CHAPTER 8
STORMWATER MANAGEMENT

I. Introduction

Historically, water pollution control has focused on obvious point sources: municipal wastewater treatment plants (WTTPs) and industrial discharges that flow from a pipe directly to a water body. While most point source pollutants have been addressed through the early focus of the 1972 Clean Water Act (CWA), water quality issues caused by runoff from the built environment was largely ignored until a 1987 amendment to the CWA. The pollution potential for urban stormwater runoff was not fully appreciated until repeated studies revealed that urban non-point sources seriously threaten water quality and can exceed the impact of municipal sewage discharges. Now, the more difficult non-point sources must be dealt with to continue to improve our water resources.

Non-point problems are both water quality and quantity based. Development of an area changes the landscape, replacing natural vegetation with less permeable surfaces that prevent rainwater and snowmelt from following their natural course into the soil. Roofs and pavement completely prevent infiltration, while even suburban lawns absorb far less than natural areas. As rainwater runs over impervious surfaces, it carries a multitude of pollutants from the land directly to storm drains, rivers, and streams. Impervious surfaces also increase the rate and volume of stormwater runoff, resulting in higher flows and more frequent floods. In Swan Creek (Lucas County), flood flows have increased up to 85 percent from pre-settlement times. The elevated flows increase the erosion of waterway beds and banks (Earthview, 1973). Other negative impacts include increasing the receiving waters' temperature, changing habitat, and decreasing stream flow stability.

To reduce the water quality impacts of stormwater runoff and reverse some of the damage that has been done to the Nation's surface waters, the U.S. Environmental Protection Agency (U.S. EPA) requires that municipalities and other entities control the volume and pollutant loads of stormwater entering local waterways. This chapter details the regulatory framework for stormwater pollution control and recommends implementation policies for local governments to meet regulatory requirements and protect streams from pollution by urban runoff.

II. History of Drainage in the TMACOG Region

Drainage in the Toledo Metropolitan Area Council of Governments (TMACOG) planning area has historically been poor, due primarily to lack of relief and a low density of natural streams to drain the land. Except for western Lucas County, the region was largely characterized by swamp forest and marshland. The area was historically referred to as "The Great Black Swamp." Ditch laws passed in the 1860s gave county commissioners in Ohio and Michigan the authority to construct, enlarge, and deepen natural streams and man-made ditches. An extensive ditch system was installed, providing an integrated drainage system for the area that permitted agricultural land uses and settlement.

In the late 19th century, the need for rapid transport of sanitary wastes had become increasingly apparent. In the urban centers, the drainage efforts intensified with engineered systems of underground pipes carrying both sanitary waste and stormwater. Storm sewer ordinances were

amended to allow disposal of sanitary wastes via the storm sewers and construction of these combined sewer systems became an accepted practice. The serious pollution and health risks were not realized until populations increased, and treatment of the wastewater became essential. More recently, constructed stormwater and wastewater collection systems have been separate systems and many older urban areas are under EPA mandates to prevent combined sanitary and stormwater discharges into waterways. Nevertheless, many combined sewers are still in use in older urban areas.

III. Stormwater Pollution

The problem with management of urban stormwater runoff is that the pollution sources are diffuse and not easily identified. Stormwater pollutants are generated through activities distributed across an entire landscape, rather than contained within a facility. Most land use activities deposit detrimental and sometimes hazardous materials on the impervious surfaces: sediments (dust and sand), toxic metal particles, pesticides, fertilizers, petroleum products, harmful bacteria, salt, pet waste, and trash. As rainfall and snowmelt move rapidly across transformed landscapes, these pollutants are carried to surface and underground collection systems. Eventually these polluted flows reach waters that we use for drinking, swimming, fishing, and recreation. See Table 8-1 for more examples of stormwater contaminants.

Table 8-1: Categories of Primary Stormwater Contaminants

Category	Examples
Metals	Zinc, Cadmium, Copper, Chromium, Arsenic, Lead
Organic Chemicals	Pesticides, Oil, Gasoline, Grease
Pathogens	Bacteria, Viruses, Protozoa
Nutrients	Phosphorous, Nitrogen
Biochemical Oxygen Demand (BOD)	Grass clippings, Hydrocarbons, Animal waste, Fallen leaves
Sediment	Sand, Soil, Silt
Salts	Sodium Chloride, Calcium Chloride
Source: Bannerman et al., 1993.	

Illicit or illegal connections to the storm sewers from homes and businesses introduce pollutants and pathogens to the storm sewers that are released without appropriate treatment. Sources of illicit discharges include, but are not limited to sanitary wastewater, effluent from septic tanks, car wash, laundry, household waste, and other waste products. Industrial facilities often negligently discharge wastewater that should be directed to the sanitary sewers into floor drains, dry wells and cesspools, which feed into their stormwater system. The result is untreated discharges that contribute high levels of pollutants into receiving waterbodies.

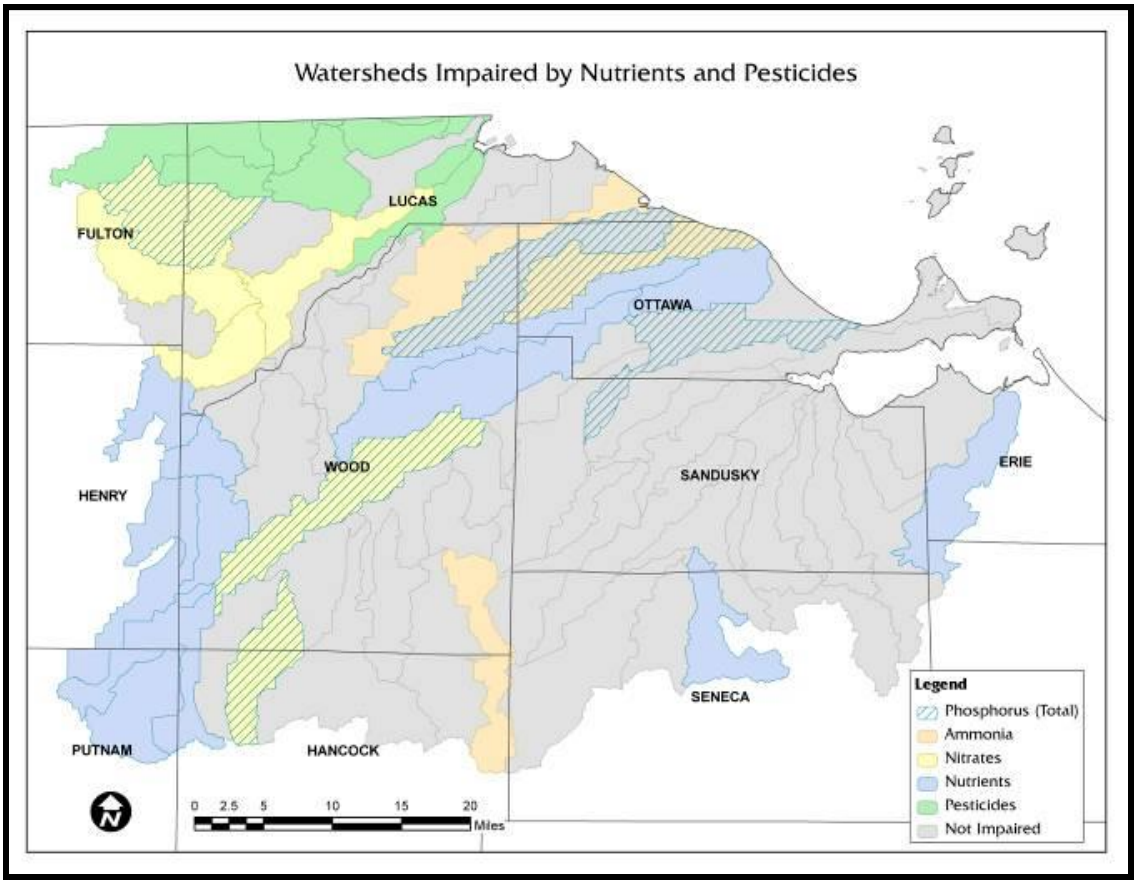

Figure 8-1: Watershed Impairment Caused by Nutrients and Pesticides in the TMACOG Region

Landscaping practices that use fertilizers or pesticides and poor housekeeping practices are potential sources of pollutants in urban runoff. Improper or over application on landscaping and lawn areas is very common. The excess eventually makes its way to ditches and streams. Rain and melting snow can erode piles of stored materials such as sand, loose topsoil, or road salt that is left uncovered. Similarly, precipitation can flush contaminants off unwashed equipment stored outside. These common pollutants can degrade the quality of receiving waters, almost to the same degree as if they were introduced by direct discharge, causing water quality impairments in watersheds. Figure 8-1 highlights the watersheds that are affected by common landscaping pollutants such as nitrates, pesticides, and nutrients, in general.

As impervious surfaces replace a watershed's farmland, forests, and meadowlands with hard surfaces that have virtually no ability to absorb stormwater, the effect on the volume of stormwater runoff is dramatic. For example, a one-inch rainstorm on a 1-acre natural meadow produces approximately 218 cubic feet of runoff. The same storm over a 1-acre paved parking lot would produce almost 16 times that volume of runoff. The proliferation of hard surfaces not only changes the volume of stormwater flows, but also the distribution of flows over time. The stormwater is forced off the land immediately, causing much sharper peaks in runoff. These "flashy" flows can lead to problematic changes in the hydraulics of the system. These flows cause larger and more frequent floods and increase erosion of stream banks and beds. Eroded banks, in turn, have caused damage to adjacent property as well as a potential safety hazard. The higher flows also result in increases in stream temperature, changes in

habitat, and decreases in stream flow stability (Table 8-2).

Table 8-2: Impacts from Increases in Impervious Surfaces

Increased Imperviousness Leads to:	Resulting Impacts				
	Flooding	Habitat Loss	Erosion	Channel Widening	Streambed Alterations
Increased volume	●	●	●	●	●
Increased peak flow	●	●	●	●	●
Increased peak flow duration	●	●	●	●	●
Increased stream temperature		●			
Decreased base flow		●			
Increased sediment loadings	●	●	●	●	●
Source: USEPA, 1997					

Research has shown that when impervious cover reaches between 11 and 25 percent of the area of a watershed, hydrological and ecological stresses become apparent (Schueler, 1994). As shown in Figure 8-2, six sub-watersheds (smaller divisions of larger watersheds, also known as 12-digit hydrologic units) in the region have above 10% imperviousness. A second threshold appears to exist at 26% impervious cover, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores). Four watersheds in the region are above the 26% impervious cover threshold. Established urban areas in the region are estimated to have 30-35% impervious surface area. For example, in 2001, the Toledo Stormwater Utility estimated 13,219 impervious acres, plus approximately 1,000 miles of streets. Assuming average pavement and sidewalk width, the total is 16,128 acres, not including highways. The impervious area is 31% of the city's 80.6 square miles. Toledo, the only jurisdiction with impervious area data at present, is probably typical of urban areas in the region.

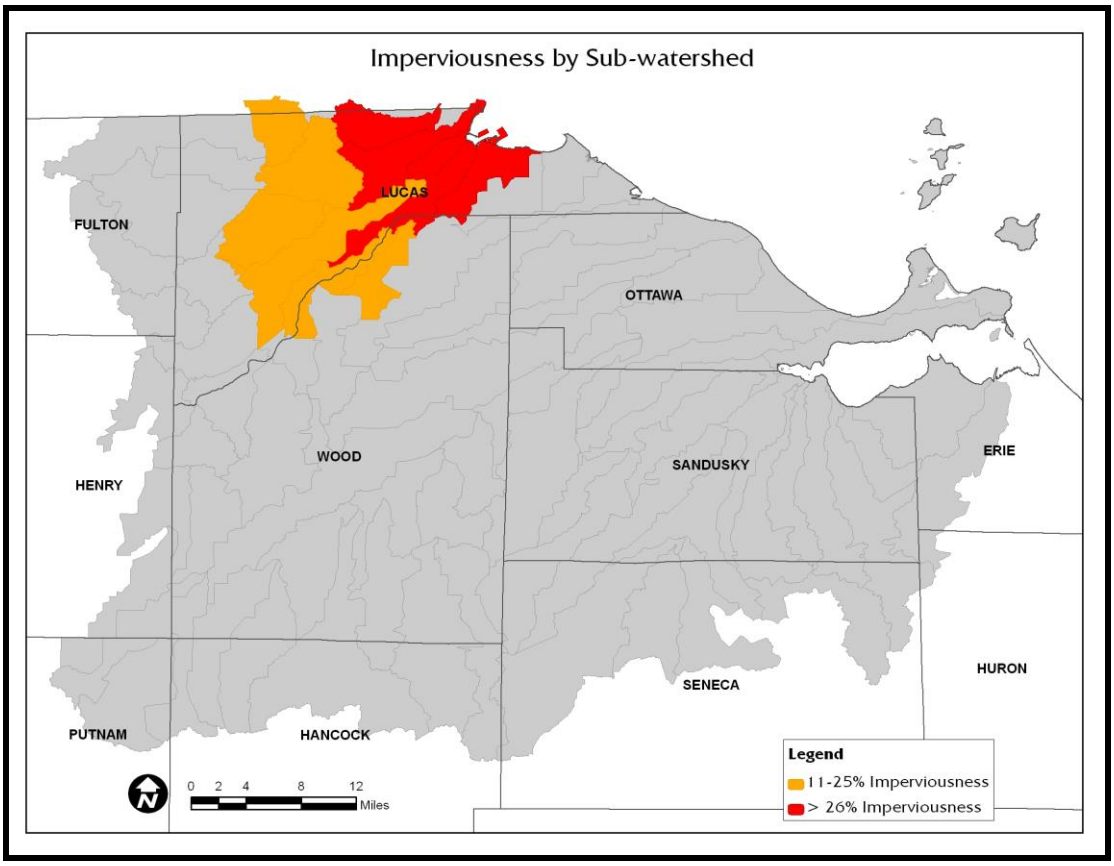

Figure 8-2: Urban Imperviousness by Subwatershed

Source: USGS Multi-Resolution Land Characteristics Consortium (MRLC);
http://www.mrlc.gov/multizone_download.php?zone=11

In many communities, most impervious cover is related to transportation infrastructure – streets, roads and parking lots. Not only does transportation infrastructure produce some of the highest concentrations of hydrocarbons, suspended solids (sediment) and bacteria, but it also generates a disproportionate amount of runoff volume from the watershed (Bannerman et al., 1993). Automobiles contribute several different types of pollutants to urban runoff. High levels of metals are found in tire wear, used motor oil and grease, diesel fuel, and vehicle rust. Engine coolants and antifreeze are toxic and can contribute to high biological oxygen demand (BOD) in the receiving waters. Fossil fuel combustion is a large contributor of nitrogen to the waters in urbanized areas of the U.S. Salts are used to keep facilities free of ice, but in large volumes can be toxic to fish and other wildlife.

Of concern for water quality, are soluble metals, which are much more likely to exert a toxic effect on aquatic life and are not easily removed by natural processes. Table 8-3 identifies common metals associated with the transportation. In the 208 region, metals are responsible for impairment in the Sibley Creek-Ottawa River Watershed (Figure 8-3). These pollutants accumulate on impervious surfaces during dry weather conditions, only to form a concentrated first flush during storm events. Impervious surface and parking lot runoff is a source of impairment in several watersheds in the region (see the section “Complete Watershed-Based Planning & Coordination” in this chapter).

Table 8-3: Sources of Heavy Metals from Transportation

Source	Cadmium	Cobalt	Copper	Iron	Manganese	Nickel	Lead	Zinc
Gasoline	•		•				•	•
Exhaust						•	•	
Motor Oil & Grease		•		•		•	•	•
Antifreeze				•				•
Undercoating							•	•
Brake Linings			•	•		•	•	•
Tire Wear	•		•				•	•
Asphalt			•			•		•
Concrete			•			•		•
Diesel Oil	•							
Engine Wear					•	•	•	•
Source: Terrene Institute and USEPA, 1995								

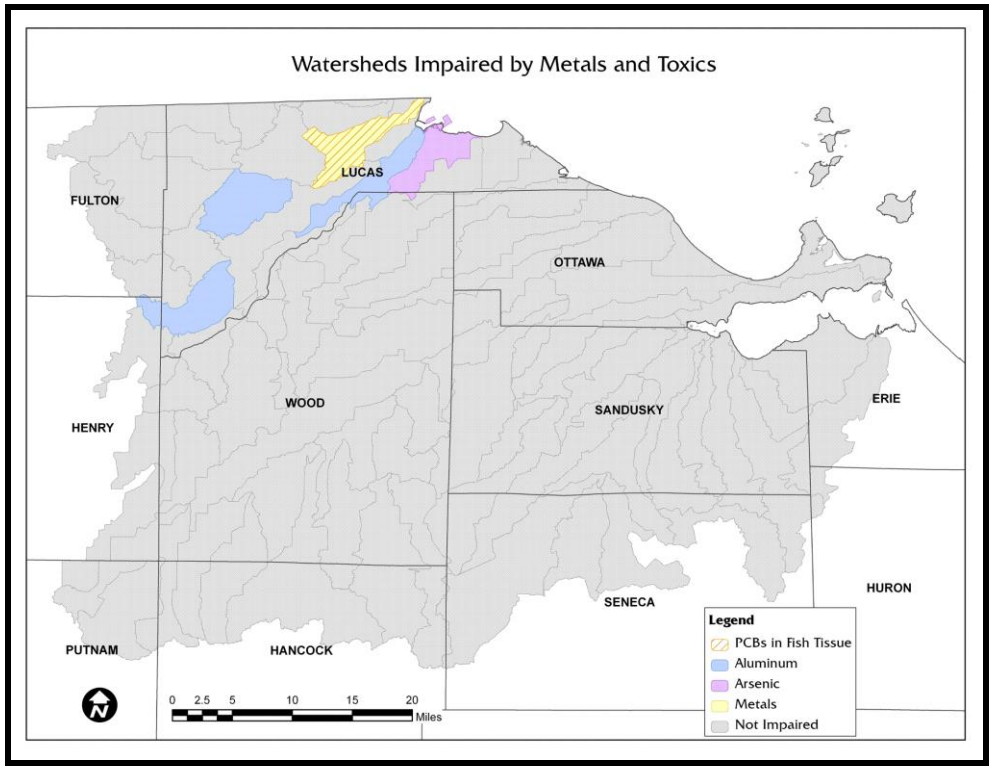

Figure 8-3: Watersheds Impaired by Metals and Toxics

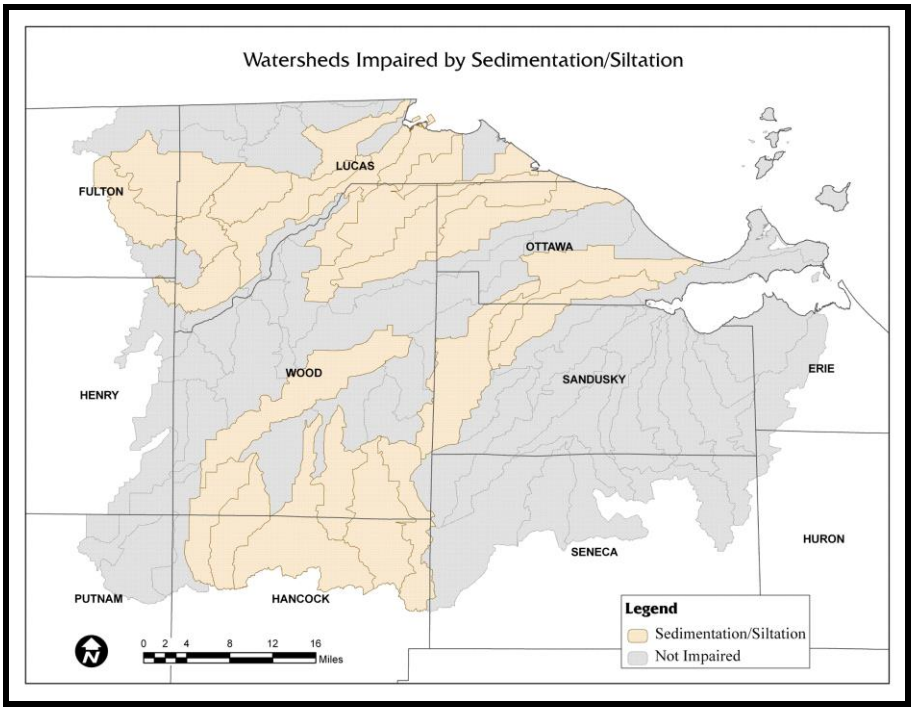

Figure 8-4: Watersheds Impaired by Sedimentation in the TMACOG Region

Erosion rates from construction sites are significantly greater than rates from almost any other land use. Field studies and erosion models have shown that erosion rates from construction sites are typically an order of magnitude larger than row crops and several orders of magnitude greater that rates from well-vegetated areas such as forest or pastures (U.S. EPA, 1999). Excess sediment causes several problems for waterbodies. Suspended sediments increase turbidity and reduce light penetration in the water column, which directly impacts aquatic organisms. Long-term effects of sedimentation include habitat destruction and increased difficulty in filtering drinking water. Watersheds impaired by sedimentation and siltation in the 208 region are shows in Figure 8-4.

IV. Critical Urbanizing Watersheds

To address the water quality impairments caused by expanding urbanized areas, this Plan recommends priority areas, identified as Critical Urbanizing Watersheds. This designation is intended to prioritize watersheds that are undergoing urbanization and meant only to be used by this Plan. Watershed designations are based on three criteria:

- Ohio Environmental Protection Agency (Ohio EPA) or Michigan Department Environment, Great Lakes, and Energy (Michigan EGLE) classify streams as non-point source "impaired." Urban runoff and other urban sources such as construction sites are identified as being known or suspected sources for the nonpoint source impact/impairment.
- The watershed is undergoing rapid urban development and/or is under pressure for development.

- Sensitive or unique habitat or natural resources in the watershed are threatened because of urban development, such as the Oak Openings Region (Refer to TMACOG Areawide Water Quality Management Plan, **Chapter 3** "Environmental Policies" — Section on "Policy and Goal Statements" for more information).

Watershed Impairments Resulting from Urban Causes and Sources

The Ohio EPA 2010 Integrated Water Quality Monitoring and Assessment Report contains information about the causes and sources of water quality impairments in the TMACOG 208 region watersheds (Ohio EPA, 2010). This data can be used for watershed-based planning efforts because it identifies areas that are impaired because of a certain activity or pollutant. Figures 8-5 through 8-9 highlight the sources of impairment that are typically related to urban activities or stormwater runoff. It is recommended that communities target these sources in impaired watersheds for planning efforts and apply related stormwater best management practices (BMPs) to help remedy the impairment.

Figure 8-10 shows watersheds that drain high growth jurisdictions (defined in this Plan as jurisdictions with greater than five percent population) and have at least one source or cause of impairment that is related to urban stormwater runoff. The watersheds shown in blue are the critical urbanizing watersheds with two or more stormwater-related impairments.

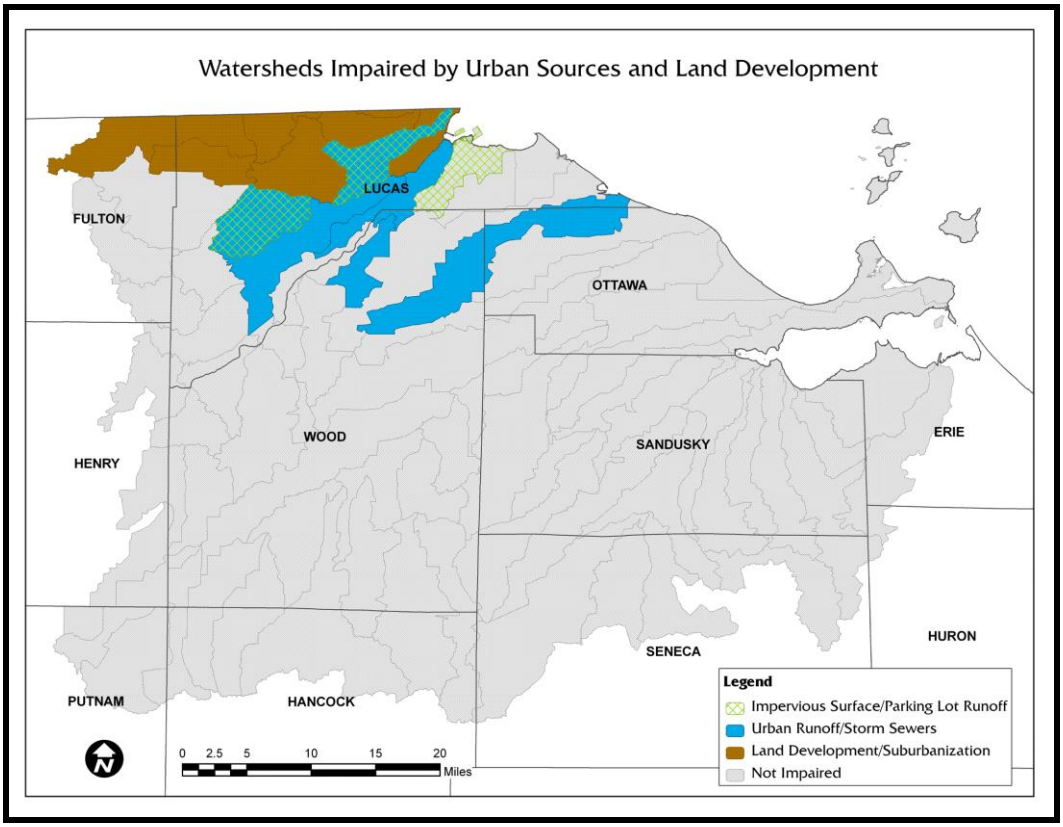

Figure 8-5: Watersheds Impaired by Urban Sources and Land Development

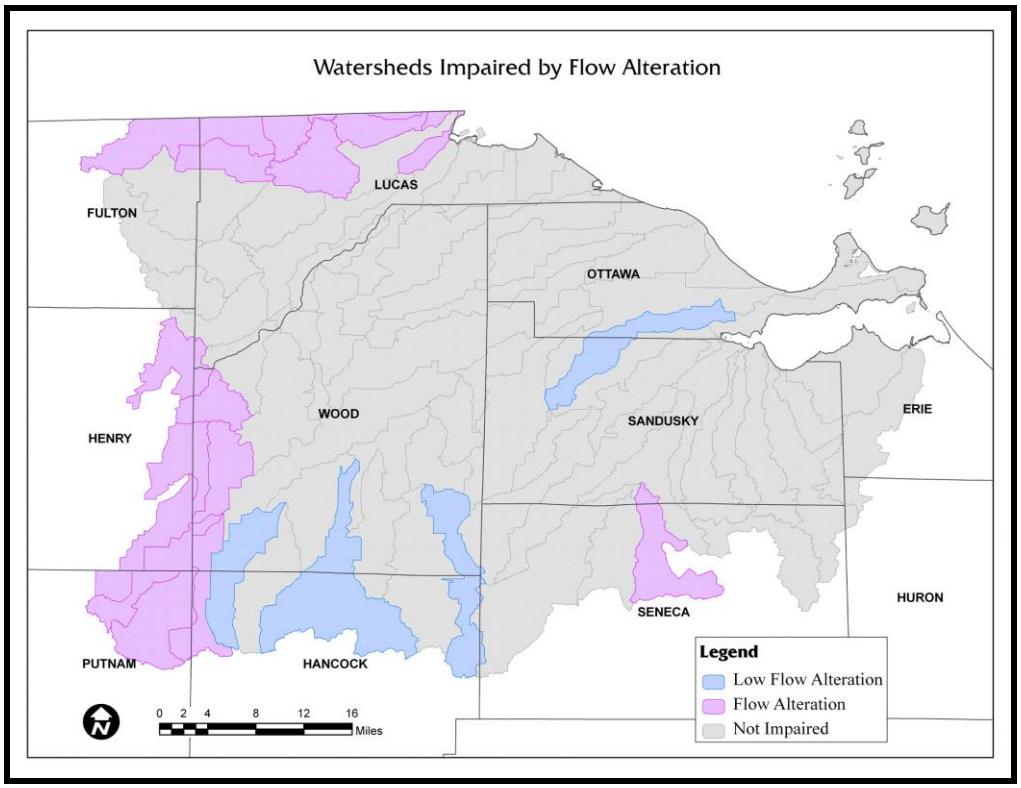

Figure 8-6: Watersheds Impaired by Flow Alteration

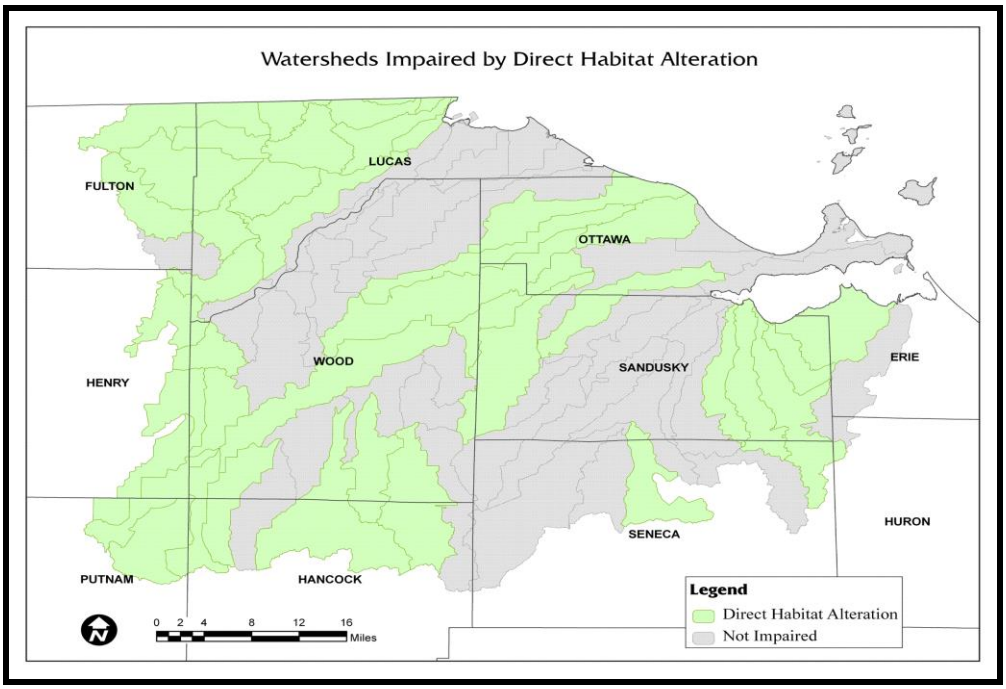

Figure 8-7: Watersheds Impaired by Direct Habitat

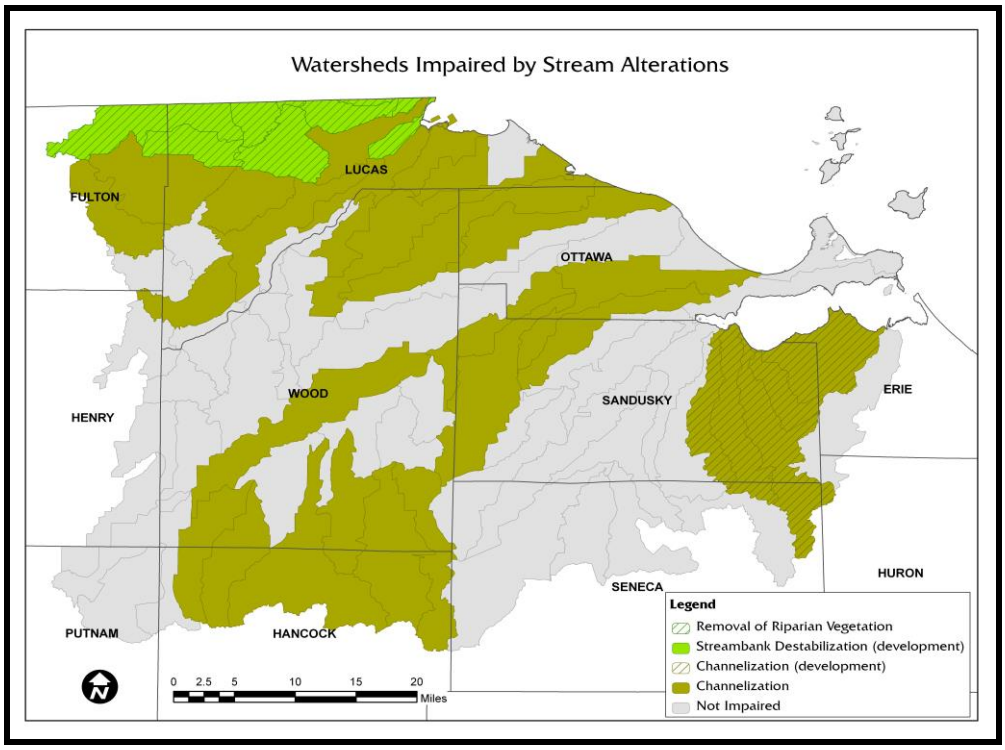

Figure 8-8: Watersheds Impaired by Stream Alterations

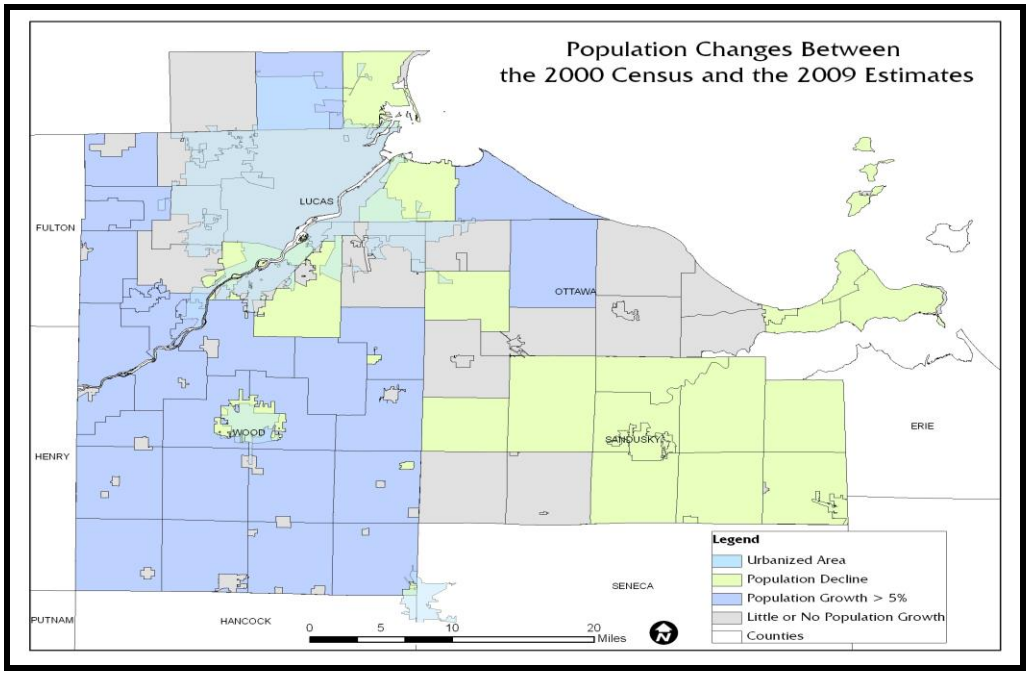

Figure 8-9: Population Changes 2000-2009

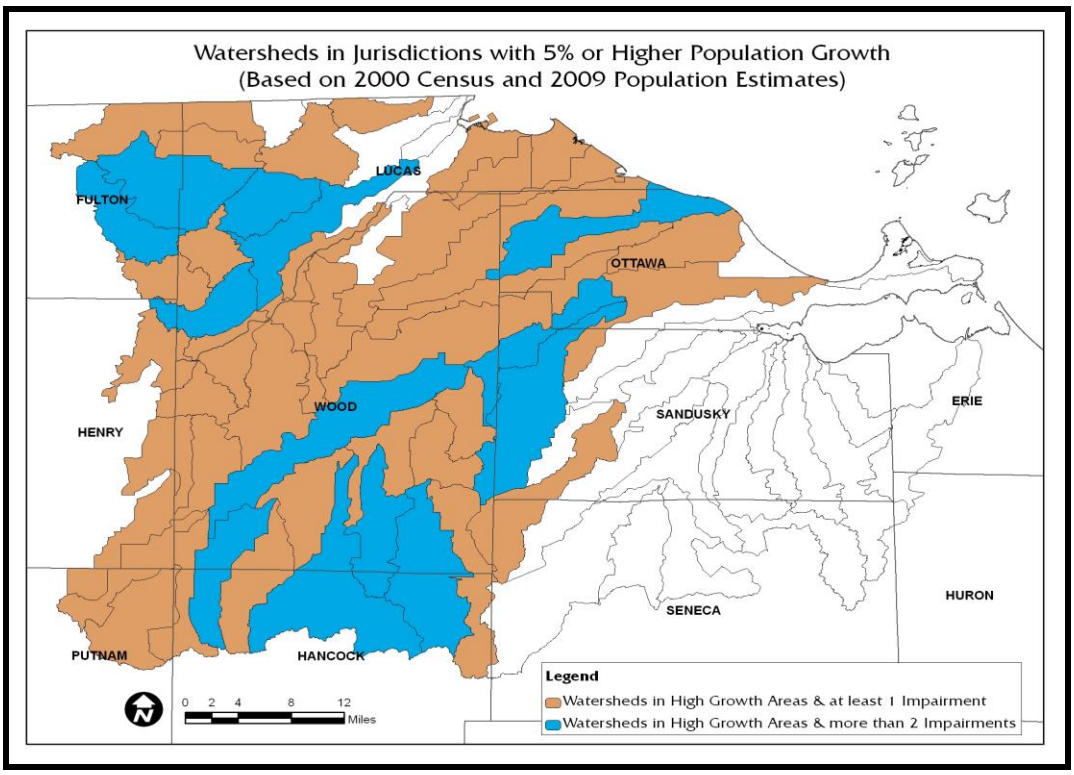

Figure 8-10: Critical Urbanizing Watersheds

V. Stormwater Regulations & Policies

There are two different types of laws that help control urban runoff: one focusing on urban point sources and the other focusing on urban nonpoint sources. The National Pollution Discharge Elimination System (NPDES) permit program of the Federal CWA, which regulates stormwater discharges, addresses urban point source pollution. Nonpoint source management programs under Section 319 of the CWA cover urban nonpoint source pollution. The Total Maximum Daily Load (TMDL) program deals with both point and nonpoint sources of pollution in watersheds with degraded water quality. In the Lake Erie coastal zones, programs to protect coastal waters from nonpoint source pollution also are required by section 6217 of the Coastal Zone Act Reauthorization Amendments.

National Pollution Discharge Elimination System Stormwater Program

The CWA prohibits the discharge of any pollutant to waters of the U.S. from a point source unless the discharge is authorized by an NPDES permit. The NPDES permitting program is designed to track point sources, monitor the discharge of pollutants from specific sources to surface waters, and require the implementation of the controls necessary to minimize the discharge of pollutants. Initial efforts to improve water quality under the NPDES program primarily focused on reducing pollutants in industrial process wastewater and discharges from municipal sewage treatment plants.

As pollution control measures for point sources were implemented and refined, studies showed that more diffuse sources of water pollution were also significant causes of water quality impairment, specifically, stormwater runoff draining from large surface areas, such as urbanized land. In 1987, the

CWA was again amended by Congress to require implementation of a comprehensive national program for addressing problematic non-agricultural sources of stormwater discharges. As required by the amended Act, the NPDES Stormwater Program has been implemented in two phases. Phase I requires NPDES permits for stormwater discharges from:

- Ten categories of industrial activity.
- Construction activity disturbing five acres of land or greater, and
- "Medium" and "large" municipal separate storm sewer systems (MS4s) serving populations of 100,000 or greater,

The 1999 Phase II of NPDES expanded stormwater permitting by requiring additional MS4 operators and operators of small construction sites to control stormwater pollution through the NPDES program.

Regulated entities under both Phase I and Phase II must obtain coverage under an NPDES stormwater permit and implement stormwater pollution prevention plans (SWPPPs) and stormwater management programs (SWMPs), using BMPs, which effectively reduce or prevent the discharge of pollutants into receiving waters.

To implement the NPDES program U.S. EPA published initial permit application requirements in the *Federal Register* on November 16, 1990. As NPDES delegated states, Ohio EPA and Michigan EGLE implement the federal stormwater program. Ohio and Michigan have different regulatory authorities for NPDES programs.

NPDES Industrial Permitting

To minimize the impact of stormwater discharges from industrial facilities, the NPDES program includes an industrial stormwater permitting component that covers 10 categories of industrial activity that require authorization under an NPDES industrial stormwater permit for stormwater discharges. This coverage is also provided by the local permitting authority (Ohio EPA or Michigan EGLE).

NPDES Permitting for Construction

Initial permit coverage for construction activities included those sites that disturbed greater than five acres of land. With Phase II of the NPDES permit, the U.S. EPA expanded construction site permit coverage to include small construction sites that result in a land disturbance between 1.0 and 5.0 acres or sites smaller than 1.0 acre that are part of a larger plan of development that will result in a total disturbance of 1-5 acres. Operators of small construction activities may obtain waivers from coverage, which can only be issued by the permitting authority if operators can certify low predicted rainfall potential using the approved method (U.S. EPA, 2012a) or the permitting authority determines that that stormwater controls are not necessary based on existing water quality conditions (U.S. EPA, 2005).

In 2004, the 125th Ohio General Assembly passed HB 411, adopting changes to Ohio Revised Code (ORC) §307.79, to abate soil erosion and water pollution caused by land development. This legislation provided counties with enforcement powers for Phase II of the Stormwater Permits consistent with Ohio EPA rules. The rules require sediment control plans before developing sites disturbing one or more acre of land and give jurisdiction's authority to impose a filing fee for plan review. The TMACOG

Stormwater Management Standards Manual outlines specific requirements for a site plan and the review process (TMACOG, 2008).

Construction activities meeting above criteria are required to manage stormwater and prevent pollution onsite. Some of these requirements include sediment and erosion controls, controls for runoff volume and velocity, minimizing soil exposure during construction, stabilizing disturbed soils, removing sediment from stormwater discharges, preventing discharges of waste materials, and providing stream buffers (Ohio EPA, 2013).

NPDES Permitting for MS4: Phase I

At the local level, the City of Toledo is the only entity in the TMACOG planning area that is affected by the MS4 portion of the Phase I rule. Toledo was issued an NPDES permit for its MS4 discharges, first effective on September 1, 1997. The permit needs to be renewed every five years. Ohio EPA and the City of Toledo work cooperatively to implement the requirements of the City's NPDES stormwater permit. These requirements include:

- Establishing the City's legal authority to control discharges to and from the City of Toledo MS4.
- Developing and implementing a SWMP to reduce the discharge of pollutants and protect water quality per the requirements of the ORC 6111 and the CWA. The SWMP is divided into six program areas called minimum control measures (MCMs):
    1. Public Education and Outreach on Stormwater Impacts
    2. Public Involvement and Participation
    3. Illicit Discharge Detection and Elimination
    4. Construction Site Stormwater Runoff Control
    5. Post-Construction Storm Water Management in New Development and Redevelopment
- Pollution Prevention/Good Housekeeping for Municipal Operations
  Achieve the objectives in the City's SWMP through implementation of stormwater BMPs aimed at addressing specific water quality impairments in the City's watersheds.

NPDES Permitting for MS4s: Phase II

In 1999, Phase II of the NPDES program expanded stormwater permitting requirements to operators for small MS4s, which are those serving populations of less than 100,000. Small MS4s can be designated for NPDES permitting in one of three ways. The first is "Automatic Nationwide Designation", which requires coverage for all owners and operators of small MS4s within Urbanized Areas as identified by the most recent decennial U.S. Census. The second method requires local permitting authorities (Ohio EPA and Michigan EGLE) to designate additional MS4s outside of the Urbanize Area if they are significant contributors of pollutants, are densely populated, are contiguous to a highly populated area, or exhibit high growth potential. This local designation applies specifically to small MS4s serving a population of at least 10,000 with a population density of at least 1,000 persons per square mile. These communities are referred to as "Appendix 7" communities in

reference to Appendix 7 to the Preamble of the Phase II Rule. The third method of Phase II designation requires local permitting authorities to designate any small MS4 outside of the Urbanized Area that directly discharges to a regulated MS4.

Operators of automatically designated small MS4s may obtain waivers from coverage if their discharges meet criteria under two options. The first option allows for a waiver in cases where 1) an MS4 serve less than 1,000 people, 2) the system does not contribute significantly to a regulated system, and 3) stormwater controls are not needed based on waste load allocations identified in a TMDL (discussed in more detail in next section) study. The second option allows an exception in cases where 1) the MS4 serves fewer than 10,000 people, 2) an evaluation of all waters of the U.S. that receive a discharge from the system shows that stormwater controls are not needed based on waste load allocations identified in a TMDL, and 3) it is determined that future discharges from the small MS4 do not have the potential to result in exceedances of water quality standards. Waivers must be reviewed by the permitting agency a minimum of every five years (U.S. EPA, 2012b).

According to NPDES permits, MS4s must develop stormwater management programs that go beyond maintaining systems of curbs, gutters, pipes, and detention basins. Operators of Phase II MS4s are required to apply for NPDES permit coverage and implement "Six Minimum Control Measures" similar to those listed above for Phase I MS4s. Phase II permittees are required to address the abovementioned minimum control measures with BMPs aimed at addressing pollutants of concern and water quality impairments as defined in a TMDL report for each watershed in an MS4. While the Minimum Control Measures remain the same between the Phase I and Phase II permittees, methods for implementation and level of responsibility is different between the two types of MS4 NPDES permit.

About 280 jurisdictions located in urbanized areas that operate an MS4 are included in the State of Ohio program. Table 8-4 identifies MS4s in the 208 region that are required to obtain NPDES permits as of 2015 based on 2010 Urban Area boundaries. Figure 8-11 shows the jurisdictions in the 208 region that are subject to NPDES stormwater permits. After Ohio EPA's review of the expanded urbanized area, new permittees will be notified of coverage by Ohio EPA sometime in 2015.

Stormwater permits are required for MS4s, but the management practices for Phase I and II communities are applicable and encouraged in non-regulated MS4s as well. The six minimum control measures (Public Education and Outreach, Public Involvement/Participation, Illicit Discharge Detection and Elimination, Construction or Post-Construction Runoff Controls, and Pollution Prevention/Good Housekeeping) can be met using applicable BMPs. These measures can be found in more detail within their respective chapters of the TMACOG *Stormwater Management Standards Manual* (TMACOG, 2008). In the appendix, the manual contains model ordinances/resolutions for those that are required by stormwater permits, which are also applicable for non-MS4s.

Table 8-4: Designated Stormwater NPDES Communities

Separate Permits – Municipalities	Joint Permit Holders – Co-permittees
Lucas County, OH	
City of Toledo (under Phase I)	Lucas County
City of Oregon	Jerusalem Township
City of Sylvania	Monclova Township
City of Maumee	Spencer Township
City of Waterville	Springfield Township
Village of Ottawa Hills	Swanton Township
Village of Whitehouse	Sylvania Township
Village of Swanton (Partially in Lucas County)	Washington Township
	Waterville Township
	Village of Holland
Wood County, OH	
Bowling Green	Wood County
Fostoria (Partially in Wood County)	Lake Township
Northwood	Perrysburg Township
Perrysburg	Middleton Township
Rossford	Troy Township
Millbury	
Walbridge	
Ottawa County, OH	
	Ottawa County
	Allen Township
	Clay Township
Sandusky County, OH	
City of Fremont	
Monroe County, MI	
Monroe County Drain Commission	
Bedford Township	
Erie Township	
Non-Traditional MS4s	
Ohio Department of Transportation, Ohio Turnpike, Michigan Department of Transportation	
University of Toledo Main Campus, Health Science & Scott Park Campuses	

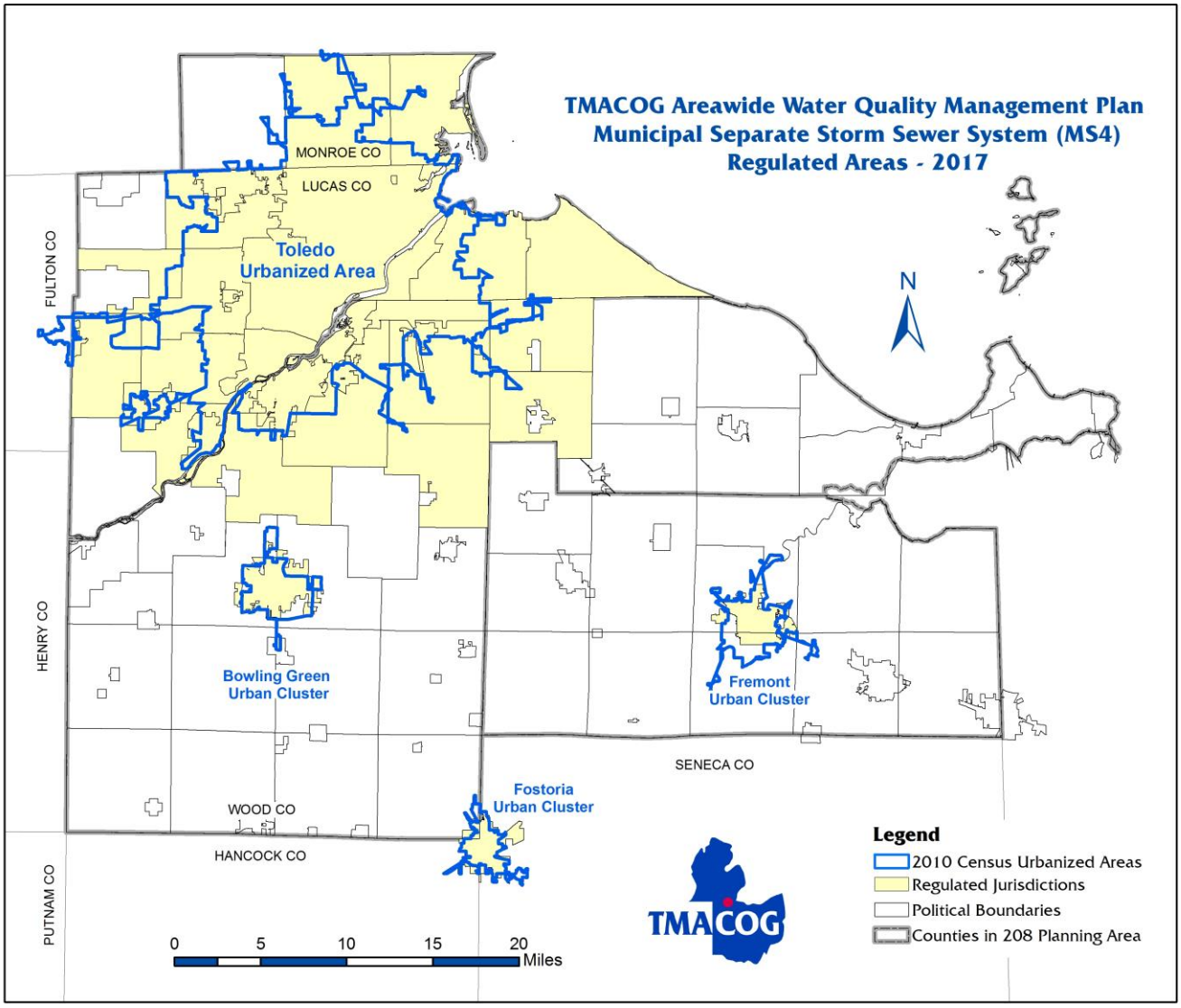

Figure 8-11: MS4 Jurisdictions in the TMACOG Region

VI. Programs, Governments, and Agencies

Total Maximum Daily Load Program

Under the Federal CWA, every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the goal of "swimmable/fishable" waters. Ohio EPA and Michigan EGLE have assigned a specific set of water quality standards to most major streams and rivers throughout the states, which are based on the waterway's ability to support "beneficial uses". Beneficial use designations describe existing or potential uses of water bodies. They take into consideration the use and value of water for public water supplies, protection and propagation of aquatic life, recreation in and on the water, agricultural, industrial and other purposes (see **Chapter 2**). Examples of beneficial use designations include: public water supply, primary contact recreation, and aquatic life uses (warm water habitat, exceptional warm water habitat, etc.)

To determine a stream's attainment, Ohio EPA samples multiple chemical, physical, and biological measures. The biological parameters are emphasized because resident organisms are good indicators of water quality and potential for recreational opportunities and other beneficial uses. If analyses indicate an impairment of water quality standards and technology-based controls are inadequate, Section 303(d) of the CWA establishes the TMDL process to achieve state water quality standards. Each state is required to submit a prioritized list of impaired waters to U.S. EPA for approval (the "303(d) list"). These impaired waters are listed in Integrated Water Quality Assessment Reports, which can be found on the Ohio EPA and Michigan EGLE websites. A TMDL must be developed for each of the impaired waters.

A TMDL is a written, quantitative assessment of water quality problems and contributing sources. It is a watershed approach to quantifying and reducing both point and nonpoint sources of pollution to impaired waterbodies. Ohio EPA's TMDLs establish allowable loadings (both point and nonpoint source) necessary to meet water quality standards in each watershed. TMDLs specify the amount a pollutant needs to be reduced to meet water quality standards, allocate pollutant load reductions for both point and non-point sources, and provides the basis for taking actions needed to restore a body of water. In urbanized watersheds, reductions in urban runoff pollution will be a significant part of meeting the TMDL allowable loadings. Recent TMDLs for watersheds in the TMACOG region define wasteload allocations for specific permitted small MS4s. However, the state has not yet developed a process for enforcement through the NPDES permit.

Like Ohio, Michigan EGLE prepares a TMDL for each waterbody not meeting Water Quality Standards (WQS). WQS are state rules established to protect the Great Lakes, the connecting waters, and all other surface waters of the state. These rules define the water quality goals for a lake or stream. The goals are in three areas:

- Uses of the lake or stream
- Safe levels to protect the uses
- Procedures to protect high quality waters

Non-Point Source Management Program

Congress amended the CWA in 1987 to establish the Section 319 Non-point Source (NPS) Management Program because it recognized the need for greater federal leadership to help focus state and local NPS efforts. Under section 319, Ohio and Michigan receive grant money which support a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific non-point source implementation projects.

Both states manage significant non-point source grant programs designed to provide financial assistance to local watershed groups; Ohio EPA and the Michigan EGLE are the two agencies responsible for managing the states' NPS programs. The grant programs emphasize education, technical assistance, financial incentives, and voluntary actions as opposed to regulatory mandates or permits. The programs rely heavily on watershed management plans to address water quality problems. These plans emphasize: identification of the nature, extent, and cause of water quality problems; development of an implementation plan; implementation of BMPs; education and evaluation.

Wetlands Protection Programs

Permits are required for the discharge of dredged or fill material into waters of the U.S., except as provided in 33 Code of Federal Regulations (CFR) Section 323.4. Requirements for preventing and mitigating irreversible impacts to jurisdictional wetlands are imposed through various legislation and regulations:

- Section 404 of the CWA administered by the U.S. Army Corps of Engineers (USACE)
- Council of Environmental Quality (CEQ) regulations and guidelines implemented through the National Environmental Policy Act (NEPA)
- Executive Order 11990, "Protection of Wetlands"
- EPA guidelines at Section 404(b)(1) and their regulations
- Michigan's wetland statute, Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451
- State Water Quality Certification through Section 401(a) of the CWA
- Ohio Administrative Code Chapter 3745-32
- Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

A federal Section 404 permit cannot be issued by the USACE unless the Ohio EPA or Michigan EGLE issues a Section 401 Water Quality Certification. If Ohio EPA or Michigan EGLE issues a Section 401 Certification for the project, the conditions become requirements of the federal permit. If Ohio EPA or Michigan EGLE denies the Section 401 Certification, the USACE must deny the Section 404 permit without prejudice.

In 1984, Michigan received authorization from the federal government to administer Section 404 of

the CWA in most areas of the state. The Michigan 404 program must be consistent with the requirements of the CWA and associated regulations set forth in the Section 404(b)(1) guidelines. Whereas in Ohio, where an applicant must apply to the USACE and a state agency for wetland permits, applicants in Michigan generally submit only one wetland permit application to the Michigan EGLE.

Floodplain/Floodway Protection Programs

In 1968, Congress created the National Flood Insurance Program (NFIP) in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods. The NFIP makes federally backed flood insurance available in communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage. The Federal Emergency Management Agency's (FEMA) Federal Insurance Administration and Mitigation manages the NFIP. FEMA produced a Frequently Asked Questions booklet, *Answers to Questions about NFIP*, for those with additional questions regarding the flood insurance program. For information about floodplain/floodway protection, in general, consult the TMACOG *Stormwater Management Standards Manual* (TMACOG, 2008).

Coastal Non-Point Pollution Control Program

In 1990, Congress passed the Coastal Zone Act Reauthorization Amendments (CZARA) to tackle the nonpoint source pollution problem in coastal waters. Section 6217 of CZARA required Ohio and Michigan to develop a Coastal Nonpoint Pollution Control Program Plan. The states' plans must conform to the 56 management measures in six categories described in U.S. EPA's *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. Urban Runoff (stormwater) is one of the six categories that must be addressed. If these original management measures fail to produce the necessary coastal water quality improvements, the states then must implement additional management measures to address remaining water quality problems.

Ohio Coastal Non-Point Pollution Control Program

Ohio's plan is based upon and expands the existing statewide Ohio Nonpoint Source Management Program. The responsibility for management of the non-point source control program is networked between Ohio Department of Natural Resources (ODNR) and Ohio EPA. The Division of Real Estate and Land Management (RELM) within ODNR has the lead for implementing the Ohio Coastal Management Plan (OCMP).

Michigan Coastal Non-Point Pollution Control Program

In Michigan, the Great Lakes Shorelands Section in the Land and Water Management Division (LWMD) of the Michigan EGLE administers the program. The program includes local pass through grants, administration of coastal related sections of the Natural Resource and Environmental Protection Act, 1994 PA 451, and review of federal agency activities for consistency with Michigan's approved program.

Ohio Department of Natural Resources

ODNR was granted the legal authority to coordinate urban water pollution abatement efforts through Ohio Revised Code Chapters (ORC) 1501, 1511 and 1515. ODNR is also the lead agency for development of the Ohio Coastal Nonpoint Pollution Control Program Plan.

Areawide Water Quality Management Planning

The *Areawide Water Quality Management Plan* (AWQMP) is a regional document mandated by Congress under Section 208 of the Clean Water Act. Overall, the "208 Plan" is a statement of how Northwest Ohio and Southeast Michigan will restore our waterways to "fishable and swimmable" conditions. TMACOG is responsible for updating and maintaining this plan for four Counties in Ohio (Lucas, Wood, Ottawa, and Sandusky) and the southern three Townships in Monroe County, Michigan (Whiteford, Bedford, and Erie). Ohio EPA and Michigan EGLE use this plan in reviewing and approving permit applications.

County Governments (Ohio)

Ohio Counties must design their stormwater management programs to satisfy applicable CWA water quality requirements and technology County governments in Ohio are responsible for implementation of the Ohio drainage laws. Counties may construct and maintain stormwater infrastructure including "gray infrastructure" drainage facilities (i.e. storm sewers, mains, ditches) and "green infrastructure". These green stormwater practices, called "prevention and replacement facilities" in ORC Chapter 6117, include vegetated swales, permeable pavement, trees, vegetated roofs, and other practices that use or mimic natural processes to filter or reuse stormwater. Counties may enter into inter-local agreements to perform construction and maintenance functions for any municipal corporation or special district. Under the NPDES MS4 permit, counties must adopt resolutions or rules for sediment and erosion control during construction and must also establish legal authority to prohibit, detect, and eliminate illicit discharges to MS4.

Boards of County Commissioners in Ohio are authorized to construct and maintain storm sewer systems through the establishment of sewer districts, as outlined in ORC Chapter 6117. House Bill 549, signed on December 8, 2000, modified the Sewer Districts and County Sewers Law (ORC Chapter 6117) relative to the procedures for the acquisition, construction, maintenance, and operation of various facilities and other improvements and the procedures for financing the various improvements. Prior to the Bill, ORC 6117 only gave districts the authority to establish sanitary sewer and water utilities. HB 549 enabled legislation that explicitly gave the County Commissioners and the County Engineer the authority to establish utilities for the management and maintenance of stormwater systems.

Stormwater utilities are an innovative approach to finance and manage stormwater. A stormwater utility operates similarly to water and sewer utilities, which are financed through user fees and administered separately from the general tax fund. Among counties in the TMACOG planning area, Lucas County is the only one that uses a stormwater utility to fund storm system improvements and implement NPDES requirements. The utility is assessed on all residential, commercial, and industrial properties with discounts given to non-residential landowners for onsite stormwater treatment and green infrastructure.

Currently, the level of stormwater management program implementation varies considerably from one county to another and is done through a combination of subdivision regulations and county resolutions. The major focus of the County Engineer continues to be on drainage with an increasing emphasis on overall stormwater program management per the requirements of the NPDES permit.

Three of the four Ohio county governments in the TMACOG "208" region are identified by the NPDES Phase II Rules as operators of regulated small MS4s. As the primary permit holders of joint permits, these counties are responsible for implementing stormwater programs and practices for all townships and certain municipalities within the urbanized portions of each respective county. Under joint permits, several jurisdictions can apply for NPDES coverage under one permit. Each "co-permittee" must sign a memorandum of understanding stating the responsibilities of each jurisdiction in meeting permit requirements and the role of the County in coordinating stormwater management and planning. Major responsibilities under the NPDES permit for each county include construction plan review and inspection, providing stormwater education and participation opportunities for the public, detecting and eliminating illicit discharges into MS4s, maintaining map data of the entire storm sewer and drainage system, and maintenance of gray and green infrastructure.

County Government (Michigan)

Michigan Counties must design their stormwater management programs to satisfy applicable CWA water quality requirements. In the TMACOG 208 area, the Monroe County Drain Commission is identified by the NPDES Phase II Rules as an operator of a small MS4. While permits were issued separately to Monroe County and selected townships, the jurisdictions tend to work together on several permit requirements, with the Monroe County Drain Commission taking a lead role.

As with any other small MS4 within an urbanized area, Michigan Counties are required to implement programs and practices to control polluted stormwater runoff. In Monroe County, the Board of Commissioners assigned the Drain Commissioner the responsibility to enforce the State of Michigan's Soil Erosion and Sedimentation Control Act. This authority does not extend to cities, villages, or charter townships that have erosion and sediment control ordinances in effect. Under provisions of the Subdivision Control Act, the County Drain Commissioner is required to review subdivision plats involving five or more parcels, to ensure that adequate stormwater facilities are included.

The County Drain Commissioner, through the Michigan Drain Code, carries out the majority of stormwater drainage improvements in Monroe County. The Drain Commissioner has responsibility for all aspects of the construction and maintenance of drainage facilities in the County and has the assessment authority to fund these projects.

Municipal and Township Governments (Ohio)

The ORC grants municipal corporations in Ohio the statutory authority to construct, own, and operate sewers, drains, and ditches for the collection and conveyance of urban stormwater runoff. They are authorized to establish drainage districts for the purpose of constructing, maintaining, repairing, cleaning, and enclosing ditches. The ORC enables municipalities to adopt ordinances or rules for urban sediment control. NPDES permittees are required to adopt ordinances that control runoff from

construction sites, ensure that new and redevelopment treats and manages runoff using stormwater BMPs, require that property owners maintain BMPs, and prohibit illicit discharges into the MS4.

Municipalities possess more extensive land use powers than counties, such as zoning and subdivision control. These powers, together with their power of eminent domain, extend to the regulation of construction site runoff and other non-point source pollution. Municipalities are not bound by the Ohio Drainage Laws, and may construct and expand drainage facilities without being constrained by the petition process. In these ways, municipalities hold advantages over unincorporated areas in the control of urban runoff.

Funding mechanisms for municipal level urban stormwater management are similar to those of counties with a notable addition. Municipalities have the authority to acquire, construct, own, lease, and operate within or without its corporate limits, any public utility the product or service of which is or is to be supplied to the municipality or its inhabitants. Generally, a municipality enacts two ordinances to create a stormwater utility: one to establish the various components of the utility, and the other to determine the rate structure. Forming the utility through two separate ordinances allows the municipality to alter the rate structure without having to modify the ordinance governing the utility structure.

Municipal and Township Governments (Michigan)

Municipalities in Michigan are authorized to provide public services and make necessary improvements, including storm sewers to drain urban runoff. These entities may also administer and enforce ordinances to control erosion and sedimentation, wetlands, subdivision activity, and land use. Municipalities may elect to administer and enforce erosion and sediment control ordinances pursuant to the Soil Erosion and Sediment Control Act. The County Drain Commissioner governs all general law townships and all municipalities who choose not to administer such ordinances. Local governments are also authorized to adopt wetland protection ordinances.

Michigan municipalities may adopt subdivision control ordinances that require subdivision plats to be reviewed and approved in accordance with a stormwater management. While a drainage review is not specifically required, local governments can consider stormwater management when they review subdivision plats. Similar to Ohio, municipalities in Michigan also have broad authority to adopt zoning ordinances to regulate land use within their jurisdictions, and may require land owners to submit a site plan as part of a rezoning approval. Site plan review requirements provide a legal basis for stormwater management review of proposed developments other than subdivisions.

In the Michigan portion of the TMACOG 208 area, Bedford Township, and Erie Township are identified by the NPDES Phase II Regulations as operators of regulated small MS4s. Operators of small MS4s within urbanized areas are required to implement programs and practices to control polluted stormwater runoff, described above under stormwater NPDES permit program.

VII. Areawide Stormwater Initiatives

TMACOG Stormwater Coalition

The Stormwater Coalition (SWC) is a forum of regulated MS4 jurisdictions in the TMACOG region working to meet MS4 permit requirements. The group works closely with health departments, engineers, soil and water conservation districts (SWCDs), planning commissions, private sector consultants, and other groups. TMACOG staff provides direct support to members of the Stormwater Coalition through, regional coordination and education and training programs that fulfill permit requirements. The group produced the *TMACOG Stormwater Standards Manual* to guide TMACOG area MS4s in NPDES permit implementation (TMACOG, 2008).

The Toledo-Lucas County Region Green Stormwater Infrastructure Task Force

The Green Stormwater Infrastructure Task Force was formed to promote and support the installation of green infrastructure in Northwest Ohio. The group is a collaboration of public and private sector stakeholders working to influence GI implementation through design standards, stormwater codes and ordinances, and public education and outreach.

The Toledo-Lucas County Rain Garden Initiative

The Rain Garden Initiative (RGI) promotes rain gardens as a method of natural on-site stormwater management to homeowners, developers, nurseries and landscapers, business owners, and governmental agencies. RGI assistance includes providing demonstration gardens, technical training, and public information and involvement opportunities. This collaborative effort launched in 2006 with the support of Congresswoman Marcy Kaptur.

Problem Identification

According to the Ohio EPA Integrated Report, about 68% of TMACOG's 208 region streams are identified as impaired for aquatic use and only about 5% are in attainment. Stormwater and urban runoff are major sources of water quality impairments in many of the regions watersheds. The beneficial use status of the watersheds in the TMACOG 208 area can be found in **Chapter 2** of this Plan. The Ohio EPA Integrated Water Quality Monitoring and Assessment Report details beneficial uses, goals, and on-going monitoring.

The following sections explain issues at the institutional level that have contributed to the stormwater problems in the TMACOG region. Many of these issues are not unique to our region as they typify problems with urbanization and land use across the nation. Each section is followed by recommended actions that stormwater managers and decision-makers can take to improve water quality in the TMACOG region.

Insufficient Watershed-Based Stormwater Planning

To control current and future stormwater runoff adequately, stormwater management needs to be looked at from a watershed perspective. Much of the control of stormwater occurs separately within each community through a variety of subdivision regulations and other ordinances. Maintenance of ditches, storm sewers, and drainage systems is largely the responsibility of a county engineer, drain commissioner, or individual municipality. However, stormwater runoff does not obey political boundaries, and several drainage systems within the region flow through more than one community.

Without some type of agreement and coordination between communities to take care of their common drainage systems jointly, there is no guarantee that the natural watershed system will work to provide adequate drainage and water quality. A regional master plan for stormwater drainage is necessary to establish the guidelines for maintaining and improving the existing facilities, as well as providing for future development. A watershed level stormwater master plan will aid in the orderly development of new drainage facilities, water quality practices, and capital improvements. The improvements outlined in a master plan should be based on land use, proposed land use, and current land use trends in each watershed.

Recommended Actions: Coordinate a Regional Stormwater Planning Effort

Each community should bring stormwater management issues into the land use planning process at the local and county planning commission level. The protection of wetlands, floodplains, and sensitive riparian corridors should be addressed in order to ensure the stormwater impacts of development are considered. Master stormwater drainage plans should be completed at the watershed level to aid in the orderly development of new stormwater facilities and capital improvements across the region.

A regional organization should be formed to build master plans and capital improvements that cover regional streams and ditch systems that serve two or more communities. A region-wide master plan should be developed based on existing jurisdictional or watershed master plans. To ensure that plans meet each watershed's water quality goals, the Ohio EPA Integrated Water Quality Report should be considered for guidance on implementing BMP based on causes and sources of impairment.

TMACOG's SWC is a group of NPDES permitted jurisdictions that have organized around a goal of collaboratively meeting NPDES permit requirements. SWC was formed through the process of planning for a regional stormwater management district. While the formation of a regional stormwater district was not successful, many elements from the original effort can be used to form a regional plan as described above. For information on the originally proposed regional stormwater management district, see Appendix B "Plan of Operation for a Regional Stormwater Management District in the Lower Maumee River Watershed."

Land Use Decisions

Past development patterns, lack of comprehensive planning, and poor land use decisions have resulted in sprawling suburban landscapes, increased costs for the construction and maintenance of infrastructure, and increased stormwater runoff and associated water quality impairments.

Stormwater does not obey political boundaries, so a cross-jurisdictional, watershed-based planning philosophy is necessary. However, the planning process is complicated by the fact that responsibility for stormwater management is fragmented between several levels of government and is organized around political boundaries. Many communities have failed to regulate implement stormwater policies for development for fear of driving economic development to neighboring jurisdictions. Comprehensive land use planning at the level of each jurisdiction as well as at the regional scale is often overlooked, but is an essential element of any stormwater management program. Challenges to comprehensive watershed-based planning include lack of watershed-based stormwater management, a lack of stormwater considerations in zoning and inconsistent or inadequate standards for stormwater management across jurisdictional lines.

Recommended Action: Develop a Regional Land Use Plan

A comprehensive and collaborative land use plan is needed to prioritize areas for development, conservation, and redevelopment for the TMACOG region. Available tools such as zoning overlay districts, and conservation development should be used while providing for equitable economic development across the region. With a collaborative cross-jurisdictional approach, the region can plan development that emphasizes each community's unique sense of place and culture, while protecting and enhancing natural areas that are vital for stormwater management and water quality in our region.

Recommended Action: Update Zoning to Improve Stormwater Management

Zoning is a powerful tool in the land use planning process and is available to most communities. In many cases, however, zoning elements such as minimum lot sizes, requirements for oversized streets and parking lots, and storm sewer connection requirements have hindered the ability of communities to plan for conservation development and implement green infrastructure.

Jurisdictions in the TMACOG region should perform a review of their local codes against a checklist to ensure good storm water best management practices and green infrastructure are encouraged and allowed by local rules and regulations. Funds and technical support should be made available at state and federal levels to support local implementation of comprehensive code review

In addition, watershed conditions must be considered in land use decisions. Watershed based zoning involves defining watershed conditions, measuring current and potential future development, identifying and classifying sub-watersheds based on the amount of future development, and most importantly, modifying master plans and zoning to shift the location and density of future development to appropriate sub-watershed management categories.

Recommended Action: Plan for Conservation Development

Conservation development is an urban and suburban design technique that concentrates buildings in a compact area in one portion of a development site in exchange for providing

open space elsewhere on the site. This type of design, including residential "cluster development" or mixed-use "planned unit development", can be applied to both newly developed areas and redevelopment. Minimum lot sizes, setbacks, and frontage distances are relaxed to form larger areas of open space. Conservation site designs have many benefits compared to conventional developments. They can reduce impervious cover, stormwater pollutants, construction costs, infrastructure installation and maintenance costs, grading, and the loss of natural areas. In exchange for denser development in one area, the community enjoys larger shared open spaces and natural areas. However, many barriers to conservation development exist in the TMACOG region due to dated zoning codes and misperceptions among decision-makers and residents. Many communities in the region will need to revise zoning codes to allow for conservation development to achieve greater water quality, economic, and social benefits.

The benefits of neighborhood designs that preserve open space can be amplified when combined with other site design techniques such as narrow streets and alternative turnarounds. This policy involves promoting the use of narrower streets to reduce the amount of impervious cover created by new development, and in turn, reduce the stormwater runoff and associated pollutant loads. Currently, many communities require wide residential streets that are 32, 36, and even 40 feet wide. In most residential settings, streets can be as narrow as 22 to 26 feet wide without sacrificing emergency access, on-street parking, or vehicular and pedestrian safety.

Residential street design requires a careful balancing of many competing objectives: design, speed, traffic volume, emergency access, parking, and safety, to name a few. Communities that want to change their road standards to permit narrower streets need to involve all the stakeholders who influence street design in the revision process.

Recommended Action: Provide Training

Jurisdictions in the TMACOG planning area should require developers and plan commission members to attain a yearly minimum number of training hours in the areas of regional planning and the importance of integrating stormwater planning within economic development. This will help to ensure well-informed zoning and code decisions and encourage neighborhood designs that are economically, environmentally, and socially beneficial. Local and regional planning agencies should work with homebuilder and realtor associations to develop regular training programs.

Destruction of Wetlands and Floodplains

Wetlands provide a natural way to manage and store stormwater and protect water quality. The TMACOG region has a rich heritage of extensive wetland areas. Historically, the Great Black Swamp and the closely connected Oak Openings Region were part of a vast wetland complex that reached from Fort Wayne, Indiana to Sandusky, Ohio. Today over 95% of these vast wetlands are gone, primarily a result of drainage efforts in the late 19th Century and subsequent conversions to other land uses.

Most jurisdictions in the TMACOG region have programs that meet the minimal requirements of the USACE and the FEMA regarding development in wetlands and floodplains. These requirements prohibit filling large wetlands, but allow the filling of isolated wetlands and portions of the floodplain. Additional filling occurs outside of the knowledge of the regulatory agencies, through ignorance of the rules and simple negligence.

Existing federal and state laws currently protect larger, identified wetlands and floodplain areas. However, wetlands are regularly destroyed and floodplains are filled because of a lack of enforcement and inadequacy of records. Wetlands and floodplains are also negatively impacted by adjacent development on unprotected uplands.

Recommended Action: Augment Protection of Wetlands and Floodplain

A variety of options are available to protect wetlands and floodplain areas. Fee acquisition is the most recognized and permanent strategy for protection, although it is also the most expensive. Conservation easements are another option and can be effective in situations where private landowners desire to retain ownership. Easements can be purchased from landowners to protect special resource areas and an adjacent buffer, allowing for the use of the remaining land. Options for donating and conserving special resource areas should be made available to any landowner with wetlands or floodplain areas on their property. Local governments can become involved with conservation efforts by informing property owners about the conservation easement and donation options as well as the tax benefits from these options.

Recommended Action: Look for Wetlands during Site Plan Reviews

The standards local governments use to review site plans should include provisions for reviewing projects for wetland and floodplain impacts. For an example of standards that include these provisions, see the Wetlands Protection chapter of the *Stormwater Management Standards Manual* (TMACOG, 2008). Because of the importance of wetlands in stormwater management, the manual dedicates an entire chapter to natural wetlands protection. Consult the manual for more information on wetland delineation, wetland permits, and considerations for the Oak Openings region.

Recommended Action: Enforce Regulations Locally

The local floodplain administration agencies should work the local and county planning commissions, township and municipal governments and developers to enforce FEMA's floodplain regulations strictly. County, township, and municipal governments should adopt ordinances that advocate no net loss in floodplain storage volumes.

Ohio EPA and Michigan EGLE should work to expand the current protections provided wetlands through Section 404 of the Clean Water, which is administered by the USACE. Efforts should focus on fully implementing existing state and federal wetlands protection laws.

Local governments, soil and water conservation districts, and planning agencies should work to identify, describe, and document wetlands in their jurisdictions. This information should be used to develop wetland inventories and update the USACE wetland maps.

Older Developed Areas

Older, developed areas face infrastructure challenges related to sewer system capacity, maintenance, replacement, and surface runoff. At the same time, many of these areas are faced with declining tax bases, aging infrastructure, and decreasing available revenue to support water quality programs. The high-cost for construction of storage facilities to retain and treat water from combined sewer systems and the separation of sewer systems to address pollution from combined sewer overflows eliminate only the sanitary sewage portion of the urban water pollution equation.

Typically, there are limited urban runoff control practices in use in the older, built-out urban areas that were developed prior to stormwater management regulations. New site drainage design regulations most often only apply to new development and redevelopment. On existing pre-regulation sites, there are few options through the regulatory process to enforce new stormwater detention or quality requirements on these sites. Therefore, the stormwater systems in older cities must be capable of accepting this runoff volume and potential pollutants must be eliminated at their source through on-site controls and green infrastructure. Implementing stormwater controls to retrofit existing sites is more expensive and challenging from an engineering standpoint, so working these improvements into plans for infrastructure improvements, redevelopment, and demolition of obsolete sites is necessary.

Compounding runoff issues in older cities is the prevalence of abandoned industrial sites and brownfields with often undocumented, undersized, and damaged storm drainage systems. Contaminated drainage areas, pipe capacities, and runoff flow that exceed the system's capacities can release toxins into stormwater runoff and cause flooding, erosion and sedimentation.

Recommended Action: Systematically Retrofit Gray Infrastructure with Green

Older urban areas should create an inventory of prioritized sites for green infrastructure retrofits. To minimize costs, priority should be placed on sites that have plans for improvements or other grading activities. Opportunities to install onsite stormwater management exist during road, sidewalk, and other infrastructure replacement. During demolition, vacant lots should be considered for their potential role in stormwater management and flood control. A 2012 TMACOG study identified several urban sites across the Swan Creek watershed for stormwater retrofits (TMACOG, 2012). This type of analysis should be completed for the remaining urban areas in the TMACOG region.

Aging Infrastructure

Stormwater infrastructure requires regularly scheduled maintenance, routine repairs, and a set schedule to manage replacement of old infrastructure. Many municipalities struggle with funding the maintenance of aging traditional "grey" infrastructure. Expanding urban areas and increasing impervious land cover exacerbate pressures on existing stormwater systems for some municipalities.

At the same time, aging drinking water treatment facilities are facing extraordinary pressure as outdated facilities must find new ways to battle increasing water quality issues at intakes in order to provide clean, affordable drinking water across the TMACOG region. Non-point pollution from both agricultural and urban land uses combined with faulty septic systems and combined sewer overflows have been the cause of nutrient enrichment, bacterial contamination and harmful algal blooms. Upgrading water treatment plants requires that they address these water quality problems that have resulted from years of land use practices and insufficient stormwater and sanitary infrastructure that occur from the mouth all the way up to the smallest agricultural tributaries.

Recommended Action: Maintain and Upgrade Infrastructure

Based on stormwater management needs assessment, municipal, township, and county governments should develop a list of both short-term and long-term maintenance and upgrade needs of their stormwater systems. A maintenance and capital improvement schedule should be developed that outlines specific projects, responsible parties, and a priority ranking. Regular maintenance issues for existing and proposed stormwater facilities should be identified and incorporated into a stormwater facility maintenance plan for each community. A regional planning entity should identify those stormwater systems that service more than one community. Maintenance and facility upgrades should be conducted in a coordinated fashion, so that improvements compliment the efforts in neighboring communities.

Combined Sewer Overflows

The combined sanitary and storm systems of the late 19th century were designed to accelerate stormwater drainage while also transport sanitary sewage efficiently to a treatment facility. Under normal precipitation conditions the two lines run separately. However, when the systems exceed their capacity during extreme wet weather, the systems are designed to combine their flows, sending the overflow stormwater and sewage into streams without treatment. Overflow points and treatment plant bypasses are provided, by design, to prevent damage to the wastewater treatment plant and reduce local flooding during periods of high flow. Combined sewer overflows (CSOs) can be a source of long-term pollution in the receiving water, since the solids that are discharged settle to the bottom and form sludge deposits. These deposits create a continuing oxygen demand and bacterial contamination that persist during periods of dry weather. Figure 8-12 shows watersheds that are impaired by CSOs.

Most communities are under U.S. EPA mandates to develop long-term control plans to reduce the number of combined sewer overflows, but upgrading existing systems requires complex engineering and extremely expensive capital improvement outlays. More detailed information on combined sewers is available in the **Chapter 5** of this Plan that details Facility Planning Areas (FPAs).

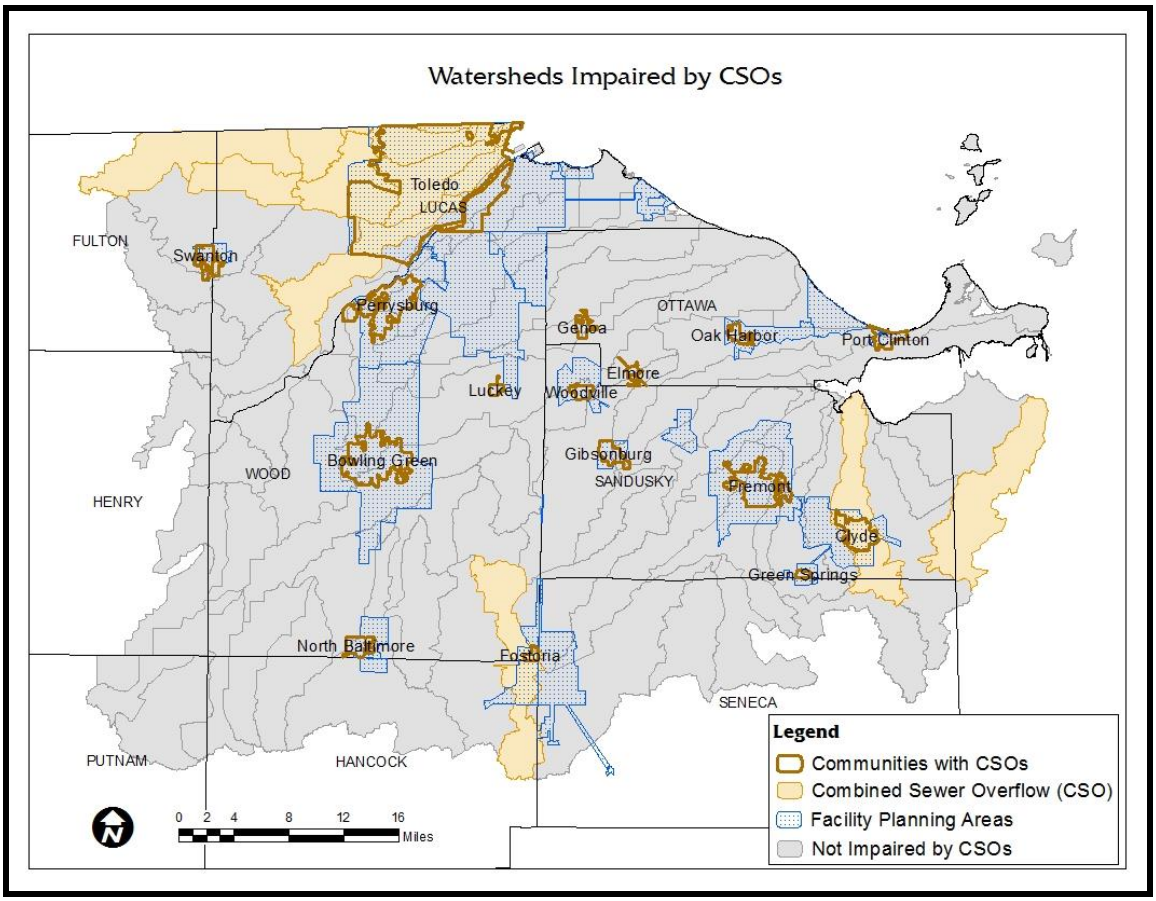

Figure 8-12: Watersheds Impaired by Combined or Sanitary Sewer Overflows

Recommended Action: Supplement Long Term Control Plans

Separation and storage plans for combined sewers need to be augmented with green infrastructure policies to reduce urban runoff load volumes to combined sewers. Additionally, U.S. EPA, Ohio EPA, Michigan EGLE, and the State Water Pollution Control Load Funds should increase grant funding and low-cost loans for the upgrade of sewer system and continued separation of combined sewers.

Lack of Space or Easements for System Maintenance and Improvement

Most urban sites are surrounded by existing development that limits or prohibits structural water quality control practices. Due to high building densities, these sites may present challenges to installing structural controls. Design engineers must be creative in order to gain needed flood control and deal with water quality concerns. Alternatives to traditional detention ponds or large infiltration structures must be identified. Improving or dredging drainage ditches and streams can be nearly impossible when confined to a narrow right-of-way with few access points. Obtaining additional space through easements or purchase can be politically and financially problematic. Nevertheless, unique projects with the support of property owners have been implemented in the region through the use of green stormwater infrastructure to manage and treat stormwater onsite.

In 2010, two creative stormwater improvement projects were implemented within the region. The first project is an alley improvement project in the City of Toledo. The Dexter Street alley required frequent repairs because the over 100-year old sanitary system was collapsing and storm drains connecting to it were a significant concern. Because houses and garages limited the space for conventional construction methods, an innovative approach was used. Engineers separated the sanitary and storm sewer systems and designed an inward sloped (as opposed to the typical crown design) permeable alley that would allow stormwater to drain through.

The second project is located at Maywood Avenue in the City of Toledo. The area flooded often because the storm pipes could not handle large rain events. To reduce flooding and stormwater pollution, several right-of-way areas were converted into bioretention areas and permeable sidewalks were installed. With support from residents, several rain gardens were installed on properties. Due to these early successes, the City of Toledo is in the process of using green stormwater infrastructure to improve drainage on unimproved streets that are not tied into the City's storm sewer network. These smart stormwater management approaches highlight the potential for stormwater retrofits and have paved the way for numerous green infrastructure projects in the TMACOG region.

Recommended Action: Retrofit with Green Infrastructure & Low Impact Development (LID)

Federal and state governments are increasingly expecting jurisdictions to build stormwater infrastructure that reduces pollution that results from urban runoff. This means integrating traditional stormwater management approaches with "green" stormwater infrastructure, which mimics natural hydrologic function and treats rainwater where it falls by encouraging infiltration, evapotranspiration, or reuse. The use of green infrastructure and low impact development combined with comprehensive neighborhood planning, and flexible zoning and building codes can provide many co-benefits including reducing urban runoff, improving water quality, and improving urban aesthetics, and increasing property values and urban livability. Unlike traditional gray infrastructure, which uses systems of curbs, gutters, and pipes to rapidly dispose of rainwater, green infrastructure uses vegetation and well-drained soils to manage rainwater where it falls. By mimicking natural hydrologic functions, green infrastructure can reduce or eliminate stormwater runoff by allowing rainwater to percolate into soils and be taken up by plants.

Figure 8-13: Example of Green Infrastructure in the 208 Plan Area

(Photo by University of Toledo)

There are numerous examples of green infrastructure in the TMACOG region. At the University of Toledo, a green roof was built on new building that was designed for Leadership in Energy and Environmental Design (LEED) certification (Figure 8-13). Other examples can be found on the TMACOG Green Infrastructure website, the Toledo-Lucas County Rain Garden Initiative, and the Toledo-Lucas County Sustainability Commission. For design and technical LID information as well as photographs of installed practices, the American Rivers' *Low Impact Development Manual for the Lower Maumee and Ottawa River Watersheds (American Rivers, 2010)* is a good resource.

Expansion of Urbanized Area

Development trends after World War II indicate a rapid shift in population and land development from urbanized areas to rural areas. Figure 12 illustrates more recent development shifts experienced in the TMACOG region. The resulting developments offer residents larger lot sizes but also require a disproportionate amount of infrastructure to support suburban populations in areas that were once farmland and natural areas. As a result, per capita construction and long-term maintenance costs of roads, stormwater infrastructure, and other infrastructure is significantly higher. The suburbanization process, once driven by the desire for small town or rural living, has produced the sprawling suburban residential and commercial development seen throughout the TMACOG region. Suburbs across the nation and within the TMACOG region have increased the necessity for urban stormwater infrastructure, roads, and retail establishments.

As the greatest growth continues to expand the urban footprint of the TMACOG metropolitan area, the associated impervious areas and miles of stormwater pipes within TMACOG's watersheds expand at ever increasing rates. This has led to exponential increases in stormwater pollution and increases in flow velocity and stream bank erosion, the effects of which are felt by suburban and downstream

communities alike (Lehner et al., 1999).

Recommended Action: Plan for Redevelopment and Restoration in the Urban Core

There are opportunities in already urbanized watersheds to focus development on previously developed sites that have been abandoned. Not only does this save on construction costs, it keeps development from encroaching on farmland, green spaces, and forest and helps to restore habitat and water quality. Areas within urbanized watersheds may be designated as Priority Development Areas (PDAs). Because they may already have been developed or use infrastructure efficiently, PDAs are ideal locations for development. Redevelopment of older city areas may offer opportunities for improving urban habitat by reducing construction in undeveloped areas or sensitive ecological habitats. Besides compliance with NPDES permits, wetland, floodplain, and habitat restoration are recommended as part of the redevelopment. Priority should be given to redevelopment with a potential for restoring riparian habitat and natural floodplains. Additionally, vacant land sites within cities should be considered for on-site green infrastructure implementation.

Recommended Action: Make Critical Urbanizing Watersheds a Priority

Jurisdictions in critical urbanizing watersheds should prioritize and focus stormwater management efforts on projects that expand, enhance, and preserve wetland, habitat, and floodwater storage. These areas should be the top priority for cost share, demonstration, and Supplemental Environmental Projects (SEP, an environmentally beneficial project to mitigate environmental law violations). These watersheds are also recommended as priority areas for TMDLs to identify sources and BMPs addressing urban nonpoint sources. To protect important natural stormwater infrastructure, jurisdictions in these watersheds should place priority on enacting ordinances and codes to focus future development on previously developed areas to protect wetlands and floodplains. In addition, the plan supports funding proposals to purchase natural habitat properties or conservation easements in these areas for the purposes of natural habitat and floodwater storage.

Recommended Action: Regulate All New development

Under the NPDES permit, all regulated MS4s must implement stormwater management programs and establish legal authority to regulate development and redevelopment. Although some communities within critical urbanizing watersheds are not under the same Ohio EPA mandates as MS4 permittees, these communities face development pressures nonetheless. Each community within the region's critical urbanizing watersheds, whether or not they are compelled by an NPDES permit, should pass ordinances governing new development and requiring utilization of stormwater BMPs.

VIII. Construction Site Runoff

A byproduct of urban expansion and development, construction site runoff is generated during the construction process when soil is the most vulnerable to erosion by wind and water. Studies indicate that poorly managed construction sites can release 7 to 1,000 tons of sediment per acre during a year, compared to one ton or less from undeveloped land (U.S. EPA, 1993). Suspended sediment lowers the quality of water for municipal and industrial uses as well as for boating, fishing, swimming, and other water based recreation. Deposited sediment clogs storm sewers, culverts, and drains, reduces the storage capacity of stream channels and reservoirs, fills ponds and lakes, and buries aquatic life habitat.

The construction NPDES permit requires that construction site operators control runoff leaving their site. Under the NPDES permit for MS4s, jurisdictions are responsible for reviewing site plans, inspecting sites to ensure that sediment and erosion control requirements are being met, and taking enforcement action if controls are not in place. However, programs in many jurisdictions do not meet these requirements.

Recommended Action: Enforce Construction Site Runoff Control

Jurisdictions must, under the NPDES permit, establish the legal authority to enforce construction site runoff controls. The TMACOG *Stormwater Standards Manual* provides model ordinances for establishing legal authority and guidelines for best management practices.

The ODNR *Rainwater and Land Development* manual for Ohio provides further guidance on sediments and other secondary pollutants that may be found. Recommendations are given for both temporary and permanent runoff controls.

Limited Inspection and Maintenance after Construction

Under NPDES permitting, new development and redevelopment require "post-construction" best management practices for long term runoff control and water quality protection. Lists of BMPs and design specifications can be found in the TMACOG *Stormwater Standards Manual* and the ODNR *Rain Water and Land Development Manual*.

Within the TMACOG region several jurisdictions utilize design standards for stormwater management. The cities of Toledo, Oregon, Maumee, and Sylvania have and enforce their own standards. The Lucas and Wood County Engineers' offices have developed and enforce design standards for development that occurs in the unincorporated areas of their respective counties. However, standards and the site plan review process is not consistent across jurisdictions.

Effective runoff management using structural practices requires successful execution of all phases of development. This includes a thorough site plan review, inspection to ensure proper construction, and committed resources for long-term operation and maintenance after these facilities are constructed. Most areas of the TMACOG region have some level of site plan review and require a permit or other type of approval prior to construction. However, limited resources and training have resulted in inadequate review and inspection in many cases.

The expense of maintaining most stormwater infrastructure is relatively small compared to original construction costs. However, maintenance is often not completed, particularly when facilities are privately owned. Inadequate maintenance decreases the efficiency of the stormwater management facilities, and may also detract from the aesthetic qualities of some practices. In addition, jurisdictions struggle with the logistical and legal challenges of requiring and enforcing long-term maintenance agreements with private property developers and land-owners.

Recommended Action: Set Clear Regional Standards

To meet NPDES permit requirements and to ensure uniformity in standards across jurisdictions in the TMACOG region, political jurisdictions in urbanized areas are recommended to adopt and implement the policies and practices detailed in the TMACOG *Stormwater Management Standards Manual.* All stakeholders — local governments, developers, construction contractors, industries, and citizens — need clear statements of what is expected of them and need to be held to an acceptable performance level. Local governments should facilitate this by setting clear standards, creating incentives, conducting routine monitoring and strongly enforcing laws and regulations.

Municipal, township and county governments are required by the NPDES permit to pass or update ordinances that establish design guidelines for new facilities and require regular maintenance activities for existing facilities. Regional design, construction, and maintenance standards for post-construction BMPs should be agreed upon and implemented to create consistency across jurisdictions. Long- or short-term funding options for inspection, enforcement, and maintenance should be explored.

Recommended Action: Implement Long-term Maintenance Agreements

Clearly defined operation and maintenance requirements within a stormwater ordinance can ensure that initial designs facilitate easy maintenance and that regular maintenance activities are completed. Long-term maintenance agreements with homeowners' associations or other private entities must be implemented for stormwater management practices on privately owned land. *The Stormwater Standards Manual* provides a model ordinance that, once adopted, gives jurisdictions the authority to regulate and enforce standards and long-term maintenance agreements.

IX. Funding and Program Management

Implementing effective stormwater management programs does cost money, but traditional government funding sources do not address the unique nature and growing problem of stormwater runoff. Many of TMACOG's jurisdictions do not have the funding sources, organization, or expertise to administer a comprehensive program required under the expanding NPDES stormwater rules, nor do they have a reliable funding source devoted to operation, maintenance, or capital costs of their stormwater system. Community leaders are reluctant to allocate adequate funds for stormwater pollution control, because the money comes from the same pool as more politically popular programs.

In addition to local funding hurdles, low interest loans from federal and state revolving loan funds are designed to fund capital projects and are not applicable for many of the non-capital aspects of a stormwater pollution program. Local governments should choose and implement an appropriate stormwater financing mechanism(s) based on documented needs, sound financial planning, input from their constituents and consultation with adjacent or overlapping governmental entities.

Recommended action: Identify Needs

Municipal, township and county governments should identify and document stormwater management and drainage needs. This should include a thorough assessment of water quality issues and their relationship to urban runoff and stormwater management in their jurisdiction. Stormwater Management Plans should set goals for meeting each of the NPDES minimum control measure and TMDL waste load allocations. An annual budget should be developed that addresses documented needs and provides for planning and study of future needs.

Recommended action: Develop Reliable Stormwater Funding Sources

A dedicated source of revenue should be developed to provide adequate programming and maintain program continuity. Some local governments have funded stormwater management measures through charging inspection and permit fees, taxing new development at an increased rate, forming regional stormwater management districts, and creating stormwater utilities. Research has shown that the most effective programs have been the stormwater management districts and stormwater utilities that operate similarly to water and sewer programs, and are funded through service fees that are administered separately from the general tax fund. However, stormwater utilities can be politically challenging as stormwater rate payers are asked to pay to prevent flooding and water pollution problems, which are not always perceived as necessary. An EPA study identified three major advantages of stormwater district or utilities over funds generated through property tax revenues (Doll et al., 1998):

- Increased stability and predictability
- Greater equity
- The opportunity for incorporating incentives for implementation of on-site stormwater management.

The City of Toledo established a stormwater utility in 2000 to fund long neglected planning, maintenance and capital improvement of their system. Similarly, Lucas County implemented a stormwater utility in 2011 to serve its unincorporated areas. Unincorporated areas, under Ohio law, do not have the option of forming stormwater utilities. A utility may be formed to serve unincorporated areas by the County Commissioners per ORC §6117 as described earlier in this chapter or through a Regional Water and Sewer District per ORC §6119.

Recommended action: Take advantage of State and Federal Funding

Although grants to address water pollution from the federal government have become more

competitive, jurisdictions should take advantage of the state and federal funding mechanisms that do exist. These include support in the way of grants, loans, and technical assistance to support long range stormwater infrastructure planning and green stormwater infrastructure demonstration projects. Programs that may be available to provide planning and implementation funds include:

- Ohio Public Works Commission (OPWC): Issue 2 Local Public Infrastructure Financing Program
- Ohio Department of Development (ODOD): Ohio Water and Sewer Commission Rotary Loan Program, Community Development Block Grant Program
- Ohio EPA Division of Environmental and Financial Assistance (DEFA): Water Pollution Control Loan Fund
- U.S. EPA / Ohio EPA / Michigan EGLE: Clean Water Act §319 Non-Point Source Grants
- U.S. EPA Great Lake Restoration Initiative
- ODNR / Michigan EGLE: Coastal Management Program

Recommended action: Gain Citizen Support of Stormwater Funding

To gain citizen support of stormwater management funding, jurisdictions should prioritize education efforts that communicate the necessity of well-maintained and sustainable stormwater infrastructure and its role in flood prevention and water quality protection. The County SWCDs, TMACOG, Partners for Clean Streams, the Portage River Basin Council, and the Sandusky River Watershed Coalition should assist jurisdictions with information and education programs. To fund educational programs, these organizations should form regional partnerships to apply for competitive grant funding through programs such as the Ohio Environmental Education Fund, the Lake Erie Protection Fund, and the Coastal Zone Management Assistance program.

Recommended action: Provide Federal and State Support

U.S. EPA should continue to provide and expand technical and financial support to the state agencies responsible for implementing the NPDES program. Additionally, financial assistance to the local MS4 permit holders is needed to assist in meeting public education, mapping, inspection, operations and maintenance, and enforcement requirements of the permits. Additionally, U.S. EPA should increase funding to existing loan and grant assistance programs targeted at upgrading municipal stormwater infrastructure with green infrastructure retrofits.

Ohio EPA and Michigan EGLE should provide technical assistance and guidance to local governments on stormwater regulatory requirements. Grant assistance should be provided to local governments and planning agencies to develop stormwater management plans and financing mechanisms.

Water Quality – Regulation Disconnect

While the goal of the Ohio EPA MS4 stormwater program is to fulfil the requirements of the Clean Water Act for municipal stormwater discharges, the state has not implemented regulatory authority to enforce water quality standards set through the TMDL program. Strict enforcement of end of pipe pollutant loads is not an appropriate approach for regulating urban runoff and doing so would create a tremendous burden for municipalities and regulatory agencies alike. On the other hand, the primary tool for regulating stormwater runoff is not being fully utilized. The NPDES permit for small MS4s does not enforce measures that will meet waste load allocations for MS4s and have a measurable impact on water quality. If MS4s are to integrate stormwater programs with water quality goals, coordination between regulators and permit holders is necessary.

Recommended Actions: Develop Rules Acceptable to Stakeholders

U.S. EPA, Ohio EPA, and Michigan EGLE must reach agreement to establish TMDLs expeditiously and a plan for implementation within the framework of the NPDES MS4 permit. During each step of the TMDL process, Ohio EPA should work within existing public input and participation processes and with local watershed groups, other state and local agencies, local elected officials, and the public to ensure a program is practicable and implementable. Scientifically defensible implementation schedules for MS4s should be set through cooperative partnerships between state permitting authorities and MS4s or their appointed representatives. A well-coordinated enforcement program will include specific waste load allocations for jurisdictions, generous timelines, and flexibility in meeting load reduction goals.

Recommended Actions: Provide Support for Implementation

Regulatory agencies should provide clear guidance on appropriate BMPs to meet these goals with a focus on green infrastructure practices. State permitting authorities should provide technical guidance to MS4s to meet these new requirements. At the federal level, non-competitive funds and technical support should be made available to regulated MS4s to meet TMDL reduction requirements.

Recommended Actions: Support Green Infrastructure

Because green infrastructure offers more water quality benefits than traditional stormwater infrastructure and because these techniques are often more cost-effective long term than traditional techniques, state regulatory agencies should provide MS4s with all necessary resources to meet waste load allocations using green infrastructure. The U.S. EPA recognizes the multiple benefits of managing storm water on-site using these practices and strongly supports incorporation of these techniques into NPDES permits. State and federal regulatory agencies can support MS4s by providing quantitative credits and incentives for green infrastructure installation.

Recommended Actions: Leverage Resources from Other Programs

Ohio EPA and Michigan EGLE should work through the Coastal Non-point Pollution Control Program to further encourage the adoption of stormwater BMPs in sensitive coastal areas. Local, regional and state management agencies should work toward full implementation of the urban areas management measures outlined in Chapter 5 of the Ohio Coastal Non-point Pollution Control Program Plan and the Michigan Coastal Non-point Pollution Control Program Plan.

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