

(Working Draft Ready for Use in Developing Projects)

Lake St. Clair Area Planning Strategy

A Planning Companion to the St. Clair River and Lake St. Clair Comprehensive Management Plan



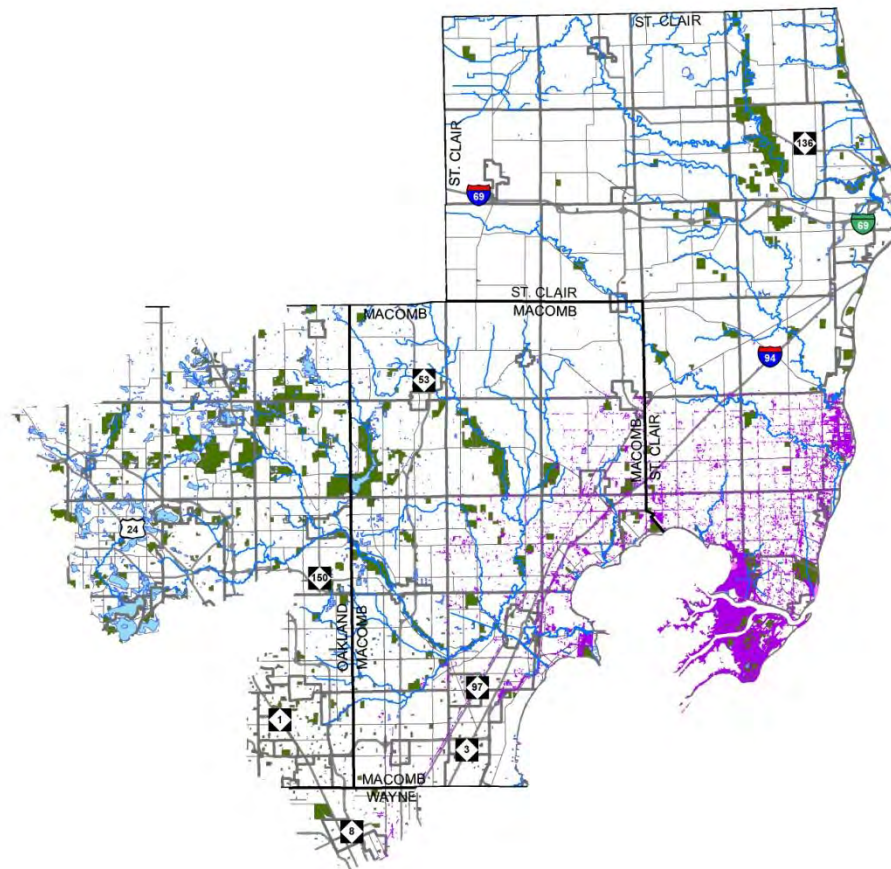
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INTRODUCTION

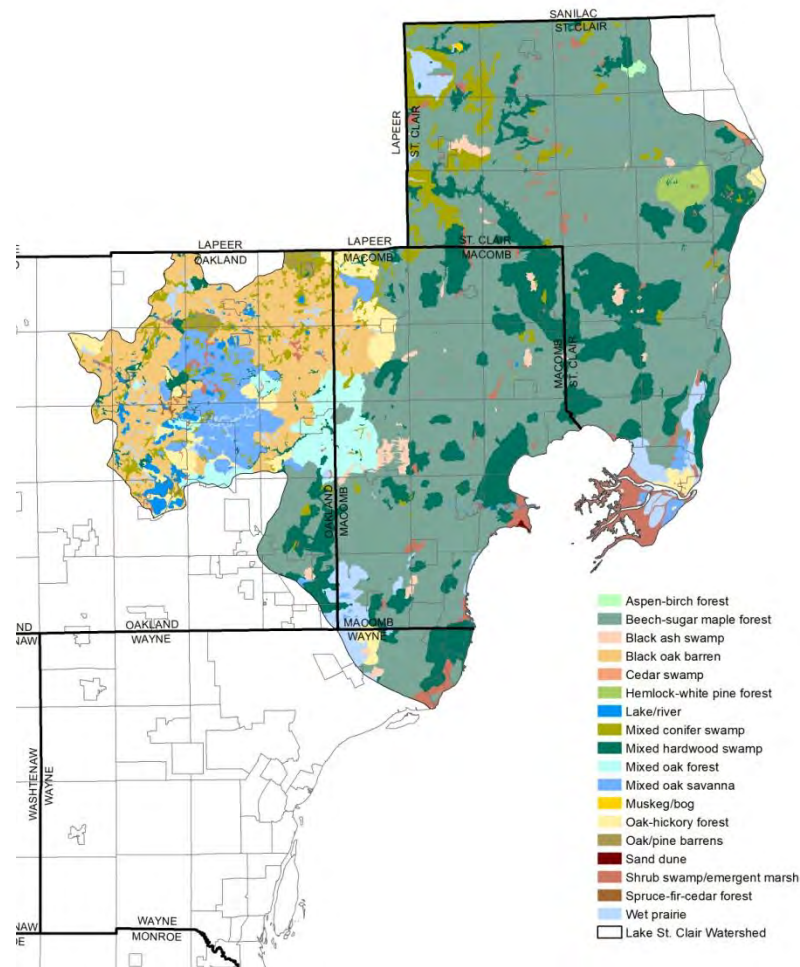
The geographic scope (**Figure 1**) of the Lake St. Clair watershed includes Lake St. Clair, the Grosse Pointes (Wayne County), Clinton River in Macomb County and Oakland County, Lake St. Clair Direct Drainage, Anchor Bay Watershed, the St. Clair River and its tributaries (Black River, Pine River, Belle River), and the St. Clair River Direct Drainage in St. Clair County. These geographic areas are included in the scope of the St. Clair River and Lake St. Clair Comprehensive Management Plan (Management Plan). The Management Plan was developed between 1999 and 2004 when it was approved by Army Corps of Engineers and released for public consumption. The report which is now 13 years old, addresses Environmental and Public health of the watershed, Loss of habitat, Land use and Stormwater management, Fisheries and recreational boating and Monitoring. Today, the plan is outdated and does not reflect current local and regional planning activity and even some terminology or nomenclature has changed. For example, terms such as green infrastructure and Cooperative Invasive Species Management Area are absent.

Figure 1 Lake St. Clair Watershed



The Management Plan includes 110 recommendations for protecting, restoring and enhancing the Lake St. Clair Area watershed. The watershed is vast, covering approximately 2,100 square miles and offering diverse types of natural green infrastructure. In fact the watershed possesses physical qualities that have global significance, including the St. Clair River Delta, one of the largest freshwater deltas on earth; coastal marshes, that have the biological productivity rivaling a tropical rain forest, and tall grass prairies and oak savanna ecosystems that contain hundreds of plant species. **Figure 2 Highlights the Presettlement Land Cover for Southeast Michigan.**

Figure 2 Presettlement Land Cover for Southeast Michigan



Assistance in Developing Relevant Projects for the SIP

The purpose of this document is to serve as a bridge between the comprehensive management plan and current local and regional planning issues in order to assist partners and stakeholders in developing relevant projects with identified funding opportunities for the next (2018) update of the Strategic Implementation Plan (SIP). A four month project development phase has just begun. This is part of a year long process to upgrade the Strategic Implementation Plan and make its implementation process more effective based on eligible funding opportunities. The Schedule of Milestones for the SIP Upgrade process is as follows:

- 08/1-12/1 *Project Development Period:* A four month period dedicated to project development based on the new Lake St. Clair Area Planning Strategy. During this period, implementation Strategies will be developed for each Plan Priority which contain significant numbers of projects.
- 12/14 *Meeting of full Lake St. Clair/St. Clair River Partnership:* To review and advise on the list of projects developed to date and provide details of project solicitation and submission process beginning in January 2018.

2018

- 01/2/-03/2 *Project Solicitation and Submission Process:* A two month project submission process, in which a solicitation package is distributed to Lake St. Clair partners and stakeholders which guide the submission of projects to the Partnership over SEMCOG's website, as in the past.
- 03/15 *Meeting of SIP Implementation Team (SIT):* Reviews and lists all projects in the SIP document bins all projects in Plan Priority categories, Identifies and lists all projects that are not consistent with the plan priority categories, reviews draft implementation strategies.
- 04/17 **Meeting of full Partnership:** Release of Draft SIP to Partnership for 30 day review. Partners are asked to send comments to SEMCOG by May 1st (5/1).
- 05/17 SIP Report is completed and distributed to Partnership.
- 05/18 Begin scheduling meetings with Congressional supporters and state and federal funding agency representatives.

This document is iterative and will be updated as needed by the Partnership. The document uses current planning issues, policies, recommendations, actions and example projects from existing county, regional and state planning documents as well as other technical references that apply to the issues raised in and addressed in the Comprehensive Management Plan. This document uses text – in some cases large sections of text -- pulled directly from these public planning resources. Please refer to the Reference page at the end of this document for a complete listing of the documents used.

This planning document is a tool to assist Lake St. Clair Partners and stakeholders in developing projects that address current water quality, conservation, restoration and recreational use issues. For example, planning issues that are high on the list of local and state land managers and planners include: The *Blue economy*, an economic model that draws a closer tie to natural resource protection as a method of building economic growth. *Green infrastructure* consists of the natural ecosystems that are found within a community providing significant social, environmental and economic benefits to the residents and wildlife within the community. *Resiliency*, describes the ability of an ecosystem (such as riparian,

wetland, or forest) to survive and thrive in the face of rising conditions of impermeability or climatic changes (such as warming) and its impacts. *HABs (Harmful Algal Blooms)*, are endangering public health, public use, and ecological health of the people and wildlife in the western and central basins of Lake Erie. Numerous actions and planning initiatives are underway to reduce the production of the toxic blue-green algae -- primarily through a recommended reduction of phosphorus by 40 percent.

Consistency with the Great Lakes Restoration Initiative and Lake Erie Action Management Plan

In 2004, The federal government launched the Great Lakes Regional Collaboration (GLRC), an unique partnership between federal, state and local governments and other stakeholders to develop a strategic action plan for protecting, restoring the Great Lakes basin for this and future generations. This action plan is intended to build on the extensive regional work that is currently going through strategies in the areas of:

Aquatic Invasive Species Strategy is to prevent significant future ecological and economic damage to the Great Lakes through such actions as: passage of comprehensive federal AIS legislation, prevention of AIS introductions by ships through ballast water, stopping invasion of species through canals and waterways, restricting trade in live organisms, establish a rapid response and management program and education and outreach.

Habitat/Species Strategy will provide significantly more habitat conservation and species management through such recommendations as: native fish community in open water and near shore habitats, wetlands, riparian (streams) habitats in tributaries in to the Great Lakes, and, coastal shore and upland habitats.

Coastal Health Strategy to protect source water, recreational activities and minimize health risk resulting from contact with coastal near shore waters through: major improvements in wet weather discharge controls from combined and sanitary sewers, identify and control releases from indirect sources of contamination, implement a “risk-based approach” to manage recreational water, protect sources of drinking water, and improve the drinking water infrastructure.

AOC/Sediments Strategy to address the 31 most contaminated areas of the Great Lakes (St. Clair River, Detroit River and Clinton River are located adjacent to Lake St. Clair) include: amend the Great Lakes Legacy Act to increase funding and streamlining the process, Improve federal, state and local capacity to manage the AOC clean-up, create a federal-state AOC coordinating committee to work with local and tribal interests to accelerate the clean-ups, promote clean treatment and disposal technologies as well as better beneficial use and disposal options.

Nonpoint Sources Strategy, which will address the significant NPS pollution in AOCs, other locations in the Great Lakes including open, includes: wetland restoration, restoration of buffer strips, improvement of cropland soil management, implementation of comprehensive nutrient and manure management plans for livestock operation, and, Improvements to the hydrology in watersheds.

Toxic Pollutants Strategy will address the continued threats to human and wildlife health and will include: Reducing or virtually eliminating the discharge of mercury, PCBs, dioxins, pesticides, and other toxic substances in the Great lakes, Prevent new toxic substances from entering the Great Lakes, Institute a comprehensive research, surveillance and forecasting capability, create consistent, accessible and easy to understand fish consumption advisories throughout the basin enlist the general public in efforts to reduce the generation and use of toxic substances throughout the Great Lakes.

Indicators and Information Strategy will provide information about the status of the ecosystem through representative indicators and include: coordination of monitoring, information management, representative indicators, research and communication under a coordinating council, support the U.S. Integrated Earth Observing System (IEOS) and Integrated Ocean Observing System (IOOS) as key components of the Global Earth Observation System of Systems, double funding for Great Lakes research over the next five years, establish a regional information management infrastructure, and create a Great Lakes communications workgroup to manage scientific and technical information.

Sustainable Development Strategy will address actions needed to: adapt and maintain programs that promote sustainability across all sectors, align governance to enhance sustainable planning and management of resource, and build outreach that brands the Great Lakes as an exceptional and competitive place to live, work, invest and play.

In 2010, the **Great Lakes Restoration Initiative** was launched to implement the recommendations of the GLRC, accelerate efforts to protect and restore the largest system of fresh water surface water in the world – and provide additional resources to make progress toward the most critical long-term goals for this important system.

As of July 2015 the GLRI has provided \$1.66 billion dollars funding some 2,000 projects across the basin. The GLRI is accelerating Great Lakes protection and restoration focusing its resources now in four areas:

- Cleaning up Great Lakes Areas of Concern,
- Preventing and controlling invasive species (Both AIS and TIS)
- Reducing runoff that contributes to algal blooms and
- Restoring habitat to protect native species

Lake Erie Lakewide Action and Management Plan

Lake Erie is the shallowest and warmest Great Lake, resulting in the highest primary production (i.e., algae growth), biological diversity and fish production of all the Great Lakes. Home to over 12 million people, the Lake Erie watershed is highly agricultural, and includes a number of large urban centers and zones of very intense industrial activity. These agricultural and industrial activities have resulted in increased nutrient concentrations, pollution, and habitat loss and degradation.

The next Lake Erie LAMP will be issued in 2018. In the interim, the Lake Erie Partnership are issuing annual reports assessing the state of the lake, measuring progress against existing LAMP goals and objectives, and promoting management actions to address identified problems. The 2015 Lake Erie Lakewide Action and Management Plan Annual Report focused heavily on the challenges and accomplishments in reducing phosphorus and hazardous algal blooms in the Western Lake Erie Basin.

Michigan's Domestic Action Plan (DAP)

Michigan's DAP for reducing phosphorus from the Michigan side of the basin include the following:

- Waste Water Treatment Plant reductions at Great Lakes Water Authority WWTP), Wayne County Downriver Wastewater Treatment Facility (DWTF), Ypsilanti Community Utility Authority Wastewater Treatment Plant (YCUA WWTP)
- Based on 2008 loads, reduce the following by 20 percent by 2020, and 40 percent by 2025:
 - TP loads from the Detroit River.
 - Spring TP loads from the River Raisin.
 - Spring SRP loads from the River Raisin.
 - Spring TP and SRP contributions from the Maumee River. This objective will be refined for Michigan's waters of the Maumee River following results of watershed monitoring conducted by Michigan, Ohio, and Indiana.
- Monitor and implement Maumee River Watershed reductions
- Implement Nonpoint Source reductions throughout Michigan's portion of the basin (accelerate MAEAP (Agriculture Environmental Assurance Program) certifications, Implement wetland restoration on state managed lands)
- Support and invest in research to understand Harmful Algal Blooms, invasive mussels, and Soluble Reactive Phosphorus*

The GLRI is funding research and actions— basically the objectives of the Lake Erie Lakewide Action Management Plan to reduce phosphorus and occurrences of Harmful Algal Blooms in the Western Lake Erie Basin.

Content of this Document

This document, the Lake St. Clair Area Planning Strategy is consistent with both the GLRI Action Plan II and the Lake Erie Lakewide Action Management Plan. It addresses the following issues: Protecting Drinking Water (monitoring and modeling of source water and benefits of wellhead protection programs, Green Infrastructure, as it deals with stormwater management and protecting and restoring natural Green Infrastructure (trees/woodland, wetlands and riparian corridors), the emerging Blue Economy, Invasive Species Management and Adaptive Planning for climate change (warming).

PLANNING CATEGORIES

Protecting Drinking Water

Testing Source Water

There are approximately 22 million organic and inorganic substances now known. Of that number, 6 million are available commercially, yet only 250,000 (about 1 percent of the known chemical universe) have been inventoried, assessed and regulated by any of the countries in the world. Advances in chemical analysis are finding a significant number of new potential pollutants in our nation's drinking water system. Just because a chemical is found in a drinking water source, does not make it harmful. The risk must be assessed and if necessary limits established. The regulatory agenda is still narrower. Regulatory agencies, since the 1970s have focused nearly exclusively on conventional pollutants such as bioaccumulative chemicals of concern (BCCs), persistent organic pollutants (POPs), or persistent bioaccumulative toxic (PBT) pollutants. In addition, there is no significant state or federal requirements for monitoring a source water for spills or other types of contamination.

Monitoring Source Water

The 80 mile Huron to Erie Corridor, consists of the St. Clair River, Lake St. Clair and the Detroit River. There are 14 municipal water treatment plants and numerous chemical and petrochemical facilities along its course. In addition, 9 petroleum pipelines cross both rivers, threatening catastrophe for the rare and endangered flora and fauna residents of the St. Clair River delta. In addition, this international corridor is a major global shipping route and used by boaters, anglers, hunters, kayak and canoers, hikers and as a drinking water source for some 4 million people.

Integrating Modeling with Monitoring

According to a 2006 Government Accounting Office report, 991 reports of spills along the St. Clair/Detroit River System were received by the NRC (National Response Center) between 1994 and 2004. Yet current state and federal drinking water regulation does not require any meaningful level of source water monitoring.

PEAS (Pollution Emergency Alerting System) is the current notification used in Michigan to alert parties about spills. All calls to the PEAS hotline are handled internally by DEQ staff. There is a new database that stores information from new intake forms. Once a spill is received by PEAS it is referred to Water Division staff to investigate the size, location and impacts the spill may have on shoreline facilities and populations. Unfortunately many of the spills originate on the Canadian side. In the past Canadian notification to DEQ of spills on their side have lagged and water treatment plants did not receive timely

information to react. Notification time between Ontario and Michigan has improved. However, not all spills come with a notification, especially if not immediately discovered or if done intentionally.

Spill planning scenarios are performed regularly along the Huron to Erie Corridor by U.S. EPA, Michigan DEQ and local governments. The purpose is to plan for and be ready for any spill or catastrophic scenario that could occur along the corridor. A table top exercise was held in May of 2015 to develop plans and actions for an Enbridge pipe breakage and spill within the St. Clair River.

In order to protect public health, water treatment plant operators must be aware of potential source water risk/threats such as accidental spills, emergency diversions into source water areas, or the presence of nutrient triggered toxic algal blooms. A major spill event that drove home the need for intake protection came on February 1, 2004 -- Super Bowl Sunday in Detroit -- when a chemical spill occurred at the Imperial Oil facility in Sarnia's "Chemical Valley." The contaminants flowed downstream and eventually forced the nine municipal drinking water plants on the St. Clair River and Lake St. Clair to shut their intakes.

In response to these public health threats, the Huron to Erie Drinking Water Protection Network was established in 2005. See **Figure 3**, *Map of Drinking Water Protection Network*. A system of real-time monitoring equipment including YSI Sonde, TOC Analyzer, Fluorometer, and GC/MS (Gas Chromatography/Mass Spectroscopy) were installed in the fourteen WTPs along the waterway and funded through state and federal grants with significant local cost share. A benefit of the system is that it links all water treatment plants through a communication/notification system.

The equipment was expensive, prone to errors, and hard to maintain. Eventually the network fell apart with only 6 WTPs remaining as members in 2015.

Original members of the network included:

- City of Port Huron
- City of Marysville
- City of St. Clair
- City of Marine City
- East China Township
- City of Algonac
- Ira Township
- City of New Baltimore
- City of Mount Clemens
- City of Grosse Point Farms
- Water Works Park Pump Station (Great Lakes Water Authority)
- Southwest Pump Station (Great Lakes Water Authority)
- City of Wyandotte
- City of Monroe

Figure 3 Municipal Water Treatments Along Huron to Erie Corridor



SEMCOG, as part of its update to its Water Resources Plan for Southeast Michigan, addressed Drinking Water as a priority issue. As part of the planning process, SEMCOG is re-initiating the Huron to Erie Drinking Water Protection Network. The new network will use less expensive monitors such as sondes or higher depending on the ability of the plant to maintain and calibrate the monitors.

Integrating Real-time Modeling with Monitoring

In 2009-2010, contaminant spill scenarios were simulated along the St. Clair River in a joint Great Lakes Observing System (GLOS) GLOS and NOAA-GLERL (Great Lakes Environmental Research Laboratory) initiative (Anderson and Schwab) using the Huron-Erie Corridor Waterway Forecast System (HECWFS), a three-dimensional hydrodynamic model. There were three spill transects used along the St. Clair River -- at Sarnia, Marysville, and St. Clair. Each transect had five release locations equally spaced across the river. Two dye releases were made at each release location -- one surface (floating) and the other bottom (sinking) -- for a total of 30 spill scenarios. The simulations calculated spill characteristics data such as time of arrival at each of the eight downstream transects (for recording spill parameter data), or at water treatment plants through interpolation, location of plume relative to shoreline, and location of peak plume concentration over time. A graphic-based spill tracking tool for the St. Clair River was developed by NOAA-GLERL for the Water Treatment Plant operators based on data generated in each

spill simulation. Funding has recently been secured to conduct spill scenario simulations in Lake St. Clair and the Detroit River beginning in Summer 2017.

Other applications that HECWFS can address include:

- Navigation needs (water levels and currents)
- Search and rescue
- Petrochemical spills
- Drinking water safety
- Water quality at swimming beaches
- Habitat restoration projects
- Hotspots for invasive species.

Protecting Public Ground Water Supply Systems

Local communities have an obligation to protect public health. For communities with ground water public supply systems (PWSS), protecting its source water supply aquifer from potential sources of contamination must be a priority.

The State of Michigan developed its Wellhead Protection Program in response to the 1986 amendments to the Safe Drinking Water Act (SDWA). Unlike many programs around the country, Wellhead protection (in Michigan) is a voluntary program which is implemented on a local level through the coordination of activities by local, county, regional, and state agencies. Guidelines for the program was developed by the Michigan Department of Environmental Quality (MDEQ); and while the program is voluntary, public water supply systems (PWSS) who wish to participate in wellhead protection must develop a WHPP that follows the guidelines established by the MDEQ.

Seven Elements of Wellhead Protection

Local Wellhead Protection Programs must specifically address seven elements which include:

Roles and responsibilities: This element requires identifying individuals to work together in developing the wellhead protection program. Also, as the source aquifer may be located under several communities, this element may require partnership building among local, county and state agencies that will share the responsibilities of developing and operating the wellhead protection program.

Wellhead Protection Area (WHPA) Delineation: The federal SDWA defines a wellhead Protection Area as “. . . the surface and subsurface area surrounding a well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field. In essence, the area which contributes ground water to a PWSS. Michigan’s WHPP requires a hydrogeologic study to identify this contributing area.

Potential Sources of Contamination: Michigan’s WHPP requires the identification of potential sources of contamination within the WHPA. As a minimum, known and potential sites of environmental contamination should be included on a contaminant source inventory for the WHPA. Known sites of environmental contamination may include leaking underground storage tanks, Superfund sites, sites of environmental contamination, and oil and gas contamination. Sites of potential contamination include registered underground storage tanks, hazardous waste generators, chemical storage facilities and ground water discharges.

Wellhead Protection Area Management: Managing the wellhead protection area is done through the development and implementation of mechanisms which prevent existing and potential sources of contamination from reaching the public water supply well or well field. Communities are encouraged to develop management strategies which may be unique to their situation and specific to the contaminant

source inventory. Management approaches may entail a broad range of activities including facility inspections, land-use regulations, operational policies, best management practices, public information and education.

It is important that community leaders support the establishment of a wellhead protection program. This will provide a measure of assurance that land use and land protection regulations that supports wellhead protection are developed. Further, for effective land use development that respects wellhead protection, it is important that both the wellhead concept and the WHPA is incorporated into the community's Master Plan.

Contingency Plans: It is the responsibility of the PWSS to develop an effective contingency plan for emergencies that may threaten wells serving the PWSS. The plan should identify personnel, testing equipment, materials and procedures necessary for the fast and effective mitigation of emergencies. A contingency plan should include public water supply system emergency response protocol (as required by the SDWA), notification procedures, and methods for handling emergencies based upon the nature of the emergency and the threat to the PWSS. Contingency plans should provide a course of action with an emphasis on providing a mechanism for containment in the case of chemical spills.

New Wells: Where water supply expansion, increases in water use, or susceptibility of existing wells to contamination threats, warrant development of additional production facilities, a mechanism should be provided to incorporate the new facilities into the local WHPP. PWSSs which undergo expansion with the construction of new wells are strongly encouraged to incorporate the new wells into the local WHPP. WHPA delineation is easier (and cheaper) at the time of construction, wellhead protection can be used to evaluate the availability of the ground water resources in an area, and helps ensure that ground water resource development is occurring in areas which are not subject to contamination.

Public Education and Participation: Community involvement in the development and implementation of the local WHPP helps to ensure its success and longevity. It is essential that individuals who live, work, and own businesses in the WHPA take an active interest in the program. To generate interest in wellhead protection, communities have focused on public education and the dissemination of wellhead protection information. Public education may be provided by presentations, at village/city/township meetings, before local boards and commissions, and at local schools. Information can be provided through wellhead protection newsletters and brochures, radio and cable television spots, and signs posted in WHPAs.

Outcomes

- All 14 WTPs along the Huron to Erie Corridor are participating in the Huron to Erie Drinking Water Protection Network.
- More efficient and effective operations for spill response/search and rescue.
- Timely response to spill events by water intake plant operators.
- The human health of some 3 million people is now protected.
- All communities in the Lake St. Clair Area with potential or existing sources of contamination to a community well or well fields are taking advantage of Michigan's Wellhead Protection Program.

Regional Policies

- Reduce health risks and costs associated with pollutant spills in the Lake Huron to Lake Erie Corridor.
- Ensure that all have safe drinking water, monitor intakes to detect contaminants and implement coordinated and timely procedures for notification and emergency response.
- A strong link between Coast Guard National Response Center and DEQ's PEAS must be established so that in the event of an oil spill local governments that receive damage from oil spill

can be reimbursed under the Oil Spill Liability Act if notification occurs upfront and not after the fact.

- Consider integrating real-time modeling with monitoring to improve the effectiveness and ability to track spills and protect human health.
- Stable state and local funding sources should be investigated to support this human health protection priority.
- Local and county governments using ground water public supply systems are encouraged to consider the benefits of a wellhead protection program to protect their drinking water supplies from potential or known sources of contamination.

Actions

- Re-establish the Huron to Erie Drinking Water Protection Network collaborative of municipal water treatment plant operators to provide the tools and means for Water intakes protection from spill contaminants and investigate the benefits of an integrated system of both monitors and modeling.
- Go forward with spill scenario modeling in Lake St. Clair and the Detroit River and develop results for the entire Huron to Erie Corridor.
- Evaluate the need for public education on wellhead protection in the Lake St. Clair watershed.

Example Projects

- Implement the Great Lakes Observing System (GLOS) funded project entitled Simulating Spill Scenarios for Public Health Protection in the Huron to Erie Corridor.
- Integrate more closely the working relationship of Huron to Erie Drinking Water Protection Network with GLOS.
- Look for other water quality protection applications for applying HECWFS.
- Search for cost effective methods and funding for a WTP intake monitoring program.
- Initiate development of an inventory of communities in the Lake St. Clair Watershed on well water supply, that could receive information on contaminant sources (potential or existing) and wellhead protection options.

Green Infrastructure in the Lake St. Clair Area

What is Green Infrastructure?

Green Infrastructure is important as it recognizes the efficiency of natural systems in treating and managing stormwater and promotes the local management, enhancement and conservation of natural areas within local communities. This discipline also extends to creating engineered stormwater facilities that replicates a natural system's physical processes for treating and managing stormwater. Thus, Green Infrastructure is defined in two broad categories in Southeast Michigan. First, it includes ecosystems that are present in the natural, undisturbed environment such as wetlands, woodlands, prairies, and parks. The second category includes constructed or built green infrastructure such as rain gardens, bioswales, community gardens and agricultural lands. Within these natural and built categories, it's critical that green infrastructure be viewed as and evaluated as an integrated system.

Where is Green Infrastructure found?

Green infrastructure can be found almost anywhere. There is 180,000 acres of green infrastructure in Southeast Michigan. Much of our green infrastructure is located in parks, schools, along riparian corridors, and even along main streets in downtowns.

Types and Locations of Green Infrastructure

Urban

- Street trees
- Community gardens in previous vacant lots
- Small active or passive recreational parks
- Rain gardens and bioswales along roads and parking lots
- Green roofs
- Non-motorized paths that connect with urban trails

Suburban

- Regional parks and recreation areas
- Rain gardens and bioswales along roads and parking lots
- Conservancy land
- Trails
- School yard habitats

Rural

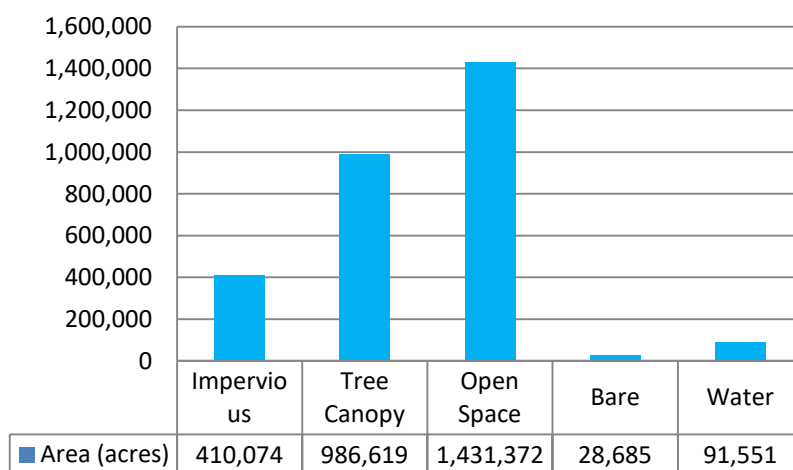
- Agricultural land
- Riparian corridors
- Natural areas, such as wetlands, woodlands and prairies

Land cover

Green infrastructure is a component of Southeast Michigan's land cover. Five classifications of land cover were determined for Southeast Michigan using 2010 leaf-off imagery.

Table 1 *Land Cover of Southeast Michigan*

- Impervious surface
- Tree canopy
- Open space
- Urban: bare
- Water



Lake St. Clair Area Impervious: 180,659 (6%)

Parks

Public parks are one of the most recognizable types of green infrastructure. Public parks can range in size from small pocket parks to large recreation areas over 200 acres.

The public should have access to public parks, especially from their neighborhoods. Walking distance to a local public park is generally accepted at 0.25 to 0.5 mile. At the regional level, and in more urbanized areas, access to residential parks fall within this recommendation. In rural counties – such as Monroe and St. Clair Counties this recommendation is not met. **Table 2 Distance to Parks (Miles)**, provides a summary of the distance to parks from residential parcels as well as other land use facilities.

Table 2 Distance to Park (miles)

	Livingston	Macomb	Monroe	Oakland	St. Clair	Washtenaw	Wayne	Out Wayne	Detroit	Regional
Commercial	0.34	0.37	0.50	0.28	0.39	0.30	0.28	0.30	0.27	0.31
Institutional	0.33	0.31	0.52	0.23	0.36	0.31	0.25	0.25	0.25	0.27
Medical	0.26	0.39	0.42	0.27	0.28	0.20	0.27	0.27	0.28	0.29
Mixed use	0.18	0.23	0.38	0.24	0.41	0.35	0.25	0.23	0.25	0.27
Residential	0.48	0.35	0.85	0.27	0.71	0.42	0.27	0.27	0.27	0.34
All parcels average	0.50	0.36	0.90	0.27	0.74	0.45	0.27	0.28	0.26	0.35

Large public parks (over 200 acres) provide additional recreational opportunities not found in smaller parks. These opportunities include mountain biking, hiking, hunting, horseback riding, open spaces for wildlife viewing and access to rare habitat. Reaching these facilities often require use of a motor vehicle, so accessibility recommendations have been increased to a five mile drive from residential property. **Figure 4** illustrates the distance of public parks over 200 acres from residential parcels.

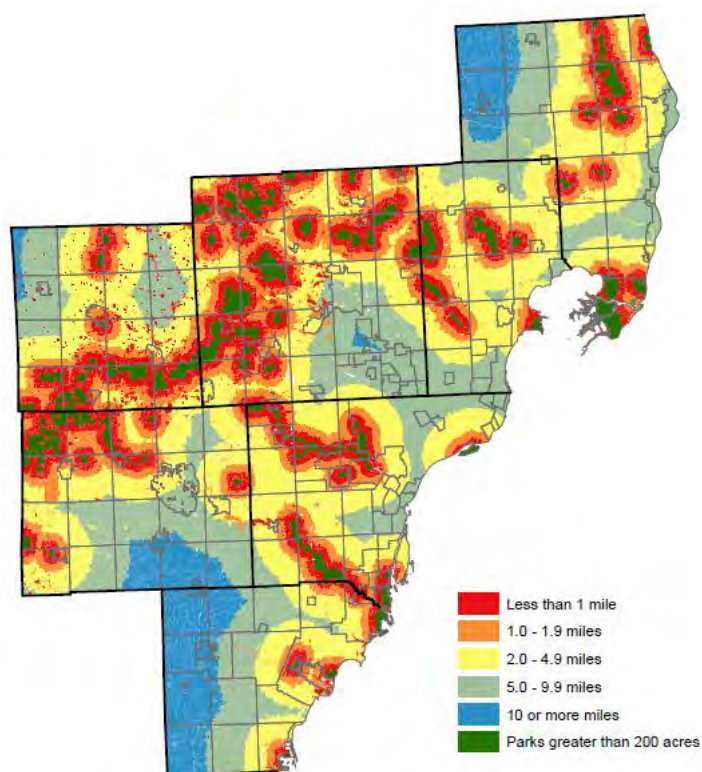


Figure 4 Distance to Parks 200 Acres or Larger, Southeast Michigan

Regional Policies

- Seek opportunities to increase access to public parks in urban, suburban, and rural areas to meet the recommendation of an average public access of .25 to .5 mile. For large parks the accessibility recommendation is increased to 5 mile drive from residential property.
- Incorporate access to public green infrastructure as part of local planning, including downtown/commercial revitalization, health care facilities and government buildings.
- Partner with recreation providers to determine and address gaps between public recreational needs and the recreational opportunities provided with the existing large park system.
- Seek opportunities to use vacant land to increase protected green infrastructure around existing parks, natural areas and riparian corridors.

Actions

- Explore the acquisition of culturally or naturally significant property or properties in both the southern and western part of St. Clair County for the eventual development of county park facilities.
- Identify appropriate waterfront properties that could be acquired, developed and integrated into St. Clair County's existing green infrastructure network.
- Develop a park system in Macomb County that uses a public millage to acquire and develop parks in areas with significant natural green infrastructure.
- Implement local wetland, woodland, tree protection ordinances

Built Green Infrastructure and Water Quality

There is almost 100,000 acres of water in Southeast Michigan, This includes, the Great Lakes, inland lakes, rivers and streams. Michigan is dependent on these rivers and lakes to provide drinking water and recreational opportunities to millions of residents. For example, recreational boating, angling and hunting along the Huron to Erie corridor contributes approximately \$1.7 billion annually to Southeast Michigan's economy.

Southeast Michigan is comprised of watersheds that primarily drain to the Huron to Erie Corridor. The water quality of the rivers and lakes within the watersheds as well as the Huron to Erie Corridor is directly connected to the activities on the land. Research from the Center for Watershed Protection proves that negative impacts to streams are evident at levels of five to 10 percent impervious cover. Not only are the negative impacts experienced through a reduction in stream quality but recreational opportunities are also impacted – which can range from beach closings in Lake St. Clair to HABs (hazardous algal blooms) in western Lake Erie.

There is 410,074 (14%) acres of impervious land cover in Southeast Michigan. Fourteen percent impervious is indicative of an urbanizing region – where as the North Branch of the Belle River (St. Clair County) is 4% impervious surface, the Red Run sub-watershed (Macomb County) is 47% impervious surface.

Based on the impervious surfaces from the land cover data, approximately 900 billion gallons of storm water runoff is generated annually in Southeast Michigan. This includes over 800 tons of phosphorus and 140 thousand tons of sediment.

Stormwater Runoff

Roadways contribute significant volumes of stormwater to natural resources. Urban runoff challenges are typically lumped into two categories: runoff quantity and runoff quality. Watershed planning efforts have now shown that excessive stormwater runoff volumes with high pollutant loading, negatively impact streams through such incidents as high turbidity, down cutting and sedimentation ruining spawning grounds, contaminating the water column and creating localized flooding. Because roadways are the largest generator of stormwater, government planners can receive the biggest bang for their dollars in retrofitting roadways with green infrastructure.

Green Infrastructure Techniques for Retrofitting Transportation Corridors

Once there is an understanding of the local and regional outcomes for green infrastructure along transportation corridors, consideration can then be given to identifying the types of green infrastructure techniques that will be used in these constrained areas.

Bioretention and Bioswales

Bioretention and bioswales provide some of the largest runoff reduction and water quality benefits for green infrastructure projects. Bioretention areas are typically shallow surface depressions planted with specially selected native vegetation to capture and treat runoff from surrounding impermeable surfaces. A bioswale is a shallow stormwater channel that is densely planted with a variety of grasses, shrubs and or trees designed to slow, filter and infiltrate stormwater runoff.

Native Plant Grow Zones

The term grow zone refers to the large scale conversion of land adjacent to roadways that use native plants in areas that are not mowed for improving water quality, habitat, and reducing stormwater runoff volumes. Native vegetation has significant root systems that promote runoff infiltration and uptake. Grow zones work best in adjacent roadside areas that receive runoff through sheet flow.

Permeable Pavement

A pervious pavement system facilitates stormwater infiltration through a porous surface course underlain by a storage reservoir placed on uncompacted subgrade material. The storage reservoir may consist of a bed of uniformly graded stone, and washed course aggregate with a void space of 40%, or other pre-manufactured structural storage units. Porous concrete mix has little to no sand and contains an interconnected system of spaces to allow water to drain. Typical spacing present in the mix is estimated at 15-25 percent. In general permeable pavement techniques are used in low traffic areas or limited traffic maneuvering (i.e. turning, starting or stopping).

Outcomes

- Transportation and watershed planning is now a coordinated effort between local and county agencies.
- A local or regional stormwater management plan has been developed for the Lake St. Clair area.
- County, regional and state transportation planning agencies are now familiar with green infrastructure techniques.
- Technical assistance is now provided, where feasible to county and state transportation agencies to
 - Identify areas of excess roadway capacity
 - Consider the Transportation Alternatives Program (TAP) as a funding source.

- The GLRI and other federal opportunities are funding green infrastructure built projects within the Lake St. Clair Area reducing runoff impacts on the lake and its watershed.

Regional Policies

- Encourage policies to integrate constructed green infrastructure in publicly-funded projects, including institutional properties and major roadways. Focus implementation on roads, parking lots (public and private) and large managed turf areas.
- Minimize mowing within riparian corridors and seek opportunities to increase tree canopy and native plant grow zones in open space areas (particularly public land) along riparian corridors as a method to increase infiltration, prevent erosion, shade rivers and lakes, and improve habitat.
- Work with communities and watershed groups to quantify the level of green infrastructure implementation that will lead to direct benefits in the region's water resources.
- Modernize road and highway planning and infrastructure and integrate with watershed planning to effectively accommodate storm water runoff and infiltration needs, thereby reducing the costs and impacts of flooding.
- Provide technical and financial support to communities and their partners to plan and implement green infrastructure techniques and low impact development while preserving natural spaces and water quality, to ensure stormwater management, improved hydrology and overall water quality.
- Encourage communities along rivers and lakes to develop riparian corridor/buffer ordinances.
- Incorporate Green Infrastructure plans into municipal master plans.
- Federal agencies and their partners will continue to implement watershed management and green infrastructure projects under the GLRI Action Plan II to reduce impacts of polluted urban runoff on nearshore water quality at beaches and other coastal areas.

Actions

- By 2020, increase the number of Michigan's new road and highway projects designed to better accommodate stormwater runoff and infiltration needs over a baseline established in 2016.
- By 2020, increase the number of attendees to green infrastructure conferences, application for projects, amount of grant dollars awarded to projects incorporating green infrastructure or low impact development.
- Establish a committee comprised of MDOT, MDEQ, MDNR, county agencies, local governments and nonprofits for developing a Lake St. Clair Watershed Stormwater Management Plan.
- Develop and implement natural areas plans.

Example projects

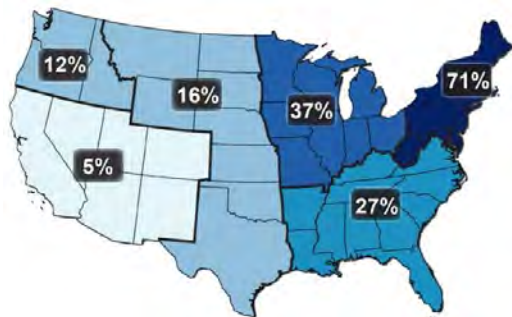
- Develop joint project of Macomb County Public Works Office and Oakland County Water Resources Office to 1st Reduce stormwater runoff through installation of built green infrastructure in a watershed such as the Red Run, and, 2nd develop projects to restore natural green infrastructure to both reduce phosphorus release to waterways and improve wildlife habitat and recreational opportunities.
- Expand Green Macomb Partnership to include other Macomb County urban communities. See other recommended tree canopy densities for land uses in regional policies above.
- Begin a stormwater management planning process for the urbanized area within Macomb County – focusing first on Red Run Subwatershed as a demonstration. Consider TAP and SRF as funding opportunities.

Climate Resiliency and Stormwater Management

Michigan is getting warmer. It has been on an upswing since 1895. Between 1895 and 2012 the average state temperature has increased 6.7°, from 41.7°(1895) to 48.4° (2012). Increasing greenhouse gases or CO2 emissions is a facilitator of current climate conditions. Current climate conditions include increasing temperatures, changing precipitation patterns and extreme storm events. These conditions are already affecting our environment both built and natural. As the climate conditions continue to change, water resources will be affected in different ways across the country.

Projections or scenarios (from the report *Climate Change Impacts in the United States*) have been developed by the Intergovernmental Panel on Climate Change illustrating both regional and seasonal changes in climatic elements such as temperature, and precipitation patterns and intensity. **Figure 5** illustrates how some regions may experience conditions of drought or water shortage, others may experience more frequent extreme events, and still others may experience alternating drought and extreme precipitation events. Michigan has experienced increase in extreme rain events by 37% in Michigan during the period (1958 --2012)

Figure 5 Observed Change in Very Heavy Precipitation

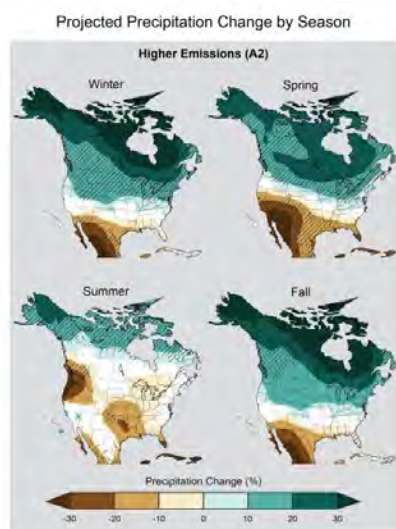


Map shows percent increases in amount of precipitation in very heavy storm events (defined as the heaviest 1% of all daily events (from 1958 to 2012)

In addition, seasonal differences in precipitation rates can vary significantly from season to season as shown in **Figure 6**. Many areas are anticipating an increase in precipitation in spring and winter, if that is accompanied by a decrease in precipitation in summer and fall, that could lead to conditions of drought or water shortages.

In the Great Lakes there are signs of a changing climate too. The lakes are showing signs of change. Water temperatures have been increasing and in some cases increasing at a faster rate than air temperatures. Other signs of climate change in the Great Lakes basin include increased precipitation and reduced ice cover on the lakes. In addition, there has been a large increase in extreme precipitation events that bring greater risk of flooding and runoff.

Figure 6 Projected Precipitation Changes by Season



This map projects seasonal changes in precipitation for 2071 –2099 (compared to 1970 –1999)

Incorporating Climate Change into Planning

In general, planners need a horizon – reference points with accepted data and information that adequately describes future conditions to guide their planning process. This is not assured in planning for changing climate conditions. It is not assured that climatic change projections will happen. There are good projections out there but they are not well known by the public or local government practitioners. NOAA is now using a series of projections or scenarios that were developed by the Intergovernmental Panel on Climate Change. Great Lakes Climate Change Maps have been developed by GLISA (Great Lakes Integrated Science and Assessments) – a NOAA regional partnership with the University of Michigan and Michigan State University illustrating the scenario's.

These maps can be used in the process of developing tools for local planners in the Lake St. Clair Area of Southeast Michigan. The maps provide projections for temperature and precipitation changes in the middle (2041-2070) or end (2071-2099) of our current century (and assuming greenhouse gases continue to rise) as compared to the 1971-2000 period. Understanding projected temperature and precipitation levels can lead to the development of strategies for mitigating the impacts of the climate stressors (expected temperature rise, precipitation changes and number of extreme storm events.) by building resilient landscapes that can handle the stress of drought or flood.

Resources for Adaptation Planning

National Integrated Drought Information Network

<https://www.drought.gov/drought/documents/quarterly-climate-impacts-and-outlook-great-lakes-region-june-2017>

National Drought Resilience Partnership: Comprises seven federal agencies which work collaboratively to support state, tribal, local, and private sector approaches to managing drought risks and impacts. <https://www.drought.gov/drought/resources/national-drought-resilience-partnership>

GLISA (Great Lakes integrated Sciences and Assessments), a partnership between the University of Michigan and Michigan State University, is one of ten Regional Integrated Sciences and Assessments in the U.S., known as RISAs, funded by the National Oceanic and Atmospheric Administration (NOAA). GLISA builds capacity to manage risks from climate variability and change in the eight Great Lakes

states and Ontario and leverages a number of unique strategies and research to fulfill its goal of increasing the production and use of climate adaptation knowledge by different stakeholders such as cities, farmers, businesses, and Tribes in the region. <http://glisa.msu.edu/>

Outcomes

- Tools have been developed providing the necessary data and information to local planning agencies for developing strategies for a resilient landscape.
- Partnership's with NOAA and Army Corps have been developed to enhance the local field of knowledge on climatic and hydrologic projections.
- Municipal departments are now cooperating on change in climate conditions. Climate change is a cross-sector issue that affects all aspects of government work.
- Incorporate planning for wet weather extremes, droughts and increased seasonal variability of precipitation into state, regional, watershed and community planning and infrastructure design to mitigate impacts to ecological, economic, social and cultural resources.
- Best management practices have been developed (at the state level) for planning and strategy development and are reviewed every five years to reflect climatic changes in rainfall frequency, duration or intensity.
- Consider developing a stormwater model ordinance for a local jurisdiction seeking to incorporate climate change projection or green infrastructure incentives into local legislation.
- Alternative incentives such as fast-track permitting for projects that adhere to a more strict set of requirements (e.g. projects that manage 80% of runoff onsite or incorporate a green roof)
- Significant information on cost and effectiveness of Green Infrastructure is now available to government officials on which to base decision-making on whether to use green infrastructure or an alternative method.

Regional Policies

- Climate change adaptive planning for stormwater management should be encouraged among Lake St. Clair Communities and performed across the watershed.
- Technical and financial support should be provided to communities and their partners to plan and implement green infrastructure.

Actions

- Adaptive planning should be implemented by the Partnership group generally for the watershed.

Example Projects

- The Partnership sponsors meetings of its members and other stakeholders with technical experts from the field to engage in adaptive planning.

Natural/Existing Green Infrastructure

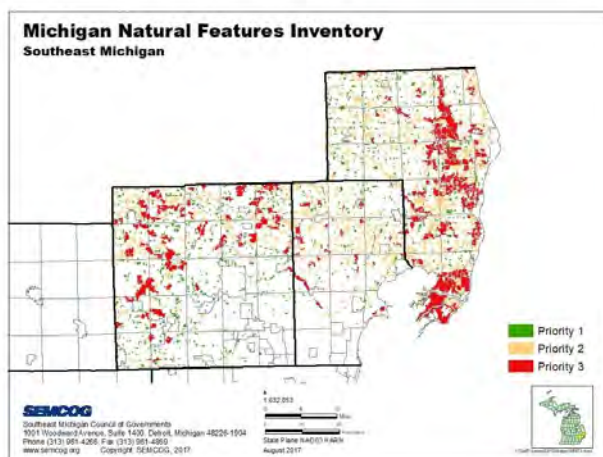
Natural Green Infrastructure plays a critical role in treating and disposing of billions of gallons of stormwater annually on Southeast Michigan. It also provides habitat for shelter, food and nursery for the fish and wildlife that inhabit the lakes, rivers and woodlands of this region. Our wildlife and natural areas contribute to a robust and growing blue economy. Therefore, the ecological function of our land and water resources must be maintained even as we develop. We should strive to remain sustainable, maintaining a balance between developed lands and natural areas. To do this though will require regional coordination and partnerships that identify the crucial high ecological value ecosystems that should be fully protected through acquisition to the extent possible.

Land use planning and other land use management programs can have a major influence on the future of Southeast Michigan's natural landscapes. Municipalities have a responsibility to prepare official planning and zoning documents. Through these documents, they can protect the integrity of this very valuable natural resource system. Knowing which lands are ecologically important can assist in prioritizing preservation and restoration efforts. If avoiding significant habitat is not possible, projects can be planned that minimize the negative effects frequently associated with development.

Planning for Protection and Restoration

County planners within the region have been working with the Michigan Natural Features Inventory (MNFI) to create comprehensive natural area mapping that identifies and prioritizes natural resources and critical ecosystems such as ecologically important wetlands, woodlands, openspace, and riparian corridors. This mapping is readily available within Macomb and St. Clair and Oakland counties. In addition to mapping, the inventory also provides data and information about the plant and animal communities and their element occurrence and biological rarity present both historically and currently in the counties, as well as species that are threatened, endangered and of special concern. This information is available for Macomb, St. Clair and Oakland counties at the MNFI website -- <https://mnfi.anr.msu.edu/> or in hard copy for Macomb and St. Clair Counties in the publication entitled *Potential Conservation Areas Assessment and Natural Features Summary for Macomb and St. Clair Counties* (see Reference page). This comprehensive mapping and collection of ecological data can help shape development and may provide a starting point from which to build a connected resource system (*Oakland County Green Infrastructure Vision*). Wetlands, woodlands and riparian corridors, along with their vegetative buffers, are critical links that hold these natural areas together and should be taken into consideration whenever development occurs. **Figure 7** is the MNFI Potential conservation areas (PCAs) for Macomb, St. Clair and Oakland and counties.

Figure 7 PCAs for Macomb, St. Clair and Oakland Counties



Connecting the Landscape Through Green Infrastructure

Oakland, Macomb, St. Clair, Genesee, Lapeer, and Shiawassee counties along with various stakeholders have developed county wide Green Infrastructure Vision Plans in order to connect and protect their remaining natural lands. These visions will encompass natural and restored native ecosystems that make up a system of hubs, sites, and links. When completed, the visions have the potential to act as a guide for future development and should provide coordination for long-term ecosystem preservation and restoration efforts.

Green infrastructure networks consist of the following components:

- **Hubs:** Hubs anchor the network and provide an origin or destination for wildlife. Hubs range in size from large conservation areas to smaller parks and preserves. Hubs provide habitat for native wildlife and help maintain natural ecological processes.
- **Sites:** Smaller ecological landscape features that can serve as a point of origin or destination or incorporate less extensive ecologically important areas.
- **Links:** The connections that hold the network together and enable it to function. Links facilitate movement from one hub to another.

Land Preservation Tools

Many different approaches are needed to preserve and/or restore an ecologically important system such as wetlands, riparian corridor, woodlands, openspace. River restoration is often difficult because the damage has accumulated over decades and restoration efforts may take a long time to be fully realized. It is much more cost effective to prevent the problem than it is to fix it. Forming a local conservation vision (reserve, monitor, and restore) will provide purposeful direction to guide the most appropriate actions within a given area.



Each land protection tool has pros and cons which must be weighed in context of the overall local conservation vision. A comprehensive list of land conservation tools is attached as Appendix A a Part of the overall strategy should include prioritizing the most fragile natural resource sites for acquisition or potential conservation easements by public agencies (local governments) and private organizations (land trusts).

- **Land Acquisition:** Landowners can donate lands with conservation value to land conservancies so that the land can be managed and preserved for its ecological value. Outright donation of land has several benefits including substantial income tax deductions. On occasion, lands with unique natural features are purchased by municipalities and/or conservancies.
- **Conservation Easements:** A conservation easement is a legal agreement with a landowner that permanently limits the type and amount of development that may take place on the property. Landowners retain all other ownership rights and may qualify for income tax and property tax benefits. State and federal programmatic examples include:

Michigan's Farmland and Open space Preservation Program: State program implemented through the Michigan Department of Agriculture offering 6 opportunities to preserve land through instruments that impose temporary restrictions on development rights, as well as permanent restrictions to maintain private property in natural state.

Farmland Development Rights Agreements (commonly known as PA 116): A temporary restriction on the land between the State and a landowner, voluntarily entered into by a

landowner, preserving their land for agriculture in exchange for certain tax benefits and exemptions for various special assessments.

Conservation Easement Donations: A permanent restriction on the land between the State and a landowner, voluntarily entered into by a landowner, preserving their land for either open space or agriculture.

Agricultural Preservation Fund: A fund established to assist local units of government in implementing a local purchase of development rights program.

Local Open Space Easement: A temporary restriction on the land between the local government and a landowner, voluntarily entered into by a landowner, preserving their land as open space in exchange for certain tax benefits and exemptions for various special assessments.

Designated Open Space Easement: A temporary restriction on specially designated lands between the State and a landowner, voluntarily entered into by a landowner, preserving their land as open space in exchange for certain tax benefits and exemptions for various special assessments.

Purchase of Development Rights: A permanent restriction on the land between the State and a landowner, voluntarily entered into by a landowner, preserving their land for agriculture in exchange for a cash payment for those rights. Currently funding is not available for this program. Contact your township or county to see if there is a local PDR program established.

Conservation Reserve Program (CRP): The USDA Natural Resources Conservation Service (NRCS) operates the Conservation Reserve Program (CRP), a land conservation program that pays a yearly rental to farmers enrolled in the program to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length.

Farmable Wetlands Program (FWP): A program of the NRCS, the FWP is designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. FWP is a voluntary program, providing rental payments and cost sharing and other incentives for implementing practices to restore up to one million acres of farmable wetlands and associated buffers. Participants must agree to restore the wetlands, establish plant cover, and to not use enrolled land for commercial purposes. Plant cover may include plants that are partially submerged or specific types of trees.

While programs offering temporary restrictions on development rights do make a contribution toward protecting critical ecologically important lands, these restrictions often have a time limit; and when they have expired. . . the land is again vulnerable to development pressures. In addition, the monetary penalties for developing these lands with temporary restrictions on development rights (such as P.A. 116 agreements or some environmental easements) are not sufficient to deter violators from developing these lands before the time limits of these restrictive covenants have expired. The only way to ensure that these lands of high ecological value are truly preserved is through Acquisition. **Appendix A** is a comprehensive

list of conservation tools that can be applied to both preserving and restoring designated natural green infrastructure sites.

Funding Conservation and Restoration

The number of funding sources offered through state and federal agencies is quite limited – and insufficient for the existing preservation need. **Table 3** is a short list of federal and state funding sources for acquisition.

Under the GLRI Action Plan II, federal agencies and their partners will implement protection, restoration and enhancement projects focused on open water, nearshore, connecting channels, coastal wetlands and other habitats in the Great Lakes basin. Relevant projects include:

- Removing dams and replacing culverts to create fish habitat and reconnect migratory species to Great Lakes tributaries (2018 target: 3,100 miles)
- Restoring riparian in-stream habitat to prevent erosion and to create sufficient habitat for aquatic species (2018 target: 225 miles)
- Protecting and restoring coastal wetlands (2018 target: 52,000 acres of coastal wetlands protected)
- Restoring habitat necessary to sustain populations of migratory native fish and wildlife species
- Protecting, restoring, and managing existing wetlands and high-quality upland areas to sustain diverse, complex and interconnected habitats for species reproduction, growth and seasonal refuge.

Other Types of Non-local Match

In addition to state and federal funding opportunities, non local match funding can come from national endowments such as *The Conservation Fund*. *The Conservation Fund* makes loans to conservancy organizations (throughout the nation) to acquire high ecological valued land. Since their first loan in 1993, The Conservation Fund has helped local partners achieve their conservation goals, providing more than \$190 million in almost 350 loans to 160 partners, protecting more than 140,000 acres across 35 states.

Local Funding: The Keystone to Conservation Financing Local Funding Strategies

Federal, state, and private funds frequently serve as supplemental matches to primary funds raised at the local level. Therefore, consistent local funding is the keystone to effective conservation financing. Several incentives exist for pursuing conservation financing at the local level:

- Local funding means local commitment and local control of funds
- Local funds can be used to leverage federal, state, and private dollars
- Public awareness and support for local conservation initiatives can be elevated
- Successful measures set a precedent for future conservation financing proposals
- Securing local conservation funds strengthens a community's ability to attain supplemental funding from federal, state, and private sources

Many conventional and innovative tools exist for raising conservation revenues at the local level. Funding may be raised through traditional measures such as budget appropriation, sales and property taxes, or voter-approved conservation taxes and bond

Table 3 Short List Federal and State Funding Opportunities

<i>Name</i>	<i>Description</i>	<i>Maximum grant</i>
<i>Michigan Natural Resources Trust Fund (MDEQ)</i>	MNRTF supported by annual revenues from oil and gas resources – provides grants for acquisition of land for recreational purposes.	No identified maximum
<i>Michigan Coastal and Estuarine Land Conservation Program (MDEQ/NOAA)</i>	Protects coastal and estuarine lands that are important for ecological, historic and recreational value.	\$3 million
<i>National Coastal Wetland Conservation Program (USFWS)</i>	NCWC provides matching grants to states (only) for acquisition and restoration, of coastal wetlands.	\$1 million
<i>Michigan Areas of Concern Land Acquisition Grants (MDEQ/NOAA)</i>	The purpose of this NOAA grant program is to provide financial and technical assistance to land acquisition projects within U.S. AOCs..	\$100,000 - \$1,000,000
<i>Community Forest and Open Space Conservation Program (USFS)</i>	This U.S. Forest Service grant to (tribes, Local Govts, not-for-profits) is to acquire private forest land for ownership in fee simple.	\$100,000 -- \$1,000,000

issues. Communities may also choose to pursue unconventional conservation financing options such as tapping local income and cell phone taxes. Innovative conservation financing measures, such as impact fees is also an option. The levying of a stormwater tax, based on the impermeable surface area of a property, is one example. In Michigan, this form of conservation financing is currently prohibited by the Bolt decision.

Local Funding Strategies

In general, conservation financing tools can be classified into one of two categories: ‘pay-as-you-go’ or ‘borrowing’. Each funding approach has its own advantages and disadvantages. Pay-as-you-go measures provide funding from general appropriations or dedicated revenues. Funding sources can include property assessments, sales tax set-asides, real-estate transfer taxes, onetime environmental fines, and budget surpluses. Such financing can be appealing to debt-resistant voters and public officials because it entails year-by-year accountability and does not incur borrowing costs. On the downside, pay-as-you-go measures tend to generate relatively small annual revenues, and are vulnerable to changes in community politics. **Table 4** is a list of common local financing options that can be used for conservation funding.

Table 4 Common Local Financing Options

Common Local Financing Options			
Method	Definition	Pros	Cons
Property Tax	Tax on real property paid for by commercial and residential property owners	• Steady source of revenue • Relatively easily administered • Tax burden fairly broadly distributed • Small increases create substantial funding	• Competition for other public purposes • Overall concern among taxpayers about high rates

		• Popular with voters when focused on compelling land conservation needs	
Sales and Use Tax	Tax on the sales of goods or services	• Relatively easily administered • Low reporting costs • Can generate large sums, even at small tax levels • May be paid in part by out-of town visitors • Can tap into tourism profits generated by open space amenities • May include exemptions such as food and medicine	• Revenues can drop when economy slows • Considered regressive
Impact Fee	One-time fee paid by developer to offset costs of infrastructure caused by new development	• Nexus between taxing new development and protecting open space	• Parks and open space projects might require direct link to new development • May make housing development unaffordable
Special Assessment District	Special tax district for an area that benefits from an open space project	• Users finance acquisition and management • Predictable revenue stream • Accountability in government spending • Sense of ownership of and responsibility for area parks and services • Taxable in small increments • Ability to set own election date and process	• Possibly time consuming to implement • Overall concern over high rates among taxpayers
General Obligation Bond	Loan taken out by a city or county against the value of the taxable property	• Allows for immediate purchase of open space, locking in land at current prices • Distributes the cost of acquisition over time	• Extra interest costs of borrowing • Voter approval required, sometimes by supermajority levels
Revenue Bond	Loan paid from proceeds of a tax levied for a specific public project, or with proceeds of fees charged to those who use the financed facility	• Not constrained by debt ceilings of general obligation bonds • Voter approval rarely required	• More expensive than general obligation bonds

Land Conservancies can play a crucial role in land acquisition as a middle man between the seller and purchaser. The purchaser often does not have the immediate funding to acquire the land. A land

conservancy (as a partner to the purchaser) can step in and purchase the land from the seller. The purchaser then secures the funding and pays off the land conservancy -- taking possession of the land. The land conservancy can retain stewardship responsibility for the land if negotiated with the purchaser.

Following are a few examples of local conservation funding approaches from within the Lake St. Clair watershed with land conservancy participation:

- **Black Creek Marsh Additions and Restoration:** Six Rivers Regional Land Conservancy assisted HCMA with purchase of additional properties to the Black Creek Marsh to consolidate their ownership and continue restoration work. Six Rivers purchased the land directly from owners. HCMA sought and received funding through NOAA and MNRTF to take possession of land from Six Rivers.
- **Anchor Bay Woods Preserve:** Six Rivers recently acquired a 20 acre parcel that is part of a large wooded wetland complex in New Baltimore. There are other parcels in the complex protected by conservation easements held by DEQ because of regulatory violations. There are still large parcels within the complex that are unprotected and the goal is to secure more to prevent conversion before starting on stewardship work. Ultimately the City of New Baltimore will purchase the parcels from Six Rivers for development of a municipal coastal park.
- **Land Addition to Goodells County Park-St. Clair County:** Six Rivers acquired a parcel adjoining Goodells County Park (through a loan from The Conservation Fund) on behalf of the St. Clair County Parks and Recreation Commission (PARC). The property included wetlands and frontage on a headwaters tributary of the Pine River. St. Clair County PARC applied to MNRTF and was awarded a grant to purchase the property from Six Rivers and add it to the park. It is now permanently protected and the natural/riparian/wetland areas of the property are managed as natural area.

Outcomes

- Plans and approaches have been developed for acquiring and restoring multiple sites of high ecological value natural areas for purposes of environmental protection, eco-tourism and recreation.
- Shorebirds and water fowl habitat identified as high value in the Lake St. Clair Area has been restored.

Regional Policies

- A partnership of local state and federal agencies and organizations are encouraged to engage in conservation planning using existing MNFI data as the basis for conservation planning.
- A partnership of local state and federal agencies and organizations are encouraged to develop local approaches for funding acquisition, and restoration of sites of high ecological value natural areas. This can include both millage and fee based approaches as well as the use of temporary or permanent restrictive covenants.
- Local governments should partner with land conservancies to assist in developing financing strategies.
- Local governments should engage in acquiring and restoring natural areas such as shorebird and waterfowl habitat as these sites can become important parts of recreation-based economic development strategies.

Tree Canopy/Woodlands

There are 281,021 acres of tree canopy in the Lake St. Clair Watershed. Tree canopy is one element of green infrastructure that supports numerous outcomes including: necessary habitat, improved aesthetics, addition to a pedestrian friendly downtown, improved property values, improved water quality and air

Lake St. Clair Watershed Tree Canopy
Southeast Michigan



quality such as reducing the urban heat island effect in paved open spaces such as parking lots. Southeast Michigan's tree canopy is 33 percent of the regional green infrastructure. At the community level there are many urbanized communities at 6-10 percent tree canopy. American Forests, the oldest national nonprofit conservation organization in the country, recommends a regional tree canopy of 40 percent with tree canopy recommendations for specific areas of the region, including 50 percent tree canopy in

suburban residential areas, 25 percent in urban residential areas, and 15 percent tree canopy in central business districts. **Table 5** identifies the percentage of tree canopy by county.

Table 5 Percentage Tree Canopy by County

Area	Tree Canopy (%)
Livingston	41
Macomb	26
Monroe	20
Oakland	44
St. Clair	32
Washtenaw	35
Wayne	24
Wayne (Excluding Detroit)	26
Detroit	16

Outcomes

- The biodiversity of tree types in Southeast Michigan communities has significantly improved to avoid monotype situations.
- Communities are now planting trees in their downtown areas and central business districts to improve stormwater management and property values.
- Tree canopy is now being planted in rural natural areas to improve habitat values /benefits such as along riparian corridors and wooded open space areas.

Regional policies

- Southeast Michigan will strive to meet the standards set forth by American Forest, including a 40 percent tree canopy for the region. Other tree canopy recommendations include: 50 percent tree canopy in suburban residential areas, 25 percent in suburban residential areas, and 15 percent tree canopy in central business districts.
- Increases in tree canopy will be focused in the urban areas where tree canopy is below 20%, as well as specific land uses such as around industrial property, within riparian areas, central business districts, and along roadways and parking lots.
- Expand tree canopy in urban areas and woodlands to reduce the volume of stormwater runoff in local watersheds.
- Seek opportunities to increase tree canopy in open space areas along riparian corridors as a method to shade rivers and lakes, prevent erosion and increase aesthetics.

Actions

- Research methodologies, including the Chesapeake Bay program, to define the role of urban trees in stormwater management considering species, growth over time, crediting options and effectiveness.
- Work with local groups and the Michigan Department of Natural Resources to update optimal tree planting species for the region based on changing vegetation pattern and implementation functions.
- Evaluate research alternatives to recognize trees as an infrastructure component that may be capitalized for long-term funding options.
- Develop local greening and tree canopy goals at the community level
- Achieve Forest Stewardship Council (FSC) and Sustainable Forest Initiative (SFI) standards for biodiversity management within Southeast Michigan's state forests.

Example Projects

- Expand Green Macomb Partnership to include other Macomb County urban communities. See other recommended tree canopy densities for land uses in regional policies above.
- Identify areas in rural/suburban communities along Clinton River blueways and greenways between parks, or at identified sites of high ecological value restoration.
- Add trees at sites of coastal wetland restoration along Lake St. Clair, St. Clair River and tributary corridors.
- Improve tree canopy and ground vegetation in rural county and local parks.

Wetlands

A wetland is an area with physical characteristics between dry land and water and is regularly saturated with surface or ground water. In fact, it's inundated with water so consistently that vegetation and animals that thrive in wet conditions exist there. Wetlands are generally home to a large variety of fish and wildlife including migratory birds, waterfowl, mammals, reptiles and amphibians. Wetlands are hydrologically connected to the landscape through groundwater and surface water. Wetlands filter's and cleanses surface water as it enters and moves through. Wetland vegetation slows its movement allowing contaminants to fallout. Contaminants in ground water are broken down as it flows through soil into a wetland. Further cleansing occurs in the wetland.

Coastal: There are two major natural communities that form the coastal wetland complexes within the Lake St. Clair basin: 1) lakeplain prairie, and 2) Great Lakes marsh. Both of these communities are very rare and considered to be globally imperiled. These communities can be found adjacent to each other in the St. Clair River delta on Dickinson Island and St. John's Marsh. Lakeplain prairie can also be found inland in slight depressions adjacent to hardwood swamps, mesic southern forest, dry mesic southern forest, and lakeplain oak openings. These formations and community types are very likely similar in function and value to maritime delta formations in that they provide important habitat for a diversity of

Lake St. Clair Watershed Wetlands
Southeast Michigan



plant and animal life. There are 22,634 acres of wetlands remaining within the Lake St. Clair coastal area. Of that, 19,764.31 acres, or 87.3 percent, are of nationally decreasing wetland types (Palustrine-Emergent, Palustrine-Forested, and Palustrine-Scrub-Shrub).

Inland: Wetlands in the Lake St. Clair watershed, are often associated with inland lakes and streams – found along the shoreline, and associated with floodplain. Wetlands are determined based on the presence of three factors:

Wetland vegetation: plants capable of living in saturated soil conditions,

Hydric soils: Soils that are developed in conditions where soil oxygen is limited do to saturated conditions for long periods of the growing season, and

Hydrology: the presence of water at or above the soil surface for sufficient periods of the year to influence plant type and soils in the area.

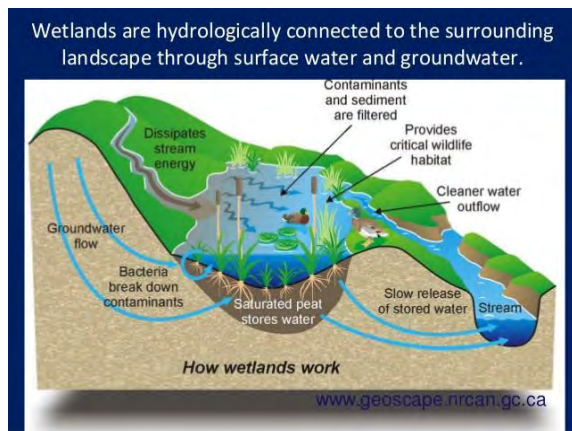
Benefits and values of wetlands

There are numerous environmental functions and benefits of wetlands that positively effects both the natural and built environments. Wetlands protect water quality by trapping sediments and retaining excess nutrients and other pollutants such as heavy metals found in runoff entering the wetland. Wetlands serve as a reservoir providing some measure of flood protection by holding the excess runoff after a storm, and then releasing it slowly. Wetlands that occur along the shoreline of lakes or along the banks of rivers and streams help protect the shoreline soils from the erosive forces of waves and currents. The wetland plants act as a buffer zone by dissipating the water's energy and providing stability by binding the soils with their extensive root systems. Aquifers and groundwater are "recharged," with water by precipitation that seeps into the ground and by surface waters. Those wetlands connected to groundwater systems or aquifers are important areas for groundwater exchange. They retain water and provide time for infiltration to occur. During periods of low streamflow (or low lake water levels), the slow discharge of groundwater often helps maintain minimum water levels. **Figure 8** illustrates the hydrologic connection of wetlands to the landscape through surface and groundwater.

Many species of birds, fish, mammals, reptiles, and amphibians rely on wetland habitat for breeding, foraging, nursery and cover. Special wetland conditions provide unique habitat for species that cannot survive elsewhere. Migratory birds depend on wetlands, and many endangered and threatened animal

species require wetlands during part of their life cycle. The incredibly high rate of wetlands loss has contributed to their demise. Wetland plants and small animals -- especially insects -- are essential links at the lowest levels of the food chain. A wetlands environment supports these plants and animals, which in turn support the larger animals that feed on them.

Figure 8 Hydrologic Connection of Wetlands to the Landscape



Source: Natural Resources Canada

Outcomes

- By 2020, we will have identified 6,400 acres of coastal wetlands for restoration in western Lake Erie Basin and the Huron to Erie Corridor.
- By 2023, the number of reptiles, amphibians, shorebirds, waterfowl and fish species will be increased along shoreline areas.
- By 2025 coastal and tributary wetlands will be increased by 50% over 2015 levels.

Regional policies

- Protect highly sensitive wetland areas and restore areas contiguous to wetlands using available adjacent vacant land opportunities.
- Use green infrastructure to managed stormwater runoff and protect existing high-quality wetlands and natural areas from pollution and runoff volume.
- Buffer highly sensitive wetland areas and restore areas adjacent to wetlands using opportunities such as vacant land adjacent to existing wetlands.
- Seek opportunities to protect existing quality wetlands by using local development options, easements, and continuing the State of Michigan wetland protection program.
- Encourage local governments to use Michigan DEQ 's wetland mapping tool to identify and evaluate the quality of remaining wetlands as part of watershed planning process.

Actions

- Increase riparian complexity/connectivity through increased softened shorelines and native riparian vegetation.
- Use geographic Information System technology, such as MDEQ's Wetland Mapping tool to map and evaluate remaining inland and coastal wetlands as a mechanism to support local, regional and state watershed planning decision-making.

- Identify high priority wetlands along streams, riparian corridors and headwater areas using wetland function and values analysis.
- Encourage diverse wetland landscapes in restoration and mitigation practices that will encompass changing vegetation patterns from climate resiliency and invasive species challenges.
- Define those wetlands that can provide flood control and stormwater management functions based on climate resiliency precipitation patterns/projections.
- Align publically-funded wetland mitigation projects with restoration opportunities identified in local watershed and remedial action plans.
- Update wetland best practices recommendations for use in master planning, local codes and ordinances.

Example Projects

- Restoration of shoreline and shallows for fish and wildlife habitat along Lake St. Clair Shoreline as part of road repair and upgrades proposed for 3 mile section of Lake Shore Drive in Grosse Pointe Farms and Grosse Pointe Shores.
- Restoration of shoreline and shallows for fish habitat at several Lake St. Clair coastal municipal parks.
- Work with state and federal agencies and non-profit organizations such as TNC to Identify sites along Great Lakes shoreline, including Huron to Erie Corridor and tributary areas that are appropriate for riparian and coastal wetland restoration. Develop projects based on specific funding opportunities,
- St. Clair River AOCs recently completed 10 shoreline/shallow and riparian corridor restoration projects.

Riparian Corridor

Riparian corridors are the land adjacent to rivers and lakes. These areas provide important green infrastructure value including protecting local rivers and lakes, providing a habitat corridor to animals, offering access to local waterways and providing the potential for recreation such as non-motorized trails. The width of riparian corridors vary greatly depending on the topography and the needs of the study. For this regional analysis (*Green Infrastructure Vision for Southeast Michigan*), the riparian corridor comprises 50 feet on each side of the center of the stream. Thus, there is approximately 53,000 acres of riparian corridor in Southeast Michigan with 28,000 acres being in tree canopy and 15,000 acres being open space.

Riparian corridors provide one of the best opportunities to link or re-connect green infrastructure in Southeast Michigan. Using riparian corridors has numerous benefits including:

- Protecting water quality by shading rivers and lakes,
- Providing access to water for fishing and canoe/kayak launches,
- Reducing the potential of streambank erosion,
- Reducing habitat fragmentation,
- Providing recreational opportunities for trails, and
- Connecting to upland areas, allowing wildlife to use upland and riparian areas.

Aristotle stated that “The whole is greater than the sum of its parts.” Green infrastructure is meant to be part of a network, where each individual part is connected to the whole --maintaining viable healthy

habitat used by fish and wildlife. Restoring degraded habitat areas along shorelines, including wetlands and woodlands is a mechanism for expanding and reconnecting green infrastructure.

Oakland County's Riparian Protection and Restoration Resource provides significant assistance on options for protection and restoration of a river corridor.

Conserving and Restoring the Riparian Corridor

A few key points about preserving and restoring riparian corridor:

Wider the better: The wider the buffer vegetation around a water body, the more effective.

Listen to the landscape: The optimal width of a buffer is not a fixed distance from the stream but varies depending on the local development pattern, natural topography, and resources

Native: Riparian buffer vegetation should consist of native existing or planted trees, shrubs, grasses and forbs well-suited to the site.

Any buffer is better than no buffer: Even narrow strips of vegetation around a water body can stabilize streambanks and filter runoff

It all adds up: The cumulative effects of many small restoration efforts can have a big impact.

Pocketbooks benefit as well: Protecting natural areas and improving water quality enhances property values.

Protecting and Restoring Stream Banks & Instream Habitat

Beyond the riparian buffer, the stream itself may be in need of restoration. The stream can be separated into two main components: (1) the banks and (2) the instream habitat. The banks of a stream are the immediate zone of separation between the streams and their floodplains. They are shaped by “bank full flow”, which is the amount of stream flow that occurs when the river is at its full capacity (before it spills over its banks into its floodplain). The instream habitat consists of the continuously varying patterns of rocky substrate, overhanging vegetation, aquatic vegetation, and woody debris. **Table 6** presents a framework for protecting and restoring the riparian corridor. It describes the four components of stream corridor.

An increase in stream flow resulting from large volumes of stormwater runoff from the watershed is the primary cause of stream bank and instream habitat degradation. Agricultural and urbanizing watersheds have increased amounts of stormwater runoff delivered to their streams as a result of a diminished capacity of the watershed's land surface to absorb rainfall.

This diminished absorption capacity is the result of vegetation removal and increased impervious surfaces (roads, rooftops, driveways, and parking lots) that accompany agricultural clearing and urban development.

When the landscape of a watershed is stable, its streams have reached equilibrium with respect to the rates of erosion and deposition of sediment carried by the stream. Changes in the landscape of a watershed, such as increased impervious surfaces, cause a change in the hydrologic regime and sediment loading regime in that watershed.



Table 6 Protecting and Restoring the Riparian Corridor

	Instream Habitat <i>From water's edge to water's edge</i>	Streambank <i>Top of the water to the top of the bank</i>	Primary Buffer <i>Top of the bank inland</i>	Secondary Buffer <i>primary buffer to the nearest structure</i>
Function	Provides aquatic habitat for fish, macro-invertebrates and herpetiles	Controls erosion, provides shade, visual screen, and noise control	Provides wildlife habitat and captures pollutants	Captures sediment and runoff, protect primary buffer from intense land uses and exotic invasive species
Action	Maintain adequate habitat through woody debris management, mitigation of erosion and sedimentation, and conservation of wetlands	Plant with native trees and large shrubs. Stabilize bank using natural methods when possible	Explore options for permanent protection such as conservation easement or acquisition. Plant with native trees, shrubs and perennial ground cover	Plant with native grasses and wildflowers
Tip	Utilize local efforts using volunteer labor from groups such as Trout Unlimited	Depending on the condition of the stream bank, hard or soft engineering approaches may be needed	Using a variety of plant species will attract more wildlife and better contribute to biodiversity	Place less emphasis on lawns and more on views

Each component of a riparian corridor has unique characteristics functions and can benefit from specific actions targeted toward that component

As a result, streams come out of equilibrium. As streams seek to establish a new equilibrium they must accommodate changes in runoff and sediment delivery from the watershed. In doing this, they must change form, often deepening and widening, and course, often cutting off existing meanders or migrating to accommodate the increased demands from the watershed. This rebalancing is a natural process, occurring whether the changes in a watershed's land cover are natural or manmade. Once watershed landscape changes have occurred, it can take decades to reach a new equilibrium after the landscape has once again stabilized.

Throughout this process, the stream banks, instream habitat, and fish community can become seriously degraded. High flows scour the stream, uprooting vegetation and collapsing banks. Increased sediment loads settle in the stream, choking off the rocky bottom substrates that provide good instream habitat. Frequent stream-scouring flows turn the river into a homogenous conduit, destroying the variation in substrate that provides good aquatic habitat. Straightened stream channels provide less habitat.

Benefits of Stream Buffering: Riverbanks that contain natural vegetation can reduce erosion and flooding, filter pollution, and serve as migration routes and forest connectors between habitats for a variety of wildlife. All streamside landowners, whether in urban or rural areas, can work to reestablish gaps (areas lacking vegetation) along riverbanks.

To improve water quality, the design of riparian vegetative buffers must take into account the area's hydrology, topography, soils, pollutant loadings, and adjoining land uses. Riparian vegetative buffers, although very important, should be recognized as only one part of a comprehensive land management plan. Whenever possible, urban and rural parks and open spaces should be linked to form functional wildlife corridors.

Stream Bank Stabilization: Stabilization of stream banks is an increasingly common practice as urban streams erode their banks, threatening properties as well as river ecosystems. Options for stream bank

stabilization depend on the nature and extent of the erosion, characteristics of the stream, and resources available to address the problem. Two main types of solutions involve “hard” engineering approaches which stabilize stream banks with hard structures such as rock, concrete, and metal, and “soft” engineering which involves the use of natural materials and plants to reinforce the stream banks.

Because stream bank erosion is a natural process that involves the entire watershed, it is critical to have an understanding of what is going on along the entire length of the stream before attempting to manage banks at specific locations. The stream must not be too far from equilibrium, and future changes in the watershed landscape that might drive the stream out of equilibrium in the future must be taken into account. Attempting to stabilize a stream bank that is severely out of equilibrium or whose watershed is likely to have significant increases in impervious surfaces in the near future may prove futile. The stabilization treatment may fail within a short period of time or may cause problems elsewhere along the stream.

From an environmental standpoint, soft engineering methods are preferred and every effort should be made to favor soft approaches when possible. Soft engineering approaches can improve habitat and are generally more aesthetically pleasing than hard approaches. In some situations, soft approaches will not provide the desired stability. Combination approaches may be employed using harder solutions for areas

under great stress and softer approaches for less threatened areas.



Managing Instream Habitat:

Improvement of the habitat in a stream is an important part of managing for fisheries. A wide range of tools are available for managing instream habitat. Approaches concern the removal of excess sediment, installation of man-made habitat structures, and best management of existing instream habitat resources. Sediment removal and the installation of sediment traps can improve fish habitat if done in the

proper situation. The approach should only be employed when upstream sediment control methods have been implemented. Removing and trapping sediment in an unstable, severely eroding stream system is most likely a waste of resources and will not provide long-term benefit.

Man made habitat structures are designed to provide refuge, spawning habitat, and transportation pathways for fish and include lunker structures, boulders, logs, weirs, dikes, fish passage structures, and off-channel oxbows, ponds and coves. Optimally, the structures should be constructed from local materials. Man-made structures are less effective than natural structures, so maintenance and preservation of existing natural habitat should always be a top priority.

Existing instream habitat resources includes the management of woody debris and rocky habitat in a system. Principles for woody debris management include leaving most logjams in place instead of removing them to clear the stream of obstruction. Excess materials from logjams can be used to create habitat structures. Management of rocky habitat focuses on preventing or managing the deposition of sediment around rocky substrates.

Outcomes

- Riparian corridors along inland lakes and Great Lakes shorelines have been enhanced and expanded to improve instream water quality and habitat, reduce stormwater impacts and minimize erosion.
- An integrated greenway corridor vision plan has been developed within the Lake St. Clair Area.

Regional policies

- Link riparian corridors with upland areas to allow for connections for human and animal use.
- Focus river and stream restoration efforts on addressing small hydrological impediments like culverts to enhance connectivity and restore stream stability.
- Develop tools and guidance related to shoreline and riparian ecology and management and provide necessary technical support and training to municipalities, watershed-based organizations and landowners to achieve full benefits of riparian areas.
- Remove and improve dams that are no longer safe or ecologically, economically or socially viable to protect public safety and create healthy, connected aquatic systems.
- Minimize mowing within riparian corridors and seek opportunities to increase tree canopy and native plant grow zones in open space areas (particularly public lands) along riparian corridors as a method to increase infiltration, prevent erosion, shade rivers and lakes and improve habitat.
- Focus increasing protected green infrastructure along existing parks, natural areas, and riparian corridors. Opportunities to increase green infrastructure in these areas should be focused around ecologically significant areas, as well as vacant lots and large lots.
- Connect riparian corridors to natural areas and parks using available vacant properties to enhance wildlife and recreational corridors.

Actions

- Increase the use of native vegetation, grow zones and tree canopy in riparian corridors
- Develop riparian best practice recommendations and goals at the local level in master plans and ordinances.
- By 2020, increase the number of small hydrologic impediments that are restored over a baseline established in 2016.
- By 2020, address all dams classified by MDEQ as high hazard facilities in unsatisfactory condition.
- Identify appropriate waterfront properties in Macomb and St. Clair Counties that could be acquired, developed and integrated into the existing protected green infrastructure network.
- Explore other potential locations for acquisition of significant property or properties in St. Clair County, such as:
 - Significant properties in conjunction with the Southeast Michigan Greenways Plan and the Michigan and Natural Features Inventory.

- Properties up and downstream from Columbus County Park, particularly Belle riverfront properties.
- Properties adjacent to existing PARC facilities.
- Opportunities for extending the Wadhams to Avoca Trail from Avoca to Yale to the county line.

Example Projects

- Identify sections of riparian corridors along Lake St. Clair, Clinton River, St. Clair River for development of restoration projects based on specific funding opportunity.
- Inventory publicly owned parcels, vacant parcels, sites of natural green infrastructure and ownership along Clinton River, St. Clair River and its delta.

Great Lakes Migratory Birds Stopover Habitat

Migratory stopover sites are places where migrating birds stop to rest, refuel, and seek shelter enroute between breeding and wintering areas. **Figure 8** shows the best sites on the Great Lakes Flyway that can shelter and provide food for these birds. GLRI is protecting, restoring and enhancing the sites most suitable for migratory birds.

Figure 8 Map of Shorebird Habitat Values



Source: TNC

Green Infrastructure Data for Lake St. Clair Watershed Areas

This section provides land cover data for each of the watersheds/subwatersheds in the Lake St. Clair Area as well as highlighting areas of opportunity for constructed green infrastructure

Clinton River Watershed Land Cover by Planning Area

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Paint Creek	45,592	12%	1,536	3,976	16,245	21,002	404	2,429
Stony Creek	46,867	4%	372	1,371	29,672	14,371	528	553
North Branch	116,936	5%	1,413	4,484	72,608	35,953	830	1,648

Upper Clinton	50,235	15%	2,104	5,267	14,621	22,850	438	4,954
Clinton Main	49,975	29%	3,802	10,821	14,270	15,872	825	4,385
Clinton East	74,029	30%	6,811	15,100	30,322	19,456	1,075	1,266
Red Run	104,794	47%	14,832	34,157	30,838	26,946	1,380	696

Clinton River Watershed Areas of Opportunity

Subwatershed								
	Institutional Land Use (Publicly Owned)			Major-Roadways (Publicly-Owned)		Privately-Owned Parking Lots	Riparian Corridor	
	Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space	Impervious Surfaces: Pavement	Open Space		Tree Canopy Existing	Open Space
Paint Creek	54	181	578	519	331	467	523	112
Upper Clinton	101	271	832	905	477	1,082	365	110
Clinton Main	269	766	1,933	1,882	827	3,382	608	250
Clinton East	277	600	1,673	2,161	1,431	3,358	1,047	326
Red Run	852	1,637	3,332	5,820	2,114	9,122	445	478
Total Area	1,552	3,455	8,347	11,286	5,180	17,411	2,987	1,276

Belle, Black and Pine Watershed Land Cover by Planning Area

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Belle River	95,617	4%	853	2,985	63,720	26,046	842	1,170
Pine River	28,289	17%	959	3,863	17,440	3,660	925	1,442
Black Watershed	131,945	4%	1,258	4,106	83,183	41,220	518	1,661
Total Area	255,945	8%	3,070	10,955	164,344	70,926	2,285	4,273

Lake Huron to Lake Erie Direct Drainage

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Lake Huron	30,861	4%	338	1,007	20,902	8,254	138	222
St. Clair River	15,479	23%	954	2,571	5,677	5,671	336	269
Anchor Bay	113,596	9%	2,820	7,683	64,011	33,320	1,488	4,275
Lake St. Clair	68,281	48%	9,567	22,969	19,713	14,654	828	549
Lake Erie	237,181	7%	3,429	11,646	158,613	57,205	2,212	4,076
Total Area	465,398	18%	17,108	45,876	268,917	119,104	5,002	9,391

Lake Huron to Lake Erie Areas of Opportunity

Subwatershed	Institutional land use (publicly owned)			Major Roadways (publicly owned)		Privately owned Parking Lots	Riparian Corridor	
	Impervious surface: Buildings	Impervious surfaces: Parking Lots	Open Space	Impervious surfaces: Pavement	Open Space		Tree Canopy Existing	Open space
La Plaisance Creek- Lake Erie	0	18	53	85	53	118	0	0
Lake St. Clair	191	911	1,650	5,413	1,651	3,577	57	83
St. Clair River	5	125	341	452	341	501	31	21
Total Area	196	1,053	2,046	5,950	2,046	4,196	88	104

Southeast Michigan's Blue Economy

A hundred years ago Michigan's water resources were used as sewers to take away the waste of industry and human habitation. By the 1940's Southeast Michigan streams were referred to as "fermenting cesspools and filth laden open sewers". In the 1950's and 1960's, rivers were catching fire including the Rouge (Michigan), Buffalo (New York) and most famously the Cuyahoga (Cleveland, Ohio). Finally, Lake Erie Sportsmen and the League of Women's Voter's took to the pavement in an early form of environmental activism. Sportsmen eager to gain some media attention dumped thousands of oil laden duck carcasses on the steps of the Michigan Capitol in Lansing.

Over the last 100 years the worst of the pollution has been removed but plenty remains in the form of point source and nonpoint source pollution, in pockets around the Great Lakes. Much of the historical industry along the rivers and lakes is disappearing. Given Michigan's access to the Great Lakes for water and transportation services, new types of industry and manufacturers focused on water-based technology are being sought and are now investing in Southeast Michigan. Accompanying this new blue form of economic development, local governments, state, federal agencies and nonprofit organizations, are now restoring their natural area habitat areas and landscapes for recreation and eco-tourism opportunities. Collectively, these new types of economic development that draw on a closer relationship with natural resource protection is known as the Blue Economy. Macomb and St. Clair Counties are each developing their own brand of Blue economy – both of which are closely linked to recreational opportunities.

Macomb County's Blue Economy Strategy

Macomb County's *Blue Economy Strategic Development Plan* undertakes its activities based on three principles:

Environmental stewardship: Increase restoration of natural areas to offset losses, seek opportunities to manage stormwater runoff through green infrastructure, develop strategies to address bacteria at each beach, implement invasive species control programs,

Economic development: Increase commercial development oriented to boating, anglers and hunting industry, Seek opportunities to link recreation and entertainment into hubs (e.g. Lake St. Clair Metropark, Nautical Mile, Salt River Marsh, Downtown New Baltimore, etc.), Develop and implement a coordinated marketing strategy, Increase collaboration to leverage resources; and

Quality of life (public Access): Increase number of boat launches/kayak launches, piers, public parks/beaches on Lake St. Clair, Seek opportunities to open more parks for public use, Seek opportunities for additional acquisition of public land through foreclosure process.

The urban landscape on the western side of Lake St. Clair, has become the site for some 200 water-based businesses and industries. A series of blueway and greenway trails through the Clinton River and around Lake St. Clair have been established and mapped. Blueways and greenways are terms used to describe corridors of land and water and the natural, cultural, and recreational resources they link together. Macomb's Greenway initiative provides a vision for a series of Greenway trails through the Clinton River Watershed that connects people and provides natural, cultural and economic development opportunities. The Iron Belle Trail runs through the Lake St. Clair Area along its way to Ironwood, Wisconsin.

Trail Towns Program

The Trail Towns program is central to both Macomb and St. Clair Counties Blue Economy efforts. A Trail Town is a destination along a long-distance trail. Whether on a rail trail, water trail or hiking trail - trail users can venture off the trail to enjoy the scenery, services and heritage of the nearby community with its own character and charm. It is a safe place where both town residents and trail users can walk, find goods and services they need, and easily access both trail and town by foot or vehicle. In such a town, the trail is an integral and important part of the community. Trail Towns Master Plans have been developed for the Clinton River (in Macomb County) and the Great Lakes coastline in St. Clair County. As part of the SIP project development process, a county agency (s), local not-for-profit or local government could recommend implementing projects from the Trail Towns Master Plans in both Macomb and St. Clair counties.

Blueways and Greenways of St. Clair

St. Clair County is developing recreational opportunities for its citizens and tourists to enjoy the sizeable natural marsh areas that comprise the St. Clair River Delta (on the eastern side of Lake St. Clair) as well as the interior streams of the county. St. Clair County has developed its coastal waterways and interior trailways into a series of 18 blueways and 5 greenways known as the *Blueways and Greenways of St. Clair*. These routes deliver the traveler to sites of incredible natural beauty along St. Clair County's coastal and interior areas. Canoe, kayak or float down one of St. Clair County's beautiful waterways. Enjoy shoreline activities such as hiking, fishing, shopping, or just relaxing next to a unique body of water.

The St. Clair County greenway trails include the 54 mile Bridge to Bay coastal bike trail, 12 mile Wadhams to Avoca Trail, providing opportunities to walkers, bikers, rollerbladers, even horseback riders along this former railroad line, and the Underground Railroad Bicycle Route from Oberlin, Ohio to Marine City, Michigan ending at Owen Sound, Ontario, featuring routes of the underground Railroad.

The St. Clair County Parks and Recreation Commission, operates a system of Parks that provides a county and regional audience with recreational and ecotourism opportunities to recreate both passively and at more intensive levels (*St. Clair County Parks and Recreation Master Plan*). Some of the parks are over 200 acres providing more advanced forms of recreation such as fishing, hunting, hiking mountain biking and BMX track, and equestrian activities.

Outcomes

- More natural area has been purchased as parkland in both Macomb and St. Clair Counties.
- Local governments have increased access to Lake St. Clair (i.e. new boat launches, canoe and kayak launches, new parkland and beaches.)
- A strategy is in place for restoring, protecting and publicizing the natural assets around Lake St. Clair.
- Governments and organizations are now working together as members of the Lake St. Clair CISMA on reducing the spread of aggressive invasive plant species into parkland, greenways and blueways and high ecological value lands.
- Trail Towns Master Plans have been implemented in both Macomb and St. Clair counties
- Seven ADA designed kayak launches developed at St. Clair River and inland river locations.

Regional Policies and Actions

- Promote activities – such as the Trail Towns Program -- that contribute to increased tourism, recreation, and water-related economic development opportunities.
- Support efforts to protect, enhance, and publicize the natural assets and water resources that strengthen the region's quality of place.
 - Promote the region's natural water resources and waterfront places through coordinated marketing and branding strategies.
 - Improve access to water for fishing, kayaking, etc.
 - Increase local awareness about the region's water resources by promoting educational efforts and stewardship.
 - Embrace business opportunities associated with quality of place assets near our waterways, such as paddling tours and equipment rentals.
 - Support and promote local and regional programming, events, festivals, and public gatherings that highlight the region's abundance of water resources.
- Promote and support activities that connect with Southeast Michigan's water resources and contribute to increased tourism, recreation, and economic development opportunities.
 - Identify strategies to improve Great Lakes shipping and expand opportunities to ship goods locally, regionally and internationally.
 - Promote ferry services on the Great Lakes and connecting channels as a viable alternative mode of transportation between local, regional and international destinations.
 - Foster partnerships between water-related businesses, local governments, and water research and education programs to integrate new information and best practices into planning and decision making processes.
 - Develop and implement waterfront redevelopment plans and blue economy plans, coordinating activities across jurisdictions.
 - Ensure that importance of water resources is recognized and integrated in community and economic development plans.
 - Partner with existing programs that promote water trail towns to maximize economic development opportunities around waterfront communities.
 - Develop programs to interpret the natural, cultural and physical resources and educate the public of their importance.
- Ensure that water-based recreation opportunities are widely available to support a variety of uses that meet the needs of the region's diverse population.

- Continue to expand and implement the region's network of designated water trails, ensuring that they are easily accessible and well-integrated with their surrounding communities.
 - Support local recreation planning efforts to increase regional coordination and share resources.
 - Encourage the acquisition and development of public water recreation facilities and programming.
 - Participate in water stewardship, education, and outreach programs for youth to increase awareness and introduce positive experiences around water resources.
 - Support efforts to monitor, protect, enhance and restore the region's water resources to recognize and maintain their economic benefits and value as recreational amenities.
- Expand public access to the region's waterways, particularly in areas that would improve connectivity between waterfront amenities, parks and natural areas, or other areas where access is currently limited.
 - Encourage the development of multi-modal transportation facilities near water resources to ensure that they are accessible to all users and well connected to other amenities such as parks, trails, and downtown areas.
 - Increase coordination between stakeholders to ensure that waterways and waterfront areas balance and support the needs of both recreational and industrial users, as well as the health of local ecosystems.
 - Identify and promote public-private partnerships that would enhance waterfront access.
 - Increase public access along the Great Lakes and connecting channels to meet the recommendation of public boat access every five miles along with the long-term goal of moving toward access every one mile. In addition to public boat access, seek opportunities to enhance other public access for fishing, paddling, swimming, and visual access.
 - Assess the need for additional public access on inland lakes and rivers in Southeast Michigan, including traditional boat launches, paddling launches, swimming, and visual access.
 - Identify appropriate waterfront properties that could be acquired and developed and integrated into St. Clair County's existing green infrastructure network.
 - Explore other potential locations in St. Clair County for acquisition of significant property or properties, such as:
 - Significant properties in conjunction with the Southeast Michigan Greenways Plan and the Michigan Natural Features Inventory.
 - Properties up and downstream from Columbus County Park, particularly Belle riverfront properties.
 - Properties adjacent to existing St. Clair County PARC facilities.
 - Opportunities for extending the St. Clair County Wadhams to Avoca Trail from Avoca to Yale to the county line.

Example Projects

- Establish a Black River Blueway route through the Port Huron State Game Area down to Wadhams bridge. Include development of non-motorized kayak launch at the bridge and another one in the state Game Area at the head of the route.
- Purchase new parkland using vacant adjacent land to existing parks or new park assets.
- Add public access points (either boating or kayak/canoe launches) along Great Lakes shoreline to meet recommendation of one public access point every mile.
- Expand or develop new greenway or blueway trails.

Invasive Species

An invasive species is defined as a species that is not native and whose introduction causes, or is likely to cause economic or environmental harm, or harm to human health. There are numerous pathways for introduction through which invasive species spread into new areas. These include: Ballast water transfer, vessel fouling, boating and fishing, construction activities, use of vehicles for moving earth, transporting materials and waste, and hitchhiking on people in their cloths, or their luggage, etc.

Intensive Phragmites control activities within the Lake St. Clair Watershed began in Anchor Bay and the St. Clair Flats/St. Johns Marsh area in 2009. Over the next five years a Partnership of local, county state and federal agencies and waterfowler organizations managed approximately 2,500 acres of Phragmites at a cost of approximately \$1.4 million within those areas. In 2015, the Lake St. Clair CISMA (Cooperative invasive Species Management Area) was formed with approximately 22 municipal, county, state and federal agencies and organizations. Invasive species control moved to inland areas within the watershed. In addition to the high ecological value sites invasive species management now focused on control along roads, county drains, commercial retention/detention basins and along regional trail areas.

The CISMA is a simple partnership of government and organizations focused on managing the spread of aquatic and upland invasive species within the Lake St. Clair Watershed. Membership in the CISMA comes with significant benefits including technical assistance on management procedures, identification of priority invasive species, and assistance in mapping and monitoring. Membership in the CISMA is established by signing a Lake St. Clair CISMA Memorandum of Understanding.

Five Priority Invasive Species

Phragmites australis: A highly aggressive invading grass – ubiquitous across the landscape – that is invading wetlands/marshes across Lake St. Clair, as well as channels, road ditches, county drains, lakes inland lakes, streams and ponds.

Black swallow-wort: A native to southwestern Europe and around the Mediterranean. Found in hardwood forests, shaded woods, open prairies, fields, savannas, and roadside ditches. Introduced to the U.S. in the 1800s, Black swallow-wort is a highly invasive species forming a dense monoculture in sun or shade. Black Swallow-wort produces toxins that are harmful to mammals including livestock as well as insects.

Japanese knotweed: This species is prohibited under Michigan law; forms dense thickets that shade out natives; rhizomes can damage pavement; extremely difficult to eradicate; spread by flood waters.

European frog-bit: The species is listed as a prohibited noxious weed by the Michigan Department of Agriculture. Frog-bit is a perennial free floating aquatic herb that forms large colonies creating dense mats with tangled roots. Frog-bit occurs in shallow, slow-moving water on the edges of lake, rivers, streams, swamps, marshes and ditches.

Flowering rush: This species has been invading Michigan waters since the early 1900s. It forms a mat of vegetation that out competes other native vegetation. Flowering rush has been listed as a restricted noxious weed by the Michigan Department of Agriculture.

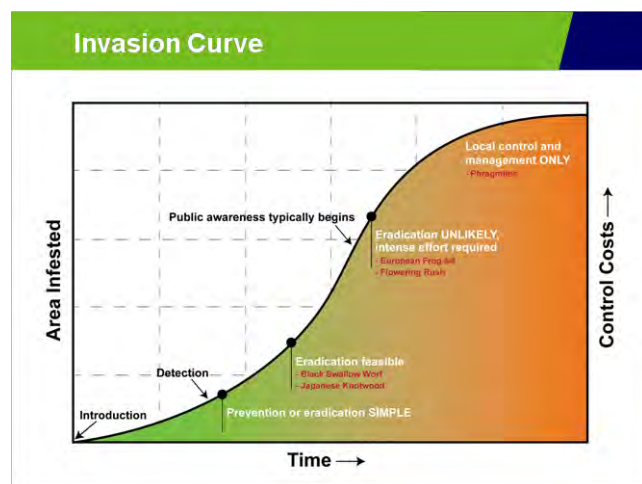
Implementing the Early Detection and Response Program

The Lake St. Clair CISMA's Early Detection and Response (EDR) program will be the major outreach effort used to identify new invasives within the jurisdiction. The CISMA will utilize both member and volunteer labor to survey sites or areas that are identified as priorities – a medium or high likelihood that the area is a pathway for entrance or spread.

Inventorying

The EDR program starts by inventorying all MISIN (Midwest Invasive Species information Network) reports of the priority invasive species within the Lake St. Clair CISMA boundary (Appendix B). It will then inventory all geographic locations such as a known conservation sites as well as potential

conservation areas (PCA) established by the Michigan Natural Features Inventory for Macomb and St. Clair counties in 2011 that could serve as an entrance or pathway for spread throughout the CISMA boundary. A GIS will be used to determine the likelihood (high, medium, low) of a site or PCA to be a pathway for entrance or spread for a priority invasive.



Invasion Curve

Based on the initial number of reports, the priority invasives have been placed on the Invasion Curve to gauge the likelihood of eradication. The longer an invasive species goes undetected, leads to a larger area of infestation, and a greater amount of resources and time required to eradicate or manage. Thus, new invaders theoretically require less time and money to eradicate, than established species.

More recently funding for the control of invasive species has come through the Michigan DNR's Michigan Invasive Species Grant Program. The DNR focuses approximately \$3.6 million per year

into the operations of C SMA's as well as municipalities and Not-For-Profit organizations that provide services to C SMA's.

Responding to Climate Resiliency

Separately, invasive species and climate change are two of the most important issues according to natural resource managers concerned about the health of ecosystems (From the report *Bioinvasions in a Changing World: A Resource on Invasive Species-Climate Change Interactions for Conservation and Natural Resource Managers*). The globalization of trade and transport is increasing the risk as well as actual introductions of invasive species. While invasive species present an immediate threat, climate change poses a threat for the long term. The Lake St. Clair CISMA needs to respond to both the threats of invasive species and climate change, realizing that both stressors work off each other and can magnify their respective impacts.

Changing Environmental Conditions

The potential impacts from climate change on species and ecosystems are well documented, resulting from changes in temperature, carbon dioxide (CO²) concentrations, hydrology (including precipitation, groundwater, soil moisture, soil chemistry snow melt and ice cover), severe weather events, sea level rise, water salinity, and interactions with the natural processes.

These changing environmental variables affect how and where species move and establish themselves and impact ecosystems. In some cases, it can be the establishment of an invasive species that instigates changing environmental conditions and climate change in a new area (e.g. cheatgrass (Mack 1986, Bradley et al. 2009) in the American west makes its habitat more prone to wildfire -- impacting CO₂ sequestration -- releasing more greenhouse gases contributing to climate change. As our environment warms, we can expect both native and non native plants to move in and out of Michigan do to changing environmental stressors. Some plants respond to increased CO₂ levels with improved growth rates. *Changing environmental conditions may make the conditions right for a non-native species to switch from a benign individual to an aggressive invasive species capable of impacting the ecosystems.*

Climate Change Adaptation Planning

Climate change adaptation is an emerging field that focuses on preparing for, coping with and responding to the impacts of current and future climate change (Stein et al. 2013a). Assessing the vulnerability of a community or particular landscape is the key to developing effective adaptation strategies. In planning one must be able to link action to impact. Developing climate change adaptation strategies is a four part process of: 1) identifying the vulnerabilities or impacts the environment will experience, 2) Service delivery impacts – those human interactions with the environment that will be impacted, 3) Planning opportunities – Developed actions for mitigating or reducing the severity of both types of impacts, 4) Integrate adaptation planning into the invasion management process: Prevention, Early Detection and Response (eradication), and Control.

Prevention

Prevention is cited as the most effective defense against biological invasions, because we do not know when the invaders will arrive. It is the only tactic that will ensure that an aggressive invader does not become an additional stressor to the vulnerable ecosystem. Not knowing when the invasion will arrive requires that we evaluate both species and pathways for risk of invasion. Then let that risk assessment guide actions and funding.

Eradication – Early Detection and Response

When Prevention fails to stop an arrival of an invasive species to an ecosystem, the EDR could minimize harmful impacts of the invader before it takes hold. Eradication is often only effective within a short period of time do to rapid reproduction capabilities of the invaders. Rapid eradication depends on adequate preparedness – having the necessary method, equipment, staff and resources to act before the invasion takes hold.

Control

Once an invading species has spread beyond the possibility of eradication – long term control can still manage the impacts of the invasive on an ecosystem (locally). Long term control can improve ecosystem function and preserve ecological resiliency of an invaded area. Primary strategies for invasive species control include: chemical methods (herbicides), mechanical methods (mowing or cutting), burning, or biological tools (introduction of host-specific predator).

Outcomes

- By 2025, local control (60% reduction in priority invasive species) has been achieved across the landscape in priority areas such as:
 - Roads, drains, channels, rivers and streams: vectors for the spread of invasives.
 - High quality natural green infrastructure such as parks, wetlands, woodlands, wildlife preserves, etc.
 - Sites for public recreation and tourism.
- Throughout the CISMA, invasive species management and recreation opportunities are maintained and enhanced for the benefit of citizens and wildlife within the region.
- Complementary strategies (such as chemical treatment followed by ecological restoration) are employed – where possible to strengthen the long-term success and effectiveness of restoration projects and programs.
- Adaptive strategies for climate change has been incorporated into the Invasive species management approaches of all Southeastern Michigan C SMA's .

Regional Policies & Actions

- Promote invasive species prevention, control, eradication and public stewardship to protect and restore Southeast Michigan's environment.)
 - Prevent introductions of aquatic invasive species (AIS) and minimize their presence by supporting and promoting training programs such as Clean Marina, Clean Boats, and Clean Waters.
 - Foster cooperation across agencies and CISMAs to expand public outreach programs to identify terrestrial invasive species and minimize their spread across the landscape.
 - Develop and implement a Lake St. Clair Cisma Strategic Implementation Plan that will guide the process of preventing, controlling and eradicating invasive species in the Lake St. Clair watershed.
 - Expand volunteer training programs for using the MISIN cell phone application for local stakeholders that encourage identification, notification and coordination opportunities.
 - Control and/or mitigate the impacts of invasive species on the biodiversity of plants and animals. Plant additional plant species as needed.
 - Complete inventory of shovel-ready projects to improve funding opportunity readiness.
- Enhance collaboration and coordination across local, state, and federal agencies, and nonprofit organizations on invasive species to identify management actions, share technical expertise, and utilize resources.
 - Strengthen communication and coordination between the DNR, CISMAs and other agencies to manage the spread of invasive species. (Modified)
 - Encourage local government and non-profit organizational participation in the statewide early detection and response programs.
 - Using invasive species inventories, identify priority species and areas for targeted management efforts.
 - Develop and implement standardized monitoring and reporting protocols across agencies.
 - Integrate invasive species management into the SIP Process
- Climate change adaptation planning will be integrated into the Cisma process with the assistance and guidance of the Department of Natural Resources
 - The Lake St. Clair Cisma as part of the implementation of its Strategic Management Plan will develop and integrate adaptation strategies into its invasive species management process.
 - Perform risk assessments for both the potential invasive species and pathways to determine the risk level of invasion from specific pathways.
- Under the GLRI Action Plan II, federal agencies and their partners will continue to restore site degraded by aquatic, riparian, or terrestrial invasive species.
- Federal land management agencies will also partner with states and local governments to promote larger scale protection and restoration through MISIN and Cooperative Invasive Species Management Areas.

Example Projects

- Complete and implement the Lake St. Clair Strategic Management Plan with recommendations for Invasive species control process and climate change adaptation.
- Implement Early Detection and Response process in Lake St. Clair Cisma
- Establish climate change committee to implement Adaptive Climate Change planning in Lake St. Clair Cisma as part of EDR
- Develop invasive species projects for high ecological value sites in Lake St. Clair watershed.
- Identify large federal funding opportunity for invasive species management projects in the LSC Watershed.

References

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<http://www.ecy.wa.gov/programs/sea/wetlands/functions.html>
- Michigan Natural Features Inventory website -- <https://mnfi.anr.msu.edu>
- [Green Infrastructure Vision for Southeast Michigan](#)
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- [Oakland County Planning for Green River Corridors](#)
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- [Macomb County Blue Economy Strategic Plan, 2012](#)
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- [Water Resources Plan for Southeast Michigan \(Draft\)](#)
- [Department of Natural Resources: Managed Public Land Strategy, May 2013](#)
- [Potential Conservation Areas Assessment and Natural Features Summary for Macomb and St. Clair Counties](#)
- [Lake St. Clair Habitat Evaluation Study](#)
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- [Simulating Spill Scenarios for Public Health Protection in the Huron to Erie Corridor, Funding Proposal to Great Lakes Observing System \(GLOS\), March 2015](#)
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- [An Overview of Michigan's Wellhead Protection Program, Michigan Department of Environmental Quality \(November 2012\)](#)
- [St. Clair County Master Recreation Plan](#)
- [Stormwater Management in Response to Climate Change Impacts: Lessons from the Chesapeake and Great Lakes Regions, United States Environmental Protection Agency, Office of Research and Development Washington D.C. , March 2016](#)
- [Climate Change Impacts in the United States, Chapter 2 our Changing Climate](#)
- Michitucky?, Ann Arbor News Article, Thursday, June 1, 2017
- [Bioinvasions in a Changing World: A Resource on Invasive Species-Climate Change Interactions for Conservation and Natural Resource Management](#)
- [Michigan's Aquatic Invasive Species State Management Plan 2013 Update](#)
- [Draft Michigan's Terrestrial Invasive Species State Management Plan](#)

Appendix A

Example Conservation Tools

Below is a list of potential conservation tools that may be applied to preservation and restoring designated Green Infrastructure cells. A comprehensive approach to addressing an ecological stress and the sources of that stress may require the application of multiple conservation tools.

Planning Support

- Community Plans
 - Master Plans
 - Capital Improvement Plan/Expenditures
 - Area/Special Purpose Plans
 - Parks and Recreation Plans
- Intergovernmental Cooperative Measures
- Growth Boundary/Service Area

Regulation and Ordinances

- Overlay Zoning
- Wetland Regulations
- Woodland Regulations
- Floodplain Regulations
- Natural Features Setback
- Stormwater Management
- Light Pollution Ordinance
- Retention of Native Vegetation & Natural Communities
- Designated Natural Beauty Road
- Designated Wildlife Management Area
- Designated Natural Area
- Farmland Preservation Ordinance

Open Space Acquisition & Protection

- Open Space/Conservation Easements
- Transfer of Development Rights (TDR)
- Purchase of Development Rights (PDR)
- Land Acquisition
- Donation
- Private Restriction: Subdivision Deed Restrictions
- Land Banking
- Wetland Mitigation & Banking

Site Design Techniques

- Large Lot Zoning
- Site Plan Review Standards
- Planned Unit Development
- Cluster Open Space Regulations
- Impervious Surface Reduction
- Steep Slope Regulations
- Development Agreements
- Subdivision Ordinance
- Traditional Neighborhood Development
- Native Landscaping/Landscape Restoration
- Roadway and Street Tree Preservation
- Infill Development
- Adaptive Reuse
- Brownfield Redevelopment
- LEED Certified Building and Developments
- Traffic Calming Median
- Traffic Circle
- Community Parking Lots
- Shared Driveways
- Rain Gardens
- Vegetated Swales
- Filter Strips
- Green Roofs
- Porous Pavement
- Grass Pavers
- Water Quality Inlets (oil/grit separators)
- Interpretive/Educational Signage

Land Management Practices

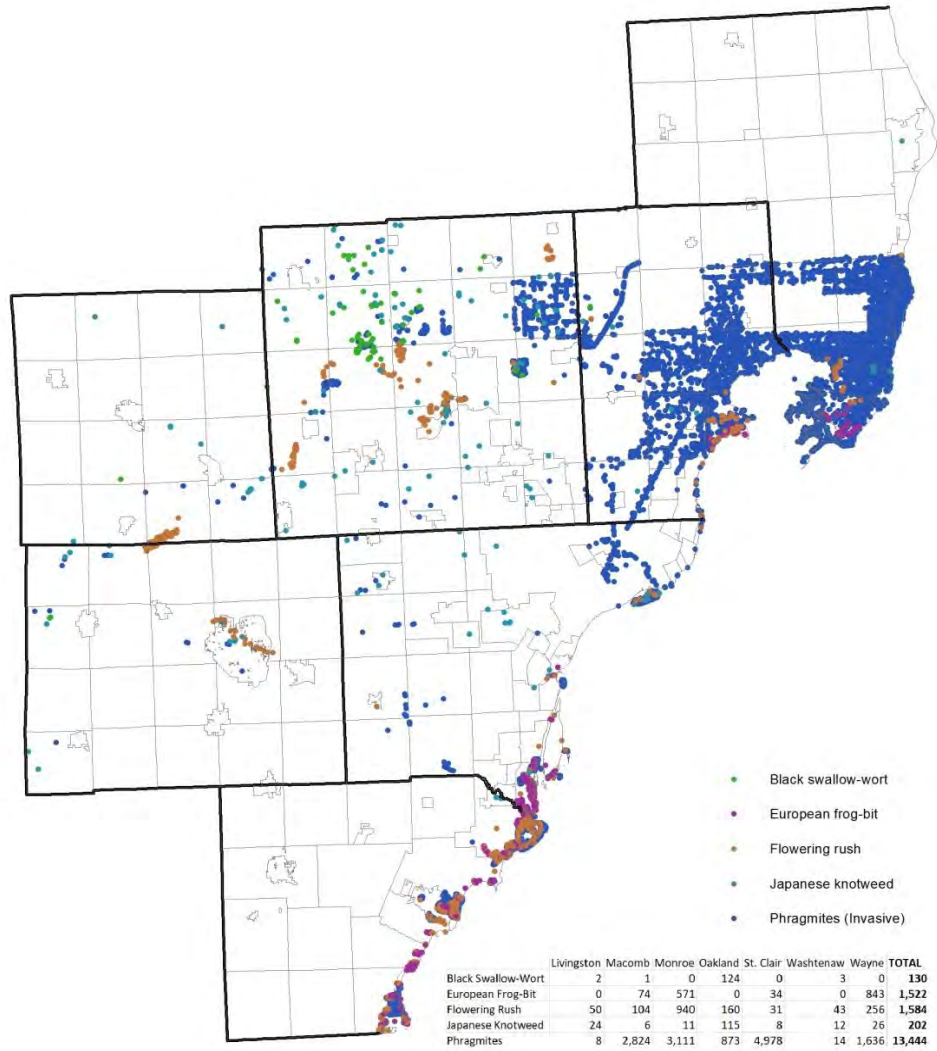
- Invasive Species Management
- Native Plant Restoration – Upland
- Native Plant Restoration – Wetlands
- Riparian Buffer Restoration
- Soft shoreline Engineering
- Soil Bioengineering
- Prescribed Burn
- Species Reintroduction
- Species Specific Habitat Restoration
- Dam Removal
- Woody Debris Management
- Nutrient Runoff Control
- Erosion & Sedimentation Control
- Improve Landscape Connectivity

Conservation Financing

- Federal Cost Share Programs
- Michigan Natural Resources Trust Fund Grant
- Community Foundation Grants
- Open Space/Land Preservation Millage
- Land Stewardship Millage
- Conservation Endowment
- Developer Impact Fee
- Homeowners Association Fee
- Special Assessment District Tax
- Property Tax

Appendix B

Midwest Invasive Species Information Network Southeast Michigan



SEMCOG

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