environment knows no jurisdictional boundaries, the most effective plans are developed when communities work together, as this prevents competing or incompatible actions. If one community along a river approves development in a floodplain, downstream communities are likely to be flooded. If one community on a lake adopts keyhole development regulations, but other communities abutting the same lake do not, then achieving the objective of preventing overuse of the surface of the lake is not likely to be achieved. If one community establishes a buffer zone around sensitive environmental areas, but abutting jurisdictions do not, then the benefits of the buffer zone will be limited. These examples demonstrate the importance of communities working cooperatively in the development of plans and the implementation of programs to protect our natural resources.

A future land use plan sets forth the desired pattern of land uses in the community for the next 20 to 30 years. It shows where agricultural and forest land should be retained and where new residences, commercial and industrial areas should be constructed. It creates the basis for planning for new roads, sewers and water infrastructure to meet the needs of the land uses displayed on the map. Future land use can work with nature, or against it. Communities can plan to keep development out of floodplains and population density low along waterbodies. Communities can plan to preserve greenbelts for wildlife and vegetation along waterbodies to help filter stormwater runoff and provide space for trees to shade streams, keeping them cold enough for sportfish like trout. By planning with nature, they can preserve the characteristics of nature that immeasurably add to our quality of life. Following is a list of key strategies that communities can follow in the development of local future land use plans to help protect the environment and natural resources for use and enjoyment by both present and future generations:

Environmental Protection Options for Local Governments

The MDEQ maintains a web site that hosts the document "Filling the Gaps: Environmental Protection Options for Local Governments". This document helps local governments sift through the maze of protecting the environment from a top down approach: applicable federal laws, applicable state laws, how these apply to various environmental features, and options for local governments authorized by federal and state law to protect the various environmental features.

The site can be accessed by going to http://www.michigan.gov/deq/ then selecting "Water", then "Great Lakes", then "Coastal Management". The document is listed in the "Information" section.

Source: MDEQ, 2006.

The Development Cycle

The actions under 'Ordinances, Zoning, and Development Standards' cover stormwater issues in the first two phases of the development cycle: land use planning and site design. Some stormwater management BMPs deal with the construction phase, where soil erosion is of primary concern. Many of the actions from the other categories focus on the final phase: home ownership and building occupation.

Wildlife Corridor

Source: RCRCD, 2005.

> **More on Zoning**
>
> An enforceable zoning ordinance requires that it be based on some type of plan for a given community, such as a land use master plan.
>
> ZONING OPTIONS
>
> Watershed-based Zoning – this is a zoning methodology designed to consider information presented in a watershed management plan (refer to www.stormwatercenter.net for additional information).
>
> Prescriptive Zoning – characterized by segregation of land uses into districts; includes very explicit standards and use exclusions.
>
> Mixed-Use Zoning – exemplified by the juxtaposition of different uses to reduce automobile dependence, preserve green space, and promote a sense of community.
>
> Incentive Zoning – a reward-based system to encourage development that meets established development goals.
>
> Performance Zoning – uses goal-oriented criteria to establish review parameters for proposed development projects in any area of a municipality.

- Prepare local future land use plans based on a comprehensive inventory of natural resources;
- Keep density and intensity of land use low near and along watercourses;
- Avoid developing in sensitive areas like floodplains, wetlands, environmental areas, sand dunes and high risk erosion areas;
- Plan for greenbelts and buffers along watercourses;
- Provide for links between natural areas so wildlife have safe corridors to move within;
- Protect renewable natural resources like farm and forest land in large blocks; and
- Set forth the specific zoning and other land use regulations that should be adopted to promote wise natural resource management and environmental protection.

The future land use plan provides the legal foundation for local land use regulations. If the community wishes to protect natural resources and the environment through local land use regulations, then it must have a basis for these regulations in the future land use plan and then adopt zoning and related regulations consistent with the plan. However, to realize the maximum benefit, communities must coordinate the future land use plan with the planning efforts of adjoining communities.

Zoning

Zoning is the principal local tool for guiding land use change in a community. Zoning classifies land uses into zones or districts generally on the basis of land use intensity ranging from "high" (e.g. industrial) to "low" (e.g. nature preserve) intensity. The range of intensity is based largely on environmental impacts and infrastructure needs of the land use. A zoning map illustrates the location of various zones or districts within a given jurisdiction. Within each zone, a range of land uses are permitted by right, or after some special review and approval process. The zoning ordinance establishes development standards for each mapped district. This includes the uses permitted, building height, bulk, lot size, setback, minimum yard and related standards. If the zoning ordinance has appropriate standards to protect our waterways and minimize harm to them as new development occurs, then not only the present generation, but also future generations will benefit.

Advanced Regulation

There are many regulatory options communities may consider in protecting the watershed. This section describes three regulatory options that are available to communities to better protect their local lakes and streams. These options are not mutually exclusive nor are they interdependent; communities could adopt some or all of the measures in the first option as well as some or all of the second or third options, or vice versa. Because of this flexibility and the potential complexity, it is important that properly trained planners and attorneys be involved in adapting sample ordinance language to a community's planning and regulatory structure. The options are discussed below:

- The first option is model ordinance language that specifically addresses stormwater management. These models could be adopted as overlay zones in the zoning ordinance, or as a separate ordinance that applies to development in particular locations, in addition to zoning;

- The second option is a series of brief ordinance provisions that address common natural resource and environmental protection concerns associated with stormwater management. These provisions are commonly found in zoning ordinances across the state; and
- The third option focuses on coordinating land use permit review and approval procedures between the MDEQ and local zoning authorities. This approach is based on refining the local site plan review procedure (as are some of the techniques in the second option).

Additional measures to consider are presented at the end of this subsection.

Option 1 – Adopt Model Ordinance Language Targeted at Stormwater

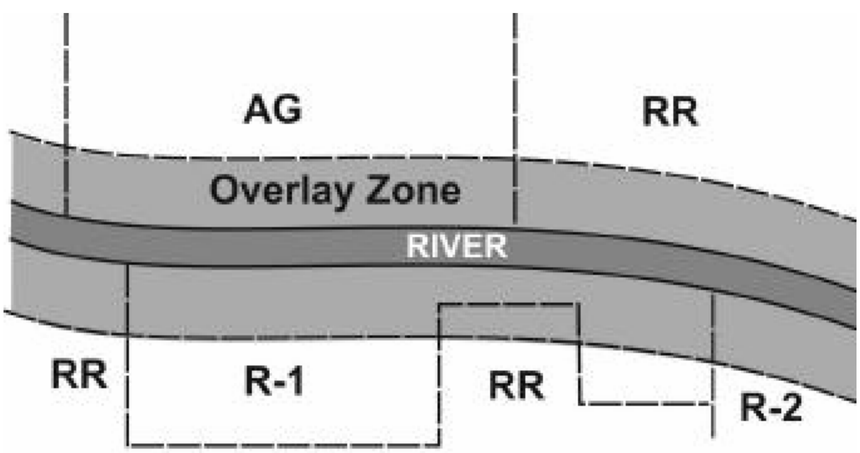
Separate statutory authority exists for local units of government to adopt regulations to protect the following natural resources:

- Wetlands;
- Environmental areas (e.g. sand dunes, submerged lands, forests);
- Soil erosion and sedimentation control;
- Inland lakes and streams;
- Natural rivers;
- Floodplains;
- High risk erosion areas; and
- Landmark trees.

The Michigan Department of Natural Resources (MDNR) in 1996, prepared model ordinance language to guide local governments in the preparation of ordinance language applicable to each of these natural resources – except for environmental areas. There are many variations of some of these models. All but the soil erosion and sedimentation model ordinance language is structured as an overlay zone.

An example of an overlay zone is illustrated in Figure 7-1. The letter designations in the figure refer to existing zoning types (e.g. AG = agriculture; RR = rural residential).

Figure 7-1. Example of an Overlay Zone.



Source: John Warbach, Planning and Zoning Center, Inc.

Macomb County Model Ordinances

The Macomb County Department of Planning and Economic Development (MCPED) has developed a number of model ordinances for use by local communities. The currently available model ordinances are:

- Storm Water Management;
- Floodplain Management;
- Wetlands Ordinance;
- Overlay District;
- Natural Feature Setback;
- Native Vegetation; and
- Woodlands and Trees.

Due to the initial success of this program, the MCPED is working with Southeast Michigan Council of Governments to further explore the implementation and application of the more pertinent ordinances.

The ordinances are available on-line at:

http://macombcountymi.gov/planning/index.html

Source: MCPED, 2005.

Macomb County Stormwater Standards

The Macomb County Public Works Office (MCPWO) is in the process of updating its design standards manual for the control of post-construction runoff from new development and significant redevelopment. The design standards are expected to be adopted in 2007.

Storm Water Center Model Ordinances

The Storm Water Center (www.stormwatercenter.net) has numerous model and example ordinances and other zoning and regulatory devices on the following subjects:

- Post-Construction Stormwater Management;
- Stream Buffers;
- Illicit Discharge and Elimination Program;
- Erosion and Sediment Control;
- Open Space Design;
- Operations and Maintenance for Stormwater Practices; and
- Groundwater Protection.

Source: SWC, 2006.

Floodplain Forest at River Bends Park: With Environmental Assessment, a Nearby Proposed Development Would Consider its Impacts on this Resource

Photo courtesy of Tetra Tech.

In an overlay zone, the special environmental provisions only apply in a limited area which is usually depicted on a map. For example, the floodplain regulations only apply to the area defined as a floodplain. This is usually an area that may be inundated by a flood with an average frequency of being equaled or exceeded once each 100 years.

Model ordinance language can be incorporated into a separate section or article of the local zoning ordinance or adopted as an independent police power ordinance. Cities, villages, townships, and, to a lesser extent, counties in Michigan have authority to adopt police power regulations. The public purpose of the regulation must be stated in the ordinance and must advance one or more aspects of the public health, safety and general welfare. Some communities adopt environmental regulations as separate ordinances outside of the local zoning ordinance in order to "shelter" the zoning ordinance from any legal attacks that may be directed at the ordinance. Should a court find that the community had adopted or was administering the ordinance improperly, the judge could invalidate all or part of the ordinance without in any way affecting or undermining the integrity of the local zoning ordinance. Another reason why some communities choose to adopt separate police power ordinances is because they do not have to protect nonconforming uses (unless the statute they are operating under specifically requires protecting them). A nonconforming use is one that pre-existed the zoning ordinance or an amendment to the zoning ordinance. Such a use is considered "grandparented" and is allowed to continue in the future in the same manner and to the same extent as it did when it became nonconforming. When nonconforming uses are not protected, then even without a proposed change to the property, it could be required to be brought into conformance with the new regulations.

Option 2 – Zoning Ordinance Provisions that Cover a Wide Range of Environmental Issues

Many local units of government are unwilling to take on the significant administrative responsibilities and potential liability associated with implementation of some or all of the model ordinance language described in the first option above. Nevertheless, they cherish protection of Michigan's environment and natural resources as much as the next community and want to do their part in ensuring it is protected. Short, simple approaches to environmental and/or natural resource protection are presented below and in the dialog boxes on this and the following page.

Environmental Assessment Requirements

When projects are proposed in or adjacent to sensitive natural resources, some communities require applicants to submit an environmental assessment which details the impact of the proposed development on natural resources. Communities that have plans and zoning regulations based on a solid environmental inventory are able to set the threshold for future environmental assessments at a defensible level. Without such a basis, an environmental assessment may be considered arbitrary as there is little context for the requirement. An environmental assessment can be a valuable source of information, and in some cases an important tool for ensuring that new development is designed in such a way that unavoidable environmental impacts are properly mitigated. Environmental assessments can also be viewed as an affirmative tool for helping a local government meet its responsibility for preventing pollution, impairment or destruction of the environment.

Shoreline Protection Provisions

More refined shoreline provisions may address a host of other environmental protection issues such as the application of fertilizers or weed killers in near shore and stream bank areas, the trimming of shoreline vegetation for views, prohibitions on removal or replacement of natural shoreline vegetation with grass or ornamental landscaping, or requiring restoration of damaged natural vegetation on stream banks. These regulations tend to vary dramatically across the state, but for the most part, provide some measure of protection from overuse or removal of natural vegetation near the shore. These may also be called buffer strip or greenbelt provisions.

Groundwater Protection Standards

The Michigan Department of Public Health and MDNR, and more recently the MDEQ, have widely collaborated with hundreds of Michigan communities to develop and implement groundwater protection standards as a part of the local site plan review process. In most cases, communities adopting sample ordinance language also included standards to ensure protection of surface waters from land uses that had the potential to pollute, impair or destroy soil and water resources. These standards have many parallels to stormwater protection and the cooperative effort between the state and local governments on this issue has piloted the way for continuing this approach on a wider scale. Groundwater protection standards are fundamental public health and safety measures that should be adopted by local governments throughout the state.

Sensitive Area Protections

Instead of targeting specific natural resources for protection by means of a single regulatory approach, many communities have folded basic separation distances (setback provisions) into sensitive area or natural features provisions. These regulations list a set of sensitive areas or natural features in the community and require that all new structures or intensive use areas of the proposed development be set back at least a certain distance from the identified natural feature. Such provisions have been applied to shoreline, waterfront, floodplain, wetland, woodland, sand dune, and high risk erosion areas. Because of a Michigan Attorney General opinion (No. 6892, March 5, 1996) that says setbacks from wetlands may not be required under a wetland ordinance, but may be required if properly crafted as part of a zoning ordinance regulating natural features, it is important for communities to be very careful about how natural features are defined and how such regulations are crafted. In some ordinances these provisions are called buffer strip or greenbelt provisions.

Planned Unit Developments and Cluster Developments

Planned unit developments (PUDs) and cluster developments are forms of land design that usually focus on integration of the natural features of a site with the new development to be constructed on the site. Most PUDs are largely residential, although increasingly they are mixed use–usually commercial and residential. The combination of a golf course with a residential subdivision or site condominium is the most common form of PUD in Michigan. Commercial, office and industrial PUDs are also becoming common, especially in urban and suburban locations along

Riparian Buffer

Source: Sygenta, 2005.

Macomb County Natural Features Inventory

The Macomb County Maps page at

http://macombcountymi.gov/GIS/Maps.asp

has many resources that may be useful for local planning efforts. The page has links for a wetland indicator map, watershed boundaries, and the Macomb County Natural Features Inventory Report and Map.

The Macomb County Natural Features Inventory is a resource that documents and prioritizes local potential conservation areas and natural areas.

freeways. In suburban and rural Michigan, PUDs are increasingly designed around a sensitive natural feature like a small pond or wetland. Good design with a large natural vegetation buffer area around the sensitive resource can result in its protection as an asset to the PUD.

A cluster development is a form of PUD that is usually exclusively residential and surrounded by large amounts of open space. An example of a conventional subdivision compared with a cluster development is shown in Figure 7-2.

Figure 7-2. Conventional subdivision compared to cluster development.

(a) Conventional Subdivision **(b) Cluster Development**

Recent amendments to Michigan's zoning enabling acts require many communities to adopt cluster development provisions that permit projects with at least 50% open space in townships and counties and 20% open space in cities and villages by "right" (i.e., without any special review and approval process). Communities can define what constitutes permissible open space, but it cannot include land in a golf course. See for example MCL 125.286h in the Township Zoning Act, MCL 125.584f in the County Zoning Act, and MCL 125.584f in the City-Village Zoning Act.

The combination of a PUD and cluster development can be a very effective way for communities to permit some development in areas with sensitive natural resources without seriously undermining the integrity of the natural features. This takes careful design, attention to mitigation, good site plan review standards and experienced professionals reviewing the proposed site plans to get the best result. There are many different sample PUD and cluster development ordinances in use throughout Michigan.

Site Plan Requirements / Better Site Design

Next to placing land into various zoning districts, site plan review is the most powerful planning and watershed protection tool. Easily enforced, site plan review is a way for communities to ensure what is approved on a site plan is what will be built. A site plan is a plan, drawn to scale, showing the layout of proposed uses and structures. Site plans include lot lines, streets, building sites, existing structures, reserved open space, utilities, and any other required information. The Center for Watershed Protection (www.cwp.org) and the Low Impact Development Center (www.lowimpactdevelopment.org) can provide additional information.

Communities can require a number of sustainable development best management practices such as landscaping standards, use of native plant species, on-site stormwater best management practices, percentage of allowable impervious coverage, and a host of other environmental design considerations through the use of site plan requirements and reviews.

Most ordinances automatically call for site plan review of industrial, office, commercial, and multi-family uses. But communities can require that other uses, even uses allowed by legal right, go through a site plan review.

For example, proposed single family home construction in areas where wetlands, critical habitat, or other unique natural features exist can be regulated to protect these features through the site plan review process. Communities can also adopt provisions addressing preservation of mature trees, preventing light pollution, and other design mechanisms which in turn protect community character.

For environmental, as well as aesthetic concerns in a community, site plan review (of both drawings and written requirements) is one of the best overall zoning tools that can be implemented by local governments. Site plan requirements are a good way of eliminating any development "surprises" and also serve as a mechanism for working with a community's natural features.

Option 3 – Coordinated Permit Review and Approval Procedures

An effective way to combine the strength of local zoning with the weight of state environmental permitting and enforcement is for local governments to coordinate zoning decisions with the MDEQ and MDNR when sensitive natural features are involved. When local governments have appropriate, but limited environmental protection standards in the zoning ordinance, they can condition final development approval on receipt of necessary permits from the state government. This type of coordinated review and approval process helps ensure key environmental and natural resources are protected as new development occurs. Many communities have informally been working with the MDEQ/MDNR this way for years. In some cases, more formal coordinated review procedures are desirable and can be beneficial to all involved parties. One form for such an agreement is a memorandum of understanding that spells out state and local responsibilities.

This approach is possible because all three zoning enabling acts permit local governments to condition approval of zoning permits generally and site plan review specifically, on approvals under statutes administered by other governmental agencies (see for example MCL 125.286e(4) and (5), the Township Zoning Act; MCL 125.216.e (4) and (5) of the County Zoning Act and MCL 125.584d (4) and (5) of the City-Village Zoning Act).

This approach is especially desirable because local governments can be additional "eyes and ears" for natural resource protection, while leaving the environmental permit and enforcement decisions to the state agencies that have the technical wherewithal, the statutory responsibility and the

Better Site Design Options

Some options for better site design include:

- Decreased number of parking lots;
- Providing compact car parking spaces and minimizing stall dimensions;
- Encouraging shared parking;
- Minimizing required street pavement width based on need to support travel lanes, street parking, and emergency, maintenance, service vehicle access;
- Optimizing street layout to minimize total roadway length;
- Minimizing required street right-of-way widths to accommodate travel-way, sidewalk, and vegetated open channels;
- Minimizing the number of street cul-de-sacs and reducing cul-de-sac radius to accommodate emergency and maintenance vehicles;
- Considering alternative turnarounds, including the use of mountable curbing and grass shoulders for occasional access by fire trucks and other large commercial trucks;
- Promoting flexible design standards for residential subdivision sidewalks such as locating sidewalks on only one side of the street and providing common walkways linking pedestrian areas; and
- Relaxing side yard setbacks and allowing narrower frontages to reduce total road and driveway lengths within the community.

Small Towns and Rural Townships

Small towns and rural townships rarely have the kind of professional staff available to perform a thorough technical review of all the complex elements of many contemporary development proposals. Everything from issues associated with stormwater retention, sewage disposal or water supply, or the impacts on wetland species from partially filling a wetland for an access road, may be beyond the scope of local zoning staff. In these cases, a community needs to hire outside professionals to perform reviews of development applications to ensure conformance with ordinance requirements. Communities are often unwilling to hire outside experts because they don't want the cost to be borne by existing taxpayers. A recent appellate court decision has demonstrated that a community can collect fees in escrow to pay for the cost of professional reviews, provided the community has a provision enabling such fees in its zoning ordinance, and it returns to the applicant any unused fees (see Cornerstone Investments v. Cannon Township, 459 Mich 908 (1998); after remand, 239 Mich App98, 1999). This ruling means no community need go without the professional expertise necessary to ensure a project meets ordinance requirements.

ability to absorb any liability for the decisions made. For small and rural communities especially, these are huge considerations. In the end, development proposals that do not meet both state environmental standards, and local zoning standards are not approved. Projects whose site plans do meet the standards of both local zoning ordinance and state regulations must be approved.

Additional Measures to Consider

Four other common zoning techniques that have significance as regards to certain decisions affecting natural resource and environmental protection are presented below.

Nonconforming Uses

Uses of land that pre-date the zoning ordinance or an ordinance amendment that no longer comply with zoning regulations are called nonconforming uses. Essentially, these uses are protected from changes created by new zoning regulations. Local governments are permitted to restrict or prohibit expansion or structure additions of nonconforming land uses or structures, with the long-term goal of eventually phasing them out. In riparian areas, local planning officials have an opportunity to address the rapidly changing dynamic of their shoreline through the manner in which nonconforming uses are regulated. For example, if a nonconforming structure exists on a property and is demolished, a new structure cannot replace it without conforming to the current zoning or other applicable regulations. This situation has become increasingly common in recent years as small coastal cottages are torn down and replaced by much larger single family or multifamily dwellings. This presents an opportunity to gain conformance with ordinance requirements, which should be sensitive to watershed protection considerations.

Rezoning

The process of changing from one zoning district classification to another is called rezoning. The most fundamental question which must be asked regarding a rezoning request is whether the area proposed to be rezoned is an appropriate area for the permitted uses in the proposed zone. Typically, rezoning requests are made for the purpose of increasing the intensity of the use of a parcel. In riparian areas, where there are significant, fragile natural features such as critical habitats and wetlands, rezoning from a low-intensity use classification to a high-intensity use classification could have significant ecological impacts.

Special Land Uses

Special land uses, also called conditional uses or special exception uses, are uses of land that are allowable within a particular zone only when the proposed activity meets a defined set of standards that are particular to that use and are included in the zoning ordinance. Site-specific issues can be addressed using these designations as opposed to the more general considerations typical of a zoning district.

The dominant land use in a district is usually a use "by right", such as farmland in an agricultural district. Special use provisions can provide communities with the opportunity to control certain activities not allowed "by right", but commonly associated with "by right" uses. Typical special land uses include communication towers, churches, junkyards, private airfields, etc.

Marinas are another type of activity that can be controlled through special land use permits. A community can establish provisions for dock length, number of allowable slips, types of boats, setbacks, and a number of other environmental considerations. By defining special use standards for such activities, local governments can determine what type of marina will be allowed in their community prior to development. Special land uses often prompt concerns from the public regarding potential effects on surrounding property values, traffic, noise, litter, and neighborhood character. It is very important for planning officials to consider if a special land use is consistent with the character of the area and is also consistent with the future land use element of the master plan before permitting them.

A Marina

Photo courtesy of Tetra Tech.

Variances

A variance is a legally granted action to waive a requirement in a zoning ordinance. If a community grants a variance, it permits one property owner to do something that is otherwise not permitted in the zoning ordinance. As a result of the zoning enabling acts, most zoning ordinances and court cases have a very narrow set of circumstances that must exist before a variance can be lawfully granted. In most cases, if a property owner can use the land for the desired use, or place a structure or addition elsewhere on the land without a variance, then the variance is not appropriate. As is apparent, the improper granting of a variance can quickly undermine the integrity of the zoning ordinance. This is even more consequential when the variance has the effect of undermining the integrity of natural resources. In general, if communities adopt zoning measures to protect natural resources and prevent pollution, impairment or destruction of the watershed, they should consider variance requests very carefully and only grant them when not doing so would preclude the land owner from otherwise exercising a lawful property right. Even then, the community should consult with environmental professionals and attorneys familiar with zoning and environmental law.

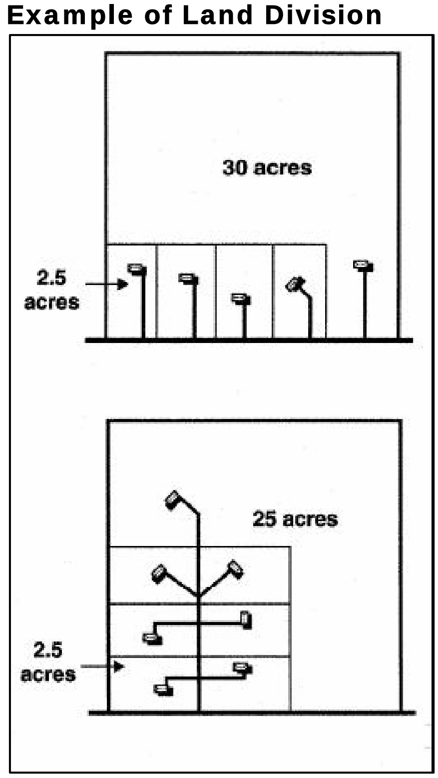
Land Division and Subdivision Ordinances

Two of the local regulatory tools with the greatest potential to minimize harm in sensitive environmental areas are regulations that apply to land divisions and subdivisions. These are usually two separate ordinances that are linked to the zoning ordinance, but because the authority for them derives from a statute different from the zoning enabling acts, they are adopted as separate ordinances. The first is usually known as a land division ordinance. The second is usually called a subdivision or plat ordinance.

Land Division Ordinance

A land division ordinance may be adopted by a local unit of government pursuant to Section 109 of the Land Division Act, Public Act 288 of 1967, as amended (MCL 560.109). A land division ordinance regulates the creation of lots and bounds splits of a parcel of land. Refer to the figure on the left for an example of land division. A statutory formula in Section 108 specifies the maximum number of splits that are permitted from a "parent parcel" without platting. Bonus lots are permitted for shared access and preservation of open space. Minimum standards for lot size, width-to-depth ratio and relationship to access are provided by statute. All parcels splits smaller than 40 acres in size are required to be reviewed and

Example of Land Division



Source: John Warbach, Planning and Zoning Center, Inc.

A Subdivision being Constructed: Woodberry Estates

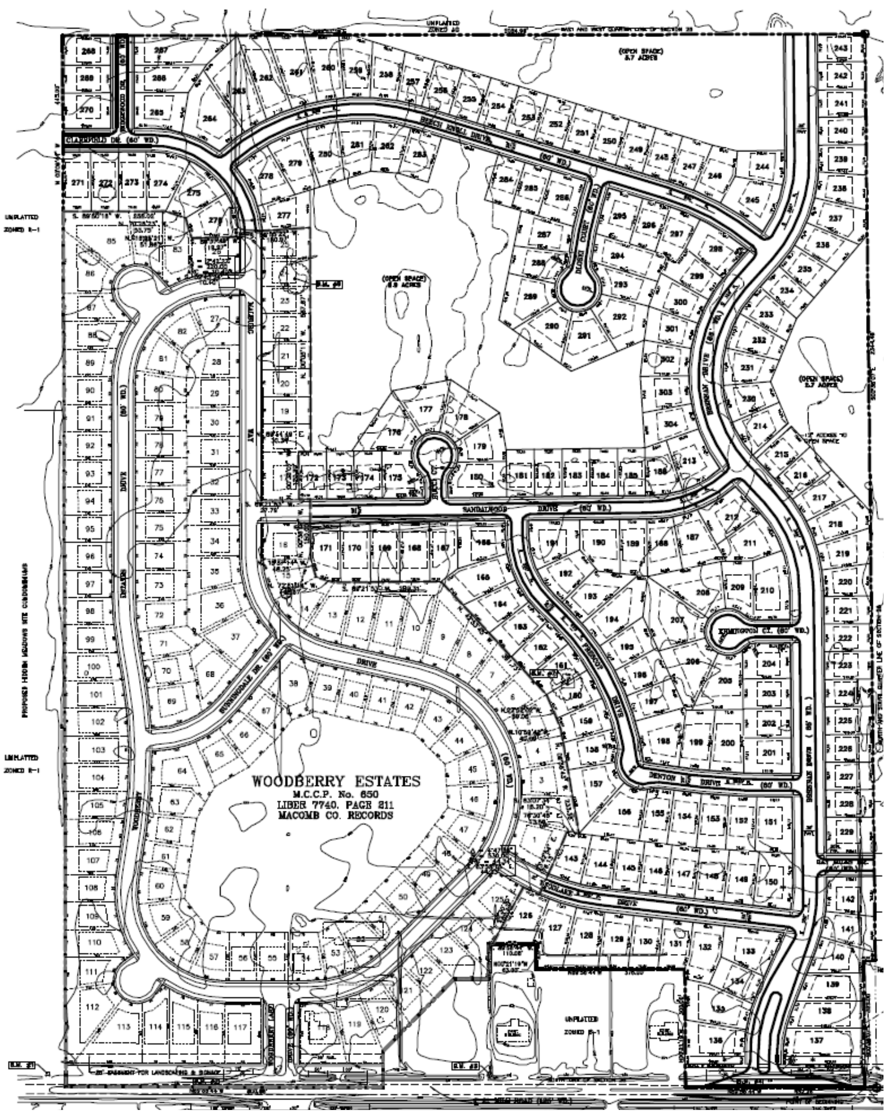
Photo courtesy of Anderson, Eckstein and Westrick.

approved locally before they can be recorded with the county register of deeds. Land divisions being created must also conform to local zoning regulations, provided those regulations are not in conflict with the land division provisions of the Land Division Act.

Subdivision Ordinance

A subdivision ordinance is adopted by a local unit of government to regulate the creation of more splits than are permitted under the land division provisions of the Land Division Act. Refer to the figure on the left for an example of a subdivision. Section 105 of P.A. 288 of 1967, as amended, provides authority for the adoption of local subdivision ordinances. Developers of platted subdivisions are required to put in public infrastructure such as paved streets, curb, gutter, stormwater, sewer and water pipe, unless exempted by local ordinance. Lots being created must also conform to local zoning regulations, provided those regulations are not in conflict with the platting provisions of the Land Division Act.

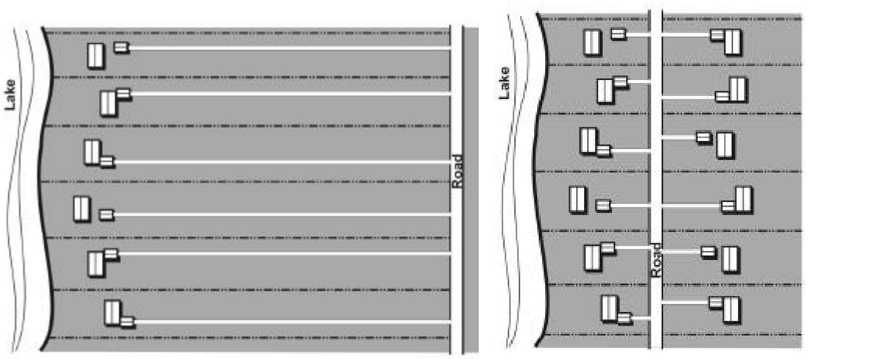
A Subdivision: Woodberry Estates in Macomb Township



Courtesy of Anderson, Eckstein, and Westrick

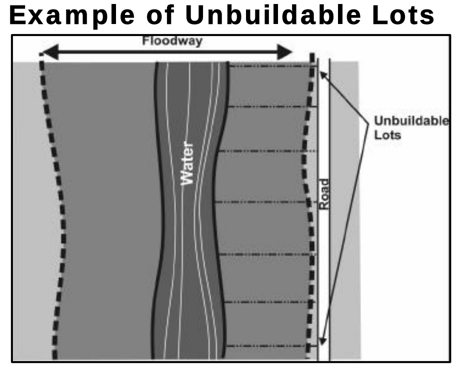
The primary environmental issues associated with land divisions and plats relate to lot width, depth, area, access and "buildability". Proper review and approval of land divisions and plats can dramatically reduce future problems associated with use of the lots. The process is similar to site plan review described earlier, except that in the case of plats, there are many statutorily required reviews by different entities, including the local government, the county road commission, drain commissioner, Michigan Department of Transportation (MDOT), and MDEQ, depending on the location and characteristics of the parcel being platted. For example, deep narrow frontage lots along shorelines will often result in long driveways and many structures close to the water. This often translates into considerable impervious surface and water runoff which can carry pollutants, nutrients and warm water into the lake, river, stream or pond. Shallow lots also often have considerable impervious surface and leave little room to site a structure farther from the shoreline. This may be critical in the case of a high risk erosion area, wetland, or floodplain. See Figure 7-3 for a comparison of long and short, narrow waterfront lots.

Figure 7-3. Long narrow vs. short narrow waterfront lots.



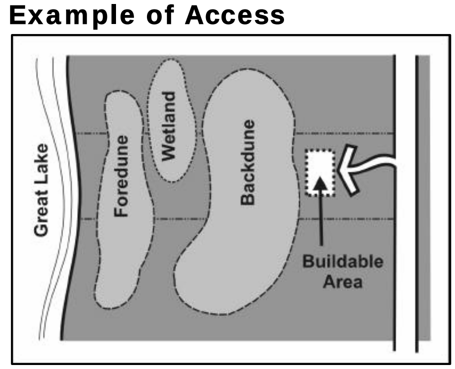
Source: John Warbach, Planning and Zoning Center, Inc.

Example of Unbuildable Lots



Source: John Warbach, Planning and Zoning Center, Inc.

Example of Access



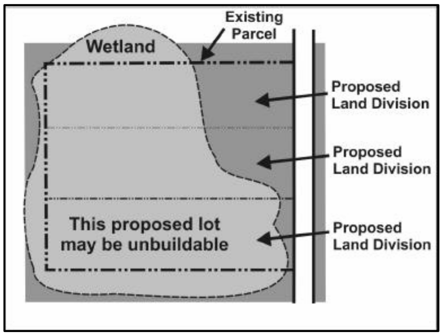
Source: John Warbach, Planning and Zoning Center, Inc.

A parcel size between the two types is more desirable, especially if each lot is wider along the lake. This will result in less impervious surface and adequate room to locate a structure outside of a floodplain.

Total area is a function of lot width and depth, so if one or both are short, then the total area of the parcel will often be small, leaving few options to mitigate potential environmental impacts, such as trying to avoid siting structures in a floodplain.

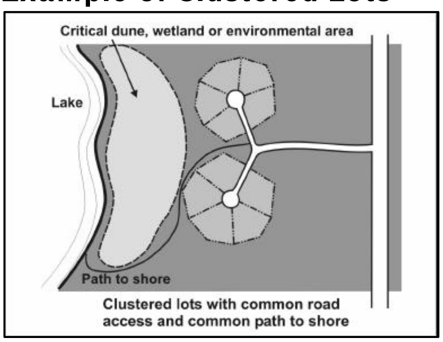
Access is an issue linked to connecting a driveway between a structure and the public or private road leading to the lot. Especially on long narrow lots, such as those in a designated environmental area, it may be difficult to site an access road without seriously and negatively impacting the sensitive natural features in the area. "Buildability" relates to the issue of whether a proposed lot of a certain size and shape results in an area of land on which a permanent residence or other structure may be built under existing environmental regulations. For example, a proposed land division of a parcel that is largely wetland and that includes no high ground, may have no place on which a residence and a septic field could be legally sited. Approval of such land divisions undermines the integrity of the environment, of environmental enforcement and sets up multiple governmental agencies for potential takings claims. On the other hand, ensuring that a lot is "buildable" under all applicable regulations prior to

Example of Buildability



Source: John Warbach, Planning and Zoning Center, Inc.

Example of Clustered Lots



Source: John Warbach, Planning and Zoning Center, Inc.

Drawing of Clustered Lots

Source: NCSP, 2005.

approval, not only protects the environment, but also plays an important consumer protection function—people can buy a lot that is "buildable". Unfortunately, the land division provisions of Section 109 of the Land Division Act can be read to prohibit a community from denying approval of a proposed land division on the environmental regulations. As a result, many communities feel obliged to approve such land divisions, but then file a notice with the County Register of Deeds that such a lot does not conform to other applicable regulations. If it were purchased for a building use, such as for a residence or business, the land division request would be denied. This is a very awkward way to protect the consumer, but appears to be the only lawful way to do so under Section 109. Michigan appellate courts have upheld a township zoning regulation prohibiting counting unbuildable area on a site due to wetlands when calculating permitted density. See Frericks v. Highland Twp. 228 Mich App 575, appeal denied, 459 Mich 66 (1999).

The best proactive measures a community can take to prevent the creation of lots that do not undermine the integrity of the environment and are "buildable", are listed below:

- Adopt and consistently administer land division regulations;
- Adopt and consistently administer subdivision regulations;
- Try to persuade landowners who propose to create "unbuildable" lots not to do so. If unsuccessful, file a notice with the County Register of Deeds that runs with "unbuildable" parcels that informs purchasers of the unique status of such lots; and
- Put provisions in the shoreline district provisions or shoreline overlay provisions of the zoning ordinance which:
    - Require wide and deep lots with shared access; or
    - Ensure lots are clustered with all the common open space along the shoreline, sensitive environmental areas are avoided and all access is shared.

Public Spending and Capital Improvement Programs

Another important way to protect sensitive natural features is to watch how, where and when the public spends money on public facilities. Where new public facilities are constructed and where they are not can have profound effects on natural resources. The extension of sewer and water lines into a sensitive environmental area or the construction of a new road along a large wetland will have significant long term impacts–many of which could be negative. At the same time, the construction of a sewer line around an inland lake being contaminated by leaking septic tanks can help restore water quality in the lake. Communities that work with nature avoid creating the conditions which promote intensive development in areas with a large area of sensitive natural features.

Large capital improvements should be planned to meet future needs and should be based on the future land use plan or master plan–just as zoning should be. When the master plan has a solid foundation on a natural features inventory, future land uses will be planned in locations to avoid negative impacts on sensitive natural features. Subsequently, future capital improvements will then be located to accommodate needed community growth in locations that don't negatively affect sensitive natural features. The best tool for planning for future public improvements is the capital improvement program (CIP). This is a schedule of proposed capital improvements for future years. It specifies where the facilities are proposed to be located, what their cost will be, the means of financing and when they will be constructed. Each year the CIP is updated. This process permits plenty of time to examine the CIP for its environmental friendliness and to ensure that public investments aid, rather than diminish, the quality of local natural resources.

Good Housekeeping and Pollution Prevention

Storm Sewer Outfall w/ Dry Weather Flow – *possible illicit discharge*

Watershed protection requires that actions be taken to minimize the environmental exposure of pollutants. These actions include preventing the generation of potential pollutants, implementing procedures to ensure that existing compounds are handled and disposed of in such a way that they never become pollutants, and inspecting infrastructure that handles pollutants to ensure it is working correctly. Some examples for which pollution prevention and good housekeeping apply include: the storm sewer system (including illicit discharges), the sanitary sewer system, municipal facilities, managed and manicured turf, solid waste management facilities, commercial facilities (e.g. chemical spills), and septic systems.

Some agencies and programs that can provide assistance in this area are discussed in the following subsections.

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 (e.g. nitrate testing, sprayer tips, rotational grazing, backflow devices, manure testing, spill kits) for pesticide and nitrogen fertilizer users. The MGSP helps 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 financial and technical constraints which guide decision making. The following programs are administered through the MGSP:

*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.

*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.

*Crop*A*Syst*

Crop*A*Syst is an assessment tool that helps develop and implement a management plan that prevents contamination of groundwater and surface water resources and maintains economic crop production. Just like Farm*A*Syst, the Crop*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. Stewardship Teams determine local cost-shares, which are often as high as 75 to 90 percent of the total cost.

MDEQ – Water Programs

Information on the following programs can be obtained through the MDEQ's website at http://www.michigan.gov/deq/.

Biosolids & Industrial Pretreatment

Biosolids & Industrial Pretreatment Program

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

Drinking Water

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 abandoned wells, drinking water well contamination, and oversees remedial activities at sites of groundwater contamination affecting drinking water wells.

The Michigan Wellhead Protection Program

This program assists local communities utilizing groundwater for their municipal drinking water supply systems in protecting their water source.

Spill Response

While the MDEQ is generally responsible for implementing spill response activities for the waters of the state, the U.S. Coast Guard has the primary responsibility for spills on Lake St. Clair and in the nearshore area of the lake.

Emergency Response

Emergency Response

The MDEQ operates the Pollution Emergency Reporting System (PEAS), a unified 24-hour hotline for reporting environmental emergencies, including those related to the twenty-six state and federal regulations requiring chemical release notification. The MDEQ is also 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.

Groundwater Discharge

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 Modeling

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 groundwater models for site remediation.

Inland Lakes & Streams

Inland Lakes and Streams

The State's water resources are monitored by the MDEQ 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.

MDEQ/USACE Joint Permit Application

"Joint Permit Application"

This package covers permit requirements pursuant to state and federal (MDEQ and USACE) rules and regulations for construction activities where the land meets the water and including wetlands, often referred to as the land/water interface.

Surface Water

The MDEQ is committed to protecting and preserving Michigan's water resources. There are numerous programs supporting this goal, including:

Enforcement

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.

NPDES Permits

The MDEQ administers the federal NPDES permitting program at the state level. This program restricts pollutant discharges to waterbodies and sets strict effluent concentration and loading limitations on those facilities that must discharge to waterbodies, such as waste water treatment plants.

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.

Septage

The MDEQ enforces rules for the handling of domestic septage and licenses the haulers wishing to do so. The program provides technical assistance as well as contacts for staff, haulers, and end-users.

Sanitary and Combined Sewer Overflow

The MDEQ has broad regulatory authority to deal with SSOs and CSOs. The SSO/CSO program includes setting policy, reporting occurrences, and initiating enforcement actions against offending entities.

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.

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.

MDEQ – Other Programs

Land Development: On-Site Sewage Disposal Systems

The MDEQ has promulgated rules for on-site sewage disposal systems (OSDS) as they apply to the Land Division Act. The MDEQ also issues numerous reports regarding the status of OSDS in the state and provides technical assistance.

Waste and Hazardous Materials Division

The Waste and Hazardous Materials Division (WHMD) administers a diverse number of prevention programs to protect the environment and the public's health through proper management of hazardous products; solid, liquid, medical, and hazardous waste; and radioactive materials.

The Michigan Department of Transportation

Information on the following programs can be obtained through the MDOT's website at http://www.michigan.gov/stormwatermgt/.

Educational Materials

MDOT provides educational and outreach materials that describe how pollution prevention and good housekeeping can be implemented on transportation, and related, structures. Available information includes the types of BMPs that can be implemented on or near roads and car care tips to prevent pollution.

Drainage Manual

The MDOT Drainage Manual defines specific practices and the standards thereof that are implemented to minimize the pollutant-related impacts of transportation infrastructure.

Stormwater Best Management Practices

As described by the US EPA, stormwater nonpoint source pollution diminishes water quality in the United States. To reduce the impact, it is important that watershed protection measures include examination of best management practices (BMPs) used to reduce the amount of pollution 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:

Soil Erosion and Sediment Control

Good soil erosion and sediment control (SESC) is a critical watershed protection tool that protects surface waters from the effects of sedimentation, flooding, and other property damage. SESC can be divided into two distinct components: construction related and non-construction related.

Construction Related SESC

Although construction related SESC is not a requirement of the Watershed-based Permit, a brief discussion is warranted.

In the State of Michigan, county enforcing agents (CEAs) are authorized under Part 91 of Public Act 451 to require that a permit be obtained for any land disturbance greater than 1 acre or within 500′ of a waterbody (except for exempted crop production practices). Authorized Public Agencies (APAs) are exempt from obtaining a permit, but must notify the appropriate enforcing agency in advance and must follow the SESC guidelines stipulated in the Act.

The MDEQ, through Part 31 of Public Act 451 (a.k.a., 'Permit by Rule'), 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).

Persons engaged in agricultural practices may enter into an agreement with the conservation district instead of obtaining a permit from a CEA or MEA.

Additional information can be obtained from:

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

Silt Fence for Sediment Control

Courtesy of MCPWO

Cross-Jurisdictional Enforcing Agent
MDEQ, Water Bureau

County Enforcing Agents
Macomb County Public Works Office (MCPWO)

Authorized Public Agencies
Various State of Michigan Depts. (MDEQ, MDOT, etc.)
MCPWO
Road Comm. of Macomb County

Municipal Enforcing Agencies
City of Fraser
City of Sterling Heights

Conservation District
Macomb Conservation District

BMP Resources

Additional resources for stormwater BMPs include:

- The Stormwater Manager's Resource Center's *BMP Fact Sheets* (www.stormwatercenter.net).
- *Stormwater Management Guidebook*. Menerey, B.E., et al. (1999). MDEQ Land and Water Management Division;

(continued on following page)

Non-Construction Related SESC

This type of SESC includes any activity that is not undertaken in relation to an active construction site. General activities of non-construction SESC include:

- Repairing bare soil such as occurs on poorly maintained yards or eroding hillsides;
- Repairing and stabilizing stream banks that are eroding;
- Repairing roads and associated transportation structure that are eroding or causing nearby erosion;
- Excluding sensitive uses from occurring near waterbodies, especially within the riparian corridor;
- Insuring sediment generating sites install proper controls to prevent sediment from leaving the property;
- Providing controls in sensitive areas to ensure that sediment is not transported by wind;
- Installing structural controls at inlets to, or inside of, the storm sewer system to ensure sediment does not travel to receiving waterbodies; and
- Encouraging the implementation of agricultural runoff BMPs that prevent soil particles from traveling to nearby waterbodies.

Many other techniques, such as street sweeping, may be considered non-construction SESC. Many of these techniques have been included under other headings (e.g., street sweeping is considered pollution prevention).

Impervious Surface Mitigation

Impervious surface mitigation is a broad category comprised of practices designed to directly reduce impervious surface and/or treat the runoff from impervious areas. Some of these practices have the characteristics of the practices discussed in the following subsections ('Infiltration Practices', etc.) This category focuses on retro-fit implementation, but the practices herein can be implemented on new development and/or incorporated into ordinances, zoning, or development standards (discussed previously in this chapter). Common mitigation practices include:

- Vegetated Parking Lot Islands – vegetated depressions receiving runoff from parking lots and other impervious surfaces for infiltration into ground and filtration before discharging to storm sewer system or waterbody;
- Vegetated Road Medians and Side Ditches – vegetated channels in the median or along the side of a road, functioning similar to parking lot islands except they also convey runoff;
- Green Roofs – building roofs that are covered with vegetation and soil planted over a waterproof membrane to retain and evaporate rainfall and slow its runoff;
- Pervious Pavement and Asphalt / Paving Bricks – alternative paving types that allow for the percolation of water into subgrade soils or an engineered sub-base that facilitates infiltration and/or slow discharge to the storm sewer system;
- Rain Barrels and Cisterns – storing of rooftop runoff for later use as irrigation or other non-potable applications, these only provide benefits if water is used or drained between rainfall events;
- Bridge Scupper Drain Treatment – install piping on bridge scupper drains to ensure runoff does not directly drop into

BMP Resources (cont'd)

- *Guidebook of Best Management Practices for Michigan Watersheds*. Peterson, A., et al. (1998). MDEQ Surface Water Quality Division; and
- EPA's *National Menu of BMPs*; cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

Some of these resources have been consulted in the development of this section.

Impervious Surface Mitigation Scorecard

Impervious surface mitigation practices provide wide-ranging water quality and water quantity benefits. The information presented below is for comparative purposes only. Values to be used for design purposes or to calculate pollutant load reductions should be determined through additional research.

WATER QUALTIY CATEGORY	REMOVAL EFFICIENCY*
TSS	60%
Phosphorus	45%
Metals (Cd, Cu, Pb, Zn)	55%
Nitrogen	50%
Pathogens	50%
Toxins	50%

* *Efficiency = % removal of influent concentration (median)*

Source: Winer, 2000.

WATER QUANTITY CATEGORY	APPLIC.**
Channel Protection	H/M/L
Overbank Flood Protection	M/L
Extreme Flood Protection	L
Recharge Volume	M/L

** *Applicability = suitability of practice for given purpose; H=High, M=Medium, L=Low*

Source: Minnesota, 2005.

Additional Considerations

Mitigating impervious surfaces can also be addressed by: 1) cutting out concrete and planting trees or constructing planter boxes; 2) placing planter boxes on top of existing impervious surfaces; and 3) utilizing native vegetation wherever possible.

Infiltration Systems Scorecard

Infiltration practices provide wide-ranging water quality and water quantity benefits. The information presented below is for comparative purposes only. Values to be used for design purposes or to calculate pollutant load reductions should be determined through additional research.

WATER QUALTIY CATEGORY	REMOVAL EFFICIENCY*
TSS	95%
Phosphorus	65%
Metals (Cd, Cu, Pb, Zn)	95%
Nitrogen	50%
Pathogens	n/a
Toxins	n/a

* *Efficiency = % removal of influent concentration (median)*

Source: Winer, 2000.

WATER QUANTITY CATEGORY	APPLIC.**
Channel Protection	M
Overbank Flood Protection	M/L
Extreme Flood Protection	L
Recharge Volume	H

** *Applicability = suitability of practice for given purpose; H=High, M=Medium, L=Low*

Source: Minnesota, 2005.

waterbody, but instead is treated through natural and/or structural means; and
- Impervious Surface Disconnection – altering drainage systems such that adjacent pervious areas are not hydraulically connected (i.e. routing rooftop downspouts to discharge onto grass instead of onto a driveway).

Benefits of impervious surface mitigation include:
- Reduced stormwater runoff volume;
- Increased groundwater recharge;
- Improved runoff water quality; and
- Simulation of pre-development hydrology.

Limitations of impervious surface mitigation include:
- May fail if not properly maintained; and
- May consume land or surfaces available for other uses.

Due the wide array of possible actions that fall in this category, cost and maintenance requirements range from low cost / low maintenance, such as impervious surface disconnection, to high cost / high maintenance, such as intensive green roof systems.

Infiltration Systems

In general terms, infiltration systems can be described as natural or constructed depressions located in permeable soils that capture, store, and infiltrate stormwater runoff. These depressions can be located at the surface of the ground or they can be designed as underground facilities. Common infiltration practices include:
- Rain gardens – small depressions typically planted with native vegetation, no structural infrastructure;
- Tree boxes – ground-level or raised vegetation-filled boxes with open bottoms connected to soils;
- Bioretention facilities – large depressed areas with engineered soils and native planting, typically with supporting infrastructure such as overflows to the storm drain system;
- Infiltration basins – natural or constructed impoundment;
- Infiltration trenches – shallow excavated trenches, 3 to 12 feet deep, backfilled with coarse stone aggregate;
- Porous pipe – underground pipes made of porous substance or with weep holes that allow infiltration as water flows;
- Dry wells – smaller variation of infiltration trench;
- Underground systems – typically pre-manufactured structures that are buried in space-limited locations; and
- Water spreading / irrigation – involves the reuse of stored runoff water for land-based functions such as crop irrigation.

Benefits of infiltration systems include:
- Reduced stormwater runoff volume;
- Increased groundwater recharge;
- Improved surface water quality;
- Thermal protection; and
- Simulation of pre-development hydrology.

Limitations of infiltration systems include:
- Unusual construction considerations;

- Potential for groundwater contamination;
- May lose effectiveness over time if not maintained;
- Not recommended in areas with steep slopes; and
- May require landscaping for drought/inundation conditions.

Infiltration systems require semi-annual inspections (clogging, vegetation health, structural elements), regular removal of accumulated trash and vegetation maintenance (mowing, pipe auguring for roots), and extensive rehabilitation upon failure. Construction costs range from 2$ to 7$ per cubic foot of stormwater treated with annual maintenance costs ranging from 5% to 10% of construction costs.

Filtration Systems

In general, filtration systems are structural controls that capture, temporarily store, and route stormwater runoff though a filter bed to improve water quality. Filtration systems can be off-line systems or designed as pre-treatment before discharging to other stormwater features. Common filtration practices include:

- Sand Filters – systems designed to route runoff through sand to remove pollutants, variations include: surface, pocket, underground, and perimeter;
- Organic Filters – generally a surface or pocket variant of sand filter that utilizes an organic media either alone or mixed with sand to increase filtration efficiency; and
- Re-circulating Variant – involves add-on structural components such as a holding tank and pump to store runoff greater than filter capacity for later treatment and to recirculate treated runoff for greater removal efficiency.

Benefits of filtration systems include:

- Good for highly impervious areas with low sediment/high pollutant load (e.g. urban land use and retrofit scenarios);
- High pollutant removal rates;
- May be used in a variety of soil types; and
- Good for the treatment of hotspots because it can be isolated from ground water if contamination concerns exist.

Limitations of filtration systems include:

- Some applications may require indoor location (e.g. dedicated heated building) to ensure proper functioning in Michigan's cold-weather climate;
- Higher maintenance requirements (facility should be kept dry before it freezes in late fall);
- Some installations (media filters) have higher construction costs;
- Potential to cause odor problems;
- Minimal treatment of soluble nutrients; and
- Potential for nitrification in media filters where aerobic conditions exist.

Filtration systems require monthly inspections to ensure that tributaries areas are stabilized and that the structural components are free of debris. Annual maintenance involves inspecting for clogging and sediment filling, checking the concrete walls, looking for signs of bypassing flow, and correcting these problems, if documented. Costs range from 2$ to 7$ per ft^3 with average annual maintenance costs near 5% of construction costs.

Filtration Systems Scorecard

Filtration practices provide wide-ranging water quality and water quantity benefits. The information presented below is for comparative purposes only. Values to be used for design purposes or to calculate pollutant load reductions should be determined through additional research.

WATER QUALTIY CATEGORY	REMOVAL EFFICIENCY*
TSS	85%
Phosphorus	50%
Metals (Cd, Cu, Pb, Zn)	50%
Nitrogen	35%
Pathogens	35%
Toxins	80%

* *Efficiency = % removal of influent concentration (median)*

Source: Winer, 2000.

WATER QUANTITY CATEGORY	APPLIC.**
Channel Protection	M
Overbank Flood Protection	L
Extreme Flood Protection	L
Recharge Volume	M/L

** *Applicability = suitability of practice for given purpose; H=High, M=Medium, L=Low*

Source: Minnesota, 2005.

Vegetated Buffers / Natural Conveyance Scorecard

Vegetated buffers and natural conveyance practices provide wide-ranging water quality and water quantity benefits. The information presented below is for comparative purposes only. Values to be used for design purposes or to calculate pollutant load reductions should be determined through additional research.

WATER QUALTIY CATEGORY	REMOVAL EFFICIENCY*
TSS	55%
Phosphorus	50%
Metals (Cd, Cu, Pb, Zn)	50%
Nitrogen	50%
Pathogens	50%
Toxins	50%

* *Efficiency = % removal of influent concentration (median)*

Source: Winer, 2000.

WATER QUANTITY CATEGORY	APPLIC.**
Channel Protection	M
Overbank Flood Protection	M
Extreme Flood Protection	L
Recharge Volume	M

** *Applicability = suitability of practice for given purpose; H=High, M=Medium, L=Low*

Source: Minnesota, 2005.

Vegetated Buffers and Natural Conveyance

In general, vegetated buffers and natural conveyance predominantly use vegetation and natural drainage to control stormwater runoff. Depending on the circumstances, some practices may require a minimal amount of structural features. These practices provide runoff reduction and water quality benefits in similar fashion to the infiltration and filtration practices, but do so as they provide water transport, as opposed to storage. Common practices include:

- Filter Strips - vegetated surfaces designed to treat sheet flow from adjacent surfaces, function by slowing runoff velocities and filtering out sediment and other pollutants, and by providing some infiltration into underlying soils;
- Buffers – areas of natural vegetation (grass, native vegetation, and forest) that filter stormwater as it drains overland, especially useful for treating runoff before it enters sensitive environmental areas such as groundwater recharge areas or streams, wetlands, and lakes;
- Grassed Channels – simple drainage ditches with flat bottoms and shallow slopes, a main alternative to curb and gutter in residential areas; and
- Swales – drainage ditches with enhanced natural vegetation types, compost, and/or rip-rap to enhance pollutant removal, two types include:
  - Dry Swales – incorporate engineered underdrains that route percolated runoff, which is treated, to the storm sewer system; and
  - Wet Swales – eventually intersect the ground water table.

The benefits of vegetated buffers/natural conveyance systems include:

- Reduced stormwater runoff volume;
- Increased groundwater recharge;
- Improved runoff water quality; and
- Simulation of pre-development hydrology.

The limitations of vegetated buffers/natural conveyance systems include:

- Pollutant removal may be limited;
- Space requirements;
- If not properly designed, they can change the natural flow of surface water and adversely affect downstream waters;
- If the design capacity is exceeded by a large storm event, the vegetation might not be adequate to prevent erosion and the channel might be destroyed. Clogging with sediment and debris reduces the effectiveness of for stormwater conveyance; and
- Ponding can allow mosquitos to breed.

The maintenance requirements of vegetated buffers/natural conveyance systems include:

- Mowing
- Litter and sediment removal
- Spot vegetation repair

The costs for these practices range from 0.25$ to 0.70$ per square foot with annual maintenance costs averaging $350/acre.

Retention and Detention

Retention and detention is generally accomplished through the use of stormwater ponds and/or stormwater wetlands. Both provide similar water quality benefits, but ponds generally provide more effective water quantity control. These practices are discussed below:

- Stormwater ponds – constructed basins that: 1) receive and hold runoff to improve water quality through settling and biological uptake; and 2) prevent downstream channel degradation or flood damage through peak flow reduction (detention) and total runoff reduction (retention); variation include:
  - Dry Detention – primarily designed for flood control; generally grass-lined so pollutant removal by settling only;
  - Wet – include a permanent pool of water which supports vegetation to enhance biological pollutant removal;
  - Wet Detention – a combination of a wet pond for water quality treatment and detention above the permanent pool for extreme runoff events;
  - Evaporation Basin – similar to a wet pond, but generally shallower to facilitate evaporation; and
  - Reuse – pond which acts as a source for water, primarily irrigation; and
- Stormwater wetlands – constructed shallow marshes that: 1) receive and hold runoff to improve water quality through settling and biological uptake; 2) provide detention and retention benefits similar to, but less effective than, stormwater ponds; and 3) provide additional benefits such as aesthetics and wildlife habitat; variation include:
  - Wetland/Marsh – provide shallow wetland areas and deep marsh areas for different biological treatment types;
  - Extended Detention – similar to the wetland/marsh but with extended storage above the normal water surface;
  - Wetland/Pond – the wet pond situated near the inlet allows pollutants to settle out prior to entering the more environmentally sensitive shallow wetland area; and
  - Submerged Gravel – more like a filtering system in which runoff is treated as it flows through a submerged bed of gravel that incorporates wetland vegetation.

Benefits of retention/detention systems include:

- Able to effectively reduce pollutant loads and control runoff;
- Relatively straightforward pond design procedure; and
- Potential wildlife habitat, aesthetic or recreational enhancement.

Limitations of stormwater ponds include:

- Relatively large space requirement;
- Increase water temperature / cause downstream thermal impact;
- Potential nuisance for insects or odor;
- Poor in areas of low slope, high water table, and shallow bedrock;
- More complicated wetland design procedure; and
- Water quality behavior can change seasonally.

Maintenance includes annual vegetation and sediment accumulation inspections, monthly debris removal, and 5-year to 20-year sediment removal. Construction costs range from $11,000-$57,000/acre-foot. Annual maintenance costs equal 3% to 5% of construction costs.

Retention / Detention Scorecard

Retention / detention practices provide wide-ranging water quality and water quantity benefits. The information presented below is for comparative purposes only. Values to be used for design purposes or to calculate pollutant load reductions should be determined through additional research.

WATER QUALTIY CATEGORY	REMOVAL EFFICIENCY*
TSS	75%
Phosphorus	40%
Metals (Cd, Cu, Pb, Zn)	50%
Nitrogen	35%
Pathogens	70%
Toxins	80%

* *Efficiency = % removal of influent concentration (median)*

Source: Winer, 2000.

WATER QUANTITY CATEGORY	APPLIC.**
Channel Protection	H/M
Overbank Flood Protection	H/M
Extreme Flood Protection	H/M
Recharge Volume	L

** *Applicability = suitability of practice for given purpose; H=High, M=Medium, L=Low*

Source: Minnesota, 2005.

Vegetation Management Actions to Consider for Natural Features and Resources Management

Some vegetation management actions to consider include:

- Maintaining or introducing native landscaping;
- Critical area plantings;
- Municipal buffer zones;
- Prescribed burnings;
- Reforestation;
- Urban forestry, tree plantings and protection ordinances;
- No mow zones;
- Protecting threatened and endangered species; and
- Eradicating exotic/invasive species.

Natural Features and Resources Management

While many of the actions under 'Ordinances, Zoning, and Development Standards' serve to protect natural resources, the techniques listed here promote a more active approach that encompasses not only the protection of existing natural features but also their enhancement and restoration, where appropriate.

Land Reserves

Conservation of land helps protect existing water quality from degradation and prevents encroachment into important natural areas such as riparian corridors, wetlands, or critical habitat. Methods for conserving land include: purchasing land, development rights transfer, conservation easements, land trusts, leases, deed restrictions, and covenants.

Many programs are available that conduct or assist with land conservation efforts that can be implemented by any organization, including the WMP participants. Many of these programs, listed below, also provide assistance for natural feature protection and restoration (discussed in the next sub-section).

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 Natural Resources Trust Fund

The Michigan Natural Resources Trust Fund (MNRTF) has been in place since 1976. It provides financial assistance to local governments and the Department of Natural Resources (DNR) to purchase land or rights in land for public recreation or protection of land because of its environmental importance or its scenic beauty. It also assists in the appropriate development of land for public outdoor recreation.

The Trust for Public Land

The Trust for Public Land (TPL) is a national, nonprofit, land conservation organization that conserves land for people to enjoy as parks, community gardens, historic sites, rural lands, and other natural places, ensuring livable communities for generations to come. The TPL website is located at http://www.tpl.org/.

Michigan Nature Association

The Michigan Nature Association, established in 1952, is a conservation organization dedicated to protecting Michigan's most exceptional natural habitats and extraordinary or endangered species. Our mission is not only to preserve exceptional land and natural flora, but also to carry on programs of conservation education and scientific study. With the help of our members, MNA now has 163 nature sanctuaries throughout the state for people to enjoy today and forever. The association's website is located at http://www.michigannature.org/.

Southeast Michigan Land Conservancy

Southeast Michigan Land Conservancy is a non-profit organization dedicated to the preservation and stewardship of natural and agricultural land in the southeast Michigan counties of Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne. They also work to educate the public and public policy makers about land conservation issues.

SMLC protects land by purchasing it, by accepting donations of land, and by holding conservation easements to preserve natural features on private parcels. Their focus is on open spaces close to home, and their activities also include participation in coalition efforts to coordinate land use policy, protect open space, preserve scenic beauty, and defend watersheds from harmful development and pollution. The conservancy's website is located at http://www.southeastmichiganlandconservancy.org/.

Macomb Land Conservancy

The Macomb Land Conservancy (MLC) is dedicated to the preservation of forests, wetlands, wildlife habitats, farmlands, rivers, and streams in Macomb County through: identification and preservation significant natural areas and habitats, supporting the preservation of farmland and the agricultural economy of Macomb County, assisting local communities to plan for growth and development, and conducting public education programs that encourage residents and communities to become stewards of public and private land. The conservancy's website can be found at http://www.savingplaces.org/.

Michigan Department of Agriculture

The MDA has a 'Farmland and Open Space Preservation Program' that consists of 5 methods for preserving farmland and open space, including: Farmland Development Rights Agreements, Conservation Easement Donations, an Agricultural Preservation Fund, Local Open Space Easements, Designated Open Space Easements, and Purchasing of Development Rights.

Natural Feature Protection and Restoration

Not only is conserving land important, but protection and restoration practices must be employed on this land and on private land to ensure that the greatest natural functioning is achieved. Many programs are available that directly participate in these types of activities or provide technical and financial assistance to implement them.

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/.

Landowner Incentive Program

The primary goal of the Landowner Incentive Program is to help private landowners and non-profit organizations create, restore, protect, enhance, and manage habitat for species that are rare and/or declining (including wetlands, prairies, savannas, etc.). They do this by providing advice,

Waterways for Wildlife

At the Ford Utica plant in Shelby Township, a 55-acre site of wildlife habitat was recently integrated into an overall plant stormwater runoff plan. The site consist of two retention ponds, ten acres of newly reforested land, open meadows, and a large stand of 30-foot white pines. Wood duck, bluebird, purple martin, owl nest boxes and bathouses were included in the project. Amenities also exist to allow humans to enjoy the site and wildlife with minimal impact including a wildlife garden, an observation deck, and a hiking/bike path.

Source: CRPAC, 2000.

technical assistance, management plans, and funding to individuals and organizations throughout the state that qualify.

Forest Stewardship Program / Forest Land Enhancement Program

To promote the wise use and stewardship of privately owned forestlands is the goal of the Forest Stewardship Program. Candidates for the program are those landowners who are both interested in and committed to long term management that is economically viable and socially, ecologically and environmentally responsible.

The Forest Land Enhancement Program (FLEP) is intended to promote sustainable forest management on non-industrial private forest lands by offering educational, technical and financial assistance to private forest landowners.

Cost-sharing in the program is available for a number of activities including: management plan development, reforestation, forest stand improvement, water quality improvement, and watershed protection, fish and wildlife habitat improvement, forest health and protection, invasive species control, and wildfire and catastrophic event rehabilitation.

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. More information of the NRCS can be found at http://www.nrcs.usda.gov/.

Grassland Reserve Program

The NRCS, Farm Service Agency and Forest Service coordinate the Grassland Reserve Program (GRP) which is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property.

Wildlife Habitat Incentives Program

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. NRCS provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat.

Wetlands Reserve Program

The Wetlands Reserve Program is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The NRCS provides technical and financial support to help landowners with their wetland restoration efforts.

Conservation Reserve Program

The Conservation Reserve Program (CRP) provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner.

Other notable NRCS programs include: the Watershed Protection and Flood Prevention Operations, Conservation Technical Assistance, the Environmental Quality Incentives Program, the Farm and Ranch Land Protection Program, the Conservation of Private Grazing Land Program, the Conservation Security Program, and the Resource Conservation and Development Program.

Michigan Department of Agriculture

Conservation Reserve Enhancement Program

The MDA's 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/.

Stewardship Network

The Stewardship Network is a grassroots cooperative organization working to protect, restore, and manage Michigan's natural lands and waters. It helps individuals, organizations, and businesses manage specific sites through sharing ideas, resources, and information. The network's website is located at http://www.stewardshipnetwork.org/.

Michigan Conservation Districts

Michigan's Conservation Districts (CDs) 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. The Michigan Association of Conservation Districts can be accessed through http://www.macd.org/.

Macomb Conservation District

The Macomb CD was established in 1950 with the mission of "ensuring that land, water, forest, and wildlife, and all natural resources of the county are managed for sustained use for future generations".

Conservation District Website

Macomb Conservation District
www.macombcd.com

U.S. Fish and Wildlife Services

The goal of the U.S. Fish and Wildlife Services (FWS) is to conserve, protect, and enhance fish, wildlife, plants, and their habitats. The FWS works with the public and other government agencies to conduct environmental reviews for habitat protection and restoration, environmental contaminants, and federally threatened and endangered species. Their Partners for Fish and Wildlife Program provides assistance to landowners to restore wetlands and native prairies. Through its Coastal Program, the service focuses its efforts in bays, estuaries, and watersheds around the U.S. coastline, including Lake St. Clair. The agency's website is located at http://www.fws.gov/.

Federal Interagency Committee for the Management of Noxious and Exotic Weeds

The committee coordinates information regarding the identification and extent of invasive plants in the U.S. and federal agency management of these species by developing and sharing scientific and technical information, fostering collaborative efforts, providing recommendations for national and regional level management of invasive plants, and sponsoring technical/educational conferences and workshops concerning invasive plants. The committee's website is located at http://www.fws.gov/ficmnew/.

Geese

In many locations, geese are considered a nuisance and may contribute to water pollution, especially where they congregate in large numbers. There are many options available to control geese populations, including: a MDNR egg replacement program, a MDNR molt migration program (destroying nests to induce migration), and professionally trained border collies.

North American Waterfowl Management Plan

The North American Waterfowl Management Plan is an international action plan to conserve migratory birds throughout the continent. The Plan is a partnership of federal, provincial/state and municipal governments, non-governmental organizations, private companies and many individuals, all working towards achieving better wetland habitat for the benefit of migratory birds, other wetland-associated species and people. The Plan's unique combination of biology, landscape conservation and partnerships comprise its exemplary conservation legacy. Plan projects are international in scope, but implemented at regional levels. These projects contribute to the protection of habitat and wildlife species across the North American landscape. In fact, the North American Waterfowl Management Plan is considered one of the most successful conservation initiatives in the world. The plan can be accessed on the internet at http://www.nawmp.ab.ca/.

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. Trout Unlimited 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/.

Michigan Audubon Society

Michigan Audubon Society works to foster the appreciation and protection of birds and their habitats through education, research, and conservation/preservation. The organization's website is located at www.michiganaudubon.org/.

Sierra Club

The Sierra Club is a diverse organization protecting communities and the planet. Their mission statement has four tenets: 1) to explore, enjoy, and protect the wild places of the earth; 2) to practice and promote responsible use of the earth's ecosystems and resources; 3) to educate and enlist humanity to protect and restore the quality of the natural and human environment; and 4) to use all lawful means to carry out these objectives. The club's website is accessible at http://www.sierraclub.org/.

Clean Water Action

Clean Water Action is a national citizens' organization working for clean, safe and affordable water, prevention of health-threatening pollution, creation of environmentally-safe jobs and businesses, and empowerment of people to make democracy work. The group's website is located at http://www.cleanwateraction.org/.

Natural Resources Defense Council

The Natural Resources Defense Council's (NRDCs) purpose is to safeguard the Earth: its people, its plants and animals and the natural systems on which all life depends. They work to restore the integrity of the elements that sustain life (air, land and water); to defend endangered natural places; to establish sustainability and good stewardship of the Earth as central ethical imperatives of human society; and to protect nature in ways that advance the long-term welfare of present and future generations. The council's website is available at http://www.nrdc.org/.

East Michigan Environmental Action Council

The East Michigan Environmental Action Council (EMEAC) works with a broad variety of stakeholders to solve environmental problems. They help residents address community concerns by providing information, research, and tools for working with local government. They also meet with business and political leaders to find practical alternatives to industrial practices that pollute air and water. The council's website can be accessed at http://www.emeac.org/.

Great Lakes Panel on Aquatic Nuisance Species

Since 1991, the Great Lakes Panel on Aquatic Nuisance Species has worked to prevent and control the occurrence of aquatic nuisance species in the Great Lakes. The Great Lakes Panel on Aquatic Nuisance Species is directed to perform the following tasks:

- Identify Great Lakes priorities;
- Assist / Make recommendations to a national Task Force on Aquatic Nuisance Species;
- Coordinate exotic species program activities in the region;
- Advise public and private interests on control efforts; and
- Submit an annual report to the task force describing prevention, research and control activities in the Great Lakes Basin.

More information on the panel can be obtained at http://www.glc.org/ans/panel.html.

U.S. Department of Agriculture – Animal and Plant Health Inspection Service

Among many other functions, the service works with state and local agencies as well as private landowners and managers to eliminate invasive plants on private lands, as well as regulating importation of biological control agents. The service's website is located at http://www.aphis.usda.gov/.

Michigan Invasive Plant Council

The Michigan Invasive Plant Council (MIPC) is a non-profit organization spanning a wide array of groups from governmental agencies, to commercial enterprises, conservation organizations, educational institutions and the gardening public. The council's website is located at http://forestry.msu.edu/mipc/.

Aquatic Nuisance Species Task Force

The Aquatic Nuisance Species Task Force (ANSTF) is an intergovernmental organization dedicated to preventing and controlling aquatic nuisance species and implementing the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 and the National Invasive Species Act of 1996.

Michigan's Aquatic Nuisance Species Council

The purpose of the Council is to advise the Office of the Great Lakes and the MDEQ, MDNR, MDA, and MDOT on implementation of the Aquatic Nuisance Species Management Plan, including: the state's efforts to prevent and control aquatic nuisance species' introduction and spread within Michigan; information/education activities about aquatic nuisance species; the coordination of research and monitoring activities pertaining to aquatic nuisance species; and revising and updating Michigan's Aquatic Nuisance Species State Management Plan as necessary.

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 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/.

Michigan Natural Features Inventory

The goal of the Michigan Natural Features Inventory (MNFI) is "to actively contribute to decisions that impact the conservation of biological and ecological diversity by collecting, analyzing, and communicating information about rare and declining plants and animals, and the array of natural communities and ecosystems native to Michigan." The Inventory's website can be found at http://web4.msue.msu.edu/mnfi/.

Steelhead in the Clinton River

Courtesy of CRWC

Clinton River Watershed Council

The CRWC operates numerous educational and stewardship programs that seek to enhance and natural resources. These include assessments for wetland protection, restorations of water resources, and educational guides.

Clinton River Coldwater Restoration Project

The CRCRP, a partnership between the CRWC, Trout Unlimited, and the MDNR, seeks to generate public support for the Clinton River watershed as a valued recreational resource through efforts to improve water quality, aesthetics, and access to the Clinton River and its tributaries and explore opportunities to enhance the Clinton River as an urban trout fishery.

The United States Geological Survey

The United States Geological Survey (USGS) serves as an independent fact-finding agency that collects, monitors, analyzes, and provides scientific data about natural resources. The USGS has no regulatory or management mission. Through its National Water Quality Assessment Program (NAWQA), the USGS is conducting water quality investigations throughout the United States. The survey's website is located at http://www.usgs.gov/.

Great Lakes Gap Analysis Program

The goal of the Great Lakes Aquatic GAP Program is to evaluate the biological diversity of aquatic species and their habitats, and to identify gaps in the distribution and protection of these species and their habitats within the Great Lakes basin. This information will provide managers, planners, scientists, and policy makers with the information they need to identify priority areas for conservation before a species is threatened or endangered.

Recreation Promotion and Enhancement

While not generally considered an essential component of watershed protection, recreation-related actions are important for a number of reasons. First, input from the public generally contains references to increased recreation opportunities. Second, recreational access to natural areas serves to foster a stewardship ethic through a greater appreciation of the watershed as a resource.

The following programs can provide assistance with recreation-related issues in the subwatershed.

Clinton River Watershed Council

The CRWC hosts many recreation activities in the watershed, including River Day in which individuals, businesses, community groups, and local governments across the watershed join forces to protect, enhance, and celebrate the Clinton River and Lake St. Clair through activities ranging from nature hikes, canoe trips, fishing derbies, and fly-fishing lessons to storm drain stenciling, river clean-ups, habitat restoration, and native landscaping. The CRWC also acts as a clearinghouse for identifying other recreation facilities and activities within the watershed through their Clinton River Watershed Recreation Guide.

Huron-Clinton Metropark Authority

The Huron-Clinton Metropark Authority is a regional special park district encompassing Wayne, Oakland, Macomb, Washtenaw and Livingston counties. Currently, 13 Metroparks covering almost 24,000 acres, serve about 9.5 million visitors annually. The Metroparks are located along the Huron and Clinton rivers, providing a greenbelt around the Detroit metropolitan area. The authority's website is available at http://www.metroparks.com/index.php.

Friends of the Macomb Orchard Trail

The Friends of the Macomb Orchard Trail is involved in promoting and enhancing the Macomb Orchard Trail which runs (for its portion in the subwatershed) through Shelby Township, Washington Township, and Romeo. The Friends' website can be found at http://www.orchardtrail.org/.

Rails-to-Trails Conservancy

The Rails-to-Trails Conservancy is a nationwide organization "creating a nationwide network of trails from former rail lines and connecting corridors to build healthier places for healthier people." The conservancy's website can be found at http://www.railstrails.org/.

Michigan Department of Natural Resources

The MDNR regulates many of the recreational activities throughout the state of Michigan including hunting, fishing, boating, and off-road vehicle use. The department also operates numerous state forest lands, campgrounds, parks, recreation areas, harbors, and trails.

State Historic Preservation Office

Historic preservation enhances the quality of our environment and lives. Urban areas find renewal. Small towns retain the character that set them apart from other communities. Cultural landscapes are protected from uncontrolled development. The office's main function is to provide technical assistance to local communities in their efforts to identify, evaluate, designate, and protect Michigan's historic resources. The State Historic Preservation Office (SHPO) also administers an incentives program that includes state and federal tax credits and pass-through grants available to Certified Local Governments.

A Storm Sewer Outfall to the Harrington Drain: IDEP Programs Target These to Identify Illicit Discharges

Photo courtesy of MCPWO.

Monitoring

This section discusses existing programs that can be leveraged and other protocols that can be utilized to obtain data for measuring success of the WMP.

Existing Programs

The programs listed in this sub-section are currently being implemented by their respective organizations.

County and Municipal Illicit Discharge Elimination Programs

Based on Watershed-based Permit requirements, the county departments and municipal governments are conducting field work to identify illicit connections to and discharges from the storm sewer infrastructure. A significant portion of this work involves walking waterbodies and sampling outfalls for a number of pollutants. These programs should be kept in mind for leveraging and combining field work and data collection.

County Health Departments – Surface Water Quality Monitoring

The Macomb County Health Department (MCHD) conducts a number of monitoring programs that document water quality conditions throughout the subwatershed, including the Lake St. Clair Assessment, Beach Monitoring, Surface Water Testing, and the Lake St. Clair Regional Monitoring Project. The work done by the MCHD is regarded as one of the best water quality monitoring programs in the State of Michigan.

CRWC Stream Leaders

Courtesy of CRWC

Clinton River Watershed Council - Stream Leaders Program

Across the watershed, students and teachers are learning about water quality issues and helping protect their community's water resources by becoming volunteer water quality monitors. They are analyzing water samples for dissolved oxygen, nutrients, pH, temperature, and a host of other chemical constituents; evaluating the health of stream habitats and aquatic biological communities; inventorying physical stream-side conditions and land uses that may affect water quality; cataloging and collecting river, lake and beach debris; restoring degraded habitats; and making community presentations.

Clinton River Watershed Council - Adopt-A-Stream

Twice a year, teams visit their adopted sites and collect data, including physical information (such as extent of streambank erosion and surrounding land use) and chemical information (such as water temperature and pH). They collect and identify benthic macroinvertebrates that live in the streambed and surrounding vegetation. Different macroinvertebrates need specific conditions in which to survive and reproduce. Some are very pollution sensitive while others can tolerate highly polluted water. A stream's health can be determined by the number and types of macroinvertebrates that live in it.

CRWC Adopt-A-Stream

Courtesy of CRWC

Macroinvertebrates

Backbone-less organisms that are large enough to see with the naked eye. Two examples are insects and benthic organisms.

Public Education Plan Evaluation

The public education plans (PEPs) for all of the permittees in the subwatershed are currently being implemented (since 2004), including an assessment of the measures of success associated with the PEP actions. The data for these assessments should also be considered with respect to the assessments to be conducted in evaluating and revising this WMP.

Southeast Michigan Council of Governments – Social and Municipal Surveys

The Southeast Michigan Council of Governments (SEMCOG) conducted a social survey to establish a baseline level of knowledge among the residents in the region, including the subwatershed. Additionally, SEMCOG conducts surveys with respect to its municipal training and other educational activities. These data, and data from future surveys, can be used in assessing many of the measures of success in this WMP.

MDNR Collecting Fish Data: White Suckers in the Healy Brook

Courtesy of MCPWO

Michigan Department of Natural Resources

The Michigan Department of Natural Resources (MDNR) routinely collects data similar to the MDEQ's but with a greater focus on macroinvertebrates and especially fish studies (including habitat, diversity of fish, abundance of fish, contaminants in fish tissue, and taste and odor tests). A wildlife action plan was generated for Michigan to identify and prioritize conservation needs of native species and habitats. The plan gives a greater emphasis on species of greatest conservation needs. Other monitoring and management programs include the fish consumption advisory study, fish identification programs, and amphibian surveys.

Environmental Protection Agency

In some cases, the U.S. Environmental Protection Agency (EPA) may be involved in obtaining water quality data. This data may be documented in specific reports and also stored in the agency's STORET database. This database also contains data provided by outside sources.

U.S. EPA STORET

"STORET (short for STOrage and RETrieval) is a repository for water quality, biological, and physical data and is used by state environmental agencies, EPA and other federal agencies, universities, private citizens, and many others." (U.S. EPA, 2006)

The database may be accessed at http://epa.gov/storet/.

United States Geological Survey

The United States Geological Survey (USGS) is involved in obtaining stream-flow data and some water quality data. The USGS maintains the National Water Information System that houses and organizes this data for easy access.

United States Army Corps of Engineers

The United States Army Corps of Engineers (USACE) conducts sediment and water quality sampling as part of its maintenance dredging program under the Rivers and Harbors Act.

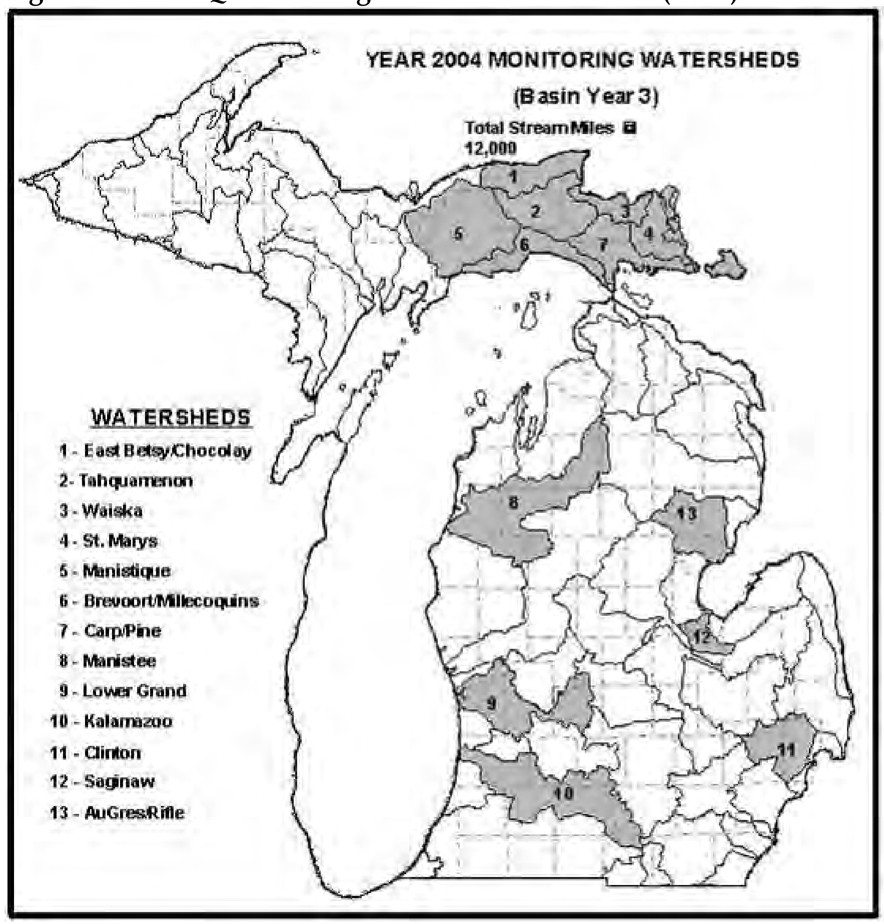
MDEQ Basin Years 1,2,4 & 5

Source: MDEQ, 2006.

Michigan Department of Environmental Quality

The Michigan Department of Environmental Quality (MDEQ) routinely collects data that include water quality, macroinvertebrate sampling, and fish studies. The environmental monitoring program incorporates four main goals, including assessment of current conditions of waters of the state, identifying whether water quality standards are being met, measuring water quality trends, evaluating water quality protection and prevention program effectiveness, and recognize emerging water quality problems. The data collection occurs on a five-year cycle, as depicted in the sidebar figures and Figure 7-4 which depicts Basin Year 3 (2004).

Figure 7-4. MDEQ monitoring basins for Basin Year 3 (2004.)



Source: MDEQ, 2006.

The five year rotating basin watershed monitoring activities include fish contamination studies, macroinvertebrate evaluations, water and sediment chemistry studies, and wildlife contamination studies. Information from the studies is summarized and available to the public. For more water quality monitoring program information, see Chapter 3 of this plan or visit the MDEQ web site at www.michigan.gov\deq\.

Other Existing Programs

Many other existing programs may exist that can provide data to use in assessing the measures of success. Some organizations to consider for the possibility of programs to generate these additional data include the National Oceanic and Atmospheric Administration (NOAA), the International Joint Commission (IJC), and the Great Lakes Commission (GLC).

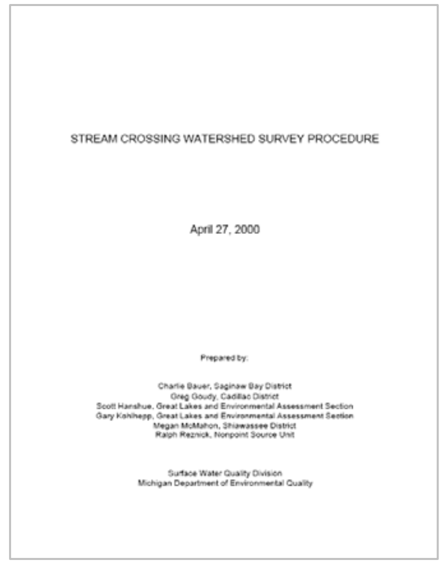
Other Protocols

The protocols listed below are not currently implemented on a regular basis but should be considered as methods to obtain appropriate data for conducting assessments.

Road-Stream Crossing Surveys

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.

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


STREAM CROSSING WATERSHED SURVEY PROCEDURE

April 27, 2000

Prepared by:

Charlie Bauer, Saginaw Bay District
Greg Goudy, Cadillac District
Scott Hanshue, Great Lakes and Environmental Assessment Section
Gary Kohlhepp, Great Lakes and Environmental Assessment Section
Megan McMahon, Shiawassee District
Ralph Reznick, Nonpoint Source Unit

Surface Water Quality Division
Michigan Department of Environmental Quality

Stream Assessment

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 overlap 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.

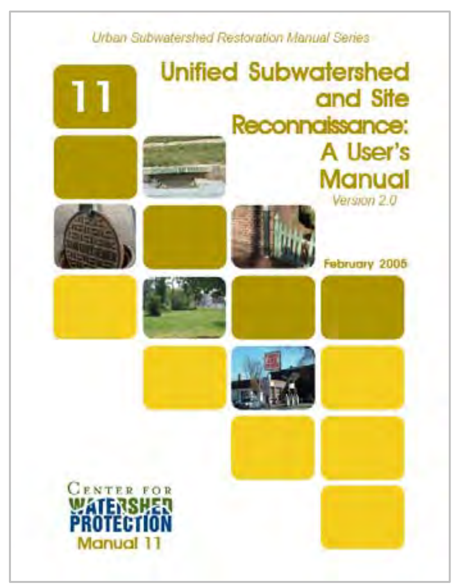
This method is similar to the Road-Stream Crossing Surveys but is conducted on entire stretches of stream as opposed to discrete sites where streams and roads cross. Example methodologies include that which is developed by the Center for Watershed Protection (CWP) and outlined in 'Unified Stream Assessments: A User's Manual' Version 2.0 and the method developed by the U.S. EPA .

Unified Stream Assessment

Source: CWP, 2005.

Unified Subwatershed and Site Reconnaissance

The Unified Subwatershed and Site Reconnaissance (USSR) survey, developed by the CWP (2005), involves conducting quick but thorough characterizations of upland areas. The goal of the USSR is to identify major source types and areas that potentially contribute pollutants to waterbodies. The four major components of this survey include: neighborhood source assessments, hotspot site investigations, pervious area assessments, and street and storm drains assessments.

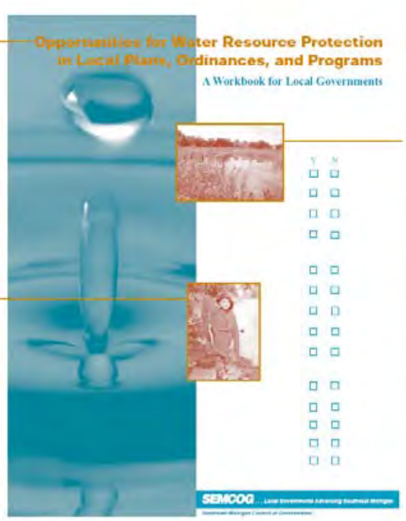


Hot Spot Testing

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.

Water Quality Index

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).



BMP Monitoring

In order to properly document load reductions (Level Four), monitoring may be done at sites where BMPs are installed both before and after implementation. Alternately, load reductions can be calculated using standard values.

Wet Weather Discharge Sampling

Currently, the various IDEP programs are responsible for monitoring dry weather discharges from the storm sewer systems. However, to properly document changes in water quality discharged from the storm sewer systems (Level Five), sampling will need to be done during wet weather conditions.

Additional Methodologies

Additional methodologies may be required to properly assess the effectiveness of this plan. Possibilities for these include assessments of: the R-B flashiness index; the extent of channelization; the level of imperviousness; open space; development in the floodplain; basement flooding, CSOs, and/or SSOs; the status of the designated and/or beneficial uses for waterbodies; groundwater conditions; septic system distribution and performance; and beach closings.

Summary

As the 'Current Subwatershed Protection Practices' section of Chapter 3 detailed, the level of aquatic resource protection in the subwatershed is less than optimal. This chapter detailed many actions that can be taken towards improving aquatic resource protection and achieving the goals and objectives presented in Chapter 6. Also included were actions for meeting natural feature protection / restoration and recreational goals and objectives and for monitoring to evaluate the effectiveness of the plan.

When determining the specific actions to implement, each entity represented by the plan can reference "Opportunities for Water Resource Protection in Local Plans, Ordinances, and Programs" (SEMCOG, 2002) to help determine deficiencies and suggested improvements in the following categories:

- Stormwater Management Standards;
- Engineered Best Management Practices;
- Infiltration Practices;
- Impervious Surface Reduction, including:
  - Parking Lots and Streets; and
  - Lot Setbacks, Widths, and Coverage;
- Land Conservation and Development Techniques, including:
  - Open Space and Parks Acquisition;
  - Conservation Easements and Similar Tools;
  - Urbanized Community Activities;
  - Rural Community Activities; and
  - Clustering and Open Space Development;
- Soil Erosion and Sediment Control;
- Sanitary Sewer Planning and Infrastructure, including:
  - Septic Systems; and
  - Illicit Discharge Elimination;
- Groundwater Protection;
- Green Infrastructure;
- Natural Area Preservation and Restoration, including:
  - Habitat;

- Native Plant Species;
    - Wetland Protection;
    - Woodlands Preservation; and
    - Stream Corridors and Floodplains;
- Capital Improvement Plan;
- Watershed-based Activities;
- Public Education;
- Pollution Prevention / Good Housekeeping; and
- Development Review Process.

The list of actions that will be implemented is presented in Chapter 8. The selection of the actions was done in an adaptive management setting based in part on the information presented in this chapter.

References

Center for Watershed Protection [CWP], *Water Protection Audit,* Accessed September 20, 2005. Available at: http://www.cwp.org/Community_Watersheds/Watershed_Protection_ Audit2.pdf

Center for Watershed Protection [CWP], "The Practice of Watershed Protection". 2002.

Macomb County Department of Planning and Economic Development [MCPED]. "Macomb County Promotes Use of Environmental Ordinances to Assist Local Governments with EPA Regulations & Smart Growth Opportunities". News Release, 2005.

Michigan Association of Planning [MAP], *Community Planning Handbook: Tools and Techniques for Guiding Community Chang*

Michigan Department of Environmental Quality [MDEQ], (2003). *Filling in the Gaps: Environmental Protection Options for Local Governments*, Accessed September 20, 2005, Available at: http://www.mi.gov/deq/0,1607,7-135-3313_3677_3696-73358--,00.html

Michigan Department of Environmental Quality [MDEQ]. National Pollutant Discharge Elimination System Wastewater Discharge General Permit: Storm Water Discharges from Municipal Separate Storm Sewer Systems Subject to Watershed Management Plan Requirements. 2002.

Rouge River Wet Weather Demonstration Project [RRWWDP], *Ordinance Information*, Accessed September 20, 2005, Available at: http://www.rougeriver.com ordinance/

Southeast Michigan Council of Governments [SEMCOG], (2003). *Land Use Tools and Techniques: A Handbook for Local Communities. Available at: http://www.semcog .org/cgi-bin /products/ publications.cfm*

Southeast Michigan Council of Governments [SEMCOG], (August 2002). *Opportunities for Water Resource Protection in Local Plans, Ordinances, and Programs: A Workbook for Local Governments.* Available at: http://www.semcog.org/ cgi-bin/products/publications.cfm

Pictures

http://www.dakotacountyswcd.org/liddemo.htm

http://www.dakotacountyswcd.org/images/lid/P1010008.jpg

Northeast County Sector Plan [NCSP]. Website. Via: http://www.knoxmpc.org/ plans/necounty/specdev.htm. Last accessed: September 30, 2005.

Planning With Power [PWP]. Website. Via: http://www.planningwithpower.org /images/photos/Aerial/subdivision-2.htm. Last accessed: September 30, 2005.

Riverside-Corona Resource Conservation District [RCRCP]. Website. Via: http://www.rcrcd.com/canhelp.htm. Last accessed: September 30, 2005.

Sygenta. Website. Via: http://www.syngentacropprotection-us.com/enviro/sustainable_ag/index.asp?nav=Sustainable_Agriculture. Last accessed: September 30, 2005.

Other Resources

A vast number of other resources may be utilized or consulted in implementing watershed protection, including:

- The Michigan Department of Community Health;
- The United States Forest Service;
- Other Department of the Interior Agencies (in addition to the previously mentioned Fish and Wildlife Service and USGS);
- World Wildlife Fund;
- Wildlife Habitat Council;
- The Conservation Fund;
- The National Wildlife Federation;
- United States Army Corps of Engineers;
- United States Coast Guard;
- United States Department of Homeland Security; and
- United States Department of Transportation.

Subwatershed Photo Tour: View of Downtown Mt. Clemens from a Dock on the Clinton River

Photo courtesy of Tetra Tech.

8. Implementation Roadmap

Quotable Quotation

"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 … alive at an absolutely critical moment in the history of our planet."

- Carl Sagan

Introduction

This chapter of the Watershed Management Plan (WMP) details the steps to achieve the goals and objectives for the subwatershed (see Chapter 6). Simply, it is a roadmap to guide implementation of these steps or actions. To facilitate their presentation, the actions have been grouped into the categories used in Chapter 7 (except that 'Stormwater Best Management Practices' has been broken down into two categories – see 5 and 6 below; and 'Monitoring' is discussed in Chapter 9):

1. **Watershed Planning, Institutionalization, and Implementation;**
2. **Public Education and Participation;**
3. **Ordinances, Zoning, and Development Standards;**
4. **Good Housekeeping and Pollution Prevention;**
5. **Stormwater Best Management Practices: Non-Construction Related Soil Erosion and Sediment Control;**
6. **Stormwater Best Management Practices: Other Pollutant Load Reducing Controls;**
7. **Natural Features and Resources Management; and**
8. **Recreation Promotion and Enhancement.**

In order to meet the goals and objectives of the plan, the Subwatershed Advisory Group (SWAG) developed a reasonable schedule that is based on numerous factors including: water quality improvement potential, cost, and projected implementation time. This general schedule is presented in Figure 8-1 on an 'action category' basis (the actual implementation schedule may vary by entity). The markers in the timeline (◆) denote implementation milestones (note that not all actions have milestones associated with them). These milestones are introduced in Figure 8-2. Details for each milestone are discussed further in Chapter 9.

Figure 8-1. General schedule.

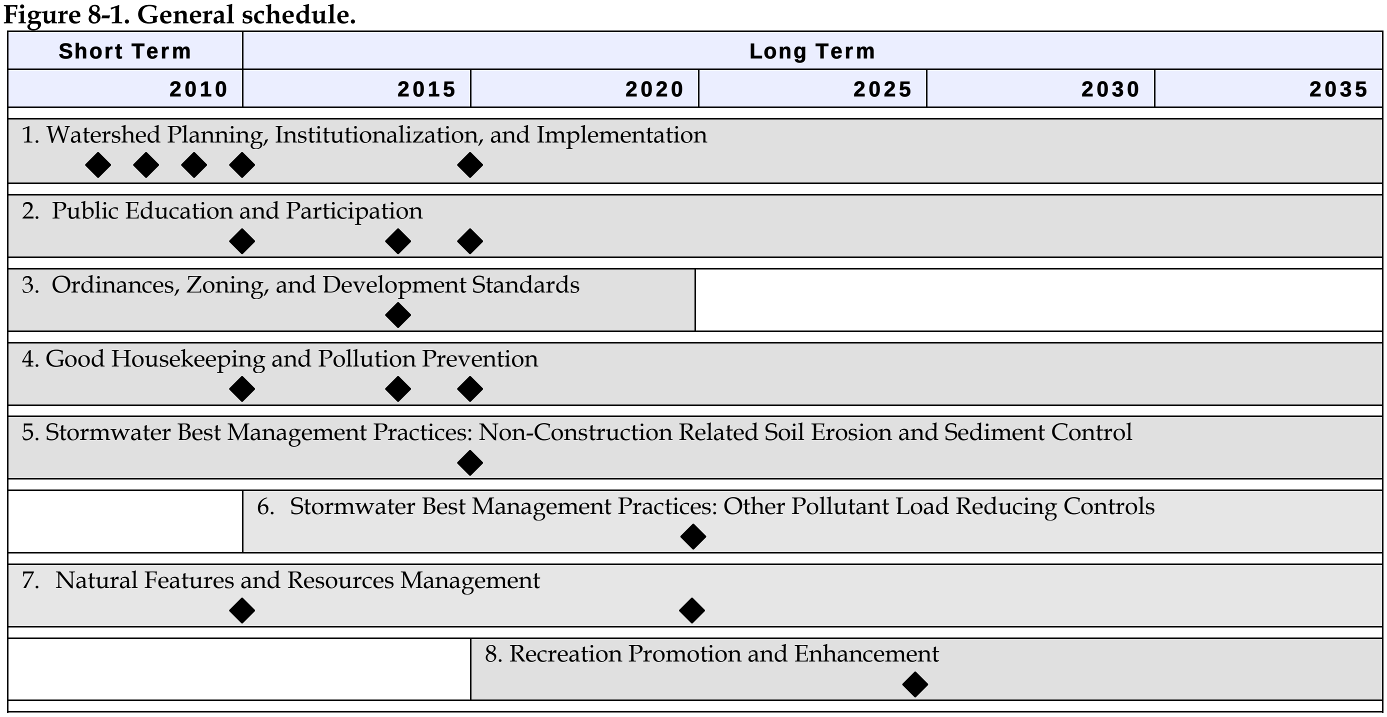


Figure 8-2. Implementation milestones.

Action Category	2010	2015	2020	2025
1. Watershed Planning, Institutionalization, and Implementation	2007: Evaluation and Revision Guidance 2007: Update SWPPI 2008: Update WMP 2009: Update SWPPI Reconvene SWAG Implementation Clearinghouse Pollutant Source Identification	Total Maximum Daily Loads		
2. Public Education and Participation	Signage Public Involvement Public Meetings Municipal Officials Education	Municipal Employee Training *(2013)* Demonstration Projects		
3. Ordinances, Zoning, and Development Standards *(all milestones = 2013)*		Stormwater Management Stds. Development Management Preserve Natural Features Pollution Prevention		
4. Good Housekeeping and Pollution Prevention	Sources of Sediment Contaminants Actions to Remediate Contaminated Sediments Trash/Debris Reduction Spill Prevention / Notification / Response	Storm Sewer Maintenance and Operations *(2013)* Pollution from Roads / Lots *(2013)* Pollution from Municipal Facilities *(2013)* Turf Management Practices *(2013)* Waste Management Animal Waste Control Sanitary / Combined Sewer Planning and Maintentance Flood Control Projects Septic System Practices Marine Industry Activities Groundwater		
5. Stormwater Best Management Practices: Non-Construction Related Soil Erosion and Sediment Control		Bare Soil Repair Streambank Stabilization Eroding Road Stabilization Streambank Use Exclusion Sensitive Site Control Structural Controls Agricultural BMPs		
6. Stormwater Best Management Practices: Other			Mitigate Existing Impervious Surfaces Infiltration Techniques Filtration Techniques Vegetative Buffers and Natural Conveyance Retention and Detention	
7. Natural Features and Resources Management	Identify Natural Features		Natural Land Reserves Natural Feature Protection Natural Feature Restoration	
8. Recreation Promotion and Enhancement				Recreation Program Riparian Parks Access Sites Fishing Opportunities Trails / Decks

Actions to Achieve Goals and Objectives

This section discusses the individual actions that will be taken to meet the goals and objectives of this plan. As discussed in Chapter 1, this plan was developed to meet the requirements of the National Pollutant Discharge Elimination System (NPDES) Phase II program and General Permit No. MIG619000 (or 'Watershed-based Permit') but also to meet the requirements of a number of funding programs (see Chapter 1). As such, not all of the actions detailed in this chapter are required actions.

Requirements of the Phase II program derive mainly from the 'Watershed-based Permit' language and include actions related to a Public Education Plan (PEP), an Illicit Discharge Elimination Plan (IDEP), development of a WMP containing actions (with permittee commitments) needed to achieve the goals and objectives and evaluation methods, and submittal of Storm Water Pollution Prevention Initiatives (SWPPIs) that contain other specific actions.

Additionally, the Michigan Department of Environmental Quality (MDEQ) has issued Certificates of Coverage (COCs) that indicate dates by which PEPs, IDEPs, WMPs and updates, SWPPIs and updates, and Annual Reports must be submitted.

In order to provide the most robust plan possible, this WMP contains references to most of the aforementioned elements. To distinguish which actions are required and commitable actions of this WMP, consider that:

1) The PEPs and IDEPs have been submitted and are being implemented as of submittal of this WMP. As such, the communities neither modify their existing plans nor commit to additional actions through this WMP, but simply include these as actions in the plan for reference and potential funding above and beyond the existing actions being taken in compliance with the PEPs and IDEPs. Some communities may choose to include PEP and IDEP actions in their SWPPIs;
2) The 'other specific actions' to be included in the SWPPI have been defined as actions in the plan to reduce confusion; and
3) Submittal of the WMP-updates, SWPPIs and updates, and Annual Reports are not SWPPI reportable commitments.

To further clarify the issue, the text in the following sub-sections which gives the details of each action, is abutted by an outlined box that defines which actions are Phase II requirements with supporting discussion.

The bracketed text following each item indicates its short name used in some tables in the plan.

The permittees feel that some elements of even the Phase II required actions may be fundable through various grant programs. For example, the permittees feel that the development of products or programs which are utilized by non-permittee Subwatershed Advisory Group (SWAG) members represented by the WMP, or other non-permittees outside of the subwatershed, can be grant funded, but it is the application of the products or implementation of the program that is the Phase II component.

Appropriateness of Actions

The implementation measures presented in this plan are in accordance with the Water Quality Management Plan (WQMP) for Southeast Michigan which stipulates that actions should at least address:

- constructing pollution and flood control equipment and structures;
- identifying municipal and private sector BMPs;
- identifying agricultural, livestock, and manure BMPs;
- identifying project administration and funding; and
- promoting education programs.

Source: SEMCOG, 1999.

Terminology

'Permittees' or **'Phase II Permittees'** are those entities which are covered by a COC under permit MIG619000 and include any nested jurisdictions with a cooperative agreement with a permittee.

'Subwatershed Advisory Group (SWAG) members' are those entities represented and participating in the SWAG and are eligible for grants to implement the appropriate action (a case-by-case basis).

'Other entities' are those present in the subwatershed or with a vested interest in the subwatershed that have not participated as a 'SWAG member' and are eligible for grants to implement the appropriate action (a case-by-case-basis; upstream municipalities or international organizations are possible examples).

1 Watershed Planning, Institutionalization, and Implementation

These actions consist of those that are meant to foster the cooperative watershed planning and decision-making approach in both the short and long term between all levels of government and local stakeholders. *The benefit of these actions is the funding, implementation, and long-term institutionalization of the WMP.*

When feasible and appropriate the Subwatershed Advisory Group (SWAG) will attempt to coordinate planning efforts with the groups representing the other subwatersheds in the Clinton River Watershed, and other watershed groups (and their respective subwatershed groups) that the communities of the SWAG are involved with. The focus of coordinating planning efforts can be to consolidate goals and objectives and coordinate actions being taken such that implementation and achievement is streamlined, especially for SWAG members represented by multiple WMPs (e.g. Clinton Township, which is in the CREW, Red Run, and North Branch subwatersheds of the Clinton River Watershed, in addition to the Lake St. Clair Direct Drainage and Anchor Bay subwatersheds of the Lake Drainage Watershed).

When feasible and appropriate, the SWAG and its members will utilize planning tools such as Geographic Information Systems (GIS), the Integrated Coastal Management (ICM) tool, the Potential Conservation Area Analysis (GLC, 2004), and those developed through the Clinton River Watershed Initiative (CRWI) – including a hydrological model of the watershed – to guide action implementation and other management decisions with the most up-to-date information and analytical processes.

Planning Levels

Watershed planning occurs on many levels. This is one of many subwatershed plans being prepared throughout the watershed, region, and state. Planning for the entire watershed is occurring through the Remedial Action Plan (RAP) process and cooperation with the Clinton River Watershed Council. Some planning has also occurred for the entire Lake St. Clair Sub-basin.

Benefits of the Actions

The benefits of the actions are given on a category basis. The introductory text for each subsection discussing an action category has italicized text that highlights the benefits of that group of actions.

1-1 Promote and Reconvene Subwatershed Advisory Group [SWAG]

Voluntary Action – dependent on funding

During the four years following submittal of this plan, the SWAG will document the progress of implementing the WMP under the current voluntary and informal organizational structure (see Chapter 9) and will take actions to promote visibility of and encourage increased participation in the SWAG.

Encouraging visibility and increasing participation may include regular e-mail communication with the member entities about the mission and purpose of the SWAG, current news, status of activities, a schedule for upcoming activities, and benefits of membership and may include communication with other interested entities (including business and citizen groups), formal means of communication such as a newsletter, and attendance at relevant meetings

Also during this time, the SWAG will research alternative methods for long-term WMP implementation (as presented in Chapter 10). At the end of this four year period, the SWAG will reconvene for long-term WMP implementation (which may simply be continuing with the current organizational structure), continuing its visibility and participation activities.

Phase II Requirement

The evaluation mechanisms defined in Chapter 9 (that will be included in the ERG) meet the 'Watershed-based Permit' requirement for the WMP to contain *methods for evaluation of progress.*

1-2 Evaluation and Revision Guidance [ERG]

In the year following submittal of the WMP (and its subsequent updates), the SWAG will develop 'Evaluation and Revision Guidance' (ERG) to guide future updates to this WMP (see Action 1-6). The ERG will provide the context for measuring action completion, product and facility usage, and behavioral and pollution-level changes associated with WMP implementation. The ERG will define:

- Monitoring protocols (locations, data, parameters, etc) based on information presented in the WMP;
- Achievement levels to help gauge success;
- Data reporting/submittal requirements, both audience (international, national, state, regional, and local governments, and the public) as well as mechanism (web site, etc);
- Triggers to initiate the evaluation and revision procedure (including the WMP update schedule); and
- Steps to take to complete the evaluation and revision procedure.

The ERG will be based largely on the information presented in Chapter 9, but will be developed in consideration of any conditions that have changed since the plan was submitted.

Voluntary Action – dependent on funding

1-3 Develop Funding Program [Funding]

The SWAG will develop a 'Funding Program' that identifies anticipated budget needs and funding sources to help implement the WMP. The Funding Program will define:

- Funding sources for all actions in the plan (including contaminated sediment remediation – which is not technically addressed in the plan, but will benefit the SWAG);
- Funding sources at all appropriate levels (international, federal, state, regional, local, private sector, etc.);
- Program dates, eligibility requirements, and funding levels;
- Advantages and disadvantages of the funding sources;
- Steps to take to procure identified funding; and
- Actions to take with respect to establishing a stormwater utility (e.g. supporting legislation),

The Funding Program will be based largely on Table 8-2, which identifies estimated costs and hours associated with each action, and Tables 8-4 and 8-5, which expand on Table 8-2 to identify potential sources of financial and technical assistance. Chapter 7 may also help identify some valuable resources for action implementation.

The Funding Program should be updated annually such that up-to-date information on grant availability and funding levels is readily available to SWAG members.

Importance of the Funding Program

The Funding Program (Action 1-3) is a vastly important mechanism for defining how the WMP-participants will implement the actions defined in this plan. Although not specifically mentioned in the narrative on these pages, referencing the Funding Program to identify potential funding sources is a task that will be required to successfully implement most of the actions in the WMP.

1-4 Develop Grant Proposals [Grants]

Grant proposals will be developed and submitted as available and as determined by the SWAG members, utilizing the Funding Program to save time and effort. When feasible, SWAG members will work together to share funding on an action-by-action basis.

Voluntary Action – dependent on funding

1-5 Update SWPPI [Update SWPPI]

Following the submittal of this WMP in 2006, the SWAG will coordinate the revision of the Phase II Permittees' Storm Water Pollution Prevention Initiatives (SWPPIs) or Abbreviated SWPPIs which were submitted on or before November 1, 2005. This coordination may be, in part, in the form of guidance or a template which is developed based on the contents of this plan. The end result of this action will be for every Phase II Permittee to have developed a revised or first full SWPPI (no longer 'Abbreviated'), based in part on information provided to them by the SWAG, and submit it to the MDEQ by May 1, 2007.

Following the submittal of the updated WMP in 2008, the SWAG will assist with the revision of the Phase II Permittees' SWPPIs which were submitted on or before May 1, 2007. This assistance may be, in part, in the form of guidance or a template which is developed based on the contents of the updated plan. The end result of this action will be for every Phase II Permittee to have developed a revised SWPPI, based in part on information provided to them by the SWAG, and submit it to the MDEQ by May 1, 2009.

<u>Phase II Requirement</u>

A SWPPI update based on this WMP is listed in the COC for each permittee.

This action does not have to be addressed in the SWPPI, however.

1-6 Update WMP [Update WMP]

During the second year following submittal of this plan, the SWAG will update this plan in accordance with the ERG (Action 1-2) or prepare a written determination not to update the plan and submit it to MDEQ on or before November 1, 2008.

The plan updates will then continue based on the schedule spelled out by the MDEQ in the reissued Certificates of Coverage under the Watershed-based Permit, expected to be every two to five years.

<u>Phase II Requirement</u>

A WMP update or determination not to update the plan is listed in the COC for each permittee.

This action does not have to be addressed in the SWPPI, however.

1-7 Annual Reports [Annual Reports]

Annually, each Phase II Permittee is required to submit an 'Annual Report' by the date specified in their respective Certificate of Coverage. The report should document all of the decisions, actions, and results performed as part of the Phase II program during the previous year, including: IDEP, PEP, New Point Source Discharges of Stormwater, SWPPI, Other Actions, Nested Drainage System Agreements, and Special Reporting Requirements. Specifics for each category can be found in the Watershed-based Permit text.

The SWAG will coordinate the Annual Reports by providing guidance or a template to each Phase II Permittee and providing necessary information related to actions that have been implemented (see Action 1-2 – the ERP).

<u>Phase II Requirement</u>

Annual Reports are listed in the COC for each permittee.

This action does not have to be addressed in the SWPPI, however.

Phase II Requirement

The 'Watershed-based Permit' language requires listing TMDL *concerns*, *problems*, or *opportunities* and *some actions specific to storm water controls* in the WMP.

The language also requires *that long-term goals … shall include attaining compliance with any TMDL*.

This action ensures that TMDLs are incorporated into the WMP and as such does not have to be addressed in the SWPPI.

However, Phase II actions added to the WMP under this action will likely be included in future SWPPIs.

1-8 Total Maximum Daily Loads [TMDLs]

When a lake or stream does not meet Water Quality Standards (WQS), a study is led by the MDEQ to determine the amount of a pollutant that can be put in a waterbody from point sources and nonpoint sources and still meet WQS. The result of this study is termed a 'Total Maximum Daily Load' (TMDL) and describes how much of a pollutant a lake or stream can assimilate. The SWAG will support the implementation of TMDLs affecting the subwatershed through modifications to the WMP.

The list of scheduled TMDLs for the subwatershed includes:

- 2007 – Metropolitan Beach on Lake St. Clair for pathogens (CSOs);
- 2010 – Clinton River Watershed for PCB WQS exceedances;
- 2010 – Clinton River for a fish consumption advisory (PCBs);
- 2010 – Clinton River for pathogens (CSOs);
- 2011 – Clinton River (Mt. Clemens) for mercury WQS exceedances;
- 2011 – Clear Spring Lake for a fish consumption advisory (PCBs); &
- 2012 – Lake St. Clair for a fish consumption advisory for PCBS and for the presence of mercury in fish tissue

The purpose of this action is to ensure that future TMDLs are incorporated to the plan by updating the contents including problems and concerns, goal language, opportunities, and actions.

Voluntary Action – dependent on funding

1-9 Implementation Clearinghouse [Clearinghouse]

In order to efficiently track the implementation of the WMP, to support its evaluation and revision (Action 1-2), and to coordinate the reporting of the Phase II Permittees (Actions 1-5, 1-7, and 1-8), the SWAG will track all programs and activities related to implementation of the WMP.

All SWAG members implementing WMP actions will be responsible for reporting their activities to the SWAG on a quarterly basis, including survey results. The SWAG will log the reported information in accordance with the ERP (Action 1-2). The SWAG may also check with non-SWAG entities to document if any related actions have been implemented.

The SWAG will explore the possibility of using an interactive website where this information can be submitted/ retrieved.

Voluntary Action – dependent on funding

1-10 Identify Sources of Pollutants [Sources]

An integral part of watershed management planning is documenting pollutant sources. This information will form the basis for the implementation of most of the actions of this WMP.

The SWAG will base the identification primarily on the contents of this WMP. The pollutant source identification should also consider studies conducted after this plan is submitted and additional focused work including stakeholder surveys, additional field assessments, and reports from field crews (for which reporting protocols may be developed and adopted). Focus should also be placed on distinguishing wet weather and dry weather sources and their relative contributions.

Pollutant Sources

Consideration should be given to researching new generation pesticides, pharmaceuticals, endocrine disrupters, and other chemicals. Their potential for affecting the subwatershed should be considered.

2 Public Education and Participation

As alluded to in the beginning of this section, public education is a Phase II requirement (based on language of the Watershed-based Permit) and is addressed through each permittee's PEP. Each PEP lays out the approach for informing the public about their role in protecting water quality and preventing stormwater pollution. These PEPs were created with the input of resident, stakeholders, and professionals in the environmental education field, were submitted on May 1, 2004, and are currently being implemented.

However, in seeking to broaden public education activities, include public participation concerns, and leverage potential funding opportunities, the SWAG has included additional actions in this WMP. Again, as the beginning of this section explained, the permittees do not intend these actions to modify their existing PEPs nor commit them to additional actions (under the Phase II program).

In general, the SWAG will rely on the materials and messages of existing educational programs, such as the Clinton River Watershed Council (CRWC), the Southeast Michigan Council of Governments (SEMCOG) or the state, to educate and engage the public.

The text in the following subsections describes actions to be taken in the public education and participation realm. *The benefit of these actions is the increase in public and municipal staff knowledge and awareness to facilitate the paradigm shift needed to change adverse behavior affecting the watershed.*

2-1 Public Education Plan Implementation [PEP]

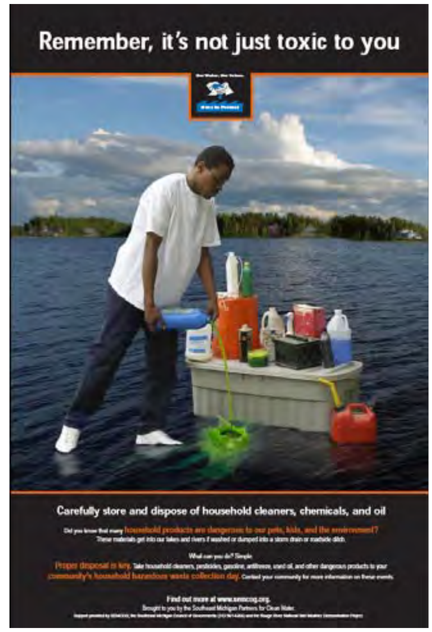
The PEPs contain numerous actions that are currently being implemented by SWAG entities. Most of this implementation is contracted with the CRWC or provided by SEMCOG (in support of its member communities), but some entities are engaged in their own or additional implementation. Many of these actions support the goals and objectives of this WMP and, as such, this action is included for reference.

The general components of the PEPs are listed in Chapter 4. A brief summary of these components includes:

- Community Education – consisting of watershed stewardship, stormwater system knowledge, illicit discharge program, personal actions impacting water quality, waste management / dumping, and riparian land management; and
- Youth Education – consisting of the community education components repackaged for students, other programs, experiments and activities, and lesson plans / info for teachers.

The limited summary given above is not comprehensive. Some of the permittees may include components of the following actions in their PEP.

Example of Public Education Materials



Courtesy of SEMCOG.

<u>Phase II Requirement</u>

The PEPs are currently being implemented outside of this WMP.

Reporting is currently done in the Annual Reports for each permittee.

Inclusion in the SWPPI is an option and is not required.

Voluntary Action – dependent on funding – unless included in PEP

Potential Targets for Business Education

Potential targets for business education include, but are not limited to:

- Marine-related businesses;
- Automotive maintenance centers;
- Restaurants;
- Junk yards;
- Golf courses; and
- Lawn care providers.

Agricultural Practices

The Michigan Right to Farm Act, P.A. 93, 1981, provides farmers with protection from nuisance lawsuits and authorizes the development and adoption of Generally Accepted Agricultural and Management Practices for farms in Michigan to promote sound environmental stewardship and help maintain a farmer's right to farm."

Source: www.michigan.gov/mda

Phase II Requirement

The 'Watershed-based Permit' language requires that the SWPPI include *a training and inspection program for staff and contractors*.

2-2 Additional Public Education [Public Ed.]

Additional activities and messages not included in an individual PEP may be considered for implementation by the SWAG or its constituent members. Where not part of an implementing entity's PEP, these actions may be eligible for grant funding:

- Additional Community Education – such as habitat conservation and restoration, native and invasive wildlife management, dissemination of planning and water quality information, registered watercraft owner information, recreation education, and a rain garden awareness program;
- Business Education – including how facilities and operations affect stormwater, pollution prevention activities to minimize this potential, environmentally-friendly construction, new ordinance details, and environmental audit assistance;
- Agricultural Education – such as how traditional agricultural practices affect soil erosion and receiving waters, encouraging the use of state-agency approved Generally Accepted Agricultural Management Practices (GAAMPS); and

  Agricultural education activities will require the involvement of appropriate agencies detailed in Chapter 7, including the Natural Resources Conservation Service (NRCS), Farm Service Agency (FSA), the Michigan Department of Agriculture (MDA), soil conservation districts and/or Michigan State University Extension (MSUE)..

2-3 Municipal Employee Training [Municipal Train.]

Municipal employee training refers to keeping staff, both in-house and contracted, aware of how their actions affect stormwater. While many different departments affect stormwater in some way, a key department is the maintenance department. Maintenance staff maintain fleet vehicles, store chemicals, sweep streets, clean catch basins, conduct lawn care, maintain dumpsters, dispose of solid waste, and de-ice the roads. If not done correctly or regularly, these activities can have an adverse affect on stormwater.

Each permittee will ensure the appropriate amount of training is attained by each staff member with the potential to directly impact stormwater runoff. Mainly, this training will be provided by SWAG entities other than the individual communities, such as SEMCOG or county-level governments.

2-4 Demonstration Projects [Demos]

Supporting demonstration projects for stormwater management at new developments or redevelopments will help the community, including municipal officials, developers, planners, residents, and businesses, understand how stormwater management techniques can be incorporated into the community. Developers may be more open to non-traditional techniques if they see that the techniques are successful or other incentives are provided. Demonstration projects will be chosen based on their minimization of impact to the environment, visibility, innovation, coordination with developer, and cost. Examples of demonstration projects include green roofs, pervious pavement parking lots, zero discharge development, residential rain gardens, and cluster development. Developers should be approached early in the project planning phase to incorporate low impact design techniques.

Similar to development and redevelopment demonstration projects, water quality friendly agricultural demonstration projects may be suitable to promote more extensive use of non-traditional techniques by farmers.

Voluntary Action – dependent on funding

2-5 Signage [Signage]

Educational signage refers to educating the public about specific issues through the use of signs placed strategically throughout the subwatershed. Examples of possible sign uses include:

- to mark watershed boundaries;
- to mark wellhead protection boundaries;
- to point out tips and directives at recreation areas such as "No Dumping" or "Don't Feed the Geese";
- to indicate times, at beaches, when it may not be safe to participate in water-based activities due to the presence of pathogens may reduce the risk of sickness; and
- to provide water quality, vegetation, and wildlife protection tips at boat launches.

Voluntary Action – dependent on funding – unless included in PEP

Watershed Sign

Courtesy of SEMCOG.

2-6 Public Involvement [Involvement]

WMP-participant support of volunteer-based watershed programs helps increase the public's involvement and subsequent awareness of watershed issues. Examples of public involvement programs that the SWAG may initiate or leverage to foster watershed stewardship and disseminate public education materials include adopt-a-road, adopt-a-river, children's water festival, water reuse rally, community focus/planning groups, storm drain marking/door hanger programs, clean-up days, and data collection (water quality, frog and toads, benthic macroinvertebrates).

Voluntary Action – dependent on funding – unless included in PEP

Voluntary Action – dependent on funding – unless included in PEP

2-7 Community Forums and Stakeholder Workshops [Meetings]

Community forums and stakeholder workshops provide a means to mold the ever-evolving WMP. It is critical to have community input in order for the watershed to work together as a whole toward the common goal of protecting and restoring the watershed. Public forums and stakeholder workshops were held to develop this WMP and may continue to be held periodically to keep the public informed and involved. Forums and workshops may include a report on progress made towards achieving the goals and objectives of the plan.

Voluntary Action – dependent on funding – unless included in PEP

2-8 Municipal Officials' Involvement and Education [Officials]

Involving and educating municipal officials (mayors, city/village councils, township trustees, department heads, zoning boards, planning commissions, etc.) on the existence, reason for, and contents of the WMP is essential to successful implementation of many of the actions.

Municipal officials may become involved by participating in workshops, demonstration projects, and public speaking engagements on community stormwater issues. Information can also be passed on to officials through letters, informational packets, and meetings. Educational topics may include:

- best management practices and standards that can be used to promote sustainability in the community and reduce point and nonpoint source pollution;
- model ordinances and information on existing programs that provide technical and cost-share assistance; and
- techniques for reviewing each development project for water quality impacts and a fair mechanism for rejecting those that would adversely affect water quality (e.g. violate water quality standards); and
- stormwater-related and other curricula to get feedback on adopting a standard curriculum into the school districts.

3 Ordinances, Zoning, and Development Standards

These actions consist of those that require administrative measures by the implementing agency and potentially a program supporting implementation. *The benefit of these actions is an improvement in surface water and groundwater quality through the prevention or minimization of the effects of urbanization or other pollutant sources.*

The Phase II Permittees are required to implement some combination of elements because the Watershed-based Permit requires:

> "The development, implementation, and enforcement of a comprehensive stormwater management program for post-construction controls for areas of new development and significant redevelopment. The goal is to protect the designated uses in the receiving water from the effects commonly associated with urbanization.
>
> The permittee shall evaluate and implement site appropriate, cost-effective structural and nonstructural BMPs that prevent or minimize the impacts on water quality. Common controls for urbanization include: policies and ordinances to direct growth to identified areas, to limit the rate and volume of stormwater discharged to pre-development hydrologic levels, to protect sensitive areas such as wetlands and riparian areas, and to maintain or increase open spaces; encouraging infill development in higher density urban areas and areas with existing infrastructure; establishing in-stream maximum flow targets designed to minimize streambank erosion and maintain healthy aquatic populations; and coordinating release volumes and rates from detention basins to achieve in-stream maximum flow targets."

The implementation of these actions, including development of ordinances, zoning changes, and development standards, will be coordinated with appropriate stakeholders, such as the Michigan Townships Association (MTA), planners, developers and homebuilders, and realtors to find incentives for developers to implement non-traditional stormwater management techniques. This coordination may be in the form of a roundtable discussion.

Implementing the following actions may include the development of design manuals containing:

- standards;
- inspection requirements;
- maintenance requirements;
- pollutant removal efficiencies for the different practices that developers can consider for to meet stormwater standards;
- site layout requirements; and
- natural features protection.

Recommended Implementation Approach

MDEQ personnel have indicated that they would like to see the appropriate entities in the subwatershed begin implementation of the actions in this category by conducting an internal review of programs and ordinances within two years of submitting this plan. The focus of the review should be to determine which ordinances support the actions in this category and what new ordinances or changes to existing ordinances are necessary to successfully implement these actions.

Phase II Requirement

The 'Watershed-based Permit' requires a comprehensive stormwater management program … for areas of new development and significant redevelopment.

This action will be tailored, as appropriate, for permittees in all settings, both urban and suburban.

This action is also desirable for implementation in rural (non-permittee) areas to minimize mitigation efforts in the future.

3-1 Stormwater Management Standards [Standards]

Because of the varying characteristics of the permittees in the subwatershed, they require a wide range of options to meet this Phase II requirement. Options that may be considered include:

- Discharge Limitations:
  - Of pollutant levels in runoff water (i.e. suspended solids, phosphorus, pathogens); and
  - Of peak flow rates and total runoff volume (i.e. limiting to pre-development levels);
- Infiltration Requirements:
  - Of total volume or percentage of site;
- Impervious Surface Limitations:
  - Of overall site imperviousness (i.e. road widths, cul-de-sacs, parking lots); and
  - Of directly connected impervious areas; and
- Natural Drainage Patterns:
  - Through minimization of site disturbance to retain natural topography;
  - Through restricting slopes to encourage sheet flow; &
  - Through preserving or reintroducing open channel conveyance with natural channel shapes and meanders.

This action is meant to allow both prescriptive and non-prescriptive approaches in combination. For example, some situations may require certain BMPs while others may require any combination of BMPs to achieve certain targets or limitations.

Phase II Requirement

The 'Watershed-based Permit' requires a comprehensive stormwater management program … for areas of new development and significant redevelopment.

This tailorable action is most appropriate for permittees in settings that have developable land, but is available as an option to all permittees to control redevelopment.

This action is also desirable for implementation in rural (non-permittee) areas to minimize mitigation efforts in the future.

3-2 Managing Development Patterns [Development]

Because of the varying characteristics of the permittees in the subwatershed, they require a wide range of options to meet this Phase II requirement. Options that may be considered include:

- encouraging infill and redevelopment (i.e. relaxing frontage and setback requirements);
- encouraging open space in development and redevelopment projects;
- implementing a site plan and review process;
- limiting future infrastructure expansion (i.e. sewer and water service boundaries);
- restricting the construction of private roads;
- developing urban growth boundaries;
- restricting development in the 100-year floodplain;
- setting large minimum lot sizes for development;
- requiring cluster development;
- implementing forest districts;
- implementing farming districts to preserve farmland;
- incorporating above and other measures into existing land use / master plans and zoning; and
- developing these if they don't currently exist.

3-3 Preserve Natural Areas / Features [Natural Features]

Because of the varying features of the permittees in the subwatershed, this action, or components thereof, may not be applicable. However, there are a wide range of features to protect and many considerations to make for their protection.

Features to be protected may include: pre-settlement areas, wetlands, waterbodies, riparian areas, headwater areas, groundwater recharge areas, forested areas, and habitat areas.

Measures for their protection may include:

- no net loss policies;
- restricting alteration of these areas (e.g. limiting road crossings);
- restricting disruptive or soil disturbing uses in or near protected areas;
- encouraging their connection to adjacent natural and undeveloped areas; and
- setback ordinances restricting development and significant maintenance from occurring within a specified buffer zone,

Stronger measures will specifically reference those known existing areas and features in need of protection and identify opportunities for including features in large-scale green infrastructure systems. Consideration should be given for the use of some of these areas as passive parks to increase support for action.

> **<u>Phase II Requirement</u>**
>
> **The 'Watershed-based Permit' requires a comprehensive stormwater management program … for areas of new development and significant redevelopment.**
>
> **This tailor-able action is most appropriate for permittees in suburban settings that have natural features, but is available as an option to all permittees.**
>
> **This action is also desirable for implementation in rural (non-permittee) areas to minimize mitigation efforts in the future.**

Other types of legal-based mechanisms the SWAG may be pursuing are those to prevent pollution from activities as opposed to land types.

3-4 Pollution Prevention Ordinances / Programs [Prevention]

Generally, these are not Phase II requirements. However, permittees may opt to use this action to support Phase II actions listed under Action Category 4 'Good Housekeeping and Pollution Prevention'. As such, some permittees may construe implementation of mechanisms under this action as components of, or in lieu of, some Action Category 4 Phase II requirements.

> **Voluntary Action – dependent on funding – unless indicated as a component of, or in lieu of, a Phase II requirement in Action Category 4**

Ordinances or programs that may be considered include:

- Requirements for the maintenance and disposal of wastes from private stormwater infrastructure;
- Requirements for private pavement (e.g. roads, lots) cleaning methods, cleaning schedules, and the disposal of wastes;
- Requirements for the restriction of phosphorus in fertilizers and the proper use of pesticides, herbicides, and fertilizers, including proper disposal of excess product;
- Requirements for waste management at vehicle service stations;
- Requirements for materials storage, spill prevention, and cleanup;
- Requirements for the use and maintenance of dumpsters;
- Requirements for proper solid waste management, including prohibitions against illegal dumping;
- Requirements for proper yard waste disposal; and
- Requirements for septic systems, including: site standards (e.g. exclusion areas, lot size requirements, setbacks), performance standards, point-of-sale inspections, and annual licensing based on proof of inspection.

Strong ordinances and programs will also address enforcement of the requirements.

4 Good Housekeeping and Pollution Prevention[1]

These actions consist of those that the SWAG members may take with respect to their facilities and encourage with respect to their employees, citizens, and other stakeholders. The purpose of good housekeeping and pollution prevention is to reduce the generation of pollutants and prevent those that have been generated from reaching environmentally sensitive areas, including waterbodies. *The benefit of good housekeeping and pollution prevention is the improvement of surface water and groundwater quality by minimizing the impacts of pollution generating activities.*

Some of these actions are Phase II requirements as the Watershed-based Permit requires:

> "The submission of the SWPPI (Stormwater Pollution Prevention Initiative) shall, at a minimum, include…the evaluation and implementation of pollution prevention and good housekeeping activities, as appropriate. This item shall include a training and inspection program for staff and contractors employed by the permittee in activities that may affect stormwater runoff. The permittee shall include the following activities for inclusion in the SWPPI, or explain why the activities do not apply: maintenance activities, maintenance schedules, and inspection procedures for stormwater structural controls to reduce pollutants (including floatables) in discharges from the permittee's separate stormwater drainage system; controls for reducing or eliminating the discharges of pollutants from streets, roads, highways, parking lots, and maintenance garages; procedures for the proper disposal of operation and maintenance waste from the separate stormwater drainage system (dredge spoil, accumulated sediments, floatables, and other debris); ways to ensure that flood management projects assess the impacts on the water quality of the receiving waters and, whenever possible, examine water quantity structures for incorporation of additional water quality protection devices or practices; and implementation of controls to reduce the discharge of pollutants related to application of pesticides, herbicides, and fertilizers applied in the permittee's regulated area."

[1] The definition of pollution prevention used in this plan is that which is used in the Watershed-based Permit language. Other programs utilize different definitions and this is important to consider, especially when applying for pollution prevention grants.

4-1 Identify Sources of Sediment Contaminants [Sed. Sources]

Not a Phase II Requirement

An objective of this WMP is to select and implement pollution prevention activities for current and future sources of sediment contamination. This action embodies the first step in that process: identifying the sources. To accomplish this, the SWAG may take the following steps:

- Reference the WMP and additional sources to identify all sediment contaminants present in the subwatershed;
- Review the WMP, scientific literature, a survey of stakeholders, and visual assessments to generate a list of sources and their respective locations, including Part 201 sites and 'Superfund' sites; and
- Generate a document, and/or database, that summarize this information. These may feed into the decision-making process for implementing the remaining pollution prevention and good housekeeping actions (4-2 through 4-16) such that the current and future sources of sediment contamination are considered.

4-2 Identify Actions to Remediate Contaminated Sediments [Remediation]

Voluntary Action – dependent on funding

Where sediment contamination exists, it is desired to identify clean-up opportunities that are cost effective and non-threatening to the environment (in terms of contaminant re-suspension). Building on the identification of sediment contaminants performed in Action 4-1, research may be conducted to identify existing and emerging technologies to remediate the sediment. This information will be provided to SWAG members, along with identified funding opportunities (see the Funding Program – Action 1-3), for them to explore the possibility of implementing remediation activities and obtaining funding for such (as the actual implementation of such activities is outside of the scope of this plan).

4-3 Storm Sewer System Maintenance and Operations [Storm Sewer]

<u>Phase II Requirement</u>

The 'Watershed-based Permit' language requires that the SWPPI include *maintenance activities, maintenance schedules, and inspection procedures for stormwater structural controls* and *procedures for the proper disposal of operation and maintenance waste from the separate stormwater drainage system.*

Committing permittees will define procedures to ensure that inspection, maintenance, and cleaning of the storm sewer system are done in such a manner that pollutant discharges from the system are minimized. Additionally, the procedures will include provisions for the proper disposal of wastes generated from these activities.

The procedures may include:

- implementation of an optimized catch basin and BMP cleaning schedule;
- a program that disconnects any downspouts which are directly connected to the storm sewer system and reroutes them to discharge onto pervious or vegetated areas;
- an asset inventory to ensure that all infrastructure is accounted for and documented; and
- a labeling program for the storm sewer infrastructure to ensure accurate field work and cross-referencing with an asset management database.

> **Phase II Requirement**
>
> **The 'Watershed-based Permit' language requires that the SWPPI include *controls for reducing or eliminating the discharges of pollutants from streets, roads, highways, parking lots….***

4-4 Minimizing Pollution from Roads and Lots [Roads / Lots]

Committing permittees will define procedures to ensure that the discharges of pollutants from streets, roads, highways, and parking lots are minimized.

The procedures may include:

- proper design, construction, maintenance, and reconstruction of roads, utilities, and their waterbody crossings (including proper materials handling/disposal);
- an optimized street and parking lot sweeping schedule;
- an optimized street and parking lot sweeping protocol (e.g. wet instead of dry to minimize wind transport);
- an optimized pavement de-icing protocol;
- an optimized fire hydrant flushing protocol; and
- consideration of structural BMPs, as necessary.

> **Phase II Requirement**
>
> **The 'Watershed-based Permit' language requires that the SWPPI include *controls for reducing or eliminating the discharges of pollutants from … maintenance garages.***

4-5 Minimizing Pollution from Municipal Facilities [Garages]

Committing permittees will define procedures to ensure that the discharge of pollutants from maintenance garages is minimized.

The procedures may include:

- vehicle fleet management requirements (e.g. purchasing requirements, non-polluting service areas, washing vehicles in proper locations);
- materials storage and spill prevention requirements; and
- consideration of structural BMPs, as necessary.

> **Phase II Requirement**
>
> **The 'Watershed-based Permit' language requires that the SWPPI include *controls to reduce the discharge of pollutants related to application of pesticides, herbicides, and fertilizers…***

4-6 Turf Management Practices [Turf Practices]

Committing permittees will define procedures to ensure that the discharge of pollutants such as pesticides, herbicides, and fertilizers from turf areas is minimized.

The procedures may include:

- restrictions on the types and amount of fertilizers, pesticides, and herbicides that can be used;
- proper training and certification for pesticide applicators;
- optimum watering protocols;
- optimum mowing protocols; and
- standards and incentives to accelerate the planting of trees on both public and private lands.

> **Voluntary Action – dependent on funding**

4-7 Waste Management [Waste]

One component of waste management is managing solid waste. SWAG members may choose to implement new or augment existing programs, including:

- A recycling program (e.g. curb-side collection & drop-off);
- A hazardous waste management program (e.g. household hazardous waste collection, electronics drop-off, oil and grease collection, mercury thermometer exchange;
- A dumpster management program that ensures that all trash is inside the dumpster, it is covered, and that it is not discharging contaminated stormwater;
- A yard waste collection/management program (e.g. curb-side collection & drop-off; composting and reuse/selling);
- Support of legislative efforts to reduce pollutant discharges, especially those of concern in the subwatershed, from all sources including air emissions; &
- Regular evaluation of MDEQ data related to point sources.

> **Solid Waste Management Plans**
>
> When implementing this action, entities will have to follow the rules defined by any Solid Waste Management Plan that may apply.

4-8 Animal Waste Control [Animal Waste]

Voluntary Action – dependent on funding

Animal waste has the potential to contribute to pathogen and nutrient contamination of waterbodies. In order to minimize this potential, the SWAG members may choose to implement new or augment existing programs, including:

- Evaluating the impacts of animals (wild, pet, and livestock) on *E. coli* levels in waterbodies and developing/participating in a regional bacterial source tracking system;
- Requiring the collection and proper disposal of pet wastes;
- Identifying areas where wild animal populations (e.g. geese) contribute to waterbody contamination and prescribing the appropriate measures to deter animals from congregating; and
- Defining and promoting pet run areas away from waterbodies where feasible.

4-9 Sanitary and Combined Sewer System Planning and Maintenance [San. Sewer]

Voluntary Action – dependent on funding

Planning and maintenance of sanitary and combined sewers is critical in preventing the occurrence of sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs). There are a number of considerations to make in this realm, including:

- Giving high priority to connecting areas of septic service, particularly those areas causing documented problems;
- Ensuring proper plant capacities and interceptor capacities;
- Replacing failing system components;
- Constructing facilities or implementing programs to prevent the occurrence of CSOs, SSOs, and basement backups (e.g. infiltration and inflow programs including downspout disconnection);
- Improving municipal and industrial pretreatment programs (e.g. reduced pollutant concentrations, reduced flows – provides offset capacity for service expansion);
- Defining of future service areas or to guide development and preserve natural areas; and
- Employing operating and maintenance procedures that minimize the generation and discharge of pollutants.

SWAG members may choose to directly address some of these considerations. However, in some cases, the SWAG members may have little direct influence on the decision-making process and must rely on expressing these concerns as recommendations to the appropriate entities.

Phase II Requirement

The 'Watershed-based Permit' language requires that the SWPPI includes *ways to ensure that flood management projects assess the impacts on the water quality of the receiving waters and, whenever possible, examine water quantity structures for incorporation of additional water quality protection devices or practices.*

4-10 Flood Control Projects [Flood]

Committing permittees will define mechanisms for assessing the impacts of flood management projects on water quality and examining water quantity structures for incorporation of additional water quality protection devices or practices.

The mechanisms may include:

- Making recommendations to other entities engaging in flood control management to report the impacts on water quality; and
- Instituting a program to examine water quantity structures under the permittee's jurisdiction, developing a prioritized program to retrofit these structures, and implementing the prioritized program.

Phase II Requirement

The IDEPs are currently being implemented outside of this WMP.

Reporting is currently done in the Annual Reports for each permittee.

Inclusion in the SWPPI is an option and is not required.

IDEP Hotline Numbers

Macomb County 877 679 4337

4-11 Illicit Discharge Elimination Plan Implementation [IDEP]

The IDEPs contain numerous activities for identifying and correcting illicit connections that are currently being implemented by SWAG entities. This action supports the goals and objectives of this WMP and, as such, this action is included for reference.

The IDEPs contain at least some of the following characteristics:

- dry weather screening of outfalls into waters of the state;
- dye testing municipal facilities, including swimming pools;
- provisions for determining the source and responsibility of the discharge, and ownership and maintenance of the sewer system and drains;
- an integration of outfall inspections and reporting during routine field operations;
- a 24-hour hotline that provides the public an immediate mechanism to report any water quality issues; and
- updates to outfall location maps, when appropriate.

Permittees may wish to implement additional related activities that are not included as part of their IDEP. Non-permittee SWAG members may also wish to implement some of these listed, or unlisted, activities. Where not part of an implementing entity's IDEP, or in the case of non-permittees, these activities may be eligible for grant funding.

An additional consideration for funding is expanding the scope of the hotlines to be used for: 1) documenting violations of natural features protection (i.e. dumping, tree removal); 2) reporting recreational hazards such as log jams; and 3) providing information for those residents wishing to become more involved or participate in pollution prevention and conservation activities.

4-12 Septic System Practices [Septic]

Voluntary Action – dependent on funding

The SWAG and/or its members may develop a program to minimize pollutant discharges from:

- single and two family residential septic systems;
- commercial and small community septic systems discharging up to 10,000 gallons per day; and
- other On-site Sewage Disposal Systems (OSDS), as appropriate.

In Michigan, the local health departments, with autonomous sanitary codes, are the primary regulators for single and two family residential septic systems. Commercial and small community septic systems discharging up to 10,000 gallons per day fall under the "Michigan Criteria for Subsurface Sewage Disposal". This statewide document is carried out by the local health departments under certification by the MDEQ.

Septic system practices to be implemented may include:

- Technical assistance (clustering systems, maintenance education, maintenance districts, leaching chambers, siting, etc.);
- Inspections (point-of-sale, annual licensing, performance level, identification of failing systems, etc.);
- Enforcement (correction of problems, maintenance checks, etc.);
- Recommendations for alternative technologies in areas where septic systems and sewers are not highly feasible sewage disposal methods; and
- Incentives for septage transfer stations and convenient disposal facilities.

The proper implementation of this action may require revisions to the local health or sanitary code in addition to other legal-based mechanisms.

4-13 Trash / Debris Reduction [Trash]

Voluntary Action – dependent on funding

The SWAG and/or its members may develop a program to identify sites that have excessive trash and debris and to prioritize these sites.

This program may include procedures for removing the trash and debris and will be coordinated with volunteer activities conducted under Action 2-6 (e.g, Adopt-A-Road, Adopt-A-River).

Additionally, measures may be instituted to ensure that all events which result in excessive trash, such as festivals and street fairs, are coordinated with the appropriate O&M Departments.

4-14 Spill Prevention / Notification / Response [Spills]

Voluntary Action – dependent on funding

The SWAG and/or its members may develop a spill prevention, notification, and response program which may include assistance with investigation of major spills to waterways, fish kills and other emergency water quality issues.

Voluntary Action – dependent on funding

4-15 Marine Industry Activities [Marine]

The SWAG and/or its members may develop a program to prevent pollution from marine-related activities. Some components of this program may include:

- Requirements for marinas and boat maintenance facilities;
- Increasing the number of pump-out stations to accommodate boater demand; and
- Supporting the Great Lakes Dredging Team which develops guidance for acceptable contamination thresholds for different uses of dredged material.

Voluntary Action – dependent on funding

4-16 Groundwater [Groundwater]

The SWAG and/or its members may develop a program to prevent the pollution of groundwater and ensure that levels are maintained by ensuring proper recharge and restricting overuse. Components of such a program may include:

- A groundwater inventory to identify areas of groundwater recharge and vulnerable areas, as well as their proximity to potentially polluting activities or land uses. This assessment may consider the needs of future developing areas;
- Wellhead protection areas may be delineated based on the results of the inventory and signage erected to identify the areas. The development of wellhead protection plans may be considered, and if pursued, may be coordinated with the MDEQ's Water Wellhead Protection Program; and
- An abandoned well locating, inspection, and closure program may be implemented. This may include supporting legislation to increase regulatory control at the state and local level thus making the process more cost-effective.

Abandoned Well Issues

It has been recommended that entities wishing to locate and close abandoned wells should involve the county health department. In many cases, it is their responsibility to ensure that abandoned wells are sealed.

Municipal authorities can encourage formal abandonment by requiring cross-connection installation and testing for wells that may remain active after buildings are connected to municipal water supplies.

Source: Mair, 2006.

5 Stormwater Management Best Management Practices: Non-Construction-Related Soil Erosion and Sediment Control

These actions are generally those that can be implemented to begin the process of achieving pollutant loading reductions in the short term, extending into the long term. These actions consist of those specifically targeted to prevent soil erosion, control sediment from non-point sources or potential point sources, and correct known soil erosion problems. Early implementation of these actions should focus on public lands, with long-term implementation including private lands if necessary. *These actions benefit surface water quality by identifying areas of significant soil erosion and utilizing controls to prevent or minimize sediment discharge to waterbodies.*

Specific sources to identify include:

- Bare soil areas;
- Streambank erosion areas;
- Road erosion areas;
- Problematic uses within the riparian corridor;
- Specific sites potentially generating considerable amounts of pollution (i.e., landscape supply companies, landfills, quarries, concrete suppliers, etc.);
- Wind erosion areas;
- Other areas requiring structural controls; and
- Agricultural areas generating pollution.

It is noted that construction-related soil erosion and sediment control is a recognized potential source of sediment; however this source is addressed through other permit programs and is not a component of this plan. SWAG members wishing to address this source should explore becoming involved in the authorizing and enforcing hierarchy regulated by the MDEQ (refer to Chapter 7 for additional discussion on this topic).

5-1 Bare Soil Repair [Bare Soil]

Voluntary Action – dependent on funding

Areas of bare soil have the potential to erode and load sediment into waterbodies. The most problematic bare soil areas are those near waterbodies or those near impervious surfaces. The SWAG and/or its members may take the following steps to repair bare soil areas:

- Utilizing the pollutant source identification (Action 1-10), repair soil problem areas on public land and contact private landowners to encourage repair;
- Researching the possibility for instituting corrective action on private lands through various enforcement mechanisms; and
- Implementing enforcement mechanism if possible, and correct bare soil problems on private lands.

Efforts to repair bare soil include grass or native vegetation planting and sod placement or the use of containing structures, retaining walls, or terracing. Steep slopes which contribute to the problem may be mitigated with stabilization structures, including vegetation, and grade breaks.

Voluntary Action – dependent on funding

5-2 Streambank / Shoreline Stabilization [Stabilization]

Streambank and outfall erosion are of critical concern because the eroded soil directly enters a waterbody. The SWAG and/or its members may take the following steps to stabilize streambanks:

- If seeking MDEQ funding for streambank stabilization, obtain documentation that stream hydraulics will not cause the problem to re-emerge;
- Utilizing the pollutant source identification (Action 1-10), repair eroding streambanks in accessible locations; and
- Seek access to problematic locations through interactions with appropriate stakeholders and repair streambanks when access issues are resolved.

Voluntary Action – dependent on funding

5-3 Road and Ditch Stabilization [Roads]

Road and ditch erosion is of critical concern because the eroded soil may directly enter the storm sewer system or a nearby waterbody (through runoff or by wind action) and may also cause a public safety concern. The SWAG and/or its members may take the following steps to stabilize roads and ditches:

- Utilizing the pollutant source identification (Action 1-10), repair failing paved roads, pave or stabilize dirt roads, and stabilize ditches and embankments on public land and contact private landowners to encourage repair;
- Researching the possibility for instituting corrective action on private lands through various enforcement mechanisms; and
- Implementing enforcement mechanism if possible, and correct eroding roads and ditches on private lands.

Voluntary Action – dependent on funding

5-4 Streambank Use Exclusion [Use Exclusion]

Certain activities in the riparian corridor may exacerbate soil erosion problems. These may include ad hoc walking trails too near a waterbody (as opposed to planned and properly constructed trails) or livestock with access to a stream. The SWAG and/or its members may consider the following to exclude problematic uses from streambank access:

- Utilizing the pollutant source identification (Action 1-10) to identify problematic uses;
- Installing physical barriers to restrict access where appropriate and feasible;
- Installing educational / informational signage; and
- Engaging in cooperative efforts with riparian landowners to restrict harmful uses.

5-5 Specific Site Control [Specific Sites]

Voluntary Action – dependent on funding

Certain sites in the subwatershed, such as (e.g. landscaping supply companies), have the potential to generate large amounts of sediment that may unintentionally enter the stormwater drainage system either on-site or by being transported off-site and deposited on impervious surfaces. The SWAG and/or its members may consider the following to minimize pollution from sensitive sites:

- Utilizing the pollutant source identification (Action 1-10) to identify specific sites;
- Developing appropriate procedures or structural modifications to implement at these sites and working with the sites to realize the improvements (i.e. on-site vehicle washing for vehicles dealing with sediment generating substances); and
- Installing appropriate structures in the public right-of-way (i.e. rock entrances designed to dislodge sediment from vehicle tires).

5-6 Structural Controls [Structural]

Voluntary Action – dependent on funding

Where point sources cannot be controlled with sensitive site actions (see 5-5) or non-point sources are a problem, structural controls may be added that intercept sediment either before it enters or before it is discharged from the storm sewer system. The SWAG and/or its members may consider referencing the pollutant source identification (Action 1-10) and constructing appropriate structures (e.g. catch basin inserts, grit chambers) where appropriate to achieve pollutant load reductions.

The implementation of structural controls should be coordinated with road or utility work to reduce installation costs.

5-7 Agricultural BMPs [Agricultural BMPs]

Voluntary Action – dependent on funding

Runoff and wind-borne pollutants from agricultural areas have the potential to introduce excessive loadings of pollutants into waterbodies. The SWAG and/or its members may consider the following to minimize pollution from agricultural locations:

- Utilizing the pollutant source identification (Action 1-10) to identify agricultural sources;
- Encouraging agricultural land operators to implement appropriate actions and encouraging them to work with appropriate agencies and funding programs;
- Contacting appropriate agencies to begin dialogue with operators and seek implementation of actions; and
- Implementing mechanisms in the public right-of-way in problematic locations where operator cooperation has not been obtained.

6 Stormwater Management Best Management Practices: Other Pollutant Load Reducing Controls

These actions are those that are expected to be implemented in the long-term to achieve the majority of pollutant loading reductions in accordance with targeted levels (see Chapter 5). These actions can be implemented on public lands but are more geared towards private land implementation. Many of these actions can be implemented during new development and significant redevelopment (see '3 Ordinances, Zoning, and Development Standards'), although retrofit implementation (the type required to quantify pollutant loading reductions) is likely to require a significant funding source, due to the intensive nature of many of these actions. Implementation of the following actions should rely on the pollutant source identification (Action 1-10). These actions are applicable to the major stressors that impact the subwatershed: sediment, phosphorus, and pathogens, and flow. *Similar to Category 5, Category 6 actions benefit surface water quality through the implementation of controls to prevent or minimize pollutant discharge to waterbodies.* For implementation of these activities, coordination with developers and government officials should be sought to gain support for these type of projects (see Actions 3-1, 3-2, and 3-3).

Refer to Chapter 7 for additional information concerning the following actions.

Voluntary Action – dependent on funding

6-1 Mitigate Existing Impervious Surfaces [Imperviousness]

By managing runoff from impervious surfaces before it enters the storm sewer system or nearby waterbody, peak flow rates, total volume runoff, and pollutant concentrations can be reduced.

The SWAG and/or its members may consider the following to mitigate existing impervious surfaces:

- Vegetated parking lot islands;
- Vegetated road medians;
- Green roofs;
- Pervious pavement / pavers;
- Rain barrels and cisterns (only with timely usage or interim draining protocols being followed); and
- Managing flow from bridge scupper drains.

Voluntary Action – dependent on funding

6-2 Infiltration Techniques [Infiltration]

Using infiltration techniques to manage runoff reduces peak flow rates, total volume runoff, and pollutant concentrations that would otherwise enter the storm sewer system and impact a nearby waterbody. Infiltration techniques refer to practices which promote groundwater recharge and where the soils are conducive for infiltration.

The SWAG and/or its members may consider the following to reduce stormwater impacts through infiltration:

- Rain gardens / tree boxes / bioretention;
- Infiltration basins;
- Infiltration trenches;
- Porous pipe and underground infiltration systems; and
- Water spreading.

6-3 Filtration Techniques [Filtration]

Voluntary Action – dependent on funding

Filtration techniques are similar to infiltration techniques in that they reduce peak flow rates, total volume runoff (if bio-filtration is used), and pollutant concentrations. They differ in that filtration is usually used in areas where the soils are not appropriate for infiltration. Subsequently, filtration techniques bring in an alternative filtering media, such as sand, and use an underdrain to direct the treated water to a storm sewer system or waterbody.

The SWAG and/or its members may consider the following to reduce stormwater impacts through filtration:

- Sand/ organic / media filters (surface and underground);
- Pocket filters;
- Intermittent filters;
- Recirculating filters;
- Filter strips; and
- Perimeter sand filters.

6-4 Vegetative Buffers & Natural Conveyance [Natural Buffers]

Voluntary Action – dependent on funding

Using vegetative conveyance to manage runoff reduces peak flow rates, pollutant concentrations, and in some cases total volume runoff that would otherwise enter the storm sewer system or nearby waterbody.

The SWAG and/or its members may consider the following to reduce stormwater impacts through vegetative buffers and natural conveyance:

- Herbaceous and forested riparian buffers;
- Wet and dry swales; and
- Vegetated channels.

6-5 Retention and Detention [Re-/Detention]

Voluntary Action – dependent on funding

Using retention and detention to manage runoff reduces peak flow rates, pollutant concentrations, and total volume runoff that would otherwise enter the storm sewer system or nearby waterbody.

The SWAG and/or its members may consider the following to reduce stormwater impacts through vegetative buffers and natural conveyance:

- Detention / retention ponds;
- Pond/wetland systems;
- Extended detention wetlands;
- Shallow wetlands; and
- Submerged gravel wetlands.

7 Natural Features and Resources Management

These actions target the identification, protection, and restoration of natural features within the subwatershed. Natural features include animal habitat, land preserves, water resources, geology, and wildlife. *The benefit of these actions is to our natural resources that provide economic and social benefits as well as vital habitat for wildlife and aquatic animals.*

Voluntary Action – dependent on funding

7-1 Identify Natural Features [ID Natural Features]

Identifying natural features in the subwatershed is integral to implementing other protection and restoration actions. The natural features identification will be prepared by the SWAG and will rely heavily on the contents of this WMP and should utilize any information generated or updated since this WMP was submitted, input from other state, regional, and local resources, and field verifications. The identification should prioritize locations that should be targeted for protection and restoration (along with noted deficiencies), and also:

- which features are unprotected and which are in imminent danger, including: shoreline areas; amphibians, reptiles, and mussels; endangered/threatened species; and sources of woody debris;
- the most effective method for protecting specific features;
- the cost associated with the protection method;
- any limits to preservation and/or restoration (incompatible adjacent land uses and site contamination);
- any factors reinforcing candidacy for preservation and/or restoration, including:
  - proximity to other protected areas or waterbodies;
  - inclusion in existing green infrastructure such as trails or natural corridors;
  - connecting a variety of natural community types;
  - seeking to increase contiguous natural area; and
  - increasing the acreage of underrepresented communities;
- the current ownership status;
- the lead organization for implementing the protection measure, including the ultimate owner of the land and/or development rights; and
- maps of appropriate detail.

Natural Features Information in the WMP

As a basis for the natural features identification, the WMP has summarized information in the Michigan Natural Features Inventory, Macomb County Natural Features Inventory, Lake St. Clair Environmental Characterization / Coastal Habitat Restoration and Conservation Plan, 'Explore Our Natural World: A Biodiversity Atlas of the Lake Huron to Lake Erie Corridor', and numerous other documents.

Voluntary Action – dependent on funding

7-2 Natural Land Reserves [Land Reserves]

This action deals with the preservation of land as natural area and to add to the green infrastructure. Action 3-3 embodies the passive method of preserving natural areas: passing ordinances and zoning. This action is comprised of active preservation methods, including: purchasing land, purchasing/transferring development rights, conservation easements, land trusts, leases, deed restrictions, and covenants. This action should be implemented mainly through the SWAG members coordinating with and supporting the work of conservancy groups and government agencies, but may be implemented by the SWAG members themselves if appropriate situations arise. Incentives such as tax credits may also be developed for allowing natural features to be restored through such actions as conservation easements or long-term leases.

7-3 Natural Feature Protection [NF Protection]

Voluntary Action – dependent on funding

The SWAG and/or its members may consider protecting natural features in the public domain as well as encouraging and helping facilitate protection on private lands. Some directives upon which to implement actions for natural feature protection may include:

- Ensuring appropriate boundaries around natural areas and waterbodies are established to exclude incompatible land uses and other problem activities (except designated access spots);
- Ensuring wetlands and floodplains are hydraulically available to be used for water retention purposes;
- Ending the practice of straightening and enclosing drains;
- Changing existing dam operations such that minimum flow requirements are established and met and dams are operated as fixed crest structures (not as opened / closed gates);
- Restrict the construction of new dams, in-line detention basins, and lake-level regulators to protect natural water cycles, protect wetlands, and ensure adequate stream flow;
- Remove dams that are no longer used for their original purpose, are a safety hazard, or have failed (the exception is the Yates Dam which currently provides biological control benefits– see the Clinton River Assessment [Francis, 2005]);
- Managing shoreline erosion by utilizing alternatives to traditional shoreline hardening;
- Restricting new, or focusing mitigation on existing, impervious areas near waterbodies and wetlands;
- Engaging in fisheries and aquatic habitat management activities with sport fishing and conservation groups
- Engaging in terrestrial habitat management;
- Engaging in threatened and endangered species management;
- Supporting implementation of Michigan's Aquatic Nuisance Species State Management Plan Update, noting that the U.S. Coast Guard has primary control over ballast water discharges (which introduce most nuisance species); and
- Developing a comprehensive aquatic wildlife program.

7-4 Natural Feature Restoration [NF Restoration]

Voluntary Action – dependent on funding

The SWAG and/or its members may consider restoring natural features in the public domain as well as encouraging and helping facilitate restoration measures on private lands. Example activities to restore natural features include:

- Daylighting streams;
- Utilizing/encouraging native plantings & management techniques;
- Engaging in or encouraging reforestation and the planting of trees;
- Protecting endangered and threatened species;
- Eradicating invasive and exotic species;
- Advocating the use of backyard conservation programs by private citizens to add valuable habitat in developed areas;
- Supporting the stocking of native fish in streams;
- Managing areas to provide habitat and act as corridors between natural areas (such as utility corridors and roads);
- Incentives for private landowners to allow the reestablishment of vegetated buffers around already impacted waterbodies; &
- A wetland mitigation/expansion program.

Recreation Consideration

To ensure funding is available to assist in the implementation of these actions, each entity should ensure that desired actions (and associated activities) are documented in a Recreation Master Plan.

8 Recreation Promotion and Enhancement

These actions relate to increasing recreational opportunities in the watershed and providing education within the recreation areas related to habitat, natural features, and the watershed. *These actions benefit the public by connecting them to their water resources and fostering a stewardship ethic.*

Voluntary Action – dependent on funding

8-1 Recreation Program [Recreation Program]

To enhance and create recreation areas in the subwatershed, the SWAG and its members may coordinate with existing recreation programs to:

- target locations to provide public education;
- minimize the impacts that problematic activities have on water resources; and
- identify locations to provide recreation activities and facilities.

Voluntary Action – dependent on funding

8-2 Riparian Land Conservation for Parks [Riparian Parks]

For the SWAG and/or its members, incorporating riparian land into parks is a way to conserve this area and let the community enjoy the resource. When using sensitive riparian land for new parks, consideration should be given to leaving vegetated buffers along the water's edge and keeping parking lots away from the water. Existing riparian parks with modified riparian corridors may consider: utilizing stormwater management techniques, reducing grass mowing and fertilizing, and addressing any other maintenance issues that may affect the waterbody.

Voluntary Action – dependent on funding

8-3 Canoe / Boat Landings / Access Sites [Access]

The SWAG and/or its members may consider adding or enhancing existing access sites to help promote recreation. Access sites provide a stabilized area to access the water, thus protecting other locations. They also provide an opportunity to educate the public about the watershed and how their actions can affect water quality and recreational opportunities.

The SWAG may also support legislation to add a recreational component to the definition of navigability. This may help define a public right on streams, especially smaller ones, to use the waterbody for recreational activities.

Voluntary Action – dependent on funding

8-4 Restore Fishing Opportunities [Fishing]

The SWAG and/or its members may consider restoring natural fisheries that may currently be compromised. While large-scale wildlife management is the function of the Michigan Department of Natural Resources, certain local activities can provide benefits in terms of habitat restoration, migration assistance/blockage removal, and public access that will increase recreational fishing opportunities.

Voluntary Action – dependent on funding

8-5 Trails / Observation Decks [Trails / Decks]

Similar to Action 8-3, the SWAG and/or its members may consider adding or enhancing trails and observation decks to help promote recreation. These facilities provide access to natural areas while controlling and minimizing disturbances. They also provide an opportunity to educate the public about natural features and impacts to them. It may be necessary to increase the public right-of-way if seeking to add trails in certain areas.

Relationship to Goals and Objectives

The actions discussed in this section have been selected to make progress towards achieving the goals and objectives. The relationship of the actions to the goals / objectives (and other requirements) is presented in Table 8-1.

The actions are indexed to the goals / objectives as either 'primary' or 'secondary'. Primary actions for a goal / objective are those in which the goal language explicitly or implicitly addresses specific wording of the goal / objective or is likely to provide quantifiable load reductions for pollutants related to the goal / objective. Secondary actions may address specifics of a goal / objective but require implementation information that has not been generated at the plan level or may provide load reductions for pollutants related to the goal / objective but the load reductions are non-quantifiable.

Also in the table, the actions denoted as Phase II requirements are marked with an asterisk. In this plan, all of the goals / objectives have at least one action supporting them in the primary / secondary category. However, because the Phase II program does not deal with funding or recreation, there are no Phase II actions supporting goal / objective III.A.i, III.A.ii, VI.A.i, VI.A.ii, and VI.A.iii.

Additional Actions

An additional set of actions designed to provide an evaluation and revision mechanism for this WMP is defined in Chapter 9.

Sources of the Actions

The actions laid out in this WMP have been generated through consideration of numerous sources, including:

- Watershed-based Permit Requirements;
- The SEMCOG Water Quality Management Plan;
- The Clinton River Assessment (Francis, 2005);
- Clinton River Watershed Remedial and Preventative Action Plan, 1998;
- The St. Clair River and Lake St. Clair Comprehensive Management Plan, June 2004;
- Storm Water Pollution Prevention Initiatives of various permittees; and
- Other Watershed Management Plans representing various permittees.

Action Details

This section presents the details of the actions. Table 8-2 lists the actions and includes the following columns:

- Number (**No.**) – lists the action category and action number;
- **Action** – gives the action title;
- **Lead** – indicates the lead agency in charge of the action (only reflects who will coordinate/initiate an activity and does not imply complete responsibility) and includes: 'SWAG' and 'Permittees';
- **Schedule** – gives the **begin and end** schedule for an action (short term = prior to 2010; long term = after 2010), milestone year, the cycle for the action, and an indication of whether or not the action has been started or is complete;
- **Cost Estimate** - indicates material costs and labor hour estimates, and the details, primary cost bearer, and cost cycle to implement an action;
- **Assistance Needed** - indicates financial and technical assistance needed to implement an action;
- **Authority** – lists the federal, state or local legislation, or other mechanism, which allows, prohibits, or requires an action;
- **Comments** – lists any additional detail about the action;
- **Include in SWPPI** - indicates whether or not the action (or a portion thereof) is to be included in the SWPPI or is optional (Y, N, O); and

History of Actions Taken

Various entities in the Clinton River Watershed and surrounding areas have implemented watershed protection actions in the past. The 1988 MDNR RAP identifies some of these, including:

- Implementation of drain commissioner requirements for stormwater detention;
- Adoption of sewer service areas map;
- Establishment of Areawide Water Quality Board;
- Designated Management Agency agreements;
- Educational materials;
- Technical assistance projects;
- The CRWC strategy for stormwater management in urbanizing watersheds (assessment report, technical assistance directory, guide for stormwater management, master stormwater policy plans, etc.);
- Consideration of water quality and habitat conditions in flood control planning studies and projects by the USACE;
- Dredging of the Clinton River mouth segment and consideration of ideas to improve the conditions of this segment;
- Stricter enforcement of NPDES permit compliance;
- Proactive environmental policies implemented by private entities;
- Habitat improvements; and
- River cleanups.

Source: MDNR, 1988.

Many of these actions have continued to the present day, and many other actions not listed here have been implemented in the intervening time.

- SWPPI Commitment Level – indicates whether or not, and to what level, each permittee is committing to the Phase II actions; the commitment levels are as follows:

  - - = no commitment by the Phase II Permittee as the action is not applicable;

  N = no commitment by the Phase II Permittee as the action is not able to be implemented;

  W = no commitment by the Phase II Permittee, but would like to consider implementing the action if funding is acquired;

  Y = Phase II Permittee commits to the action;

  E = Phase II Permittee commits to the action and is already doing it in some capacity; and

  D = Phase II Permittee commits to the action and has already completed it.

Any disagreements that a SWAG member or Permittee may have with the actions of the plan, or any other part, are detailed in Appendix E.

Financial and Technical Assistance

To assist the SWAG and its members in implementing the actions of the plan, sources of financial and technical assistance have been identified. In Table 8-3 potential grant programs and technical resources are identified for each action. Table 8-4 cross-references the funding programs with the numerical references assigned in Table 8-3.

Table 8-1. Relationship of actions to goals and objectives.

Goal / Objective	SWAG	ERG*	Funding	Grants	Update SWPPI*	Update WMP*	Annual Reports*	TMDLs*	Clearinghouse	Sources	PEP*	Public Ed.	Municipal Train.*	Demos	Signage	Involvement	Meetings	Officials	Standards*	Development*	Natural Features*	Prevention
VII.C.i - Green Infrastructure																			●	●	●	
VII.B.ii - NF Restoration Plan								○			○											
VII.B.i - Identify NF Restoration											○											
VII.A.ii - NF Protection											○								○	○	●	○
VII.A.i - Natural Features Inventory																				○		
VI.B.ii - Implementation Mechanism	●	●	●		●	●	●		●													
VI.B.i - Institutionalize Plan	●					●																
VI.A.iii - Create New Funding			●																			
VI.A.ii - Grant Proposals				●																		
VI.A.i - Funding Opportunities			●																			
V.B.i - Reduce CSO / SSO								●											●	○	○	
V.A.i - Manage Storm Water																			●	○	○	
IV.A.ii - Habitat Restoration																					○	
IV.A.i - Habitat Identification																					○	
III.A.iii - Increase Opportunities																						
III.A.ii - Recreational Education												●										
III.A.i - Health Risk Education												●										
II.C.ii - Outreach Evaluation		●							●													
II.C.i - Social Marketing											●	●	●		●			●				
II.B.ii - Behavior Modification											○	○		●			●					
II.B.i - Action Understanding											●	●	●		●			●				
II.A.ii - Interactive Learning											○	○		●		●	●					
II.A.i - Targeted Outreach											●	●	●		●			●				
I.D.iii - Pathogen Reduction								●		●									○	○	○	○
I.D.ii - Illicit Connections								○														
I.D.i - Septic Systems								○														
I.C.ii - Sediment Management																			○	○	○	○
I.C.i - Sediment Sources										●												
I.B.ii - Nutrient Control																			○	○	○	○
I.B.i - Nutrient Sources										●												
I.A.ii - Prevent Contamination								○														
I.A.i - Sediment Remediation								○														
Action — Short Title	SWAG	ERG*	Funding	Grants	Update SWPPI*	Update WMP*	Annual Reports*	TMDLs*	Clearinghouse	Sources	PEP*	Public Ed.	Municipal Train.*	Demos	Signage	Involvement	Meetings	Officials	Standards*	Development*	Natural Features*	Prevention
No. — Action Number	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	1	2	3	4
Action Category	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3

LEGEND
● = Primary
○ = Secondary

* denotes Phase II required action.

Table 8-1. Relationship of actions to goals and objectives. (continued)

																							●	○		●	●		●							
												○																	●		●				●	
												○																●								
		○	○	○	○		○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		●	●	●					
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		○	○	○	○	○		○	○	●	○	○	○	○		●	●	●	●	●	●	●	●	●	●	●	●		○	○	○					
										○				○																						
		○	○	○	○	○	○	○	○	●	●		○	○		○	○	○	○	○	●	●	●	●	●	●	●		○	○	○					
										○				○																						
●										○			○																							
	●													○																						
Sed. Sources	Remediation	Storm Sewer*	Roads / Lots*	Garages*	Turf Practices*	Waste	Animal Waste	San. Sewer	Flood*	IDEP*	Septic	Trash	Spills	Marine	Groundwater	Bare Soil	Stabilization	Roads	Use Exclusion	Specific Sites	Structural	Agricultural BMPs	Imperviousness	Infiltration	Filtration	Natural Buffers	Re-/Detention	ID Natural Features	Land Reserves	NF Protection	NF Restoration	Recreation Program	Riparian Parks	Access	Fishing	Trails / Decks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	1	2	3	4	5	1	2	3	4	1	2	3	4	5
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	6	6	6	6	6	7	7	7	7	8	8	8	8	8

Table 8-2. Action details.

Action			Lead	Authority	Schedule					
Category	Number	Long Title	Lead Agency ** - does not exclude other SWAG members from doing*	Federal, state or local legislation, or other mechanism, which allows, prohibits, or requires an activity	Started (Y/N)	Begin	Milestone	End	Cycle ** - or permit schedule*	Complete (Y/N); *n/a for ongoing*
1	1	Promote and Reconvene Subwatershed Advisory Group	SWAG	Various state laws	N	Short Term	2010	n/a	Ongoing	n/a
1	2	Evaluation and Revision Guidance	SWAG	Phase II Permit	N	Short Term	2007	n/a	5-year*	n/a
1	3	Develop Funding Program	SWAG	n/a	N	Short Term	n/a	n/a	Annual	n/a
1	4	Develop Grant Proposals	SWAG	Various federal / state laws	N	Short Term	n/a	n/a	As needed	n/a
1	5	Update SWPPI	Permittees	Phase II Permit - COC	N	2007	2007/9	n/a	5-year*	n/a
1	6	Update WMP	SWAG	Phase II Permit - COC	N	2008	2008	n/a	5-year*	n/a
1	7	Annual Reports	Permittees	Phase II Permit - COC	Y	n/a	n/a	n/a	Annual-Oct	n/a
1	8	Total Maximum Daily Loads	SWAG	Phase II Permit	N	Short Term	2015	n/a	n/a	n/a
1	9	Implementation Clearinghouse	SWAG	n/a	N	Short Term	2010	n/a	Ongoing	n/a
1	10	Identify Sources of Pollutants	SWAG	n/a	N	Short Term	2010	Long Term	n/a	N
2	1	Public Education Plan Implementation	Permittees	Phase II Permit - PEP	Y	n/a	n/a	n/a	Ongoing	n/a
2	2	Additional Public Education	SWAG	n;/a	N	Short Term	n/a	n/a	Ongoing	n/a
2	3	Municipal Employee Training	Permittees*	Phase II Permit	Y	n/a	2013	n/a	Ongoing	n/a
2	4	Demonstration Projects	SWAG	n/a	N	Long Term	2015	n/a	Ongoing	n/a
2	5	Signage	SWAG	n/a	Y	n/a	2010	n/a	Ongoing	n/a
2	6	Public Involvement	SWAG	n/a	Y	n/a	2010	n/a	Ongoing	n/a
2	7	Community Forums and Stakeholder Workshops	SWAG	n/a	Y	n/a	2010	n/a	Ongoing	n/a
2	8	Municipal Officials Involvement and Education	SWAG	n/a	Y	n/a	2010	n/a	Ongoing	n/a
3	1	Stormwater Management Standards	Permittees*	Phase II Permit / Home Rule	N	Short Term	2013	Long Term	n/a	N
3	2	Managing Development Patterns	Permittees*	Phase II Permit / Home Rule	N	Short Term	2013	Long Term	n/a	N
3	3	Preserve Natural Areas/Features	Permittees*	Phase II Permit / Home Rule	N	Short Term	2013	Long Term	n/a	N
3	4	Pollution Prevention	Permittees*	Home Rule	N	Short Term	2013	Long Term	n/a	N
4	1	Identify Sources of Sediment Contaminants	SWAG	n/a	N	Short Term	2010	Long Term	n/a	N
4	2	Identify Actions to Remediate Contaminated Sediments	SWAG	n/a	N	Short Term	2010	Long Term	n/a	N
4	3	Storm Sewer System Maintenance and Operations	Permittees*	Phase II Permit	N	Short Term	2013	Long Term	n/a	N
4	4	Minimizing Pollution from Roads and Lots	Permittees*	Phase II Permit	N	Short Term	2013	Long Term	n/a	N
4	5	Minimizing Pollution from Municipal Facilities	Permittees*	Phase II Permit	N	Short Term	2013	Long Term	n/a	N
4	6	Turf Management Practices	Permittees*	Phase II Permit	N	Short Term	2013	Long Term	n/a	N
4	7	Waste Management	SWAG	n/a	N	Long Term	2015	Long Term	n/a	N
4	8	Animal Waste Control	SWAG	n/a	N	Short Term	2015	Long Term	n/a	N
4	9	San. / Combined Sewer System Planning and Maintenance	SWAG	n/a	N	Long Term	2015	n/a	Ongoing	n/a
4	10	Flood Control Projects	SWAG	Phase II Permit	N	Short Term	2015	Long Term	n/a	N
4	11	Illicit Discharge Elimination Program (IDEP)	Permittees*	Phase II Permit - IDEP	Y	n/a	n/a	n/a	Ongoing	n/a
4	12	Septic System Practices	SWAG	n/a	N	Long Term	2015	n/a	Ongoing	n/a
4	13	Trash/Debris Reduction	SWAG	n/a	Y	Short Term	2010	n/a	Ongoing	n/a
4	14	Spill Prevention / Notification / Response	SWAG	n/a	N	Short Term	2010	Long Term	n/a	N
4	15	Marine Industry Activities	SWAG	n/a	N	Long Term	2015	Long Term	n/a	N
4	16	Groundwater	SWAG	n/a	N	Long Term	2015	Long Term	n/a	N
5	1	Bare Soil Repair	SWAG	n/a	N	Short Term	2015	n/a	Ongoing	n/a
5	2	Streambank Stabilization	SWAG	n/a	N	Short Term	2015	n/a	Ongoing	n/a
5	3	Eroding Road Stabilization	SWAG	n/a	N	Short Term	2015	n/a	Ongoing	n/a
5	4	Streambank Use Exclusion	SWAG	Home Rule	N	Long Term	2015	Long Term	n/a	N
5	5	Specific Site Control	SWAG	n/a	N	Long Term	2015	Long Term	n/a	N
5	6	Structural Controls	SWAG	n/a	N	Long Term	2015	Long Term	n/a	N
5	7	Agricultural Runoff BMPs	SWAG	n/a	N	Long Term	2015	Long Term	n/a	N
6	1	Mitigate Existing Impervious Surfaces	SWAG	n/a	N	Long Term	2020	n/a	Ongoing	n/a
6	2	Infiltration Techniques	SWAG	n/a	N	Long Term	2020	n/a	Ongoing	n/a
6	3	Filtration Techniques	SWAG	n/a	N	Long Term	2020	n/a	Ongoing	n/a
6	4	Vegetative Buffers and Natural Conveyance	SWAG	n/a	N	Long Term	2020	n/a	Ongoing	n/a
6	5	Retention and Detention	SWAG	n/a	N	Long Term	2020	n/a	Ongoing	n/a
7	1	Identify Natural Features	SWAG	n/a	N	Short Term	2010	Long Term	n/a	N
7	2	Natural Land Reserves	SWAG	n/a	N	Long Term	2020	n/a	Ongoing	n/a
7	3	Natural Feature Protection	SWAG	n/a	N	Long Term	2020	n/a	Ongoing	n/a
7	4	Natural Feature Restoration	SWAG	n/a	N	Long Term	2020	n/a	Ongoing	n/a
8	1	Recreation Program	SWAG	n/a	N	Long Term	2025	Long Term	n/a	N
8	2	Riparian Land Conservation for Parks	SWAG	n/a	N	Long Term	2025	n/a	Ongoing	n/a
8	3	Canoe / Boat Landings / Access Sites	SWAG	n/a	N	Long Term	2025	n/a	Ongoing	n/a
8	4	Restore Fishing Opportunities	SWAG	n/a	N	Long Term	2025	n/a	Ongoing	n/a
8	5	Trails / Observation Decks	SWAG	n/a	N	Long Term	2025	n/a	Ongoing	n/a

Table 8-2. Action details. (rows continue across from previous page)

Cost / Labor Estimate					Assistance Req.		Comments	SWPPI Commitment Level											
Material Costs ($) ** - does not include long term costs associated with changes*	Labor Hours ** - does not include long term labor associated with changes*	Cost Details	Cost / Labor Bearer ** - or other entity if implementing*	Cost / Labor Cycle	Financial ($) *see Table 8-4 for potential grant progs.*	Technical *see Table 8-4 for potential sources*	**COMMITMENT LEGEND** --=not applicable N=no commitment W=no commitment, wish list item E=commitment, already doing Y=commitment D=commitment, completed	Include in SWPPI (Yes/No/Option)	Bruce Township	Clinton Township	Fraser, City of	Harrison Township	Macomb Township	Mt. Clemens, City of (+nested	Romeo, Village of	Shelby Township	Utica, City of	Washington Township	Macomb County (+ nested juris.)
$15,000	150-300	Promo. Materials	Entire SWAG	annual	$0	$0		N											
None	100-200		Entire SWAG	each cycle	$0	$0		N											
$5,000	100-200	Legal Fees	Entire SWAG	annual	$0	$0		N											
$500	40-80	Proposal Copies	Entity Seeking Grant	each proposal	$0	$0		N											
$500	100-250	SWPPI Copies	Each Permittee	each update	Chapter 4	Chapter 4		N											
$5,000	500-1000	Plan Copies	Entire SWAG	each update	$0	$0		N											
$1,500	100-250	Report Copies	Each Permittee	annual	Chapter 4	Chapter 4		N											
None	200-400		Entire SWAG	each TMDL	$0	$0		N											
None	150-300		Entire SWAG	annual	$0	$0		N											
None	200-400		Entire SWAG	once	$0	$0		N											
$10,000	250-500	Materials / Dist.	Each Permittee	annual	Chapter 4	Chapter 4	REFER TO PEP	O											
$10,000	250-500	Materials / Dist.	Implementing Entity	annual	$0	$0		N											
$5,000	250-500	Handouts	Each Permittee	annual	Chapter 4	Chapter 4		Y	Y	E	E	E	E	E	Y	Y	Y	E	Y
$30,000+	500-1000	Materials/Adverts	Implementing Entity	each project	$0	$0		N											
$2,500	100-250	Signs	Implementing Entity	per 10 signs	$0	$0		N											
$5,000	150-300	Materials	Implementing Entity	per activity	$0	$0		N											
$5,000	150-300	Materials	Implementing Entity	per meeting	$0	$0		N											
$5,000	200-400	Materials	Implementing Entity	annually	$0	$0		N											
$30,000	1000-2000	Legal Fees, Docs.	Each Permittee*	once	Chapter 4	Chapter 4		Y	Y	Y	Y	E	Y	E	Y	W	Y	Y	Y
$30,000	1000-2000	Legal Fees, Docs.	Each Permittee*	once	Chapter 4	Chapter 4		Y	E	Y	E	E	Y	E	N	W	E	Y	--
$30,000	1000-2000	Legal Fees, Docs.	Each Permittee*	once	Chapter 4	Chapter 4		Y	E	E	--	E	Y	E	Y	W	E	W	E
$30,000	1000-2000	Legal Fees, Docs.	Each Permittee*	once	$0	$0		O	E	Y	E	Y	Y	E	E	W	E	W	E
None	500-750		Entire SWAG	once	$0	$0		N											
$10,000	400-800	Documents	Entire SWAG	once	$0	$0		N											
None*	400-800*		Each Permittee*	once	Chapter 4	Chapter 4		Y	E	E	E	W	Y	E	E	Y	Y	E	Y
None*	400-800*		Each Permittee*	once	Chapter 4	Chapter 4		Y	E	Y	E	W	Y	E	E	W	E	Y	Y
None*	400-800*		Each Permittee*	once	Chapter 4	Chapter 4		Y	E	E	E	Y	Y	E	Y	Y	E	E	Y
None*	400-800*		Each Permittee*	once	Chapter 4	Chapter 4		Y	Y	E	Y	Y	Y	E	Y	W	Y	E	Y
$5,000*	600-1200*	Legal Fees	Implementing Entity	once	$0	$0		N											
$5,000*	600-1200*	Legal Fees	Implementing Entity	once	$0	$0		N											
$1,000	200-400	Documents	Implementing Entity	annual	$0	$0		N											
None*	400-800*		Each Permittee*	once	Chapter 4	Chapter 4		Y	W	Y	W	E	Y	W	Y	W	Y	W	--
$2,000	150-300	Documents	Each Permittee	ann./100 outfall	Chapter 4	Chapter 4	REFER TO IDEP	O											
None	2000-4000		Implementing Entity	annual	$0	$0		N											
$1,000	100-200	Materials	Implementing Entity	per event	$0	$0		N											
None*	200-400*		Implementing Entity	once	$0	$0		N											
$50,000*	1000-2000	Materials	Implementing Entity	total	$0	$0		N											
$50,000*	1000-2000	Materials	Implementing Entity	total	$0	$0		N											
$5,000	200-400	Materials	Implementing Entity	each location	$0	$0		N											
$10,000	300-600	Materials	Implementing Entity	each location	$0	$0		N											
$10,000+	250-500	Materials	Implementing Entity	each location	$0	$0		N											
$10,000	250-500	Signs, Fencing	Implementing Entity	each location	$0	$0		N											
$10,000	250-500	Structures	Implementing Entity	each location	$0	$0		N											
$15,000	250-500	Structures	Implementing Entity	each location	$0	$0		N											
$10,000	500-750	Materials	Implementing Entity	each project	$0	$0		N											
$25,000+	400-800	Materials	Implementing Entity	each project	$0	$0		N											
$25,000+	400-800	Materials	Implementing Entity	each project	$0	$0		N											
$25,000+	400-800	Materials	Implementing Entity	each project	$0	$0		N											
$25,000+	400-800	Materials	Implementing Entity	each project	$0	$0		N											
$25,000+	400-800	Materials	Implementing Entity	each project	$0	$0		N											
$1,500	250-500	Documents	Entire SWAG	once	$0	$0		N											
$100,000+	500-1000	Land, Legal Fees	Land Purch. Entity	each location	$0	$0		N											
$10,000+	300-600	Various	Implementing Entity	each project	$0	$0		N											
$10,000+	300-600	Various	Implementing Entity	each project	$0	$0		N											
$1,500	250-500	Documents	Entire SWAG	once	$0	$0		N											
$100,000+	500-1000	Land, Legal Fees	Land Purch. Entity	each acquisition	$0	$0		N											
$25,000+	400-800	Materials	Implementing Entity	each facility	$0	$0		N											
$15,000+	500-1000	Materials	Implementing Entity	each location	$0	$0		N											
$25,000+	400-800	Materials	Implementing Entity	each facility	$0	$0		N											

Table 8-3. Potential funding/technical assistance.

Actions			Financial Assistance Programs			
Category	Number	Action Title	USDA NRCS	USFWS USGS NPS	USEPA	GLC
1	1	Promote and Reconvene Subwatershed Advisory Group	4, 6	7	3, 6, 7, 8, 9, 11, 13, 22, 23, 28	
1	2	Evaluation and Revision Guidance	2, 4, 6		3, 6, 7, 8, 9, 13, 18, 22, 23, 25, 26	
1	3	Develop Funding Program	2, 4, 6		3, 6,7, 8, 9, 13, 18, 22, 23, 25, 26, 35	
1	4	Develop Grant Proposals	2, 4, 6		3, 6, 7, 8, 9, 13, 18, 22, 23, 25, 26, 35	
1	5	Update SWPPI	6		3, 6, 7, 8, 11, 13, 23, 26	
1	6	Update WMP	2, 4, 6		3, 6, 7, 8, 9, 13, 18, 22, 23, 25, 26	
1	7	Annual Reports	2, 4, 6		3, 6, 7, 8, 9, 13, 18, 22, 23, 25, 26	
1	8	Total Maximum Daily Loads	4, 6		3, 6, 7, 8, 11, 13, 23	
1	9	Implementation Clearinghouse	2, 6		3, 6, 7, 8, 13, 23, 26	
1	10	Identify Sources of Pollutants	2	6, 7	1, 3, 4, 6, 7, 8, 9, 13, 17, 18, 19, 22, 23, 25, 26, 30, 31, 32, 39, 41	
2	1	Public Education Plan Implementation	1, 2, 3, 4, 8, 11, 12	1, 2, 3, 4, 5, 9, 10, 11,	3, 6, 9, 11, 13, 21, 23, 25, 26, 40	
2	2	Additional Public Education	2		3, 6, 7, 9, 11, 13, 23, 25, 26, 40	
2	3	Municipal Employee Training	2		3, 6, 9, 11, 13, 23, 25, 26, 40	
2	4	Demonstration Projects	2, 9	6, 12	1, 3, 4, 6, 7, 9, 11, 13, 18, 19, 25, 37, 38, 40, 42, 43	
2	5	Signage	2		3, 6, 7, 9, 11, 13, 23, 25, 26, 40	
2	6	Public Involvement	2		3, 6, 7, 9, 11, 13, 23, 25, 26, 38, 40, 43	
2	7	Community Forums and Stakeholder Workshops	2		3, 6, 7, 9, 11, 13, 23, 25, 26, 38, 40, 43	
2	8	Municipal Officials Involvement and Education	2		3, 6, 9, 11, 13, 23, 25, 26, 40	
3	1	Stormwater Management Standards	2	2,3	2, 3, 9, 10, 11, 13, 26	
3	2	Managing Development Patterns	1, 2, 3, 4, 6, 7	12	2, 3, 7, 9, 13, 23, 26	
3	3	Preserve Natural Areas/Features	1, 2, 3, 8	12	2, 3, 9, 13, 23	
3	4	Pollution Prevention	2		2, 3, 9, 13, 23, 26, 30, 31, 32	
4	1	Identify Sources of Sediment Contaminants	2, 4, 9	6, 7	1, 3, 4, 6, 7, 8, 9, 13, 17, 18, 19, 22, 23, 25, 26, 27, 39, 41	
4	2	Identify Actions to Remediate Contaminated Sediments	2, 4, 9	6, 7	1, 3, 4, 6, 7, 8, 9, 13, 17, 18, 19, 22, 23, 25, 26, 27, 39, 41	
4	3	Storm Sewer System Maintenance and Operations	13, 14, 16		11, 23, 24	
4	4	Minimizing Pollution from Roads and Lots	2		3, 7, 9, 13, 23, 26, 30, 31, 32, 39, 41	
4	5	Minimizing Pollution from Municipal Facilities	2		3, 7, 9, 13, 23, 26, 30, 31, 32, 39, 41	
4	6	Turf Management Practices	4		7, 9, 13	
4	7	Waste Management	2, 13, 14, 15, 16		3, 7, 8, 9, 13, 22, 23, 26, 30, 31, 32, 33, 34, 41	
4	8	Animal Waste Control	2		3, 6, 7, 9, 11, 13, 23, 25, 26, 39, 41	
4	9	San. / Combined Sewer System Planning and Maintenance	13, 14, 16		11, 23, 24, 29, 36	
4	10	Flood Control Projects	4, 17	4	9	
4	11	Illicit Discharge Elimination Program (IDEP)	2		3, 6, 7, 9, 11, 13, 23, 24, 25, 26, 39, 41	
4	12	Septic System Practices	13, 14, 16	7	3, 6, 7, 11, 13, 23, 24, 26, 39, 41	
4	13	Trash/Debris Reduction	13, 14, 15, 16	7	3, 6, 13, 23, 26, 33, 34, 39, 41	
4	14	Spill Prevention / Notification / Response	2		3, 7, 9, 13, 23, 26, 30, 31, 32, 39, 41	
4	15	Marine Industry Activities			3, 6, 13, 23, 26, 28, 39, 41	
4	16	Groundwater	3	7	3, 4, 5, 12, 15, 16, 22, 41, 44	
5	1	Bare Soil Repair	3, 4		9	1
5	2	Streambank Stabilization	3, 4	1, 4, 5	9	1
5	3	Eroding Road Stabilization	4		9	1
5	4	Streambank Use Exclusion	4	1, 4, 5	9	1
5	5	Specific Site Control	3, 4		9	1
5	6	Structural Controls	3, 4		9	
5	7	Agricultural Runoff BMPs	2, 3, 4, 6, 9, 18	7	3, 8, 9, 14, 25, 39, 31, 32, 41	
6	1	Mitigate Existing Impervious Surfaces			3, 13, 39	
6	2	Infiltration Techniques	2, 3, 4, 9		3, 9, 11, 13, 24, 39	
6	3	Filtration Techniques	2, 3, 4, 9		3, 9, 11, 13, 24, 39	
6	4	Vegetative Buffers and Natural Conveyance	2, 3, 4, 5, 8, 9	2, 3	2, 3, 9, 10, 11, 13, 24, 39	
6	5	Retention and Detention	2, 3, 4		3, 9, 11, 13, 24, 39	
7	1	Identify Natural Features	1, 2, 3, 5, 6, 8, 10, 11, 12	2, 3, 7, 9, 11, 12	10, 20	
7	2	Natural Land Reserves	1, 2, 3, 5, 6, 8, 10, 11, 12	2, 3, 9, 10, 11, 12	10	
7	3	Natural Feature Protection	1, 2, 3, 5, 6, 8, 10, 11, 12	2, 3, 9, 10, 11, 12	10	
7	4	Natural Feature Restoration	1, 2, 3, 4, 5, 6, 8, 10, 11,	2, 3, 9, 10, 11, 12	9, 10	
8	1	Recreation Program	1	8, 11		
8	2	Riparian Land Conservation for Parks	1, 4, 8, 10, 12	1, 4, 5, 8, 9, 10, 11, 12		
8	3	Canoe / Boat Landings / Access Sites	1, 3	1, 4, 5, 8	13	
8	4	Restore Fishing Opportunities	1, 3, 4, 8	1, 4, 5, 11	13	
8	5	Trails / Observation Decks	1	8, 12		

Table 8-3. Potential funding/technical assistance. (rows continue across from previous page)

Fin. Asst. Progs. (cont'd)				Technical Assistance Programs and Resources
NOAA EDA USDOC	USACE	FHA USDOT	MDEQ MDNR MDCH	
				SEMCOG, NRCS & USDA (6), CWP, legal
3, 5	2		2, 3	MDEQ , EPA, CWP, SEMCOG, NRCS & USDA (6), USACE (2)
3, 5	2		2, 3	SEMCOG, NRCS & USDA (6), USACE (2), legal
3, 5	2		2, 3	SEMCOG , NRCS & USDA (6), USACE (2), legal
2				MDEQ, SEMCOG, local entities, CRWC
3, 5	2		2, 3	CRWC , SEMCOG, NRCS & USDA (6), USACE (2)
3	2		2, 3	MDEQ, SEMCOG, CRWC, NRCS & USDA (6), USACE (2), local entities
				MDEQ , USEPA, USGS, MSU IWR
	2			CRWC , SEMCOG, MDEQ, SN
3, 4				MDEQ , MDNR, CWP, USEPA, local entities
1, 2, 4, 5, 6	1		1	CRWC, SEMCOG, NRCS & USDA (3), MDNR, MDEQ, MSUE, AAW, MAS, TNC, TPL, MNA, WHIP, MDA, (ALSO 2-2)
4				CDs, USFWS, NAWMP, PF, DU, MLC, USACE (1), MLC, GRP, LAP, School Districts, CGEE, USEPA, GREEN, (ALSO 2-1)
4				SEMCOG , MDEQ
4				Local Entities , CRWC, SEMCOG, MDEQ, MDNR
4				CRWC , MDEQ, MDNR, local entities
4				CRWC , SEMCOG, MEC, MLC, SN, MSUE, AAW
4				CRWC , SEMCOG, AAW
4				SEMCOG, CRWC, local government
				Local Entities, MDEQ, Legal , SEMCOG, MDOT
				Local Entities, MDEQ, Legal, SEMCOG, LID Center, NRCS & USDA (3), MDA, MDNR, MEC, CRP, CDs
5				Local Entities, MDEQ, Legal, SEMCOG, SMLC, TNC, TPL, MNA, MLC, NRCS & USDA (3), CDs, MDNR
				Local Entities, MDEQ, Legal , SEMCOG, MDNR
2, 3, 4, 6	3			MDEQ, GLC, USEPA GLNPO, USFWS, USGS, NOAA
2, 3, 4, 6	3			MDEQ, GLC, USEPA GLNPO, USFWS, USGS, NOAA
				Local Entities, MDEQ, Legal , CWP
				MDEQ, Legal, local entities, MDOT, CWP, FHA, FTA
				Local Entities, MDEQ, Legal , MDOT, CWP
				Local Entities, MDEQ, Legal, MDNR, MTESP, GRP
2, 3				MDEQ, Legal, local entities, WHMD, MRC
4				Local Entities, MDNR, USFWS
				MDEQ, Local Entities, SEMCOG
6	4, 5			Local Entities, MDEQ, FEMA-NFIP, USACE (4)
4				MDEQ, Legal, local entities, CRWC, SEMCOG, CWP, SWC
				MDEQ, local entities, legal
				Local Entities, CRWC , MDEQ
				MDEQ, Legal, local entities, CWP
2, 3, 4, 6, 8				MDEQ, Local Entities , CRWC
				MDEQ, Legal , MGSP, GF, USEPA, NRCS & USDA (3), local entities
				Local Entities, MDEQ , CWP, EPA, SWC, MDNR
1, 2, 6				Local Entities, MDEQ , CWP, EPA, SWC, MDNR, NRCS & USDA (3)
				Local Entities, MDEQ , CWP, EPA, SWC, MDNR, MDOT
1, 2, 6				Local Entities, MDEQ , CWP, EPA, SWC, MDNR, NRCS & USDA (3), legal
	6			Local Entities, MDEQ , CWP, EPA, SWC, MDNR, NRCS & USDA (3), MDA, legal
				Local Entities, MDEQ , manufacturers, EPA, MDOT
				CDs, MDA, NRCS & USDA (3), MDEQ, EPA, MSUE
2				MDEQ, LID Center, EPA, CWP, SWC, MDOT, local entities
2, 4				MDEQ, LID Center, EPA, CWP, SWC, local entities
2, 4				MDEQ, LID Center, EPA, CWP, SWC, local entities
2, 4, 5				MDEQ, LID Center, EPA, CWP, SWC, local entities
2, 4				MDEQ, LID Center, EPA, CWP, SWC, local entities
5				MDNR, MNFI, MCNFI, CDs, MLC, MNA, SMLC, TNC, TPL, NRCS & USDA (5, 6, 10)
5				SMLC, MLC, MNA, TNC, TPL, CDs, MDNR, GRP, NRCS & USDA (5, 6, 10)
5				MDNR , MNA, TNC, CRP, NRCS & USDA (5, 6, 10), CDs, MDA , SN
5	1			MDNR , MNA, TNC, CRP, NRCS & USDA (5, 6, 10), CDs, MDA , SN, USACE (1), MDA, GLC, MIPC, MANSC, GLPANS, GLAGAP
				Local Entities, CRWC, MDNR, SEMCOG
1, 2, 5, 6				SMLC , MLC, TPL, local entities, NRCS & USDA (10), CDs, MDEQ, MDNR,
1, 2, 6				CRWC, MDNR, local entities
1, 2, 5, 6, 7				CRWC, TU, USFWS, MDNR, CRCRP, GLC, CDs, local entities
		1		CRWC , HCMA, local entities, MDNR

Table 8-4. Numerical cross-reference for previous table.

Organization	Program #	Program	Federal Catalog #	Financial Assistance	Technical Assistance
USDA	1	Conservation Reserve Program	10.069	X	
USDA	2	Cooperative Extension Service	10.500	X	
NRCS, USDA	3	Soil and Water Conservation	10.902		X
NRCS, USDA	4	Watershed Protection and Flood Prevention	10.904	X	X
NRCS, USDA	5	Plant Materials Conservation	10.905		X
NRCS, USDA	6	Watershed Surveys and Planning	10.906		X
NRCS, USDA	7	Farmland Protection Program	10.913	X	
NRCS, USDA	8	Wildlife Habitat Incentive Program	10.914	X	
USDA	9	Scientific Cooperation and Research	10.961	X	
NRCS, USDA	10	Resource Conservation and Development	10.901		X
NRCS, USDA	11	Water Bank Program	10.062	X	
NRCS, USDA	12	Wetlands Reserve Program	10.072	X	
USDA	13	Water and Waste Disposal Systems for Rural Communities	10.760	X	
USDA	14	Technical Assistance and Training Grants	10.761	X	
USDA	15	Solid Waste Management Grants	10.762	X	
USDA	16	Water and Waste Disposal Loans	10.770	X	
NRCS, USDA	17	Watershed Rehabilitation Program	10.916	X	X
NRCS, USDA	18	Agricultural Management Assistance	10.917	X	
NOAA	1	Interjurisdictional Fisheries Act of 1986	11.407	X	
NOAA	2	Coastal Zone Management Administration Awards	11.419	X	
NOAA	3	Unallied Management Projects	11.454	X	
NOAA	4	Cooperative Science and Education Program	11.455	X	
NOAA	5	Habitat Conservation	11.463	X	
NOAA	6	Coastal Services Center	11.473	X	
NOAA	7	Anadromous Fish Conservation Act	11.405	X	
NOAA	8	Unallied Science Program*	11.472	X	
NOAA	9	Hydrologic Research*	11.462	X	
NOAA	10	Environmental Sciences, Applications, Data, and Education*	11.440	X	
NOAA	11	Marine Sanctuary Program*	11.429	X	
NOAA	12	Office of Oceanic and Atmospheric Research (OAR) Joint and Cooperative Institutes*	11.432	X	
USACE	1	Aquatic Plant Control	12.100		X
USACE	2	Planning Assistance to States	12.110		X
USACE	3	Remedial Action Plan Program		X	
USACE	4	Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works	12.102		X
USACE	5	Emergency Operations Flood Response and Post Flood Response	12.103	X	X
USACE	6	Beach Erosion Control Projects	12.101	X	X
USFWS	1	Sport Fish Restoration	15.605	X	
USFWS	2	Coastal Wetlands Planning, Protection and Restoration Act	15.614	X	
USFWS	3	North American Wetlands Conservation Fund	15.623	X	
USFWS	4	Coastal Program	15.630	X	
USFWS	5	Partners for Fish and Wildlife	15.631	X	
USGS	6	Assistance to State Water Resources Research Institutes	15.805	X	
USGS	7	U.S. Geological Survey Research and Data Acquisition	15.808	X	
USGS	8	Outdoor Recreation Acquisition, Development Planning	15.916	X	
USFWS	9	Conservation Grants Private Stewardship for Imperiled Species	15.632	X	
USFWS	10	Landowner Incentive	15.633	X	
USFWS	11	Challenge Cost Share	15.642	X	
USGS	12	Rivers, Trails and Conservation Assistance	15.921	X	X
USFWS	13	Wildlife Restoration	15.611	X	
NPS	14	Historic Preservation Fund Grants-In-Aid*	15.904	X	
NPS	15	National Natural Landmarks Program*	15.910		X
NPS	16	National Historic Landmark*	15.912		X
FHA, USDOT	1	Recreational Trails Program	20.219	X	
USEPA	1	Surveys, Studies, Investigations, Demonstrations and Special Purpose Activities Relating to the Clean Air Act	66.034	X	
USEPA	2	Compliance Assistance Support Services to the Regulated Community and Other Assistance	66.305	X	
USEPA	3	Water Pollution Control State and Interstate Program	66.419	X	
USEPA	4	Surveys, Studies, Demonstrations, and Special Purpose Section 1442 of the Safe Drinking Water Act	66.424	X	
USEPA	5	State Public Water System Supervision	66.432	X	
USEPA	6	Surveys, Studies, Investigations, Demonstrations and Training Grants and Cooperative	66.436	X	
USEPA	7	Targeted Watershed Initiative	66.439	X	
USEPA	8	Water Quality Management Planning	66.454	X	
USEPA	9	Nonpoint Source Implementation Grants	66.460	X	
USEPA	10	Wetland Program Development Grant	66.461	X	

Table 8-4. Numerical cross-reference for previous table. (continued)

Organization	Program #	Program	Federal Catalog #	Financial Assistance	Technical Assistance
USEPA	11	Water Quality Cooperative Agreements	66.463	X	
USEPA	12	Capitalization Grants for Drinking Water State Revolving Funds	66.468	X	
USEPA	13	Great Lakes Program	66.469	X	X
USEPA	14	Pesticide Environmental Stewardship Regional Grants	66.714	X	
USEPA	15	Water Protection Grants to the States	66.474	X	
USEPA	16	Water Security Training and Technical Assistance Grant Program	66.478	X	
USEPA	17	Science to Achieve Results (STAR) Program	66.509	X	
USEPA	18	Surveys, Studies, Investigations and Special Purpose Grants Within the Office of Research and Development	66.510	X	
USEPA	19	Office of Research and Development Consolidated Research	66.511	X	
USEPA	20	State Information Grants	66.608	X	
USEPA	21	Protection of Children and the Aging as a Fundamental Goal of Public Health and Environmental	66.609	X	
USEPA	22	Surveys, Studies, Investigations and Special Purpose Grants Within the Office of the Administrator	66.610	X	
USEPA	23	Pollution Prevention Grants Program	66.708	X	
USEPA	24	Capacity Building Grants and Cooperative Agreements for States and Tribes	66.709	X	
USEPA	25	Surveys, Studies, Investigations, Training Demonstrations and Educational Outreach	66.716	X	
USEPA	26	Source Reduction Assistance	66.717	X	
USEPA	27	Toxic Substances Compliance Monitoring Cooperative Agreements	66.701	X	
USEPA	28	International Financial Assistance Projects Sponsored by the Office of International Affairs	66.931	X	
USEPA	29	State Revolving Fund		X	
USEPA	30	The Pollution Prevention Information Network Competition (Pollution Prevention Resource Exchange)		X	
USEPA	31	The Source Reduction Grant Program Competition		X	
USEPA	32	The Pollution Prevention Grant Program		X	
USEPA	33	Solid Waste Management Assistance	66.808	X	
USEPA	34	Hazardous Waste Management State Program Support	66.801	X	
USEAP	35	Capitalization Grants for State Revolving Funds	66.458	X	
USEAP	36	Wastewater Operator Training Grant Program (Technical Assistance)	66.467	X	
USEPA	37	Environmental Protection Consolidated Research	66.500	X	
USEPA	38	Senior Environmental Employment Program	66.508	X	
USEPA	39	Environmental Protection Consolidated Grants Program Support	66.600	X	
USEPA	40	Environmental Justice Grants to Small Community Groups	66.604	X	
USEPA	41	Performance Partnership Grants	66.605	X	
USEPA	42	Surveys, Studies, Investigations and Special Purpose Grants	66.606	X	
USEPA	43	Environmental Policy and Innovation Grants	66.611	X	
USEPA	44	State Underground Water Source Protection	66.433	X	
USEPA	45	Environmental Education Grants*	66.951	X	
USEPA	46	Environmental Education and Training Program*	66.950	X	
USEPA	47	Construction Grants for Wastewater Treatment Works*	66.418	X	
USEPA	48	Beach Monitoring and Notification Program Implementation Grants*	66.472	X	
USEPA	49	Chemical Emergency Preparedness and Prevention (CEPP) Technical Assistance Grants*	66.810	X	
NIH, HSS	1	Biological Response to Environmental Health Hazards*	93.113	X	
ATSDR, HSS	2	Great Lakes Human Health Effects Research*	93.208	X	
MDEQ	1	Beach Act Funds		X	
MDEQ	2	Clean Water Act Section 319 Grant Program		X	
MDEQ	3	Clean Michigan Initiative Environmental Bond		X	
GLC	1	The Great Lakes Basin Program for Soil Erosion and Sediment Control Grant Program		X	

Pollutant Load Reductions

In addition to meeting Phase II permit requirements, and addressing the goals and objectives of the WMP, the actions presented in this chapter are designed to address the significant stressors presented in Chapter 5. These stressors include: sediment, phosphorus, pathogens, and hydrologic flow. Addressing sediment, phosphorus, and pathogens involves achieving a reduction in loading of these pollutants. Addressing hydrologic flow involves mitigating impervious surfaces such that the flashiness of target waterbodies does not increase.

The following sub-sections discuss the actions to be taken to address each stressor.

Future Loadings

Changing conditions in the subwatershed, such as land use conversion, may result in higher pollutant loadings than those calculated in Chapter 5. However, it is assumed these increases will be offset by planning actions (see Action Category 3) that are designed to minimize the impacts of development.

Sediment

Based on the analysis in Chapter 5, the following load reductions are required for the various catchments in the subwatershed:

o Gloede Drain	156	tons/year
o Central Main Branch	90	tons/year
o East Main Branch	205	tons/year
o West Main Branch	70	tons/year
o Middle Branch (E., N., & W.)	1,712	tons/year

This equals a total of 2,233 tons/year that will be prevented from loading into the waterbodies of the subwatershed.

The loading reductions will come from the implementation of many actions over many years, including some from sources that have yet to be specifically identified.

Activities to Address Known Sources

Based on data previously collected and other data collected specifically in support of this plan, a list of specific activities to reduce pollutant loads has been identified.

Bare Soil Repair (Action 5-1)

The 'Pervious Area Assessment' of the 'Unified Subwatershed and Site Reconnaissance' protocol documented 4 locations of bare soil within the subwatershed. This is assumed to be 1% of the total in the subwatershed, giving a total of 400 locations. These locations are assumed to be distributed between the catchments on an area-weighted basis, yielding:

- Gloede Drain with 66 locations
- Central Main Branch with 54 locations
- East Main Branch with 68 locations
- West Main Branch with 40 locations
- East Middle Branch with 46 locations
- North Middle Branch with 59 locations
- West Middle Branch with 67 locations

Each location is estimated to be 500 square feet and have a loading rate of 2.5 lbs/sf/yr (0.00125 tons/sf/yr). The annual sediment load in each catchment that may be removed by repairing bare soil areas can be calculated as:

Bare Soil Repair Load Reduction (tons/yr) =
locations X 500 sf per location X 0.00125 tons/sf/yr

Applying this equation for each catchment yields the following estimated load reductions:

- Gloede Drain: 41 tons/yr
- Central Main Branch: 34 tons/yr
- East Main Branch: 43 tons/yr
- West Main Branch: 25 tons/yr
- East Middle Branch: 29 tons/yr
- North Middle Branch: 37 tons/yr
- West Middle Branch: 42 tons/yr

Streambank Stabilization (Action 5-2): Utilizing Road-Stream Crossing Data

The 'Road-Stream Crossing Survey' involved surveying sites in each of the catchments as follows:

- Gloede Drain: 10 sites out of 30 total (33%)
- Central Main Branch: 10 sites out of 17 total (59%)
- East Main Branch: 10 sites out of 36 total (28%)
- West Main Branch: 8 sites out of 24 total (33%)
- West, North, and East Middle Branch: 26 out of 52 (50%)

The number of poor and fair streambank conditions documented is given as follows:

- Gloede Drain: 2 poor sites and 1 fair site
- Central Main Branch: 1 poor site and 0 fair sites
- East Main Branch: 0 poor sites and 1 fair site
- West Main Branch: 0 poor sites and 0 fair sites
- West, North, and East Middle Branch: 8 poor sites and 9 fair sites

If these documented conditions are extrapolated to the non-surveyed locations, the total number of expected poor and fair streambank conditions in each catchment is:

- Gloede Drain: 6 poor sites and 3 fair sites
- Central Main Branch: 2 poor sites and 0 fair sites
- East Main Branch: 0 poor sites and 4 fair sites
- West Main Branch: 0 poor sites and 0 fair sites
- West, North, and East Middle Branch: 10 poor sites and 14 fair sites

Each site is assumed to be 500 sf, the erosion rate for poor sites is 10 lbs/sf/yr (0.005 tons/sf/yr), and the erosion rate for fair sites is 5 lbs/sf/yr (0.0025 tons/sf/yr). The annual sediment load in each catchment that can be removed by repairing streambanks at road/stream crossings can be calculated as:

Road-Stream Crossing Stabilization Load Reduction (tons/yr) =
(# poor sites X 500 sf X 0.005 tons/sf/yr) +
(# fair sites X 500 sf X 0.0025 tons/sf/yr)

Applying this equation for each catchment yields the following estimated load reductions:

- Gloede Drain: 19 tons/yr
- Central Main Branch: 5 tons/yr
- East Main Branch: 5 tons/yr
- West Main Branch: 0 tons/yr
- West, North, and East Middle Branch: 43 tons/yr

Streambank Stabilization (Action 5-2): Utilizing Unified Stream Assessment Data

The 'Unified Stream Assessment' surveyed eight 0.5 mile stretches on three streams in the subwatershed and five others in three other subwatersheds (Red Run, North Branch, and Lake St. Clair Direct Drainage). Based on this data, the eroding area per stream mile averaged 300 feet long by 10 feet high (3,000 sf/mile). However, this data was applicable to 3rd order streams only and it is necessary to estimate eroding area characteristics for 1st, 2nd, 4th, and 5th order streams. These characteristics include:

- 1st order streams: 50 feet long by 1 foot high (50 sf/mile)
- 2nd order streams: 100 feet long by 3 feet high (150 sf/mile)
- 4th order streams: 400 feet long by 12 feet high (4,800 sf/mile)
- 5th order streams: 500 feet long by 15 feet high (7,500 sf/mile)

Based on photographic evidence, it was noted that many of the eroded areas did not appear to be active. As such, it was assumed that the eroding area square footage per mile should be reduced by approximately 66%, such that:

- 1st order streams: 20 sf/mile
- 2nd order streams: 100 sf/mile
- 3rd order streams: 1,000 sf/mile
- 4th order streams: 1,600 sf/mile
- 5th order streams: 2,500 sf/mile

The total stream miles in each catchment were obtained from GIS and are given as:

- Gloede Drain: 55 miles
- Central Main Branch: 40 miles
- East Main Branch: 33 miles (approximately 68 miles of streams and canals in this catchment are tributary to Lake St. Clair and not included in this analysis)
- West Main Branch: 29 miles
- West, North, and East Middle Branches: 197 miles

The total stream miles in each catchment were broken down into stream orders based upon ratios presented in 'Fluvial Processes in Geomorphology' (Leopold, 1964). These are presented as follows (where indicated, the numbers have been adjusted to account for unique catchment configurations – e.g. the catchment having reduced 1st and 2nd order streams due to the presence of storm sewers)::

- Gloede Drain
    - 1st Order: 32 miles
    - 2nd Order: 16 miles
    - 3rd Order: 8 miles
- Central Main Branch
    - 1st Order: 14 miles (adjusted)
    - 2nd Order: 1.3 miles (adjusted)
    - 3rd Order: 5 miles (adjusted)
    - 4th Order: 3 miles (adjusted)
    - 5th Order: 5 miles (adjusted)
- East Main Branch
    - 1st Order: 12 miles (adjusted)
    - 2nd Order: 8 miles (adjusted)
    - 3rd Order: 3 miles (adjusted)
    - 4th Order: 3 miles (adjusted)
    - 5th Order: 7 miles (adjusted)
- West Main Branch
    - 1st Order: 3 miles (adjusted)

Stream Order

Stream order is a measure of the position of a stream in the hierarchy of tributaries.

- 1st order streams are those which have no tributaries; the average length is 1 mile with an average 1 square mile drainage area
- 2nd order streams are those which have only 1st order streams as tributaries; the average length is 2.3 miles with an average 4.7 square mile drainage area
- 3rd order streams have only 1st and 2nd order streams as tributaries; the average length is 5.3 miles with an average 23 square mile drainage area
- 4th order streams have only 1st, 2nd, and 3rd order streams as tributaries; the average length is 12 miles with an average drainage area of 109 square miles
- 5th order streams have only 1st, 2nd, 3rd, and 4th order streams as tributaries; the average length is 28 miles with an average drainage area of 518 square miles

- 2nd Order: 5 miles (adjusted)
    - 3rd Order: 5 miles (adjusted)
    - 4th Order: 8 miles (adjusted)
    - 5th Order: 8 miles (adjusted)
- West, North, and East Middle Branches
    - 1st Order: 119 miles (adjusted)
    - 2nd Order: 60 miles (adjusted)
    - 3rd Order: 25 miles
    - 4th Order 3 miles (adjusted)

The loading rate is assumed to be 5 lbs/sf/yr (0.0025 tons/sf/yr). The annual sediment load in each catchment that can be removed by stabilizing streambanks (not at road-stream crossings) can be calculated as

Unified Stream Assessment Stabilization Load Reduction (tons/yr) =
((# 1st order stream miles X 20 sf/mile actively eroding) +
(# 2nd order stream miles X 100 sf/mile actively eroding) +
(# 3rd order stream miles X 1,000 sf/mile actively eroding) +
(# 4th order stream miles X 1,600 sf/mile actively eroding) +
(# 5th order stream miles X 2,500 sf/mile actively eroding))
X 0.0025 tons/sf/yr

Applying the equation for each catchment yields the following load reductions:

- Gloede Drain: 26 tons/yr
- Central Main Branch: 56 tons/yr
- East Main Branch 59 tons/yr
- West Main Branch: 96 tons/yr
- West, North, and East Middle Branches: 95 tons/yr

Summary

The following table summarizes the load reductions that are estimated to be achieved if the known sources are addressed.

Table 8-5. Loading reductions that result from addressing known sources.

Catchment	Bare Soil (tons/yr)	Road-Stream Crossing (tons/yr)	Unified Stream Assessment (tons/yr)	Total (tons/yr)
Gloede Drain	41	19	26	**86**
Central Main Branch	34	5	56	**95**
East Main Branch	43	5	59	**107**
West Main Branch	25	0	96	**121**
West, North, & East Middle Branches	108	43	95	**246**
TOTAL	**251**	**72**	**332**	**655**

Addressing these known problems will account for a significant portion (or all) of the target sediment load reduction in each of the catchments except for the Middle Branches.

Activities to Address Other Sources

To meet the target load reductions (either in concert with or in lieu of addressing the issues discussed in the previous topic) additional actions will have to be implemented. A detailed removal plan has not been developed because different municipalities may choose to use different techniques based on preferred practices, available resources, physical site constraints, and funding. Some of the actions that may be implemented and for which a reduction in sediment load may be calculated include, with select examples (additional details can be found in Chapters 7 and 8):

- 4-3 Storm Sewer System Maintenance and Operations
- 4-4 Minimizing Pollution from Roads and Lots
- 4-5 Minimizing Pollution from Municipal Facilities
- 4-11 IDEP
  Example: Once the current IDEP cycle is completed, each community may take its measured data and the number of problems that were corrected to calculate a reduction in sediment loading.
- 4-12 Septic System Practices
- 5-1 Bare Soil Repair
- 5-2 Streambank / Shoreline Stabilization
- 5-3 Road and Ditch Stabilization
- 5-4 Streambank Use Exclusion
  Example: Where unauthorized access to a waterbody has resulted in erosion problems, exclusion measures may be erected and the reduction in sediment loading calculated.
- 5-5 Specific Site Control
  Example: A site, such as a landscaping supply company, which is determined to discharge 50 t/yr of sediment, may have controls installed to reduce this discharge.
- 5-6 Structural Controls
  Example: Swirl separators or sediment traps may be installed in municipal catch basins to achieve a reduction in sediment loading that can be calculated once the devices have been put into service.
- 5-7 Agricultural BMPs
  Example: Waterbodies which drain 3,000 acres of agricultural land (with a loading rate of 200 lbs/ac/yr) may be outfitted with BMPs with a 90% removal efficiency (such as buffer strips) that results in a 270 t/yr reduction in sediment load.
- 6-1 Mitigate Existing Impervious Surfaces
  Example: 1,000 acres of urban land (with a loading rate of 300 lbs/ac/yr) may be outfitted with parking lot islands and side drainage ditches (with a 60% removal efficiency) that result in a 90 t/yr reduction in sediment load.
- 6-2 Infiltration Techniques
- 6-3 Filtration Techniques
- 6-4 Vegetative Buffers and Natural Conveyance
- 6-5 Retention and Detention
- 7-4 Natural Feature Restoration

Summary

This subsection of the plan does describe in some detail how sediment loading reductions can be achieved, but does not prescribe in detail how this implementation has to occur. This is to provide the greatest flexibility for the entities implementing this plan to select actions that are appropriate based on cost, funding opportunities, and other factors such as updated data and load analyses.

The ultimate goal of the actions presented in this subsection is to collectively achieve the desired sediment loading reduction in each catchment of the subwatershed.

Phosphorus

Based on the analysis in Chapter 5, the following load reductions are required for the various catchments in the subwatershed:

- Gloede Drain 0.72 tons/year
- Central Main Branch 0.41 tons/year
- East Main Branch 0.81 tons/year
- West Main Branch 0.38 tons/year
- Middle Branch (E., N., & W.) 9.00 tons/year

This equals a total of 11.32 tons/year that will be prevented from loading into the waterbodies of the subwatershed.

The loading reductions will come from the implementation of many actions over many years, including some from sources that have yet to be specifically identified.

Activities to Address Known Sources

First, given an assumed concentration of phosphorus in soil of 0.0005 lb/lb, the actions presented in Table 8-5 provide phosphorus reductions as presented in Table 8-6.

Table 8-6. Phosphorus load reductions associated with the addressing of known sediment problems.

Catchment	Bare Soil (tons/yr)	Road-Stream Crossing (tons/yr)	Unified Stream Assessment (tons/yr)	Total (tons/yr)
Gloede Drain	0.02	0.01	0.01	**0.04**
Central Main Branch	0.02	< 0.01	0.03	**0.05**
East Main Branch	0.02	< 0.01	0.03	**0.05**
West Main Branch	0.01	< 0.01	0.05	**0.06**
West, North, & East Middle Branches	0.05	0.02	0.05	**0.12**
TOTAL	**0.12**	**0.03**	**0.17**	**0.32**

When feasible, these load reductions should be corrected with sampled phosphorus/soil ratios. As currently calculated, these reductions account for only around 3% of the total needed for the subwatershed.

Activities to Address Other Sources

To meet the target load reductions (either in concert with or in lieu of the reductions obtained through addressing sediment issues) additional actions will have to be implemented. A detailed removal plan has not been developed because different municipalities may choose to use different techniques based on preferred practices, available resources, physical site constraints, and funding. Some of the actions that may be implemented and for which a reduction in phosphorus load may be calculated include, with select examples (additional details can be found in Chapters 7 and 8):

4-3 Storm Sewer System Maintenance and Operations
4-4 Minimizing Pollution from Roads and Lots
4-5 Minimizing Pollution from Municipal Facilities
4-8 Animal Waste Control
4-9 Sanitary and Combined Sewer System Planning and Maintenance
Example: Connecting all of the septic systems in the subwatershed to a sanitary sewer system will reduce 3.9 t/yr in the Middle Branch catchments, 1.0 t/yr in the Gloede Drain catchment, 0.1 t/yr in the Central Main Branch catchment, 0.8 t/yr in the West Main Branch catchment, and 0.4 t/yr in the East Main Branch catchment.
4-11 IDEP
Example: Once the current IDEP cycle is completed, each community may take its measured data and the number of problems that were corrected to calculate a reduction in phosphorus loading.
4-12 Septic System Practices
Example: A number of failing septic systems may be corrected over a year, giving a documentable reduction in phosphorus loading.
5-1 Bare Soil Repair
5-2 Streambank / Shoreline Stabilization
5-3 Road and Ditch Stabilization
5-4 Streambank Use Exclusion
5-5 Specific Site Control
Example: A site, such as a nursery or greenhouse which is determined to discharge 1 t/yr of phosphorus may have controls installed such that its discharge is reduced to 0.1 t/yr.
5-6 Structural Controls
5-7 Agricultural BMPs
Example: Waterbodies which drain 3,000 acres of agricultural land (with a loading rate of 0.8 lbs/ac/yr) may be outfitted with BMPs with a 90% removal efficiency (such as buffer strips) that results in a 1.08 t/yr reduction in phosphorus load.
6-1 Mitigate Existing Impervious Surfaces
Example: 1,000 acres of urban land (with a loading rate of 1.0 lbs/ac/yr) may be outfitted with parking lot islands and side drainage ditches (with a 60% removal efficiency) that result in a 0.3 t/yr reduction in sediment load.
6-2 Infiltration Techniques
6-3 Filtration Techniques
6-4 Vegetative Buffers and Natural Conveyance
6-5 Retention and Detention
7-4 Natural Feature Restoration

Summary

This subsection of the plan does describe in some detail how phosphorus loading reductions can be achieved, but does not prescribe in detail how this implementation has to occur. This is to provide the greatest flexibility for the entities implementing this plan to select actions that are appropriate based on cost, funding opportunities, and other factors such as updated data and load analyses.

The ultimate goal of the actions presented in this subsection is to collectively achieve the desired phosphorus loading reduction in each catchment of the subwatershed.

Pathogens

The complex nature of pathogens requires an analysis that does not rely on achieving quantified load reductions, but instead eventually achieving compliance with concentration-based water quality standards.

This approach involves implementing pathogen reducing actions to address all sources (especially those present in the Middle Branch catchments, the Central Main Branch catchment, and the West Main Branch catchment) and continuously monitoring to determine if progress is being made.

Achieving the water quality standard will be the result of many actions over many years, including some that address sources that have yet to be specifically identified. Some of the actions that may be implemented to reduce pathogen discharges include, with select examples:

- 4-8 Animal Waste Control
  Example: Providing pet waste disposal opportunities near waterbodies where pet runs are available will prevent pathogens from this waste from entering waterbodies through stormwater runoff.
- 4-9 Sanitary and Combined Sewer System Planning and Maintenance
  Example: Improvements to sanitary and combined sewer systems, especially where known SSOs and CSOs occur, will reduce pathogen discharges to waterbodies.
- 4-11 IDEP
  Example: The main emphasis of the IDEP programs is to find and correct illicit discharges to waterbodies, especially those of the type where raw sanitary sewage is discharging from the storm sewers. This action will reduce pathogen discharges to waterbodies.
- 4-12 Septic System Practices
  Example: A number of failing septic systems may be corrected over a year, reducing the discharge of pathogens to nearby waterbodies.
- 5-4 Streambank Use Exclusion
- 5-5 Specific Site Control
- 5-6 Structural Controls
- 5-7 Agricultural BMPs
  Example: Agricultural operations which currently incur discharges of manure contaminated stormwater to nearby waterbodies can implement various practices to control and eliminate this problem.
- 6-1 Mitigate Existing Impervious Surfaces
- 6-2 Infiltration Techniques
- 6-3 Filtration Techniques
- 6-4 Vegetative Buffers and Natural Conveyance
- 6-5 Retention and Detention
- 7-4 Natural Feature Restoration

The ultimate goal of the actions presented in this subsection is to collectively achieve the pathogen water quality standard at all sampled locations throughout the subwatershed.

Hydrologic Flow

The complex nature of hydrologic flow requires an analysis that does not rely on achieving quantified load reductions, but instead addressing impervious surfaces such that the flashiness of the flow in waterbodies does not increase.

This approach involves implementing imperviousness mitigating actions especially on directly connected impervious areas (based on the prioritized critical area catchments defined in Chapter 5: Gloede Drain, Central Main Branch, and East Main Branch) and regularly monitoring to determine if progress is being made.

Ensuring that flashiness does not increase, or actually decreases, will be the result of many actions over many years. Some of the actions that may be implemented to mitigate impervious surfaces include, with select examples:

- 6-1 Mitigate Existing Impervious Surfaces
  Example: 1,000 acres of urban land may be outfitted with parking lot islands and side drainage ditches that reduce peak discharge rates to nearby waterbodies which reduces their peak flow rates.
- 6-2 Infiltration Techniques
  Example: A 500 acre residential neighborhood may be outfitted with infiltration devices that reduce discharge volume to nearby waterbodies which reduces their total discharge.
- 6-4 Vegetative Buffers and Natural Conveyance
- 6-5 Retention and Detention
- 7-4 Natural Feature Restoration

The ultimate goal of the actions presented in this subsection is to collectively mitigate impervious surfaces such that waterbodies in the subwatershed experience no increase in their flashiness indices.

Adaptive Management

The actions and the associated details presented in this chapter were selected in an adaptive management setting that considered the current conditions of the subwatershed. As the planning process moves forward, and new information becomes available, the actions and details will change as appropriate in future versions of the plan.

Decision-making Principles and Prioritization Process

While there were numerous factors in play when determining the actions to include in the WMP, a few of the important principles include:

- Addressing permit requirements;
- Addressing other funding requirements;
- Addressing the goals and objectives of the plan;
- Addressing known water quality issues;
- Addressing the desires of the public;
- Addressing public concerns;
- Cost considerations;
- Maintenance considerations;
- Appropriateness of action;
- Likelihood of success (i.e., achieving pollutant reduction or successfully addressing an objective);
- Relevant social and scientific research;
- Previous experience with the actions; and
- Potential for public acceptance.

The actions have been prioritized in that a timeline has been assigned to guide their implementation. The timeline was assigned based on:

- prescribed dates for submittals;
- feedback from the SWAG members as to when the actions needed to and realistically could be implemented (with a consideration for leveraging those actions which are already occurring)
- addressing the most pressing water quality problems as soon as possible;
- implementing the most cost-effective measures in the short-term (to make the best use of scarce funds); and
- relegating actions requiring outside funds to the long-term portions of the schedule (to provide ample time to procure necessary funding).

References

Leopold, L.B., et al. Fluvial Processes in Geomorphology. Dover Publications, Inc. New York. 1964.

Mair, R. E-mail communication concerning a MDEQ presentation given at an AWWA meeting. 2006.

Michigan Department of Environmental Quality [MDEQ]. NPDES General Permit No. MIG619000 for Coverage of Stormwater Discharges for Municipal Separate Storm Sewer Systems Subject to Watershed Plan Requirements.

Southeast Michigan Council of Governments [SEMCOG]. "Water Quality Management Plan for Southeast Michigan". 1999.

9. Evaluation and Revision

Introduction

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 subwatershed as new information becomes available. This adaptive management approach to watershed planning provides for continuous input and modification of procedures, processes, and products. An integral component of planning in this setting is the evaluation and revision mechanisms that drive these modifications.

As required by the Watershed-based Permit, the WMP must include the following evaluation and revision components:

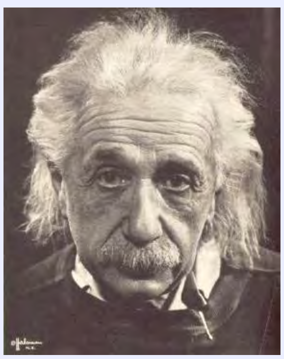
- Evaluate the effects of the implemented actions and progress toward goals and objectives; and
- Re-evaluate goals and objectives as part of an on-going, iterative process.

This chapter establishes the evaluation procedures (including monitoring protocols selected from Chapter 9) and lists suggestions for steps to guide revision of the WMP. The procedures and suggestions reflect the importance of an on-going iterative process. 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).

Quotable Quotations

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

\- Albert Einstein



"However beautiful the strategy, you should occasionally look at the results."

\- Winston Churchill

Elements of Watershed Planning

Watershed planning generally consists of three elements:

- Program Planning;
- Program Implementation; and
- Effectiveness Assessment.

The relationship between the three elements is presented in Figure 9-1. They are discussed in the following subsections.

Figure 9-1. Relationship between the three elements.

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. While the elements of program planning interact in a cyclical manner, program planning typically initiates the cycle (as it has done for this initial submittal of the WMP). However, program planning also occurs following the effectiveness assessment phase if changes to the WMP are necessary.

This program planning phase can be broken down into the four steps discussed in the topics below 1) Goal and Objective Development, 2) Action Development, 3) Measures of Success, and 4) Assessment.

Goal and Objective Development

The subwatershed advisory group (SWAG) has worked with the stakeholders and public to obtain input and comments during the initial watershed planning process. Discussions at SWAG meetings helped to prioritize long-term watershed goals and short-term 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 Chapter 4. The finalized goals and objectives are presented in Chapter 6.

Action Development

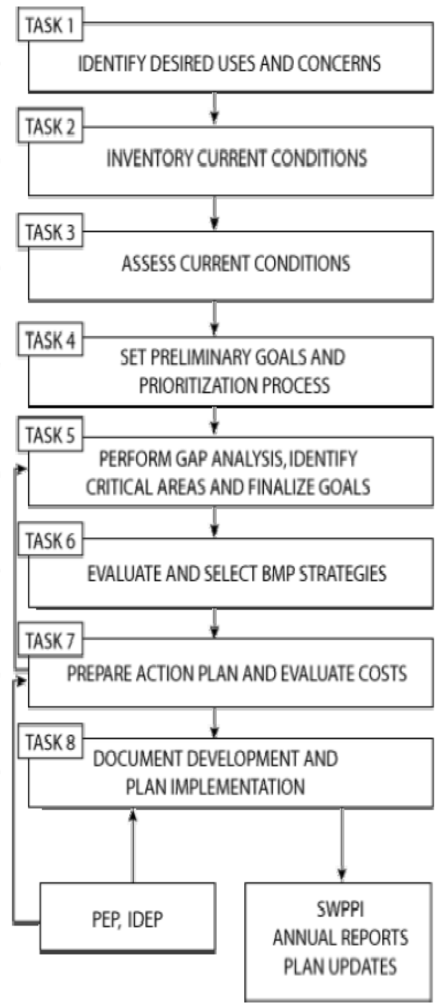
To implement the goals and objectives, specific actions were developed for each objective. Action plan development was completed as part of this WMP and is presented in detail in Chapter 8. The actions were assigned a schedule, responsible party, cost, and means to measure success (see following topic).

Measures of Success

Measures of success, or '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.

Figure 9-2. Success levels.

The Planning Process (detail) – see Chapter 1 for Expanded Information



Permit Requirements

The following actions are Phase II requirements that are being implemented to meet 'Success Level 1':

1-2: Evaluation and Revision Procedure

1-5: Update SWPPI

1-6: Update WMP

1-7: Annual Reports

1-8: Total Maximum Daily Loads

2-1: Public Education Plan Implementation

2-3: Municipal Employee Training

3-1: Stormwater Management Standards

3-2: Managing Development Patterns

3-3: Preserve Natural Areas/Features

4-3: Storm Water Sewer System Maintenance and Operations

4-4: Minimizing Pollution from Roads and Lots

4-5: Minimizing Pollution from Municipal Facilities

4-6: Turf Management Practices

4-10: Flood Control Projects

4-11: Illicit Discharge Elimination Program (IDEP)

Level 1: Compliance with Activity-Based Permit Requirements

Success at this level involves implementing the actions 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.

Level 2: Changes in Knowledge / Awareness

Success at this level requires showing an increase in knowledge and awareness in the various elements of the public that are targeted through the Public Participation Plan (PPP), Public Education Plan (PEP), and this WMP.

Level 3: Behavioral Change / BMP Implementation

Success at this level requires showing behavioral changes in the public due to increased knowledge and awareness. This may be documented through the use of a survey or tracking the number of Best Management Practices (BMPs) installed or retrofitted.

Level 4: Load Reductions

Success at this level requires showing that the amount of pollutants entering local waterbodies are being reduced. Load reductions may be quantified by comparing monitoring data from before and after a particular action is implemented or calculated based on other information.

Level 5: Changes in Discharge Quality

Success at this level requires showing that the stormwater discharge entering waterbodies is of better quality than before. This involves comparing stormwater outfall monitoring data from before and after a series of complementary actions (to address a specific problem) has been implemented.

Level 6: Changes in Receiving Water Quality

Success at this level requires showing that the water quality of the receiving waterbody is of better quality than before. This involves comparing waterbody monitoring data from future 'improved' conditions to the data collected when waterbody problems were defined.

Assessment

Each evaluation mechanism requires some data as feedback to allow an assessment to occur. Thus the evaluation mechanisms can be classified based on the data that is required, as follows:

Measure of Activity Completion

These mechanisms require only an indication of whether or not an activity has been completed. These measures are used to assess implementation and include the 'Implementation Milestones' which are discussed in a sub-section of the 'Evaluation and Revision Procedure' section of this chapter.

Measure of Usage

These mechanisms require data concerning how much a facility has been used or how much material has been distributed or collected. These measures are used to assess implementation.

Measure of Change

These mechanisms require data concerning baseline and post-action levels of knowledge or water quality. These measures are used to assess effectiveness.

Measures which are used to assess the effectiveness of WMP implementation are sometimes referred to as 'Indirect'. Those which are used to assess changes in water quality are 'Direct'.

Program Implementation

The program implementation phase consists of implementing the actions defined in the WMP which was developed or updated during the program planning phase.

Data, lessons learned, and comments on the WMP are compiled during this phase and are 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, as discussed in the following topics.

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.

Program Assessment

Program assessment involves reviewing the attainment of the indirect evaluation mechanisms. This review involves checking that implementation has occurred according to schedule and that program effectiveness can be shown (where appropriate). The review also involves investigating failures and making recommendations for the plan update, including continuing the implementation of certain actions, modifying some, and ceasing others – as well as the reasons behind the recommendations.

Program assessment is an annual task that will be reported in the annual progress reports.

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.

Generally, determining the effectiveness of the actions is a qualitative process that relies on both the assessments showing at least minimal improvement in water quality / awareness and knowledge over time.

Notes on the Annual Reports

The annual progress report is required to cover decisions made, actions performed, and results of the IDEP, PEP, SWPPI, and other stormwater 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 stormwater system.

Evaluation Procedure

This section defines the specific evaluation and revision guidance (ERG) that has been developed for this WMP, based on the information presented in the preceding section of this chapter.

Evaluation Mechanisms

The first component of the ERG involves looking at each action and assessing its success in implementation according to its schedule and effectiveness. As discussed in the previous section of this chapter, success is evaluated through six levels which can be grouped under three classifications 1) Measure of Activity Completion, 2) Measure of Usage, and 3) Measure of Change

Characteristics of the Evaluation Measures

In accordance with the Water Quality Management Plan (SEMCOG, 1999) for Southeast Michigan, the evaluation measures for this plan have been developed to:

- Be understandable;
- Reflect changes over time; and
- Reflect the unique characteristics of the study area.

Measure of Activity Completion

Most of the actions can be assessed on the basis of whether or not they are complete and on schedule (some cannot as they are ongoing). This is indicated and tracked in Table 8-2. These evaluation mechanisms are largely not included in a level of the success level pyramid. However, for those actions which are Phase II Requirements, the measures of activity completion fall into Level 1 of the success level pyramid (Compliance with Activity-Based Permit Requirements).

Measure of Usage

Most of the actions can be assessed on the basis of measure of usage. Many of the actions also have multiple measures of usage associated with them. As with the activity completion assessments, most of the usage assessments do not fall into any level of the success level pyramid; however, some do fall into Level 1.

Measure of Change

The same actions that are assessed on the basis of a measure of usage can also be assessed on the basis of a measure of change. All of the 'measure of change' assessments fall into one of four levels:

- Level 2: Changes in Knowledge / Awareness;
- Level 3: Behavioral Change / BMP Implementation;
- Level 4: Load Reductions; and
- Level 5: Changes in Discharge Quality.

Level 2: Changes in Knowledge and Awareness are measured primarily with respect to the Public Education and Participation actions (Action Category 2 in Chapter 8).

Level 3: Behavioral Change and BMP Implementation are measured primarily with respect to:

- Ordinance, Zoning, and Development Standards (Action Group 3 in Chapter 8) – e.g. observing the rate at which communities adopt ordinances, zoning, and development standards;
- Good Housekeeping and Pollution Prevention (Action Group 4 in Chapter 8) – e.g. observing the rate at which communities adopt procedures and programs;
- Stormwater BMPs: Non-construction Related SESC (Action Group 5 in Chapter 8) – e.g. observing the amount of implementation that occurs at problem sites on private land;
- Stormwater BMPs: Other Pollutant Load Reduction Controls (Action Group 6 in Chapter 8) – e.g. observing the amount of implementation that occurs on private land; and
- Natural Features and Resource Management (Action Group 7 in Chapter 8) – e.g. observing the amount of implementation that occurs on private land.

Level 4: Load Reductions can be measured primarily with respect to:

- Good Housekeeping and Pollution Prevention actions (Category 4) – e.g. calculating the load reductions associated with newly implemented activities;
- Stormwater BMPs: Non-construction Related SESC actions (Category 5) – e.g. calculating load reductions associated with installed BMPs; and
- Stormwater BMPs: Other Pollutant Load Reduction Controls actions (Category 6) – e.g. calculating the load reductions associated with installed BMPs.

Level 5: Changes in Discharge Quality can be documented through an assessment opportunity presented through Action 4-12 (*IDEP*) by documenting the discovery rate of illicit discharges over time.

Note that none of the task or action assessments fall into Level 6: Changes in Receiving Water Quality; rather all of the tasks and actions in this WMP are working together to help improve receiving water quality.

The correlation between actions, the specific measures, and their respective success levels are displayed in Table 9-1. While these assessment measures are presented in Chapter 9, they are technically part of the actions (from Chapter 8) with which they are associated. As such, the measures listed that are associated with Phase II requirements are part of the commitment made by each permittee. *These measures are shown in italics.* All of the measures associated with the other actions (non-Phase II) are suggestions for potential measures. Additional measures, substitutions, or omissions may be made depending on the specific activities undertaken under these actions (as they are generally less specific in nature than the Phase II actions).

The data by which to assess some of the evaluation mechanisms comes directly from implementation of the associated action. However, data to assess other evaluation mechanisms requires additional actions. For example, Changes in Knowledge and Awareness (Level 2) and Behavioral Change / BMP Implementation (Level 3) likely require some sort of survey. Load Reductions (Level 4) likely require post-implementation monitoring and/or calculations. Additionally, Changes in Discharge Quality (Level 5) and Changes in Receiving Water Quality (Level 6) have few or no measures associated with specific actions and likely require extensive review of collected monitoring data or the collection of new monitoring data to gauge success.

Actions Most Likely to have Quantifiable Load Reductions

The following actions are listed in Chapter 8 as having the potential for quantifiable load reductions associated with them:

- 4-3: Storm Sewer System Maintenance and Operations
- 4-4: Minimizing Pollution from Roads and Lots
- 4-5: Minimizing Pollution from Municipal Facilities
- 4-8: Animal Waste Control
- 4-9: Sanitary and Combined Sewer System Planning and Maintenance
- 4-11: Illicit Discharge Elimination Program (IDEP)
- 4-12: Septic System Practices
- 5-1: Bare Soil Repair
- 5-2: Streambank / Shoreline Stabilization
- 5-3: Road and Ditch Stabilization
- 5-4: Streambank Use Exclusion
- 5-5: Sensitive Site Control
- 5-6: Structural Controls
- 5-7: Agricultural BMPs
- 6-1: Mitigate Existing Impervious Surfaces
- 6-2: Infiltration Techniques
- 6-3: Filtration Techniques
- 6-4: Vegetative Buffers and Natural Conveyance
- 6-5: Retention and Detention
- 7-4: Natural Feature Restoration

Table 9-1. Measures of success associated with the actions.

No.		Action	Measure of Usage		Measure of Change	
Action Category	Action Number	Short Title	Data requirement	Success Level	Data requirement	Success Level
1	1	SWAG	Percentage of all entities in subwatershed participating			
1	1	SWAG	Average percentage of SWAG members represented at meetings			
1	4	Grants	The number of grant proposals submitted			
1	4	Grants	The number of grants received			
1	6	Update WMP	*Percentage of all entities in subwatershed participating*	1		
1	6	Update WMP	*Percentage of eligible permittees continuing with watershed permit*	1		
1	6	Update WMP	*Percentage of nested jurisdictions incorporated into planning*	1		
1	8	TMDLs	*Percentage of completed TMDLs addressed in WMP*	1		
1	9	Clearinghouse	Percentage of SWAG members reporting to clearinghouse			
1	9	Clearinghouse	Documented number of non-SWAG actions supporting WMP			
1	10	Sources	Number of additional sources consulted during identification			
2	1	PEP	*see PEPs*	1	*see PEPs*	2
2	1	PEP			*see PEPs*	3
2	2	Public Ed.	Number of education materials distributed		Percentage of target audience indicating increased awareness	2
2	2	Public Ed.			Percentage of target audience implementing recommendations	3
2	3	Municipal Ed.	*Percentage of staff trained*	1	*Percentage of municipal tasks performed with improved protocols*	3
2	3	Municipal Ed.	*Percentage of staff surveyed*	1	*Knowledge level trends over time*	2
2	4	Demos	Number of projects identified			
2	4	Demos	Number of projects initiated			
2	4	Demos	Number of projects completed			
2	5	Signage	Percentage of watershed boundary locations with signs			
2	5	Signage	Percentage of boat launch locations with signs			
2	5	Signage	Number of other signs installed			
2	6	Involvement	Percentage of total catch basins with markers			
2	6	Involvement	Percentage of total road miles adopted			
2	6	Involvement	Percentage of total stream miles cleaned			
2	6	Involvement	Number of volunteers for various events			
2	6	Involvement	Number of river walks held			
2	7	Meetings	Number of individuals attending events		Percentage of attendees providing positive feedback	2
2	7	Meetings	Percentage of specifically invited individuals attending events			
2	8	Officials	Percentage of municipal officials directly educated		Percentage of municipal officials familiar with SWAG / WMP	2
2	8	Officials	Percentage of municipal officials surveyed / responding		Percentage of municipal officials with postive perception	2
3	1	Standards	*Percentage of committed permittees adopting standards*	1	Percentage of other SWAG members adopting standards	3
3	2	Development	*Percentage of committed permittees managing development*	1	Percentage of other SWAG members managing development	3
3	3	Natural Features	*Percentage of committed permittees protecting natural features*	1	Percentage of other SWAG members protecting natural features	3
3	4	Prevention	Percentage of committed permitees adopting ordinances/progs.		Percentage of other SWAG members adopting ordinances/progs.	3
4	1	Sed. Sources	Number of additional sources consulted during identification			
4	3	Storm Sewer	*Percentage of committed permittees adopting procedures*	1	Percentage of other SWAG members adopting procedures	3
4	3	Storm Sewer	Number of downspouts disconnected from system		Pollutant load reductions	4
4	3	Storm Sewer	Percentage of appropriate infrastructure documented / labeled			
4	4	Roads / Lots	*Percentage of committed permittees adopting procedures*	1	Percentage of other SWAG members adopting procedures	3
4	4	Roads / Lots	Percentage reduction in sand/salt application to roads		Pollutant load reductions	4
4	5	Garages	*Percentage of committed permittees adopting procedures*	1	Percentage of other SWAG members adopting procedures	3
4	5	Garages			Pollutant load reductions	4
4	6	Turf Practices	*Percentage of committed permittees adopting procedures*	1	Percentage of other SWAG members adopting procedures	3
4	6	Turf Practices	Percentage reduction in chemical application to turf		Percentage of population familiar with / implementing procedures	3
4	6	Turf Practices	Percentage reduction in water usage for turf		Pollutant load reductions	4
4	6	Turf Practices	Number of trees planted			
4	7	Waste	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
4	7	Waste	Percentage increase in materials collected		Pollutant load reductions	4
4	8	Animal Waste	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
4	8	Animal Waste	Number of waste disposal stations added		Percentage of visitors collecting wastes	3
4	8	Animal Waste	Number of pet run areas		Percentage of visitors utilizing pet run areas	3
4	8	Animal Waste			Pollutant load reductions	4
4	9	San. Sewer	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
4	9	San. Sewer	Number of recommendations made / projects undertaken		Reduction of basement backups / CSOs / SSOs	3
4	9	San. Sewer			Pollutant load reductions	4
4	10	Flood	*Percentage of committed permittees adopting procedures*	1	Percentage of other SWAG members adopting procedures	3
4	10	Flood			Percentage of flood control structures augmented based on action	3
4	10	Flood			Pollutant load reductions	4
4	11	IDEP	*see IDEPs*	1	*see IDEPs*	2
4	11	IDEP			*see IDEPs*	3
4	11	IDEP			Pollutant load reductions	4
4	11	IDEP			Change in discharge quality due to illicit discharges removed	5
4	12	Septic	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
4	12	Septic	Percentage of existing septic systems connected to sewers			
4	12	Septic	Percentage of septic system owners requesting technical assistance		Percentage of septic systems voluntarily implementing upgrades	3
4	12	Septic	Percentage of septic systems inspected			
4	12	Septic	Percentage of inspected systems with enforcement action		Percentage of enforcement actions resulting in problem abatement	3
4	12	Septic			Pollutant load reductions	4

Table 9-1. Measures of success associated with the actions (continued).

Action Category	Action Number	Short Title	Data requirement	Success Level	Data requirement	Success Level
4	13	Trash	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
4	13	Trash	Percentage of stream miles / crossings with trash problems			
4	13	Trash	Amount of trash removed		Number of volunteers participating	3
4	14	Spills	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
4	14	Spills	Percentage of spills contained		Pollutant load reductions	4
4	14	Spills	Percentage of notifications for uncontained spills			
4	14	Spills	Number of assisted investigations			
4	15	Marine	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
4	15	Marine	Number of additional pump-out stations provided			
4	16	Groundwater	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
4	16	Groundwater	Number of wellhead areas delineated / registered with MDEQ			
4	16	Groundwater	Number of abandoned wells located			
4	16	Groundwater	Percentage of located wells closed			
5	1	Bare Soil	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
5	1	Bare Soil	Total square feet (sf) of area repaired		square feet (sf) of repairs done by private landowners	3
5	1	Bare Soil			Pollutant load reductions	4
5	2	Stream Banks	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
5	2	Stream Banks	Total square feet (sf) of area repaired		Pollutant load reductions	4
5	3	Roads	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
5	3	Roads	Total square feet (sf) of area repaired		square feet (sf) of repairs done by private landowners	3
5	3	Roads			Pollutant load reductions	4
5	4	Use Exclusion	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
5	4	Use Exclusion	Total square feet (sf) of area excluded		square feet (sf) of exclusion done by private landowners	3
5	4	Use Exclusion			Pollutant load reductions	4
5	5	Sensitive Sites	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
5	5	Sensitive Sites	Number of sites where controls installed		Number of controls installed by private owners	3
5	5	Sensitive Sites			Pollutant load reductions	4
5	6	Structural	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
5	6	Structural	Number of sites where controls installed		Number of controls installed by private owners	3
5	6	Structural			Pollutant load reductions	4
5	7	Agricultural BMPs	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
5	7	Agricultural BMPs	Number of controls installed in public right of way		Number of controls installed by private owners	3
5	7	Agricultural BMPs			Pollutant load reductions	4
6	1	Imperviousness	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
6	1	Imperviousness	Total square feet (sf) of mitigated imp. surface		square feet (sf) of mitigation done by private owners	3
6	1	Imperviousness			Pollutant load reductions	4
6	2	Infiltration	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
6	2	Infiltration	Total square feet (sf) of area treated w/ infiltration		square feet (sf) of area treated w/ infiltration by private owners	3
6	2	Infiltration			Pollutant load reductions	4
6	3	Filtration	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
6	3	Filtration	Total square feet (sf) of area treated w/ filtration		square feet (sf) of area treated w/ filtration by private owners	3
6	3	Filtration			Pollutant load reductions	4
6	4	Natural Buffers	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
6	4	Natural Buffers	Total linear feet (lf) of natural conveyance implemented		linear feet (lf) of natural conveyance implemented by private owners	3
6	4	Natural Buffers	Total linear feet (lf) of vegetative buffers implemented		linear feet (lf) of vegetative buffer implemented by private owners	3
6	4	Natural Buffers			Pollutant load reductions	4
6	5	Re-/Detention	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
6	5	Re-/Detention	Total square feet (sf) of area subject to re/detention		square feet (sf) of area subject to re/detention by private owner	3
6	5	Re-/Detention			Pollutant load reductions	4
7	1	ID Natural Features	Number of additional sources consulted during identification			
7	2	Land Reserves	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
7	2	Land Reserves	Total acres of land protected		Number of inquiries about programs	3
7	3	NF Protection	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
7	3	NF Protection	Number of protections installed / undertaken		Number of protections installed by private owners	3
7	4	NF Restoration	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
7	4	NF Restoration	Number of restorations undertaken		Restorations undertaken by private owners	3
8	1	Recreation Program	Percentage of SWAG members participating		Percentage of SWAG members participating	3
8	2	Riparian Parks	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
8	2	Riparian Parks	Number of parks established / total acreage			
8	3	Access	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
8	3	Access	Number of landings / access sites added			
8	4	Fishing	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
8	4	Fishing	Number of fishing opportunities restored			
8	5	Trails / Decks	Percentage of SWAG members implementing action		Percentage of SWAG members implementing action	3
8	5	Trails / Decks	Number of trail miles established			
8	5	Trails / Decks	Number of observation decks constructed			

Evaluation Procedure Actions

The actions listed below are designed to ensure that at least the minimum amount of data and assessments are conducted to provide ample evaluation of the WMP and guide revisions to it. They are listed in category '9' to provide consistency between the actions in Chapter 8 and those presented here.

The data collected through these actions should be coordinated with data presented in earlier chapters of this WMP to facilitate temporal analyses of conditions at a variety of locations. Additionally, the monitoring and assessments should be conducted in such a way as to develop relationships between them and a holistic view of a particular area.

9-1a Water Quality Assessment: Existing Monitoring Programs

The SWAG and its members will leverage existing data collection programs to obtain data for assessing water quality. These data will generally be used to document success in Level 4: Load Reductions, Level 5: Changes in Discharge Quality, and Level 6: Changes in Receiving Water Quality (and any measures of success in these levels listed in Table 9-1).

The programs to leverage may include:

- Clinton River Watershed Council (CRWC) benthic macroinvertebrate monitoring;
- County or municipal IDEP;
- County surface water quality monitoring; and
- State/federal water quality monitoring.

Specifically, the data obtained from these programs will be used to assess if the target reductions for stressors (sediment, phosphorus, and pathogens) are being met.

Where appropriate, the SWAG and/or its members should make recommendations to the organizations collecting data to ensure that the data collected is beneficial to the evaluation of this WMP. Specific recommendations for monitoring protocols are listed in Chapter 5.

9-1b Water Quantity Assessment: R-B Index

The SWAG and its members will conduct an assessment of the R-B Index every five years to see if the target for no increase in the R-B Index is being met (related to the hydrologic flow stressor). This assessment will generally rely on existing flow data being collected at gage locations by the United States Geological Survey (USGS).

Where appropriate, the SWAG and/or its members should make recommendations to ensure that the data collected is beneficial to the evaluation of this WMP. Specific recommendations for monitoring protocols are listed in Chapter 5.

9-2 Surveys and PEP Data Assessment

SWAG entities are currently involved in numerous surveys and assessments involved with assessing public education activities. The SWAG and its members will continue to leverage these surveys and assessments. If appropriate, the SWAG and/or its members will recommend changes to existing surveys and/or develop new surveys to meet the assessment needs of this WMP.

Guideposts for Achieving Loading Reductions

<u>SEDIMENT</u>

The preferred way to determine if sediment loading reductions are being achieved is to quantitatively analyze water chemistry data.

Alternatively, or in addition to analyzing water quality data, reductions may be qualitatively shown through: improved macroinvertebrate and fish communities; reduced time between dredging; and a decrease in the number/severity of bank erosion problems.

<u>PHOSPHORUS</u>

The preferred way to determine if phosphorus loading reductions are being achieved is to quantitatively analyze water chemistry data.

Alternatively, or in addition to analyzing water quality data, reductions may be qualitatively shown through a reduced prevalence of algae and macrophytes.

<u>PATHOGENS</u>

The preferred way to determine if pathogen loading reductions are being achieved is to quantitatively analyze water chemistry data.

Alternatively, or in addition to analyzing water quality data, reductions may be qualitatively shown through: continued progress in correcting illicit connections; decreased occurrences of sanitary and combined sewer overflows (i.e. SSO, CSOs); and fewer beach closings.

These needs include documenting success at Level 2: Changes in Knowledge and Awareness and Level 3: Changes in Behavior / BMP Implementation – among the public (and addressing any measures of success in these levels – see Table 9-1)

The data and associated assessments may be related to any of the stressors affecting the watershed, but any pollutant load reductions from the actions being assessed through surveys and such are not likely to be quantifiable.

9-3 Program Assessment

SWAG members are currently implementing a portion of the program assessment through documentation provided in the annual reports. The SWAG and its members will enhance the program assessment to include:

- Logging which actions have been started and which have been completed;
- Making calculations (e.g. pollutant load reductions) associated with action implementation;
- Considering the organizational structure of the SWAG and its effectiveness in implementing the actions; and
- Checking the milestones to see if they have been met.

The data generated from these activities will generally be used to document success in Level 1: Compliance with Activity-based Permit Requirements, Level 3: Changes in Behavior / BMP Implementation – among SWAG members, Level 4: Load Reductions (and any measures of success in these levels, and those associated with no level, in Table 9-1).

9-4 Field Data Collection

The SWAG and its members will implement some of the field data collection activities that were conducted during the development of this plan. The methodologies to obtain this data may include:

- Road/stream crossing assessments;
- Stream assessments; and
- Unified Subwatershed and Site Reconnaissance.

The data collected through these activities will help develop a holistic view of the health of the subwatershed and identify more specific sources to target for achieving pollutant load reductions.

Table 9-2 presents the details of the evaluation actions. The table lists the actions, comments, schedule, and cost/labor to implement the assessment techniques, and commitments to perform them. The commitment level notation is the same as the notation used in Chapter 8:

-- = no commitment by the Phase II permittee as the action is not applicable;

N = no commitment by the Phase II Permittee as the action is not able to be implemented;

W = no commitment by the Phase II Permittee, but would like to consider implementing the action if funding is acquired;

Y = Phase II Permittee commits to the action;

E = Phase II Permittee commits to the action and is already doing it in some capacity; and

D = Phase II Permittee commits to the action and has already completed it.

Guideposts for Achieving Loading Reductions (continued)

<u>HYDROLOGIC FLOW</u>

The preferred way to determine if hydrologic flow flashiness reductions are being achieved is to quantitatively analyze actual flow data.

Alternatively, or in addition to analyzing flow data, reductions may be qualitatively shown through reduced levels of impervious cover.

Field Data Collection for Developing the Plan: Unified Stream Assessment

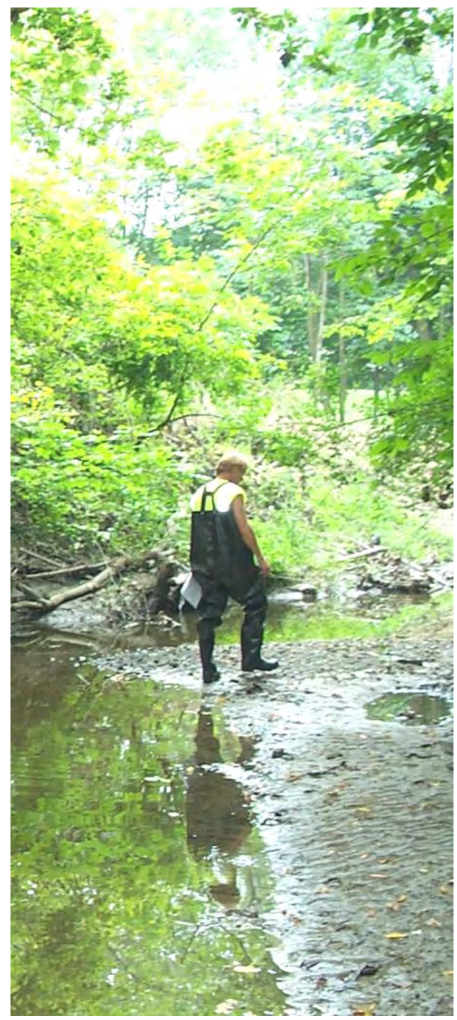


Photo courtesy of MCPWO.

Table 9-2. Evaluation action details.

Number		Action		Schedule	Estimated Costs			Commitment Level --=not applicable N=no commitment W=no commitment, wish list item E=commitment, already doing Y=commitment										
Action Category	Action Number	Action Title	Comments	Cycle * - or permit cycle	Material Costs (SWAG total)	Labor Hours (SWAG total)	Cost / Labor Basis	Bruce Township	Clinton Township	Fraser, City of	Harrison Township	Macomb Township	Mt. Clemens, City of (+ nested jurisdiction)	Romeo, Village of	Shelby Township	Utica, City of	Washington Township	Macomb County (+nested jurisdictions)
9	1a	Water Quality Assessment: Existing Monitoring Programs		Annually		200-400	annual	E	E	E	Y	Y	Y	Y	Y	Y	E	Y
9	1b	Water Quantity Assessment: R-B Index		5-year*		50-100	cycle	W	W	W	Y	Y	Y	Y	Y	Y	W	W
9	2	Surveys and PEP Data Assessment		Annually	$10,000	200-400	annual	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
9	3	Program Assessment		Annually		100-200	annual	E	E	E	Y	Y	Y	Y	Y	Y	E	Y
9	4	Field Data Collection		Annually		500-1000	annual	E	E	E	Y	Y	Y	Y	Y	Y	E	Y

Implementation Milestones

This sub-section lists out and expands upon the implementation milestones initially addressed in Chapter 8. The milestones are presented to gauge progress and are not meant to indicate commitments for any of the actions, as many of the actions are highly dependent on the availability of funding that the SWAG and its members have limited control over.

The primary function of the milestones is to act as a mechanism for guiding realistic revisions to actions and schedules in future versions of this WMP. Commitments to actions by the permittees are detailed in Tables 8-2 and 9-2. However, the milestones associated with Phase II requirements are highlighted textually for cross-referencing purposes.

<u>**Year**</u> <u>**Milestone**</u>

By 2007 **Action 1-5: Update SWPPI**

As a Phase II requirement, each permittee will have submitted a Storm Water Pollution Prevention Initiative (SWPPI) that considers the contents of this WMP by the date listed in their respective certificates of coverage.

Action 1-2: Evaluation and Revision Procedure

If this action has been implemented (above and beyond the Phase II requirement to include 'progress evaluation mechanisms' in the WMP – which is met by the contents of this chapter), the SWAG will have formalized the Evaluation and Revision Procedure in consideration of any conditions that have changed since 2006.

By 2008 **Action 1-6: Update WMP**

As a Phase II requirement, the SWAG will have developed and submitted an updated WMP or provided a written determination not to update the WMP to the MDEQ by November 1st, 2008.

By 2009	**Action 1-5: Update SWPPI** As a Phase II requirement, each permittee will have submitted a Storm Water Pollution Prevention Initiative (SWPPI) by the date listed in their respective certificate of coverage.
By 2010	**Action 1-1: Promote and Reconvene SWAG** If the action has been implemented, the SWAG will have agreed on and implemented a mechanism for long term implementation of the WMP. If the action has been implemented, the SWAG will have increased participation and meeting attendance over levels documented at the time of submittal of the plan.

By 2009 **Action 1-5: Update SWPPI**

As a Phase II requirement, each permittee will have submitted a Storm Water Pollution Prevention Initiative (SWPPI) by the date listed in their respective certificate of coverage.

By 2010 **Action 1-1: Promote and Reconvene SWAG**

If the action has been implemented, the SWAG will have agreed on and implemented a mechanism for long term implementation of the WMP.

If the action has been implemented, the SWAG will have increased participation and meeting attendance over levels documented at the time of submittal of the plan.

Action 1-9: Implementation Clearinghouse

If the action has been implemented, the SWAG will have developed an implementation clearinghouse which effectively logs actions taken and allows members to easily obtain implementation information.

Action 1-10: Pollutant Source Identification

If the action has been implemented, the SWAG will have completed a pollutant source identification that can be used to implement many other actions in the WMP.

Action 2-5: Signage

If the action has been implemented, those SWAG members participating will have installed ample signage to further achievement of the appropriate goals and objectives of the WMP.

Action 2-6: Public Involvement

If the action has been implemented, those SWAG members participating will have conducted public involvement activities in a more ambitious schedule than existed at the time of submittal of this WMP and will have provided opportunities for a greater segment of the population to become involved.

Action 2-7: Community Forums & Stakeholder Wkshps.

If the action has been implemented, those SWAG members participating will have conducted public meetings in a more ambitious schedule than existed at the time of submittal of this WMP and will have provided opportunities for a greater segment of the population to become involved.

Action 2-8: Municipal Officials' Involvement and Educ.

If the action has been implemented, those SWAG members participating will have educated municipal officials in a more ambitious schedule than existed at the time of submittal of this WMP and utilizing educational agendas with a greater scope of information.

Action 4-1: Identify Sources of Sediment Contaminants

If the action has been implemented, the SWAG will have completed an identification of sources of sediment contaminants that can be used to implement many other actions in the WMP.

Action 4-2: Identify Actions to Remediate Contaminated Sediments

If the action has been implemented, the SWAG will have completed an identification of the actions necessary to remediate contaminated sediments that can be used to implement many other actions in the WMP.

Action 4-13: Trash/Debris Reduction

If the action has been implemented, those SWAG members participating will have implemented a program to identify and clean-up areas of excessive trash in the subwatershed.

Action 4-14: Spill Prevention / Notification / Response

If the action has been implemented, those SWAG members participating will have implemented a spill prevention, notification, and response program that reduces pollution to a degree that is greater than what would have been expected at the time of submittal of this WMP.

Action 7-1: Identify Natural Features

If the action has been implemented, the SWAG will have conducted an identification of natural features that can be used to implement other actions of the WMP.

By 2013 **Action 2-3: Municipal Employee Training**

Each of the permittees committing to this action as a Phase II requirement, or other SWAG members implementing this action, will participate in, or have in place, a program that regularly trains all employees on pollution reducing measures to be utilized during regular job performance.

Action 3-1: Stormwater Management Standards

Each of the permittees committing to this action as a Phase II requirement, or other SWAG members implementing this action, will have researched and adopted measures to manage stormwater from areas new development and significant redevelopment.

Action 3-2: Managing Development Patterns

Each of the permittees committing to this action as a Phase II requirement, or other SWAG members implementing this action, will have researched and adopted measures to manage development patterns such that new development and significant redevelopment occur in such a way as to lessen environmental impacts in comparison to traditional development.

Action 3-3: Preserve Natural Areas / Features

Each of the permittees committing to this action as a Phase II requirement, or other SWAG members implementing this action, will have researched and adopted measures to preserve natural areas and features by protecting them from destruction or the undesirable impacts of traditional development practices.

Action 3-4: Preserve Natural Areas / Features

If the action has been implemented, those SWAG members participating will have enacted and/or instituted ordinances and programs to increase the level of pollution prevention to a greater degree than was in place at the time of submittal of this WMP. Each of the permittees committing to this action as a Phase II requirement (as a component of, or in lieu of an action from category 4), will also have enacted and/or instituted programs to increase the level of pollution prevention.

Action 4-3: Storm Sewer Maintenance and Operations

Each of the permittees committing to this action as a Phase II requirement, or other SWAG members implementing this action, will have defined procedures for the maintenance and operations of the storm sewer system that reduce pollutant discharges.

Action 4-4: Minimizing Pollution from Roads and Lots

Each of the permittees committing to this action as a Phase II requirement, or other SWAG members implementing this action, will have defined procedures for the minimization of pollutant discharges from streets, roads, highways, and parking lots.

Action 4-5: Minimizing Pollution from Municipal Facilities

Each of the permittees committing to this action as a Phase II requirement, or other SWAG members implementing this action, will have defined procedures for the minimization of pollutant discharges from municipal facilities.

Action 4-6: Turf Management Practices

Each of the permittees committing to this action as a Phase II requirement, or other SWAG members implementing this action, will have defined procedures for turf management that minimize the discharge of pollutants such as pesticides, herbicides, and fertilizers.

By 2015 **Action 1-8: Total Maximum Daily Loads**

As a Phase II requirement, the SWAG will have incorporated all completed TMDLs (currently scheduled through 2012) into the regularly scheduled WMP updates.

Action 1-5: Demonstration Projects

If the action has been implemented, those SWAG member participating will have at least identified one demonstration project and begun preliminary activities towards completing it.

Action 4-7: Waste Management

If the action has been implemented, those SWAG members participating will have implemented or augmented existing waste management programs such that pollution potential from waste or the collection infrastructure is reduced to a level below that which existed when the WMP was submitted.

Action 4-8: Animal Waste Control
If the action has been implemented, those SWAG members participating will have implemented or augmented existing animal waste control facilities or programs such that pollution potential from animal waste is reduced to a level below that which existed when the WMP was submitted.

Action 4-9: Sanitary / Combined Sewer Planning and Maintenance
If the action has been implemented, those SWAG members participating will have engaged in the planning of and/or defined maintenance procedures for, the sanitary/combined sewer system such that pollutant discharges are reduced to a level that is lower than at the time of submittal of this WMP.

Action 4-10: Flood Control Projects
Each of the permittees committing to this action as a Phase II requirement, or other SWAG members implementing this action, will have defined mechanisms for ensuring that flood control projects are assessed for water quality impacts and incorporate all reasonable measures to reduce these impacts.

Action 4-12: Septic System Practices
If the action has been implemented, those SWAG members participating will have implemented various mechanisms and programs to ensure that the pollutant discharges from septic systems as a whole is reduced to level lower than that which existed at the time of submittal of this WMP.

Action 4-15: Marine Industry Practices
If the action has been implemented, those SWAG members participating will have taken steps to reduce the pollution potential from marine activities to a level lower than that which existed at the time of submittal of this WMP.

Action 4-16: Groundwater
If the action has been implemented, those SWAG members participating will have taken steps to ensure that groundwater levels and quality are protected such that the conditions existing at the time of submittal of this WMP are preserved.

Actions 5-1 through 5-7: Non-Construction Related Soil Erosion and Sediment Control
The SWAG and/or its members will have implemented some combination of these actions such that at least 20% of the sediment loading reduction target is being achieved (also considering reductions from previously implemented actions from other categories).

By 2020

Actions 6-1 through 6-5: Other Pollutant Load Reducing Controls
The SWAG and/or its members will have implemented some combination of these actions such that at least 40% of the sediment loading reduction target and 20% of the phosphorus loading reduction targets are being achieved (also considering reductions from previously implemented actions from other categories).

Action 7-2: Natural Land Reserves
If the action has been implemented, those SWAG members participating will have preserved at least one parcel of natural land.

Action 7-3: Natural Feature Protection
If the action has been implemented, those SWAG members participating will have implemented programs or completed projects such that natural features are protected to an extent greater than at the time this WMP was submitted.

Action 7-4: Natural Feature Restoration
If the action has been implemented, those SWAG members participating will have implemented programs or completed projects such that natural features have been restored to a condition greater than that which existed at the time this WMP was submitted.

By 2025

Actions 8-1 through 8-5: Recreation Promotion and Enhancement
If these actions have been implemented, the participating SWAG members will have increased recreational opportunities in the subwatershed to a level greater than that which existed at the time of submittal of this WMP.

Guidance for Revision of the WMP

The SWAG will be updating this WMP regularly for both regulatory purposes and to reflect changing conditions in the subwatershed. The following sub-sections discuss some of the revision options available.

Integrated Assessment

The SWAG and/or its members may wish to implement some form of integrated assessment to look at all collected data holistically and help guide any WMP revisions. The integrated assessment may involve:

- Examining collected data and related assessments to identify gaps in the data;
- Looking for causal relationship between the actions taken and the results documented; and
- Examining the goals and objectives (see Table 9-3) for achievement status, modification, omission, or addition.

Other Data and Assessments

The SWAG and/or its members may wish to collect additional data or implement other assessments that they deem to be necessary to successful watershed management planning. Examples of possible activities are presented in Chapter 7. Such activities should be added to the evaluation procedure actions in this chapter

Final Recommendations for WMP Modification

The SWAG and/or its members may wish to summarize recommendations for changes to the WMP (to assist in implementing Action 1-6) based on collected data, associated assessments, and the findings of such assessments. Recommendations may include:

- Updating actions to reflect current implementation levels;
- Modifying goals and objectives;
- Modifying actions; and
- Modifying evaluation mechanisms and monitoring protocols.

Goals and Objectives Evaluation

In addition to evaluating the actions, it is also beneficial to ask some general questions with respect to the goals / objectives, as presented in Table 9-3. The answers to these questions will assist in determining the progress being made toward achieving the goals / objectives. This progress helps define the changes to be made to the WMP, when revised.

References

Michigan Department of Environmental Quality [MDEQ]. Website. Via: http://www.deq.state.mi.us/documents /deq-wb-swas-strategyupdate.pdf. Last Accessed: July 20, 2006.

Michigan Department of Natural Resources [MDNR]. Website. Via: http://www.michigan.gov/dnr. Last Accessed July 20, 2006.

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

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

Southeast Michigan Council of Governments [SEMCOG]. "Water Quality Management Plan for Southeast Michigan". 1999.

Non-Action Milestones

By 2030

Over the summer 4-month period, the instances of pathogen water quality standard violations will have decreased 50% from the number of instances documented in 2007.

A trend will have emerged that at least shows that the flashiness indices (e.g. R-B Index) for the measured waterbodies are slowing their rate of increase.

Actions without Milestones

Actions without milestones include: Action 1-3 (Funding Program), Action 1-4 (Grant Proposals), Action 1-7 (Annual Reports), Action 2-1 (Public Education Plan Implementation), Action 2-2 (Additional Public Education), and Action 4-11 (Illicit Discharge Elimination Program). Also, none of the evaluation actions (Category 9) have been assigned any milestones.

Goals and Objectives Evaluation – Phase II Related

In the 'Evaluation Questions' column of Table 9-3, those specific actions which are Phase II related are in bold. Where an 'Action Group' is referenced, it is italicized if the group contains actions that are Phase II related. For these, one would have to refer to Chapter 8 to determine which actions in the group are Phase II related.

Table 9-3. Goals and Objectives evaluation questions.

Goal / Objective	Evaluation Questions
<u>Goal I: To protect, restore, and enhance water quality of the subwatershed</u>	Are objectives (A), (B), (C), and (D), below, being addressed? Has water quality deteriorated in any part of the subwatershed? Has water quality been restored or enhance in any part of the subwatershed?
A. Address existing and future contaminated sediments.	Are parts (i) and (ii), below, being addressed?
i. Identify feasible actions to remediate existing contaminated sediments.	Has Action 4-2 been completed?
ii. Identify and implement pollution prevention activities for current and future sources.	Has Action 4-1 been completed? Have BMPs been implemented under *Action Group 4* or 6 that specifically target current and future sediment contamination sources?
B. Reduce the amount of nutrients and excessive algae to improve dissolved oxygen levels.	Are parts (i) and (ii), below, being addressed? Do monitoring data show loading reductions for nutrients? Do monitoring data show lower nutrient concentrations in receiving waters? Have there been incidences of excessive algae documented in the subwatershed? Do monitoring data show improved dissolved oxygen levels?
i. Identify sources of nutrients and BOD.	Has Action 5-1 been completed?
ii. Identify and implement management practices to limit nutrient and BOD loadings.	Have BMPs been implemented under *Action Groups 4*, 5, or 6 that specifically reduce nutrient and BOD loadings?
C. Reduce the amount of sediment	Are parts (i) and (ii), below, being addressed? Do monitoring data show loading reductions for sediment? Do monitoring data show lower sediment concentrations in receiving waters?
i. Identify sources of sediment.	Has Action 1-10 been completed?
ii. Identify and implement management practices to limit sediment loadings.	Have BMPs been implemented under *Action Groups 4*, 5, or 6 that specifically reduce nutrient and BOD loadings?
D. Reduce amount of pathogens.	Are parts (i), (ii), and (iii), below, being addressed? Do monitoring data show loading reductions for pathogens? Do monitoring data show lower pathogen concentrations in receiving waters?
i. Identify and address failing septic systems.	Has Action 4-12 been implemented?
ii. Identify and address illicit connections.	Has **Action 4-11** been implemented?
iii. Identify stormwater management techniques to reduce other nonpoint source pathogen loadings and implement techniques where practical.	Have BMPs been implemented under *Action Groups 4*, 5, or 6 that specifically reduce pathogen loadings?
<u>Goal II: To educate the public on how to protect, restore, and enhance water quality</u>	Are objectives (A), (B), and (C), below, being addressed? Do survey results indicate that the public is learning how to protect, restore, and enhance water quality?
A. Increase the public's level of awareness about watershed problems and management activities.	Are parts (i) and (ii), below, being addressed? Do survey results indicate the public is becoming aware about watershed problems and management activities?

Table 9-3. Goals and Objectives evaluation questions. (continued)

Goal / Objective	Evaluation Questions
i. Develop and utilize existing outreach materials using messages and formats tailored to specific target audiences.	Have **Actions 2-1**, 2-2, **2-3**, 2-5, and 2-8 been implemented?
ii. Provide hands-on, interactive learning opportunities focused on watershed concepts tailored to specific target audiences.	Have **Actions 2-1**, 2-2, 2-4, 2-6, and 2-7 been implemented?
B. Increase the public's understanding of steps to take to improve water quality.	Are parts (i) and (ii), below, being addressed? Do survey results indicate that the public is understanding the steps needed to improve water quality?
i. Ensure existing outreach materials focused on positive actions to improve water quality reach key target audiences.	Have **Actions 2-1**, 2-2, **2-3**, 2-5, and 2-8 been implemented?
ii. Provide hands-on learning opportunities for key target audiences that address specific behaviors and pollutants of concern.	Have **Actions 2-1**, 2-2, 2-4, and 2-7 been implemented?
C. Produce measurable changes in the public's behaviors that negatively impact water quality.	Are parts (i) and (ii), below, being addressed? Do survey results indicate that behaviors in the public that negatively impact water quality are decreasing?
i. Develop and utilize existing social marketing programs that target specific polluting behaviors in specific target audiences.	Have **Actions 2-1**, 2-2, **2-3**, 2-5, and 2-8 been implemented?
ii. Conducting evaluations of outreach and social marketing activities to assess effectiveness over time.	Have **Actions 1-2** and 1-9 been implemented?
<u>Goal III: To promote and enhance recreational opportunities in the subwatershed</u>	Is objective (A), below, being addressed?
A. Increase opportunities for water-based recreation.	Are parts (i), (ii), and (iii), below, being addressed?
i. Educate the public about the potential dangers and health risks associated with water-based recreational activities.	Has Action 2-2 been implemented?
ii. Educate public on watershed-based recreational opportunities in the subwatershed.	Have Actions 2-2, 8-1, 8-3, and 8-5 been implemented?
iii. Increase recreational opportunities through additional programs / facilities and enhance public access to existing facilities.	Have Actions 8-1 through 8-5 been implemented?
<u>Goal IV: To appropriately manage suitable habitat for aquatic life, wildlife, and fisheries in the subwatershed</u>	Is objective (A), below, being addressed?
A. Increase the amount of desired suitable habitat to support aquatic life, wildlife, and fisheries.	Are parts (i) and (ii), below, being addressed?
i. Identify high-quality habitat in need of protection.	Have **Actions 3-3** and 7-1 been implemented?
ii. Identify targeted areas with habitat in need of restoration.	Have **Actions 3-3** and 7-4 been implemented?
<u>Goal V: To reduce runoff impacts through sustainable stormwater management</u>	Are objectives (A), and (B), below, being addressed?
A. Reduce impacts from urban stormwater runoff.	Is part (i), below, being addressed?
i. Identify and implement best management practices to effectively manage quantity and quality of urban stormwater.	Have BMPs been implemented under *Action Groups 3*, 5, or 6 that specifically reduce nutrient and BOD loadings?

Table 9-3. Goals and Objectives evaluation questions. (continued)

Goal / Objective	Evaluation Questions
B. Reduce urban stormwater contributions leading to CSOs and SSOs.	Is part (i), below, being addressed?
i. Identify and implement best management practices to effectively manage quantity and quality of urban stormwater that will promote reduction of CSO and SSO frequency.	Have BMPs been implemented under *Action Groups 3, 4*, or 6 that specifically manage quantity and quality of urban stormwater?
Goal VI: to seek out opportunities to sustain implementation of the plan	Are objectives (A), and (B), below, being addressed?
A. Increase funding available for implementation.	Are parts (i), (ii), and (iii), below, being addressed?
i. Identify existing federal, state, and local funding opportunities.	Has Action 1-3 been implemented?
ii. Coordinate the development of grant proposals.	Has Action 1-4 been implemented?
iii. Create new opportunities for funding.	Has Action 1-3 been implemented?
B. Institutionalize the plan and the advisory group.	Are parts (i) and (ii), below, being addressed?
i. Identify and adopt a mechanism for ensuring the advisory group continues its activities in the future.	Has Action 1-1 been implemented?
ii. Identify and adopt a mechanism for ensuring the plan is implemented, updated, and revised in the future.	Have Actions 1-1, **1-2**, 1-3, **1-5**, **1-6**, **1-7**, and 1-9 been implemented?
Goal VII: To promote opportunities to preserve, protect, restore, and enhance natural features	Are objectives (A), (B), and (C), below, being addressed?
A. Protect existing high-quality natural features.	Are parts (i) and (ii), below, being addressed?
i. Compile an inventory of existing high-quality natural features for protection.	Has Action 7-1 been implemented?
ii. Identify and implement tools to protect inventoried natural features, such as ordinances and programs for managing natural features to benefit stormwater quality and quantity.	Have Actions **3-3**, 7-2, and 7-3 been implemented? Have other BMPs been implemented under *Action Groups 3, 4*, 5 or 6 that specifically protect inventoried natural features?
B. Restore important natural features.	Are parts (i) and (ii), below, being addressed?
i. Compile an inventory of natural features in need of restoration.	Has Action 7-1 been implemented?
ii. Develop plans and tools for restoration of natural features.	Have Actions 7-2, 7-3, and 7-4 been implemented?
C. Enhance existing natural features.	Are parts (i) and (ii), below, being addressed?
i. Participate in local and regional efforts to promote green infrastructure.	Have BMPs been implemented under *Action Groups 3*, 6, or 7 that specifically promote green infrastructure?
ii. When feasible, stabilize streambanks where erosion is occurring and prevent streambank failure in susceptible locations.	Have BMPs been implemented under *Action Groups 3*, 6, or 7 that specifically stabilize eroding streambank and protect other locations?
Additional / Revised Goals?	Have any additional goals been identified for inclusion in the plan? Do any goals need to eliminated or revised?
Additional / Revised Objectives?	Have any additional objectives been identified for inclusion in the plan? Do any objectives need to be eliminated or revised?

10. Plan Institutionalization

Introduction

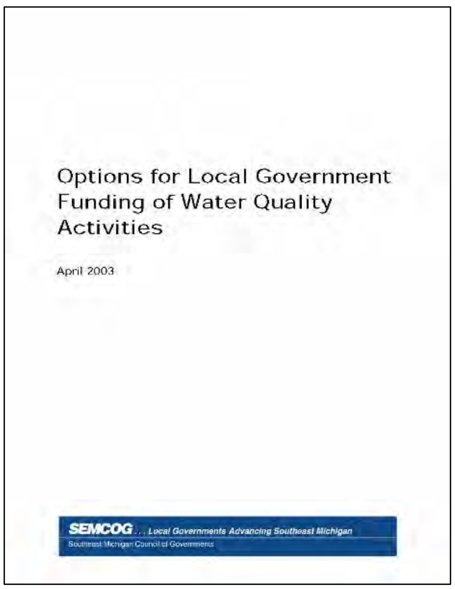
Institutionalization involves defining a mechanism to implement the WMP once it is complete, including essential adaptive management measures such as provisions for updating and improving the plan. Defining the actual mechanism will involve researching the myriad alternatives that are available and evaluating how successful the implementation is under the current mechanism. This research and evaluation will occur over the first four years after submittal of this WMP (see Action 1-1 in Chapter 8).

Additionally, regardless of the mechanism that is chosen, the inner workings of a cooperative approach must be defined.

The purpose of this chapter is to first define these inner workings, provide options for the institutionalization mechanism, and then explore how these options and some additional programs can fund implementation of the WMP.

The information in this chapter is not exhaustive. The focus is on the enabling statutory provisions most likely to be used. While SWAG members are likely to focus on programs related to the new regulations for addressing pollution from stormwater, the information in this report includes other water quality initiatives.

In large part, the latter sections of this chapter are an updating and reorganization of the Southeast Michigan Council of Governments' (SEMCOGs) *Options for Local Government Funding of Water Quality Activities (2003)*.


Options for Local Government Funding of Water Quality Activities

April 2003

SEMCOG ... Local Governments Advancing Southeast Michigan
Southeast Michigan Council of Governments

Structure

The development of this WMP has occurred under the direction of a voluntary group structure known as a subwatershed advisory group (SWAG) – see Chapter 1.

It is expected that this structure will guide the implementation of the WMP over the four years following submittal of this WMP. During this time, the SWAG will evaluate how the current structure is able to implement the plan. Specifically, how voluntary membership with ad hoc committees can implement and track the various actions and results and the ability for the SWAG to get the members to act as a watershed as opposed to isolated and independent actors.

SWAG Meeting

Photo courtesy of MCPWO.

SWAG Structure

Some of the actions in the WMP may be implemented by the SWAG at large. Others may be solely actions of the individual entities with little or no SWAG involvement. However, some of the actions may require focused attention of members within the SWAG to provide a coordinated watershed approach. This has been, and will continue to be, (at least for the first four years), dealt with through the formation of ad hoc committees that meet for specific purposes for a set period of time.

The members of each committee, including the chairperson, will be determined at the SWAG meeting in which the committee is formed. Each subsequent SWAG meeting will include updates from the existing committees, including membership and chairperson issues.

Some recommendations for the committees that may be utilized to implement the actions of the WMP are addressed in the following topics.

Implementation and Evaluation Committee

This committee may oversee: the implementation of some of the planning actions (Action Group 1 – see Chapter 8), the integration of much of the data collected as part of the WMP evaluation process, the analysis of the data (measures of completion, usage/attainment, and change), and making recommendation for modifications to the WMP and other documents derived from the WMP, as appropriate (see Chapter 9).

Ordinance/Standards Committee

This committee may provide guidance for: development of language for ordinances, standards, and pollution prevention programs (Action Group 3 – see Chapter 8); review of existing ordinances, standards, and programs of the individual SWAG members; and recommendations for each SWAG member to make to appropriately implement an action.

Technical Guidance Committee

This committee may be responsible for: providing technical guidance for the planning and implementation of pollution prevention activities (Action Group 4 – see Chapter 8) and stormwater BMPs (Action Groups 5 and 6 – see Chapter 8), and providing technical guidance to SWAG members or other committees to help them fully implement other actions.

Public Education Committee

This committee may be responsible for planning and implementing portions of the public education and participation actions (Action Group 2 – see Chapter 8).

Budget and Funding Committee

This committee may be charged with developing the funding plan for SWAG operations (Action 1-3 – see Chapter 8) and handling requests from SWAG members as to the appropriate funding considerations to explore.

Conservation/Recreation Committee

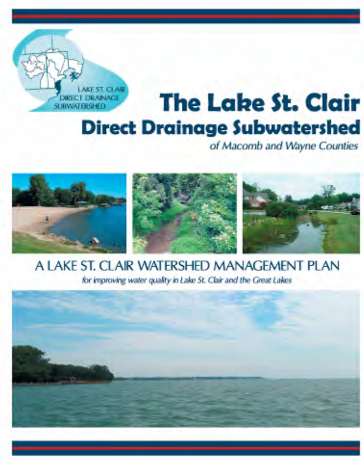
This committee may be in charge of developing programs and implementing actions related to conservation and recreation (Action Groups 7 and 8, respectively – see Chapter 8).

Cooperative Involvement

Because this WMP has been developed in conjunction with two other WMPs (Red Run Subwatershed and Lake St. Clair Direct Drainage Subwatershed), many of the actions between the plans are similar. As such, and because some of the SWAG members are involved in multiple plans, the SWAG will explore operating ad hoc committees singly for all three of the subwatersheds. At least one member from each subwatershed should participate in each committee to ensure that the goals and objectives of each distinct subwatershed are being adequately addressed.

Additionally, other subwatershed groups in the Clinton River Watershed, and groups from adjacent watersheds and subwatersheds, should be contacted for input and/or involved in SWAG and committee activities. This will be encouraged to ensure that actions, especially those required of SWAG members represented in a subwatershed (or subwatersheds) outside of the primary three, will be coordinated and effective as possible without being overly burdensome.

Plans Developed in Conjunction with this WMP



Other Groups to Consider for SWAG Participation

Anchor Bay Subwatershed
Clinton Main Subwatershed
Lake St. Clair Direct Drainage Subwatershed
North Branch Subwatershed
Red Run Subwatershed
Stony Creek / Paint Creek Subwatershed
Upper Clinton Subwatershed

Belle River, Flint River, Shiawassee River, Huron River, Rouge River, and Detroit River Watersheds and Subwatersheds

Examples of Legal Entities Utilized Throughout Michigan for Watershed Protection and Contact Information

Inter-Municipal Committee Act:
Greater Lansing Regional Committee – Red Cedar, Looking Glass, and Grand Rivers
Contact: Erin Campbell at the Tri-County Regional Planning Commission
Phone: (517) 393-0342

Municipal Sewerage and Water Systems
Saginaw Area Storm Water Authority
Contact: www.saswa.org

County Public Improvement Act:
Lower Flint River
Contact: Genesee County Drain Commissioner's Office
Phone: (810) 732-1590

Watershed Alliance:
The Alliance of Rouge Communities
Chair: <currently vacant>
Vice-Chair: Wayne Domine
Phone: (734) 433-7731

Voluntary Cooperation:
Battle Creek Area Clean Water Partners
Contact: www.bcwater.org

Legal Relationships

Considering various methods for institutionalization is a critical component of this WMP and to sustain the SWAG's effort to-date. It is especially important for those SWAG members submitting this plan for Phase II Watershed-based Permit compliance.

Michigan has a number of different methods available for the SWAG to form into a legal entity. At least seven approaches are available under Michigan statutes to lead and assign funding responsibilities for WMP implementation. These options include the following:

1) Drain Code – Public Act 40 (1956);
2) County Department and Board of Public Works – Public Act 185 (1957);
3) Inter-Municipal Committee Act – Public Act 200 (1957);
4) Municipal Sewerage and Water Systems - Public Act 233 (1955);
5) County Public Improvement Act – Public Act 342 (1939);
6) Watershed Alliance Act – Public Act 517 (2004); and
7) Voluntary Cooperation.

Table 10-1 provides a brief summary of each of these options, how each of these options can be used (including a working example in the state, if possible), and some advantages or disadvantages for using each option. Any of these options could be used independently or in combination to handle a specific project area.

Funding

When looking to cooperatively implement the WMP, it is important to consider how costs will be divided and paid. A common method for funding allocations is to use a formula that is a function of land area and population. Funding formulas based on other factors include, number of parcels, impervious area, land use, diversity of development, opportunity for new development, and community resources. Furthermore, not every task must use the same formula. Different work initiatives may use different formulas. For example, funding allocations for illicit discharge elimination program (IDEP) may be based on land area and the number of outfalls, whereas funding for public education may be based on population.

Independent of which allocation approach is selected is the issue of raising the funds to pay for the activity. Local governments have three basic means of raising revenues – special assessments, taxes, and fees.

Special Assessments

Special assessments are assessments imposed on real property which benefits especially from a government expenditure or service. Special assessments are limited in amount to no more than the increase in value which the real property gains because of the expenditure. Local street and sewer projects are often paid for by special assessments on the real property served by the street or sewer.

Table 10-1. Legal relationship options.

	Description
The Drain Code	**PA 40(1956).** The watershed drainage district created under chapter 20 could include an area within a single municipality or more than one municipality, depending upon the type of agreement to be used. A watershed drainage district established under the Drain Code petition process can be accompanied by a contract between the municipality and the Drainage Board through the execution of an agreement under section 471 or 491. These agreements would describe the services the Drainage Board would provide for each community in the drainage district, identify the process of assessing charges for those services, and establish a mechanism for identifying and approving needed projects. In the case of a section 471 agreement, a watershed committee would be established with a representative from each municipality in the drainage district. Before a proposed project could go to the Drainage Board for consideration, it would need the approval of the watershed committee. Each municipality in the watershed drainage district would be apportioned their share of the cost of the projects. Municipalities could cover their costs either through their general fund or levy those costs to the individual properties within the drainage district through ad valorem taxes, rates/fees, or special assessments.
Public Works Act	**PA 185(1957).** Gives county departments of public works broad authority to provide a range of services, including the collection and transport of stormwater. These county departments may also contract with other units of government to provide specific facilities or services. Funding mechanisms for these services includes property taxes, special assessments, and user charges/rates.
Inter-Municipal Committee	**PA 200(1957).** Allows participating municipalities to adopt resolutions for the establishment of a study committee. Funding is provided by the participating municipalities. However, activities of the committee are limited to study and planning. Construction, operation, maintenance of facilities or implementation of projects beyond studies is not permitted under this legislation.
Municipal Sewerage & Water Syst.	**PA 233(1955).** Municipalities can jointly create an Authority which then contracts with individual municipalities to provide specific facilities or services. Once established, activities of the Authority are limited to those related to owning and operating a sewage disposal system, including storm sewers. Contracting municipalities use a variety of mechanisms to pay for the facilities or services they receive from the Authority, including property taxes, special assessments, and user charges/rates. PA 233 authorities can issue bonds for capital improvements.
County Public Improvement Act	**PA 342(1939).** For purposes of water quality activities, this legislation is similar to the Public Works Act. It authorizes the County Board of Commissioners to designate a county agency to provide specific services, including the collection and transport of stormwater. County agencies eligible to serve as the designated agency include the Board of Public Works, Road Commission, or Drain Commissioner. Rates, charges, or assessments are paid based on the facilities or services provided and the agency can contract with other units of government for the cost of such facilities or services. Again, property taxes, special assessments, and user charges/rates can be used by the contracting governments to pay for the facilities or services they receive.
Watershed Alliance Act	**PA 517(2004).** Two or more communities can form a watershed alliance if they adopt bylaws with the approval of the governing body. Through by-laws, Alliances establish boundaries, assessments to members, structure, and decision-making process. The law provides for authority to receive grant funding, manage its own money, contract its own staff and services, and implement plans and projects. Alliances *can not* levy taxes or assess individuals, businesses, or property. They do not have the authority to regulate or issue permits. Membership is voluntary and can include municipalities, counties, school districts, colleges and universities, or other local or regional public agencies.
Voluntary Cooperation	It is possible to work voluntarily without any contracts or legal agreements. To accomplish this, affected units of government must voluntarily agree to work together cooperatively. This requires trust and accountability. There are many different ways to implement a cooperative agreement, with reliance upon committees being one of the dominant structures. Different structures can be considered prior to organizing a committee. Regardless of what structure is decided upon, leadership is a critical component. Some committees elect chairman, others have series of subcommittees. Many committees use Roberts Rules of Order to manage committee operations.

Table 10-1. Legal relationship options. (rows continue across from previous page)

Advantages	Disadvantages
• Flexibility in paying apportioned share (property taxes, rates/fees, special assessments, or general fund); such property taxes may not be subject to the Headlee Amendment. • Define the scope of the work to be performed, responsibilities, active participation by local governments and various agencies involved; allows for use of in-kind services in lieu of cash payments.	• Petition needs to be carefully drafted to include implementation activities. • Agreements with multiple municipalities can be difficult and time consuming. • May limit the role of local government in decision making.
• Allows use of various funding mechanisms.	• Absent companion agreements, may limit the role of local government in decision making.
• Simple to start. • Municipal support can be funds or in-kind services, equipment, etc.	• For study purposes only.
• Allows use of various funding mechanisms. • Can provide services to non-member municipalities at same or greater fee.	• Creates a separate authority. • Primarily intended for water and wastewater services, but can include stormwater. • Contracts between county and municipality(ies) are subject to a right of referendum.
• Allows use of various funding mechanisms.	• Absent companion agreements, may limit the role of local government in decision making. • Contracts between the county and participating municipality(ies) are subject to a right of referendum.
• Specifically written to allow communities to undertake water quality activities. • Allows for the planning/design and implementation of multi-jurisdictional projects. • Can receive and administer external funding. • Equitable membership. • Auditing of finances required by State.	• Still must submit separate permits, IDEPs, SWPPIs, etc. • Does not solve the funding problem.
• Raising revenue is each community's responsibility which allows for flexible approaches. • Direct relationship between cost and benefit to each community.	• Requires trust and individual accountability. • Absence of leadership can limit implementation • Not a reliable stream of funding.

Taxes

Local governments' power to tax is limited to those taxes expressly authorized by constitution or statute. Local government taxing authority is primarily limited to ad valorem taxes on real and personal property and to personal income tax. The rate of these taxes is also limited by statute. In general, local governments do not have the authority to tax on any other basis and cannot impose a sales tax or a tax on consumption like state and federal taxes on gasoline. Thus, a local government does not have the authority to impose a tax on sewer or water use in order to pay for providing those services. Taxes may be imposed to raise revenues for general governmental purposes or for specific projects or objects. The Headlee Amendment requires a local vote of approval for any tax not authorized by law at the time the amendment was enacted. In addition, some authorizing statutes also require a local vote before a tax is imposed under certain circumstances.

A recent SEMCOG study (*Land Use Change in Southeast Michigan: Causes and Consequen*ces, March 2003) has shown that because Proposal A limits taxable value increases for properties remaining in the same ownership to five percent or the rate of inflation, whichever is less, communities without much land available for development are severely limited in taxable value growth. Without new construction to bring more State Equalized Valuation (SEV) and its full taxable value, municipal revenues from ad valorem taxes often do not keep pace with increases in SEV.

Fees

Fees are charges for services offered or carried out pursuant to a local government's "police" power, meaning government's authority to undertake or regulate actions to promote public health, safety, and welfare. Building inspection fees paid for city building inspection services conducted as a part of the city's program to maintain safe housing are one example of a fee. The *Bolt* decision, together with many other court decisions, puts bounds on the circumstances under which a local government can impose a valid fee. Because fees are the most common method in Michigan for financing the provision of safe drinking water and sewerage services, any changes in the law which affect how a local government can impose a fee are of great import to both a local government and its residents.

Summary of Funding Mechanisms

This subsection discusses in more detail the possible taxes, special assessments, and fees that can be used to generate funding. Also included are appropriate grant programs. The mechanisms include:

1) Stormwater Utility;
2) Sewer Rates;
3) Special Assessment;
4) Natural Resources and Environmental Protection Act;
5) Revised Municipal Finance Act (RMFA);
6) User Fees / Charges;
7) State Revolving Fund; and
8) Other State grant and loan programs, which may validly be used for the contracted purpose.

The individual mechanisms are presented in Table 10-2.

Legal Issues

In the *Bolt* decision, the court established a three-part test for distinguishing a valid user fee from a tax:

- The fee must serve a *regulatory purpose* rather than a revenue raising purpose;
- A user fee must be *proportionate* to the necessary costs of the service; and
- A user fee must be *voluntary* – users must be able to refuse or limit their use of the commodity or service.

These criteria are being used to distinguish whether a government-imposed charge is a fee or a tax. As noted above, this distinction is important because there are constitutional and statutory limitations on a government's authority to impose taxes. A charge which is determined to be a tax is subject to those limitations. The *Bolt* decision and subsequent court decisions have far reaching implications for both state and local governments. While the *Bolt* case dealt with a fee imposed by a local government for a sewer project, the fee versus tax test laid out by the *Bolt* court has been applied in a number of cases beyond water and sewer fees at both the state and local level. The result of the *Bolt* decision has been a lack of necessary certainty and predictability with regard to using fees as a mechanism to fund the provision of essential governmental services.

Currently there is a legislative proposal being developed that will assist in the creation of stormwater utilities.

Example of a Program Implementation Activity: Volunteers Participating in the Clinton River Watershed Council's Clinton Clean-Up at Harrington Trails Park

Photo courtesy of MCPWO.

Example of a Capital Project: Enclosing the Nicol Drain in Macomb Township

Photo courtesy of MCPWO.

Implementation and Funding

SWAG members are faced with implementing a wide range of actions associated with this WMP. While many of these are related to compliance with the Watershed-based Permit, others, such as recreation enhancement are not. With the recognition that land use activities directly impact water quality, SWAG members are now faced with a broad range of new water quality responsibilities, particularly those that are experiencing significant development pressure.

In this chapter, the actions to be taken by SWAG members are grouped into two different categories: 1) planning and program implementation activities and 2) capital projects. The first category includes activities such as development of a stormwater management plan and implementation of non-capital programs (e.g. public education programs and ordinance development and enforcement). Planning and program implementation activities are on-going in nature, and, for the most part, do not require the outlay of large financial resources. Nonetheless, they do require a commitment to long-term, stable sources of funding. Capital projects, on the other hand, are usually short-term construction projects that often require borrowing and a long-term commitment of dedicated funding to repay the loan.

Planning and Program Implementation Activities

Many of the actions that WMP-participants will be implementing may go beyond their technical and financial resources. Additionally, there are significant cost efficiencies that may be realized by developing programs that meet the need of several WMP-participants instead of a collection of independent programs. Therefore, the WMP-participants may opt to contract with other government agencies for specific planning and program implementation activities.

Capital Projects

Capital projects to address water quality concerns, such as extension of sanitary sewer service or the construction of septage receiving facilities have traditionally been the responsibility of local governments. These projects usually require a significant investment over a short period of time with a repayment schedule that can extend several years beyond the actual construction schedule. Municipalities that own or operate wastewater collection and/or treatment systems are required to develop capital improvement plans (CIP), usually on an annual basis. The CIP identifies the major capital projects expected in the next several (5 to 10) years, as well as the anticipated funding mechanism.

Capital projects are paid through some combination of either a pay-as-you-go basis as revenues are available or from the proceeds of indebtedness (bonds), with revenues dedicated to debt retirement. In either case, the revenues supporting the CIP may include some or all of tax revenues, user rates and charges, special assessments, connection fees, and capital reserve funds.

Table 10-2. Funding mechanisms.

	Description
Stormwater Utility	Like other utilities, stormwater utilities are established to charge a fee for providing a service, and typically are accounted for as an enterprise fund. This fund is used to cover the operation and maintenance of the stormwater system and, in some cases, finance capital improvements. Fees are paid periodically, often quarterly, and included on the water and sewer billing. Fee structures often include a flat rate charge and a land area charge, generally with a minimum per parcel fee. The land area charge may vary, based on such factors as the parcel's total impervious area, ratio of impervious to pervious surface area, the ratio of retention to impervious surface, or the installation of approved best management practices (BMPs).
Sewer Rates	Sewer rates are simply charges to residents and businesses for services associated with being connected to the municipal sewer systems. Sewer charges must be attributable to the service provided. Typically, sewer rates include the cost of operating and maintaining the infrastructure necessary to collect and treat the sewage, along with debt service for capital projects and, in some cases, funding for future capital projects identified in the capital improvement plan. Connection fees are commonly used as a means of funding the capital expenditures needed to provide new or expanded sewer service. Sewer rates and charges, like other user fees, must be established so as not to be a tax.
Special Assessment	Special assessments are levied against individual properties benefiting from the program/project through the establishment of a special assessment district (SAD) to cover the cost of specific activities/improvements. While the authority to establish special assessment districts varies by the type of governmental unit, special assessments must always be directly related and proportional to the benefit received from the improvement and funds can only be used to pay for the cost of the improvement.
Natural Resources and Env. Prot.Act	**PA 451 (1994).** Part 43 of the Natural Resources and Environmental Protection Act authorizes cities, villages and townships to borrow to pay the cost of improvements to waterworks systems or sewage systems in those instances in which the DEQ, State Department of Public Health or a court of competent jurisdiction has ordered the installation, construction and/or improvement of such systems or the DEQ has issued a permit for the installation, construction, alteration, improvement or operation of such a system and the plans for such improvements or system have been prepared and approved by the State department or agency having the authority to grant such approval.
RMFA	**PA 34 (2001).** Section 517 of the Revised Municipal Finance Act authorizes counties, cities, villages and townships to borrow for capital improvement items that will improve or protect water quality.
User Fees/ Charges	User fees and charges are financial charges for services provided or activities undertaken, such as sewer rate charges or sewer connection fees, which provide a benefit to the ratepayer and not the general public. User fees, however, have been the subject of recent litigation and must meet the criteria established by Michigan law so as not to be determined a tax: a user fee must serve a regulatory purpose (not a revenue raising purpose), be proportional to the cost of the service provided, and be voluntary (the user must be able to limit or avoid the use of the service in order to reduce or avoid paying the fee).
State Revolving Fund	The state and federal governments have made limited financial assistance available to municipalities for capital projects. Municipalities can obtain low-interest loans through the state revolving fund (SRF). In order to obtain a loan, the municipality issues bonds which are sold to the Michigan Municipal Bond Authority in amounts approved by the MDEQ. All of the applicable procedures and requirements for issuing bonds under state and federal law continue to apply. One further condition of these loans is a demonstration that the municipality has the ability to repay the loan. Used almost exclusively in Michigan to finance large sewer treatment works and sewer separation projects, the loan repayments are financed through a combination of rates, connection fees, special assessments, and property taxes.
Other Grant & Loan Programs	The Michigan Department of Environmental Quality administers a range of grant and loan programs aimed at assisting local governments develop and implement pollution abatement programs. Information on MDEQ grant and loan programs can be obtained from the MDEQ Assistance and Support Services. Additionally, there are numerous other local, state, federal, and international entities that operate myriad grant programs providing funds to implement most of the actions identified in this WMP. See Chapter 8 for additional information regarding these grant programs.

Table 10-2. Funding mechanisms. (rows continue across from previous page)

Advantages	Disadvantages
• Fee based on runoff; assessed against all properties. • Is equitable; directly related to benefit received. • Not based on property value. • Consistent funding stream. • Use existing billing system; reduces costs. • Fee can be reduced through implementation of BMPs. • Can contract with other governmental units.	• Must be set up to withstand challenges under *Bolt* - this may add complexity to the utility and increase costs. • Determining ratio of impervious surface area for parcels may be difficult/ costly. • Risk of financial liability for refunds in the event a user fee is determined later to be a tax.
• Equitable - direct relationship between cost and service. • Users have some control over costs they incur. • Not dependent upon property ownership. This may be especially important in municipalities where tax exempt entities have significant land holdings.	• Can be difficult to set rates sufficient to meet *future* capital improvement needs. • Difficult to include stormwater and other *nonpoint* source activities.
• Direct relationship between benefit and assessment. • No property tax limitations. • Assessments are against all properties (certain tax-exempt entities are also exempted by the General Property Tax Act from paying special assessments).	• Municipality may incur additional administrative costs. • Difficult to achieve consensus for the allocation of benefits.
• Municipality can borrow in response to court or regulatory order with respect to water quality.	• Borrowing is subject to a right of referendum. • Borrowing is limited to the purposed set forth in the order.
• Use more than one funding mechanism to pay debt. • No need to have MDEQ or court order to borrow.	• Borrowing is subject to a right of referendum. • Borrowing is limited to 5% of municipality's State.
• Direct relationship between cost and service. • User can limit or avoid the fee. • Not bound by Headlee limits. • Includes capital cost recovery. • Fees and charges are paid by all system users; this may be especially important in municipalities where tax exempt entities have significant land holdings.	• The *Bolt* decision has cast a cloud over traditional means. of setting / imposing user fees. • Can be administratively complex. • Risk of financial liability for refunds in the event a user. fee is determined later to be a tax.
• Low-interest. • Significant amounts. • Can now be used for planning infrastructure projects.	• Must still pay State back. • May require bond issue to cover repayment. • Limited pool of funds. • Competitive program.
• Many programs are grants. • Many programs require inter-governmental cooperation. • Municipality does not have to draw on general fund for program/initiative.	• Programs tend to be focused. • Limited funds available. • Many programs are competitive. • Local match funding is usually required. • Many programs require inter-governmental cooperation.

Summary

In summary, the range of actions SWAG members are responsible for implementing has expanded greatly. There are a variety of alternatives for funding these activities that need to be evaluated in choosing a course of action for any particular activity.

Table 10-3 lists a number of actions communities may implement and the institutional mechanisms available for funding them. This table was prepared to use as a tool to compare and contrast the desirability of the different mechanisms with respect to any particular activity. For example, communities could use this table to rank the alternatives low, medium, or high as part of narrowing options and focusing discussion in the decision making process.

Cool Cities Initiative

In the State of Michigan, entities receiving grants through the 'Cool Cities' program receive preferred consideration for other grants that are part of the program. For more information, refer to the website:

http://www.coolcities.com/

Source: www.coolcities.com, 2006.

Table 10-3. Examples of actions and potential funding mechanisms.

Action	Drain Code[3]	Public Works Act	Inter-Municipal Committee Act	Municipal Sewer and Water Authorities	County Public Improvement Act	Stormwater Utilities	Sewer Rates	Special Assessment Districts	Natural Resources and Env. Protection	Revised Municipal Finance Act
Planning, Institutionalization, and Implementation[4]	X	X	X	X	X	X	X			
Ordinances, Zoning, and Development Standards[4]	X	X		X	X	X	X			
Public Education and Participation[4]	X	X	X	X	X	X	X			
Good Housekeeping and Pollution Prevention[1,4]	X	X	X	X	X	X	X			
Stormwater Best Management Practices[4]	X	X		X	X	X	X			
Water Quality Monitoring[4]	X	X		X	X	X	X			
Capital Improvement Projects[2]	X	X		X	X	X	X	X	X	X

1 – Includes Illicit Discharge Elimination Plans and Catch Basin Cleaning/Street Sweeping (although the latter is not fundable through the Inter-Municipal Committee Act).

2 - Includes Stormwater Control Facilities, Sanitary Sewer Overflow Control, Combined Sewer Overflow Control, Sewer Rehabilitation, and Sewer Extension.

3 - While the Drain Code is primarily used for generating funding for capital projects, other activities can be funded if included in a petition and inter-municipal agreements.

4 - All of these activities will include both a planning and an implementation component, e.g.: an illicit discharge elimination program will require developing a plan, which may include new ordinances, periodic assessment of program effectiveness, etc, as well as implementation activities, such as surveying commercial/industrial facilities to identify cross-connections or inspecting residential septic systems on a periodic basis.

References

Herrmann, K. and J. Scholl. (2004). *Developing a Community Based Phase II Watershed Organization in the Greater Lansing Michigan Area,* Tetra Tech, Lansing, Michigan

Scholl, J. and J. Gerth, (2002). NPDES Phase II Storm Water Permitting: Public Act 342 Case Study, Genesee County. *Pipeline,* Michigan Association of County Drain Commissioners, Voll 11, No. 4.

Southeast Michigan Council of Governments [SEMCOG], (April, 2003). *Options for Local Government Funding of Water Quality Activities,* available at www.semcog.org

Southeast Michigan Council of Governments [SEMCOG], (February, 2005). *State and Local Government Financing of Essential Services with User Fee,* available at www.semcog.org

Definition of Terms

Introduction

This introductory division of the plan lists and defines most of the acronyms encountered in the plan.

Acronyms

AAW	Adopt-A-Watershed
ANGB	Air National Guard Base
ANSTF	Aquatic Nuisance Species Task Force
AOC	Area of Concern
APA	Approved Public Agency
APHIS	Animal and Plant Health Inspection Service
APWG	Alien Plant Working Group
ATSDR	Agency for Toxic Substances and Disease Registry
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BUI	Beneficial Use Impairment
CDC	Center for Disease Control
CDs	Conservation Districts
CEA	County Enforcing Agency
CF	Conservation Fund
CGEE	Center for Global Environmental Education
CHRCP	Coastal Habitat Restoration and Conservation Plan
CIP	Capital Improvement Program
CMI	Clean Michigan Initiative
COC	Certificates of Coverage
COD	Chemical Oxygen Demand
CRA	Clinton River Assessment
CRBWI	Clinton River Basin Watershed Initiative
CRCRP	Clinton River Coldwater Restoration Project
CREP	Conservation Reserve Enhancement Program
CREW	Clinton River East Subwatershed
CRP	Conservation Reserve Program
CRPAC	Clinton River Remedial and Preventative Action Plan
CRWC	Clinton River Watershed Council
CRWI	Clinton River Watershed Initiative
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CWP	Center for Watershed Protection
DC	Drain Commissioner
DCIA	Directly Connected Impervious Areas
DDT	dichloro-diphenyl-trichloroethane
DO	Dissolved Oxygen
DPW	Department of Public Works
DU	Ducks Unlimited
DWSD	Detroit Water and Sewerage Department
ECT	Environmental Counseling & Technology
EKU	Eastern Kentucky University
EMEAC	East Michigan Environmental Action Council
EPA	Environmental Protection Agency
ERG	Evaluation and Revision Guidance
FEMA	Federal Emergency Management Agency
FHA	Federal Highway Administration
FISRWG	Federal Interagency Stream Restoration Working Group
FLEP	Forest Land Enhancement Program
FSA	Farm Service Agency

FSDWA	Federal Safe Drinking Water Act
FSP	Forest Stewardship Program
FTA	Federal Transit Administration
FWPCA	Federal Water Pollution Control Administration
FWS	Fish and Wildlife Service
GAAMPs	Generally Accepted Agriculture and Management Practices
GF	Groundwater Foundation
GIS	Geographic Information Systems
GLAGAP	Great Lakes Aquatic GAP Program
GLC	Great Lakes Commission
GLNPO	Great Lakes National Program Office
GLPANS	Great Lakes Panel on Aquatic Nuisance Species
GREEN	Global Rivers Environmental Education Network
GRP	Grassland Reserve Program
GWK	George W. Kuhn
HCMA	Huron-Clinton Metroparks Authority
HHW	Household Hazardous Wastes
HSI	Hotspot Site Investigation
HSS	Health and Social Services
HUC	Hydrologic Unit Code
ICM	Impervious Cover Model
IDEP	Illicit Discharge Elimination Program
IJC	International Joint Commission
IDNR	Iowa Department of Natural Resources
IWR	Institute of Water Research
LAP	Landowner Assistance Program
LID	Low Impact Development
LIP	Landowner Incentive Program
LSCCSR	Lake St. Clair Conference Summary Report
LSCEC	Lake St. Clair Environmental Characterization
LSCW	Lake St. Clair Subwatershed
LUSTs	Leaking Underground Storage Tanks
MAEAP	Michigan Agriculture Environmental Assurance Program
MANSC	Michigan Aquatic Nuisance Species Council
MANSC	Michigan's Aquatic Nuisance Species Council
MAP	Michigan Association of Planning
MAS	Michigan Audobon Society
MCHD	Macomb County Health Department
MCL	Maximum Contaminant Level
MCNFI	Macomb County Natural Features Inventory
MCPAO	Macomb County Prosecuting Attorney's Office
MCPHD	Macomb County Public Health Department
MCPED	Macomb County Department of Planning & Economic Development
MCPWO	Macomb County Public Works Office
MCRC	Macomb County Road Commission
MCSCD	Macomb County Soil Conservation District
MDA	Michigan Department of Agriculture
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDOT	Michigan Department of Transportation
MEA	Michigan Enforcing Agency
MEC	Michigan Environmental Council
MGSP	Michigan Groundwater Stewardship Program
MIPC	Michigan Invasive Plant Control
MLC	Macomb Land Conservancy
MML	Michigan Municipal League
MNA	Michigan Nature Association
MNFI	Michigan Natural Features Inventory

MNRTF	Michigan Natural Resources Trust Fund
MOAC	Michigan Organic Advisory Committee
MRC	Michigan Recycling Coalition
MRCC	Midwestern Regional Climate Center
MS4s	Municipal Separate Storm Sewer Systems
MSUE	Michigan State University Extension
MTA	Michigan Township Association
MTESP	Michigan Turfgrass Environmental Stewardship Program
MUGLCC	Monitoring Upper Great Lakes Connection Channel Committee
NALMS	North American Lake Management Society
NAWMP	North American Waterfowl Management Plan
NAWQA	National Water Quality Assessment
NBS	National Biological Service
NCDC	National Climatic Data Center
NDSA	Nested Drainage System Agreements
NLCD	National Land Cover Data
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRDC	Natural Resources Defense Council
NREPA	Natural Resources and Environmental Protection Act
NSA	Neighborhood Source Assessment
NSF	National Science Foundation
NSP	Nonpoint Source Program
NWF	National Wildlife Federation
NWIS	National Water Information System
NWS	National Weather Service
OC	Oakland County
OCDC	Oakland County Drain Commissioner
OEPA	Ohio Environmental Protection Agency
ORV	Off-Road Vehicle
OSDS	On-site Sewage Disposal Systems
PAA	Pervious Area Assessment
PAC	Public Advisory Council
PCB	Polychlorinated Biphenyl
PEAS	Pollution Emergency Reporting System
PEL	Probably Effect Level
PEP	Public Education Plan
PF	Pheasants Forever
POTW	Publicly Owned Treatment Works
PPP	Public Participation Plan
PUD	Planned Unit Development
R2W	Red Run Subwatershed
RAP	Remedial (and Preventative) Action Plan
R-B	Richards-Baker
RETAP	Retired Engineer Technical Assistance Program
RCMC	Road Commission of Macomb County
RRWWPD	Rouge River Wet Weather Demonstration Project
RTF	Retention and Treatment Facility
SC	Sierra Club
SEMCOG	Southeast Michigan Council of Governments
SESC	Soil Erosion and Sediment Control
SEV	State Equalized Valuation
SHPO	State Historic Preservation Office
SMLC	Southeast Michigan Land Conservancy
SMSBF	Southeast Michigan Sustainable Business Forum

SN	Stewardship Network
SOD	Sediment Oxygen Demand
SRF	State Water Pollution Control Revolving Fund
SSD	Streets and Storm Drains
SSO	Sanitary Sewer Overflow
SSOs	Sanitary Sewer Overflows
STEPL	Spreadsheet Tool for the Estimation of Pollutant Load
STORET	Storage and Retrevial
SWAG	Subwatershed Advisory Group
SWC	Storm Water Center
SWEU	Surface Water Enforcement Unit
SWSP	Surface Water Sampling Program
SWPPI	Storm Water Pollution Prevention Initiatives
TACOM	Tank-automotive and Armaments Command
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TOC	Table of Contents
TOC	Total Organic Carbon
TP	Total Phosphorus
TPL	Trust for Public Land
TSS	Total Suspended Solids
TU	Trout Unlimited
UMN	University of Minnesota
USA	Unified Stream Assessments
USACE	U.S. Army Corps of Engineers
USCB	United States Census Bureau
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDANAC	U.S. Department of Agriculture National Agroforestry Center
USDHS	U.S. Department of Homeland Security
USDOC	U.S. Department of Commerce
USDOD	U.S. Department of Defense
USDOI	U.S. Department of The Interior
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USSR	Unified Subwatershed and Site Reconnaissance
WDOE	Wayne County Department of Environment
WHC	Wildlife Habitat Council
WHIP	Wildlife Habitat Incentives Program
WHMD	Waste and Hazardous Materials Division
WMP	Watershed Management Plan
WQA	Water Quality Assessment
WQMP	Water Quality Management Plan
WQS	Water Quality Standards
WQTP	Water Quality Trading Program
WRC	Water Resources Commission
WWF	World Wildlife Fund
WWTP	Waste Water Treatment Plant

PERMIT NO. MIG619000

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTEWATER DISCHARGE GENERAL PERMIT

Storm Water Discharges from Municipal Separate Storm Sewer Systems (MS4s) Subject to Watershed Plan Requirements

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq; the "Federal Act"), Michigan Act 451, Public Acts of 1994, as amended (the "Michigan Act"), Parts 31 and 41, and Michigan Executive Orders 1991-31, 1995-4 and 1995-18, storm water and non-storm water (as specified in Part I.A.1.) is authorized to be discharged from the separate storm water drainage systems of those permittees specified in individual "certificates of coverage" in accordance with the conditions set forth in this general National Pollutant Discharge Elimination System (NPDES) permit (the "permit").

The applicability of this permit shall be limited to point source discharges of storm water and non-storm water (as specified in Part I.A.1.) from municipal separate storm water drainage systems which have requested coverage under this general permit and have not been determined by the Michigan Department of Environmental Quality (the "Department") to need an individual NPDES permit or coverage under the NPDES general permit "Storm Water Discharges from MS4s Subject to the Six Minimum Measures." Discharges which may cause or contribute to a violation of a water quality standard are not authorized by this permit.

In order to constitute a valid authorization to discharge, this permit must be complemented by a certificate of coverage issued by the Department. The following will be identified in the certificate of coverage:

- The watershed boundaries that are to be covered by a Watershed Management Plan (WMP),
- The submittal date for the process to facilitate the involvement of the watershed jurisdictions and the public in the development of the WMP,
- The submittal dates for the Illicit Discharge Elimination Plan (IDEP) and the Public Education Plan (PEP) (or a revised IDEP or PEP),
- The submittal date for the WMP,
- The submittal date for the Storm Water Pollution Prevention Initiative (SWPPI) and implementation schedule,
- Any deferred areas for a portion of a permittee's urbanized area,
- The submittal date for the Annual Progress Reports,
- The submittal date for the revised WMP (or a written determination not to revise the WMP), and
- The submittal date for the revised SWPPI (or a written determination not to revise the SWPPI).

Unless specified otherwise, all contact with the Department required by this permit shall be to the position(s) indicated in the certificate of coverage, and all Department approvals specified in this permit shall be by the position(s) indicated in the certificate of coverage.

In accordance with Section 324.3118 of the Michigan Act, the permittee shall make payment of an annual storm water fee to the Department. In response to the Department's annual notice, the permittee shall submit the fee, which shall be postmarked no later than March 15 of each year.

The terms and conditions of this general permit shall apply to the permittee on the effective date of a certificate of coverage issued to the permittee. The Department may grant a contested case hearing on this general permit in accordance with the Michigan Act. Any person who is aggrieved by this permit may file a sworn petition with the Office of Administrative Hearings of the Michigan Department of Environmental Quality, setting forth the conditions of the permit which are being challenged and specifying the grounds for the challenge. The Department may grant a contested case hearing on the certificate of coverage issued to the permittee under this general permit in accordance with Rule 2192(c) (Rule 323.2192 of the Michigan Administrative Code).

This general permit shall take effect April 1, 2003. The provisions of this permit are severable. After notice and opportunity for a hearing, this permit may be modified, suspended or revoked in whole or in part during its term in accordance with applicable laws and rules.

This general permit shall expire at midnight, April 1, 2008.

Issued December 5, 2002.

Original signed
D. Steven Eldredge
Chief, Surface Water Permits Section
Water Division

PART I

Section A. Authorizations and Coverage Provisions

1. Authorized Discharges

a. Eligible Permittees
Except as excluded below, any governmental entity that has ownership or control of discharges through separate storm water drainage systems may be eligible for coverage under this general permit including, but not limited to, a county, a city, a village, a township, a county road commission, an entity with jurisdiction under the Drain Code for an inter-county or intra-county drain, a public school district, a public college or university, a department or agency of the state, and a department or agency of the federal government.

A city, village, or township (primary jurisdiction) permittee may have, within its political or territorial boundaries, smaller "nested" drainage systems owned or operated by public bodies such as school districts, public universities, or county, state, or federal agencies. If the primary jurisdiction and the nested jurisdiction agree to cooperate in carrying out the responsibilities for control of the drainage system, the nested jurisdiction does not need to apply for a separate storm water drainage system permit. Otherwise, the nested jurisdiction shall apply for a permit.

The Department will determine eligibility on a case-by-case basis. Coverage will be granted only if the Department determines there is a sufficient number of participating watershed partners to ensure implementation of an effective WMP.

Non-governmental entities (such as individuals, private schools, private colleges and private universities, or industrial and commercial entities) are explicitly not eligible for coverage under this general permit. However, these entities are encouraged to participate in WMP development within their watershed.

b. Storm Water Discharges by the Permittee
This permit authorizes the discharge of storm water from municipal separate storm water drainage systems to the waters of the state. Following approval of the SWPPI (Part I.B.2.a.), the discharge of storm water from new point source discharges in the permittee's separate storm water drainage system are authorized only if in accordance with the approved SWPPI.

c. Discharges Authorized under other NPDES Permits
The discharge of storm water commingled with discharges authorized under other NPDES permits is authorized under this permit.

d. Non-Storm Water Discharges
The following non-storm water discharges are not authorized in this document, but do not need to be prohibited by the permittee, unless they are identified as significant contributors of pollutants to the regulated separate storm water drainage system:

- water line flushing,
- landscape irrigation runoff,
- diverted stream flows,
- rising groundwaters,
- uncontaminated groundwater infiltration (as defined by 40 CFR 35.2005(20)),
- pumped groundwaters (except for groundwater cleanups not specifically authorized by NPDES permits),
- discharges from potable water sources,
- foundation drains,
- air conditioning condensates,
- irrigation waters,
- springs,
- water from crawl space pumps,
- footing drains and basement sump pumps,
- lawn watering runoff,
- waters from non-commercial car washing,
- flows from riparian habitats and wetlands,

PART I

Section A. Authorizations and Coverage Provisions

- residential swimming pool waters and other permitted, dechlorinated swimming pool waters without untreated filter backwash, and
- residual street wash waters.

Discharges or flows from emergency fire fighting activities are exempt from prohibition by the permittee, but shall be addressed by the permittee if they are identified as significant sources of pollutants to waters of the state.

A swimming pool operated by the permittee shall not be discharged to the storm water drainage system, or directly to waters of the state, without specific NPDES authorization from the Department.

2. Application Requirements

The applicant shall submit an application to the Department when requesting coverage under this general permit. The applicant shall provide the following information:

a. The applicant's legal name, mailing address, storm water program manager, watershed name, and proposed watershed partners.

b. A map showing the boundary for the proposed watershed (this may be a watershed or sub-watershed).

c. The location of any known point source discharges of storm water and the receiving water(s) within the applicant's regulated area, unless the Department accepts an alternate submission that still adequately represents the applicant's known MS4s. This requirement can be satisfied by providing an existing map of the separate storm water drainage system.

d. A map of the applicant's political/territorial boundaries and regulated area, indicating the hydrologic boundaries and the approximate square mileage for both the drainage and urbanized areas (for urbanized areas where WMPs are deferred, the map shall define the boundaries of the urbanized area within the applicant's political or territorial boundaries and include that area for coverage under the permit).

e. A primary jurisdiction shall submit to the Department: 1) the name and general description of each nested jurisdictional area or drainage system for which a cooperative agreement has been reached to carry out storm water discharge responsibilities; and 2) the name of other nested jurisdictional areas or drainage systems within their political or territorial boundaries for which they have information that indicates a separate storm water drainage system permit may be required. Additionally, the primary jurisdiction may submit documentation of its efforts to notify the nested jurisdictions that they need to either get their own permits or work cooperatively under one permit. The primary jurisdiction shall be responsible for assuring compliance with this general permit for those nested jurisdictions with which they have entered into an agreement and listed as part of the application for this permit.

f. Any permittee eligible for coverage under the NPDES general permit "Storm Water Discharges from MS4s Subject to the Six Minimum Measures" who applies for this general permit within a watershed where a WMP has already been developed and submitted to the Department, in accordance with NPDES Permits MIG610000 or MIG619000, shall submit an approvable SWPPI and implementation schedule (Part I.B.2. of this general permit) to the Department as part of the application, or in accordance with another schedule set by the Department.

3. IDEP and PEP Submittal

<u>Within one year after the effective date of the certificate of coverage</u>, the permittee shall submit to the Department an approvable IDEP and PEP, or updates for existing Plans to comply with current permit requirements. The submission shall include the following:

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Section A. Authorizations and Coverage Provisions

a. Illicit Discharge Elimination Plan (IDEP)
The applicant shall submit an IDEP, or an update to an existing IDEP, to prohibit and effectively eliminate illicit discharges (including the discharge of sanitary wastewater) to the applicant's separate storm water drainage system for the regulated area. At a minimum, the IDEP shall include the following:

1) a program to find, prioritize and eliminate illicit discharges and illicit connections identified during dry weather screening activities;

2) a description of a program to minimize infiltration of seepage from sanitary sewers and on-site sewage disposal systems into the applicant's separate storm water drainage system;

3) a method for determining the effectiveness of the illicit discharge elimination activities which shall, at a minimum, result in the inspection of each storm water point source every five years unless the Department approves an alternative schedule (an alternative schedule may focus efforts on urbanized areas and cover other regulated areas less frequently, based on watershed goals); and

4) an updated map of the location of each known storm water point source and the respective receiving water or drainage system (the Department may accept an alternate submission if the permittee demonstrates that the submission will be sufficient in the effective elimination of illicit discharges).

"Illicit connection**"** means a physical connection to the separate storm water drainage system that 1) primarily conveys illicit discharges into the system and/or 2) is not authorized or permitted by the local authority (where a local authority requires such authorization or permit).

"Illicit discharge**"** means any discharge (or seepage) to the separate storm water drainage system that is not composed entirely of storm water or uncontaminated groundwater. Examples of illicit discharges include dumping of motor vehicle fluids, household hazardous wastes, grass clippings, leaf litter, or animal wastes, or unauthorized discharges of sewage, industrial waste, restaurant wastes, or any other non-storm water waste into a separate storm water drainage system.

b. Public Education Plan (PEP)
The applicant shall submit a PEP, or an update to an existing PEP. The PEP shall promote, publicize, and facilitate watershed education for the purpose of encouraging the public to reduce the discharge of pollutants in storm water to the maximum extent practicable. The PEP may involve combining with or coordinating existing programs for public stewardship of water resources. Pollution prevention shall be encouraged. The PEP shall describe a method for determining the effectiveness of the various public education activities.

"Public" shall be defined to include all persons who potentially could affect the quality of storm water discharges, including, but not limited to, residents, visitors to the area, businesses, commercial operations, and construction activities.

The PEP shall be designed to accomplish, at a minimum, the following as appropriate based on the potential impact on the watershed:

1) education of the public about their responsibility and stewardship in their watershed;

2) education of the public on the location of residential separate storm water drainage system catch basins, the waters of the state where the system discharges, and potential impacts from pollutants from the separate storm water drainage system;

3) encouragement of public reporting of the presence of illicit discharges or improper disposal of materials into the applicant's separate storm water drainage system,

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4) education of the public on the need to minimize the amount of residential, or non-commercial, wastes washed into nearby catch basins (this should include the preferred cleaning materials and procedures for car, pavement, or power washing; the acceptable application and disposal of pesticides and fertilizers; and the effects caused by grass clippings, leaf litter, and animal wastes that get flushed into the waterway),

5) education of the public on the availability, location and requirements of facilities for disposal or drop-off of household hazardous wastes, travel trailer sanitary wastes, chemicals, yard wastes, and motor vehicle fluids; and

6) education of the public concerning management of riparian lands to protect water quality.

Upon Departmental approval, the permittee shall begin implementation of the IDEP and PEP. If the Department does not take action to approve or comment on the Plans within 90 days of submittal, the permittee shall begin implementation of these Plans as submitted. The Department may notify the permittee at any time that the Plans do not meet minimum requirements. Such notification shall identify why the Plan does not meet minimum requirements. The permittee shall make the required changes to the Plans within 90 days after such notification from the Department. The permittee shall submit written certification of the changes to the Department as part of the annual report.

4. Identification of Additional Point Source Discharges of Storm Water

If the permittee becomes aware of any separate storm water drainage system discharges which were not identified in the application, the permittee shall provide the following information to the Department as part of the annual progress report (Part I.B.3.):

a. the location of the discharge of storm water for which coverage is requested,

b. the receiving water for the discharge, and

c. any necessary updates to the map of the drainage area indicating the hydrologic boundary and approximate square miles of the coverage area (originally submitted with the application).

These requirements can be satisfied by providing an updated map of the permittee's separate storm water drainage system.

5. Expiration and Reissuance

If the permittee wishes to continue a discharge authorized under this permit beyond the permit’s expiration date, the permittee shall submit a completed application, and any other documents requested by the Department, to the Department on or before October 1, 2007. A person holding a valid certificate of coverage under an expired general permit shall continue to be subject to the terms and conditions of the expired permit until the permit is terminated, revoked, or reissued. Coverage under a reissued permit can only begin on the effective date of the reissued permit.

If this permit is modified or reissued, the permittee shall: a) request coverage under the modified or reissued permit, b) apply for an individual NPDES permit, c) apply for another general NPDES permit, or d) request termination of discharge authorization. Lacking an adequate response, the permittee’s authorization to discharge shall expire on the effective date of the reissued or modified permit.

If this permit is terminated or revoked, all authorizations to discharge under the permit shall expire on the date of termination or revocation.

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6. Requirement to Obtain an Individual Permit

The Department may require any person who is authorized to discharge by a certificate of coverage and this permit, to apply for and obtain an individual NPDES permit if any of the following circumstances apply:

a. the discharge is a significant contributor to pollution as determined by the Department on a case-by-case basis;

b. the discharger is not complying or has not complied with the conditions of the permit;

c. a change has occurred in the availability of demonstrated technology or practices for the control or abatement of waste applicable to the point source discharge;

d. effluent standards and limitations are promulgated for point source discharges subject to this permit; and

e. the Department determines that the criteria under which the permit was issued no longer apply.

Any person may request the Department to take action pursuant to the provisions of Rule 2191 (Rule 323.2191 of the Michigan Administrative Code).

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Section A. Authorizations and Coverage Provisions

7. Discharges Requiring Separate Authorization

a. Tracer Dye Discharges
This general permit does not authorize the discharge of tracer dyes without approval from the Department. Requests to discharge tracer dyes shall be submitted to the Department in accordance with Rule 1097 (Rule 323.1097 of the Michigan Administrative Code).

b. Water Treatment Additives
In the event a permittee proposes to discharge water additives, the permittee shall submit a request to discharge water additives to the Department for approval. Such requests shall be sent to the Surface Water Quality Assessment Section, Water Division, Department of Environmental Quality, P.O. Box 30273, Lansing, Michigan 48909, with a copy to the Department contact listed on the certificate of coverage. Instructions to submit a request electronically may be obtained via the Internet (http://www.michigan.gov/deq and on the left side of the screen click on Water, Water Quality Monitoring, and Assessment of Michigan Waters; then click on the Water Treatment Additive List which is under the Information banner). Written approval from the Department to discharge such additives at specified levels shall be obtained prior to discharge by the permittee. Additional monitoring and reporting may be required as a condition for the approval to discharge the additive.

A request to discharge water additives shall include all of the following water additive usage and discharge information:

1) Material Safety Data Sheet;

2) the proposed water additive discharge concentration;

3) the discharge frequency (i.e., number of hours per day and number of days per year);

4) the monitoring point from which the product is to be discharged;

5) the type of removal treatment, if any, that the water additive receives prior to discharge;

6) product function (i.e. microbiocide, flocculant, etc.);

7) a 48-hour LC_{50} or EC_{50} for a North American freshwater planktonic crustacean (either *Ceriodaphnia sp., Daphnia sp., or Simocephalus sp*.); and

8) the results of a toxicity test for one other North American freshwater aquatic species (other than a planktonic crustacean) that meets a minimum requirement of Rule 323.1057(2) of the Water Quality Standards.

Prior to submitting the request, the permittee may contact the Surface Water Quality Assessment Section by telephone at 517-335-4184 or via the Internet at the address given above to determine if the Department has the product toxicity data required by items 7) and 8) above. If the Department has the data, the permittee will not need to submit product toxicity data.

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Section B. Watershed Management

1. Watershed Management Plan (WMP)

The permittee shall participate in the development and implementation of a WMP. The purpose of the WMP is to identify and execute the actions needed to resolve water quality and water quantity concerns by fostering cooperation among the various public and private entities in the watershed. Those concerns related to Total Maximum Daily Loads (TMDLs) established within the watershed should be included and details for those actions specific to storm water controls shall be listed in the WMP (the Department recognizes that some of the actions required to meet the goals of some TMDLs may involve actions outside of the authorization of this general storm water permit). The emphasis of the WMP shall be to mitigate the undesirable impacts caused by wet weather discharges from separate storm water drainage systems.

Those people most affected by management decisions should participate in the development of the WMP and shape key decisions. By the date specified in the certificate of coverage, the process to facilitate the involvement of the watershed jurisdictions and the public (i.e., "the Public Participation Process") in the development of the WMP shall be submitted to the Department for approval. A person, group, or agency responsible for coordinating the development of the WMP shall be identified. Where multiple permittees are responsible for submittal of a WMP for the same watershed, one coordinated public participation process shall be submitted by all of the permittees.

The WMP shall cover the watershed(s) identified on the certificate of coverage. By the date specified in the certificate of coverage, the permittee shall submit the WMP to the Department. (Note: the WMP requirement may be deferred until a later time for a portion of the permittee’s jurisdiction. The WMP shall not be deferred for the permittee’s entire urbanized area. Any portion of the jurisdiction that is deferred will be indicated on the certificate of coverage.) Significant components of the WMP which do not have complete agreement of the participants shall be detailed in an appendix to the WMP [including a description of the WMP component, identification of participants who disagreed with the component, reasons for disagreement (if provided), and suggested alternatives (if provided)]. Procedures for revising the WMP shall be identified. Where multiple permittees are responsible for submittal of a WMP for the same watershed, one WMP shall be submitted on behalf of all the permittees. Comments provided by the Department within 90 days of submittal of the WMP should be addressed by the participants.

The permittee may choose to demonstrate that a watershed(s) other than that specified on the certificate of coverage is appropriate. This demonstration shall be submitted to the Department for approval.

The WMP should be developed based on sound guiding principles. EPA’s “Watershed Approach Framework” (EPA 840-S096-001, June 1996) and MDEQ’s “Developing a Watershed Management Plan for Water Quality: An Introductory Guide” (February 2000) may be helpful in establishing a framework for a WMP. Collectively, WMP participants should employ sound scientific data, tools, and techniques in an iterative decision making process. The typical steps in a watershed planning process, that may be used to develop a WMP, are as follows:

1) assessment and characterization of the natural resources and the communities that depend upon them,
2) goal setting and identification of environmental objectives based on the condition or vulnerability of resources and the needs of the aquatic ecosystem and the people within the community,
3) identification of priority problems and opportunities (including any TMDL established for a parameter within the watershed that may be affected by storm water),
4) development of specific management options and action plans,
5) implementation of the action plans, and
6) evaluation of effectiveness and revision of plans, as needed.

The permittee shall use the WMP to develop a SWPPI that specifies the permittee’s obligations under the WMP. In order to produce an approvable SWPPI, as a minimum, a WMP shall contain:

- 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 TMDL established for a parameter within the watershed);
- determination of the actions needed to achieve the short-term measurable objectives for the watershed;

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- 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.

The permittee-specific commitments shall be elaborated upon and included in the SWPPI (Part I.B.2.a.) and may include modifications to the previously submitted IDEP and PEP.

Watershed Management is an iterative process of decision making. Therefore, revisions to the WMP are expected from time to time. By the date specified in the certificate of coverage, a revised WMP (or a written determination not to revise the WMP) shall be submitted to the Department for comment.

2. Storm Water Pollution Prevention Initiative (SWPPI)

a. SWPPI Submission

By the date specified in the certificate of coverage, the permittee shall submit an approvable SWPPI and implementation schedule to the Department. The SWPPI shall be designed and implemented to reduce the discharge of pollutants to the maximum extent practicable, shall be consistent with the WMP developed under Part I.B.1., shall include those actions expected to be implemented over the term of this permit, shall identify methods for determining the effectiveness of the actions to be implemented, and may cover urbanized areas (with a deferred WMP) outside of the watershed boundary included in the WMP. The SWPPI shall be implemented upon approval of the Department.

1) The submission of the SWPPI shall, at a minimum, include the following:

a) The actions required of the permittee in the WMP in accordance with the dates specified, taking into account any specific disagreements to the WMP which were provided by the permittee and included in the appendix to the WMP. (Note: if the WMP requirement has been deferred until a later time, as indicated on the certificate of coverage, the SWPPI shall initially be developed without consideration of the WMP.)

b) The evaluation and implementation of pollution prevention and good housekeeping activities, as appropriate. This item shall include a training and inspection program for staff and contractors employed by the permittee in activities that may affect storm water runoff.

The permittee shall include the following activities for inclusion in the SWPPI, or explain why the activities do not apply:

(1) maintenance activities, maintenance schedules, and inspection procedures for storm water structural controls to reduce pollutants (including floatables) in discharges from the permittee's separate storm water drainage system;

(2) controls for reducing or eliminating the discharges of pollutants from streets, roads, highways, parking lots, and maintenance garages;

(3) procedures for the proper disposal of operation and maintenance waste from the separate storm water drainage system (dredge spoil, accumulated sediments, floatables, and other debris);

(4) ways to ensure that flood management projects assess the impacts on the water quality of the receiving waters and, whenever possible, examine existing water quantity structures for incorporation of additional water quality protection devices or practices; and

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(5) implementation of controls to reduce the discharge of pollutants related to application of pesticides, herbicides, and fertilizers applied in the permittee's regulated area.

c) The development, implementation, and enforcement of a comprehensive storm water management program for post-construction controls for areas of new development and significant redevelopment. The goal is to protect the designated uses in the receiving water from the effects commonly associated with urbanization. These effects include: “flashiness” (higher peak flows and lower base flows), stream-bank erosion, increased stream temperature and pollutant load, reduced bank vegetation, and degraded fish and other aquatic habitats.

The permittee shall evaluate and implement site appropriate, cost-effective structural and nonstructural best management practices (BMPs) that prevent or minimize the impacts on water quality. Common controls for urbanization include: policies and ordinances to direct growth to identified areas, to limit the rate and volume of storm water discharged to pre-developmental hydrologic levels, to protect sensitive areas such as wetlands and riparian areas, and to maintain and/or increase open spaces (including a dedicated funding source for open space acquisition); encouraging infill development in higher density urban areas and areas with existing infrastructure; establishing in-stream maximum flow targets designed to minimize stream bank erosion and maintain healthy aquatic populations; and coordinating release volumes and rates from detention basins to achieve in-stream maximum flow targets. These controls shall have associated requirements for their long-term operation and maintenance to retain the level of water quality protection over time.

d) The methods of assessing progress in storm water pollution prevention.

2) If the WMP has been deferred for a portion of a permittee’s urbanized area, as indicated on the certificate of coverage, the permittee’s submission of the SWPPI shall include requirements for those urbanized areas not covered by the WMP. The permittee shall select one of the following two options for covering urbanized areas with deferred WMPs:

a) Option 1: The permittee shall submit a request to extend the coverage of an existing SWPPI throughout the permittee’s urbanized areas where a WMP has been deferred. The permittee shall be aware that additional actions may be required in this area. Under this option, the permittee shall perform a cursory assessment of the watershed(s) in the urbanized areas where a WMP is deferred, and identify concerns that are not addressed under the existing SWPPI prepared consistent with the WMP. These concerns may be inferred from significant differences between watershed characteristics in the two areas. Some examples of categories to consider include: stream type (main channel vs. headwaters), land use (agricultural vs. residential vs. industrial/commercial), age of development, historical impacts on the watershed, topography, and soil type. If the comparison shows that the two areas are significantly different, the permittee’s SWPPI submission shall include additional approvable actions to address the deficiencies of the SWPPI in the deferred area.

b) Option 2: The permittee shall submit additional information as necessary to comply with the following requirements for urbanized areas where the WMP has been deferred:

(1) Public Involvement and Participation

Public input shall be encouraged in areas where the WMP is deferred. Appropriate BMPs for this minimum measure and measurable goals for each BMP shall be submitted to the department as part of the annual report. The following minimum actions shall be taken to encourage public input:

(a) The permittee shall follow local public notice requirements, as appropriate, when notifying the public that a SWPPI must be implemented. Copies of the permittee’s SWPPI shall be available for public inspection, and the public shall be notified of when and where it is available.

(b) The permittee shall establish and implement a citizen advisory committee for the purpose of encouraging public involvement in all aspects of the SWPPI.

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(c) The permittee shall pursue cooperation with local stream or watershed protection organizations, if any, by informing them of activities under the SWPPI, providing copies of the preliminary and final SWPPI and pursuing input on the SWPPI, seeking volunteer assistance including water quality monitoring assistance, and seeking ways to meet permit requirements by assisting the local organizations with their ongoing programs for water resource protection and enhancement.

(2) Post-Construction Storm Water Management Program for New Development and Redevelopment Projects

The permittee shall develop, implement and enforce a program to address storm water runoff from new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into the drainage system. The program shall ensure that controls are in place that will prevent or minimize water quality impacts. Appropriate BMPs for this minimum measure and measurable goals for each BMP shall be submitted to the department as part of the annual report.

Under the program for new development and redevelopment projects the permittee shall:

(a) Develop and implement a comprehensive storm water management plan for development, implementation, and enforcement of controls watershed-wide or jurisdiction-wide to protect the designated uses in all receiving waters within urbanized areas from the effects commonly associated with urbanization. Common effects of urbanization to be considered under the comprehensive management plan include stream “flashiness” (higher peak flow and lower base flow), stream-bank erosion, increased stream temperature and pollutant load, reduced stream-bank vegetation, and degraded fish and aquatic habitat. Example comprehensive management plan controls for prevention of impacts from urbanization include policies and ordinances that provide requirements and standards for directing growth to identified areas, protecting sensitive areas such as wetlands and riparian areas, maintaining and/or increasing open space (including a dedicated funding source for open space acquisition), encouraging infill development in higher density urban areas and areas with existing infrastructure, establishing in-stream maximum flow targets designed to minimize stream bank erosion and maintain healthy fish populations, and coordinating release volumes and rates from detention basins to achieve in-stream maximum flow targets.

(b) Develop and implement ordinances or other regulatory mechanisms to address post construction storm water runoff from new development and redevelopment projects to the extent allowable under state or local law. Objectives of the ordinances or other regulatory mechanisms should be to protect receiving water quality from the impacts of development and limit the rate and volume of storm water discharges from any specific site during and following development or redevelopment. The ordinances or other regulatory mechanisms shall include the following:

(i) Requirements for implementation of appropriate non-structural and/or structural BMPs. Non-structural BMPs are preventative actions that involve management and source controls. Examples include: buffer preservation along water bodies, establishment of easements for vegetative filters and infiltration, education programs for developers and the public about project designs that minimize water quality and quantity impacts, minimum disturbance of soils and vegetation, planting native vegetation, restrictions on directly connected impervious areas, and incentives for reducing imperviousness. Structural BMPs are physical controls that improve water quality, including storage practices. Examples of structural BMPs include: wet ponds and extended-detention outlet structures; vegetative buffers; filtration practices such as grassed swales, sand filters and filter strips; and infiltration practices such as infiltration basins, infiltration trenches, rain gardens, and infiltration islands in parking lots.

(ii) Requirements for adequate long-term operation and maintenance of BMPs.

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(iii) Requirements to control sediment discharges from new developments and redevelopments that result from soil erosion after the local soil erosion and sedimentation permit and federal permit by rule are no longer in effect.

(iv) Requirements for regulating the rate at which storm water flows into the drainage system.

(c) Develop and implement a process for review of post-construction storm water BMPs in initial site plans, as applicable.

(d) Minimize the occurrence of illicit discharges and spills into the drainage system by reviewing site plans for commercial operations to ensure that storm drain inlets are adequately isolated from pollutant sources. Equipment washing and waste material handling shall not result in discharge of wastes to the drainage system. Polluting materials, as defined in the Part 5 Rules (Rules 324.2001 through 324.2009 of the Michigan Administrative Code), shall be stored only in areas that provide secondary containment in accordance with state and federal law.

(3) Additional BMPs and Measurable Goals

If requested by the Department, the permittee shall submit appropriate BMPs, and measurable goals for each BMP, as part of the annual report. The Department may request specific information and implementation schedules for any or all of the following minimum measures:

(a) illicit discharge elimination program,

(b) public education program, and

(c) pollution prevention/good housekeeping for municipal operations.

b. SWPPI Revisions
By the date specified in the certificate of coverage, a revised SWPPI (incorporating current permit requirements or a written determination, with support, not to revise the SWPPI) shall be submitted to the Department for approval. The revised SWPPI shall be consistent with revisions made to the WMP.

c. Designated Contact Person
The permittee may replace the storm water program manager at any time and shall notify the Department within ten days after the replacement.

d. Retention of Records
The latest approved version of the SWPPI shall be retained until at least three years after coverage under this permit terminates. All records and information resulting from the assessment of SWPPI effectiveness, including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation, shall be retained for a minimum of three years or longer if requested by the Department or the Regional Administrator.

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3. Annual Progress Report

By the date indicated on the certificate of coverage, a report shall be submitted to the Department on the implementation status of this permit and the progress of pollution prevention. The progress report shall cover all of the decisions, actions, and results performed as part of this permit during the previous year. Annually thereafter, the permittee shall submit progress reports to the Department, unless a different reporting cycle is specified by the Department.

At a minimum, the progress reports shall cover the following subjects:

a. IDEP

1) The permittee shall provide documentation of the actions taken to eliminate illicit discharges and evaluate the effectiveness of the program. For significant illicit discharges, the permittee shall list the pollutant(s) of concern, the estimated volume and load discharged, and the locations of the discharge into both the permittee's separate storm water sewer system and the receiving water. The permittee shall include certification of any changes made to the IDEP as requested by the Department in Part I.A.3.

2) The permittee shall summarize the status of the program to minimize seepage from sanitary sewers and on-site sewage disposal systems into the permittee’s separate storm water drainage system.

3) The permittee shall provide schedules for elimination of illicit connections that have been identified but have yet to be eliminated.

b. PEP

The permittee shall provide documentation of the public education effort and a summary of the evaluation of its effectiveness. The permittee shall include certification of any changes made to the PEP as requested by the Department in Part I.A.3.

c. New Point Source Discharges of Storm Water

The permittee shall provide the information requested in Part I.A.4. of this permit on the discovery of new storm water point sources to the separate storm water drainage system.

d. SWPPI

The permittee shall provide the following information:

1) The permittee shall describe the compliance status of the permittee-specific SWPPI actions and implementation schedules for the permittee’s regulated areas. This review shall cover all of the permittee’s commitments from the WMP, and the SWPPI’s conditions for pollution prevention/good housekeeping and post-construction BMPs.

2) If the permittee has urbanized areas with a deferred WMP and selected Option 1, the permittee shall describe the status of any additional requirements for any areas with a deferred WMP.

3) If the permittee has urbanized areas with a deferred WMP and selected Option 2, the permittee shall describe the status for each of the three requirements listed in Part I.B.2.a.2) b). This shall include a listing of the BMPs that will be or have been implemented, descriptions of the measurable goals for each BMP, progress made towards meeting the measurable goals, upcoming actions, and any changes or updates to the BMPs or measurable goals to which the permittee has previously committed to do or meet.

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4) The effectiveness of the actions shall be discussed and the methods for this determination shall be reviewed. The permittee shall also include any proposed revisions to the SWPPI.

5) The permittee shall report on the status of any watershed planning decisions for the permittee's regulated area where a WMP has been deferred.

6) If necessary, the permittee may update both the characterization of the watershed(s) in the deferred area, and the comparison to the jurisdiction's watershed that is covered by the WMP. The permittee shall update any additional actions that have been included as part of the SWPPI as a result of any significant discrepancy between the watersheds.

e. Other Actions
The permittee shall submit any information for any other actions taken to reduce the discharge of pollutants in storm water.

f. Nested Drainage System Agreements
Permittees which are primary jurisdictions shall update the list of each nested jurisdictional area or drainage system that should have its own separate storm water drainage system permit, originally submitted as part of the application requirements in Part I.A.2. of this permit.

g. Special Reporting Requirements
The University of Michigan (Ann Arbor Campus), the Michigan Department of Transportation, and the Cities of Ann Arbor, Flint, Grand Rapids, Livonia, Sterling Heights, and Warren shall submit the following additional information:

a) Environmental Impacts [40 CFR 122.42(c)(7)]

The permittee shall provide an assessment of the pollution reduction and probable receiving water quality impacts associated with program implementation. When applicable, a statement shall be included regarding any negative water quality impacts that may have occurred as a result of any illicit discharges or accidental spills during the report cycle.

b) Data and Results [40 CFR 122.42(c)(4)]

The permittee shall provide a summary of all information collected and analyzed, including monitoring data, if any, during the report cycle.

c) BMP Changes [40 CFR 122.42(c)(2)]

The permittee shall describe any planned changes in identified BMPs or measurable goals for those BMPs.

d) Revised Fiscal Analysis [40 CFR 122.42(c)(3)]

The permittee shall provide a summary of revisions, if necessary, to the fiscal analysis reported during the previous permit, pursuant to permit application requirements [40 CFR 122.26(d)(2)(vi)].

e) Annual Budget [40 CFR 122.42(c)(5)]

The permittee shall provide the previous reporting cycle's expenditures and proposed budget for the reporting cycle following the report.

PART II

Section A. Definitions

This list of definitions may include terms not applicable to this permit.

Acute toxic unit (TU_a) means $100/LC_{50}$ where the LC_{50} is determined from a whole effluent toxicity (WET) test which produces a result that is statistically or graphically estimated to be lethal to 50% of the test organisms.

Best management practices (BMPs) means structural devices or non-structural practices that are designed to prevent pollutants from entering into storm water flows, to direct the flow of storm water, or to treat polluted storm water flows.

Bioaccumulative chemical of concern (BCC) means a chemical which, upon entering the surface waters, by itself or as its toxic transformation product, accumulates in aquatic organisms by a human health bioaccumulation factor of more than 1000 after considering metabolism and other physiochemical properties that might enhance or inhibit bioaccumulation. The human health bioaccumulation factor shall be derived according to R 323.1057(5). Chemicals with half-lives of less than 8 weeks in the water column, sediment, and biota are not BCCs. The minimum bioaccumulation concentration factor (BAF) information needed to define an organic chemical as a BCC is either a field-measured BAF or a BAF derived using the biota-sediment accumulation factor (BSAF) methodology. The minimum BAF information needed to define an inorganic chemical as a BCC, including an organometal, is either a field-measured BAF or a laboratory-measured bioconcentration factor (BCF). The BCCs to which these rules apply are identified in Table 5 of R 323.1057 of the Water Quality Standards.

Biosolids are the solid, semisolid, or liquid residues generated during the treatment of sanitary sewage or domestic sewage in a treatment works. This includes, but is not limited to, scum or solids removed in primary, secondary, or advanced wastewater treatment processes and a derivative of the removed scum or solids.

Bulk biosolids means biosolids that are not sold or given away in a bag or other container for application to a lawn or home garden.

Chronic toxic unit (TU_c) means $100/MATC$ or $100/IC_{25}$, where the maximum acceptable toxicant concentration (MATC) and IC_{25} are expressed as a percent effluent in the test medium.

Class B biosolids refers to material that has met the Class B pathogen reduction requirements or equivalent treatment by a Process to Significantly Reduce Pathogens (PSRP) in accordance with the Part 24 Rules. Processes include aerobic digestion, composting, anaerobic digestion, lime stabilization and air drying.

Daily concentration is the sum of the concentrations of the individual samples of a parameter divided by the number of samples taken during any calendar day. If the parameter concentration in any sample is less than the quantification limit, regard that value as zero when calculating the daily concentration. The daily concentration will be used to determine compliance with any maximum and minimum daily concentration limitations (except for pH and dissolved oxygen). When required by the permit, report the maximum calculated daily concentration for the month in the “MAXIMUM” column under “QUALITY OR CONCENTRATION” on the Discharge Monitoring Reports (DMRs).

For pH, report the maximum value of any individual sample taken during the month in the “MAXIMUM” column under “QUALITY OR CONCENTRATION” on the DMRs and the minimum value of any individual sample taken during the month in the “MINIMUM” column under “QUALITY OR CONCENTRATION” on the DMRs. For dissolved oxygen, report the minimum concentration of any individual sample in the “MINIMUM” column under “QUALITY OR CONCENTRATION” on the DMRs.

Daily loading is the total discharge by weight of a parameter discharged during any calendar day. This value is calculated by multiplying the daily concentration by the total daily flow and by the appropriate conversion factor. The daily loading will be used to determine compliance with any maximum daily loading limitations. When required by the permit, report the maximum calculated daily loading for the month in the “MAXIMUM” column under “QUANTITY OR LOADING” on the DMRs.

Department means the Michigan Department of Environmental Quality**.**

Detection level means the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability.

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Section A. Definitions

District Supervisor of the Water Division is identified in the individual certificate of coverage.

Drainage System Operator: See "Municipal Separate Storm Water Drainage System Operator".

EC_{50} means a statistically or graphically estimated concentration that is expected to cause 1 or more specified effects in 50% of a group of organisms under specified conditions.

Fecal coliform bacteria 7-day is the geometric mean of the samples collected in any 7-day period. The calculated 7-day value will be used to determine compliance with the maximum 7-day fecal coliform bacteria limitations. When required by the permit, report the maximum calculated 7-day concentration for the month in the "MAXIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Fecal coliform bacteria monthly is the geometric mean of the samples collected in a calendar month (or 30 consecutive days). The calculated monthly value will be used to determine compliance with the maximum monthly fecal coliform bacteria limitations. When required by the permit, report the calculated monthly value in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMRs.

Flow proportioned sample is a composite sample with the sample volume proportional to the effluent flow.

Grab sample is a single sample taken at neither a set time nor flow.

IC_{25} means the toxicant concentration that would cause a 25% reduction in a nonquantal biological measurement for the test population.

Interference is a discharge which, alone or in conjunction with a discharge or discharges from other sources, both:
1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and
2) therefore, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or, of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including Title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including state regulations contained in any state sludge management plan prepared pursuant to Subtitle D of the SWDA), the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act. [This definition does not apply to sample matrix interference.]

LC_{50} means a statistically or graphically estimated concentration that is expected to be lethal to 50% of a group of organisms under specified conditions.

Land application means spraying or spreading biosolids or a biosolids derivative onto the land surface, injecting below the land surface, or incorporating into the soil so that the biosolids or biosolids derivative can either condition the soil or fertilize crops or vegetation grown in the soil.

MGD means million gallons per day.

Maximum acceptable toxicant concentration (MATC) means the concentration obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test. A lower chronic limit is the highest tested concentration that did not cause the occurrence of a specific adverse effect. An upper chronic limit is the lowest tested concentration which did cause the occurrence of a specific adverse effect and above which all tested concentrations caused such an occurrence.

PART II

Section A. Definitions

Maximum extent practicable: The Maximum Extent Practicable (MEP) requirement shall be met by adherence to the requirements of the approved Illicit Discharge Elimination Plan, the approved Public Education Plan and the approved Storm Water Pollution Prevention Initiative (SWPPI), in a manner that is environmentally beneficial, technically feasible, and within the permittee's legal authority. The various components of the approved Plans and SWPPI, taken as a whole (rather than individually), shall be sufficient to meet the MEP requirements.

Monthly concentration is the sum of the daily concentrations determined during a reporting month (or 30 consecutive days) divided by the number of daily concentrations determined. The calculated monthly concentration will be used to determine compliance with any maximum monthly concentration limitations. When required by the permit, report the calculated monthly concentration in the "AVERAGE" column under "QUALITY OR CONCENTRATION" on the DMRs.

For minimum percent removal requirements, the monthly influent concentration and the monthly effluent concentration shall be determined. The calculated monthly percent removal, which is equal to 100 times the quantity [1 minus the quantity (monthly effluent concentration divided by the monthly influent concentration)], shall be reported in the "MINIMUM" column under "QUALITY OR CONCENTRATION" on the DMRs.

Monthly frequency of analysis refers to a calendar month. When required by this permit, an analytical result, reading, value or observation must be reported for that period if a discharge occurs during that period.

Monthly loading is the sum of the daily loadings of a parameter divided by the number of daily loadings determined in the reporting month (or 30 consecutive days). The calculated monthly loading will be used to determine compliance with any maximum monthly loading limitations. When required by the permit, report the calculated monthly loading in the "AVERAGE" column under "QUANTITY OR LOADING" on the DMRs.

Municipal Separate Storm Water Drainage System Operator means a public body or statutory housing authority that owns a separate storm water drainage system, or has the power of authority to implement or carry out any of the requirements for storm water pollution control. There may be multiple drainage system operators within the same geographic area or for the same separate storm water drainage system.

NOAEL means the highest tested dose or concentration of a substance that results in no observed adverse effect in exposed test organisms where higher doses or concentrations result in an adverse effect.

National Pretreatment Standards are the regulations promulgated by or to be promulgated by the Federal Environmental Protection Agency pursuant to Section 307(b) and (c) of the Federal Act. The standards establish nationwide limits for specific industrial categories for discharge to a POTW.

Noncontact cooling water is water used for cooling which does not come into direct contact with any raw material, intermediate product, by-product, waste product or finished product.

Nondomestic user is any discharger to a POTW that discharges wastes other than or in addition to water-carried wastes from toilet, kitchen, laundry, bathing or other facilities used for household purposes.

On-site sewage disposal system means a natural system or mechanical device used to collect, treat, and discharge or reclaim wastewater from one or more dwelling units without the use of community-wide sewers or a centralized treatment system.

POTW is a publicly owned treatment works.

Point source means an outfall from a drainage system to waters of the state, or a point where a storm water drainage system discharges into a system operated by another public body.

Pretreatment is reducing the amount of pollutants, eliminating pollutants, or altering the nature of pollutant properties to a less harmful state prior to discharge into a public sewer. The reduction or alteration can be by physical, chemical, or biological processes, process changes, or by other means. Dilution is not considered pretreatment unless expressly authorized by an applicable National Pretreatment Standard for a particular industrial category.

PART II

Section A. Definitions

Quantification level means the measurement of the concentration of a contaminant obtained by using a specified laboratory procedure calculated at a specified concentration above the detection level. It is considered the lowest concentration at which a particular contaminant can be quantitatively measured using a specified laboratory procedure for monitoring of the contaminant.

Quarterly frequency of analysis refers to a three month period, defined as January through March, April through June, July through September, and October through December. When required by this permit, an analytical result, reading, value or observation must be reported for that period if a discharge occurs during that period.

Regional Administrator is the Region 5 Administrator, U.S. EPA, located at R-19J, 77 W. Jackson Blvd., Chicago, Illinois 60604.

Regulated areas means urbanized areas and areas identified by the permit applicant to be subject to a watershed planning process.

Separate storm water drainage system means drainage systems that convey storm water to waters of the state excluding combined sewer systems and sanitary sewer systems (separate storm water drainage systems are not intended to carry sanitary wastewater). The conveyance may be opened or enclosed, and may contain the non-storm water discharges specified in Part I.A.1.c. and d.

Significant industrial user is a nondomestic user that: 1) is subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; or 2) discharges an average of 25,000 gallons per day or more of process wastewater to a POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process wastestream which makes up five (5) percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the permittee as defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's treatment plant operation or violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)).

Storm water includes storm water runoff, snow melt runoff, and surface runoff and drainage.

Tier I value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier I toxicity database.

Tier II value means a value for aquatic life, human health or wildlife calculated under R 323.1057 of the Water Quality Standards using a tier II toxicity database.

Toxicity reduction evaluation (TRE) means a site-specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity.

Urbanized area means a place and the adjacent densely populated territory that together have a minimum population of fifty thousand (50,000) people, as defined by the United States Bureau of the Census and as determined by the latest available decennial census.

Water Quality Standards means the Part 4 Water Quality Standards promulgated pursuant to Part 31 of Act No. 451 of the Public Acts of 1994, as amended, being Rules 323.1041 through 323.1117 of the Michigan Administrative Code.

Waters of the state means all of the following, but does not include drainage ways and ponds used solely for wastewater conveyance, treatment, or control:

- The Great Lakes and their connecting waters,
- All inland lakes,
- Rivers,
- Streams,
- Impoundments,
- Open drains, and

PART II

Section A. Definitions

- Other surface bodies of water within the confines of the state.

Weekly frequency of analysis refers to a calendar week which begins on Sunday and ends on Saturday. When required by this permit, an analytical result, reading, value or observation must be reported for that period if a discharge occurs during that period.

Yearly frequency of analysis refers to a calendar year beginning on January 1 and ending on December 31. When required by this permit, an analytical result, reading, value or observation must be reported for that period if a discharge occurs during that period.

24-Hour composite sample is a flow proportioned composite sample consisting of hourly or more frequent portions that are taken over a 24-hour period.

3-Portion composite sample is a sample consisting of three equal volume grab samples collected at equal intervals over an 8-hour period.

7-day concentration is the sum of the daily concentrations determined during any 7 consecutive days in a reporting month divided by the number of daily concentrations determined. The calculated 7-day concentration will be used to determine compliance with any maximum 7-day concentration limitations. When required by the permit, report the maximum calculated 7-day concentration for the month in the “MAXIMUM” column under “QUALITY OR CONCENTRATION” on the DMRs.

7-day loading is the sum of the daily loadings of a parameter divided by the number of daily loadings determined during any 7 consecutive days in a reporting month. The calculated 7-day loading will be used to determine compliance with any maximum 7-day loading limitations. When required by the permit, report the maximum calculated 7-day loading for the month in the “MAXIMUM” column under “QUANTITY OR LOADING” on the DMRs.

<u>Preventing</u> Pollution is the <u>Best</u> Solution

The Michigan Department of Environmental Quality (DEQ) encourages you to consider pollution prevention alternatives. In some cases pollution prevention may allow you to avoid the need to discharge pollutants which would otherwise require permit limitations -- or even avoid the need for permits altogether! Pollution prevention can:

- ☑ Save Money
- ☑ Reduce Waste
- ☑ Aid Permit Compliance
- ☑ Protect Our Environment
- ☑ Improve Corporate Image
- ☑ Reduce Liability

The DEQ is helping Michigan’s industries save money, reduce waste and protect our environment through pollution prevention. DEQ staff can provide pollution prevention assistance through telephone consultations, technical workshops and seminars, and informational publications. They can also put you directly in touch with local support networks and national pollution prevention resources. For more information, contact the Michigan Department of Environmental Quality, Environmental Science and Services Division, at 1-800-662-9278 or visit our homepage at http://www.michigan.gov/deq.

PART II

Section B. Monitoring Procedures

1. Representative Samples

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations promulgated pursuant to Section 304(h) of the Federal Act (40 CFR Part 136 - Guidelines Establishing Test Procedures for the Analysis of Pollutants), unless specified otherwise in this permit. Requests to use test procedures not promulgated under 40 CFR Part 136 for pollutant monitoring required by this permit shall be made in accordance with the Alternate Test Procedures regulations specified in 40 CFR 136.4. These requests shall be submitted to the Chief of the Surface Water Permits Section, Water Division, Michigan Department of Environmental Quality, P.O. Box 30273, Lansing, Michigan, 48909-7773. The permittee may use such procedures upon approval.

The permittee shall periodically calibrate and perform maintenance procedures on all analytical instrumentation at intervals to ensure accuracy of measurements. The calibration and maintenance shall be performed as part of the permittee's laboratory Quality Control/Quality Assurance program.

3. Instrumentation

The permittee shall periodically calibrate and perform maintenance procedures on all monitoring instrumentation at intervals to ensure accuracy of measurements.

4. Recording Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information: 1) the exact place, date, and time of measurement or sampling; 2) the person(s) who performed the measurement or sample collection; 3) the dates the analyses were performed; 4) the person(s) who performed the analyses; 5) the analytical techniques or methods used; 6) the date of and person responsible for equipment calibration; and 7) the results of all required analyses.

5. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the Department.

PART II

Section C. Reporting Requirements

1. Start-up Notification

If the permittee will not discharge during the first 60 days following the effective date of the facility's certificate of coverage, the permittee shall notify the Department within 14 days following the effective date of the certificate of coverage, and then 60 days prior to the commencement of the discharge.

2. Submittal Requirements for Self-Monitoring Data

Unless instructed on the effluent limits page to conduct "retained self-monitoring," the permittee shall submit self-monitoring data on the Environmental Protection Agency's Discharge Monitoring Report (DMR) forms (monthly summary information) and the Department's Daily Discharge Monitoring Report forms (daily information) to PCS-Data Entry, Water Division, Michigan Department of Environmental Quality, P.O. Box 30273, Lansing, Michigan, 48909-7773, for each calendar month of the authorized discharge period(s). The forms shall be postmarked no later than the 10th day of the month following each month of the authorized discharge period(s).

Alternative Daily Discharge Monitoring Report formats may be used if they provide equivalent reporting details and are approved by the Department. For information on electronic submittal of this information, contact the Department.

3. Retained Self-Monitoring Requirements

If instructed on the effluent limits page (or otherwise authorized by the Department in accordance with the provisions of this permit) to conduct retained self-monitoring, the permittee shall maintain a year-to-date log of retained self-monitoring results and, upon request, provide such log for inspection to the staff of the Department (Department as defined on the certificate of coverage). Retained self-monitoring results are public information and shall be promptly provided to the public upon written request from the public.

The permittee shall certify, in writing, to the Department, on or before January 10th of each year, that: 1) all retained self-monitoring requirements have been complied with and a year-to-date log has been maintained; and 2) the application on which this permit is based still accurately describes the discharge. With this annual certification, the permittee shall submit a summary of the previous year's monitoring data. The summary shall include maximum values for samples to be reported as daily maximums and/or monthly maximums and minimum values for any daily minimum samples.

Retained self-monitoring may be denied to a permittee by notification in writing from the Department. In such cases, the permittee shall submit self-monitoring data in accordance with Part II.C.2., above. Such a denial may be rescinded by the Department upon written notification to the permittee.

Reissuance or modification of this permit or reissuance or modification of a permittee's authorization to discharge shall not affect previous approval or denial for retained self-monitoring unless the Department provides notification in writing to the permittee.

4. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

Monitoring required pursuant to Part 41 of the Michigan Act or Rule 35 of the Mobile Home Park Commission Act (Act 96 of the Public Acts of 1987) for assurance of proper facility operation shall be submitted as required by the Department.

PART II

Section C. Reporting Requirements

5. Compliance Dates Notification

Within 14 days of every compliance date specified in this permit, the permittee shall submit a written notification to the Department indicating whether or not the particular requirement was accomplished. If the requirement was not accomplished, the notification shall include an explanation of the failure to accomplish the requirement, actions taken or planned by the permittee to correct the situation, and an estimate of when the requirement will be accomplished. If a written report is required to be submitted by a specified date and the permittee accomplishes this, a separate written notification is not required.

6. Noncompliance Notification

Compliance with all applicable requirements set forth in the Federal Act, Parts 31 and 41 of the Michigan Act, and related regulations and rules is required. All instances of noncompliance shall be reported as follows:

a. 24-hour reporting - Any noncompliance which may endanger health or the environment (including maximum daily concentration discharge limitation exceedances) shall be reported, verbally, within 24 hours from the time the permittee becomes aware of the noncompliance. A written submission shall also be provided within five (5) days.

b. other reporting - The permittee shall report, in writing, all other instances of noncompliance not described in a. above at the time monitoring reports are submitted; or, in the case of retained self-monitoring, within five (5) days from the time the permittee becomes aware of the noncompliance.

Written reporting shall include: 1) a description of the discharge and cause of noncompliance; and 2) the period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and the steps taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

7. Spill Notification

The permittee shall immediately report any release of any polluting material which occurs to the surface waters or groundwaters of the state, unless the permittee has determined that the release is not in excess of the threshold reporting quantities specified in the Part 5 Rules (Rules 324.2001 through 324.2009 of the Michigan Administrative Code), by calling the Department at the number indicated in the certificate of coverage, or if the notice is provided after regular working hours call the Department's 24-hour Pollution Emergency Alerting System telephone number, 1-800-292-4706 (calls from out-of-state dial 1-517-373-7660).

Within ten (10) days of the release, the permittee shall submit to the Department a full written explanation as to the cause of the release, the discovery of the release, response (clean-up and/or recovery) measures taken, and preventative measures taken or a schedule for completion of measures to be taken to prevent reoccurrence of similar releases.

8. Upset Noncompliance Notification

If a process "upset" (defined as an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee) has occurred, the permittee who wishes to establish the affirmative defense of upset, shall notify the Department by telephone within 24-hours of becoming aware of such conditions; and within five (5) days, provide in writing, the following information:

a. that an upset occurred and that the permittee can identify the specific cause(s) of the upset;

b. that the permitted wastewater treatment facility was, at the time, being properly operated; and

c. that the permittee has specified and taken action on all responsible steps to minimize or correct any adverse impact in the environment resulting from noncompliance with this permit.

In any enforcement proceedings, the permittee, seeking to establish the occurrence of an upset, has the burden of proof.

PART II

Section C. Reporting Requirements

9. Bypass Prohibition and Notification

a. Bypass Prohibition - Bypass is prohibited unless:

1) bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

2) there were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass; and

3) the permittee submitted notices as required under 9.b. or 9.c. below.

b. Notice of Anticipated Bypass - If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the Department, if possible at least ten (10) days before the date of the bypass, and provide information about the anticipated bypass as required by the Department. The Department may approve an anticipated bypass, after considering its adverse effects, if it will meet the three (3) conditions listed in 9.a. above.

c. Notice of Unanticipated Bypass - The permittee shall submit notice to the Department of an unanticipated bypass by calling the Department at the number indicated in the certificate of coverage (if the notice is provided after regular working hours, use the following number: 1-800-292-4706) as soon as possible, but no later than 24 hours from the time the permittee becomes aware of the circumstances.

d. Written Report of Bypass - A written submission shall be provided within five (5) working days of commencing any bypass to the Department, and at additional times as directed by the Department. The written submission shall contain a description of the bypass and its cause; the period of bypass, including exact dates and times, and if the bypass has not been corrected, the anticipated time it is expected to continue; steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass; and other information as required by the Department.

e. Bypass Not Exceeding Limitations - The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of 9.a., 9.b., 9.c., and 9.d., above. This provision does not relieve the permittee of any notification responsibilities under Part II.C.10. of this permit.

f. Definitions

1) Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

2) Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

PART II

Section C. Reporting Requirements

10. Notification of Changes in Discharge

The permittee shall notify the Department, in writing, within 10 days of knowing, or having reason to believe, that any activity or change has occurred or will occur which would result in the discharge of: 1) detectable levels of chemicals on the current Michigan Critical Materials Register, priority pollutants or hazardous substances set forth in 40 CFR 122.21, Appendix D, or the Pollutants of Initial Focus in the Great Lakes Water Quality Initiative specified in 40 CFR 132.6, Table 6, which were not acknowledged in the application or listed in the application at less than detectable levels; 2) detectable levels of any other chemical not listed in the application or listed at less than detection, for which the application specifically requested information; or 3) any chemical at levels greater than five times the average level reported in the complete application (see the first page of this permit for the date(s) the complete application was submitted). Any other monitoring results obtained as a requirement of this permit shall be reported in accordance with the compliance schedules.

11. Changes in Facility Operations

Any anticipated action or activity, including but not limited to facility expansion, production increases, or process modification, which will result in new or increased loadings of pollutants to the receiving waters must be reported to the Department by a) submission of an increased use request (application) and all information required under Rule 323.1098 (Antidegradation) of the Water Quality Standards <u>or</u> b) by notice if the following conditions are met: 1) the action or activity will not result in a change in the types of wastewater discharged or result in a greater quantity of wastewater than currently authorized by this permit and certificate of coverage; 2) the action or activity will not result in violations of the effluent limitations specified in this permit; 3) the action or activity is not prohibited by the requirements of Part II.C.12.; and 4) the action or activity will not require notification pursuant to Part II.C.10. Following such notice, the certificate of coverage may be modified according to applicable laws and rules to specify and limit any pollutant not previously limited.

12. Bioaccumulative Chemicals of Concern (BCC)

Consistent with the requirements of Rules 323.1098 and 323.1215 of the Michigan Administrative Code, the permittee is prohibited from undertaking any action that would result in a lowering of water quality from an increased loading of a BCC unless an increased use request and antidegradation demonstration have been submitted and approved by the Department.

13. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharge emanates, the permittee shall notify the succeeding owner or controller of the existence of this permit and certificate of coverage by letter, a copy of which shall be forwarded to the Department 30 days prior to the actual transfer of ownership or control.

PART II

Section D. Management Responsibilities

1. Duty to Comply

All discharges authorized herein shall be consistent with the terms and conditions of this permit and the facility's certificate of coverage (COC). The discharge of any pollutant identified in this permit and/or the facility's COC more frequently than or at a level in excess of that authorized shall constitute a violation of the permit.

It is the duty of the permittee to comply with all the terms and conditions of this permit and the facility's COC. Any noncompliance with the Effluent Limitations, Special Conditions, or terms of this permit or the facility's COC constitutes a violation of the Michigan Act and/or the Federal Act and constitutes grounds for enforcement action; for COC termination, revocation and reissuance, or modification; or denial of an application for permit or COC renewal.

2. Operator Certification

The permittee shall have the waste treatment facilities under direct supervision of an operator certified at the appropriate level for the facility certification by the Department, as required by Sections 3110 and 4104 of the Michigan Act.

3. Facilities Operation

The permittee shall, at all times, properly operate and maintain all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes adequate laboratory controls and appropriate quality assurance procedures.

4. Power Failures

In order to maintain compliance with the effluent limitations of this permit and prevent unauthorized discharges, the permittee shall either:

a. provide an alternative power source sufficient to operate facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit; or

b. upon the reduction, loss, or failure of one or more of the primary sources of power to facilities utilized by the permittee to maintain compliance with the effluent limitations and conditions of this permit, the permittee shall halt, reduce or otherwise control production and/or all discharge in order to maintain compliance with the effluent limitations and conditions of this permit.

5. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the surface waters or groundwaters of the state resulting from noncompliance with any effluent limitation specified in this permit including, but not limited to, such accelerated or additional monitoring as necessary to determine the nature and impact of the discharge in noncompliance.

6. Containment Facilities

The permittee shall provide facilities for containment of any accidental losses of polluting materials in accordance with the requirements of the Part 5 Rules (Rules 324.2001 through 324.2009 of the Michigan Administrative Code). For a Publicly Owned Treatment Work (POTW), these facilities shall be approved under Part 41 of the Michigan Act.

PART II

Section D. Management Responsibilities

7. Waste Treatment Residues

Residuals (i.e. solids, sludges, biosolids, filter backwash, scrubber water, ash, grit or other pollutants) removed from or resulting from treatment or control of wastewaters, shall be disposed of in an environmentally compatible manner and according to applicable laws and rules. These laws may include, but are not limited to, the Michigan Act, Part 31 for protection of water resources, Part 55 for air pollution control, Part 111 for hazardous waste management, Part 115 for solid waste management, Part 121 for liquid industrial wastes, Part 301 for protection of inland lakes and streams, and Part 303 for wetlands protection. Such disposal shall not result in any unlawful pollution of the air, surface waters or groundwaters of the state.

8. Treatment System Closure

In the event that discharges from a treatment system are planned to be eliminated, the permittee shall submit a closure plan to the Department for approval. The closure plan shall include characterization of any wastewater and residuals which will remain on-site after the discharges are eliminated, along with disposal methods, proposed schedule, and any other relevant information as required by the Department. Closure activities involving waste treatment residuals shall be consistent with Part II.D.7. of this permit.

The permittee shall implement the closure activities in accordance with the approved plan. Any wastewater or residual disposal inconsistent with the approved plan shall be considered a violation of this permit. After proper closure of the treatment system, the certificate of coverage may be terminated.

9. Right of Entry

The permittee shall allow the Department, any agent appointed by the Department or the Regional Administrator, upon the presentation of credentials:

a. to enter upon the permittee’s premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

b. at reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect process facilities, treatment works, monitoring methods and equipment regulated or required under this permit; and to sample any discharge of pollutants.

10. Availability of Reports

Except for data determined to be confidential under Section 308 of the Federal Act and Rule 2128 (Rule 323.2128 of the Michigan Administrative Code), all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department and the Regional Administrator. As required by the Federal Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Act and Sections 3112, 3115, 4106 and 4110 of the Michigan Act.

PART II

Section E. Activities Not Authorized by This Permit

1. Discharge to the Groundwaters

This permit does not authorize any discharge to the groundwaters. Such discharge may be authorized by a groundwater discharge permit issued pursuant to the Michigan Act.

2. Facility Construction

This permit does not authorize or approve the construction or modification of any physical structures or facilities. Approval for such construction for a POTW must be by permit issued under Part 41 of the Michigan Act. Approval for such construction for a mobile home park, campground or marina shall be from the Water Division, Michigan Department of Environmental Quality. Approval for such construction for a hospital, nursing home or extended care facility shall be from the Division of Health Facilities and Services, Michigan Department of Consumer and Industry Services upon request.

3. Civil and Criminal Liability

Except as provided in permit conditions on "Bypass" (Part II.C.9. pursuant to 40 CFR 122.41(m)), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance, whether or not such noncompliance is due to factors beyond the permittee's control, such as accidents, equipment breakdowns, or labor disputes.

4. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee may be subject under Section 311 of the Federal Act except as are exempted by federal regulations.

5. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Federal Act.

6. Property Rights

The issuance of this permit and certificate of coverage does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize violation of any federal, state or local laws or regulations, nor does it obviate the necessity of obtaining such permits or approvals from other units of government as may be required by law.

CLINTON RIVER EAST WATERSHED
MEMBERSHIP LIST

	Telephone	Fax	E-Mail Address
Anderson, Eckstein & Westrick, Inc.			
Jeff Bednar, P.E.	(586) 726-1234	(586) 726-8780	jbednar@aewinc.com
Melissa Madigan	(586) 726-1234	(586) 726-8780	mmadigan@aewinc.com
Bruce Township			
Gary Schocke, Supervisor	(586) 752-4585	(586) 752-3870	
Chippewa Valley Schools			
Kenneth C. Hauer, Supervisor, Maintenance & Grounds	(586) 723-2250	(586) 723-2251	khauer@cvs.k12.mi.us
Clinton River Watershed Council			
Gary Morgan, Executive Director	(248) 601-0606	(248) 601-1280	gary@crwc.org
Tracie Beasley, Stewardship Director	(248) 601-0606	(248) 601-1280	tracie@crwc.org
Clinton Township			
Mary Bednar, Engineer	(586) 286-9387	(586) 228-9390	m.bednar@clintontownship-mi.gov
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Updated 7/19/06