CHAPTER 7
STORMWATER MANAGEMENT

Introduction

The problem with urban stormwater runoff is that the pollution sources are diffuse and not easily identified. Historically, water pollution control has focused on the more obvious point sources: municipal wastewater treatment plants and industrial discharges. The water pollution potential for 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.

Non-point problems are both water quality and quantity based. Development of an areas 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 prevent infiltration completely, while even suburban lawns absorb far less than natural areas. Consequently, impervious surfaces increase the rate and volume of stormwater runoff, resulting in higher flows and more frequent floods. In Swan Creek (Lucas Co.) flood flows have increased 17 to 85 percent from pre-settlement times. The elevated flows increase the erosion of waterway beds and banks[1]. Other negative impacts include increasing the receiving waters' temperature, changing habitat, and decreasing stream flow stability.

Table 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, R.T., D.W. Owens, R.B. Dodds, and N.J. Hornewer, *Sources of Pollution in Wisconsin Stormwater,* Water, Science and Technology vol. 28, no. 3-5, 1993.

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 this transformed landscape, 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.

In most communities, the majority of impervious cover is related to transportation infrastructure – roads and parking lots. Automobiles contribute a number of 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

[1] *Flooding and Erosion Related to Urbanization: Swan Creek Watershed, Lucas County, Ohio.* Earthview Inc., April 1973.

coolants and antifreeze are toxic and can contribute to high BOD in the receiving waters. Generally, fossil fuel combustion is the largest contributor of nitrogen to the waters in urbanized areas of the United States. Salts are used to keep facilities free of ice, but in large volumes can be toxic to fish and other wildlife. 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).

Growth trends have resulted in significant shifts in population from the urban to the suburban areas and accelerated stormwater problems. Urban development increases the amount of impervious surface in a watershed, as farmland, forests, and meadowlands with natural infiltration characteristics are converted into roads, parking lots, buildings, driveways, and sidewalks with virtually no ability to absorb stormwater. The effect of impervious surfaces 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. 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.

Table 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: *Urbanization of Streams: Studies of Hydrologic Impacts*, EPA 841-R-97-009, 1997

Landscaping practices that use fertilizers or pesticides and poor housekeeping practices are potential sources of pollutants in urban runoff. Improper or over application on urban gardens and lawn areas is very common. The excess eventually makes its way to ditches and streams. Rain and melting snow erodes 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 1 highlights the watersheds that are affected by common landscaping pollutants such as nitrates, pesticides, and nutrients, in general.

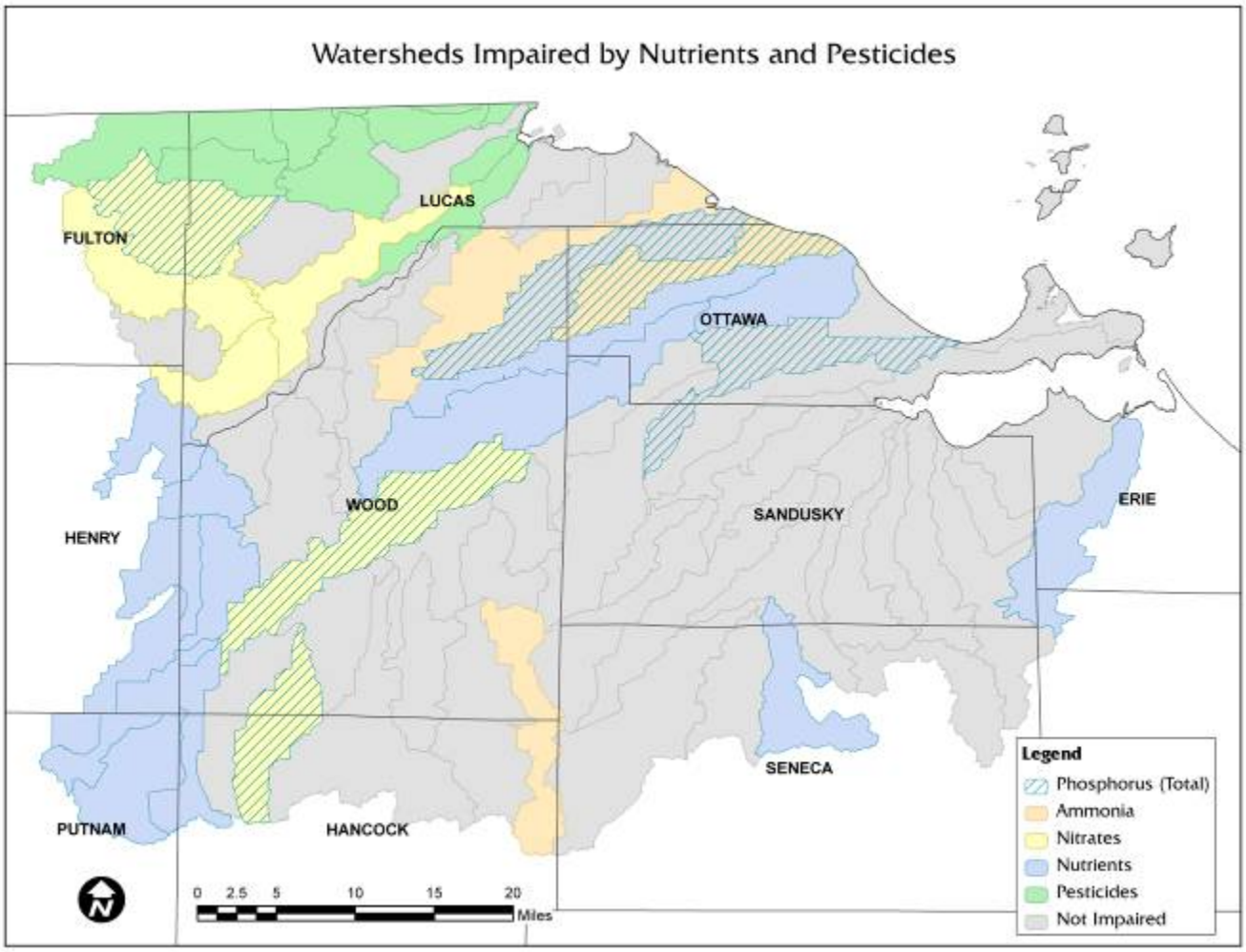

FIGURE 1: Watershed Impairment Caused by Nutrients and Pesticides in the TMACOG Region

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[2]. Excess sediment causes a number of 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.

[2] 64 Federal Register 235 (December 1999).

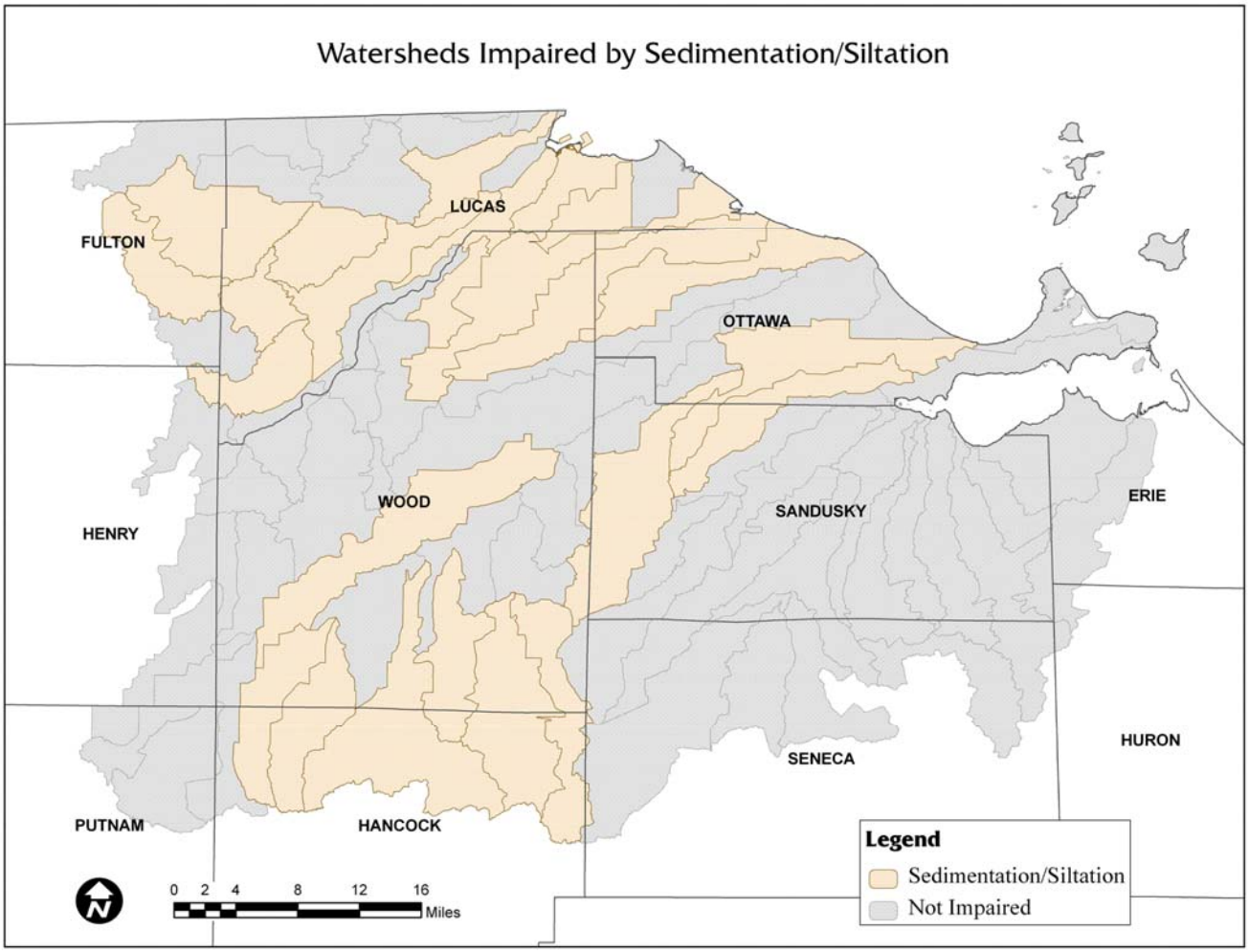

FIGURE 2: Watershed Impairment Caused by Sedimentation in the TMACOG Region

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 miscellaneous 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.

A majority of the point sources have been addressed through the early focus of the Clean Water Act. Now, the more difficult non-point sources must be dealt with in order to continue to improve our water resources. In Northwest Ohio's and Southeast Michigan's urbanized areas, stormwater runoff continues to be a significant cause of water pollution. This chapter recommends implementation policies for local governments to protect streams from pollution by urban runoff, and stormwater management alternatives to protect and enhance riparian habitat.

Implementing Stormwater Management Regulations & Policies

Regulatory Programs and Agencies

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 (NDPES) permit program of the Federal Clean Water Act (CWA), which regulates stormwater discharges, addresses urban point source pollution. Nonpoint source management programs under Section 319 of the Clean Water Act 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 (NDPES) Stormwater Program

The CWA prohibits the discharge of any pollutant to waters of the United States 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 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 CWA, the NPDES Stormwater Program has been implemented in two phases.

Phase I

In response to the 1987 Amendments to the CWA, US Environmental Protection Agency (EPA) developed Phase I of the NPDES Stormwater Program. Phase I requires NPDES permits for stormwater discharges from:

- "Medium" and "large" municipal separate storm sewer systems (MS4s) serving populations of 100,000 or greater,
- Construction activity disturbing 5 acres of land or greater, and
- Ten categories of industrial activity.

The regulated entities must obtain coverage under an NPDES stormwater permit and implement stormwater pollution prevention plans (SWPPPs) or stormwater management programs, using Best Management Practices or 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, OEPA and Michigan Department of Natural Resources and Environment (MDNRE) implement the federal stormwater program. U.S. EPA needs to continue to provide technical and financial support to the state agencies responsible for implementing the program. Additionally, financial assistance to the local permit holders is needed to assist in meeting the services and infrastructure requirements of the permits. U.S. EPA should increase funding to existing loan and grant assistance programs targeted at upgrading municipal stormwater operations and infrastructure.

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 municipal separate

storm sewer systems (MS4) discharges, first effective on September 1, 1997. The permit needs to be renewed every five years. OEPA must work cooperatively with the City of Toledo to implement the requirements of the City's NPDES stormwater permit. OEPA needs to aggressively work through education, partnerships, and inspections to identify and permit industrial discharges in the region.

Phase II

The Phase II program expands the NPDES program by requiring permits for small sized MS4s in urbanized areas as well as operators of small construction sites. This is designed to implement programs and practices to control polluted stormwater runoff. The rule automatically regulates two classes of stormwater dischargers on a nationwide basis:

- Operators of small MS4s located in "urbanized areas" as defined by the Bureau of the Census (termed a "regulated small MS4").
- Operators of construction activities that disturb 1-5 acres of land.

Operators of automatically designated small MS4s may obtain waivers from coverage if their discharges if they fit certain criteria for one of two options. The first option is for those that serve less than 1000 people, the system does not contribute significantly to a regulated system, and pollutants discharged by the MS4 that cause impairments under EPA approved Total Maximum Daily Load (TMDL) do not require stormwater controls. The second option is for systems serving fewer than 10,000 people, the system discharges do not require stormwater controls based on TMDL or equivalent analysis wasteload allocations (determined through a required assessment), and future discharges are not expected to exceed water quality standards. Waivers are reviewed by the permitting agency (OEPA or MDNRE) a minimum of every five years.[3]

Additional small MS4s (outside of urbanized areas) and construction sites (disturbing less than 1 acre of land), along with other sources which are a significant contributor of pollutants to waters of the U.S., may be brought into the NPDES Stormwater Program by the state NPDES Permitting Authority (OEPA or MDNRE). Permit applications were required by March 2003. Operators of small construction activities may also obtain waivers from coverage. These waivers can only be issued by the permitting authority if the operators of the small construction activities can certify low predicted rainfall potential using the Revised Universal Soil Loss Equation (RUSLE) or it is determined that stormwater controls are not necessary. A TMDL or equivalent analysis is the only method to determine allocations for stormwater controls are not necessary to protect water quality.[4]

Operators of Phase II MS4s are required to apply for NPDES permit coverage and implement "Six Minimum Control Measures" that effectively reduce or prevent the discharge of pollutants into receiving waters:

- Public Education and Outreach
- Public Participation/Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post-Construction Runoff Control
- Pollution Prevention/Good Housekeeping

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[3] United States Environmental Protection Agency (U.S. EPA) Office of Water. 2005. *Stormwater Phase II Final Rule: Who's Covered? Designation and Waivers of Regulated Small MS4s.* http://www.epa.gov/npdes/pubs/fact2-1.pdf.

[4] United States Environmental Protection Agency (U.S. EPA) Office of Water. 2005. *Stormwater Phase II Final Rule: Small Construction Program Overview.* http://www.epa.gov/npdes/pubs/fact3-0.pdf.

Ohio and Michigan have different regulatory authorities for NDPES programs. In 2004 the 125th Ohio General Assembly passed HB 411, adopting changes to 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 OEPA rules. The rules may require sediment control plans before developing a site by disturbing one or more acre of land, and impose a filing fee for plan review. The TMACOG *Stormwater Management Standards Manual* outlines specific requirements for a site plan and the review process.

About 280 jurisdictions located in urbanized areas that operate an MS4 will be included in the State of Ohio program. Table 7 identifies MS4s in the 208 region that are required to obtain NDPES permits.

Table 7. Designated Stormwater NPDES Communities

Cities	Villages	Townships
Lucas County		
Oregon	Harbor View	Jerusalem
Sylvania	Holland	Monclova
Maumee	Ottawa Hills	Spencer
Toledo (under Phase I)	Waterville	Springfield
		Sylvania
		Washington
		Waterville
Wood County		
Bowling Green	Millbury	Lake
Fostoria	Walbridge	Perrysburg
Northwood		Middleton
Perrysburg		
Rossford		

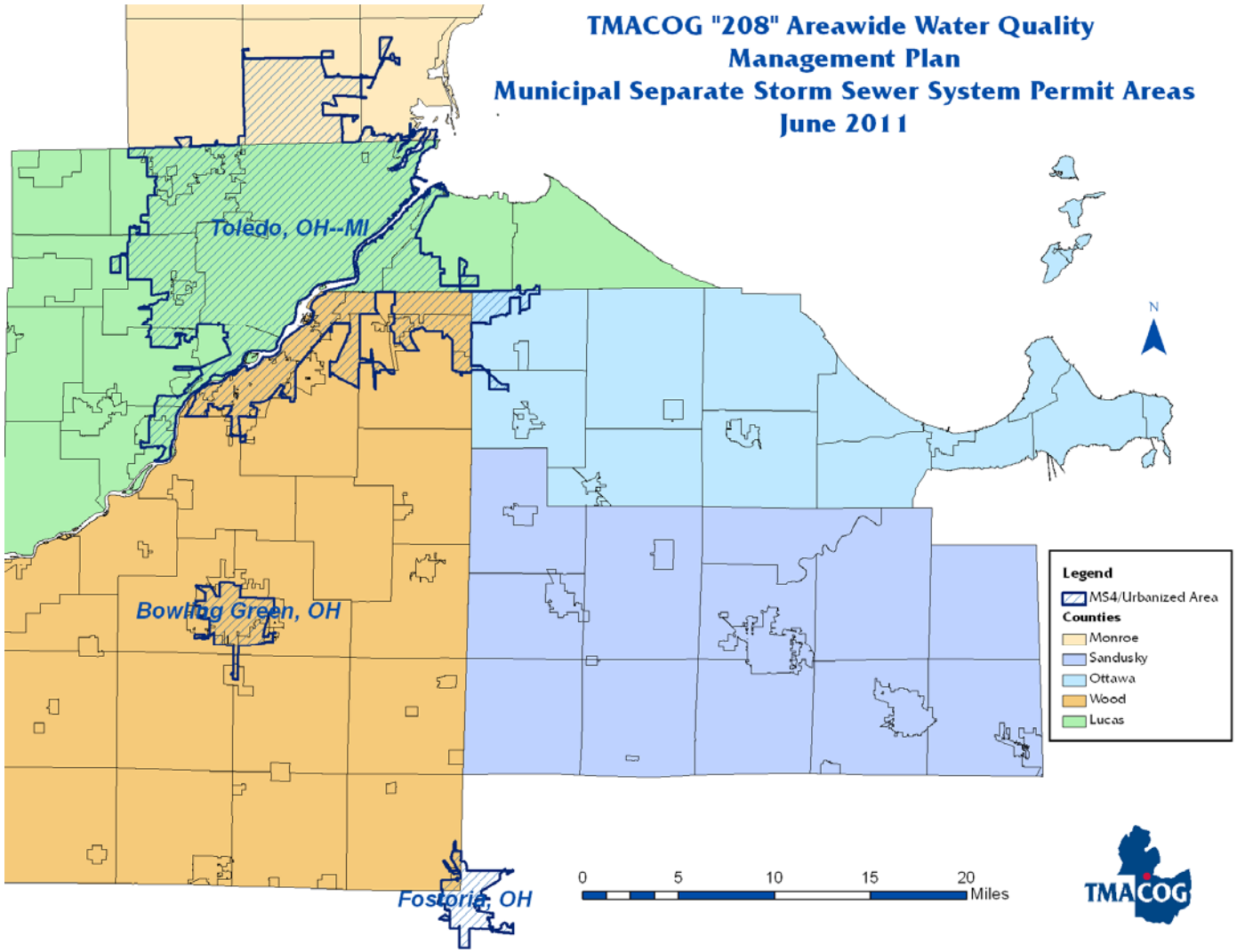
In Michigan, the Michigan Department of Natural Resources and Environment (MDNRE) is the stormwater permitting authority (formerly the Michigan Department of Environmental Quality was the permitting authority). Table 8 indicates the Michigan jurisdictions located in the 208 region responsible for obtaining Phase II permits.

Table 8. Michigan Designated Phase II Communities

Cities	Villages	Townships
Monroe County		
		Bedford
		Erie
		Whiteford

Figure 3 shows the Municipal Separate Storm Sewer System (MS4) jurisdictions of the region that are subject to NPDES stormwater permits.

FIGURE 3: MS4 Jurisdictions in the TMACOG Region



Total Maximum Daily Load Program

If analyses indicate an impairment of water quality standards and technology-based controls are inadequate, Section 303(d) of the Clean Water Act establishes the Total Maximum Daily Load (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 OEPA[5] and MDNRE[6] 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 specifies the amount a pollutant needs to be reduced to meet water quality standards, allocates pollutant load reductions in a watershed, and provides the basis for taking actions needed to restore a body of water. It is a watershed approach to quantifying and reducing both point and nonpoint sources of pollution to impaired waterbodies.

TMDLs establish allowable loadings (both point and nonpoint source) necessary to meet water quality standards in a given watershed. Specifically, allowable loadings are equal to the sum of individual wasteload allocations for point sources and the load allocations for both natural inputs and nonpoint sources. In urbanized watersheds, reductions in urban runoff non-point pollution will be a significant part of meeting the TMDL allowable loadings.

Federal and state agencies must reach agreement to establish TMDLs expeditiously and a plan for implementation. The OEPA Division of Surface Water has developed a 12-step project-management-based TMDL process to accomplish TMDLs. The process contains four broad, overlapping phases:

- *Assess* waterbody health: biological, chemical, habitat
- *Develop* a restoration target and a viable scenario
- *Implement* the solution: inside/outside OEPA
- *Validate* to monitor progress: delist or relist.

Each phase of the process will require public input and participation. OEPA needs to work with local watershed groups, other state and local agencies, local elected officials, and the public to ensure a program is practicable and implementable.

MDNRE will prepare a TMDL for all waterbodies 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:

1. Uses of the lake or stream;
2. Safe levels to protect the uses;
3. Procedures to protect high quality waters.

Non-Point Source Management Program

Congress amended the Clean Water Act (CWA) in 1987 to establish the Section 319 Nonpoint 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

[5] Ohio Environmental Protection Agency. *Final 2010 Integrated Water Quality Monitoring and Assessment Report.* http://www.epa.state.oh.us/dsw/tmdl/2010IntReport/2010OhioIntegratedReport.aspx

[6] Michigan Department of Natural Resources and Environment. *Water Quality and Pollution Control in Michigan 2010 Sections 303(d), 305(b), and 314 Integrated Report.* http://www.michigan.gov/documents/deq/wb-swas-final-2010IR_316320_7.pdf

wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects.

Both States manage significant nonpoint source grant programs designed to provide financial assistance to local watershed groups; OEPA and the MDNRE 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 Best Management Practices (BMPs); education and evaluation.

Wetlands Protection Programs

Permits are required for the discharge of dredged or fill material into waters of the United States, **except** as provided in 33 CFR Section 323.4. Requirements for preventing and mitigating irreversible impacts to jurisdictional wetlands are imposed through various legislation and regulations:

a. Section 404 of the Federal Clean Water Act (CWA) administered by the Corps of Engineers (COE)
b. Council of Environmental Quality (CEQ) regulations and guidelines implemented through the National Environmental Policy Act (NEPA)
c. Executive Order 11990, "Protection of Wetlands"
d. EPA guidelines at Section 404(b)(1) and their regulations
e. Michigan's wetland statute, Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451
f. State Water Quality Certification through Section 401(a) of the CWA
    - Ohio Administrative Code Chapter 3745-32
g. 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 COE unless the OEPA or MDNRE issues a Section 401 Water Quality Certification. If OEPA or MDNRE issues a Section 401 Certification for the project, the conditions become requirements of the federal permit. If OEPA or MDNRE denies the Section 401 Certification, the COE must deny the Section 404 permit without prejudice.

In 1984, Michigan received authorization from the federal government to administer Section 404 of the federal Clean Water Act in most areas of the state. The Michigan 404 program must be consistent with the requirements of the federal Clean Water Act and associated regulations set forth in the Section 404(b)(1) guidelines. Whereas in Ohio, where an applicant must apply to the U.S. Corps of Engineers and a state agency for wetland permits, applicants in Michigan generally submit only one wetland permit application to the MDNRE.

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*.

Coastal Nonpoint 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 Nonpoint 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 nonpoint source control program is networked between the Ohio Department of Natural Resources (ODNR) and the Ohio Environmental Protection Agency (OEPA). The Division of Real Estate and Land Management (RELM) within ODNR has the lead for implementing the Ohio Coastal Management Plan (OCMP).

Michigan Coastal Nonpoint Pollution Control Program

In Michigan, the Great Lakes Shorelands Section in the Land and Water Management Division (LWMD) of the MDNRE 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

The Department of Natural Resources (DNR) was granted the legal authority to coordinate urban water pollution abatement efforts through Ohio Revised Code Chapters (ORC) 1501, 1511 and 1515. Ohio DNR 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). OEPA and MDNRE use this plan in reviewing and approving permit applications.

County Governments (Ohio)

County governments in Ohio are responsible for implementation of the Ohio drainage laws. Counties may construct and maintain stormwater collection, treatment, and disposal facilities, and may enter into inter-local agreements to perform such functions for any municipal corporation or special district. Counties may also adopt ordinances or rules for urban sediment control pursuant to the Urban Sediment Pollution Abatement Act.

Four of the six County governments in the TMACOG region are identified by the NPDES Phase II Rules as operators of regulated small Municipal Separate Storm Sewer Systems (MS4s). Operators of small MS4s within urbanized areas are required to implement programs and practices to control polluted stormwater runoff. The program must design its stormwater management program to satisfy applicable Clean Water Act water quality requirements and technology standards.

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. The definitions pertaining to sewers were clarified to explicitly include stormwater and drainage facilities.

Currently stormwater management requirements vary considerably from one county to another, enforced through a combination of subdivision regulations and ordinances. The major focus of the County Engineer continues to be on drainage rather than overall stormwater management. County governments need to include water quality considerations in their stormwater management programs.

County Government (Michigan)

Monroe County is identified by the NPDES Phase II Rules as an operator of MS4s. Operators of small MS4s within urbanized areas are required to implement programs and practices to control polluted stormwater runoff. The program must design its stormwater management program to satisfy applicable Clean Water Act water quality requirements and technology.

In Monroe County, the Board of Commissioners assigned the Drain Commissioner the responsibility to enforce the 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)

Municipal corporations in Ohio are granted 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. Also, the Ohio constitution enables municipalities to adopt ordinances or rules for urban sediment control.

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 funding of urban stormwater runoff 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. 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. 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.

All three Townships in the Michigan portion of the TMACOG planning area are identified by the NPDES Phase II Regulations as operators of regulated small Municipal Separate Storm Sewer Systems (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.

Problem Identification

Under the Federal Clean Water Act, 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. OEPA and MDNRE have assigned a specific set of water quality standards to most major streams and rivers throughout the States. These use categories are found with the OEPA Integrated Water Quality Monitoring and Assessment Report.

OEPA divides each stream into segments and assigns each segment a specific use designation. Then, using multiple chemical, physical and biological measures, OEPA determines if the stream segments are in attainment of their use designation. The biological parameters are emphasized because resident organisms are good indicators of water pollution. A healthy fish or invertebrate community is also associated with high quality recreational opportunities. In the 208 region, around 68% of streams are

considered impaired for aquatic use (categories four and five) and only about 5% are in attainment.

Developed Areas

Older, developed areas face expensive infrastructure challenges related to sewer system capacity, maintenance, replacement, and surface runoff. The construction of storage facilities to retain and treat water from combined sewer systems and the separation of sewer systems to address pollution from wet weather events eliminate only one class of the water quality impairments. These programs need to be augmented by new initiatives to limit pollution from non-point sources such as street dirt and residential sources. At the same time some of these areas are faced with declining tax bases and aging infrastructure, decreasing available revenue to support water quality programs.

Aging Infrastructure

Drainage in the 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 extreme 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 and integrated drainage system for the area that permitted agricultural land uses and settlement. In the urban centers the drainage efforts were more intense.

In the late nineteenth century the need for wastewater treatment had become increasingly apparent. 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 grew and treatment of the wastewater became essential. More recently constructed stormwater and wastewater collection systems have been separate systems. Nevertheless, many combined sewers are still in use in older urban areas.

During wet weather, the capacities of combined sewer systems are often exceeded and the combined systems overflow into the stream 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 4 shows watersheds that are impaired by combined sewer overflows.

Most communities have developed plans to reduce the number of combined sewers, but upgrading existing systems requires complex engineering and extremely expensive capital improvement outlays. More detailed information on combined sewers is available in the Facility Planning Area Chapter (Chapter 4) of this document.

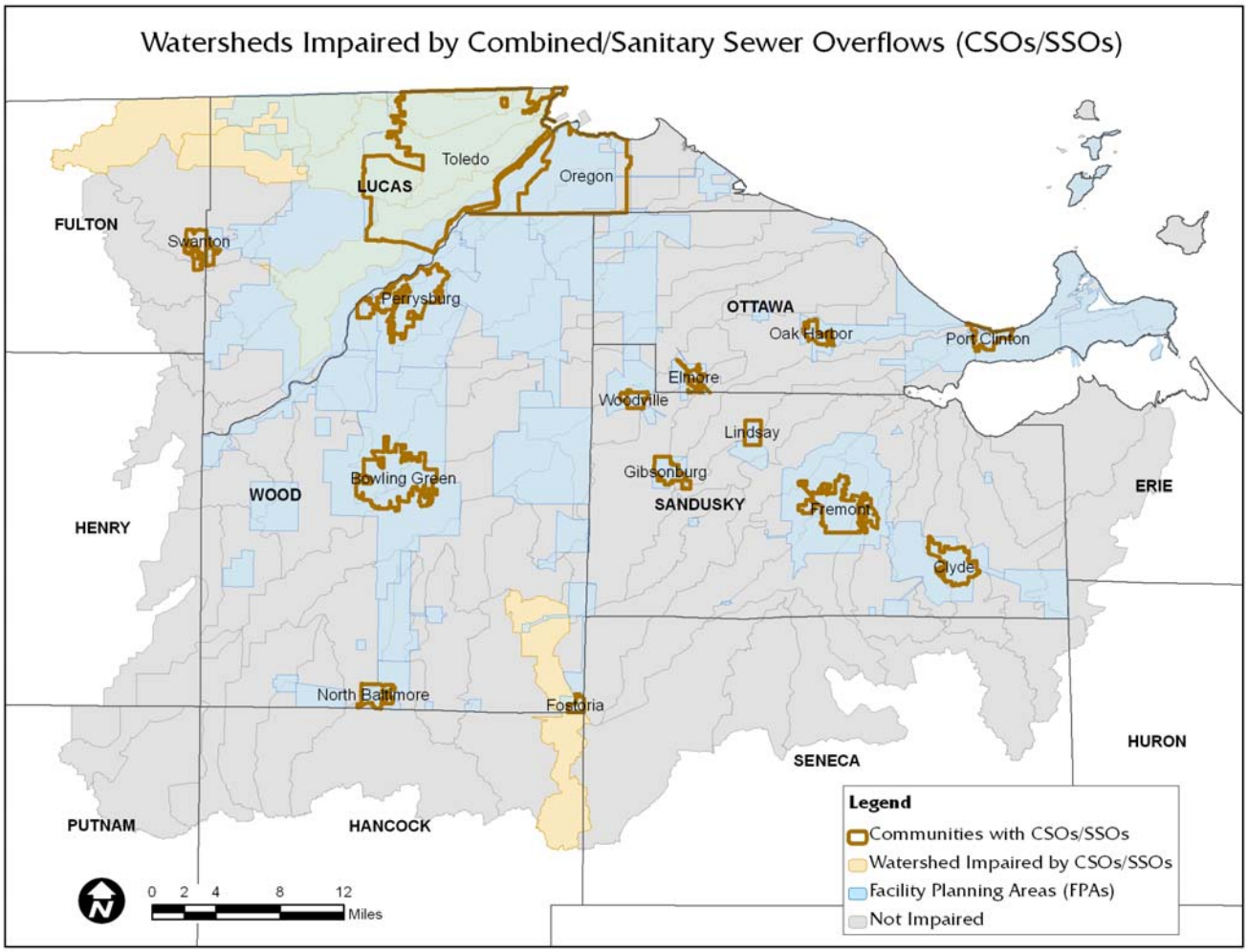


FIGURE 4: Watersheds Impaired by Combined or Sanitary Sewer Overflows

Illicit Discharges

Discharges from storm sewers often include wastes and wastewater from non-stormwater sources. Significant portions of these dry weather flows are from illicit and/or inappropriate discharges and connections to the storm sewer system. The TMACOG *Stormwater Management Standards Manual* provides detailed information for understanding illicit discharges and for preventing them through regulation.

Uncontrolled Runoff

Typically there are limited urban runoff control practices in use in the older, developed urban areas. New site drainage design regulations most often only apply to new development. Implementing stormwater controls on existing sites is more expensive and challenging from an engineering standpoint. Expanding urbanization has produced higher rates and larger volumes that overwhelm the existing drainage systems. The higher flows cause changes in urban stream morphology and increased stream-bank erosion. Eroded banks in turn have created damage to adjacent property as well as a potential safety hazard.

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. These sites may not be able to or have difficulty 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.

In 2010, two creative stormwater improvement projects were implemented within the region. The first project is an alley improvement project in City of Toledo. The Dexter St. 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. These two approaches highlight the potential for stormwater retrofit projects.

Runoff from Sites Constructed Prior to Stormwater Management Requirements

Many existing sites were developed prior to stormwater management regulations and have been grandfathered into the system. There are few options through the regulatory process to enforce new stormwater detention or quality requirements on these sites. Therefore the system must be capable of accepting this runoff volume and potential pollutants must be eliminated at their source.

In many older industrial sites, storm drainage systems are undocumented, undersized, or damaged. Often the present staff is unaware of the system's location or condition. Drainage areas, pipe capacities, and runoff flow that exceed the system's capacities can all cause water quality problems. Significant discharges at locations where flow is not expected can lead to flooding, erosion and sedimentation, and release of harmful toxins.

Street Runoff with No Controls

From the standpoint of stormwater quality, streets have been identified as the single most important source of stormwater pollutants. Not only do streets produce some of the highest concentrations of phosphorous, suspended solids (sediment) and bacteria, but they also generate a disproportionate amount of runoff volume from the watershed.[7] Of particular 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 5 identifies common metals associated with the transportation. In the 208 region, metals are responsible for impairment in the Sibley Creek-Ottawa River Watershed.

[7] Bannnerman, R., D. Owens, R. Dodds, N. Hornewer. 1993. *Sources of pollutants in Wisconsin Stormwater*. Water Science and Technology. 28:3-5pp. 241-259.

Table 5. Sources of Heavy Metals from Transportation								
Source	Cd cadmium	Co cobalt	Cu copper	Fe iron	Mn manganese	Ni nickel	Pb lead	Zn zinc
Gasoline	•		•				•	•
Exhaust						•	•	
Motor Oil & Grease		•		•		•	•	•
Antifreeze				•				•
Undercoating							•	•
Brake Linings			•	•		•	•	•
Tire Wear	•		•				•	•
Asphalt			•			•		•
Concrete			•			•		•
Diesel Oil	•							
Engine Wear					•	•	•	•
Source: *Local Ordinances: A Users Guide*, Terrene Institute and EPA, Region 5, 1995								

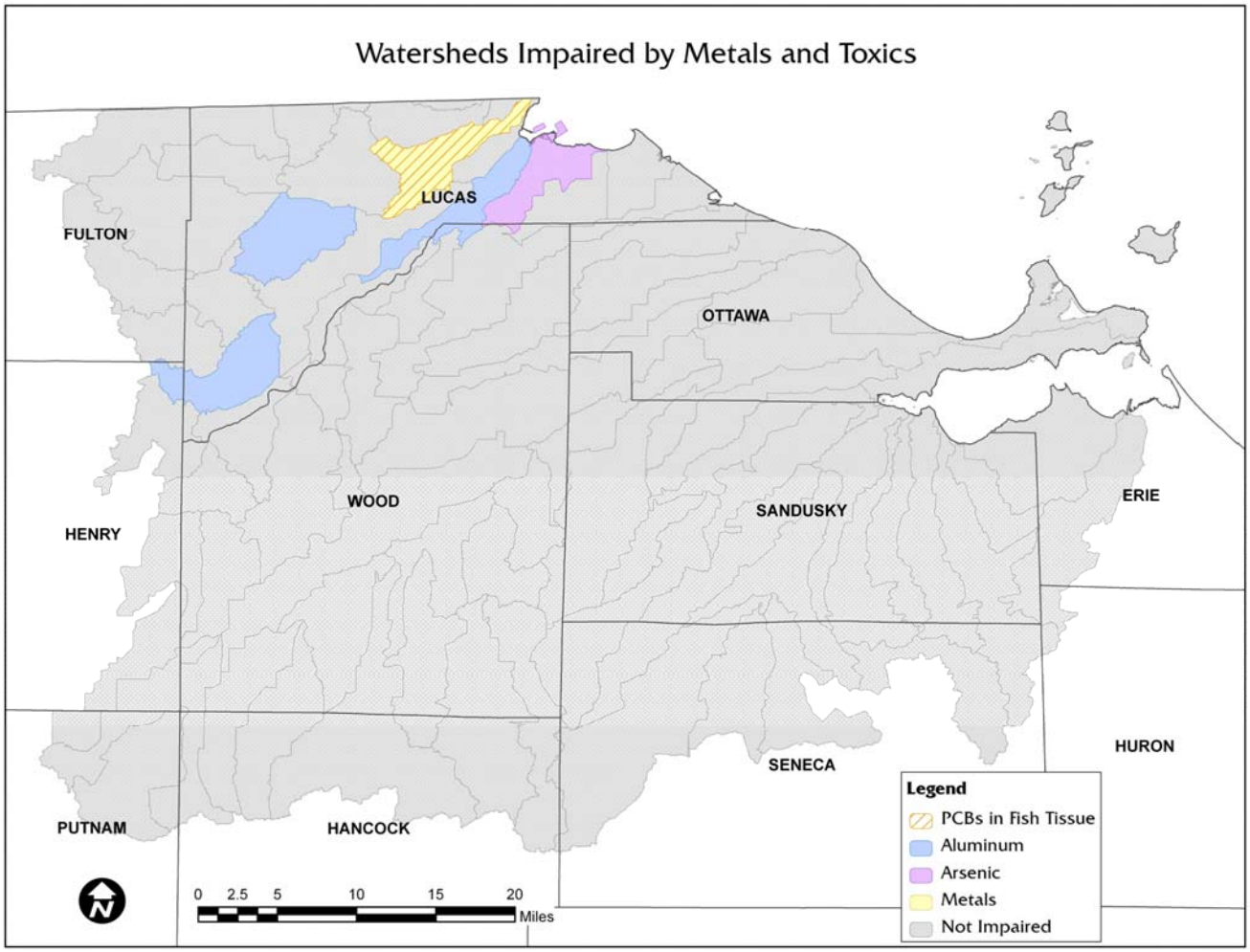


FIGURE 5: Watersheds Impaired by Metals and Toxics.

Funding

Traditional government funding sources do not address the unique nature and growing problem of stormwater runoff. Many of the jurisdictions covered under expanding federal and state stormwater rules do not have the funding sources, organization, or expertise to administer a comprehensive program.

Unlike water supply and sanitary sewers, typically there is no dedicated funding source for drainage systems. Grants for water pollution from the federal government have shrunk and become more competitive. 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. Diversions from a general revenue fund are unreliable and unpopular. 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.

Due to this lack of dedicated funding sources, local officials are forced into developing alternative solutions. One option that is gaining widespread acceptance is forming a stormwater utility. Stormwater utilities operate similarly to water or sewer, and are funded through service fees or assessments. However, stormwater rate payers are being asked to pay to prevent flooding and water pollution problems, which are not always perceived as necessary. The City of Toledo established a stormwater utility in 2000 to fund long neglected planning, maintenance and capital improvement of their system.

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 or through a Regional Water and Sewer District, ORC §6119.

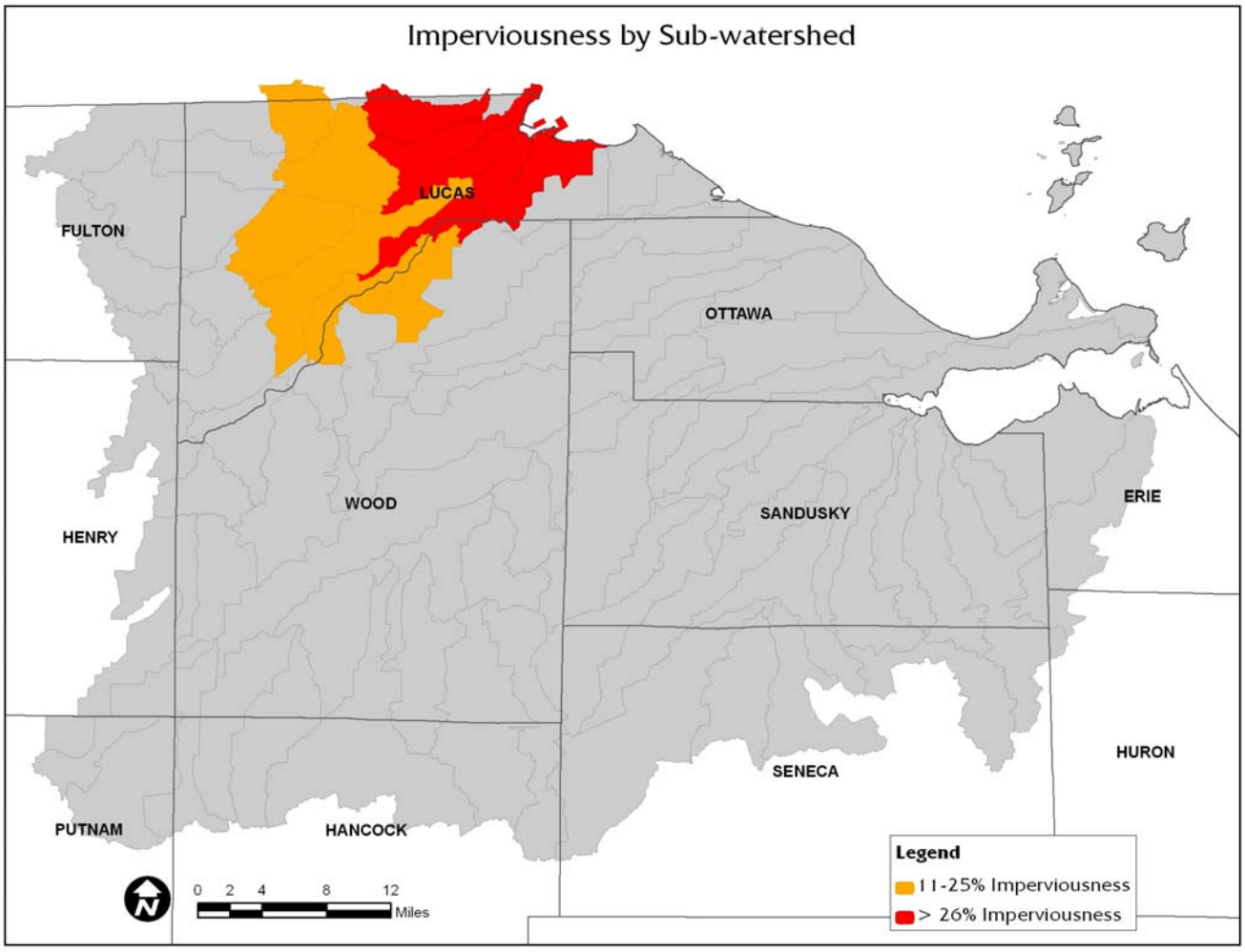
Developing Areas

With the development of open lands have come abrupt changes in the relationships between vegetation, soils, and waterways. The existing surface cover is replaced with roads, rooftops, driveways, parking lots, and other impervious surfaces. Since the new land cover is less permeable than the existing cover, this change results in a greater percentage of the precipitation becoming runoff. The increased runoff causes larger and more frequent floods and increases erosion of stream banks and beds. The higher flows can lead to increases in stream temperature, changes in habitat, and decreases in stream flow stability.

Expansion of Urbanized Area

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.[8] As shown in Figure 6, six subwatersheds (smaller divisions of larger watersheds, also known as 12-digit hydrologic units) in the region have above 10 percent imperviousness. A second threshold appears to exist at 26 percent impervious cover, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores).[9] Four watersheds in the region are above the 26 percent impervious cover threshold.

[8] Schueler, T.R. *The Importance of Imperviousness*. Watershed Protection Techniques, vol. 1, no. 3, Fall 1994, pp.100-111.
[9] See reference 8.



Source: *USGS Multi-Resolution Land Characteristics Consortium (MRLC)*[10]

FIGURE 6: Urban Imperviousness by Subwatershed

Suburban Sprawl

Stormwater pollution has two main components: the increased volume and velocity of surface runoff and the concentration of pollutants in the runoff. Both of these components are directly related to development in urbanizing areas.[11] As the greatest growth continues to occur on the fringes of the metropolitan areas, the impervious areas within our watersheds expands at ever increasing rates.

Construction Site Runoff

During the construction process, 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.[12] 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.

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[10] http://www.mrlc.gov/multizone_download.php?zone=11

[11] Lehner, P.H., G.P.A. Clarke, D.M. Cameron, A.G. Frank. 1999. *Stormwater Strategies: Community Responses to Runoff Pollution*. Natural Resources Defense Council. 269 pp.

[12] US Environmental Protection Agency. 1993. Guidance specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, EPA 840/B-92/002.

The Ohio Division of Natural Resource *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.

Lack of Comprehensive Planning

Effective runoff control should not be haphazard, but this is the common method of operation. Comprehensive planning is often overlooked, but is an essential element of any stormwater management program. 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. Stormwater does not obey political boundaries, requiring a watershed based management philosophy. Comprehensive planning is hindered by:

- Lack of watershed based stormwater management
- Lack of stormwater considerations in zoning
- Inconsistent or inadequate standards for stormwater management

Limited Inspection and Maintenance

Effective runoff management using structural practices and facilities requires successful execution of all phases of development. This includes proper construction as well as proper operation and maintenance after construction. For more information on inspection and maintenance, consult the TMACOG *Stormwater Management Standards Manual*, third edition, the chapter on inspection and enforcement.

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. Reviewers ensure that stormwater runoff and controls have been taken into account in the development typically only once during the review process. A more comprehensive process would consider stormwater controls from the onset of the design process.

Destruction of Wetlands and Floodplains

Wetlands provide a natural way to manage and store water and maintain 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 as 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 Corps of Engineers and the Federal Emergency Management Agency 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.

Because of their importance in stormwater management, the TMACOG *Stormwater Management Standards Manual*, third edition, dedicates a chapter to natural wetlands protection. Consult the manual

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[15] Doll, A., G. Lindsey, and R. Albani. *Stormwater Utilities: Key Components and Issues*. Prepared for Advances in Urban Wet Weather Pollution Reduction Conference, sponsored by Water Environment Federation, June 28 – July 1, 1998, Cleveland Ohio, 10pp.

for more information on wetland delineation, wetland permits, and the Oak Openings region.

AREAWIDE POLICIES

Develop Reliable Stormwater Funding Sources

Implementing effective stormwater management programs does cost money. A dedicated source of revenue should be developed to provide adequate programming and maintain continuity. Most communities in the TMACOG region do not have a specific funding source devoted to operation, maintenance, or capital costs of their stormwater system. 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. An EPA study identified three major advantages of stormwater district or utilities over funds generated through property tax revenues:

1.) Increased stability and predictability,
2.) Greater equity, and
3.) The opportunity for incorporating incentives for implementation of on-site stormwater management.[15]

For more information on potential structure of a regional stormwater management district, see Appendix B "Plan of Operation for a Regional Stormwater Management District in the Lower Maumee River Watershed".

Additional Stormwater Funding Sources

Use of state and federal grant programs to accomplish these goals is encouraged. Under this Plan it is TMACOG's policy to support funding of these grants programs through local, state, and federal agencies, and support funding for participating agencies to administer them. 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
- OEPA Division of Environmental and Financial Assistance (DEFA): Water Pollution Control Loan Fund
- US EPA / OEPA / MDNRE: Clean Water Act §319 Non-Point Source Grants
- Ohio DNR / MDNRE: Coastal Management Program

Recommended Implementation Activities

- Municipal, Township and County governments should identify and document stormwater management and drainage needs. An annual budget should be developed that addresses documented needs and provides for planning and study of future needs.
- Municipal, Township and County governments should choose and implement an appropriate stormwater financing mechanism(s) based on sound financial planning, input from their constituents and consultation with adjacent or overlapping governmental entities.
- U.S. EPA, OEPA, and MDNRE 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.

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.
- Municipal, Township and County governments should pass or update ordinances that establish design guidelines for new facilities and require regular maintenance activities for existing facilities.
- 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.
- Regular inspections of both public and private facilities should be conducted to ensure compliance with the stormwater ordinances. The inspection requirements should be set forth in the stormwater facility maintenance plan and recommendations should be enforceable through the stormwater ordinances.
- U.S. EPA, OEPA, MDNRE, 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.

Update Zoning to Improve Stormwater Management

Zoning is a powerful tool in the land use planning process and is available to most communities. In order to reach water quality goals, watershed boundaries and conditions must be considered in land use decisions. Watershed based zoning involves defining watershed conditions, measuring current and potential future development, identifying and classifying subwatersheds 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 the appropriate subwatershed management categories.

Watershed based zoning can employ a mixture of land use and zoning options to achieve desired results. A watershed based zoning approach should include the following steps[16]:

- Conduct a comprehensive drainage system inventory.
- Measure current levels of development.
- Verify development/stream water quality relationships.
- Project future levels of development.
- Classify subwatersheds based on stream management goals and current levels of development.
- Modify master plans/zoning to correspond to subwatershed development targets and other management strategies.
- Incorporate management priorities from larger watershed management units such as river basins or larger watersheds.
- Adopt specific watershed protection strategies for each subwatershed.

[16] Center for Watershed Protection. *The Stormwater Managers Resource Center*. http://stormwatercenter.net/.

Use of Urban Stormwater Best Management Practices

Conservation Site Design

Conservation site design is a 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. Minimum lot sizes, setbacks and frontage distances are relaxed to form more open space. Conservation site designs have many benefits compared to conventional developments: they can reduce impervious cover, stormwater pollutants, construction costs, grading, and the loss of natural areas. However, many communities lack zoning ordinances to permit open space development; those that have enacted ordinances may need to revise them to achieve greater water quality and environmental benefits.

The benefits of open space design 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.

Green Infrastructure & Low Impact Development (LID)

Green Infrastructure and LID attempt to mimic natural processes and limit the stormwater impacts of development on a site. 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 LEED certification (Figure 7). 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* is a good resource that can be found on American Rivers' website at http://www.americanrivers.org/library/reports-publications/.

Other Stormwater Management Practices

Stormwater permits are required for Municipal Separate Storm Sewer Systems (MS4s), but many of the management practices for Phase I and II communities are applicable in non-MS4s as well. The

management practices, known as the six minimum control measures, include Public Education and Outreach, Public Involvement/Participation, Illicit Discharge Detection and Elimination, Construction or Post-Construction Runoff Controls, and Pollution Prevention/Good Housekeeping. Within these there are requirements for erosion and sediment control ordinances and runoff source, conveyance, and treatment controls. The stormwater permits measures do not currently require riparian setbacks, but these are an important addition to a communities stormwater management practices.

All of these measures can be found in more detail within their respective chapters of the TMACOG *Stormwater Management Standards Manual*, third edition. In the appendix, the manual contains model ordinances/resolutions for those that are required by stormwater permits, which are also applicable for non-MS4s.

Recommended Implementation Activities

- U.S. EPA, OEPA, and MDNRE should work through the NPDES and TMDL programs to encourage the adoption of stormwater Best Management Practices (BMPs).
- Ohio DNR and MDNRE should work through the Coastal Nonpoint 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 Nonpoint Pollution Control Program Plan and the Michigan Coastal Nonpoint Pollution Control Program Plan.
- A regional planning entity should develop and maintain a uniform set of design standards for stormwater management.
- Each community should pass ordinances governing new development and significant improvements requiring utilization of stormwater BMPs. The requirements should incorporate in whole or in part the principals and practices set forth in the regional standards.
- The County Soil and Water Conservation Districts (SWCD) should develop and conduct information and education programs and materials individually and in partnership with TMACOG and watershed councils such as the Maumee RAP, the Portage River Basin Council, and the Sandusky River Watershed Coalition. Educational programs should be geared to take advantage of available funding through grant programs, such as the Ohio Environmental Education Fund, the Lake Erie Protection Fund, and the Coastal Zone Management Assistance program.

Complete Watershed Based Planning & Coordination

To adequately control current and future stormwater runoff, the problem 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 jointly take care of their common drainage systems, there is no guarantee that the natural watershed system will work to provide adequate drainage and water quality. A 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 master stormwater 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 ultimate development of the watersheds. Ultimate development is a

projection based on existing land use, proposed land use and current land use trends.

Recommended Implementation Activities

- 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.
- 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 maximize effectiveness, the OEPA Integrated Water Quality Report should be considered for guidance on implementing Best Management Practices on a watershed-specific level based on causes and sources of impairment.

Augment Protection of Wetlands and Floodplain

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.

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.

In addition, 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*, third edition.[17]

Recommended Implementation Activities

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

[17] Stormwater Management Standards Manual, TMACOG, 2008
http://www.tmacog.org/Environment/TMACOG_Stormwater_Standards_Manual_.pdf

- OEPA and MDNRE should work to expand the current protections provided wetlands through Section 404 of the Clean Water, which is administered by the Corps of Engineers. 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 Corps of Engineers wetland maps.

Improve Inspection, Enforcement, and Maintenance

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, nothing ensures that once the drainage leaves their jurisdiction, there is adequate drainage to carry the flow downstream or that the water quality meets the neighbor's use requirements.

All stakeholders — local governments, developers, construction contractors, industries, and citizens — need clear statements of what is expected of them and need to be held by all the others 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. Stormwater control measures, when properly implemented, have proven to enhance water quality and alleviate flooding problems. Long- or short-term funding options for inspection, enforcement, and maintenance should be explored.

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. Proper operation and maintenance language within a stormwater ordinance can ensure that initial designs facilitate easy maintenance and that regular maintenance activities are completed. Maintenance agreements with homeowners' associations or other private entities should be implemented for stormwater management practices on privately owned land.

Recommended Implementation Activities

- OEPA, MDNRE, and local governments should increase emphasis on the execution of stormwater BMPs and their continued maintenance. This should be accomplished by a combination of state and local inspectors that ensure that stormwater facilities are properly constructed and ordinance rules are followed.

Critical Urbanizing Watersheds

This Plan recommends priority areas, identified as Critical Urbanizing Watersheds[18]. This designation is intended to prioritize watersheds that are undergoing urbanization. Watershed designations are based on three criteria:

[18] Note: Critical Urbanizing Watersheds is a term defined for the AWQMP and is not related to the OEPA term Rapidly Developing Watersheds.

- Ohio EPA or MDNRE 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 2 "Environmental Policies" — Section on "Policy and Goal Statements" for more information).

Watershed Impairments Resulting from Urban Causes and Sources

The OEPA 2010 Integrated Water Quality Monitoring and Assessment Report contains information about the causes and sources. 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 through 11 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 Best Management Practices to help remedy the impairment.

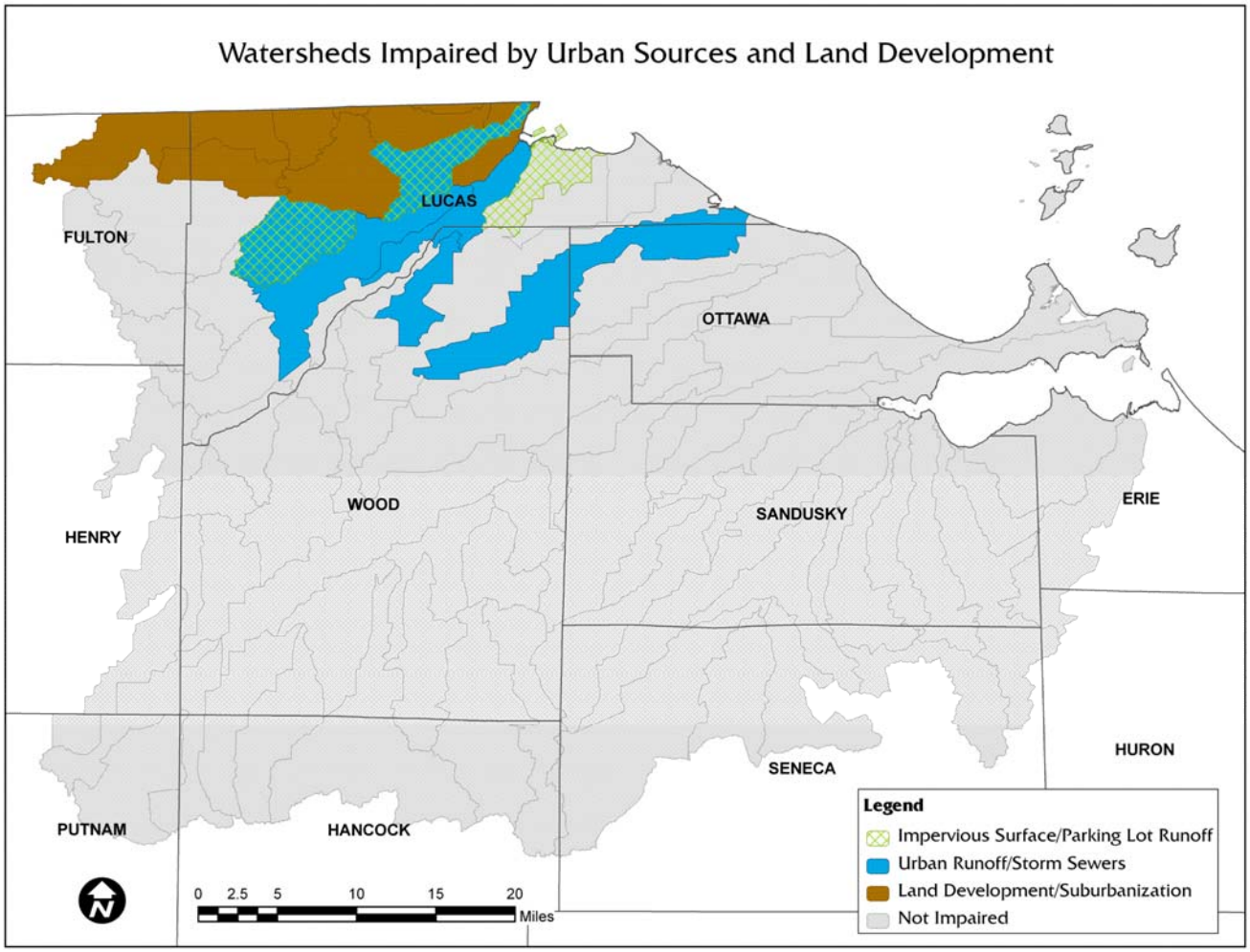

FIGURE 8: Watersheds Impaired by Urban Sources and Land Development

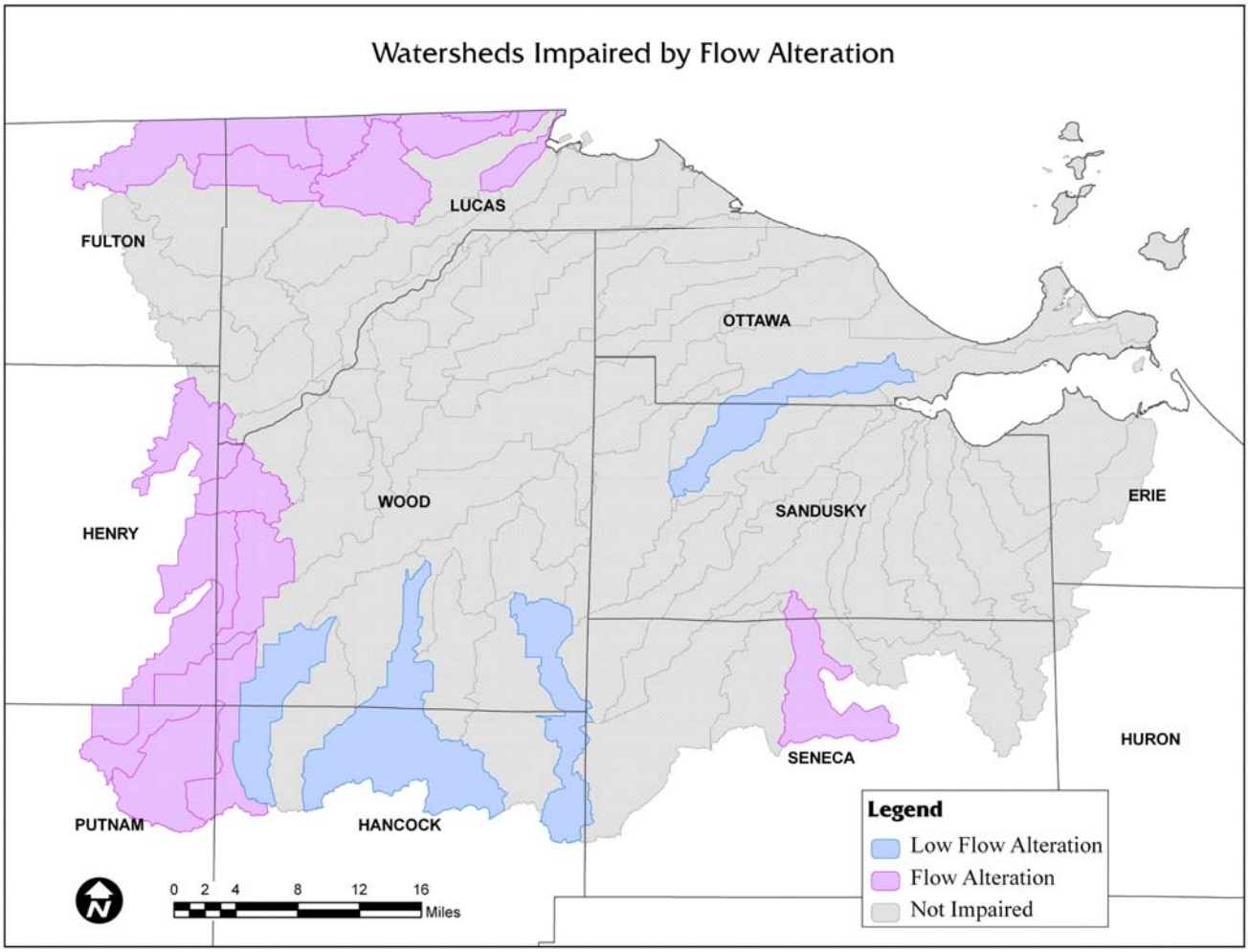

FIGURE 9: Watersheds Impaired by Flow Alteration

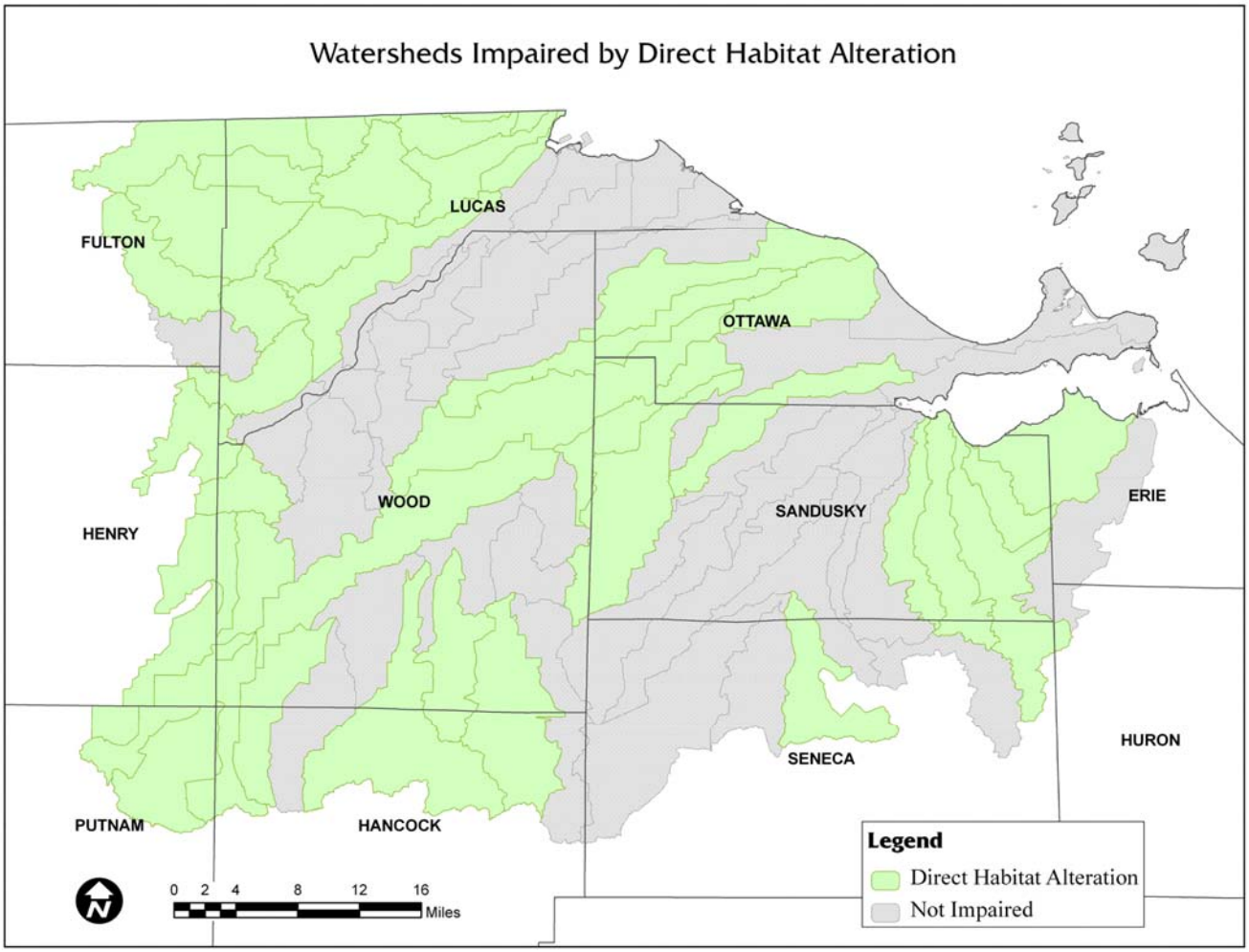

FIGURE 10: Watersheds Impaired by Direct Habitat Alteration

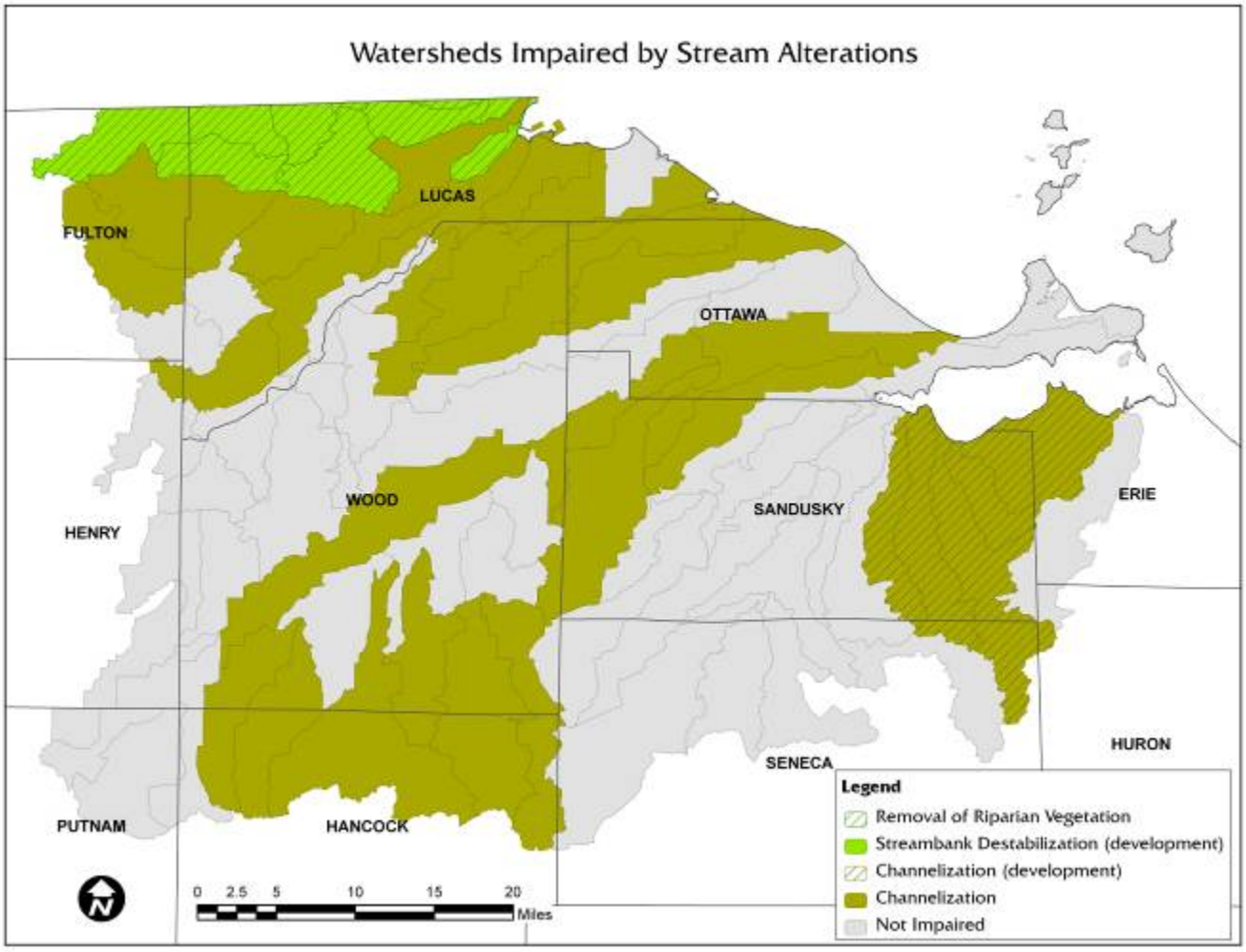

FIGURE 11: Watersheds Impaired by Stream Alterations

High Growth Jurisdictions

Figure 12 compares the 2000 to 2009 (estimated) U.S. Census Bureau data for population changes for the 208 region. Most of the population growth during that period was in Wood County and no jurisdictions in Sandusky County show high growth (as defined for this report by greater than 5% increase in population between years).

[27] The Toledo Stormwater Utility in 2001 estimates 13,219 impervious acres, plus about 1,000 miles of streets. Assuming average pavement and sidewalk width, the total is 16,128 acres, not counting 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.

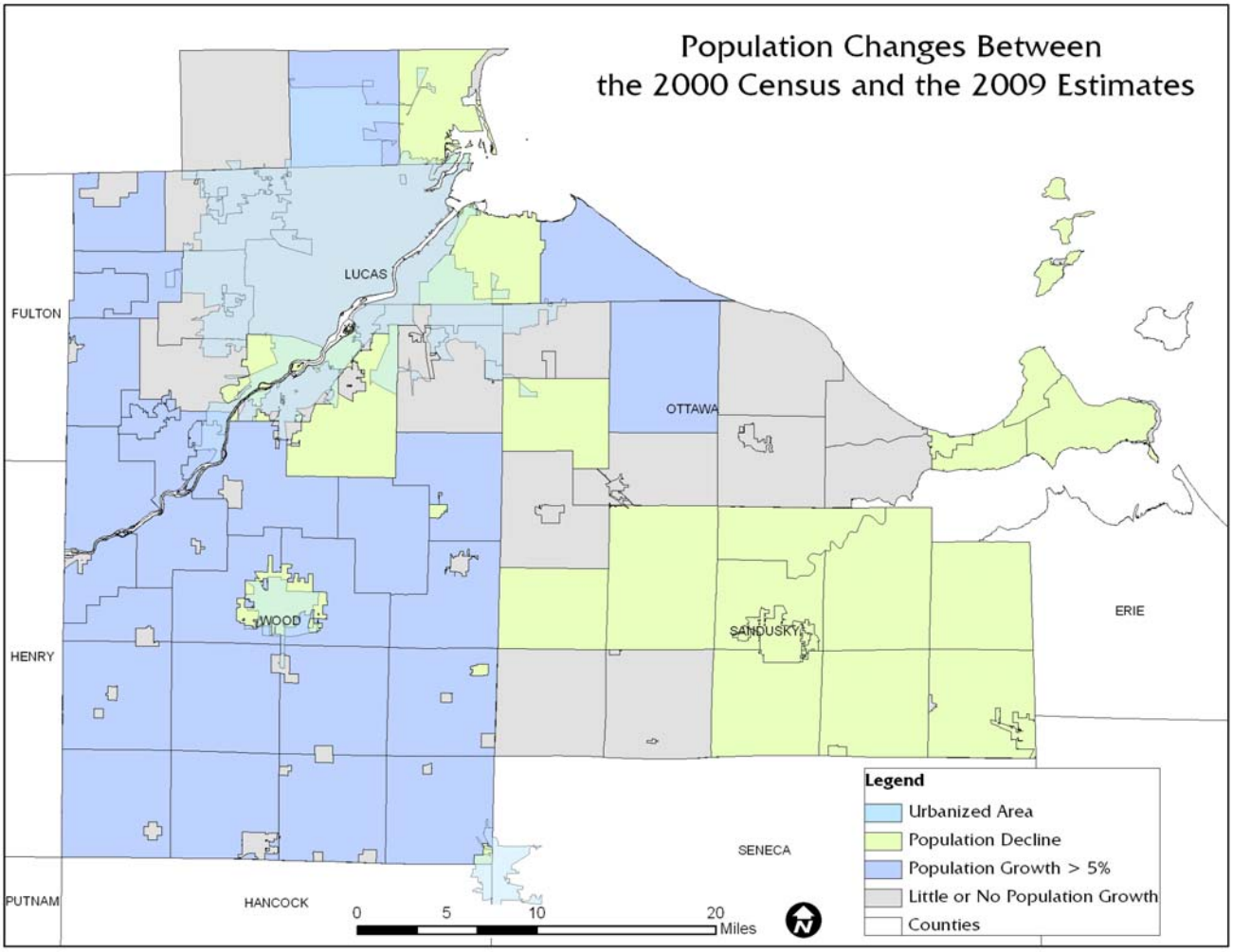

FIGURE 12. Population Changes 2000-2009

The following graph shows the percentage of high growth jurisdictions that have watershed impairments in one of eight categories (for example: 69.2 percent of high growth jurisdictions are within watersheds impaired by direct habitat alteration). These are causes and sources of impairment that are typically related to urban development. More than half of the high growth jurisdictions have watersheds impaired by direct habitat alteration. A small percentage of high growth communities had watersheds impaired by land suburbanization. This could signify that populations are moving from urban locations to suburban locations creating more impervious infrastructure in areas that were previously farmland or vegetation. This concept is further supported by the low percentage of high growth communities containing watersheds impaired by impervious surface/parking lot runoff.

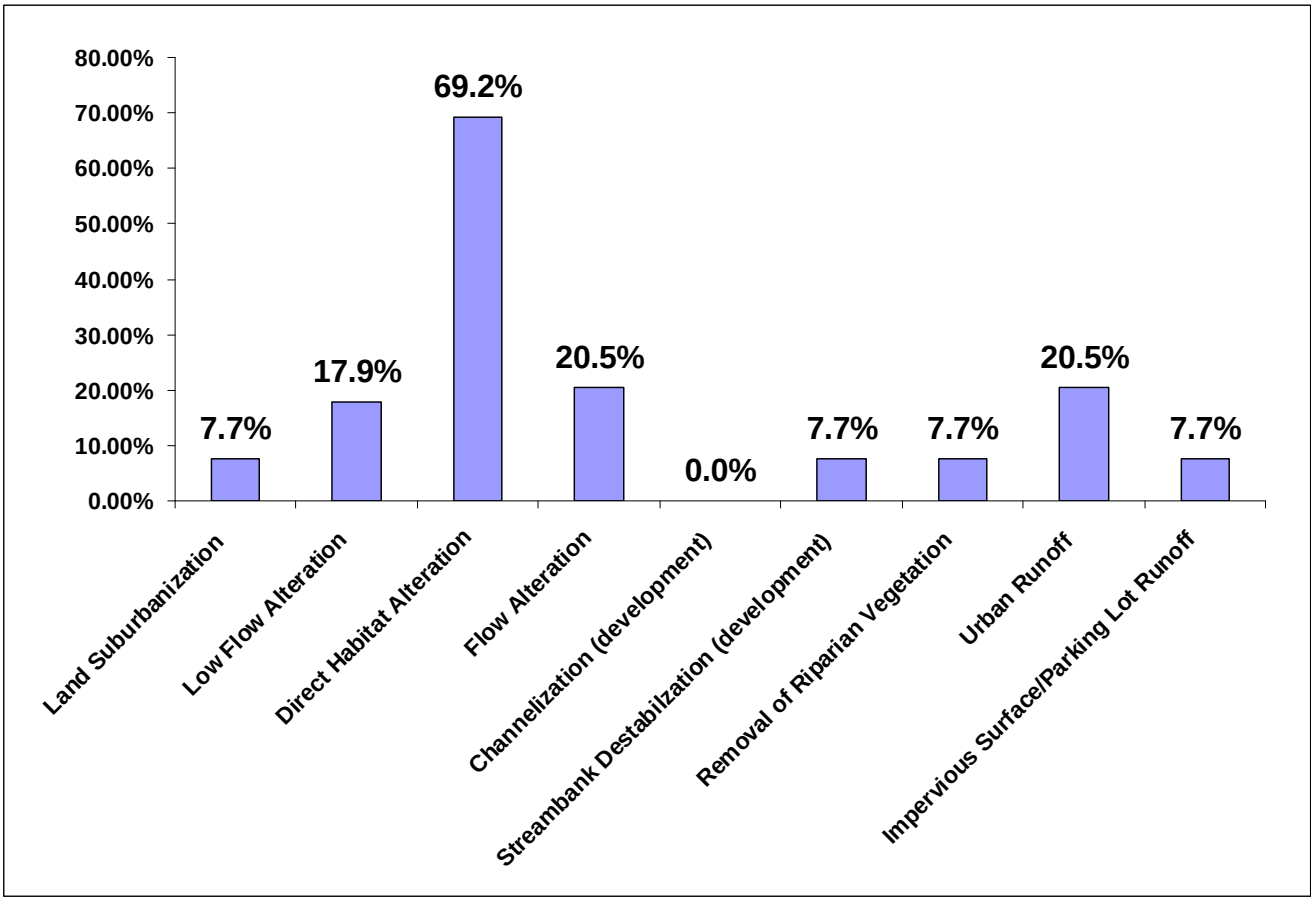

FIGURE 13. Percentage of High Growth Jurisdictions Containing Impaired Watersheds by Impairment Category

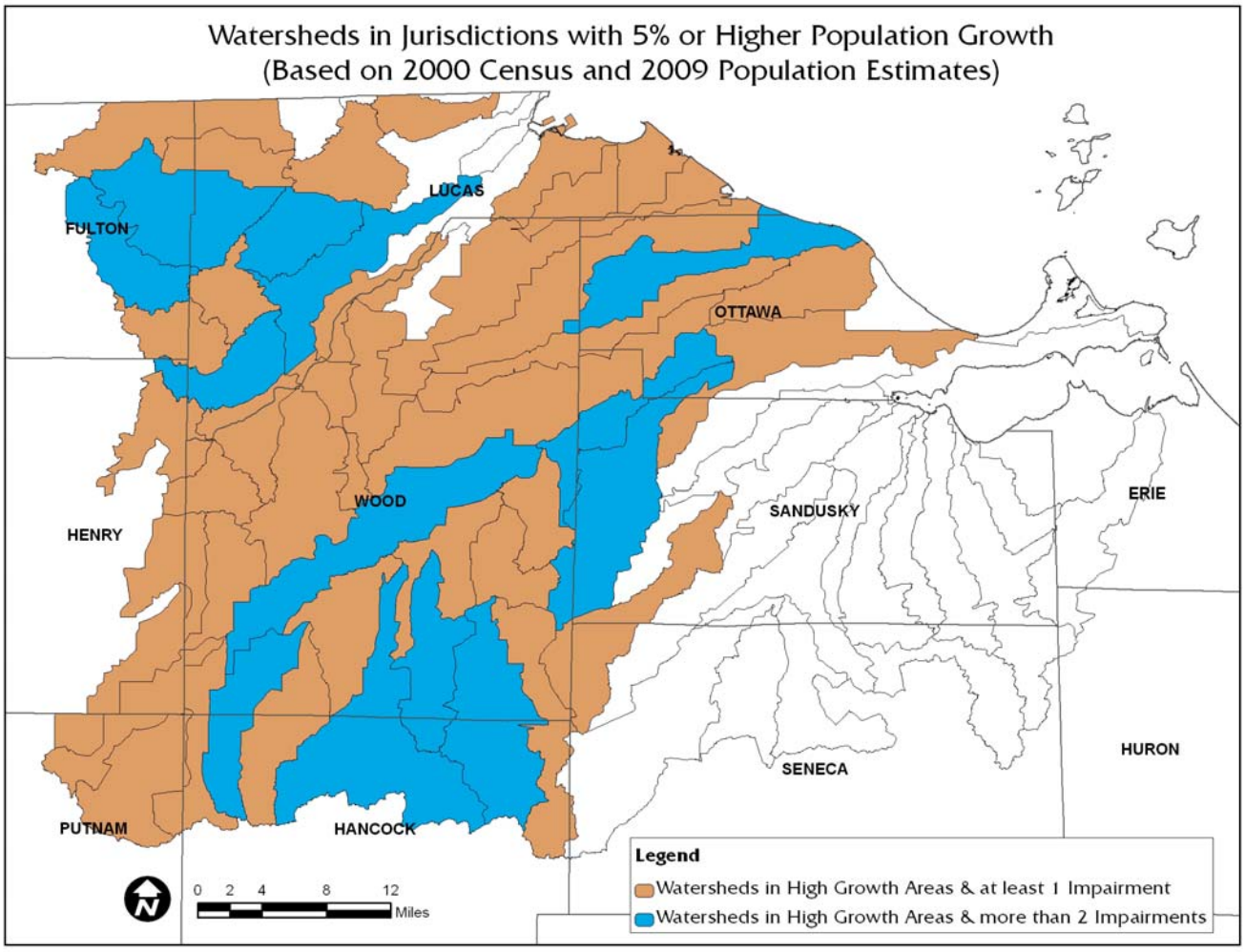

FIGURE 14. Critical Urbanizing Watersheds

Figure 14 shows watersheds that flow through high growth jurisdictions (defined in this document 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 watersheds.

Managing Critical Urbanizing Watersheds

Uses of Critical Urbanizing Watersheds

- Priority areas for projects to implement BMPs identified earlier in this plan. In particular projects expand, enhance, and preserve wetland, habitat, and floodwater storage are recommended. 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).
- Recommended as priority areas for TMDLs to identify sources and BMPs addressing urban nonpoint sources.
- Recommended as priority areas for local and county ordinances/regulations to protect wetlands and floodplains.
- This Plan supports funding proposals to buy natural habitat properties or conservation easements in these areas for the purposes of natural habitat and floodwater storage.

Priorities for Already Urbanized Watersheds

There are also opportunities in already urbanized watersheds for implementing BMPs and restoring habitat and water quality. Urban areas in the region are estimated to have 30-35% impervious surface area[27]; Schueler [28] classifies urban streams with more than 26% impervious cover as non-supporting streams. This Plan makes the following recommendations:

- Generally, urbanized watersheds are covered by either Phase I or Phase II NPDES Stormwater permits. It is recommended that local governments and businesses meet the requirements of Phase I and II, and construction site permits. BMPs are encouraged throughout urbanized areas.
- Political jurisdictions in urbanized areas are recommended to adopt and implement the *Stormwater Management Standards Manual*.
- 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.

Implementation Plans

The following documents are implementation plans specific to issues and conditions in portions of the region. They are hereby incorporated by reference as part of this chapter of the *Areawide Water Quality Management Plan*.

- TMACOG *Stormwater Management Standards Manual*[29]

[28] Schueler, T.R. *The Importance of Imperviousness*. Watershed Protection Techniques, vol. 1, no. 3, Fall 1994, pp. 107-8.
[29] http://www.tmacog.org/Environment/TMACOG_Stormwater_Standards_Manual_.pdf