CITY OF MONROE PILOT WATERSHED IMPROVEMENT PLAN

MDEQ COASTAL MANAGEMENT GRANT

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1.0 INTRODUCTION

The City of Monroe is a Great Lakes coastal community located within southeast Michigan. The River Raisin runs through the middle of the City and outlets into Lake Erie. The City has other streams and drains, such as Plum Creek and Mason Run, and many natural wetlands that drain directly to Lake Erie. The City has placed great importance upon protecting these natural features and preserving the waterfront. The long-term goal of the City's Comprehensive Master Plan (January 2003) is to, *"Create a healthy sustainable environment for Monroe's citizens to live, work and play and by preserving and enhancing Monroe's natural environment..."* Taking the necessary measures to protect these natural features, such as preventing runoff contamination, erosion and sedimentation, clearly conforms to the long term development plan which the City of Monroe has set in place for future generations.

To meet this goal, the City of Monroe has taken a leadership role in developing a Pilot Watershed Improvement Plan for the River Raisin and its tributaries within the city limits. This project has been partially funded by a grant from the Michigan Coastal Management Program, Michigan Department of Environmental Quality through a larger grant from the National Oceanic and Atmospheric Administration, US Department of Commerce. The goal of this project is to help plan efforts for improving the waterfront and the riparian areas of tributaries to the River Raisin and Lake Erie. For this project, the City reached out to local citizens, developed important baseline infrastructure, assessed open channels, and performed water quality analyses. These efforts will allow the City to identify impairments, and document a long term improvement plan to preserve and protect Lake Erie and its tributaries within the City. In addition, this plan will serve as a pilot for the development of a full Watershed Management Plan for the entire Raisin River Watershed.

A unique partnership was established for this project. The City of Monroe obtained the services of Stantec Consulting Michigan, Inc. to assist in technical aspects of the project. In addition, internships through Eastern Michigan University's Institute for Community and Regional Development (ICARD) were offered to two graduate engineering students. This unique partnership created real-world business opportunities for the students, by introducing them to practices at a municipality and a professional engineering company.

This project does not address the River Raisin Area of Concern (AOC). The AOC has and is still being addressed as part of a larger Remedial Action Plan (RAP) in coordination with the US Environmental Protection Agency and the Michigan Department of Environmental Quality. The River Raisin AOC has been defined as the lower (2.6 miles) portion of the River Raisin, downstream from the low head dam (Dam #6) at Winchester Bridge in the City of Monroe, extending one-half mile out into Lake Erie following the Federal Navigation Channel and along the nearshore zone of Lake Erie, both north and south, for one mile. This area became a concern primarily due to historical discharges of oils and grease, heavy metals, and polychlorinated biphenyls (PCBs) to the river from industrial facilities in the area. In 1997, approximately 25,000 cubic yards of PCB-contaminated sediment from a "hot spot" in the River Raisin contained over 40,000 parts per million PCB concentrations. River sediment was dredged down to the native clay to ensure that the contamination was fully removed.

1.1 SCOPE

The main components of this project are: 1) building stakeholder support and recruiting partner agencies and organizations, 2) mapping baseline data in GIS layers, 3) conducting field inventories and investigations, 4) identifying opportunities for riparian habitat protection and restoration. The information collected, analyzed and mapped in this project will support the development of recommendations for protecting and improving water quality. The purpose of this document is to present this information and recommendations in a formal plan.

This pilot plan will focus on the following objectives:

- Build baseline GIS data (storm system and misc. layers)
- Establish partnerships and build stakeholder support
- Develop a long-term vision for the City of Monroe's waterfront
- Undertake field inventories and investigations
- Make recommendations for improvements
- Estimate cost of implementing the best management practices
- Provide examples of potential funding opportunities
- Describe the process to evaluate the effectiveness of implementing the plan and achieving its goals

1.2 OVERVIEW OF THE WATERSHED

The River Raisin watershed covers roughly 1,072 square miles, contains approximately 429 lakes and ponds, 3,000 miles of man-made drainage systems, 22 main stem dams and 38 tributary dams. The River Raisin flows through southeast Michigan (part of Hillsdale, Jackson, Washtenaw, and Lenawee Counties) and northern Ohio (part of Fulton County) before emptying into Lake Erie. Figure 1 shows an overall location map of the River Raisin Watershed and the boundary of the City of Monroe.

Several areas in the River Raisin have been identified as having regional significance. The main stem of the river above Adrian has some of the richest mussel beds in the state of Michigan. Twenty-one species of mussels have been identified along with eighty species of fish----most of the original fishery. There are also several high quality, mesic hardwood forests, riparian and floodplain forests, prairie fens and remnant oak barrens in the upper watershed that support rare species such as the eastern Mississauga rattlesnake, Blanchard's cricket frog, Indiana Bat and spotted turtle.

The lower 2.6 miles of the River Raisin has been identified by the International Joint Commission as one of Michigan's fourteen Areas of Concern (AOC) due to PCB and heavy metal contamination of fish and sediments. The Remedial Action Plan was submitted in 1987

and implementation activities, including sediment dredging and remediation, have been on-going since then. In addition, the Detroit Edison Monroe Power Plant at the mouth of the River Raisin remains a significant obstacle for fish migration, typically using the entire river's flow as cooling water.

In 2000, agriculture accounted for 65% of the watershed's land use; urbanized areas represented 11%, wetlands 8% and forested and grassland areas 7% each. There are 41 point-source dischargers which are monitored by the National Pollutant Discharge Elimination System (NPDES) and 13 independent public water supply systems. During low flow periods most, if not all of the river and its tributary flow can be removed for consumptive uses. Some urbanizing areas are experiencing explosive growth pressures. Recently, massive 1,000+ unit single-family housing developments have been proposed for the Milan and Saline areas. These watershed pressures have created sediment, nutrient, pesticide, pathogen and heavy metals loads, flow instability and habitat impairments. But one of, "the greatest impediment[s] to beneficial change in the River Raisin is the poor public image of the river and its tributaries," (MDNR, 1998).

Currently the River Raisin does not meet State and Federal water quality standards. There are 12 separate 303D water-quality impaired reaches and lakes along the Raisin River and its tributaries. Four reaches have government-specified limitations (Total Maximum Daily Loads) for untreated sewage discharge, pathogens, and PCBs. Other water quality impairments include pesticides, metals and turbidity. Fish consumption advisories due to Polychlorinated Biphenyls (PCBs) have also been issued for three locations on the river.

Efforts to improve the watershed and the river have been gaining momentum. Recent notable improvement activities in the watershed have included:

- Construction of the regional wastewater treatment plant for Palmyra and Madison Townships (including the Manor Farms subdivision)
- Construction and hook-up of Mooreville area homes to sanitary sewer
- The Natural Resources Conservation District has developed a method for retiring a state's most environmentally sensitive farmlands called CREP (Conservation Reserve Enhancement Program). As a result, CREP acres provide extremely high natural resource benefits; including improvements to water quality, prevention of soil erosion, and the creation of wildlife habitat.
- Land conservation directed by the Nature Conservancy and the River Raisin Land Trust
- The River Raisin Watershed Initiative project undertaken by the Lenawee County Soil Conservation District (LCSCD), including public education and involvement programs and agricultural and stream stabilization projects known as Best Management Practices (BMPs)
- Creation of the River Raisin Adopt-A-Stream program by the LCSCD and subsequent hand-over to the River Raisin Watershed Council
- Streambank stabilization and clean-up projects by Adrian, Blissfield, Dundee, Pittsfield, Raisinville, Saline, and Somerset.
- Upcoming 2007 Raisin River Watershed Management Plan

FIGURE 1
River Raisin Watershed Map

1.3 SUMMARY OF RECOMMENDATIONS

GEOGRAPHIC INFORMATION SYSTEM

- Continue to maintain and update GIS layers
- Continue to share data with other stakeholders
- Pursue additional grants which foster partnerships with the River Raisin Watershed Council, local universities and neighboring communities.

FOSTERING PARTNERSHIP

- Re-distribute the Public Questionnaire in 2010 (after the Raisin River Watershed Council has developed their Watershed Management Plan and initiated action). This would allow the City to track the change in attitude and measure the success.
- Initiate a city-wide river clean-up. Foster partnership by teaming with the Monroe County Drain Commissioner, the River Raisin Watershed Council and upstream communities to make a larger impact.
- Amend local ordinance to include smart growth strategies.
- Follow-up on identified opportunities for additional public access
- Look for additional opportunities that support the long term goal of "Optimizing the full benefits of the River Raisin and Lake Erie." Examples of this include extending the Riverwalk, revitalizing the downtown area, completing the Michigan Southern Railway Shared Use Path Project and identifying open air farmers markets and/or other misc. public use areas.
- Continue to set an example of stewardship for communities upstream.
- Implement all strategies and timelines outlined in the Monroe Metropolitan Stormwater Management Plan

STREAM REACH ASSESSMENT

- Revisit reaches that were inaccessible during this project timeline due to construction activities.
- Utilize the GIS results to assist with planning and construction activities. This is helpful to identify potential wildlife habitat disturbance, identify other areas of improvement that are in the general vicinity of proposed construction and utilize the digital photographs.
- Overall, trash/debris pick-up, invasive species removal, concrete channel lining removal, daylighting, bioengineered streambank stabilization, native plant buffers and River Raisin in-stream plantings are recommended throughout the City of Monroe and the River Raisin.
- Eight stream reaches have been identified as needed restoration. Two of which have been rated poor and six have been rated as marginal for habitat and water quality. Here is a summary of these recommendations:

TABLE 1
SUMMARY OF RECOMMENDATIONS

Area	Drain Name	Location	Recommendation	$
1	River Raisin	Monroe Street	in-stream vegetation	$35,000
2	Mason Run	Calgary Park	Basin development native buffer	$15,000
3	Mason Run	Noble/Dixie east to Detroit/Mill	trash pick-up daylight/re-route channel	$5,000
4	Mason Run	Michigan Ave between Maywood and Noble	native buffer concrete removal	$5,000
5	River Raisin	Monroe Ave to Michigan Ave	enhancing in-stream vegetation and stabilization techniques	$5,000
6	Ives Drain	Lavendar/Calkins east to Saint Mary's St	removing invasive species	$5,000
7	Mason Run	Parallel and east of Huber St	trash pick up Retaining Wall	$5,000
8	Southworth Drain	Huber/Lorain to the Raisin River	trash/debris pick up, bioengineered bank stabilization & native plant buffer	$5,000
9	Mason Run	Huber/Lorain to the Raisin River	Rain garden, native plant buffer, streambank stabilization	$20,000
10	Mason Run	Dixie Highway Culverts	Clean sediment	$0
11	Mason Run Cut-off	At Railroad Tracks	Clean debris	$0
			TOTAL	$100,000

- Investigate dam removal and grants.
- In 2010, re-visit the stream reaches to determine whether conditions have improved or worsened. This will assist in evaluating the success of the River Raisin Watershed Management Plan.

OUTFALL INVENTORY

- Continue to perform outfall inventories, as required by NPDES permit process.
- GPS located outfalls which have not yet been completed
- Continue to maintain the outfall inventory GIS database and digital photos

WATER QUALITY

- Plan and implement a routine water quality-sampling program at locations used in this project.

2.0 CHARACTERISTICS OF THE CITY OF MONROE

The City of Monroe is located within Monroe County, in southeast Michigan and is unique in the fact that it not only borders Lake Erie but also contains the three tributaries to the Great Lake. These tributaries include the River Raisin, Mason Run and Plum Creek. The City has 1.2 miles of Lake Erie coastline, 6 miles of the River Raisin, 3.8 miles of Mason Run and 1.6 miles of Plum Creek. Figure 2 shows the area tributary to each subwatershed.

Glacial lake deposits once occupied the City of Monroe. As the glaciers melted back, they occupied the low areas in Lake Erie and blocked the drainage of surface water toward the Atlantic Ocean. As a result, the surrounding landscape flooded and fine clay and silt-sized particles were deposited. This area also contains a high water table and relatively low slopes, which makes drainage difficult. The pre-settlement vegetation was dominated by wetland vegetation due to the flat, poorly drained former lake plains. The natural features of the River Raisin where altered in 1834. The U.S. Army Corps of Engineers straightened the River Raisin so that the river would directly connect to Lake Erie, digging a canal about 4,000' long by 100' wide and 11' deep. Work began in 1835 on what would be called the United States Canal and was finished some time around 1888.[1]

The River Raisin has a cherished historical significance for the City of Monroe. Because of the area's abundance of food and easy transport found along the River Raisin and Lake Erie, Monroe was used as a crossroad, campsite, or village. The earliest artifacts of settlement were unearthed at the northwest corner of North Dixie Highway and East Elm Avenue and dated circa 1550-1650 A.D. On June 3, 1785 Potawatomi Native American Indian chiefs signed a deed giving Colonel Navarre land on the south bank of the River Raisin. The River Raisin also has a significant role in the War of 1812. More than 300-Americans died during the British counterattack --- making the Battle of the River Raisin the single most deadly battle for the U.S. during the war. The River Raisin Battlefield was placed on the National Register of Historic Places in 1982. The life-sustaining River Raisin (Indians referred to the river as the River of Sturgeon) continued attracting people of French descent and others.

The City of Monroe's 2000 census estimated a population of 22,000 citizens. Southeastern Michigan Council of Governments (SEMCOG) forecasts the City to increase to a population of 28,000 by the year 2030. Conversion of the land to agriculture and development of the land for suburban and urban residential and shopping areas has drastically changed to vegetation within the watershed.[2] This development has had a tremendous impact on how much storm water runs off a site, how fast it goes and where it ends up. The City of Monroe has an existing Land use and Zoning Ordinance as well as a Zoning Master Plan that regulates existing and proposed land uses within the units of government. These ordinances have provisions to direct development into specific areas best suited to handle such developments. These Master Plans are required to be updated every five years to remain in compliance with local and state regulations. In addition, the City has made a commitment to review and evaluate their Zoning Ordinances and Land use Master Plans for revisions needed to incorporate storm water management BMPs (No later than October 15, 2006).[3]

[1] Talcott E. Wing, *History of Monroe County, Michigan*. C 1890.
[2] Stony Creek Watershed Management Plan 2.6 Rainfall and Climate
[3] Monroe Metropolitan Area Storm Water Management Program

FIGURE 2
Subwatershed Map

As shown in Figure 3, there are 6,491 acres within the City, 31% of which is open space (grass, shrubs, forest, wetland and water), 29% is used for family housing, 12% for industrial, and 10% for active agriculture. The City of Monroe and Monroe County are currently updating their Master Plan. Many of the open spaces are used for recreational opportunities within the City of Monroe including public boat launches, parks and a Riverwalk. They continue to strive to preserve and cherish the waterfront, while providing opportunities for public recreation. Examples of this include Saint Mary's Park, a boat launch, outdoor natural ice pond, riverside fishing areas, a Riverwalk along the Raisin River and planning efforts for a Michigan Southern Railroad Trail. See Figure 4 for a location map of the recreation activities within the City of Monroe.

Monroe is Michigan's only commercial port on Lake Erie. The area along the Lake Erie coastline has long been used for industrial purposes. Since 1834, the Port of Monroe has seen shipments of pulp, steel, armor stone, asphalt, cement, coal, limestone, lumber, industrial equipment, petroleum coke, sand, and Renault cars. Ford Visteon and Detroit Edison are valued employers, which occupy the land at the very downstream mouth of the River Raisin. DTE Energy began operating the Monroe Power Plant in 1971. The coal-fire electrical generating station is located on the River Raisin and Lake Erie shore where it uses that water to generate steam, which turns the turbines, which turns generators that make electricity. The Monroe plant burns about eight million tons of coal per year. In a recent development, Visteon entered a management agreement with the U.S. Fish and Wildlife Association on November 1, 2005. Approximately 240 acres of the east and west marshes at the plant, wild areas that are home to eagles and lotus beds, will become part of the refuge. The inclusion of this property will fill in a gap within the refuge that now includes more than 2,100 acres stretching from southwest Detroit to the Michigan-Ohio line.

There are many local stakeholders and organizations working towards cleaning up the River Raisin within the City of Monroe (and beyond). In fact, one of the most famous historical residents was J. Sterling Morton, inventor of Arbor Day (planting trees on the last day of April since 1972). Some of the local organizations who actively continue these efforts include the Immaculate Heart of Mary Sisters, Lake Erie West, Lake Erie Clean-Up Committee, Lotus Garden Club, Monroe County Drain Commissioner and many of the large industrial organizations.

FIGURE 3
Zoning Map

FIGURE 4
Recreational Opportunities

3.0 GEOGRAPHIC INFORMATION SYSTEM

A Geographic Information System (GIS) is often referred to as a “smart map”. GIS combines the functionality of a map and a database into one common tool. Numerous types of organizations including local government, private facilities, and researchers use GIS. Municipalities benefit from GIS software due to the large amounts of geographic information that must be collected, organized, and used on a daily basis. Examples of this include knowing the spatial location, size, elevations, serial numbers, condition rating, and assessed value of each pipe, manhole, catch basin and outfall. Maintenance activities require catch basins to be cleaned, pipes televised, capacity evaluated and NPDES permits tracked. These daily routines require that data be readily available, well managed, and highly accurate.

A Storm GIS has been developed for the City of Monroe. The City is currently utilizing sanitary and water GIS layers and the development of the storm water system will add to their data. The storm water layer includes all storm pipes, manholes, catch basins and other features. An outfall inventory was conducted under a separate city project. To create the storm water layer, electronic AutoCAD files were migrated to GIS shapefile format and geo-referenced to State Plane 1983 coordinate system in international feet. The manhole locations were manually digitized using 3-inch pixel orthophotography and as-built drawings. The spatial locations of these structures are estimated to be within 10-feet, based upon visual location and random surveying. A full database was also created for each pipe and structure. Information such as pipe diameter, age, material, invert elevation, rim elevation, and as-built page number are all available in the database. A detailed map and example of the storm GIS and database is found in Appendix A.

Other GIS layers were also created as part of this project. The drainage areas tributary to each outfall, zoning, impervious surfaces, Brownfield sites, and Area of Concern Boundaries were created for use by City staff. Appendix B details maps of each of these datasets. All GIS data is also available electronically in a CD found in Appendix C. Data sharing agreements with Monroe County will ensure a two-way sharing of this important data. Industry-standard metadata files document all procedures, accuracy and intention of use when the data is distributed. It is the intention of the City to perform annual updates using in-house staff to maintain the GIS.

Benefits of a Geographic Information System (GIS) include the ability to manage large amounts of data, communicate with others and aid in accurate decision-making. Multiple data attributes (such as pipe diameter, age, material, hyperlink to scanned as-builts, work orders and digital televising movie files) can all be linked to one pipe feature within the GIS. This large amount of information is stored in a digital format, secure from any potential hazard. Customized maps and reports can be created to convey specific information to the public, engineers or City Council. A customized map effectively conveys specific messages, thus reducing questions and meetings. These maps and data will also be automatically posted to an intranet to be accessed by co-workers. Most importantly, the storm GIS will aid in accurate decision-making.

4.0 FOSTERING PARTNERSHIP

Fostering partnership is critical to the success of a watershed improvement project. As a pilot project for the entire River Raisin Watershed, the City of Monroe recognized the importance of contacting as many stakeholders and interested organizations as possible. The River Raisin Watershed Council, Monroe County Drain Commissioner, Lotus Garden Club, Lake Erie Clean-up Committee, Sisters of the Immaculate Heart and many more were contacted and participated in the planning for this task. Businesses and organizations such as Visteon, Detroit Edison, Port of Monroe, River Raisin Institute, YMCA, and many more were contacted to collaborate on these outreach efforts. Existing and suggestions on data standards for public mailing database, public questionnaires, and planning efforts where integrated as much as possible.

A kick-off meeting was held in during a public meeting on June 6, 2005. Approximately 25 people were in attendance. The overall project goals were presented, the team members were introduced and the public was invited to participate in planning efforts. In addition, the presentation notified the public about all field efforts about to occur and granted the Eastern Michigan University students the authority to conduct these field investigations on behalf of the City. A power point presentation was posted on the cable TV public access channel for a period of two weeks.

A stakeholder database was developed using Microsoft Access. City of Monroe GIS and assessing records were integrated for all waterfront owners. Contacts for local businesses and organizations listed above were also integrated. Each entry was sorted into classifications to allow groups to be queried separately. Examples of this included the ability to select all organizations as a separate mailing. This database was delivered to the River Raisin Watershed Council to serve as a tool to assist in their upcoming planning efforts.

A mailing was distributed to approximately 225 City of Monroe River Raisin waterfront occupants and stakeholders (see appendix for example). In addition, the mailing announcement was also posted on the City's website. The mailing consisted of a cover letter, introducing the public to the project and inviting them to attend a public meeting. The second page consisted of a Public Questionnaire, soliciting input to be used in the study. The questionnaire results were then compiled and analyzed to help determine a variety of things including, but not limited to, current problems the river is facing, activities citizen use the watershed for, and if they would be interested in participating in the watershed management process.

Out of the 226 questionnaires distributed, 50 (or 22%) were returned containing public feedback. Appendix D shows the mailing and summarizes the findings (percentage based off number people divided by total responses). Here is a summary of our findings:

- It is interesting to note that 80% of the responses where from long-time residents who resided within the City of Monroe for over 20 years.

- Approximately 52% believe that the River Raisin is in generally fair condition and needs many improvements. However 36% believe that the river is in poor condition and requires urgent improvements.

- The most popular recreational activities along the River Raisin are walking along the river and watching birds and wildlife.
- 25% of the respondents had participated in a river clean-up in the past and 68% would like the chance to participate in the future.
- Respondents feel the top five problems that the River Raisin is currently facing are (in order of priority): litter and debris dumping, preserving our open fields and green spaces, wastewater treatment facilities, reducing nuisance wildlife and improving the public perception of the river.
- Approximately 82% of respondents do not feel their concerns are currently being addressed.

As a result from the public questionnaire, 33 citizens have expressed an interest in attending future meetings regarding the River Raisin planning process or river clean up. Approximately 11 additional organizations were identified which could be additional partners for this project. This includes: Sisters of Immaculate Heart, River Raisin Watershed Council, River Raisin Public Advisory Council, Great Lakes Commission, Nature Conservancy, Sierra Club, Monroe High School Science Classes, Monroe County Gun Club, MI United Conservation Club, River Raisin Institute, Boy Scouts of America, and the War of 1812 Bicentennial Committee. All of these contacts have been forwarded to the River Raisin Watershed Council for follow-up. Another result worth noting includes 1 possible illicit connection forwarded to the City Wastewater Department. Overall, the citizens of the City of Monroe have communicated a consistent sentiment for the need for action.

A second public meeting allowed the project team to communicate these results to the public. Several potential opportunities for action have been identified as a result from fostering partnerships. One anonymous citizen has communicated interest in granting public access rights to his waterfront property. Through this project, the landowner has been put in touch with the U.S. Fish and Wildlife Service (USFWS) to initiate exploratory conversations about creating public access on this property. The USFWS and the landowner are currently working through the process of property evaluation. The Sisters of the Immaculate Heart and the Monroe County Drain Commissioner have also identified another access/recreation opportunity on Sisters Island. Planning conversations have begun about the possibility of building an environmental center, bridge, and walking trail in conjunction with the City of Monroe Parks and Recreation Department.

Overall, a vision for the waterfront has been communicated as a result of these efforts. The City of Monroe is interested in optimizing the full benefits of the River Raisin and Lake Erie. One long-term goal includes extending the Riverwalk from the downtown area to the Lake Erie coastline. Currently, it is very difficult to access, let along benefit from, the Lake Erie coastline. In addition, plans are underway for a Michigan Southern Railway Shared Use Path Project and the Visteon Wetland Refuge. See Figure 5 showing a long-term vision for the waterfront. These recent efforts would ideally be interconnected to sustain a walkable community. Citizens also recognize that education and river clean-ups are important for the entire watershed, as they see the bottleneck effects of being located downstream. Thus they see the value in how every

person's actions are important and significant to make change. The City of Monroe is eager to serve as a pilot for the River Raisin Watershed Management Plan and set an example for change.

FIGURE 5
Michigan Southern Railway Trail Master Plan

5. STREAM REACH ASSESSMENT

A unique partnership was developed between Stantec Consulting Michigan Inc. (Stantec) and Eastern Michigan University's (EMU) Institute for Community and Regional Development (ICARD) to perform the fieldwork associated for this project. ICARD was established to carry out public service activities on behalf of the University through applied research and training projects. In addition to representing the University on many community committees, ICARD conducts applied research and training programs that involve faculty and students in problem-solving projects in the community. In return, ICARD activities contribute to curriculum development and provide learning laboratories for academic departments throughout the University. ICARD program activities include: water resources and land use, geographic information system, and community education and technology.

Two graduate engineering students from ICARD underwent a two-day training course conducted by Stantec Consulting Michigan Inc. The Unified Stream Assessment (USA): A User's Manual (Center for Watershed Protection, Elliot City, MD, 2004) was utilized as the stream assessment tool for this project. The manual was written by the Center for Watershed Protection to organize the enormous amount of information needed to restore small urban watersheds into a format that can easily be accessed by watershed groups, municipal staff, environmental consultants and other users.

The team used USA techniques to locate and evaluate problems and restoration opportunities within the urban stream corridor. The reach assessment form (RCH) collects general information over the entire survey reach, which is a uniform segment of the stream corridor. The RCH form characterizes overall conditions, such as average bank stability, in stream and riparian habitat, and flood plain connectivity. The RCH form also tracks individual problem sites, screens restoration opportunities, and compares reach quality across the subwatershed. Digital pictures and sketches are documented to serve as a quality assurance tool for various aspects of the RCH assessment. Appendix E shows an example of the form used in the field, and a summary of the findings.

The team tracked individual problem sites along the stream corridor, and rapidly measured habitat conditions over discrete segments of the stream corridor, termed "survey reaches". Each reach was associated with a sketch, average channel dimensions, general stream channel assessment, water column, and flood plain characteristics. Numeric scores are assigned to each survey reach based on the quality of habitat, bank stability, and flood plain conditions. Total scores are then used to compare survey reaches across the subwatershed.

The reach assessment findings were then converted to a digital format. Microsoft Access was used to convert manual hand-written forms into a digital record. The hydrology GIS dataset from the State of Michigan was used as a base. The hydrology dataset was then edited to represent each reach. A unique ID was developed which allowed the digital database to be linked to the GIS. Please see Appendix E for a detailed list of each reach assessment.

Figure 6 shows the map summarizing the reach assessment. A total of eight miles, divided into 115 reaches, were walked or canoed during summer 2005. Portions of Bates Drain, Ives Drain, Jarbo Drain, Mason Run, Plum Creek Mason Run Cutoff and River Raisin were evaluated within City of Monroe limits. A few areas were inaccessible due to construction, private property, or contamination concerns. A reach labeling system used road crossings or other notable landmarks, and a general description. Past and current weather conditions were also tracked since recent storm events can influence stream flow conditions, sediment scouring and deposition, and water clarity. However, the summer of 2005 was unusually dry and no wet weather occurred during this assessment.

FIGURE 6
Reach Assessment Results

5.1 GENERAL FINDINGS

Although, it should not come as a surprise, the closer a development encroached upon a drain or stream the lower the assessment value tended to be. In addition, the bottom and sides of many of the reaches, particularly in the Mason Run Drain and the Mason Run Drain Cut-off are completely lined in concrete. This lowered the assessment score simply because concrete has no natural habitat value. One common, almost ubiquitous problem is trash and debris in the drains and streams. In most instances this trash and debris is unsightly. In some instances, some debris, e.g., car parts, may be leaching pollutants into the drains and streams. In other instances, the debris may be causing partial flow blockages and should be removed. Each potential problem area is called out in the sub-reach descriptions in Section 5.4 below.

Another related problem is the disposal of grass clippings and leaves on the streambank. The clippings tend to suppress or kill bank vegetative cover. After the clippings are washed out (and perhaps causing clogging problems downstream), the bare bank is more susceptible to bank erosion.

In addition, there are a few areas where construction activities are impacting the drain or stream. All construction areas should install and maintain adequate construction and silt fences. Construction debris or soil erosion can impair channel flow capacity and water quality.

In many areas, the land right up to the bank of the drain or creek is comprised of turf grass. Turf grass has several detrimental environmental impacts. Firstly, turf grass requires water, fertilizer and pesticide applications and mowing to maintain. There are alternatives to turf grass that do not need water (this is covered in the recommendations section below). Fertilizer and pesticide applications can be over-applied both in rate and area coverage. This over-application can get into the waterways and into Lake Erie. In addition, rain storms, particularly those immediately following application can quickly transport the fertilizer and pesticide to these waterways. Mowing requires time, effort, gasoline and oil. In addition, geese like the turf grass habitat, while not many other wild creatures do. Geese and pets both find it convenient to relieve themselves on turfgrass. Their excrement can also be washed directly into the waterways.

5.2 STREAM CONDITIONS

The team used the RCH form to evaluate eight parameters which rate the quality of stream and riparian habitat. Habitat parameters are classified as optimal, suboptimal, marginal, or poor condition, and are assigned a score ranging from zero to 20 (with 20 being the most pristine stream corridor condition). The RCH form combines habitat and streambank parameters from Barbour *et al.* (1999) with additional descriptions on flood plain features to characterize overall stream corridor conditions. The first four habitat parameters focus on stream channel conditions and include in-stream habitat, vegetative protection, vegetative buffer width and bank erosion. The next four parameters relate to riparian areas outside the channel and include floodplain connection, floodplain vegetation, floodplain habitat and floodplain encroachment. Together, the maximum score for all eight habitat parameters is 160 points (which represents the highest quality stream conditions). Few urban streams will score this well. The composite habitat score for a survey reach will be evaluated relative to the other survey reaches in the River Raisin Watershed and other Michigan watersheds.

1. In-Stream Habitat

Habitat structure includes riffles, boulders, large woody debris, undercut banks, and deep, stable pools, and provides locations for aquatic insects and fish to hide, eat, or breed. The more abundant and diverse habitat structures are, the better the habitat quality. Stream habitat criteria were adopted to reflect the gradient of streams in the subwatershed. The criteria provided on the RCH form are geared towards high gradient streams that tend to have a wider diversity of substrate and available cover. Barbour *et al.* (1999) recommends reducing the habitat cover percentage thresholds in lower gradient streams to 50%, 30%, and 10% to define optimal, suboptimal, and marginal habitat conditions, respectively. On average, the River Raisin within the City of Monroe was found to have a suboptimal score of 12 out of a possible 20. However a range of values was found and 14 reaches were classified as having poor in-stream habitat.

2. Vegetative Protection

Vegetative protection explicitly deals with the diversity and abundance of vegetation found on the face and top of stream banks. The roots and shoots of vegetation hold bank sediments together and help protect the bank from erosion. Each bank was evaluated separately. Survey reaches with dense and diverse bank vegetation receive the highest score. No reaches are classified as optimal or suboptimal where less than 50% of the streambank surfaces are covered by vegetation. The surveyed reaches had an average score of 6 out of 20.

3. Vegetative Buffer Width

Vegetative buffer width, on the other hand, measures the average width of the naturally-vegetated buffer on each side of the stream, and accounts encroachments. Generally, lawns and row crops are not counted as natural cover. Reaches with a continuous, naturally-vegetated buffer at least 50 feet wide receive the highest score. Average channel stability was determined by simultaneously assessing vegetative protection, bank erosion and flood plain connection. The surveyed reaches were found to have an average score of 6 out of a possible score of 20 and no reaches were classified as optimal or suboptimal.

4. Bank Erosion

Field crews also assessed the general level of bank erosion occurring throughout the reach. Bank erosion is a natural process; however, hydrologic changes associated with urbanization often cause excessive erosion. Urban streams have steep, exposed banks and may exhibit signs of collapse and active scouring. Reaches exhibiting minimal erosion receive the highest score. The surveyed reaches were found to have an average score of 8 out of a possible score of 20 and no reaches were classified as optimal or suboptimal.

5. Floodplain Connection

Floodplain connection examines the degree to which the stream and floodplain are hydro-logically connected. Flood waters typically spill into the floodplain of undeveloped streams once a year or so. When this occurs, the energy of the flood water is effectively dissipated

as it spreads over a wider area. Many urban streams become separated from their floodplain by downcutting or channel alteration. The floodplain connection was evaluated by roughly estimating if the stream has incised to the point that moderate flood events can no longer escape the channel. A connected system usually has short stream banks, which allow flood waters to move from the channel out into the floodplain. Signs of fresh sediment, water marks, and debris jams in the floodplain are used to confirm the floodplain connection. Streams where moderate flood flows can reach the floodplain receive the highest scores. Overall, the surveyed reaches resulted in a wide range of values. On average, the City of Monroe reaches received an average rating of 10 out of a possible score of 20.

6. Floodplain Vegetation

Flood plain vegetation helps to slow flood waters and promote sediment deposition, and is classified based on the dominant vegetative cover found on both sides of the stream corridor. Forest cover receives the highest score because bottomland forests slow flood waters to the greatest degree, and are valuable habitats for plant and wildlife species. Flood plains consisting of turf or crops have less ability to slow flood waters and receive lower scores. The surveyed reaches were found to have an average score of 5 out of a possible score of 20 and no reaches were classified as optimal or suboptimal.

7. Floodplain Habitat

A high scoring floodplain habitat consists of a diversity of wetland and non-wetland habitat types. Standing/ponded water in the floodplain provides valuable habitat for amphibians and other animals. Overall, the surveyed reaches resulted in a wide range of values. On average, the City of Monroe reaches received an average rating of 7 out of a possible score of 20. 8 reaches had optimal floodplain habitat, while 32 had very poor.

8. Floodplain Encroachment

Floodplain encroachment determines the extent of encroachment in the floodplain by filling, land development, and/or man made structures. Encroachment was assessed from the perspective of how it alters the flood plain ability to pass extreme flood events. Higher scores are assigned to floodplains with a low percentage of encroachment over their length. Overall, the surveyed reaches resulted in a wide range of values. On average, the City of Monroe reaches received an average rating of 10 out of a possible score of 20. 17 reaches had optimal floodplain encroachment, while 20 had very poor.

5.3 PHYSICAL FEATURES

The physical features of the channel and water column and access to the stream corridor were evaluated for potential restoration projects. The physical condition of the stream reach is defined by nine parameters; baseflow width percentage, dominant substrate, water clarity, attached and floating vegetation, evidence of wildlife, shading, channel erosion or deposition, channel dimensions and accessibility.

1. **Baseflow Width Percentage**

   Baseflow width percentage refers to the fraction of the stream bottom width covered by the baseflow channel, sometimes known as the wetted width. 42% of the surveyed reaches showed base flow covering less than 25% of the total channel width.

2. **Dominant Substrate**

   The dominant substrate reflects the predominant inorganic particle size found on the streambed observed throughout the channel (sand, gravel, cobble, etc). 56% of the surveyed reaches were fine or slick silt/clay. Two areas were identified with a concrete lining.

3. **Water Clarity**

   The general clarity of the water column was recorded before the team entered the stream. Staining generally refers to a reddish or brownish color often associated with tannic acids (think of iced tea). Turbid refers to cloudy water containing suspended silt or organic particles. Algae, suspended solids, dyes, or chemical discharges may also cause poor water clarity. Results were equally divided between clear, stained and turbid. Two areas were identified as stagnant and three were identified as opaque.

4. **Attached and Floating Vegetation**

   Field crews noted the presence of attached and floating plants in the streambed. Excessive nutrient loading can often cause excessive growth of aquatic plants and algae. The presence of stringy or clumps of floating algae is typically a sign of an unhealthy stream. The assessment found that approximately 33% or 1/3 of the reaches had no growth, 33% had some growth and 33% had excessive aquatic plant growth in the stream.

5. **Evidence of Wildlife**

   Evidence of wildlife in the stream corridor, such as beaver and deer was noted. Approximately 10% of the areas had fish and 15% had visible rodent tracks (groundhog, woodchuck or raccoon). Only a few areas were verified to have ducks and audible frogs at the time of the assessment.

6. **Shading**

   The percentage of stream shading by overhead tree canopy is an important factor, because it influences bank stability, habitat, large woody debris generation and stream temperature. Overall, a wide variety of shading was found in the City of Monroe. The areas showed approximately 20% mostly shaded, halfway, partially and unshaded.

7. Channel Erosion or Deposition

Overall channel processes were evaluated. 4 were found to be aggraded, 2 with bank failure, 9 channelized, 9 downcutting, 12 sediment deposition, 14 were stable, 3 were widening, and 2 concrete.

8. Channel Dimensions

Average channel dimensions (bank heights, channel widths) were determined within the survey reach. A range in height values were found between 0.5 feet to 18 feet. An average of 6.5 feet height was found. The width of the channels within the City of Monroe varied between 3 and 100 feet. On average, reaches were found to be approximately 21 feet in width.

9. Accessibility

On average, the reaches within the City of Monroe were found to be fairly accessible. Good accessibility is characterized as an open area in public ownership, with sufficient room to stockpile materials and easy stream channel access for heavy equipment using existing roads or trails. The average rating was 4 (out of a possible score of 5) however 13 of the 115 reaches were deemed difficult to access.

Overall scores are totaled at the bottom of the form. A grand total of 72 out of a possible 160 points classified the City of Monroe reaches a 45% score as Marginal. This is the second lowest rating per the Unified Stream Assessment Manual rating system. Please see Table 2 or Appendix E for more details.

TABLE 2

REACH ASSESSMENT RESULTS

Category	Result Format	Optimal (20-16)	Suboptimal (15-11)	Marginal (10-6)	Poor (5-0)
1. In-Stream Habitat	Number of Reaches	14	12	20	25
	Percentage	20%	17%	28%	35%
2. Vegetative Protection	Number of Reaches	0	0	42	29
	Percentage	0	0	60%	40%
3. Bank Erosion	Number of Reaches	0	0	63	8
	Percentage	0	0	88%	12%
4. Floodplain Connection	Number of Reaches	19	20	20	12
	Percentage	27%	28%	28%	17%
5. Vegetated Buffer Width	Number of Reaches	0	0	39	42
	Percentage	0	0	48%	52%
6. Floodplain Vegetation	Number of Reaches	8	6	25	32
	Percentage	11%	8%	35%	45%
7. Floodplain Habitat	Number of Reaches	15	7	6	43
	Percentage	21%	9%	8%	60%
8. Floodplain Encroachment	Number of Reaches	17	18	16	20
	Percentage	23%	25%	22%	28%
9. Overall	Number of Reaches	1	26	39	3
	Percentage	2%	37%	56%	5%

5.4 RECOMMENDATIONS

A significant number of reaches in the City of Monroe should be cleaned out. In most cases, this is simply a case of improving aesthetics. As noted above, the most critical debris/blockages are in the culverts under Dixie Highway. These culverts drain the entire Mason Run Drain. These culverts should be cleaned as soon as possible.

The City of Monroe and the River Raisin have very little relief making drainage a challenge. Clearly, the concrete-lined channels were constructed to accelerate runoff through city neighborhoods as quickly as possible. Typical channel rehabilitation techniques to improve channel habitat, such as concrete lining removal and bioengineered streambank stabilization techniques are challenges to implement in this environment. In addition, in many areas of the City space limitations will prohibit concrete removal. Also, during our assessment many of these concrete channels were dry. However, replacing the concrete with deeply rooted native plants increases the chances of decreasing peak flows and pollutant loads via infiltration and plant filtering.

The remainder of the recommendations is structured in two subsections: the first sub-section provides some general descriptions of improvement techniques with some associated estimated costs; the second sub-section provides additional description of specific geographic areas of improvement along with references to the previous defined improvement techniques.

1. General Definitions of Improvements

Trash/debris/sedimentation clean-up

As noted above, channel clean up includes the removal of trash, debris, sediment and grass clippings. The benefits of removing this material include removing sources of pollutants and bank instability. We have not assigned a cost to this activity because the cost varies widely, depending on manpower and equipment needs and because this is an activity that can be easily undertaken by volunteers. A clean-up activity such as this for volunteers should also be used as an educational exercise. This is an excellent opportunity to draw the connection between activities or improvements in the watershed and the health of the River Raisin and Lake Erie.

Native plant buffer

This is probably the most cost-effective management technique that could be implemented along the drains and channels in the City of Monroe that would help control non-point source pollution, and improve habitat and public perception. Native plants have a number of benefits. Native plant species have evolved to survive the Michigan eco-region without water, pesticide or nutrient subsidies. Many of these species are very deep-rooted (up to 15-ft deep roots), have a demonstrated capacity to increase the infiltration rate of underlying soils and are “self-seeding”. These characteristics make these plants ideal candidates for non-point source pollution control. Areas of these plants can slow down runoff, increase infiltration, and sediment and pollutant trapping. Lastly, because these species are native, co-evolved wildlife species gravitate towards them. Approximate costs (per unit costs decrease as the planting area increases) are $3,000 - $6,000 per acre (depending on seeding and plug planting needs) with management costs ranging $1,000 - $2,000 per acre per year. This includes removal/eradication of existing turf or invasives in the area to be converted to native plants.

Rain Gardens

A rain garden is an attractive landscaping feature planted with perennial native plants. It is a bowl-shaped garden, designed to absorb stormwater run-off from impervious surfaces such as roofs and parking lots. Rain gardens can be small, formal, home-owner style gardens, or large engineered bioretention basins or anything in-between. Rain garden costs can be quite modest, particularly if they are installed by the property owner. Excellent resources for designing rain gardens can be found on the internet. See for instance: http://www.dnr.state.wi.us/org/water/wm/nps/rg/#How for a downloadable PDF version of a How-To manual. Costs can range from $3 to $12 per square foot of rain garden, depending how much labor each landowner commits to the project.

Invasives Removal

Invasive plants are a problem because they rob the landscape of vegetative and habitat diversity. Habitat homogeneity ensures that wildlife variety will also diminish. Invasives in the Monroe area include, but are not necessarily limited to Canada thistle, buckthorn, purple loosestrife, the tree of heaven, and the common reed. However, invasive plants typically cannot be removed once without applying further effort. Invasive plant areas typically need to be treated (either with targeted herbicide spraying or plant removal) more than once. Additionally, planting the area with preferred species after spraying or removal helps keep the invasives away. Invasives removal is also a good candidate for volunteer assistance. Spraying typically costs $1,000 - $2,000 per acre per application.

Concrete channel lining removal

We have only recommended this adjacent to the Cantrick Middle School. While removing the concrete channel lining would probably help with public perception of the drain, infiltration opportunities and habitat value, the cost is not insignificant. The concrete has to be demolished and hauled off site. In order to maintain the same flow capacity following removal of concrete, the channel has to be enlarged. Depending on site hydrology and hydraulics this excavation may be a minor effort. However, the impact of changing the channel lining and the extent of channel enlargement would have to be evaluated by an engineer. Following any channel excavation the channel would have to be seeded and stabilized. We estimate concrete removal, excavation and stabilization costs to be on the order of $50 - $100 per linear foot of the channel. But it should be noted these costs are rough estimates given the uncertainty associated with demolition and hauling costs and the excavation necessary to ensure the same flow capacity following concrete removal.

Daylight Channel

Removing a closed storm pipe and converting the drain to an open channel is referred to as daylighting. This can be a very expensive method to recover channel habitat. Daylight can run anywhere from $100 - $500 per linear foot of recovered channel.

Bioengineered streambank stabilization

Bioengineered streambank stabilization costs can vary widely depending on the height of the banks, the factor of safety required and access. Bioengineered streambank stabilization is the use of non-engineered materials, such as seed, erosion control blanket, tree plantings, root wads, stone toe protection, etc. to provide a flexible, yet stable method for protecting streambanks from erosion and collapse. With good access, low banks (less than 6-ft high) and a fair factor of safety, stabilization costs for areas on the River Raisin could range from $50 - $200 per linear foot of bank stabilized. Bioengineering streambank stabilization is often eligible for outside funding sources.

Plant tree buffer

Native plant buffers and trees are a fairly cost-effective way to capture rainfall, increase infiltration, provide shade, cool temperature and improve public perception. One of the simple benefits of trees is that they can be planted in a variety of areas, including existing parking lot islands. Typically, tree survivability dramatically increases if trees are planted in groupings or at least two or three.

Tree plantings are a great volunteer activity. Bare root tree saplings are less than $1 each, while gallon container trees are about twice that cost. There are a variety of funding sources that provide match grants for tree plantings, including Detroit Edison.

River Raisin in-stream plantings

The concept of the River Raisin in-stream plantings is to narrow the low flow channel of the river by planting dense stands of emergent aquatic plants along both sides of the river bank The plantings would be in shallow, unvegetated or sparsely vegetated areas. The effect of dense plantings (1-foot on center) would be to create very slow moving fringe areas along the banks that would tend to increase the velocity of the river towards the center. This would help flush slower moving areas of the river particularly during low flows. Given the very shallow river bed slope in this area it is highly unlikely that these increased velocities would result in any additional erosion in the river.

In conjunction with MDEQ permitting a focused hydraulic analysis would be performed to demonstrate the potential impact of these plantings on flooding and erosion scenarios. Many emergents, like sedges, have thin and very flexible shoots. Any impact the plants may have on increasing channel roughness and energy loss, quickly dissipates once the plant is submerged. These plantings would increase bird and fish habitat, shading and demand for nutrients. The increased shading and nutrient demand would help shift the nutrient utilization dominance away from algae and more towards the emergents. This effect would be most pronounced during low flow, the most critical period for algae blooms. Probable cost per plant, installed is on the order of $5. This may also be an activity eligible for outside funding sources.

2. Specific Geographic Improvement Areas

A total 8.2 miles that were evaluated and grouped into 71 separate reach lengths. Out of those reaches, three were classified as poor, 39 marginal, 26 were suboptimal and 1 was found to have optimal conditions. Please see Figure 6 to identify the location of these reaches.

Recommendations for improvements have been developed for certain reaches within the City of Monroe. Field ratings were used to determine the priority of each improvement. Reaches with similar poor or marginal ratings were grouped together to form an Area of Improvement. Overall, trash/debris pick-up, invasive species removal, concrete channel lining removal, daylighting, bioengineered streambank stabilization, native plant buffers and River Raisin in-stream plantings are recommended throughout the City of Monroe and the River Raisin.

Area # 1: River Raisin at the Monroe Street crossing
This area rated poorly for habitat and floodplain vegetation. This area is specifically targeted for in-stream plantings. Planting five-ft to 10-ft wide strips 500-ft along the banks on either side would likely cost between $17,500 and $35,000.

Area # 2: Mason Run Drain in Calgary Park
The upstream end of the Mason Run Drain was re-routed along the railroad tracks. The Mason Run Drain Cut-off runs south along the west side of the tracks, and the Mason Run Drain now originates in Calgary Park. But what is left on the other side of the train tracks is a murky, algae-covered stagnant pool. There is little elevation change to flush this standing water down the drain. This is a parking lot to the north that drains to this area and some of the park drains here, but over an expanse of turf grass. There is an opportunity here to disburse the parking lot runoff through a 10-wide vegetated buffer before draining to a new basin. The drain area between the lot and the park would have to be excavated out to form the basin. Ideally the excavated material would be replaced with a foot of sand covered by 1 - 2 feet of very sandy topsoil. The entire basin and a 10-buffer strip on either side of the pond could be planted with a large variety of deep-rooted, flowering native plants. The basin would become an attractor for birds and butterflies and create an amenity in the park rather than an eyesore. Total estimated cost for the excavation and plantings is $15,000 ± $5,000. This kind of a project could be a candidate for funding from a variety of grant sources, including the Clean Water Act Section 319 Non-Point Source Pollution Control grant program.

Area # 3: Mason Run (cross country)
The area of concern starts from the intersection of Noble and Dixie and extends east to the intersection of Detroit and Mill. Heavy sediment problems and old building remnants have been found to be a safety hazard and needs clean-up. Drain appears to flow under old building and is a concern for potential illicit connection. Overall, this portion of the channel is very steep and densely overgrown. Recommendations include trash/debris pick up/daylight channel/sediment clean-up and possible re-routing of channel. Total estimated cost is ± $5,000.

Area # 4: Mason Run on Michigan Ave between Maywood and Noble
Field visits revealed that the existing rip-rap is overgrown with vegetation and scouring along bottom. Channel is completely broken and concrete blocks are blocking flow. Proposed improvements include installing native buffer and removing concrete channel. Total estimated cost is ± $5,000.

Area # 5: Raisin River from Monroe Ave to Michigan Ave
Potential illicit connections were found along retaining wall. Area which does not have retained wall has grassy and sensitive spots. Some floating scum concentrated towards the Dam area. Recommendations include enhancing in-stream vegetation and stabilization techniques. Total estimated cost is ± $5,000.

Area # 6: Ives Drain
Area of concern was found starting at the intersection of Lavendar and Calkins and proceeding east cross-county to the northerly dead-end of Saint Mary's Street. Channel is losing its native wetlands on its bank. Channel is wide and not deeply entrenched. House along Godfrey is heavily encroaching on stream bank. Recommendations include bank stabilization. Total estimated cost is ± $5,000.

Area # 7: Mason Run parallel and just east of Huber St
Significant debris was found along the railroad tracks and from road. Channel is located very close to the railroad tracks. Recommendations include trash pick up and construction of a retaining wall or concrete channel. Total estimated cost is ± $5,000.

Area # 8: Southworth Drain, just east of the intersection of Huber and Lorain.
Field visits revealed scouring along bottom of concrete block, evidence of illegal dumping, railroad gravel spillover, and some railroad ties partially blocking flow. Railroad gravel is designed to slow water some, but has flattened out in several areas. Channel substrate becomes finer down stream. YMCA parking lots stream area is short grass with cut bank, which is ideal location to plant stabilizing vegetation. Evidence of fish and cray fish burrowing indicate good water quality. Heavy vegetation prevented precise reach observations. Outfall into River Raisin is over an old concrete burm which slightly dams the stream vegetation on both sides. Recommendations include trash/debris pick up, stabilizing bank and native plant buffers. Total estimated cost is ± $5,000.

Area # 9: Mason Run Cutoff east of the intersection of Huber and Lorain south to the River Raisin
This would be a good area for a possible rain garden(s), native plant buffer and bioengineered streambank stabilization area. The rain garden(s) can be used to capture parking lot and roof drainage. The native plant buffer could run for 100-feet or more along the shoreline, replacing the turf grass that is there. Overall cost of the project, depending on the sizing and number of rain gardens could be on the order of $10,000 to $20,000 and would be a potentially fundable activity by outside grant sources.

Area # 10: Mason Drain – Dixie Highway Culverts
The culverts under Dixie Highway are in immediate need of cleaning and clearing. This work should be done as soon as possible.

Area # 11: Mason Run Cut-Off
Many areas along the Mason Run Cut-off next to the railroad tracks should be cleaned out. Trash and miscellaneous debris litter the drain throughout this area.

3. River Raisin Dams

Other recommendations include further investigations on dam removal. See Figure 7 for the location of each of these dams. Dam removal in the River Raisin would enhance the river's velocity/flow regime, fish passage, channel habitat and water quality characteristics. During low flow periods water would move through Monroe more quickly and stagnant water areas would be less of a problem. Clearly, the most significant impediment to fish passage and free flow of the river is the Detroit Edison dam for the Power Plant. Detroit Edison and the Monroe Intake Study Group have studied this problem extensively, but no satisfactory, economically feasible alternative has been identified at this time.

Each dam is equipped with two or three gates that are four to six feet wide. In the late 1990's the gates were removed for a period of approximately three years. The river environment changed drastically during that period. The approximate cost for permitting and pulling each gate is $7,000. However, there is some concern in the City that pulling the gates could increase the chances of the dam integrity being compromised by ice

floes during the winter. If the dams were compromised the sanitary sewer line integrity would be threatened.

An alternative to dam removal would be planting more shoreline vegetation along the River Raisin in very shallow areas in Monroe. This would enhance pollutant removal and create a somewhat narrower channel to create higher velocities through the main channel. This vegetation would shade out algae and in times of flood would offer little in the way of flow resistance and would therefore not increase the chances of river flooding. See Recommendation No. 1 (General Definitions of Improvements) above for more detail on this option.

FIGURE 7
Dam Locations

4. Drains and Creeks

Although, it should not come as a surprise, the closer development encroaches upon the drain or stream the lower the assessment value tended to be. In addition, the bottom and sides of many of the drains, particularly the Mason Drain and the Mason Drain Cut-off are completely covered in concrete. This lowered the assessment score simply because concrete has no natural habitat value. One common, almost ubiquitous problem is trash and debris in the drains and streams. In most instances this trash and debris is unsightly. In some instances, some debris, e.g., car parts, may be leaching pollutants into the drains and streams. In other instances, the debris may be causing partial flow blockages and should be removed. Each potential problem area is called out in the sub-reach description. One location deserves special note: **the culverts under Dixie Highway needs immediate attention**. These culverts are partially filled in by sediment and debris. If these culverts fill in further they could cause widespread flooding upstream.

Another related problem is the disposal of grass clippings and leaves on the streambank. The clippings tend to suppress or kill bank vegetative cover. After the clippings are washed out (and perhaps cause clogging problems downstream), the bare bank is more susceptible to bank erosion.

In addition, there are a few areas where construction activities are impacting the drain or stream. All construction areas should install and maintain adequate construction and silt fences. Construction debris or soil erosion can impair channel flow capacity and water quality.

In many areas, the land right up to the bank of the drain or creek is comprised of turf grass. Turf grass has several detrimental environmental impacts. Firstly, turf grass requires water, fertilizer and pesticide applications and mowing to maintain. There are alternatives to turf grass that do not need water (this is covered in the recommendations section below). Fertilizer and pesticide applications can be over-applied both in rate and aerial coverage. This over-application can get into the waterways and into Lake Erie. In addition, rain storms, particularly those immediately following application can quickly transport the fertilizer and pesticide to these waterways. Mowing requires time, effort, gasoline and oil. In addition, geese like the turf grass habitat, while not many other wild creatures do. Geese and pets both find it convenient to relieve themselves on turfgrass. Their excrement can also be washed directly into the waterways.

6.0 OUTFALL INVENTORY

The main objective of this task was to locate, inventory and document all the outfalls along the streams surveyed, as well as identify the type of outfall located and the quality of the water being discharged. This task was performed by the City of Monroe as a separate project outside the scope of the pilot watershed improvement plan. The results are included here for the sake of continuity with this assessment. An outfall inventory is an important element in the Monroe Metropolitan Stormwater Management Program as it provides information necessary for municipal stormwater applications, and permits. These permits include Phase 1 National Pollutant Discharge Elimination System (NPDES) permits, and Department of Environment Quality (DEQ) General Permits, and Department of Environmental Quality (DEQ) General Permits for Stormwater. These inventories are valuable as a planning tool in managing their river resources, as well as assisting in stormwater model calibrations.

Outfalls are a necessary component of all drain systems to convey storm runoff to receiving waters. The City of Monroe had approximately 128 known storm outfalls ranging from 6-inches to 84-inches in diameter which discharge directly into an open channel. Thus, a significant volume of water discharge could cause downstream erosion or water quality problems. For these reasons, it is important for the City of Monroe to inventory sewer outfalls, and keep records of new outfalls. There were three types of outfalls found within the City of Monroe:

1. Storm Sewer Outfalls are used to allow stormwater collected in a separate storm sewer system to drain into receiving waters. The typical pollutants that can be discharged from storm sewer outfalls are road salts, various types of hydrocarbons and metals washed from roadways, sediment, nutrients, and particulate matter.

2. Permitted Industrial Discharge Outfalls are used to dispose of waste water from industrial processes. These outfalls generally discharge water used for washing cooling purposes and should be treated at the source if required. These types of outfalls require a National Pollutant Discharge Elimination System (NPDES) permit.

3. There may also be private outfalls from roof drains or basements to direct stormwater and seepage away from houses as well as some illicit septic outfalls from homes in the watershed. It is important for communities to perform outfall inventories to know the quantity, type and location of outfalls that are within their boundaries. Then they can effectively begin to manage stormwater and take steps to remove illegal or combined sewage outfalls.

As noted above, the City of Monroe staff conducted these outfall inventories outside of the scope of this project. Global Positioning Satellite (GPS) equipment was also used to track the latitude and longitude of each outfall. The paper Outfall Inventory Forms were migrated to a geodatabase. Digital photos were linked to each digital point and GPS coordinates were used as available. Please see Figure 8 for a location map of all outfalls within City limits.

As part of this project, EMU students found a possible additional 12 new outfalls, which have been turned over the City Wastewater Treatment staff for follow-up. Of the previously known 128 outfalls, 85 were inventoried in the summer of 2005 and 57 remain to be inspected.

Approximately 34 were noted to have physical condition concerns, such as broken pipe or displacement. Approximately 15 were noted to have water quality concerns, such as cloudy turbidity, oil sheen or foul odor. Three private pipes were identified and communicated to the City wastewater department as potential illicit connection. Recommendations for improvements to the storm outfalls were not included as part of the City's inventory project or this project. Please see Appendix F for further details.

FIGURE 8
Outfall Inventory Location Map

7.0 WATER QUALITY ASSESSMENT

Water quality samples were taken during three separate dry weather events at seven locations along the River Raisin during August 2005 and analyzed for pH, conductivity, dissolved oxygen, and phosphate. E. *coli* was tested four during two separate dry weather events at four locations. Figure 9 shows a location map of each sample location. Two of the most important water quality parameters of concern in the lower River Raisin are *E. coli* and phosphorus. The dry weather *E. coli* and phosphorus concentrations while not alarming, showed some problems.

Because the City of Monroe lies at the mouth of the River Raisin, the city is the recipient of over 1,080 square miles of activities in the upstream watershed. The water quality in the River Raisin within the limits of the City of Monroe is largely controlled by upstream conditions in the watershed. This circumstance should not diminish the role of stewardship the City should continue to foster for watershed and river health, but rather, highlight the necessity for Monroe to remain an active participant in improvement activities for the entire River Raisin watershed.

Below is a summary of these events:

TABLE 3

WATER QUALITY RESULTS

Location	pH	Conductivity (µS)	Dissolved Oxygen (mg/L)	Phosphate (mg/L)	E. *coli* (col/100ml)
Trading Post (Outside City Limits)	7.89-8.20	536-649	6.75-9.95	.015	18-100
Telegraph Bridge	7.89-8.28	535-687	8.40-10.35	.015	N/A
Roessler Bridge	7.96-8.40	511-638	7.75-11.78	.015	20-290
Macomb Dam	7.96-8.32	513-657	7.45-10.33	.015	N/A
N. Dixie Hwy Bridge	8.10-8.23	526-711	8.40-9.74	.015	18-210
I-75 Bridge	8.21-8.41	525-670	6.90-10.61	.015	N/A
Port Rd	8.27-8.67	409-518	8.79-10.65	.013-.015	25-40

FIGURE 9
Water Quality Sample Locations

7.1 PH

The pH of water determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (e.g., phosphorus, nitrogen, and carbon) and heavy metals (e.g., lead, cadmium, copper). For example, in addition to determining how much and what form of phosphorus is most abundant in the water, pH also determines whether aquatic life can use it. Heavy metals tend to be more toxic at lower pH because they are more soluble and more bioavailable. [4]

The pH was measured in the field using an electronic probe, which was calibrated before each sampling event. Natural pH of streams should be between 6.5–8.5 and looking at the above results it appears, that during this set of sampling, the pH is within the acceptable range of natural streams. According to Rule 53 of the Michigan Water Quality Standards (Part 4 of Act 451) pH shall be maintained within the range of 6.5-9.0 in all waters of the State.

7.2 CONDUCTIVITY

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well and therefore have a low conductivity when in water. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity.

Conductivity was measured in the field using an electronic probe, which was calibrated before each sampling event. Conductivity parameters in healthy natural streams should be below 800 microSiemens (μS) and the conductivity within the River Raisin, during these sampling times, ranged from 511 – 711 μS, which is within the healthy stream range.

7.3 DISSOLVED OXYGEN (DO)

Almost all plants and animals require oxygen to breathe and live. This is true for aquatic species as well, and oxygen is present in water in a dissolved form. Most aquatic species have gills or special tissues as breathing mechanisms. Because cold water absorbs more oxygen, DO is usually higher in winter and lower in summer. Excess nutrients (manure, fertilizer) in water feed the growth of algae. Bacteria in water consume and decompose this organic matter, and in the process utilize dissolved oxygen. Low DO is an indicator of organic pollution. Michigan has a water standard for DO of 7mg/L or higher for a coldwater stream and 5mg/L or higher for warm-water streams. A DO concentration less than 3mg/L kills most species of fish.

Dissolved oxygen was measured in the field using an electronic probe. The DO in River Raisin ranged from 6.75 mg/L to 11.68 mg/L. This is well within the limits for warm-water streams and to support a variety of aquatic life.

[4] A Citizen's Guide to Understanding and Monitoring Lakes and Streams (http://www.ecy.wa.gov/programs/wq/plants/management/joysmanual/streamph.html)

7.4 PHOSPHATE

Phosphates are chemical compounds made from the elements phosphorous and oxygen. Phosphorous is necessary for plant and animal growth. Phosphorous is usually present in natural waters as phosphate (PO_4^{-3}).

Phosphates exist in several forms. Orthophosphates are produced by natural processes and are also found in wastewater. Polyphosphates are used for treating water boilers and for making laundry detergents. Organic phosphates are produced by living things and the breakdown of organic pesticides. The sum of these three forms of phosphates is referred to as total phosphorous.

Phosphorous is an essential element for life. Animals use phosphorus to conduct metabolic reactions (chemical reactions that occur inside the body that allow the body to stay alive) and to produce bone. Plants use phosphorus in order to grow. Nearly all fertilizers contain phosphates. Phosphates are usually present in the environment in low concentration which limits plant growth. Phosphates enter the environment from human or animal wastes, fertilizers, soaps, industrial wastes, and the disturbance of land and its vegetation. When too much phosphorus becomes available, plants grow rapidly and contribute to algae blooms. [5]

Phosphates were tested for using CHEMets®KIT K8505. The average phosphate concentration in the River Raisin measured during this study was 0.15 mg/L. The flow-weighted average concentration for the River Raisin as measured by Heidelberg College between 1982 and 2004 (6,772 measurements) was 0.195 mg/L. The median flow-weighted concentration of total phosphorus in relatively undeveloped basins in the United States is 0.022 mg/L (NAWQA report). The generally recommended concentration threshold for the prevention of nuisance aquatic growth in streams in 0.1 mg/L (USEPA, 1986). Clearly, the River Raisin regularly exceeds this concentration. By comparison, it should be noted that 70% of the 97 NAWQA basins sampled during 1992-1995 in areas dominated by agricultural and urban residential land had a flow-weighted total phosphorus average concentration equal to or exceeding 0.1 mg/L (USGS, 1999).

7.5 E. *COLI*

E.*coli* (short for Escherichia *coli*), is a type of fecal coliform bacteria, and is commonly found in the intestines of animals and humans and is found in human and animal wastes. There is always some E. *coli* present within natural streams but an abundance of E.*coli* in water is an indication of animal waste contamination or human sewage.

Rule 64 of the Michigan Water Quality Standards (Part 4 of Act 451) limits the concentration of microorganisms in surface waters of the state and surface water discharges. Waters of the state which are protected for total body recreations (swimming) must meet limits of 130/100 ml as a 30-day geometric mean and never exceed 300/100ml at any time. The limit for waters of the state which are protected for partial body contact recreation (boating, fishing, etc.) is 1000/100 ml.

[5] Stream Monitoring (http://pathfinderscience.net/stream/cp4po4.cfm)

Bacteria, specifically E. *coli*, was tested for using a grab method at four (4) stations along the Raisin River during two (2) different dry weather events in August 2005. These samples were then taken to the City of Monroe Wastewater Treatment laboratory for testing. When water quality testing was done on the River Raisin the E. *coli* count varied from 18-290/100ml which indicated that, during this testing period, the river was 'healthy' and 'safe' to be used for partial body contact and limited total body contact recreation.

7.6 RECOMMENDATIONS

The City of Monroe would be well served by instituting one long-term monitoring station at the I-75 Bridge and supporting the water quality sampling being conducted by the Water Quality Laboratory (WQL) at Heidelberg College at the USGS gaging site See Figure 9 (http://wql-data.heidelberg.edu/). With these two stations the City would isolate the water quality contributions from the entire upstream watershed and from the City.

The WQL has been collecting water quality data at the USGS gaging site just upstream of the City of Monroe since 1982. This is an extremely detailed and useful data set for total suspended solids, phosphorus and nitrogen concentrations and loads. The WQL has supported this sampling through a variety of funding sources. The City of Monroe should consider contributing financial resources to maintain this program. In addition, the City should explore the possibility of having the WQL take periodic grab samples at the site and have them run for *E. coli*.

In most circumstances, particularly during dry weather it is unlikely that the City will see a significant impact on pollutant concentrations between the USGS gage down to I-75. However, during wet weather events stormwater runoff from the City could show up as concentration spikes in the river for nutrients, solids, metals, hydrocarbons and pathogen indicators. Unless the City initiates a stormwater sampling program, sampling and analysis at the I-75 station should only focus on bi-weekly sampling during the summer months (May – September) for TSS, TP, and *E. coli*.

If the City were to implement only one water quality monitoring recommendation following the receipt of this report, supporting the WQL would be the most effective option for tracking basic water quality conditions in the City of Monroe. This support could simply focus on having the WQL periodically grab and analyze samples for *E. coli* during the summer period only.

8.0 GOALS AND OBJECTIVES

For the sake of completeness this plan lays out both the designated uses and desired uses for the River Raisin and its associated watershed in Monroe. Designated uses are uses of the water as established by state and federal water quality programs. Desired uses are those uses defined by the stakeholders for the river and its watershed.

This chapter also includes a list of overall challenges to river and watershed health and lays out a set of recommended strategies and BMPs to address those threats. The stream reach assessment and recommendations that arose from that assessment are to address very specific problem areas identified by the field program. The BMPs and strategies laid out here are general recommendations for planning, ordinance changes and regulation and control of new development and re-development in Monroe.

8.1 DESIGNATED USES

Per the Michigan Department of Environmental Quality, water quality is primarily measured by whether the body of water meets the designated uses as defined by the State of Michigan. In Michigan, the goal is to have all waters of the state meet the designated uses that apply to that body of water.[6]

All surface waters of the State of Michigan are designated for and shall be protected for all of the following uses (those that are applicable to the City of Monroe are in bold):

1. **Agriculture**
2. **Industrial Water Supply**
3. **Public Water Supply**
4. **Navigation**
5. **Warmwater Fishery**
6. **Other Indigenous Aquatic Life and Wildlife**
7. **Partial Body Contact Recreation**
8. **Total Body Contact Recreation between May 1 and October 31**
9. **Coldwater Fishery**

[6] Administrative Rules Part 4 Water Quality Standards, MDEQ

The following definitions apply:

1. Agriculture – a use of water for agricultural purposes, including livestock watering, irrigation, and crop spraying.

2. Industrial Water Supply – a water source intended for use in commercial or industrial applications or for non-contact food processing.

3. Public Water Supply – a surface raw water source that, after conventional treatment, provides a source of safe water for various uses, including human consumption, food processing, cooking, and as a liquid ingredient in food and beverages.

4. Navigation – a water source suitable for navigation.

5. Warmwater Fishery – a waterbody that contains fish species that thrive in relatively warm water.

6. Other Indigenous Aquatic Life and Wildlife – the use of the surface waters of the state by fish, other aquatic life, and wildlife for any life history stage or activity and the protection of fish for human consumption.

7. Partial Body Contact Recreation – any activities normally involving direct contact of some part of the body with water, but not normally immersion of the head or ingesting water, including fishing, wading, hunting, and dry boating.

8. Total Body Contact Recreation between May 1 and October 21 – any activities normally involving direct contact with water to the point of complete submergence, particularly immersion of the head, with considerable risk of ingesting water, including swimming.

9. Coldwater Fishery – waterbodies that contain fish species that thrive in relatively cold water.

State and local monitoring of the conditions of the watershed have determined that some of the designated uses are threatened or impaired. Impaired uses are those uses that are not being met, while threatened uses are those that currently meet water quality standards but might not in the future. Table 4 summarizes the designated uses as impaired, threatened, or not applicable.

TABLE 4

DESIGNATED USES

Designated Use	Impaired	Threatened	Notes
Agriculture			*Neither threatened nor impaired but still applicable to the City of Monroe.
Industrial Water Supply			*Neither threatened or impaired but still applicable to the City of Monroe.
Public Water Supply		X	
Navigation			*Neither threatened nor impaired but still applicable to the City of Monroe.
Warmwater Fishery	X		Listed as 'Beneficial Use Impairment' under EPA River Raisin Area of Concern
Other Indigenous Aquatic Life and Wildlife	X		Listed as 'Beneficial Use Impairment' under EPA River Raisin Area of Concern
Partial Body Contact Recreation		X	
Total Body Contact Recreation			

8.2 DESIRED USES

Desired uses are how the City of Monroe and other stakeholders may want to use the watershed or how they may want it to look and function. Desired uses may include current or potential natural resource concerns, such as loss of farmland and open space, or preserving unique habitat for wildlife. Many desired uses may not have a direct impact on water quality, but are still included in the watershed planning process.[7]

As stated above in Section 4 a public survey was sent out to all riparian landowners asking what activities they used the river for and what concerns they had. These survey results were then compiled into a preliminary list and categorized as either impaired or threatened. Uses were determined to be impaired or threatened based on field observations. Desired uses that were indicated as neither impaired nor threatened were categorized as unknown.

[7] Ecorse Creek Inter-Municipality Committee. 2005. Ecorse Creek Watershed Management Plan for the Michigan Department of Environmental Quality.

TABLE 5

DESIRED USES

Desired Use	Impaired	Threatened	Unknown
Aesthetics	X		
Open Space Preservation		X	
Greenway Preservation		X	
Recreational Uses	X		
Native Vegetation/Unique Habitat/Natural Buffers	X		
Flood Control			X

8.2.1 Aesthetics

Many citizens expressed concerns about the amount of litter and debris within the River Raisin and other various tributaries. The City of Monroe desires that the streams, drains, and riparian corridors provide aesthetic beauty, and encourage people to utilize the riparian areas for recreation as well as maintain property values. A high aesthetic quality increases the general quality of life in the region.

8.2.2 Open Space Preservation

Currently, there is approximately 31% open space in the entire River Raisin watershed (grass, shrub, water, wetland, forest). However, based on SEMCOG 2030 Population predictions, the City of Monroe's populations may increase by 6,000 citizens. Open space is important for a variety of reasons, including habitat, increased potential storm water infiltration, pollution prevention, aesthetics, and recreational opportunities. Impervious development and associated urban runoff is one of the greatest threats to the watershed and a great concern to the citizens surveyed. Preserving existing open space will be a critical factor in the health of the watershed.

8.2.3 Greenway Preservation

Greenways can be described as connections between people and places to protect and enhance natural resources while providing opportunities for non-motorized recreation and an increased quality of life. Greenways, protect open space that is vital to the health of the watershed, provide habitat corridors for wildlife, and have also been documented to enhance property value.

8.2.4 Recreational Uses

Currently there are a variety of recreation areas along the river but citizens surveyed expressed an interest in increasing opportunities to fish, boat, watch wildlife and participate in non-motorized activities. Bringing people closer to the streams and water bodies can also raise the level of awareness and concern for watershed issues.

8.2.5 Native Vegetation/Unique Habitat/Natural Buffers

Native vegetation and naturalization of urban areas will help to prevent pollution from reaching the watercourses. Native vegetation generally has a deeper root system than non-native species & turfgrass, which allows for greater filtration of pollutants and enhances the amount of infiltrated storm water. Native vegetation is beneficial both at the stream corridor and throughout the watershed. Native plants can also improve the aesthetic quality of the area and reduce maintenance.

Providing unique habitat can improve stream health and invite wildlife not normally seen in an urban environment. Natural buffers allow for storm water infiltration as well as enhanced pollution removal by vegetation from storm water runoff. Natural buffers also slow down storm water velocities, which are important in preventing streambank erosion, which was one of the top five concerns of citizens surveyed.

8.2.6 Flood Control

Reducing flooding of roadways and private property was also one of the top concerns of citizens surveyed. Flooding creates problems for home and business owners and can cause significant property damage. Flooding of roadways also can cause significant damage and traffic issues.

When flooding does happen it also can be a detriment to the local waterways as the runoff picks up debris, oil, sediment and other environmentally harmful substances and carries them to local streams, ditches, rivers and lakes.

8.3 THREATS TO WATERSHED HEALTH

Pollutants are defined, as any substance of such character in such quantities that when it reaches a body of water, soil, or air, it contributes to the degradation or impairment of their usefulness or renders them offensive. Pollutants not only include the traditional types of pollutants, such as sediment and nutrients, but also include such things as increased temperature and increased hydrologic flow.[8]

8.3.1 Lack Of Stable Flow/Excessive Surface Runoff

Natural base flow (dry weather base flow) in streams is primarily fed by groundwater. After a storm event, rainwater should infiltrate to the groundwater table, which in turn provides constant flow to the streams. Once urbanization occurs, rainwater infiltration is impeded by impervious surfaces. Urban runoff is able to quickly travel to drains and streams, resulting in higher (flashy) peak flows after storm events. In addition, the lack of infiltration results in lower groundwater recharge, and lower resulting stream base flows during dry weather. Higher peak flows can cause stream bank erosion and flooding while lower dry weather flows make it difficult for some aquatic species to survive.

[8] Development a Watershed Management Plan for Water Quality, MDEQ

8.3.2 Excessive Surface Runoff

As described above, the large increase in impervious surface and loss of open space or “green” space within the watershed has greatly reduced the amount of precipitation that is able to infiltrate to the groundwater table. Instead, this water becomes surface runoff and quickly travels to the stream. This results in both higher peak flows and a greater volume of runoff. Excessive surface runoff can cause stream bank erosion, flooding, and an increase in pollutants to the stream.

8.3.3 Sediment

Excessive peak flows can result in stream bank erosion, which in turn result in suspended solids and sediment deposition. Sediment in streams may also be a result of sediment being carried to the stream via urban runoff. As storm water travels across impervious surfaces, it is able to carry pollutants, including sediment. In addition, disturbed soils due to activities such as construction can contribute to the problem.

Suspended solids can result in turbidity, which is harmful to aquatic life. Waters can become warmer as suspended solids absorb heat from sunlight. Less dissolved oxygen can be retained by the warmer waters, which causes oxygen levels to fall. Photosynthesis decreases because less light penetrates the water. Since photosynthesis produces oxygen as a byproduct, this sediment induced drop in photosynthesis also can contribute to lower oxygen levels. Sediment also can clog the gills of fish and settle and deposit in areas necessary for aquatic insects and fish spawning.

Sediment deposition also changes the natural shape of the channel and can reduce the capacity of the stream. This, in turn, can contribute to flooding problems.

8.3.4 Lack Of Habitat

A lack of habitat results in a poor diversity of aquatic species. Poor habitat can be caused by sediment as it is deposited on substrate necessary for aquatic insects. The absence or downsizing of riparian buffer zones is the biggest cause of lack of habitat. Riparian buffer zones provide shade necessary for preventing heating of stream water. Riparian vegetation also results in woody debris that creates protection for aquatic life. In addition, urban runoff results in a loss of the pool and riffle structure normally found in natural streams. Pools are areas of relatively deep, slow moving water and are important in providing deeper areas for aquatic species. Riffles are relatively shallow areas of fast moving water and are important for aerating the water.

8.3.5 Low Dissolved Oxygen

Sufficient dissolved oxygen levels are necessary for the survival of aquatic species. As the levels of dissolved oxygen decrease, the diversity of aquatic life also decreases, as sensitive species are no longer able to survive. Oxygen in the water is used as microorganisms break down organic and/or chemical pollutants (biochemical oxygen demand BOD) and/or through chemical oxidation (chemical oxygen demand COD), resulting in less oxygen available for aquatic life. These biological pollutants typically include natural sources (leaf debris, grass,

animal wastes) and algae blooms. As noted above, excess suspended solids can absorb heat from sunlight and reduce photosynthesis, which also causes oxygen levels to decrease. Urban runoff, which may be heated as it travels across impervious surfaces, also can contribute thermal pollution (warming) of the streams, which decreases dissolved oxygen levels.

8.3.6 Nutrients

Nutrients can come from several sources within the watershed. Excess fertilizer runoff, animal wastes, failing septic systems, and even permitted discharges can contribute to excessive nutrients in the streams. Fertilizer used by residents, businesses, and agriculture can be carried to the streams by storm water, both in terms of soluble nutrients and attached to sediment (as suspended solids) in the runoff. Animal wastes also contribute to nutrient loading. Excessive geese populations along impoundments that are mowed to the banks can contribute significant loadings. Septic systems that are not maintained or inspected regularly and properly can result in the migration of human wastes that contain nutrients. Permitted discharges, such as those discharges from domestic and/or industrial wastewater treatment plants, also can be a source for nutrients. High nutrient levels result in excessive growth of aquatic plants (often nuisance plants) and algae. Nuisance plants are able to out compete plants that may be more valuable for habitat and water quality. Excessive plant and algae growth also results in lower dissolved oxygen levels when they die and are degraded. The lowered oxygen levels can adversely affect aquatic life.

8.3.7 E. *coli*, other Pathogens

E. *coli* is an indicator of the potential presence of pathogens. Pathogens can harm wildlife as well as impair the use of the creeks for total and partial body contact uses. Sources of E. *coli* (pathogens) can include urban storm water, illicit connections, failing septic systems, and animal wastes. Urban storm water can collect pathogens from sources such as animal waste as it travels across impervious surfaces. Failing septic systems can leach contaminated water that may find its way to streams, contributing E. *coli* and pathogens. Illicit connections in which sanitary sewers carrying human waste are improperly discharged to the storm water system can also be a source for E. *coli* and pathogen contamination.

8.4 GOALS AND OBJECTIVES

Goals are a qualitative description of a desired future condition, purpose or end stated in general terms without criteria of achievement. Objectives are actions to reduce pollution from a source to protect or restore a designated or desired use. Both goals and objectives are needed to work toward the common cause of improving the watershed and its waterways.

The City of Monroe has made a commitment to restore and/or protect designated and desired uses of the watershed and to remove the Areas of Concern designation for the lower River Raisin. In addition, the Citizens of the City of Monroe have expressed the following goals:

Goal #1
Protect, Enhance, and Restore Riparian and In-Stream Habitat

Objective	Designated/Desired Uses Addressed
• Restore Warmwater Fishery • Restore Diverse Aquatic Community • Restore Riparian Buffer	• Warmwater Fishery • Indigenous Aquatic Life and Wildlife • Aesthetics • Native Vegetation/ Unique Habitat/Natural Buffers

Goal #2
Preserve, Increase, and Enhance Recreational Opportunities

Objective	Designated/Desired Uses Addressed
• Protect and Improve Riparian Corridor Aesthetics • Meet Partial Body Contact Requirements • Obtain Land for Wetlands and Passive Parks	• Partial Body Contact Recreation • Open Space Preservation • Greenway Preservation • Recreational Uses • Aesthetics

Goal #3
Improve Water Quality

Objective	Designated/Desired Uses Addressed
• Reduce Directly Connected Stormwater Discharges to Sanitary Systems • Eliminate/reduce Illicit Discharges • Reduce/Eliminate Litter and Debris • Protect, Expand, and Restore the Riparian Corridor • Improve Erosion and Sedimentation Controls • Preserve and Restore Wetlands and Open Space • Meet Michigan Water Quality Standards for all Parameters	• Agricultural Water Supply • Industrial Water Supply • Public Water Supply • Warmwater Fishery • Indigenous Aquatic Life and Wildlife • Partial Body Contact Recreation • Aesthetics • Open Space Preservation • Natural Vegetation/ Unique Habitat/Natural Buffers • Flood Control

Goal #4
Increase Public Education, Understanding, and Participation Regarding Watershed Issues

Objectives	Designated/Desired Uses Addressed
• Improve Media Coverage • Create Partnerships with Institutions, Schools and Private Sectors • Manage Expectations of the Public for an Improved Watershed • Improve Education and Awareness of Watershed Successes and Failures	• All

Goal #5
Reduce Stream Flow Variability and Flooding

Objectives	Designated/Desired Uses Addressed
• Reduce Runoff Volume/Rate • Preserve and Restore Wetlands and Open Space • Preserve and Enhance Native Vegetation/Naturalization • Improve Drain Capacity in Streams	• Flood Control • Open Space Preservation • Warmwater Fishery • Indigenous Aquatic Life and Wildlife • Natural Vegetation/ Unique Habitat/Natural Buffers • Partial Body Contact

8.5 DESCRIPTION OF BEST MANAGEMENT PRACTICES (BMPS)[9]

A best Management Practice (BMP) is a land management practice that is implemented to control sources or causes of pollution. There are three primary types of BMPs that treat, prevent, or reduce water pollution.

- Structural BMPs: "bricks and mortar" practices that require construction activities to install, such as storm water basins, grade stabilization structures, and rock rip-rap
- Vegetative BMPs: that use plants, including native grasses, trees, and shrubs, to stabilize eroding areas
- Managerial BMPs: that involve changing the operating procedures at a site or regulatory, management and/or oversight of the development process.

[9] Ecorse Creek Inter-Municipality Committee. 2005. Ecorse Creek Watershed Management Plan for the Michigan Department of Environmental Quality.

The following are brief descriptions of these BMPs, categorized by structural, vegetative, or managerial. Managerial BMPs are further described as ordinances and policies, managerial practices, studies and inventories, public education, illicit discharge elimination, or coordination and funding. Not all of these Best Management Practices (BMP) or management alternative actions apply to the City of Monroe but a number of them are already done or being considered by the City.

8.5.1 Structural

Install porous pavement at appropriate sites

Addresses Goals 3, 5

Porous pavement helps reduce the amount of impervious land area within the watershed, which is critical to infiltrating storm water runoff, therefore, improving water quality and reducing stream flow variability. Porous pavement, including gravel, can especially be utilized in overflow parking areas that are not used regularly.

Construct infiltration basins/trenches at strategic locations

Addresses Goals 3, 5

Storm water infiltration basins are any storm water device or system, which causes the majority of runoff from small storms to infiltrate into the ground rather than be discharged to a stream. Most infiltration devices, including infiltration basins and trenches, also remove waterborne pollutants by filtering water through the soil. Storm water infiltration can provide a means of maintaining the hydrologic balance by reducing impervious areas. Infiltration devices should only be used on locations with gentle slopes, permeable soils and relatively deep water tables and bedrock levels. In new developments, permeable soil areas should be preserved and utilized as storm water infiltration areas.

Stabilize eroding streambanks

Addresses Goals 1, 2, 3, 5

Eroding streambanks are of concern due to the sediment loads and loss of aquatic habitat that can result. It is difficult for vegetation to survive in areas of erosion. Public safety at severely eroded streambanks also may be an issue. Streambanks can be stabilized using materials such as live stakes, live fascines, vegetated geogrids, live cribwall, log revetments, and brush mattress. The method used will be dependent upon the site and local conditions.

Install catch basin inserts at strategic locations

Addresses Goals 1, 3, 5

Catch basins are often the entry points into a storm drain system, and therefore are an ideal place to filter storm water before it enters the system. Catch basin inserts can collect sediment, trash, and debris. Filters in the inserts can also remove oil, nutrients, and certain metals.

Use fallen woody debris for bank stabilization and habitat

Addresses Goals 1, 3, 5

One of the challenges in river maintenance and riparian corridor management is how to deal with logjams. In the recent past, logjams were thought to be a significant problem and were completely removed from stream channels. New studies have shown that logjams help reduce erosion, provide habitat for fish and wildlife and are an important part of the natural processes of a river system. It has been found to be ecologically desirable to have a range of flow velocities and water depths within a channel. The necessity or extent of log jam removal has to be evaluated on a case by case basis. The River Raisin Watershed Council is currently working on a procedure to evaluate and assist with log jam removals, if needed.

Create off-line areas for biota (the combined flora and fauna of a region), where feasible

Addresses Goals 1, 3, 5

In order to help meet anticipated Total Maximum Daily Load (TMDL) pollutant requirements for biota, off-line (natural and undisturbed) areas could be created specifically for the purpose of providing conditions suitable for biota. These off-line areas would be located adjacent to streams. This will help reduce pollutant loading.

Replace undersized bridges and culverts

Addresses Goals 3, 5

During the field inventory and during individual community interviews, several culverts were identified as not being able to convey flow because of being having heavy sedimentation or debris build-up,. Heavy sedimentation and debris that is obstructing flow through bridges.

8.5.2 Vegetative

Install grassed swales, where possible

Addresses Goals 3, 5

Grassed swales are vegetated, open channels that are used to treat and attenuate storm water runoff. Storm water is treated by filtration through the swale vegetation and

underlying soil. The vegetation also attenuates or slows runoff and some of the runoff is infiltrated into the ground. Grassed swales are most suitable along roadsides and parking lots because of their linearity.

Install and maintain riparian buffers

Addresses Goals 1, 2, 3, 5

Riparian lands refer to the areas adjacent to streams. A vegetated riparian buffer refers to establishing or maintaining vegetation in the riparian area. The buffer protects the adjacent stream by filtering pollutants through both the vegetation and underlying soil. In addition, the vegetation slows runoff velocities reaching the stream, thus reducing stream bank erosion. Vegetation also helps stabilize stream banks. This is one of the most important BMP for maintaining river and stream health.

Construct bioretention areas, where feasible

Addresses Goals 3, 5

Bioretention refers to landscaped areas that provide on-site treatment of storm water runoff. Bioretention areas are shallow, depressed basins that collect storm water runoff. This allows the runoff to be infiltrated and filtered through the vegetation. Native vegetation is commonly used in bioretention areas because it requires less maintenance and generally has deeper roots, which are more effective in facilitating infiltration and filtering pollutants. Bioretention areas can be designed with an overflow structure and underdrain system so that during large storms, storm water runoff is able to reach the storm drain system to prevent flooding. Bioretention areas can be applied in highly urbanized areas and are generally used on small sites and can be substituted for parking lot islands.

Constructed wetlands, where feasible

Addresses Goals 1, 2, 3, 5

Constructed wetlands are excavated basins with irregular perimeters and undulating bottom contours into which wetland vegetation is purposely placed to enhance pollutant removal from storm water runoff. Storm water enters a constructed wetland through a forebay where the larger solids and course organic material settle out. The storm water discharged from the forebay passes through emergent vegetation which acts to filter organic materials and soluble nutrients. The vegetation can also remove some dissolved nutrients. Constructed wetlands can also be designed to reduce peak storm water flows. A constructed wetland may be used primarily to maximize pollutant removal from storm water runoff and also help to control storm water flows. Or, it may be used primarily to control storm water flows, with increased pollutant removal capabilities. Secondary benefits of constructed wetland include preservation and restoration of the natural balance between surface waters and ground waters, increased wildlife habitats, and higher property values than if the same area was turned into a rectangular storm water basin. The following criteria dictate the feasibility of using a constructed wetland for

storm water treatment: 1) the type of wetland designed and its characteristics; 2) the hydrologic characteristics of the designed wetland; 3) the vegetation planted within the wetland (to utilize and lower nutrients and pollutants); 4) the type and volume of nutrients and pollutants entering the wetland prior to treatment; and 5) soil texture.[8]

Restore/expand/improve existing wetlands, where feasible

Addresses Goals 1, 2, 3, 5

A restored wetland is the rehabilitation of a drained or degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to the natural conditions to the greatest extent possible. Wetland size and configuration, hydrologic sources, and vegetation selection must be considered during the design phase. Properly-sized constructed wetlands can provide a suspended solid removal of approximately 70 percent, while nutrient removal ranges from 40-80 percent. These wetlands also benefit the area by providing fish and wildlife habitat and aesthetic benefits.

Install habitat structures at strategic locations

Addresses Goals 1, 2, 3, 5

Habitat restoration techniques include in-stream structures that may be used to correct and/or improve fish and wildlife habitat deficiencies over a broad range of conditions. Examples of these techniques include: channel blocks, boulder clusters, covered logs, tree cover, bank cribs, log and bank shelters, channel constrictors, cross logs and revetment and wedge and “K” dams. The majority of these structures require trained installation with hand labor and tools. After construction, a maintenance program must be implemented to ensure long-term success of the habitat structures. In areas that experience high storm water peak flows, in-stream habitat restoration should be installed after desired flow target is reached so as to ensure the success of the habitat improvement project.

Install vegetative buffer around impoundments, where possible

Addresses Goals 1, 2, 3, 5

Like a vegetative riparian buffer, vegetative buffers around impoundments filter out pollutants from storm water runoff and stabilize the shoreline to prevent erosion. More importantly around impoundments, vegetative buffers also provide a “natural fence” that prevents geese from entering the standing water. Geese waste contributes to nutrient pollutant loads.

8.5.3 Managerial (Ordinance & Policies)

Develop No Dumping ordinance

Addresses Goals 1, 2, 3

A dumping ordinance will prohibit the disposal of such items as automotive parts, construction debris, hazardous waste/chemicals, yard clippings, rubbish, etc to any stream or body of water. The ordinance protects against the dumping or discharge of any materials/chemicals that obstructs flow, degrades water quality or damages aquatic life and habitat.

Incorporate riparian corridor in community zoning and land-use plans

Addresses Goals 1, 3

As described, the riparian corridor refers to the area adjacent to streams. A vegetated riparian buffer refers to establishing or maintaining vegetation in the riparian area. The buffer protects the adjacent stream by filtering pollutants through both the vegetation and underlying soil. In addition, the vegetation slows runoff velocities reaching the stream, thus reducing stream bank erosion. Vegetation also helps stabilize stream banks. By incorporating the riparian corridor into zoning and land-use plans, the areas adjacent to drains are identified and can more easily be protected and preserved. Opportunities for restoration of the riparian corridor are also more easily identified.

Implement phosphorous fertilizer reduction ordinance

Addresses Goals 1, 3

Nitrogen, phosphorus, potassium and other nutrients are necessary to maintain optimum growth of lawns and most gardens. While phosphorus is a naturally occurring nutrient in Michigan waters, human activities such as turfgrass fertilizing contribute excess amounts of phosphorus to lakes and rivers. Over-nutrification of freshwater systems can create nuisance algal blooms that deplete oxygen needed by aquatic organisms, which can lead to fish kills, and this prevents or reduces water-based recreation. A local phosphorus fertilizer reduction ordinance can address the proper selection, use, application, storage and disposal of fertilizers, and reduce residential and commercial herbicide/fertilizer use. The ordinance should be combined with a coordinated information and education campaign to communicate the need for the ordinance.

Review and revise grading and land clearing policies

Addresses Goals 1, 3, 5

If not already in place, grading and land clearing policies will minimize clearing and grading of woodlands and native vegetation to the minimum amount needed to build lots, allow access, and provide fire protection.

Review and revise SESC policies and program practices

Addresses Goals 1, 3, 5

Soil erosion control is the process of stabilizing soils and slopes in an effort to prevent or reduce erosion due to storm water runoff. Source areas are construction sites where soil has been disturbed and exposed, streambanks that are eroding due to lack of vegetation and an excess of peak flows during storm events and road crossing over streams where the integrity of the structure is compromised or where the road itself contributes gravel or dirt. Soils can be stabilized by various physical or vegetative methods, while slopes are stabilized by reshaping the ground to grades, which will improve surface drainage and reduce the amount of soil eroding from a site. In areas where development activity is underway, it is important to emphasize the Soil Erosion and Sediment Control ordinance inspection and enforcement, which often entails hiring an adequate number of field staff.

Adopt native landscaping ordinances

Addresses Goals 1, 2, 3, 5

A native vegetation preservation and planting ordinance gives first consideration for the use of native vegetation, includes incentives to encourage native vegetation preservation and planting, and includes provisions for protection, maintenance and replacement of native vegetation. Native vegetation assists in the infiltration and filtering of storm water runoff.

Review and revise parking requirements for new development/redevelopment

Addresses Goals 3, 5

Parking lots can contribute a large percentage of impervious area on a site. Parking lots are often oversized to handle peak usage, leaving much of the parking lot empty during normal usage. To reduce the amount of impervious surface, communities can consider revising the number of spots required (with overflow). Shared parking can also be utilized in certain situations. If two adjacent sites utilize parking at different times, a single shared lot may meet the needs of both sites. Requiring compact car spaces can also reduce the size and amount of impervious surface.

Enact wetland and/or natural features protection ordinances

Addresses Goals 3, 5

A natural features ordinance would call for the protection of such natural features as woodlands, grasslands, slopes, wetlands, and groundwater. The ordinance reduces the impact to natural features by limiting the proximity of disturbance. Protection of wetlands from sedimentation, destruction, and misuse is also provided.

8.5.4 Managerial (Practices)

Work with the County to revise drain maintenance procedures to reduce the destruction of habitat and stream vegetation

Addresses Goals 1, 3, 5

Current practices may result in the destruction of stream bank vegetation from rough clearing the drain for sediment removal or channel widening. Drain maintenance should limit the destruction of stream bank vegetation that is essential in filtering pollutants and maintaining the integrity of the stream bank. Sediment disruption should also be limited, as this will only cause additional sediment deposition downstream of the maintenance site. Downstream conditions should also be investigated before drain maintenance is put in place to ensure it can handle any additional flows. In general, drain maintenance usually results in an increased flow rate downstream as surface water is generally able to better flow through the area in which maintenance has occurred.

Areas where sediment deposition and streambank erosion have occurred should be considered for cleanout to increase the hydraulic capacity of the drain. As mentioned above, this should be done in a way that minimizes destruction of stream bank vegetation. Downstream conditions should also be investigated before maintenance occurs to ensure that any increased flows do not have an adverse effect downstream.

Implement pet waste collection program to supply the public with convenient disposal places for pet waste

Addresses Goals 3, 4

A pet waste collection program would supply the public with convenient disposal places for pet wastes in locations such as public parks and other areas that may have high pet traffic. Pet waste contributes nutrient loads and can pose a threat to partial and full body water contact. In addition, a pet waste collection program also increases public awareness since disposal locations are visible to all those passing.

Routinely sweep public streets & public parking lots

Addresses Goals 1, 2, 3

Street sweeping on a regular basis minimizes pollutant loads to receiving waters by removing sediment, debris, and other pollutants from road and parking lot surfaces. High-efficiency street sweepers are capable of removing smaller particles than older sweepers and can result in more significant pollutant removal.

Eliminate roof drains directly connected to impervious surfaces, where possible

Addresses Goals 1, 2, 3, 5

Storm water runoff that is connected directly to impervious surfaces, such as driveways

and catch basins contributes to higher peak flows and pollutant loads. If runoff is instead directed to pervious surfaces such as landscaped areas or grass swales, runoff velocities are decreased, runoff volume is decreased due to infiltration, and storm water is filtered by vegetation. Runoff can be diverted from impervious surfaces by directing runoff from roofs, driveways, parking lots, etc, to vegetated areas. This can apply to residential, commercial, and industrial developments. In older communities, downspout disconnection also can reduce directly connected impervious surfaces.

8.5.5 Managerial (Studies & Inventories)

Municipal mapping of wetlands

Addresses Goals 1, 2, 3, 5

In order to protect or expand wetlands, an inventory of existing wetlands must be completed. This inventory would be based on visual observations of wetlands, and the use of existing GIS data from the State.

Investigate opportunities for recreational areas

Addresses Goal 2

In order to encourage public awareness and concern for rivers, streams and wetlands, it is important to increase opportunities for people to access these water resources. If provided with aesthetic and accessible, well-advertised recreational areas - be it a canoe livery, a fishing pier, or a trail system — the public will be able to experience the human benefits that the water offers and in turn, may want to work to protect the resource. First, the designated and desired uses must be restored so that it is safe for the public to use the resource in the manner it is intended; i.e., reduce sediment in order to promote a canoe livery. Then, the recreational amenity can be planned, built and promoted.

Flow monitoring

Addresses Goals 1, 3, 5

Flow monitoring involves an analysis of data on rainfall, streamflow, instream water quality, storm water quality, biological communities and habitat, instream bottom sediment, air deposition, and aesthetic conditions. In addition, flow monitoring includes measurement of the performance of various storm water best management practices (BMPs) including structural controls, wetlands, and nonstructural controls.

Inventory areas lacking storm water detention for retrofit opportunities

Addresses Goals 3, 5

Storm water detention is now required for new developments, however, older developments were not subject to this requirement. Performing an inventory would

involve creating a list of these older developments and determining whether on-site conditions are suitable for retrofit opportunities, such as detention basins, bioretention islands, etc.

Initiate hydrologic and hydraulics studies to determine sources contributing to flooding

Addresses Goals 3, 5

Initiating hydrologic and hydraulics studies to determine sources contributing to flooding can be used to help prioritize areas for implementing BMPs that will help reduce the volume and rate of runoff. A comprehensive study of the hydrology of the watershed would provide an understanding of the interaction of precipitation, infiltration, surface runoff, stream flow rates, water storage, and water use and diversions. A hydraulics study would yield information about stream velocity, flow depth, flood elevations, channel erosion, storm drains, culverts, bridges and dams. Information resulting from these studies would provide greater detail on the sources and causes of problems related to hydrology-induced erosion.

8.5.6 Managerial (Public Education)

Work with the River Raisin Watershed Council to Compile State of Watershed Report

Addresses Goals 4

A State of the Watershed Report would provide a summary of Watershed activities and findings for the year. The report would outline ongoing activities, results from any studies, present case studies, report successes and findings, as well as goals and activities for the upcoming year. The report would serve as a summary that could be provided to both the DEQ and the general public for educational purposes.

Establish BMP case studies

Addresses Goals 1, 3, 4, 5

Implementing BMPs requires a change from the normal accepted practices that are now in place. Because of this, there is some reluctance in implementing BMPs that are not yet common. Establishing successful BMP case studies within the watershed will increase BMP awareness and acceptance.

Regular storm water-related information on cable TV

Addresses Goals 4

Cable Television is one source that can be utilized by communities to reach the general public. Upcoming meetings and events, as well as educational materials can be posted on Cable TV. Possible educational topics include: education of the public about their responsibility and stewardship in their watershed; education of the public on the location of residential separate storm water drainage system catch basins, the waters of the

state where the system discharges, and potential impacts from pollutants from the separate storm water drainage system; encouragement of public reporting of the presence of illicit discharges or improper disposal of materials into the separate storm water drainage system; education of the public on the need to minimize the amount of residential or noncommercial wastes washed into nearby catch basins (this should include the preferred cleaning materials and procedures for car, pavement, or power washing; the acceptable application and disposal of pesticides and fertilizers; and the effects caused by grass clippings, leaf litter, and animal wastes that get flushed into the waterway); education of the public on the availability, location and requirements of facilities for disposal or drop-off of household hazardous wastes, travel trailer sanitary wastes, chemicals, yard wastes, and motor vehicle fluids; and education of the public concerning management of riparian lands to protect water quality.

Watershed-related press releases and articles in newsletters/magazines

Addresses Goals 4

Press releases that result in publicity of watershed activities and successes will result in an increase in overall awareness, understanding, and participation regarding watershed issues. Articles in community/entity newsletters or magazines focus on public education. The messages of these newsletter or magazine articles can vary and include: ultimate discharge point, lawn and garden maintenance, pet waste disposal, septic system maintenance, trash management, etc.

Maintain City of Monroe watershed webpage and promote River Raisin Watershed Council webpage

Addresses Goals 4

News and educational materials can be displayed on entity's websites for easy access by the general public. Upcoming activities, activity summaries, as well as educational materials that include messages on ultimate discharge point, lawn and garden maintenance, pet waste disposal, septic system maintenance, trash management, etc. can be posted. A link to the River Raisin Watershed Council's website will be incorporated to promote watershed wide activities.

Provide watershed education

Addresses Goals 4

The City of Monroe believes that watershed education is essential to improving water quality from a point source standpoint. Watershed education includes a school curriculum dealing with watershed issues, organizing participation activities throughout the watershed (such as a stream cleanup day), making available flyers, education via cable TV and newsletters.

Watershed-related Informational Displays

Addresses Goals 4

Informational displays in public buildings or at public events is one way to educate the public on storm water issues. The messages of these displays can vary and include: ultimate discharge point, lawn and garden maintenance, pet waste disposal, septic system maintenance, trash management, etc.

River Crossing and Entering Watershed Signage

Addresses Goals 4

"River crossing" signs and "Entering the Watershed" signage serve as a method of public education as to the proximity of rivers and boundaries of the watershed. Knowing these locations helps citizens gain a sense of ownership and protectiveness for the waterways within the watershed.

Promote Reporting System for Illicit Discharges

Addresses Goals 4

A reporting system for illicit connections can be effective in identifying illicit connections. The reporting system should be advertised through public education and be a convenient way for residents and others to report illicit connections. To make citizens aware of the reporting system, advertisements can be made via cable TV, newsletter or magazine articles, entity websites, etc.

Household Hazardous Waste Collection Site/Day

Addresses Goals 3, 4

Some jobs around the home may require the use of products containing hazardous components. Such products may include certain paints, cleaners, stains and varnishes, car batteries, motor oil, and pesticides. The used or leftover contents of such consumer products are known as "household hazardous waste." Household hazardous wastes are sometimes disposed of improperly by individuals pouring wastes down the drain, on the ground, into storm sewers, or putting them out with the trash. The dangers of such disposal methods may not be immediately obvious, but certain types of household hazardous waste have the potential to cause physical injury to sanitation workers; contaminate septic tanks or wastewater treatment systems if poured down drains or toilets; and present hazards to children and pets if left around the house. Household hazardous waste collection sites or designated collection days allow citizens to properly dispose of household hazardous wastes.

Yard Waste Collection and/or Recycling

Addresses Goals 1, 3, 4

When yard waste decomposes, it depletes dissolved oxygen levels and has an adverse affect on aquatic species. Excessive plant material also encourages algae growth. Yard waste collection and/or recycling enables citizens to dispose of their yard waste in the proper manner so that it does not reach downstream waterways.

Watershed-related educational brochures to the public

Addresses Goals 4

Brochures and published articles focus on public education. The messages of these brochures can vary and include: ultimate discharge point, lawn and garden maintenance, pet waste disposal, septic system maintenance, trash management, rain barrels/gardens etc. Brochures can be distributed via mail, or made available at public buildings or events.

8.5.7 Managerial (Coordination & Funding)

Create partnerships with institutions, schools, and private sector to promote a collaborative effort in watershed management

Addresses Goals 1, 2, 3, 4, 5

The City of Monroe recognizes that its efforts in watershed management can be far more effective with the participation of institutions, schools, and the private sector. The committee feels that public education through the schools to change everyday practices, is a key component to watershed management. The private sector also plays an important role in watershed management. In addition to possible help with project implementation, the private sector also must change its practices for maximum improvement to occur throughout the watershed.

Create a funding source for land acquisition and protection

Addresses Goals 1, 2, 3

The protection or creation of open space can assist in counteracting further degradation from urbanization, allow for infiltration, increased floodplain, storm water treatment and storage, etc. while also serving as a recreational amenity to the community, watershed, and region. A variety of options should be investigated on an individual community and watershed-wide basis. These could include elements such as open space preservation mileages, grants, tax initiatives, donations, conservation easements, land preservation through the development process, etc.

Create law to allow illicit discharge enforcement as a source of revenue

Addresses Goals 1, 3

Creating such a law would involve establishing authority and system in order to collect a fine for punishment for illegally discharging a substance into the storm sewer conveyance system (including open drainage courses). This fine would then be used to fund storm water requirements, such as the illicit discharge elimination program.