Clean Water Legacy Plan

Of the greater Tri-Cities Area in NW Ottawa County

Acknowledgements from the City of Grand Haven and NOWS partners:

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Northwest Ottawa Water System

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Lakeshore Environmental, Inc.

Consulting Hydrogeologists & Engineers | www.lakeshoreenvironmental.com

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Acronyms used in document

BMP	Best Management Practice
CORE	Cleanup Our River Environment (a local environmental group)
CWLP	Clean Water Legacy Plan
DPW	Department of Public Works
EPA	Environmental Protection Agency
GLNPO	Great Lakes National Program Office (Of EPA)
GVMC	Grand Valley Metro Council
GVSU-AWRI	Grand Valley State University – Annis Water Resources Institute
LUST	Leaking Underground Storage Tanks
MAEAP	Michigan Agriculture Environmental Assurance Program
MDEQ	Michigan Department of Environmental Quality
NOWS	Northwest Ottawa Water System
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint Source (pollution)
NRCS	Natural Resources Conservation Service
PCBs	Polychlorinated Biphenyl's
PEG	Public Education and Government (TV station)
PEP	Public Education Plan
SWPPI	Storm Water Pollution Prevention Initiative
URL	Uniform Resource Locator
WAM	Watershed Assessment Matrix
WAP	Watershed Action Plan
WIM	Watershed Interactive Mapping
WIT	Watershed Interactive Tool
WMEAC	West Michigan Environmental Action Council

I. Introduction

*** Words highlighted in blue are defined in the glossary.**

Water quality issues in the Lower Grand River and at local Lake Michigan beaches are routinely the focus of public concern in the greater Tri-Cities area of NW Ottawa County, Michigan. The greater Tri-Cities area includes the cities of Grand Haven, Spring Lake and Ferrysburg, the Village of Spring Lake, and the townships of Fruitport, Crockery, Grand Haven, and Robinson. While a number of planning and implementation projects addressing water quality have been completed over the last 20 years, results of these efforts are not well synthesized nor are they broadly shared with community officials or the general public. The communities in the greater Tri-Cities area decided to join together to develop a Clean Water Legacy Plan (Legacy Plan) in which they could build on past efforts, address gaps in the current state of knowledge, and establish an action plan to address the water quality issues through a public process. Completion of the Legacy Plan would be accomplished by compiling and synthesizing the existing information, developing outreach and educational materials to share the compiled information with the public via meetings and forums, and then using the feedback from the public process to shape the action plan recommendations to be outlined in the Legacy Plan.

The Lower Grand River begins in Ionia County and flows westward, ultimately draining into Lake Michigan. The river borders many townships and at its westernmost reach, it flows through the communities of Grand Haven, Spring Lake, and Ferrysburg, commonly known as the Tri-Cities area. The Lower Grand River watershed area drains 2,909 square miles of land. A **watershed** is an area of land in which all the rainfall and snowmelt from that area drains to the lowest point, usually a stream or lake. For the Lower Grand River watershed, all rainfall and snowmelt drains to the Grand River, via **tributaries** and storm drains. The three largest tributaries are the Rogue River, Flat River, and Thornapple River.

An undisturbed watershed has a natural pollution filtering system by way of its soils, grasses, trees, and aquatic plants. A watershed provides habitat for plants and animals. However, as more and more people inhabit watersheds, pollution is increased and the filtering capacity of the watershed is decreased. **Pollutants** generated by human activity are carried to the water by wind and by surface **runoff** from rain and snowmelt. Pollutants can also be carried to surface waters through groundwater movement from contaminated aquifers. This pollution results in degraded water quality of the streams and lakes, a loss of native plant and animal species, an increase in non-native plants and animals, and an overall reduction in the quality of the environment.

Harbor Island

Water pollution can come from point sources and nonpoint sources. Point source pollution comes from a discrete conveyance, such as a single pipe outlet from a manufacturing plant or wastewater treatment plant. Typical pollutants from these point sources include heavy metals, nutrients, and **pathogens**. **Nonpoint source pollution** comes from multiple diffuse, or widely spread out sources that drain off the land surface into the nearby water bodies. Typical nonpoint source pollutants carried in runoff include animal manure, nutrients, organic matter, pathogens, pesticides, petroleum by-products, and **sediment**. Because of the diversity of land uses within the Lower Grand River watershed, both point and nonpoint source pollution exists.

The most problematic pollutants to local tributaries, Spring Lake, the Grand River, and Lake Michigan are nutrients, sediment, pathogens, and **storm water** runoff, as is documented in the Lower Grand River Watershed Management Plan and the many studies reviewed for this project (Appendix A). Excess nutrients can cause extreme algal blooms in Spring Lake, some of which have been identified as toxic. Excess nutrients also allow invasive aquatic species such as purple loosestrife, Eurasian water milfoil, and Phragmites to thrive and choke out the native vegetation. Nutrients flowing in from the tributaries to Spring Lake continue to build up in the sediment, creating a bank of excess nutrients in the lake bottom to feed plant and algal growth. Sediment carried in storm water makes it difficult for fish to breathe during high flow periods, covers fish spawning habitat when it eventually settles to the stream/lake bottom, and builds up. This creates sand bars that need to be dredged, which is a very costly endeavor. Pathogens, specifically fecal coliforms, have resulted in beach closures when fecal coliform counts exceed 300 colonies per 100 ml of water. High counts of fecal coliform not only impact the water quality, they impact the local tourism economy when beaches are closed.

Given the importance of water in the Tri-Cities area for life, leisure, and the economy, water quality is of the utmost concern, which is why community leaders developed this project – the Legacy Plan. It compiles and synthesizes all the studies and projects that have been conducted in the Lower Grand River and Tri-Cities area in order to identify where knowledge gaps still exist and to develop a plan of action in which everyone has a role.

Fishing in Spring Lake

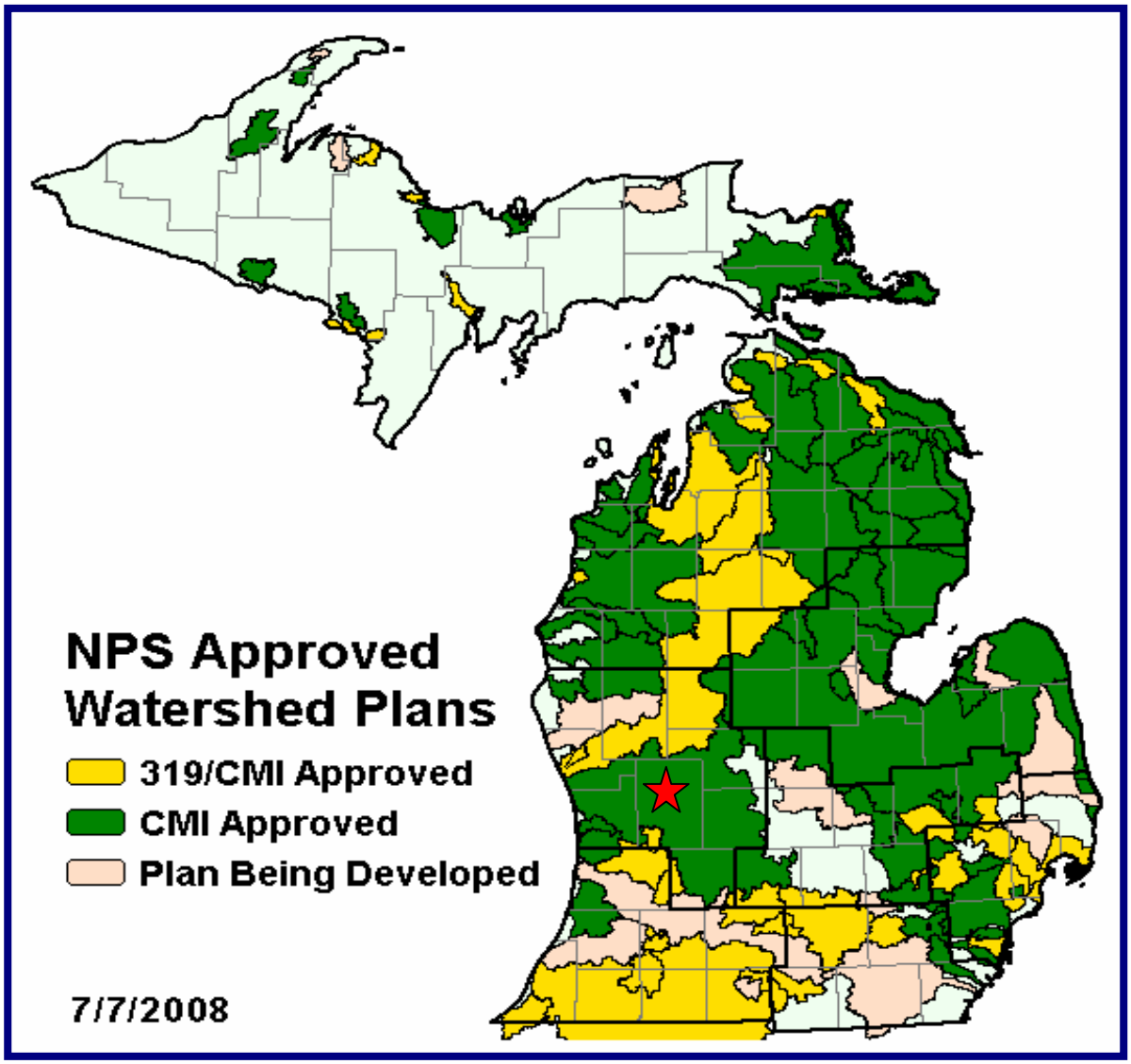
As a component of creating the Legacy Plan, public input was sought to ensure studies hadn't been overlooked and to gather prioritized suggestions for the action plan. More than 120 community leaders, residents, and students provided input. The final Legacy Plan includes 1) background information of the Lower Grand River Watershed and Tri-Cities focus area, 2) a review of the compiled existing information, 3) identified data and knowledge gaps, and 4) recommended action plans to address the pollution issues in the greater Tri-Cities area.

II. Background Information

2.1 Lower Grand River Watershed

The Lower Grand River Watershed is located in the west-central portion of the Lower Peninsula of Michigan. It consists of an area of approximately 2,909 square miles, spanning 11 counties (Fig. 2.1). The Grand River, consisting of the Upper Grand River and Lower Grand River, drains into Lake Michigan between the communities of Ferrysburg and Grand Haven on the western shore of Michigan. The general flow direction of surface water is from east to west toward Lake Michigan.

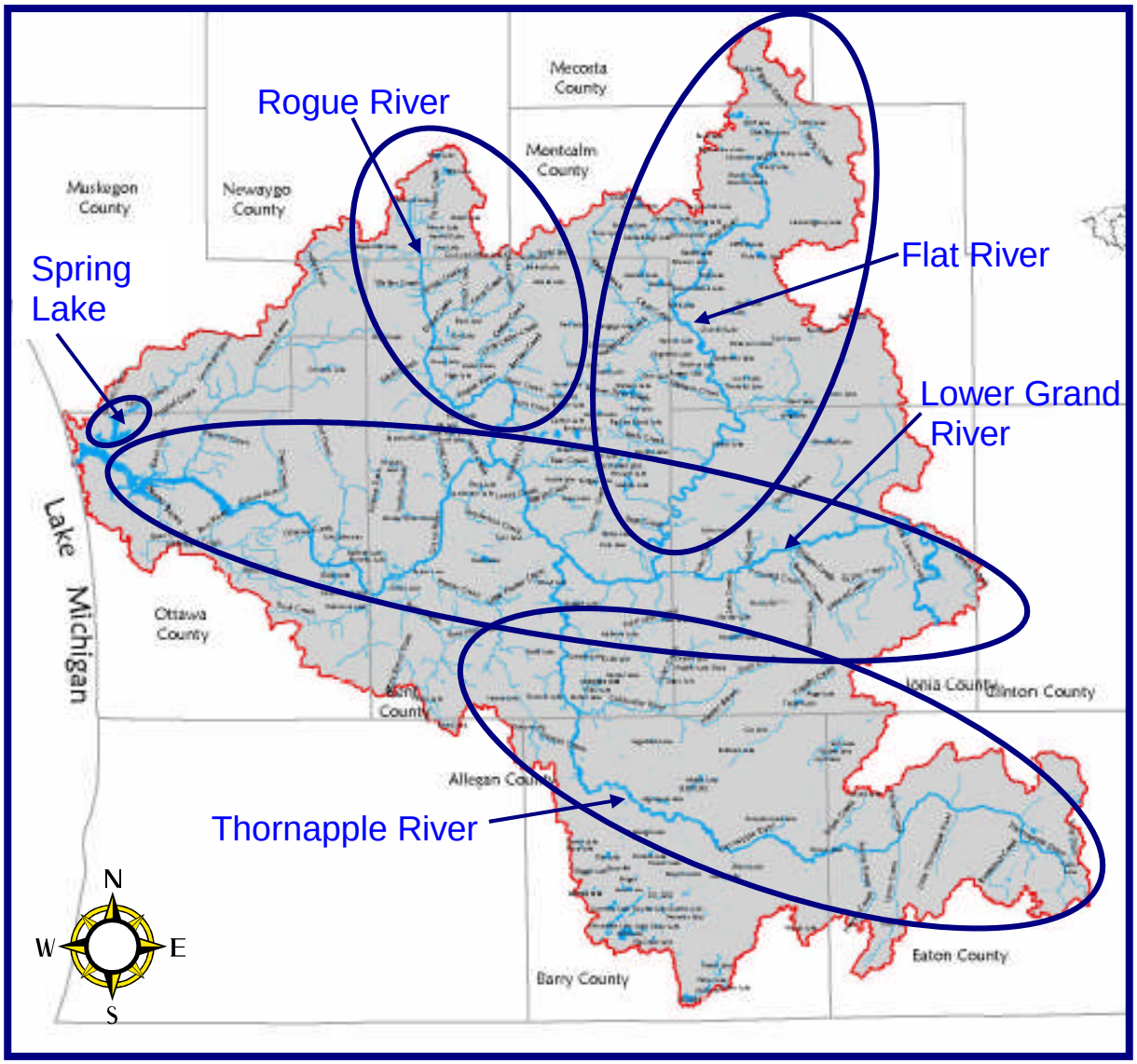
Figure 2.1 Lower Grand River Watershed location in Michigan (red star), from the MDEQ website's map of approved watershed management plans.



2.2 Water Bodies

The Lower Grand River Watershed consists of three main tributaries that drain directly into the Grand River: the Thornapple River, Flat River, and Rogue River (Figure 2.2). There are many smaller tributaries that drain to these main tributaries. Spring Lake and its tributaries, located on the west side of the watershed, directly connect to the Grand River. A larger view of this hydrography map, created by the Information Services Center of Grand Valley State University's Annis Water Resources Institute, can be seen and downloaded at the Lower Grand Watershed Interactive Tool (WIT) page of the GVSU-AWRI website http://www.gvsu.edu/wri/isc/index.cfm?id=C8E9B889-D23B-8D42-07F7E7F9E07FEE86.

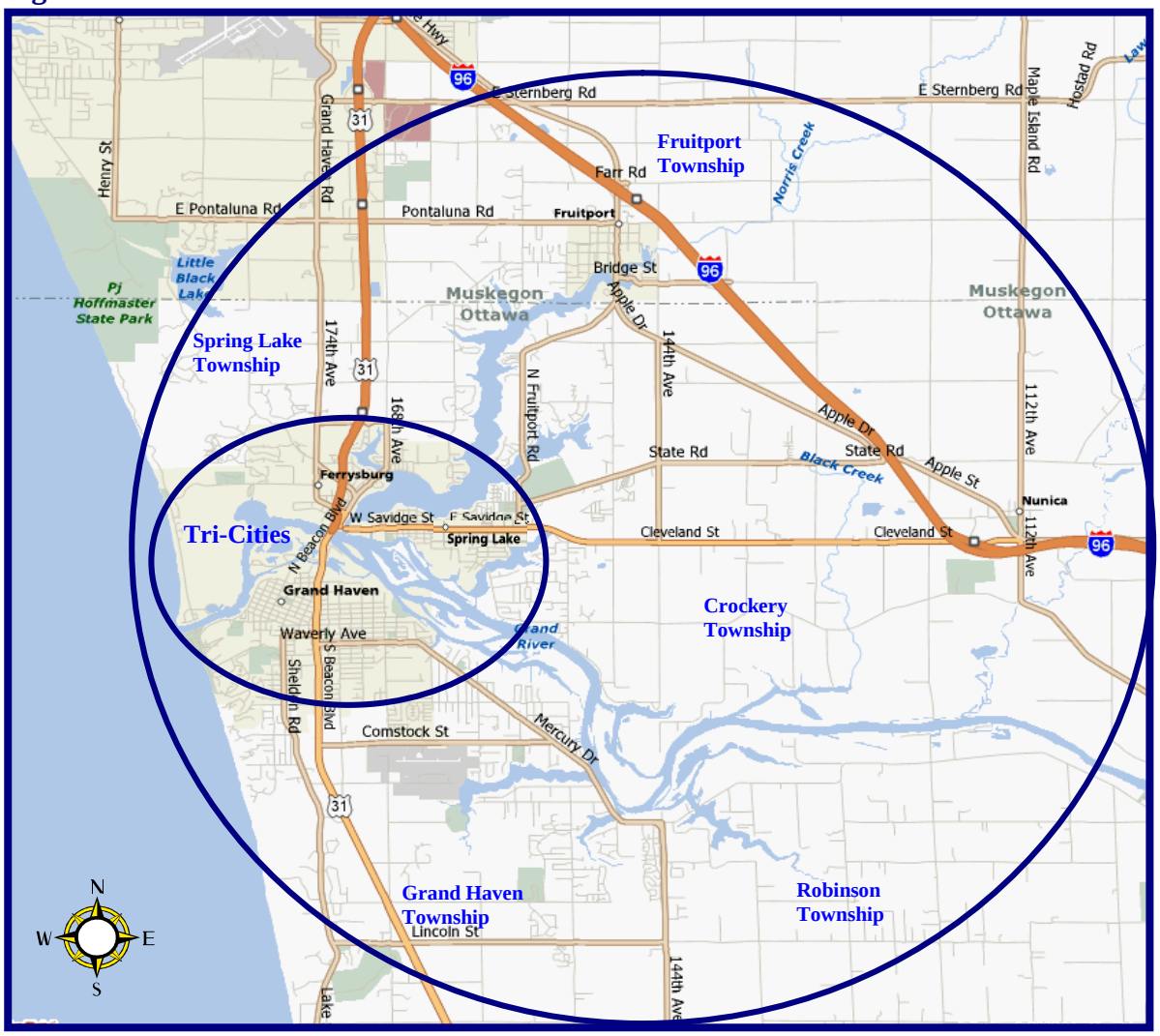
Figure 2.2 Major hydrography of the Lower Grand River Watershed



2.3 Greater Tri-Cities Focus Area

The Tri-Cities area is directly impacted by pollutants in the upstream portion of the Lower Grand River, but it also is impacted by local pollution inputs. Many upstream water quality initiatives identified in the Lower Grand River Watershed Management Plan (www.lowergrandriver.org) are underway; they are listed in Appendix A. Representatives from the Tri-Cities area participate in committees of the Lower Grand River Watershed Project to stay informed. The focus of the Legacy Plan is water quality initiatives for the greater Tri-Cities area: what can be accomplished in our own "backyard" to improve water quality. The greater Tri-Cities focus area includes the Cities of Grand Haven and Ferrysburg, the Village of Spring Lake, and the surrounding townships of Grand Haven, Spring Lake, Fruitport, Crockery, and Robinson (Figure 2.3).

Figure 2.3 Greater Tri-Cities focus areas



2.4 Public Perspective

On September 13th and November 14th of 2007, two public meetings were held in which the Legacy Plan Project was introduced. A PowerPoint presentation was given showing the known water quality issues in the area. The information in Appendix A was shared to give a perspective of all the work that already has been done, as well as work currently underway, to address water quality issues in the Lower Grand River. Participants were asked to review the list of compiled work and provide feedback if they knew of additional projects that should be included.

A survey was conducted at the close of the public meetings to gather input as to the priority of water quality concerns from the meeting participants as well as how much they learned from the presentation (Appendix B). Sixty people attended the meetings and 56 returned their surveys. When prioritizing water quality issues, drinking water was #1; swimming was #2; fishing and viewing water, wildlife, and waterfowl were #3 and #4 respectively at the first meeting and reversed for the second meeting; boating ranked #5. Many participants said the information presented to them was new information. Nearly 75% of the respondents stated they would get involved in local efforts to restore and protect water resources. More than 88% of the respondents said they would make behavioral changes once they were made aware of what they could do to improve water quality, such as changing to phosphate-free fertilizer.

On April 19, 2008, an Earth Day Community Picnic was held in Grand Haven. Attendees were primarily from Ottawa County. Question 1 of the survey was provided to attendees through an informational booth sponsored by Lakeshore Environmental. An estimated 200 people attended the event and 61 completed the survey question on water quality priorities. The results were the same as the November 14th meeting attendees (Appendix B).

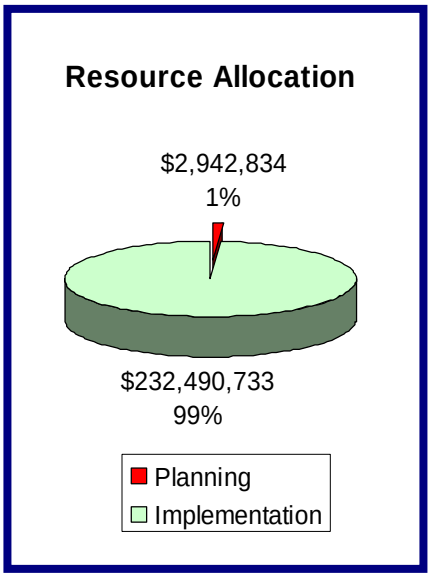
Folks are enjoying music and educational booths at the Earth Day picnic.

Combined City of Grand Haven and Lakeshore Environmental booth; staff educated Earth Day participants about storm water pollution and the Clean Water Legacy Plan.

III. Existing Information

A component of this project was to gather, review and synthesize the information from previous studies and projects that address water quality in the Lower Grand River. Appendix A summarizes in an outline format all the existing work that was identified and provides links to web locations where the documents can be viewed in their entirety. Where possible, the cost of the work was listed. It is worthy of noting that since 1990, more than $235,433,567 has been spent addressing water quality concerns in the Lower Grand River Watershed. Figure 3.1 shows how the money was spent. Planning work includes studies, research, and **watershed management plan** development. Implementation work includes all on-the-ground projects and community outreach and education. This shows a great return on investment of planning dollars that were spent to achieve the implementation goals.

Figure 3.1 Resource allocation; planning vs. implementation money



The first significant project that focused on the Grand River (which included the Lower Grand River) was the Grand River Watershed Program. This project was funded by the Grand Rapids Foundation and completed by the Water Resources Institute of Grand Valley State University in 1990. Since that initial groundbreaking effort to identify the pollution problem areas and to build community connections along the entire Grand River, more than 50 studies and projects have been completed in just the Lower Grand River and another 17 studies and projects are currently underway (Appendix A).

3.1 Studies and planning projects

The Lower Grand River Watershed Management Plan, completed in 2004, documents the primary pollutants of concern for the entire Lower Grand River as sediment, nutrients, pathogens, polychlorinated biphenyls (PCBs), mercury, and untreated sewage discharges (www.gvsu.edu/forms/ isc/lowgrand/lowergrand_wmp_final.pdf). While much of the work discussed in the Plan is cursory, it provides the framework from which future studies and implementation projects can be identified. Much of the work currently being done in the Lower Grand Watershed is spearheaded by the Grand Valley Metro Council and completed with other local partners, just as the Lower Grand River Watershed Management Plan was.

However, based on the review for this project of the Lower Grand River Watershed Management Plan AND the additional studies outlined in Appendix A, the primary pollutants of concern that need to be addressed in the greater Tri-Cities area of NW Ottawa County are sediment, nutrients, pathogens, and storm water runoff. Newly emerging issues for the area include pharmaceuticals and toxic algae that are being detected in local waters. One final and difficult issue of concern is contaminated groundwater in the Tri-Cities area venting into the Grand River and other associated tributaries. Following is a listing of the pollutants of concern, explanations of why they are problematic, and the local studies that substantiate the concerns.

Sediment

Sediment is defined as soil, sand, and minerals which can take the form of suspended, dissolved, or bedload material. Sediment within the Grand River migrates throughout the river and is ultimately deposited in Lake Michigan. Sediment migration in the river is a natural condition, but it has become more problematic due to increased external inputs of sediment, causing increased sedimentation throughout the system. This increased sedimentation has become a pollutant because when it is in a suspended or dissolved state, usually during storm event conditions, it makes it difficult for fish to breathe and for sunlight to penetrate the water column. When it becomes bedload material, it covers the natural substrate, which can impact spawning areas and habitat for fish and invertebrates.

Photo from MSU Grand River Field Experiment fact sheet showing sediment and pollutant plume into Lake Michigan.

External sources of sediment to the Lower Grand River and its adjacent water bodies in the Tri-Cities area are storm water runoff from: construction sites, impervious areas, farm fields, and road/stream crossings. Sand and salt used for deicing roads, sediment buildup on impervious surfaces, and topsoil from farm fields all get washed into creeks through rain events and snow melt by way of open storm sewer drains in rural areas and underground storm sewer drains in urbanized areas. Road/stream crossings with improper structure sizing, improper placement, or lack of sediment stabilization can wash out over

time and result in erosion, thereby adding sediment to the nearby waterbodies. The Federal National Pollution Discharge Elimination System (NPDES) Phase II permit requirements of cities will facilitate road/stream crossing inventories that will identify crossings that are in need of repair or maintenance.

Pollutants such as nutrients, metals, and PCBs can adsorb, or cling to, sediment particles. When heavy metals and PCBs are found in lake and river sediment, it is referred to as contaminated sediment. A study completed in 1999 by GVSU-AWRI (http://www.epa.gov/glnpo/sediment/GrandRiver/index.html) documented contaminated sediments in the Lower Grand River, with three local areas of concern being Spring Lake, Harbor Island, and near the Grand Haven tannery. No follow-up work has been done on the contaminated sediments identified in that study and it is likely these "hot spots" have impacted downstream locations.

Contaminated sediment collection by GVSU-AWRI

Dredging is occasionally necessary in and near the mouth of the river to remove excessive sediment buildup in order to accommodate navigation in the Grand River, especially during low water periods. The U.S. Army Corps of Engineers recently completed a study which included modeling of sediment transport in the Grand River (http://glc.org/tributary/models/documents/GrandRiverFinalReport.pdf). Results indicate the Tri-Cities region actually contributes little to the overall sediment load to the Grand River. However, the study does suggest that additional Best Management Practices be implemented for the agricultural areas in the watershed, including conservation tillage and filter strips. The model is meant to assist local resource agencies in evaluating alternatives for soil conservation and non-point source pollution prevention in the tributary watersheds.

Dredging preparation in Holland in March 2008. Chronicle file photo.

Nutrients

Excessive nutrients, primarily phosphorus and nitrogen, can adversely impact the health of lakes and streams. The nutrients stimulate algal growth, which then blocks sunlight penetration through the water column. As algal blooms die and settle to the lake and stream bottom, they decompose. Dissolved oxygen in the water is consumed by bacteria feeding off the decomposing algae; the reduced dissolved oxygen levels can, in turn, harm fish populations. This

Fertilizer being applied to lawn; Chronicle file photo.

impacts water quality and clarity, two items that determine a "livable" environment for healthy fish populations. The sources of nutrients that cause algal blooms include agricultural runoff, excessive residential fertilizer use, failing or poorly maintained septic systems, and phosphorus-rich bottom sediments. These algal blooms generally occur only in Spring Lake and the local bayous due to the slower movement of the water and increased water temperature, unlike the faster moving Grand River. However, the nutrients that flow through the lake, bayous, and into the Lower Grand River all end up in Lake Michigan – the main local drinking water source. Any and all efforts to reduce nutrient inputs to Lake Michigan are needed to ensure long-term safety of that drinking water source.

Spring Lake has a "Lake Board" consisting of board members that represent the lake's surrounding communities. The Lake Board has taxing authority to collect money for water quality related projects. The Lake Board funded the development of the Spring Lake Watershed Management Plan (report available by contacting Spring Lake Township), the Spring Lake Internal Nutrient Loading Study, and the subsequent alum treatment of Spring Lake (http://www.gvsu.edu/wri/director/index.cfm?id=6B35DDA7-96AC-47F2-C2125255E0148EF0). The findings of these studies indicate the alum treatment has been successful but that external loading continues to be a threat to improvements the alum treatment has provided.

Sediment cores from Spring Lake's alum treatment study; AWRI file photo

The Lake Board in spring 2008 funded a preliminary study of phosphorus and coliform in Norris Creek during both storm event and base flow conditions. That study was a result of the Legacy Plan partners asking for some monitoring data on Norris Creek, which was cut from the original Legacy Plan grant proposal. Findings of the study indicate both phosphorus concentrations and coliform counts are exceeding state standards under both base flow and storm event conditions, with the storm event conditions revealing higher concentrations and counts (report available by contacting Spring Lake Township).

Pathogens

Pathogens are living microorganisms such as bacteria or fungi that cause disease and are frequently found in the fecal material of warm-blooded animals. When indicators of pathogens, such as fecal coliform, are found in excessive amounts in surface waters, local beach closures occur as a safety measure. Specifically, if concentrations of fecal coliform exceed 300 colonies per 100 ml of water, beach closures will result. The Ottawa County Health Department conducts the local beach monitoring and posts results on their website (http://www.co.ottawa.mi.us /HealthComm/Health/Beach.htm). Given the importance of the local beaches as an economic stimulus via tourism, it is critical that beach closures be minimized or eliminated.

In the past, the most problematic source of pathogens was the combined sewer overflows that occurred in Grand Rapids under storm conditions. Grand Rapids' old sewer system was designed to treat storm water and waste water. During storm events though, the waste water treatment system would reach its treatment capacity and discharge its overflow as a mix of storm water and raw sewage directly to the Grand River. The City of Grand Rapids, between 1991 and the present, has invested $210,000,000 in separating the combined sewer system (http://www.grand-rapids.mi.us/index.pl?page_id=3323). Now only the wastewater is treated and storm water is directly routed to the river. This has eliminated 99% of the combined sewer outfalls to the Grand River. This is a great example of government and its citizens taking responsibility for protecting their local environment while benefiting all the downstream communities as well.

Grand Rapids storm sewer separation project work; photo from Grand Rapids URL above.

Two additional projects in Kent County related to pathogen reductions to the Lower Grand River that are worthy of noting are the Kent County Septage Management Program and the North Kent Sewer Authority's Clean Water Plant. The Kent County Septage Management Program developed a detailed septage management plan that included alternative treatment and disposal technologies and recommended institutional mechanisms to coordinate maintenance and disposal programs on a countywide and regional scale (http://www.gvsu.edu/wri/isc/index.cfm?id=4DAAA76E-0EB4-DD60-1D2F9607AF0ACE20). The North Kent Sewer Authority's initial purpose was to acquire, own, improve and repair the area's existing sanitary sewer collection and transportation system. Over time, the purpose expanded to include the construction and operation of a brand new state-of-the-art wastewater treatment facility, now known as the PARCC Side Wastewater Treatment Plant. The new treatment facility is expected to be in operation by November 2008.

The localized sources of pathogens to the Lower Grand River from the greater Tri-Cities area include manure runoff from agricultural fields, failing septic and sewage treatment systems, and both domestic and wild animal fecal material. An example is a spill that occurred in September 2007. A mobile home park had a 7,000 gallon spill of partially treated solid waste into the Grand River from its on-site sewage treatment plant. This type of spill is easily avoidable with proper management, maintenance, and oversight. The preliminary study of Norris Creek, mentioned earlier, shows high counts of coliform in Norris Creek under both base flow and storm flow conditions. The most likely sources of the coliform are runoff

Manure spread on snow-covered agricultural field.

from farm fields that have manure applied, failing septic systems, and wildlife living in the natural areas that drain to Norris Creek.

Storm water

Storm water runoff has become a major pollutant as a result of less natural area, poor farming practices, and increased development. Runoff water carries with it sediment, nutrients, and chemicals and increases the temperature of the downstream receiving water bodies. All of these pollutants negatively impact aquatic life and wildlife.

The likely causes of agricultural runoff include the absence of sizable buffer or filter strips along the edges of fields that border receiving water bodies that would otherwise intercept the runoff, poor tillage practices, and the application of manure to frozen or snow-covered ground with slopes greater than 2% and/or to fields that are tiled (filled with underground tile drains).

Increased development and a lack of ordinances either preventing certain development or requiring adequate storm water management practices (e.g., retention ponds) have resulted in increased **impervious** area and runoff to the streams and lake. The impervious areas reduce the chance for infiltration of storm water through soils and increase the amount of water discharging to storm drains.

In May 2008, an oil slick was found in Grand Haven on the Grand River that stretched nearly a mile long. It took officials days to try to find the source with no success. They could pinpoint the origination point of the fuel slick to a specific storm drain outlet, but how the fuel entered the drain system to begin with was never resolved. Because of the location of the storm drain and the oil slick, it threatened the health of 170,000 Chinook salmon being raised in pens at Grand Haven's Municipal Marina by the Grand Haven Steelheaders.


Chronicle photo • Melissa Ferguson

A crew from A1 Services attempts to contain the debris and oil from a storm drain after the heavy rainfall Friday forced the material into the Grand River in Grand Haven.

Fuel slick entered Grand River from storm drain

Muskegon Chronicle news clipping from May 3, 2008.

Through the NPDES Phase II storm water permit requirements coordinated by the Grand Valley Metro Council, continued educational efforts will occur regarding illegal dumping to storm drains through the Storm Water Pollution Prevention Initiative (SWPPI) requirements and the resulting Public Education Plan (PEP). Each of the Tri-Cities area units of government currently has storm water education materials available on their websites. In addition, required investigations by the units of government will be ongoing of potential illicit discharge connections by business and industry to the public storm drain system (http://www.gvmc.org/naturalresources/npdes.shtml).

Researchers at AWRI are currently working to identify the causes, consequences, and corrective actions required to minimize the adverse impacts of storm water discharges to

the water bodies located within and around the Village of Spring Lake and Spring Lake Township, including Spring Lake, the Grand River, and, ultimately, Lake Michigan. This integrated assessment will be a useful tool for other units of government in the Tri-Cities area to review and take the recommendations under consideration. Update information on this project can be found at http://gvsu.edu/wri/director/index.cfm?id=8C802854-FF9E-40F3-E7B436B105948577.

Pharmaceuticals

Pharmaceuticals are being detected at low levels in surface waters around the nation as a result of unwanted medicines being flushed down the toilet and from the medicines being taken simply passing through our bodies and being flushed as well. These chemicals have been found to be impacting the reproduction of some fish species. This newly emerging issue is of concern because the technology of today's wastewater treatment plants does not remove pharmaceuticals from the water it treats; the pharmaceuticals essentially pass through the treatment system. The wastewater eventually returns to the source of our drinking water, our groundwater and lakes, with the pharmaceuticals still present.

Michigan State University Extension of Ottawa County is working in this emerging field of study and is working with local environmental groups and the County Health Department to create awareness of the issue by educating folks about proper disposal of unwanted medicines. The local environmental group CORE recently applied for an EPA grant to monitor local waters, create community education programs, and establish drop-box sites for unused pharmaceuticals; unfortunately the grant was denied. Both the Grand Haven – Spring Lake Sewer Authority and Northwest Ottawa Water System are following the issue closely to remain proactive with this concern. The Northwest Ottawa Water System already completed a Source Water Assessment to determine the susceptibility of the community's source of drinking water to potential contamination. On a scale of very-low to high, the threat ranked "moderate". NOWS is currently in the process of developing a Source Water Intake Protection Plan.

October 20, 2006

LAS VEGAS SUN

Chemicals cause changes in fish and raise concerns for humans

By Launce Rake <lrake@lasvegassun.com>
Las Vegas Sun

There's something wrong with the fish.

It's been confounding scientists for years: Male fish are developing female sexual characteristics in Lake Mead and other freshwater sources around the country.

Las Vegas Sun news story related to chemicals found in the water.

Toxic Algae

Algal blooms historically have been problematic in Spring Lake. Not only are algal blooms unsightly, but they now may include a hidden danger - a species of harmful toxic algae. Lakes just north of Spring Lake, including Bear Lake, Muskegon Lake, and Mona Lake in Muskegon County, have been found to have *Cylindrospermopsis* and *Microcystis*. The toxin-producing algal blooms are usually observed as a thick green layer of scum on

the waters surface, resembling green paint. If the algae are ingested by dogs, wildlife, or humans, it can cause sickness and in some cases has caused death. In the summer of 2007, two beaches in Muskegon County, one on Mona Lake and one on Muskegon Lake were closed due to toxic algal blooms. Algae known to produce toxins have been found in Spring Lake, but they have not been tested for toxin production. The alum treatment has resulted in reduced algal blooms in Spring Lake since the time the toxic algal species was discovered in lakes to the north. Ideally the successful alum treatment will keep the toxic stains of algae from appearing in Spring Lake.

Algal bloom in Spring Lake "pre-alum treatment"

Groundwater/surface water interface

The historical chemical spills that occurred at industrial, chemical, and manufacturing facilities have resulted in many Brownfield sites in the watershed. Brownfields are abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination (http://www.epa.gov/ebtpages/cleabrownfields.html). Similar concerns exist for Leaking Underground Storage Tank (LUST) sites (http://www.epa.gov/ebtpages/cleastoragetanksleaksandspills.html) and Part 201 sites of known environmental contamination (http://www.deq.state.mi.us/documents/deq-rrd-Part201CitizensGuide.pdf) in the area. In the Tri-Cities area, eight brownfield sites have been remediated, 33 LUST sites have been remediated, and 40 Part 201 sites have been remediated at a cost of nearly $15,000,000.

Many unremediated sites continue to pose concerns to the groundwater, which in many cases migrates to other locations and, in some cases, may vent to nearby surface waters. The groundwater eventually reaches nearby surface waters by way of underground flow. This groundwater/surface water interface needs further study to determine the real impact of the many unremediated sites to the local waters.

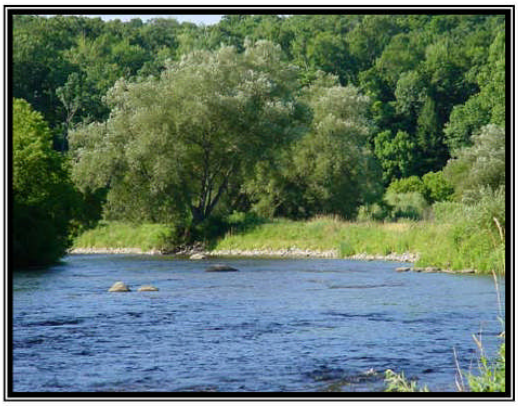
3.2 Restoration/Implementation/Outreach Projects

Below is a list of the on-the-ground type projects as well as educational outreach projects that have been completed since 1990 or are currently underway. These projects total more than $232 million. The project summaries can be found in Appendix A with URL links to their respective websites for complete project details. Many of the watershed management planning projects also included outreach efforts and small-scale demonstration projects but they are not included in the list below; this list is only on-the-ground projects and post-planning educational outreach projects.

Completed projects:

- Bear Creek Implementation Project 1 & 2 (with outreach)
- Crockery Creek Implementation projects & outreach

- Hager Creek Restoration
- Plaster Creek Storm water Detention Basin Retrofit
- Plaster Creek stream bank and storm water projects
- Rogue River watershed physical improvements
- Rogue River Information & Education
- Rogue River implementation work
- Rogue River conservation easements
- Sand Creek watershed implementation work
- York Creek Outreach & Education (4 grants)
- City of Grand Rapids Combined Sewer Overflow project
- Preliminary investigation of contaminated sediment in the Lower Grand
- Kent County Storm water Basin Retrofit
- Illicit connection elimination project, City of Grand Rapids
- Grand Rapids Uptown Revitalization Project
- NPDES Phase II Public Education Plan and Outreach Project



Rogue River stream bank restoration project, before and after photos clipped from the MDEQ fact sheet.

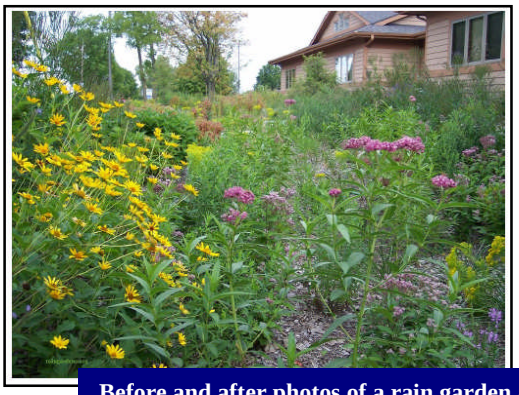
Ongoing projects:

- Lower Grand River Watershed Implementation Project
- City of Grand Haven Storm water Initiatives
- Low Impact Development Campaign for Grand Rapids
- Rogue River Watershed conservation easement projects
- Metro Hospital Project of Buck Creek
- NPDES Phase II Public Education Plan work in Lower Grand
- Kent County Sewer Authority's construction of new Wastewater Treatment Plant

Specific Best Management Practices (BMPs) that have been implemented include a variety of structural, vegetative, and managerial BMPs. More information on BMPs can be found in section 5.2 of this report. Common structural BMPs include stream bank restorations, fencing cattle out of streams, and road/stream crossing improvements. Common

vegetative BMPs are filter strips, grassed waterways, and wetland enhancements. Managerial BMPs include pasture management, integrated crop management, and waste storage plans. The more recent types of BMPs being implemented include rain gardens, detention basins, utilization of Low Impact Development designs, and storm drain retrofits. The latter BMPs tend to be a mix of structural, vegetative, and managerial BMPs.

An observation from the implementation projects listed above is that the projects are primarily located upstream of the greater Tri-Cities focus area. The Crockery Creek projects and the City of Grand Haven Storm Water Initiatives are the exceptions. This upstream activity is beneficial because it improves the water quality of the Grand River ultimately passing through the Tri-Cities Area. However, since all watersheds in the Lower Grand River share similar issues, there should be many similar projects occurring in the greater Tri-Cities areas to reduce local pollution impacts to the Grand River.



Before and after photos of a rain garden at the Sylvan Learning Center in Grand Rapids; photos from MDEQ fact sheet.

IV. Identified Data & Knowledge Gaps

4.1 Data Gaps

With the exception of Spring Lake, there is a lack of specific water quality information for the Tri-Cities area to determine the critical areas of concern and their sources and causes of pollution. The pollutants of concern identified in the existing information are either from one-time short-term studies or speculation based on events that occur, such as oil spills, beach closures, and algal blooms. In order to confirm the speculation and pinpoint problem areas, baseline water quality testing is needed. The MDEQ has conducted some biological study work in Crockery Creek and Pottawatomie Bayou but the work is old; Crockery's last sampling was in 1999 and Pottawatomie's was in 1968. New information is in order. Current data gaps that need to be filled include:

1) Identification of nutrient and pathogen concentrations in the tributaries and bayous for both base flow and storm flow conditions.
    a. Norris Creek and its tributaries
    b. Black Creek and Bruce Bayou
    c. Crockery Creek and its tributaries
    d. Pottawatomie Bayou
    e. Milhouse Bayou
    f. Stearns Bayou
    g. Lloyd Bayou
2) Biological assessments for the same sites as above; this would provide useful information on the current ecological health of these systems. The assessments are good indicators of problem areas within the systems as well.
3) Hydrologic studies of Norris Creek, Black Creek, and Crockery Creek. The hydrologic studies would allow for accurate flow measurements during base flow and peak flow events, pollutant load calculations from each system, and it would reveal the "flashiness" (extreme flow peaks over short periods) of the systems. The results would be helpful with storm water project planning.
4) Quantification of sediment transport in Crockery Creek. This system has the most agriculture within its sub-watershed and is likely the system with the most sediment transport occurring.
5) Monitoring of pharmaceuticals at Northwest Ottawa Water System and the outfall of the Grand Haven Spring Lake Wastewater Authority.
6) Monitoring for toxic algae in Spring Lake and bayous, potentially also in Grand River and Lake Michigan beaches.
7) Groundwater/surface water interface monitoring at a couple of known contaminated sites. This will answer the question of whether this issue should be of concern in the areas where groundwater migrates to the Grand River.
8) Follow-up research on the three sites identified in the Grand River as having contaminated sediments. Have the sediments migrated and will they impact the public beach areas eventually?

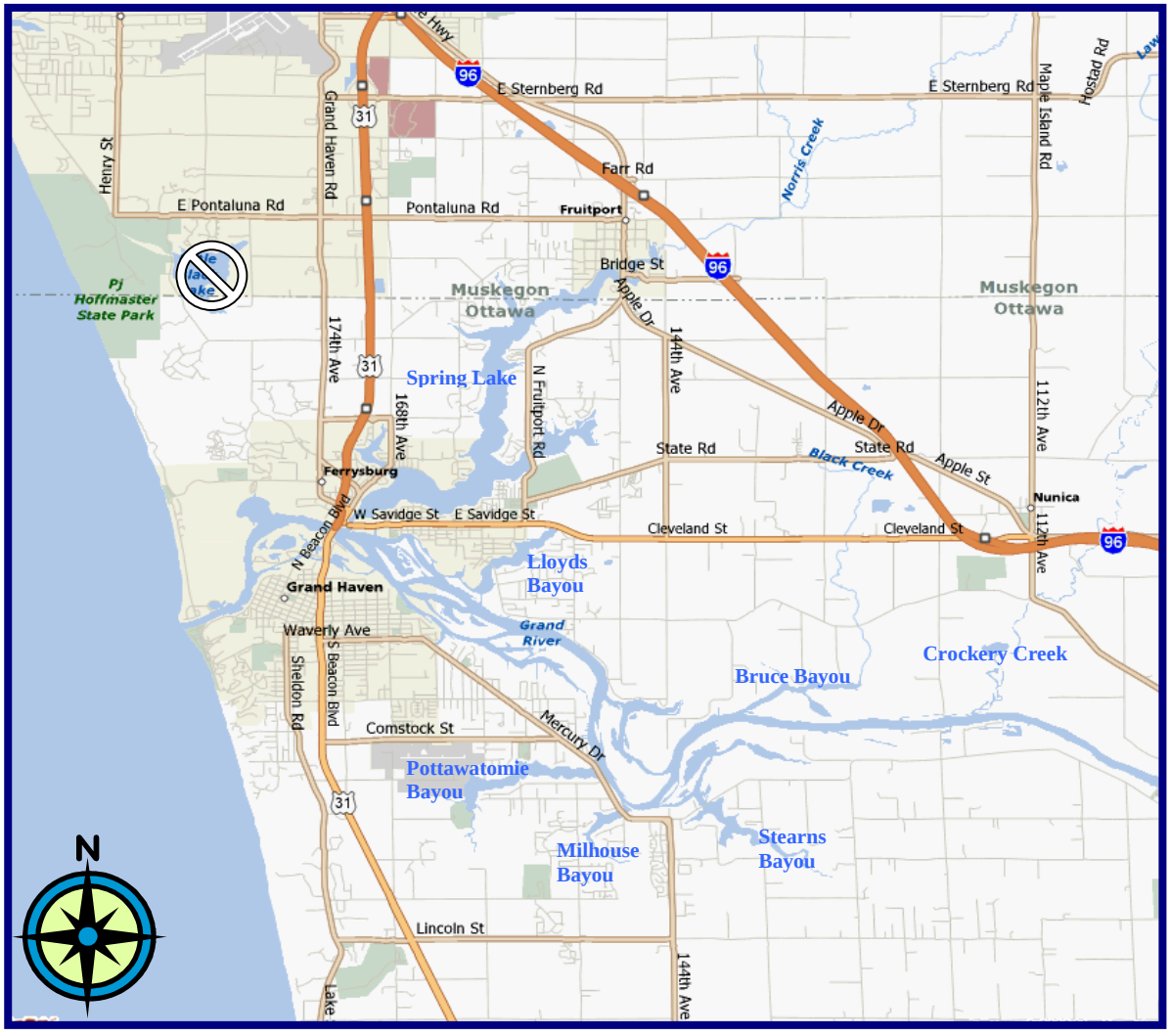
9) Identification of potential wetland restoration sites along the river and tributaries to increase natural "cleaning" abilities and improve habitat (the Lower Grand River Wetland Initiative project may help with this).

10) Identification of sources of storm drain discharge during dry weather conditions. This should be conducted under the Phase II Illicit Discharge Connection inventory.

Runoff from downtown Grand Haven area drains into the Grand River during dry weather conditions; what is the source?

Figure 4.1 shows the location of the waterbodies mentioned for study. While not all of Crockery Creek is identified in Figure 2.3 shown previously and Figure 4.1 below, all of Crockery Creek impacts the Lower Grand River.

Figure 4.1 Water bodies of focus for Tri-Cities area



4.2 Knowledge Gaps

Getting people to become part of the solution to pollution is viewed as a three step process: 1) education, 2) heightened awareness, and 3) actual behavior change. Even when items one and two are achieved, there is no guarantee of number three occurring, but there certainly is more hope. Based on the survey responses received at the close of our public meetings (Appendix B), many people responded that the information presented to them was new information. More than 88% also said once they become aware of things they could do to personally improve water quality, such as using phosphorus-free fertilizer on their lawns, that they would make those behavioral changes.

Figure 4.2 below is a clip of the survey handed out at the November 14th public meeting. The full survey can be viewed in Appendix B. Survey results are shown in red and are indicative of the knowledge gaps that exist but also show the likelihood of behavioral changes if the education and awareness occurs.

Figure 4.2 Clipping of survey results from a public meeting.

2. Based on the presentation and handouts shared tonight, please check (√) which items were new information for you?

48% ☐ The number of pollution issues impacting our local water bodies
76% ☐ The amount of research and projects completed in the Lower Grand River Watershed
76% ☐ The amount of research and projects currently underway in our "backyard"
20% ☐ I already knew most of what was presented tonight
4% each ☐ Other _1) the program itself; 2) that there are toxic algae that can harm us_____

3. Once a "road map" of projects is outlined in the Clean Water Legacy Plan, would you be willing to get involved in local efforts to restore/protect our water resources?

80% ☐ Yes 0% ☐ No 24% ☐ Would depend on the project

4. Once you become aware of things you can do to improve water quality, how likely are you to make those behavioral changes? An example is switching to no-phosphate lawn fertilizer.

88% ☐ Very likely 0% ☐ Not likely 12% ☐ I don't know

We had 30 meeting attendees and 25 surveys completed.

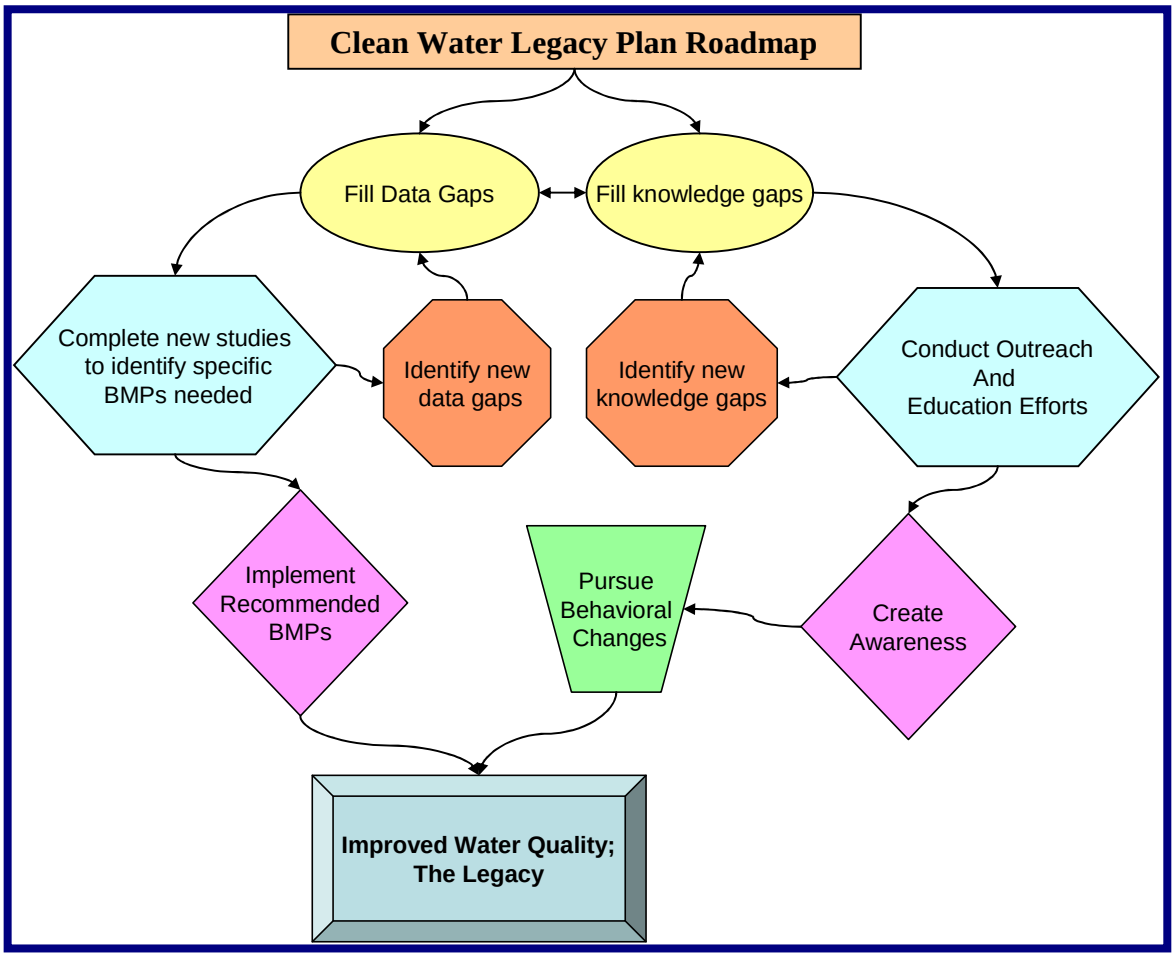
The knowledge gaps in the Tri-Cities area vary depending upon the audience. The audiences presented to, as part of this project, clearly have an interest in the topic of water quality because they took the time to attend the meetings. For the many people in the community who could not (or would not) attend the meetings, there is likely a lack of understanding and interest regarding the many water quality issues. There needs to be ongoing work with students, residents, businesses, farmers, elected officials, community groups, and other stakeholders to educate each target audience and thereby increase awareness. Based on feedback and observations, below is a list of (perceived) knowledge gaps.

1) Lack of understanding of the many water quality issues
    a. How nutrients can impact water quality and clarity.
    b. Why sedimentation in the creeks and lake bottom is problematic.
    c. Why storm water runoff has become such a big problem.
    d. Just because water is dark in color doesn't mean it is dirty and just because water is clear doesn't mean it is safe and clean.
    e. How drinking water and wastewater are inter-related.
    f. The incorrect assumption that the solution to pollution is dilution
2) Lack of understanding of hydrology in the stream systems and how it connects so many areas within a watershed.
3) Lack of understanding regarding sediment transport in the Grand River. The Grand River naturally moves tons of sediment; we simply exacerbate things with poor land use practices and storm water runoff.
4) Lack of up-to-date information regarding the Grand Rapids combined sewer overflow issue. Many still believe Grand Rapids is simply the source of all water quality problems in the Grand River.
5) Lack of understanding that septic tanks require maintenance. If a homeowner has a septic tank and a well for drinking water, the well water should be tested annually to ensure no contamination from the drain field and no contamination from nitrates in fertilizers.
6) Lack of understanding of storm water runoff impacts as well as how open storm sewer systems and underground storm sewer systems work. Also the false perception that water is "treated" when it goes into a storm drain.
7) Lack of public information and understanding regarding remediation of Brownfield, LUST, and Part 201 sites.
8) Lack of understanding on why wetlands are so important to good water quality.
9) Lack of good information on how to properly dispose of unwanted medicines. Current protocol has people dumping it down their toilet; that simply adds the medicine to our future drinking water source.
10) Lack of information regarding funding opportunities to "fill in" the gaps. Collectively communities can pool resources and seek State and Federal assistance. Many times the public will not pursue something based on perceived cost or lack of understanding on how to get assistance.

V. Recommended Action Plan; a Roadmap for the Future

A good roadmap for ensuring a legacy of clean water for current and future generations should have many route options. The objective of the Legacy Plan is to provide options as varied as the community itself. Educators may feel comfortable taking one road to help improve water quality while a farmer or an elected official may choose a very different route. Each route will encounter starts and stops, roadblocks and detours, but each can provide successful journeys into a sustainable future if everyone is simply willing to roll up their sleeves and pitch in for the work and changes that need to be completed. A basic roadmap, Figure 5.1, shows the main route and destinations needed to complete the journey to improved water quality in the Tri-Cities Area, based on the identified data gaps and knowledge gaps.

Figure 5.1 Clean Water Legacy Plan Roadmap

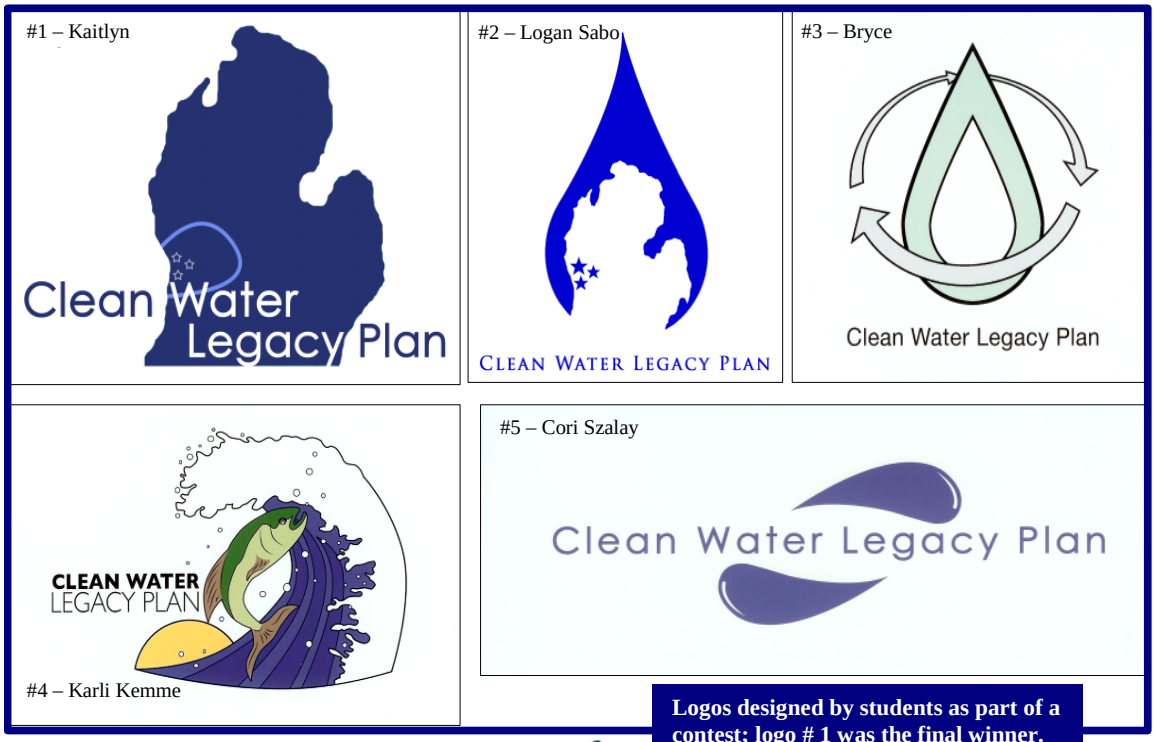


Subsections 5.1 and 5.2 provide route options for the Outreach and Education and BMP areas of the roadmap. Subsection 5.3 includes "Resources" available to complete the journey to improved water quality.

5.1 Outreach and Education

This roadmap route identifies topics and approaches to continuing education and expanding the knowledge base of the community as it relates to water quality. The intent is to spark interest in a "leader", whether a teacher, a retiree, or business owner, to do his/her part in leading others down the road of education, awareness, and behavioral change. Local environmental groups may choose to pick an area of concern, such as proper disposal of unwanted medicines, and focus their grant applications and project time on that topic until it is resolved. The reality is that without good outreach and education, the three required phases for real improvement - education, awareness, and behavioral change - cannot and will not occur. **Everyone in the community has the opportunity to be a leader of behavioral change by starting with themselves and teaching others by example.**

Education is the key to success. An example of how easy outreach and education can be is the logo design contest held as part of this project. The Ottawa County Intermediate School District shared our public meeting invitation with all of its teachers. A graphics arts teacher, Sally Salkowski, from Careerline Tech Center then called and asked if her students could put together logo design sketches for us to choose from. Sally chose a route of education by creative means. In order for the students to develop ideas for the logo, they had to read about the Clean Water Legacy Plan and its intent to improve water quality in the Tri-Cities area. This was a great way for Sally to get her graphic arts students to learn about water quality. Below are the five logos we received. The logos were sent to all project partners for a vote and logo #1 was the final winner. This logo is being used throughout this document and will be the logo on all the project partner websites to direct people to water quality related items.



Logos designed by students as part of a contest; logo # 1 was the final winner.

There has been a tremendous amount of outreach tools developed through the many projects listed in Appendix A. Many of these tools are available on the local government websites (www.grandhaven.org, www.ght.org, www.springlaketwp.org, www.springlakevillage.org, www.ferrysburg.org, www.robinson-twp.org) and the Lower Grand River Watershed website (www.lowergrandriver.org). Additional tools are available as brochures and handouts in government offices, at MSU Extension, at the Ottawa Conservation District, and the Ottawa County Complex. These fantastic educational tools are under-utilized and simply are not getting into the hands of the public. Below is a listing of the many tools available:

1) Products of the Lower Grand River Watershed Management Plan (www.lowergrandriver.org):
    a. Watershed Action Plan (WAP)
    b. Watershed Assessment Matrix (WAM)
    c. Watershed Interactive Mapping (WIM)
    d. Watershed Interactive Tool (WIT); includes information on:
        i. Lower Grand River 319 project
        ii. Nonpoint source pollutants
        iii. Water Science Education
        iv. Interactive mapping
        v. Storm water Management
        vi. Government Resources
        vii. History of the Watershed
        viii. Create a Watershed Management Plan
        ix. FYI on Local Water Issues
        x. Rain Gardens
    e. Lower Grand River Watershed Guidebook
    f. Information and Education Guidebook
2) The Information Services Center home page of AWRI (http://gvsu.edu/wri/isc) includes general watershed information for or about:
    a. Homeowners
    b. Local decision makers
    c. Agricultural producers
    d. Recreational users
    e. Citizen's guide to pest control & Pesticide safety
3) Storm water Savvy tools for Phase II communities (on most government websites)
4) Riparian Owners Guidebook
5) Septic System Owner's Guidebook
6) (Kent County) Septage Disposal Ordinance
7) (Kent County) Septage Maintenance Ordinance
8) (Kent County) Storm water Handbook
9) (Kent County) Storm water Ordinance
10) Local Tools for Lasting Change (Sustainability Futures Project)
11) CES Storm water brochure

12) Purple Loosestrife: What you should know, what you can do
13) A Landowner's Guide to Phragmites (by MDEQ)
14) Homeowners Guide to Reducing Water Pollution
15) Riparian Owner's Guidebook for watershed management
16) Landscaping for water quality
17) Choices for growing communities; Low Impact Development
18) Your Lake and You
19) Practical Tips for Home and Yard to Improve Water Quality
20) Brown Water, Green Weeds, Familiar signs of nonpoint source pollution
21) What Wetlands do for you: the value of Great Lakes Basin Wetlands
22) MiSWIM Tool (DEQ website)
23) Alliance for the Great Lakes Curriculum
24) MDEQ Water Curriculum (via AWRI)
25) Spring Lake wetland ordinance
26) Spring Lake dune ordinance

Given the feedback from the surveys and public meetings held and the general lack of participation by citizens, there is still a great deal of education that is needed of the general public relating to water quality issues in the greater Tri-Cities area. Topics and approach strategies for outreach and education have varied in the past. The Clean Water Legacy Plan was never intended to create more outreach tools. It was meant to compile all the existing information and create a new "roadmap", or action plan, for getting better use of the existing information and tools.

Below is a list of action items or "optional routes" that can be utilized for outreach and education by using existing tools and new ideas that were shared through the community feedback process. The beauty of the route options is that teachers, church leaders, elected officials, environmental groups, and individuals each have something on the list that they could do. EVERYONE has opportunities to help and EVERYONE can make a difference whether working individually or collectively.

1) Share the Clean Water Legacy Plan with everyone you know.
2) Use the Clean Water Legacy Plan logo on all Tri-Cities area government websites to be consistent and to lead web users to the related water quality links. Additional website suggestions:
    a. Through collaboration, be consistent with other Tri-Cities area websites; for example, most of the Phase II Public Education Plan information should be similar on each government website.
    b. All websites sites should post the Clean Water Legacy Plan and a link to the Lower Grand River Watershed Project.
    c. Provide related links to the County webpage (septic tank and beach closing information), the Drain Commissioner (storm sewers), the Ottawa Conservation District (conservation projects), and MSU Extension for access to outreach tools.
3) Have regular local environmental updates.

a. Host public or private forums with invited speakers to discuss specific topics or projects. Churches, schools, clubs, environmental groups and government could each host forums. Possible topics include:
    i. Toxic algae
    ii. Storm water 101
    iii. Understanding pathogens
    iv. Disposal of unwanted medicines
    v. Grand Rapids projects (to show they are cleaning things up)
    vi. Brownfield, Part 201 site remediation projects
    vii. Updates on ongoing studies
    viii. Rain Gardens (to reduce storm water)
    ix. Soil testing and proper yard fertilization
    x. Discussion of the sediment transport model developed by the Army Corps of Engineers and how local units of government can use the tool.
b. Informational "ads" before and after City Council meeting broadcasts
c. Interviews with project leaders on local TV programs (PEG stations?)
d. Develop a speaker's bureau made up of local experts to talk to school groups, community groups, church social action groups, etc.

4) Have students or club groups develop door hangers with educational messages and then hang on doors in their neighborhoods.
    a. Message on using phosphorus-free fertilizers
    b. Message on water conservation
    c. Message on septic tank maintenance (rural areas)
    d. Message on storm water and storm drain dumping
    e. Message on picking up pet waste
5) Put community-created educational pieces in with water bills or other mailings.
6) Have businesses sponsor educational billboards as a community campaign for water quality awareness; perhaps a "did you know" type of message.
7) Create a citizen advisory committee for the Tri-Cities to provide a venue for citizens to bring up concerns.
8) Tie environmental efforts into developing Tri-Cities sustainability projects
9) Provide recognition to individuals/groups that help solve problems. This leads to more volunteer time investments, is a source of pride for helping their own community, and makes people Tri-City advocates.
10) Develop a youth intern program to work with units of government, environmental groups, businesses, or churches to focus on water quality issues and outreach for staff, citizens, daycares, etc.
11) Create a mascot for the Clean Water Legacy Program; use it in parades and at community events to promote awareness.
12) Develop coloring books with a water quality message in all pictures.
13) Develop an Enviro-thon for this area.
14) Promote the Spring Lake wetland ordinance to other Tri-Cities area units of government.

The key to successful outreach and education is to have these three phases occur:
1) Education leads to **2) awareness** leads to **3) behavioral change.**
If everyone in the community takes an active role in doing their part, all three stages can happen, resulting in improved water protection, restoration, and quality for the greater Tri-Cities area.

5.2 Best Management Practices

This roadmap route is for the implementation of BMPs. Included is background information on BMPs, a list of some BMPs that are already required or recommended through other programs but that haven't happened yet, and a list of BMPs that should be considered ASAP for urban and residential areas. More specific BMP recommendations will come out of the work outlined in the "data gap" section to be completed. For example, through a sub-watershed management plan specific sources and causes of pollution will be identified and appropriate BMPs to address the pollution can be recommended.

A BMP is a land management practice implemented to control sources and causes of pollution. There are three main types of BMPs: structural, vegetative, and managerial. Structural BMPs are "bricks and mortar" type projects requiring construction. Vegetative BMPs use plants to stabilize eroding areas, filter pollutants, or provide shade to cool streams. Managerial BMPs are characterized by a change in operating procedures. In addition to BMPs, community education is instrumental for effective implementation, especially with managerial BMPs. This is why the previous section was focused on outreach and education - education is critical for project success. Outreach and education should be a critical component of all watershed management planning and implementation projects. Listed below are examples of BMPs that will be part of the roadmap to improved water quality in the Tri-Cities area. A complete list of examples of BMPs is found in Section 3.5.1 of the Lower Grand River Watershed Management Plan (http://www.gvsu.edu/forms/isc/lowgrand/lowergrand_wmp_final.pdf).

Structural:
Sediment Control basin – Man-made depression in the ground where water is collected or passed through and allows suspended solids to settle out.
Porous pavement – Permeable asphalt or interlocking pavers allowing water infiltration.
Oil & Grit separators – Used in conjunction with storm drain inlets to keep oil/grease and grit from entering local water bodies.
Storm drain retrofits – Modifications to existing structures to minimize impervious surface pollutants from entering local water bodies.
Curbs with cutouts – Combination of curb and cut outs with vegetated swales for road runoff collection and treatment.

Vegetative:
Restored wetlands – Rehabilitation of degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to the natural condition to the greatest extent practicable.

Rain gardens – Small vegetated depressions used to promote infiltration and evapo-transpiration of storm water runoff.
Vegetated buffers/filter strips – A vegetated strip of land adjacent to a water body that filters out pollutants from runoff water.
Forested or wooded riparian buffers – Forested or wooded land areas adjacent to streams that help cool the water temperature by providing shade.
Vegetated swales – A broad shallow channel consisting of dense vegetation designed to accommodate concentrated flows without erosion.
Constructed wetlands – wetlands designed and constructed to mimic the functions of natural wetlands where wetlands do not currently exist.

Managerial:
Comprehensive Nutrient Management Plans – Plans to be utilized by farmers in order to effectively manage all nutrient imports and exports from a farm; this is especially critical in dealing with manure management.
Crop residue management – Utilized by farmers to reduce erosion from farm fields.
Ordinances – Local regulations to address specific issues including: storm water, stream and lake buffers, pet waste disposal, septic systems, fertilizer, illegal or illicit discharges to storm drains, and recreational watercraft use.
Low Impact Development – designing new developments for low impact on the environment by including bio-retention, filter strips, vegetated buffers, grass swales, rain gardens, porous pavement, green roofs, etc.
Green space protection – Preserves environmentally sensitive and open areas.
Education – See info in Section 5.1 above.

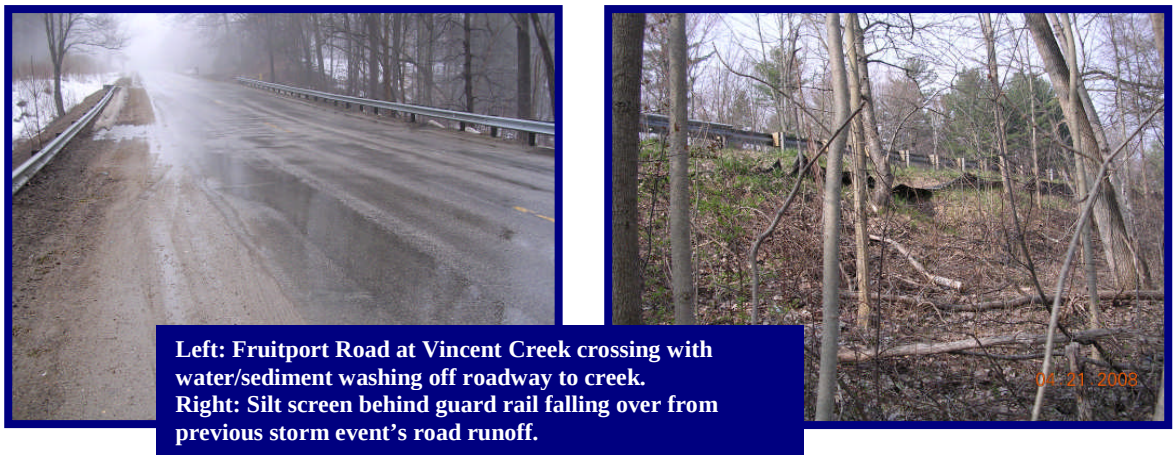
Most sub-watersheds require a mix of BMPs to adequately address nonpoint source pollution. A system of BMPs coordinated to work together in an implementation project can provide more benefit than sporadically placed BMPs. Assessing projects for greatest impact and economical practicality assists in the prioritization of project phases. Implementing incomplete systems of BMPs is a waste of resources if the isolated BMP has very little overall benefit to the environment.

Many BMPs recommended in the Lower Grand River Watershed Management Plan have been implemented or are in progress in areas upstream of the Tri-Cities area (Appendix A). Unfortunately, what the previous studies lacked was detailed locations of needed BMPs in the Tri-Cities areas. That was due to the lack of specific information gathered in those projects. Listed below are the relevant managerial BMPs that were suggested in the previous studies and a specific listing of needed subwatershed plans to generate the site-specific information still needed to identify appropriate BMPs for the Tri-Cities area.

1) Storm water ordinances (already adopted via NPDES Phase II requirements).
    a. Surface Water Pollution Prevention Initiative (SWPPI).
    b. Public Education Plan (PEP).
2) NPDES Phase II mandate also required a road/stream crossing inventory. This should result in recommended structural BMPs to replace or repair damaged road/stream crossings.

3) NPDES Phase II mandate also required a illicit discharge inventory. This should result in the correction of any illegal connection to the storm drain sewer system.
4) County-wide septic tank ordinances.
    a. Need a county-wide septic system maintenance inspection program with ongoing community education. There currently is no point-of-sale program regarding septic tanks and wells, which would serve as a great educational tool.
5) Subwatershed management planning projects. The waterbodies of focus for subwatershed management planning projects are Norris Creek, Spring Lake, Lloyd Bayou, Pottawatomie Bayou, Milhouse Bayou, Stearns Bayou, Bruce Bayou, Black Creek, Crockery Creek, and the Grand River. Interest areas for the planning projects include:
    a. Agricultural areas should be inventoried for tile drain outlets from fields that have manure applied. Plans should quantify the number of farms that are Michigan Agriculture Environmental Assurance Program (MAEAP) certified This will provide an indication of farm management philosophies.
    b. Rural areas should include investigation of areas still on septic systems to determine nutrient and pathogens inputs to ground and surface water.
    c. Urban areas need a closer look at the effectiveness of storm water BMPs. Are the storm drains increasing the flashiness of water levels during storm events? Should some of the storm drains be retrofitted with newer technologies?

As part of the photo collection efforts for the Legacy Plan, it was observed that where Vincent Creek crosses Fruitport Road, sediment was washing into the creek from the roadway during storm event conditions. Some roadwork must have taken place in the not-too-distant past as there were sagging silt-screens behind the guard rails along the crossing. Paving the shoulders of the roadway instead of keeping the current clay/shell mix would eliminate the washing of sediment into the creek and would require less long-term maintenance. This is an example of how specific BMPs could be identified through simple field inventory work of a subwatershed management plan.



Left: Fruitport Road at Vincent Creek crossing with water/sediment washing off roadway to creek.
Right: Silt screen behind guard rail falling over from previous storm event's road runoff.

Additional BMP suggestions will result from the studies currently underway. Specific items to look for when those studies are complete include:

1. How to use unspent funding from the City of Grand Haven Storm water Initiatives Project (http://www.mcgi.state.mi.us/miswims) to conduct something similar to the Kent County Storm water Basin Retrofit assessment project?
2. How will the Lower Grand River Watershed Wetland Initiative tie into possibilities for the Tri-Cities area?
3. What information can be taken from the Integrated Storm water Assessment in the Village of Spring Lake and Spring Lake Township and applied to the greater Tri-Cities Area?

5.3 Resources

The following tables condense the information outlined in detail in Section 4 and 5 above, by project, which are needed to fill the data and knowledge gaps and to implement needed BMPs. The tables identify potential leaders and responsible parties for the project and also include cost estimates where applicable, potential technical assistance sources, and potential funding sources. The Tables are:

Table 5.3.1 – Projects and resources to fill the data gaps
Table 5.3.2 – Projects and resources to fill the knowledge gaps
Table 5.3.3 – Projects and resources to identify needed BMPs

Table 5.3.1 Projects and resources needed to fill the data gaps.

Project	Potential Leader or Responsible Party	Cost Estimates	Technical Assistance	Potential Funding Source(s)
1) Identify nutrient and pathogen concentrations. Base flow vs. storm flow	Cities, Townships, local environmental groups, Grand Valley Metro Council (GVMC), Ottawa County.	$20/phosphorus test $10/nitrate test $40/coliform test +staff time	Staff, Lakeshore Environmental, GVSU-AWRI, Progressive A & E, West Michigan Environmental Action Council (WMEAC).	MDEQ's various programs such as water quality monitoring grants, coastal zone management grants, nonpoint source pollution grants. NOWS.
2) Biological assessments (Fish, invertebrates, plankton)	County, Cities, Townships, environmental groups, school classes.	Variable; ranges from free using volunteers to thousands per project	MDEQ, WMEAC, GVSU-AWRI, CORE, Wetlands Watch.	MDEQ NPS watershed management planning grants.
3) Hydrologic studies	County, Cities, Townships, local environmental groups.	$15K - $25K per sub-watershed	Lakeshore Environmental, , MDEQ, GVSU-AWRI.	MDEQ NPS watershed management planning grants.
4) Quantify sediment transport in Crockery Creek	Cities, Townships, local environmental groups, GVMC.	Request for proposal needed based on scope of project.	Lakeshore Environmental, GVSU-AWRI.	MDEQ NPS planning grants.
5) Pharmaceutical monitoring	NOWS, Grand Haven – Spring Lake Wastewater Authority, County.	Request for proposal needed based on scope of project.	MSU Extension.	EPA, MDEQ Emerging issues grants.
6) Toxic algae monitoring	County Health Department, Cities, Townships.	$20 per sample plus staff time.	GVSU-AWRI	MDEQ water quality monitoring grant EPA, MDEQ Emerging issues grants.
7) Groundwater/ surface water interface monitoring	Contaminated property owner.	$5,000-$10,000 per job	Lakeshore Environmental	EPA, MDEQ, Current site owner
8) Contaminated sediment follow-up work	Tri-Cities	$20,000-$30,000	GVSU-AWRI	EPA GLNPO
9) Identify potential wetland restoration/ preservation sites	County, Cities, Townships, local environmental groups, GVMC	Free-Should be a component of a current GVMC project.	GVMC, GVSU-AWRI	EPA

Table 5.3.2 Projects and resources needed to fill the knowledge gaps.

Project	Potential Leader or Responsible Party	Cost Estimates	Technical Assistance	Potential Funding Source(s)
1) Better utilize the existing tools listed on page 23 and 24 of this document.	All government, educational, and environmental entities.	Free; simply acquire and display tools at place of business.	None needed.	None needed.
2) Share the Clean Water Legacy Plan with everyone.	All partners of this project.	Free; make available as PDF download from websites. Hardcopies could be made available for minimal cost.	None needed.	None needed unless printing large amounts of hard copies.
3) Consistent message among partner websites and web linkages to relevant information.	Webmaster for each project partner.	Staff time involved.	DPW staff, City managers, Township supervisors.	In-house
4) Regular environmental updates to the community	Churches, schools, clubs, environmental groups, governmental units, Ottawa Conservation District, MSU-Extension	Staff or volunteer time; possible speaker fees and mileage.	Lakeshore Environmental, CORE, Wetland Watch, NRCS, MAEAP, MSU-extension, MDEQ, USEPA	Agency hosting;
5) Door Hangers with educational messages	Student groups, clubs, environmental groups.	$0.15 each if design is done in-house.	Graphic arts students, Alliance for the Great Lakes	Grand Haven Area Community Foundation, Corporate sponsors.
6) Educational inserts in water bills and community newsletters.	City, County, student interns, project partners	Staff time; printing costs.	Graphic arts students, marketing agencies.	Existing budget for community mailings; Grand Haven Area Community Foundation.
7) Billboard campaigns	Government; community and environmental groups.	$5,000 and up.	Graphic arts students, marketing agencies.	Corporate sponsorships, Grand Haven Area Community Foundation, MDEQ grants.
8) Create Citizen's Advisory Committee	Collaboration between Cities, Townships, & County.	Free.	Existing leaders in the environmental field from agencies listed in Technical Assistance cells above. Tri-City leaders	None needed.

Table 5.3.2 Projects and resources needed to fill the knowledge gaps, continued.

Project	Potential Leader or Responsible Party	Cost Estimates	Technical Assistance	Potential Funding Source(s)
9) Tie water quality projects into local sustainability efforts.	All CWLP Project Partners	Staff time	City of Grand Rapids, GVSU Sustainability Dept., Muskegon Sustainability Coalition	People and Land; Frey Foundation, Grand Haven Area Community Foundation
10) Create recognition opportunities	CWLP Project Partners	Minimal for plaque or award frame.	None needed	In-house
11) Develop a student intern program to continue the CWLP efforts	CWLP Project Partners	Free or minimum wage	GVSU Sustainability Dept (Norm Christopher)	MDEQ Coastal Zone Management Program grants
12) Create a mascot for CWLP	Student Interns	TBD	Schools that have developed mascots	MDEQ Coastal Zone Management Program grants, Grand Haven Area Community Foundation
13) Develop coloring books with water quality message for use in doctor waiting rooms.	Interns, schools, clubs, environmental groups.	Printing fees.	Lake Michigan Federation	MDEQ Coastal Zone Management Program grants, Grand Haven Area Community Foundation
14) Develop an Enviro-thon for this area.	Ottawa Conservation District, Intermediate School District.	Staff time	Michigan Conservation Districts	In-house
15) Promote Spring Lake wetland ordinance to surrounding communities for adoption of similar language.	CORE, Wetland Watch, Spring Lake officials.	Free.	MDEQ, Spring Lake officials	None needed.

Table 5.3.3 Projects and resources to identify needed BMPs.

Project	Potential Leader or Responsible Party	Cost Estimates	Technical Assistance	Potential Funding Source(s)
1) SWPPI and PEP requirements of NPDES permits (Storm water related education and BMPs)	Phase II communities (already underway)	Varies by community size and needs.	Consultant FTC&H is doing much of this work already.	Unfunded mandate; the community pays for it.
2) Road/stream crossing inventory (Storm water and sediment related BMPs)	DPW staff of Phase II communities; should also be done through subwatershed management planning activities in non-phase II communities.	$5,000-$20,000 depending on size of subwatershed.	GVSU-AWRI, Lakeshore Environmental, DPW staff.	MDEQ via NPS watershed management planning grants.
3) Illicit discharge inventory (Storm water BMPs)	Phase II communities	Staff time	DPW staff, consultants.	Unfunded mandate; the community pays for it.
4) County-wide septic tank ordinances with point-of-sale program. (Pathogen and nutrient BMPs)	Ottawa County Health Department	Staff time.	Michigan Department of Health.	Program fees.
5) Subwatershed management planning projects (All nonpoint source pollutant BMPs)	Cities and Townships, environmental groups.	$100,000 and up, depending on subwatershed size, for 2-year project.	Lakeshore Environmental, CORE, GVSU-AWRI, NRCS, Ottawa Conservation District.	MDEQ NPS watershed management planning grants.

VI. Conclusions

The Clean Water Legacy Plan is the result of concerned leadership officials in the Greater Tri-Cities area regarding the future legacy of the area's water quality. This Legacy Plan provides a roadmap in which to build on past efforts by addressing the known data and knowledge gaps through action. The roadmap to action has a route option for everyone, each with an opportunity to have a positive impact on the current and future legacy of the abundant water resources of the area.

The Clean Water Legacy Plan Roadmap includes filling the data and knowledge gaps that exist. By filling the data gaps, site specific BMP recommendations will emerge and then can be implemented. To fill the knowledge gaps, outreach and education needs to occur to create awareness. The ultimate goal after creating awareness is to see behavioral changes occur. By following this roadmap, a clean water legacy can occur.

As a post script to this document, the County of Ottawa's Planning and Grants Department released a request for proposals in June 2008 to look at water quality and water quantity for both surface water and ground water in the county. If this work is completed, it will help address some of the data gaps that exist.

VII. Glossary of Terms

Terms

Impervious: A solid surface not allowing water to penetrate through to the ground such as rooftops, pavement, and concrete.

Nonpoint Source Pollution: Pollution that comes from diffuse sources, not an end-of-pipe outlet which is referred to as point source pollution. Typical nonpoint source pollutants in Michigan include animal manure, storm water runoff, metals, nutrients, organic matter, pathogens, pesticides, pathogens, petroleum by-products, and sediment.

Pathogens: Human disease-causing bacteria or viruses that come from sewage spills, leaking septic tanks, manure runoff from farm fields, and even wildlife that live in the watershed.

Pollutant: Any substance of such character and in such quantities that when it reaches a body of water, soil or air, it contributes to the degradation or impairment of its usefulness, essentially making the water, soil, or air useless and or harmful.

Runoff: Water that travels over the land surface and ends up in streams and lakes.

Sediment: Soil, sand, and minerals which can take the form of suspended, dissolved, or bedload material.

Storm water: Runoff from a storm, snowmelt runoff, and surface runoff and drainage.

Tributary: A river or stream that flows into a larger river, stream, or lake.

Watershed: An area of land in which all the rainfall and snowmelt from that area drains to the lowest point, usually a stream or lake.

Watershed management plan: A document that assesses surface water resources impairments, land use activities, and development in a given watershed in order to provide the framework needed to implement projects and practices to restore, preserve, and sustain healthy watershed services.

Appendix A

Compiled Studies and Projects

Grand Haven Clean Water Legacy Plan Project
Task deliverable 1

This project is funded in part by the Michigan Coastal Management Program of Michigan Department of Environmental Quality and the National Oceanic and Atmospheric Administration of U.S. Department of Commerce. Match dollars to the grant are provided by members of the Northwest Ottawa Water System, the Grand Haven-Spring Lake Sewer Authority, the City of Grand Haven, and Lakeshore Environmental, Inc.

Task 1 of the MDEQ Coastal Management Program grant to the City of Grand Haven requires the identification of existing and ongoing studies, plans, and other sources of information that address known and potential sources of water pollution in the Lower Grand River, its watershed, and adjacent Lake Michigan beaches.

Section 1 of this document begins with the work that has been completed since 1990 in the Lower Grand River that has a connection to water quality. Section 2 includes work that is currently underway. Both sections include the work title, the cost of the work if available, the date the work was completed, who the work was completed and funded by, a brief description of the work (in italics), and an URL to the web link where more complete information can be viewed.

This is the final compilation and synthesis of the information identified. A preliminary version of the compiled studies and projects list was shared at the public meetings to allow feedback of any missed information.

Lakeshore Environmental, Inc.
Consulting Hydrogeologists & Engineers | www.lakeshoreenvironmental.com

Section 1
Completed research, analysis, and projects since 1990

Items with a * after the dollar amount do not include local match amount.

1) **The Grand River Watershed Program** $1,000,000
   1990 - 1995 (GVSU, funded by Grand Rapids Foundation)
   This project was a multi-faceted five-year project to determine the past, present and future problems and strengths of the entire river and its watershed. Grand Valley identified solutions to the problems and began the process of building connections with community-based organizations to address the root causes of problems over the long-term.

2) **Lower Grand River Watershed Planning and Implementation Projects**
   1990 - Present

   A) **Lower Grand River Watershed Management Plan** $398,776
      2002 – 2004 (Grand Valley Metro Council, funded by MDEQ)
      This project was to develop a comprehensive watershed management plan that identified known/suspected sources/causes of non-point source pollution and outlined an implementation plan to address the pollution.
      http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3714_31581-104284--,00.html

      i. **Buck Creek Sub-watershed Management Plan** $0
         2004 (Completed as part of the Lower Grand WMP listed above)
         http://www.gvsu.edu/wri/isc/index.cfm?id=C8E9B889-D23B-8D42-07F7E7F9E07FEE86

      ii. **Sand Creek Sub-watershed Management Plan** $0
         2004 (Completed as part of the Lower Grand WMP listed above)
         http://www.gvsu.edu/wri/isc/index.cfm?id=C8E9B889-D23B-8D42-07F7E7F9E07FEE86

   B) **Lower Grand River Sub-watershed Management Plans and Projects**
      The Lower Grand River Watershed Management encompasses 136 sub-watersheds, some of which have their own planning and implementation projects. Project details for most of the sub-watershed activities can be found by searching the MiSWIM system @ http://www.mcgi.state.mi.us/miswims. Search by watershed (Lower Grand), then click on the NPS grants tab. Projects with additional information available include the URL beneath the project description.

      i. **Bear Creek Projects**
         a. **Bear Creek Planning Project** $49,940
            1992 (Cannon Township, funded by MDEQ)
            First in a series of projects to include a watershed inspection, identification of pollutant sources, land use analysis, public education, and creation of an implementation plan.

b. **Bear Creek transition grant** $35,000*
1993 (Cannon Township, funded by MDEQ)
Continue efforts of 1992 Planning Project

c. **Bear Creek Implementation Project 1** $200,000*
1994 (Cannon Township, funded by MDEQ)
Remediation through agricultural, suburban/residential, and transportation related BMPs; also maintained public education program.

d. **Bear Creek Implementation Project 2** $100,000*
1997 (Cannon Township, funded by MDEQ)
Grant provided financial and technical assistance to watershed landowners and community officials implementing BMPs to reduce sedimentation and bacterial contamination; also continued to educate the public.

ii. **Coldwater River Watershed Management Plan** $0
2002-2004 (Coldwater River Watershed Council, funded by MDEQ)
http://www.coldwaterriver.org/mission.php

iii. **Crockery Creek**

a. **Implementation Projects and Information & Outreach** $46,840*
1990 (Muskegon Conservation District, funded by MDEQ)

b. **Crockery Creek Watershed Technician** $31,000*
1990 (Muskegon Conservation District, funded by MDEQ)

c. **Crockery Creek Watershed Technician** $26,000*
1992 (Muskegon Conservation District, funded by MDEQ)

d. **Crockery Creek Implementation Projects**.....$300,000*
1994 (Muskegon Conservation District, funded by MDEQ)
BMP surveys, pasture management, stream bank protection, conservation tillage, integrated crop management, wetland enhancement, filter strips, waste utilization and storage, grassed waterways, sediment basins.

iv. **Hager Creek Watershed Management Plan** (2004) $0

a. **Hager Creek Restoration** $424,481
2001-2004 (Ottawa County Parks and Recreation Commission, funded by MDEQ)
This project included restoration of a stream bank and installation of fencing, stabilization structures, grassed waterways, and an infiltration basin. It also included installation of a pedestrian bridge.
http://www.deq.state.mi.us/documents/deq-ess-nps-hager-creek-fact-sheet.pdf

v. **Plaster Creek Watershed Management Plan** (2004) $0

a. **Plaster Creek Storm water Detention Basin Retrofit**.....$514,800
2000-2003 (Kent County Drain Commissioner, funded by MDEQ)

This project included work at the Wyoming DPW and the Laraway-Brooklyn basin. The specific work included an extended detention basin, sediment basin, and erosion controls at both sites.
http://www.deq.state.mi.us/documents/deq-ess-nps-plaster-creek-detention-fact-sheet.pdf

b. **Plaster Creek Stream Bank and Storm water Projects**.....$99,760*
1990 (Kent County Drain Commissioner, funded by MDEQ)
The goal of this project was to implement activities such as storm drain cleanups, stream bank cleanup, and stream bank restoration.

vi. **Rogue River Watershed Management Plan** $120,000*
1998 (Grand Valley Metro Council, funded by MDEQ)
Project goal was to develop a watershed management plan for this coldwater river to address sediment, nutrients, and loss of aquatic habitat.
http://gvsu.edu/wri/isc/index.cfm?id=6B946DAD-003C-40E5-3DD5D9B7D3C29942

a. **Rogue River Watershed Physical Improvements** $546,333
2001-2004 (GVSU-Annis Water Resources Institute, funded by MDEQ)
This project consisted of construction of road stream crossing improvements, revegetation of stream banks, and installation of a boardwalk.
http://www.deq.state.mi.us/documents/deq-ess-nps-rogue-river-fact-sheet.pdf

b. **Rogue River Watershed Information & Education Outreach**$137,405*
2000 (GVSU- Annis Water Resources Institute, funded by MDEQ)
This three-year project was to implement the recommendations of the information and education strategy developed as part of the Rogue River Watershed Management Plan.
http://gvsu.edu/wri/isc/index.cfm?id=6B8104BB-B8DC-0DB9-C514E9BC9BBD87CE

c. **Rogue River Watershed Implementation work** $357,516*
2000 (GVSU- Annis Water Resources Institute, funded by MDEQ)
The goal of this project was to address pollutants by improving road stream crossings, establishing riparian vegetation, stabilizing stream banks, and removing sediment from a small tributary by eliminating three small dams.

d. **Rogue River Conservation Easements**.....$59,005*
2002 (Land Conservancy of West Michigan, funded by MDEQ)

vii. **Sand Creek Sub-Watershed Implementation work** $98,947*
2004 (GVSU-AWRI, funded by MDEQ)
Contract includes installing three rain gardens and stabilizing one stream bank.

viii. **Spring Lake Watershed Management Plan** $50,000
2001 (Progressive A&E, funded by Spring Lake – Lake Board)

The watershed management plan was developed as a guiding document for the Spring Lake - Lake Board.

ix. York Creek Projects

a. **York Creek Outreach and Education Efforts**.....$49,913*
1993 (Alpine Township, funded by MDEQ)
This project was to fund the organization of a York Creek watershed advisory committee (under Alpine Township). The group would develop quarterly newsletters and conduct workshops and public meetings.

b. **York Creek Outreach and Education Efforts**.....$17,500*
1994 (Alpine Township, funded by MDEQ)
Project was to develop a comprehensive outreach and education plan.

c. **York Creek Outreach and Education Efforts**.....$34,998*
1995 (Alpine Township, funded by MDEQ)
More outreach and education in York Creek Watershed.

d. **York Creek Outreach and Education Efforts**.....$319,561*
1996 (Alpine Township, funded by MDEQ)
More outreach and education in York Creek Watershed.

3) **City of Grand Rapids Combined Sewer Overflow work** $210,000,000
1991 to Present (City of Grand Rapids, funded by taxes)
As of January 2007, the City of Grand Rapids has separated more than 99% of the City's old combined sewer outfalls. They are currently working on the remaining 1%, which will cost another $50 million to complete.
http://www.grand-rapids.mi.us/index.pl?page_id=3323

4) **Total Maximum Daily Load (TMDL)** .....$ In-house cost for MDEQ
1997-2006 (MDEQ, funded internally)
Thirteen TMDLs have been developed and approved for water bodies in the Lower Grand River Watershed. TMDLs determine the total maximum daily load of a specific pollutant that the water body can handle without detrimental impact to the water body. TMDLs are used as a guide to plan implementation projects to address the pollutants and concerns outlined. In alphabetical order, the TMDLs are as follows:

b) Bass River, August 2005 TMDL for E. coli
c) Bass River, August 2005 TMDL for biota
d) Bear Creek, August 1997 TMDL for sediment
e) Buck Creek, March 2006 TMDL for E. coli
f) Coldwater River (and Bear Creek, Tyler Creek), May 2005 TMDL for E. coli
g) Lincoln Lake, July 2006 TMDL for E. coli
h) Plaster Creek, June 2002 TMDL for E. coli
i) Plaster Creek, July 2002 TMDL for biota
j) Rio Grande Creek, January 2003 TMDL for e. coli
k) Sand Creek, August 2005 TMDL for biota
l) Strawberry Creek, August 2005 TMDL for biota
m) Unnamed tributary (in Grand Rapids), August 2005 TMDL for biota

n) York Creek, August 2005 TMDL for biota
http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-12464--,00.html

5) **Preliminary investigation of the extent of sediment contamination in the Lower Grand River** $69,000
1999 (GVSU-Annis Water Resources Institute, funded by EPA)
This study was a preliminary investigation of the nature and extent of sediment contamination in the Lower Grand River. The resulting three areas of concern were Harbor Island, Spring Lake, and Grand Haven.
http://www.epa.gov/glnpo/sediment/GrandRiver/index.html

6) **Kent County Septage Management Program** $73,670*
2000 (GVSU-Annis Water Resources Institute, funded by MDEQ)
The goal of this project was to develop a detailed Septage management plan that would include alternative treatment and disposal technologies and recommend institutional mechanisms to coordinate maintenance and disposal programs on a countywide and regional scale.
http://www.gvsu.edu/wri/isc/index.cfm?id=4DAAA76E-0EB4-DD60-1D2F9607AF0ACE20

7) **Kent County Storm water Basin Retrofit**.....$85,800*
2000 (Kent County Drain Commissioner, funded by MDEQ)
Project goal was to complete a qualitative assessment of site-specific opportunities for retrofitting existing storm water detention basins and developing preliminary retrofit designs for six basins.
http://www.mcgi.state.mi.us/miswims

8) **Administrative Tools & Authority for Storm Water Management**.....$178,936*
2000 (GVSU-Annis Water Resources Institute, funded by MDEQ)
The goal of this project was to address the impact of land development on the environment. This was to be completed through five tasks: 1) formulate a watershed management authority, establish long-term funding mechanisms, adoption of county-wide storm water management ordinance, development of comprehensive engineering design criteria, and development of a Natural Resources Management Plan.
http://gvsu.edu/wri/isc/index.cfm?id=4DB1571E-952C-B20D-4425442630DEED4A

9) **Ottawa County Health Department beach monitoring study**.....$150,000
2002-2006 (Ottawa County, funded by County)
The health department collects water samples at local beaches to determine if the water complies with total body contact standards and is safe for swimming. Results of the beach monitoring are posted on the County Health Department website.
http://www.co.ottawa.mi.us/HealthComm/Health/Beach.htm

10) **Illicit Connection Elimination Project, City of Grand Rapids** $100,944
2002-2004 (City of Grand Rapids, funded by MDEQ)
This project detailed 495 storm water outfalls to the Lower Grand River and sampled

250 of those outfalls that had discharge in order to identify potential illicit connections to the storm sewer.
http://www.deq.state.mi.us/documents/deq-ess-nps-grand-rapids-illicit-connections-fact-sheet.pdf

11) **Spring Lake Internal Nutrient Loading Study** $88,164
2003-2006 (GVSU-Annis Water Resources Institute, funded by Spring Lake - Lake Board)
This study consisted of three phases; one looked at internal phosphorus loading from lake bottom sediment and potential use of alum for treatment, two looked at different alum concentrations and the effect of resuspension of lake sediments, and three looked at the effectiveness of the alum treatment eight months after treatment.
http://www.gvsu.edu/wri/director/index.cfm?id=6B35DDA7-96AC-47F2-C2125255E0148EF0

12) **Grand River Sediment Transport Modeling Study Report**.....$250,000
2003-2006 (U.S. Army Corps of Engineers)
The U.S. Army Corps of Engineers was directed to develop sediment transport models for tributaries to the Great Lakes that discharge to Federal navigation channels or Areas of Concern under Section 506(e) of the 1996 Water Resources Development Act. The models are designed to assist State and local resource agencies in evaluating alternatives for soil conservation and non-point source pollution prevention in the tributary watersheds.
http://glc.org/tributary/models/documents/GrandRiverFinalReport.pdf

13) **Source Water Assessment for Northwest Ottawa Water System (NOWS)**.....$?
2004 (USGS/MDEQ, funded internally by DEQ)
The purpose of the Source Water Assessment was to analyze the sensitivity and determine the susceptibility of a community's source of drinking water to potential sources of contamination.
Document available by contacting NOWS (616-842-3210)

14) **Grand Rapids Uptown Revitalization Project**. $1,900,000
2004-2005 (Uptown Advisory Council, funded by MDEQ)
Low Impact Development practices were installed at four different building sites in the East Hills Neighborhood. This project used innovative green technology on a Brownfield site to revitalize its downtown.
http://www.mcgi.state.mi.us/miswims

15) **Storm Water Pollution Prevention Initiatives (SWPPI)** ..... $150,000+
2004-2006 (FTC&H, funded by Phase II communities)
An unfunded mandate required for communities of <100,000 people to address storm water. A result of the SWPPI was the public education plan which includes information on storm water and ways to reduce storm water runoff.
http://www.grandhaven.org/publicnotices/npdes_pep2005/index.htm

16) **NPDES Phase II Public Education Plan (PEP) for Lower Grand River Watershed Phase II communities**.....$111,504
2004-2006 (GVMC & FTH&C, funded by Phase II communities)

The public education plan for this time period has projects including newsletters, brochures, handouts, website updates, newspaper stories, TV ads, give-a-ways, storm drain stenciling and marking, and bus ads.
http://www.gvmc.org/naturalresources/npdes.shtml

17) Hazardous waste cleanup sites in the Tri-Cities area..... $15,000,000+
1990-Present (Federal, state and local funding)
*Eight **Brownfield sites** have been remediated in the area. Brownfields are abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination.*
http://www.epa.gov/ebtpages/cleabrownfields.html
*Thirty-three **LUST sites** have been remediated. Leaking Underground Storage Tanks are generally associated with underground fuel storage tanks.*
http://www.epa.gov/ebtpages/cleastoragetanksleaksandspills.html
*Forty **Part 201 sites** have been remediated. Part 201 sites are those where there has been a release of a hazardous substance(s) in excess of the Part 201 residential criteria, but they do not fit other hazardous waste site criteria such as Superfund, Brownfield, or LUST sites.*
http://www.deq.state.mi.us/documents/deq-rrd-Part201CitizensGuide.pdf

18) Spring Lake wetland ordinance.....$?
This ordinance was developed to protect existing wetlands in Spring Lake.

19) Norris Creek Preliminary Study.....$5,000
2008 (Lakeshore Environmental Inc, funded by Spring Lake – Lake Board)
This short-term study looked at four locations in the Norris Creek watershed to evaluate the potential contribution of phosphorus and pathogens to Spring Lake from Norris Creek.

Cost of completed projects ..... > $233,180,793

Section 2
Research, analysis, and projects currently underway

Items with a * after the dollar amount do not include local match amount.

1) **Lower Grand River Watershed Implementation Project** .....$ 264,945
2004-2007 (Grand Valley Metro Council (GVMC), funded by MDEQ)
This is a three-year project ending in 2007 that includes: updating the Buck Creek, Plaster Creek and Coldwater River watershed management plans, e-coli source identification for Buck and Plaster Creek and Coldwater River, implementing e-coli BMPs, and the development of an outreach program.
http://www.mcgi.state.mi.us/miswims

2) **Water-borne pathogen study by MSU** (Rose & Mantha) .....$?
2005 - ?
This study is looking at bacterial occurrence in the Lower Grand River and its sediment. The study will examine special changes in water quality, and evaluate the transport of contaminants in the river. No reports have been issued yet but the public presentation given by Dr. Rose can be found at the Ottawa County web link
www.co.ottawa.mi.us/pdf/**Water**_Quality_Forum.pdf.
Part of the study is designed to help develop tools to accurately predict potential human health threats to Coastal Great Lakes waters. Field experiments were conducted by NOAA, GLERL, & MSU during the summer of 2007 studying water flow and movement in the Lower Grand.
http://www.glerl.noaa.gov/res/Centers/HumanHealth/docs/grand_haven_factsheet.pdf

3) **City of Grand Haven Storm Water Initiatives**.....$573,606*
2006 - 2008 (Funded by MDEQ and City match)
This project is to install storm sewer infiltration systems, rain gardens, underground detention, and porous pavement parking lots within the City of Grand Haven to address storm water runoff. The project has experienced little progress due to a lack of funds available for City match to the grant dollars.
http://www.mcgi.state.mi.us/miswims

4) **Low Impact Development Campaign for Greater Grand Rapids**.....$104,767
2006 - 2007 (Green Built, Inc., funded by MDEQ)
Implement the Low Impact Development Initiative for Grand Rapids; it will address pollutant sources typically found in urban runoff.
http://www.greenbuiltmichigan.org/LID

5) **Rogue River Watershed Plan update with conservation easement projects**.....$483,623
2006 - ? (Land Conservancy of West Michigan, funded by MDEQ)
The goal of this project is to update the Rogue River Watershed Management Plan and secure permanent protection of privately held natural lands that are essential to maintaining water quality.
http://www.deq.state.mi.us/documents/deq-ess-nps-fy06-grants.pdf

6) **Metro Hospital CMI project of Buck Creek** $400,000
2006 - ? (Metro Health Hospital, funded by MDEQ)
This project will install bio-retention swales.
http://www.mcgi.state.mi.us/miswims

7) **NPDES Phase II Public Education Plan (PEP) for Lower Grand River Watershed Phase II communities**.....$117,489
2007-2009 (GVMC & FTH&C, funded by Phase II communities)
The public education plan for this time period has projects including newsletters, brochures, handouts, website updates, newspaper stories, TV ads, give-a-ways, storm drain stenciling and marking, and bus ads.
http://www.gvmc.org/naturalresources/npdes.shtml

8) **Lower Grand River Watershed Wetland Initiative**.....$96,844
2007- 2009 (GVSU-Annis Water Resources Institute, funded by EPA)
This project includes an inventory and analysis of historic wetlands and their function in the Lower Grand River and a comparison to present day conditions in three sub-watersheds.
http://gvsu.edu/wri/isc/index.cfm?id=2FFDA012-D22B-88D9-548B054593199BC9

9) **Integrated storm water assessment in the Village of Spring Lake and Spring Lake Township**.....$225,000
2007 - ? (GVSU-Annis Water Resources Institute, funded by Sea Grant)
Researchers at AWRI have received funding from Michigan Sea Grant to identify the causes, consequences, and corrective actions required to minimize the adverse impacts of storm water discharges to the water bodies located within and around the Village of Spring Lake and Spring Lake Township, including Spring Lake, the Grand River, and, ultimately, Lake Michigan.
http://gvsu.edu/wri/director/index.cfm?id=8C802854-FF9E-40F3-E7B436B105948577

10) **Clean Water Action's septic system awareness program** .....$Unknown
2007 (work completed by CWA volunteers)
This is an educational campaign called "Clean Kent County", focusing on homeowners regarding the need for septic system maintenance. The program is mostly completed with volunteers going door-to-door; they've been to 2,300 homes in Kent County to-date. Kent County does not have a point-of sale program for wells and septic tanks.
http://www.cleanwateraction.org/mi/cleankentcounty.html

11) **Ottawa County beach monitoring** $30,000
2007 (Ottawa County Health Department)
Most recent e-coli data collected from eight inland lake beach sites and nine Lake Michigan beach sites.
http://www.miottawa.org/SwimmingAdvisory/beach.jsp

12) **Ottawa County Sanitary Beach Survey** $11,500
June 2007-September 2007 (Ottawa County, funded by EPA)

County is looking t e-coli and beach conditions (wind, waves, bathers, birds, storm events, algae, etc. at 4 beaches to make connections to e-coli counts.
Contact the Ottawa County Health Department for more information 616-393-5625.

13) **Delta Institute/City of Grand Rapids/Sustainable Business Forum** .....$?
Develop a green cleaning consortium to make more affordable the purchase of green cleaning supplies to reduce pollutant discharges to the GRWWTP and the Grand River.

14) **Creation of a Lower Grand River Watershed Council** (Under GVMC) .....$?

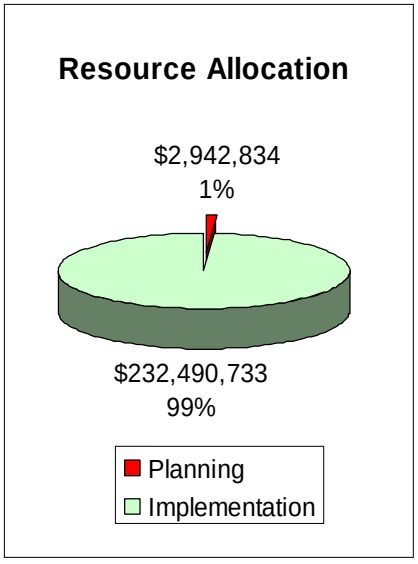
19) **Source Water Intake Protection Program (SWIPP) for Grand Haven**.....$?

Cost of ongoing projects..... > **$2,307,774**

Total investment in the Lower Grand River Watershed since 1990:

> $235,488,567

Just for reference, this pie chart shows how the money was spent. Planning work includes studies, research, and development of watershed management plans. Implementation work includes all on-the-ground projects and community outreach and education. This shows a great return on investment of planning dollars spent to achieve implementation needs.



Appendix B

Public Survey & Results

This survey form was used for both the September 13, 2007 public meeting and the November 14, 2007 public meeting. The survey was handed out at the end of the meeting and collected as folks left. Results of the surveys have been added in red. For the earth day event on April 19, 2008, small slips of paper with only question 1 from the survey were filled out by participants. A sample is shown here with the results indicated in red.

Introduction of the Clean Water Legacy Plan Project
Public Meeting
Thursday, September 13th

Survey results

1. In order to better understand your concerns related to water quality, please tell us how you would prioritize the following water uses for our area. (1=highest)

__1__ Drinking water
__2__ Swimming
__5__ Boating
__3__ Fishing
__4__ Viewing water, waterfowl, and/or wildlife
Others _Long term health and diversity of ecological systems on the surface waters

2. Based on the presentation and handouts shared tonight, please check (√) which items were new information for you?

16% ☐ The number of pollution issues impacting our local water bodies
58% ☐ The amount of research and projects completed in the Lower Grand River Watershed
55% ☐ The amount of research and projects currently underway in our "backyard"
23% ☐ I already knew most of what was presented tonight
3% each ☐ Other _1) How little public interest there seems to be; 2) septic issues, 3) more publication of information to general public; 4) everybody knows the problems_____

3. Once a "road map" of projects is outlined in the Clean Water Legacy Plan, would you be willing to get involved in local efforts to restore/protect our water resources?

74% ☐ Yes 0% ☐ No 26% ☐ Would depend on the project

4. Once you become aware of things you can do to improve water quality, how likely are you to make those behavioral changes? An example is switching to no-phosphate lawn fertilizer.

97% ☐ Very likely 0% ☐ Not likely 3% ☐ I don't know

We had 38 meeting attendees and 31 surveys completed.

Thank you for attending and for sharing your comments with us!

Lakeshore Environmental, Inc.
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Introduction of the Clean Water Legacy Plan Project
Public Meeting
Thursday, November 14, 2007

Survey results

1. In order to better understand your concerns related to water quality, please tell us how you would prioritize the following water uses for our area. (1=highest)

__1__ Drinking water
__2__ Swimming
__5__ Boating
__4__ Fishing
__3__ Viewing water, waterfowl, and/or wildlife
Others _Kayaking; habitat; water levels; water distribution & sell off

2. Based on the presentation and handouts shared tonight, please check (√) which items were new information for you?

48% ☐ The number of pollution issues impacting our local water bodies
76% ☐ The amount of research and projects completed in the Lower Grand River Watershed
76% ☐ The amount of research and projects currently underway in our "backyard"
20% ☐ I already knew most of what was presented tonight
4% each ☐ Other _1) the program itself; 2) that there are toxic algae that can harm us_____

3. Once a "road map" of projects is outlined in the Clean Water Legacy Plan, would you be willing to get involved in local efforts to restore/protect our water resources?

80% ☐ Yes 0% ☐ No 24% ☐ Would depend on the project

4. Once you become aware of things you can do to improve water quality, how likely are you to make those behavioral changes? An example is switching to no-phosphate lawn fertilizer.

88% ☐ Very likely 0% ☐ Not likely 12% ☐ I don't know

We had 30 meeting attendees and 25 surveys completed.

Thank you for attending and for sharing your comments with us!

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Introduction of the Clean Water Legacy Plan Project
Earth Day Community Picnic
Saturday, April 19, 2008

Survey results

1. In order to better understand your concerns related to water quality, please tell us how you would prioritize the following water uses for our area. (1=highest)

__1__ Drinking water
__2__ Swimming
__5__ Boating
__3__ Fishing
__4__ Viewing water, waterfowl, and/or wildlife
Others _Bathing

We had ~200 event attendees and 61 surveys completed.