Lake Charlevoix Watershed Project

Preserving Water Quality for Today and Tomorrow

Nonpoint Source Pollution Inventory and Watershed Management Plan

September 2001

Partner List

Antrim Conservation District
Antrim County
Antrim County Road Commission
Charlevoix Conservation District
Charlevoix County Board of Commissioners
Charlevoix County Planning Commission
Charlevoix County Road Commission
Charlevoix Land Conservancy
City of Boyne City
City of Charlevoix
City of East Jordan
Conservation Resource Alliance
Friends of Stover Creek
Friends of the Boyne River
Friends of the Jordan River Watershed
Grand Traverse Band of Ottawa and Chippewa Indians
Grand Traverse Regional Land Conservancy
Keep Charlevoix Beautiful
Lake Charlevoix Association
Little Traverse Bands of Odawa Indians
Little Traverse Conservancy
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
MSU Extension
Natural Resources Conservation Service
Northwest Michigan Community Health Agency
Northwest Michigan Council of Governments
Tip of the Mitt Watershed Council
Water and Air Team Charlevoix, Inc. (WATCH)

Acknowledgments:

It is the beauty and power of Lake Charlevoix and its tributaries (Jordan, Boyne, Horton, Deer, etc.) that are responsible for this document. The desire to protect and potentially improve the water quality of these resources was the motivator for this endeavor.

All of the project partners must also be thanked for their ability to divide the tasks according to skills and experience and work together to complete a watershed management plan. We are particularly thankful for the following assistance: Doug Fuller, T. Jones, and Heidi Volkhardt, Tip of the Mitt Watershed Council; Chris Anderson, Charlevoix Conservation District; John Hummer a
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We would also like to thank MDEQ Surface Water Quality staff, John Kraft and Nancy Brunette, for their patience and assistance with project management.

We are hopeful that this document will serve as a dynamic framework that all community members can use to determine appropriate steps and actions to protect the water resources in the Lake Charlevoix Watershed.

Sincerely,

Kelly Martin
Charlevoix Conservation District

Ann Baughman
Tip of the Mitt Watershed Council

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Chapter One: Getting to Know the Lake Charlevoix Watershed

1. Introduction

Lake Charlevoix is one of Michigan's premier inland lakes. With a surface area over 17,200 acres, it is the third largest lake in Michigan. The beauty of Lake Charlevoix has attracted visitors for more than a century with its clean water, scenic shoreline, and superb fishing. Lake Charlevoix's tributaries are also a draw with their good water quality and trout fishing opportunities. The largest tributary, the Jordan River, is a state-designated natural river.

In spite of all their grandeur, these valuable water resources have not always been appreciated. Impacts to Lake Charlevoix's water quality date back to the late 1800s when lumbering occurred throughout the watershed and associated industries were built along the shores of the lake in Boyne City, East Jordan, and Charlevoix. Lake Charlevoix was primarily seen as a resource to use for water supply, navigation, and waste disposal. Lake Charlevoix's tributaries experienced a similar fate with damage from erosion and sedimentation from logging.

Although nearly 100 years have passed, water quality concerns still exist for Lake Charlevoix and its tributaries. The pollutants that threaten Lake Charlevoix's health today are not primarily from industrial sources such as tanneries and lumber companies, but nutrients and sediments from different human activities such as shoreline development, streambank erosion, and agricultural activities.

Inventories completed as part of the Lake Charlevoix Watershed Project have surveyed a variety of land use activities contributing nonpoint source pollution to the lake and its tributaries. Reducing the amount of nonpoint source pollution and preventing future contributions to Lake Charlevoix is essential to protecting the many high quality uses this resource provides including swimming, boating, and fishing. The proposed implementation activities for the Lake Charlevoix Watershed Project will work towards this goal.

A. Geographic Description

The Lake Charlevoix Watershed is one of Northern Michigan's larger watersheds covering approximately 335 square miles or 214,400 acres in Charlevoix, Antrim, Emmet, and Otsego Counties. The majority of Charlevoix County's townships are in the watershed including: Bay, Boyne Valley, Charlevoix, Eveline, Evangeline, Hayes, Hudson, Marion, Melrose, South Arm, and Wilson. Antrim County townships in the Watershed include: Chestonia, Echo, Jordan, Star, and Warner. A portion of Elmira Township in Otsego County and a part of Resort Township in Emmet County are also a part of the Watershed. The Lake Charlevoix Watershed includes the municipalities of Charlevoix, Boyne City, East Jordan, and Boyne Falls. The unincorporated villages of Alba, Bay Shore, and Elmira are also in the Watershed.

B. Previous Planning Efforts

The Charlevoix County Planning Commission formed the Lake Charlevoix Management Plan

Advisory Committee in December 1984 to develop a plan for managing the use, growth, and quality of Lake Charlevoix and its adjacent lands. Funding for the project was provided by Charlevoix County, the Michigan Department of Natural Resources Coastal Management program, and Water & Air Team Charlevoix, Inc.

The Committee had 15 members, consisting of a representative from each of the townships and cities around the Lake, the County Planning Commission, the Lake Charlevoix Association, development interests, and environmental interests. The Committee had three primary objectives:

1. Accumulate all relevant data on the Lake Charlevoix Watershed.
2. Generate additional data necessary for the planning process.
3. Make recommendations to appropriate governmental units on what a Lake Charlevoix Management Plan should contain.

The Committee's recommendations focused on suggestions for managing activities on the water and the shoreline. A summary of the recommendations follows.

Water-Related Recommendations:

- Preserve fish habitat by carefully regulating activities such as dredging and filling on the lake.
- Regulate utilization of the lake surface by addressing boat density, dock and slip construction, and car/trailer parking areas.
- Explore an effective system for transfer of development rights between properties.
- Create a Lake Charlevoix Watershed Commission to monitor and make recommendations in regards to activities in the watershed that directly impact wise use of the resource.

Shoreline-Related Recommendations:

- Establish a vertical setback for new structures of 587 feet (International Great Lakes Datum) for the base of the lowest floor.
- Establish a horizontal setback of 100 to 200 feet from the lake, depending on the density of the proposed development.
- Maintain a 50-foot greenbelt of undisturbed vegetation around the lake.
- Use soil type and other factors to determine the optimum locations and densities of future development.
- Restrict development on wetlands.
- Prohibit property splits that create parcels without upland areas suitable for development.
- Offer development alternatives for properties currently without upland areas suitable for development.
- Install sanitary sewer systems or extend lines to specific areas to address existing public health and water quality concerns.
- Establish a site plan review process to address aesthetic and environmental impacts on the lake.

- Provide technical assistance on meeting development requirements and create a clearinghouse within the county to expedite development applications and permits.

- Encourage vigorous administration of all policies, regulations, and programs on the local governmental levels and periodic review of the same.
- Encourage uniformity in zoning throughout Charlevoix County.

The plan differed from the current Lake Charlevoix Watershed Project in several ways. First and foremost it did not search for specific water quality problems and provide recommendations for correcting them. Instead, it focused solely on protecting water quality by regulating development. Second, it was not a watershed-based plan in that it only covered areas of Charlevoix County. Controversy arose over the plan, especially components dealing with regulating utilization of the lake surface. The plan was never adopted by the Charlevoix County Board of Commissioners.

2. Designated Uses and Water Quality Summary

The Water Resources Commission Act (P.A. 451 of 1994, Part 31, Chapter 1) requires all waters of the State of Michigan to be of the quality to meet seven designated uses: 1) agriculture; 2) navigation; 3) industrial water supply; 4) public water supply; 5) warm water fishery; 6) habitat for indigenous aquatic life and wildlife; and 7) partial or total body contact recreation. An eighth designated use, cold water fishery, is applicable for many rivers and lakes in Michigan.

Lake Charlevoix has excellent water quality and currently meets all eight of the designated uses. Active designated uses include agriculture, navigation, industrial water supply, warm water fishery, habitat for aquatic life, and total body contact recreation. Although Lake Charlevoix's water quality is good enough for public water supply it is not being used for this purpose. Lake Charlevoix's major tributaries–Boyne and Jordan Rivers, and Deer Creek meet all eight of the designated uses. The remaining tributaries (Horton, Stover, Porter, Loeb Creeks) meet seven of the designated uses, with the exception of navigation due to their small size.

A variety of activities and changing land uses in the Watershed threaten some of the designated uses (Table 1).

Table 1: Lake Charlevoix Watershed Threatened Uses	
	• Navigation (N)
	• Habitat for indigenous aquatic life and wildlife (H)
	• Partial or total body contact recreation (R)
	• Cold water fishery (C)

A. Watershed Concerns

In 1997 a meeting was held with local government officials, conservation groups, environmental organizations, regional planning agencies, health departments, and other stakeholders within the Lake Charlevoix Watershed to discuss concerns about water quality. The group identified many different issues and committed to working together in a partnership to develop a watershed management plan. The group also prioritized the main issues of

concern, which are summarized in Table 2. The Advisory Committee for the Watershed Project was an expansion of this original group.

Table 2: Priority Concerns and Threats to Designated Uses	N	H	R	C
Loss of forest lands and agricultural lands to development and increasing impervious surface		♦	♦	♦
Urban runoff directly discharging to lake and streams	♦	♦	♦	♦
Lakeshore and streambank erosion	♦	♦	♦	♦
Shoreline septic systems		♦	♦	♦
Impacts from lawns and golf courses		♦		♦
Erosion from recreational uses on Jordan River	♦	♦		♦
Impacts to fisheries from erosion and habitat destruction		♦		♦

Agricultural impacts–livestock in streams, manure application, pesticide use	♦	♦	♦	♦
Erosion and stream habitat destruction from logging activities	♦	♦		♦
Shoreline algae		♦	♦	♦
Erosion and runoff from road/stream crossings	♦	♦		♦

Navigation (N) ● Habitat for indigenous aquatic life and wildlife (H) ● Partial or total body contact recreation (R) ● Cold water fishery (C)

B. Known and Suspected Pollutants in the Lake Charlevoix Watershed

Sediment, nutrients, and toxins such as oils, grease, and heavy metals were identified as the main pollutants of concern that threaten the designated uses in the Lake Charlevoix Watershed. Below is a list of the known and suspected pollutants.

Table 3: Known and Suspected Pollutants

Impaired Use	***Pollutants****
Navigation	Sediment (k)
Aquatic life/wildlife	Sediment (k) Nutrients (s) Oils, grease, heavy metals, pesticides (s)
Partial and total body contact recreation	Nutrients (s) Bacteria (s)
Cold water fishery	Sediment (k) Nutrients (s) Oils, grease, heavy metals (s) Pesticides (s)

* k = known s = suspected

C. Sources of Pollutants in the Lake Charlevoix Watershed

With 335 square miles of land it is not surprising that there is a diversity of land uses in the Lake Charlevoix Watershed. Land uses range from large tracts of state forests to the resort communities (urban areas) of Charlevoix, Boyne City, and East Jordan. Diverse land uses equals a diverse amount of activities and many potential sources of nonpoint source pollution. The main sources of nonpoint source pollution for each primary pollutant of concern in the Lake Charlevoix Watershed are described in Table 4.

Table 4: Sources of Pollutants in the Lake Charlevoix Watershed

Pollutant	***Sources***
Sediment	Lakeshore and streambank erosion (k) Road/stream crossings (k) Livestock in streams (s) New construction (s) Logging activities (s)
Nutrients	Lawn care on shoreline properties (k) Septic systems (s) Livestock in streams (s) Road/stream crossings (k) Lakeshore and streambank erosion (k) Stormwater discharges in urban areas (k) Manure applications and management (s) Golf courses (s) New construction (s)
Oils, grease, and heavy metals	Stormwater discharges in urban areas (k) Road/stream crossings (k)
Pesticides	Lawn care on shoreline properties (s) Agricultural fields (s) Golf courses (s)
Bacteria	Septic systems (s) Stormwater discharges in urban areas (k) Livestock waste (s)

* k = known s = suspected

D. Causes for Each Pollutant Source in the Lake Charlevoix Watershed

Understanding the potential causes of the pollution is essential in developing goals and action strategies. Below (Table 5) is a list of the causes connected to each pollutant source.

Table 5: Pollutant Information Before the Inventory		
Pollutants	***Pollutant Source***	***Cause***
Nutrients (P and N) and Pesticides (k)	Agricultural fields (s)	Heavy use of pesticides and chemical fertilizers (s)
	Septic systems (s)	Outdated, poorly maintained, and improperly designed systems (s)
	Golf courses (s)	Heavy applications of fertilizers and pesticides (s) Lack of buffer strips in riparian areas (s)
	Manure applications and management (s)	Over application of manure (s), lack of proper storage for manure (s), inadequate testing of soil properties (s)
	Lawn care on shoreline properties (k)	Use of phosphorus fertilizer (s), over application of fertilizers (s), misuse and over use of pesticides (s), removal of native shoreline vegetation (k)
	Stormwater discharges in urban areas (k)	Inadequate treatment of stormwater that may contain oils, grease, heavy metals, pet waste, etc. (s)
Sediment (k)	Agricultural fields (s)	Inadequate soil erosion control (s)
	Lakeshore and streambank erosion (k)	Shoreline development and removal of shoreline vegetation (k), angler and canoeist access (k), road/stream crossings (k)
	Livestock in streams (s)	Unrestricted access and no alternative water source (s)
	Logging activities (s)	Inadequate buffer strips near streams (s)
	New construction (s)	Lack of proper erosion control and stormwater management measures (s)
	Road/stream crossings (k)	Undersized and short culverts (k), lack of runoff diversions (k), inadequate fill on road surface (k), lack of vegetation (k)
	Stormwater discharges in urban areas (k)	Sand used in winter for traffic safety, construction, and general runoff (s)
E. coli bacteria (k)	Septic systems (s)	Outdated, poorly maintained, and improperly designed systems (s)
	Stormwater discharges in urban areas (k)	Pet waste, wildlife (k)
	Livestock in streams (s)	Unrestricted access and no alternative water source (s)
Oils, grease, and heavy metals (k)	Stormwater discharges in urban areas (k)	Inadequate treatment of stormwater that may contain oils, grease, heavy metals (s)

* k = known s = suspected

E. Watershed Goals

The mission of the Lake Charlevoix Watershed Protection Project is to protect and enhance the water quality of Lake Charlevoix and its tributaries by reducing current and future polluted runoff. Project goals for addressing each designated use follow in Table 6.

Table 6: Watershed Goals to Address Threatened Uses	
Navigation	Maintain navigation in the rivers and lake by reducing any sediment inputs.
Aquatic life/wildlife	Protect the diversity of aquatic habitats within the Lake Charlevoix Watershed by reducing the contribution of sediment, nutrient, and toxic pollutants.
Partial or total body contact	Maintain the excellent recreational opportunities in the rivers and lake by reducing sediment and nutrient contributions.
Cold water fishery	Reduce sediment and nutrient loads which threaten to harm habitat conditions for the cold water fishery in Lake Charlevoix and its tributaries.

F. Water Quality Summary

The Lake Charlevoix Watershed has four designated uses that are threatened: 1) navigation; 2) aquatic life/wildlife; 3) partial or total body contact; and 4) cold water fishery.

Project Goals: The mission of the Lake Charlevoix Watershed Protection Project is to protect and enhance the water quality of Lake Charlevoix and its tributaries by reducing current and future polluted runoff. Specific goals related to the designated uses are as follows:

1) Maintain navigation in the rivers and lake by reducing any sediment inputs.

2) Protect the diversity of aquatic habitats within the Lake Charlevoix Watershed by reducing the contribution of sediment, nutrient, and toxic pollutants.

3) Maintain the excellent recreational opportunities in the rivers and lake by reducing sediment and nutrient contributions.

4) Reduce sediment and nutrient loads which threaten to harm habitat conditions for the cold water fishery in Lake Charlevoix and its tributaries.

Navigation

Navigation is threatened in the Jordan River, Boyne River, and locations in Lake Charlevoix from increasing sediment. Lakeshore and streambank erosion along with road/stream crossings are known sources of sediment pollution. Suspected sources of sediment include agricultural practices including livestock in streams, new construction, and logging activities.

Lakeshore and streambank erosion is often a result of the removal of shoreline vegetation. Angler and canoeing access points are another source of erosion on the Jordan River. Improperly sized culverts and lack of runoff diversions are the main reason for erosion and sedimentation associated with road/stream crossings.

Livestock access to streams for a watering source can destroy the bank and cause erosion and sedimentation. New construction in the shoreline area can also contribute sediment, particularly if inadequate erosion controls are used. Not maintaining buffer strips during logging is also suspected of contributing to erosion and sedimentation.

Habitat Protection for Aquatic Life/Wildlife

Aquatic habitat is threatened throughout the Watershed from sediment, nutrients, and toxic

chemicals, such as oils, grease, heavy metals, and pesticides. Sediment impacts aquatic habitat by covering spawning areas, which makes feeding difficult and clogs gills. Nutrients harm wildlife by encouraging excessive aquatic plant growth that can deplete oxygen supplies when it decomposes. Toxic chemicals harm aquatic life by weakening immune systems and making organisms more susceptible to disease. They can also harm reproduction and if concentrations of the toxic materials are high enough they can kill aquatic life.

Sources of sediment pollution are the same as mentioned above under threats to navigation. Known sources of nutrient pollution include lakeshore and streambank erosion, road crossings, and lawn care on residential properties. Suspected sources of nutrient pollution include septic systems, agricultural practices, stormwater discharges in urban areas, manure application and management, golf courses, and new construction. Oils, grease, and heavy metals are known to be contributed from stormwater discharges in urban areas and road/stream crossings. Pesticides may be contributed from agricultural fields and lawns.

Nutrients often attach to sediment particles. When erosion from lakeshores, streambanks, and road/stream crossings occurs it contributes not only sediment pollution but also nutrient pollution. Residential properties, agricultural activities, and golf courses are suspected sources of fertilizers which can contribute nutrients that encourage nuisance plant and algae growth. When septic systems in shoreline areas malfunction nutrients such as nitrogen and phosphorus can migrate to the lake.

Recreation (Partial and Total Body Contact)
Nutrient pollution can stimulate nuisance levels of aquatic plant and algae growth which disrupt recreational activities and make swimming and boating undesirable. In addition, high bacteria counts can make it unsafe for swimming. Although none of these scenarios currently exist for Lake Charlevoix and its tributaries, preventative measures are important to maintain the diversity and quality of recreational opportunities in this Watershed.

Sources and causes of nutrients have been described previously. Suspected sources of bacteria include stormwater discharges in urban areas, manure application and storage, and livestock access to streams. Stormwater discharge in urban areas can collect and deposit pet and wildlife waste into Lake Charlevoix. Excessive application of manure, runoff from manure piles, or livestock access to streams can all be causes of bacteria pollution from agricultural sites.

Cold Water Fishery
Lake Charlevoix is fortunate to be able to support both a warm and cold water fishery. The majority of the rivers and streams in the Watershed also support a cold water fishery. Sediment, nutrient, and toxic pollution (oils, grease, heavy metal, and pesticides) can all be harmful to a cold water fishery.

In the lake, nutrients are potentially the most harmful. Excessive aquatic plant growth as a result of nutrient pollution can decrease the oxygen available in the bottom of the lake (hypolimnion) during the summer months.

In rivers, sediment may be the most harmful pollutant to the cold water fishery. As mentioned

previously it destroys habitat and can impact the health of fish.

Chapter Two: Defining the Priority Area

The priority area is that portion of the Watershed which is most sensitive to environmental impacts, and which has the greatest likelihood to affect water quality and aquatic habitat. United States Geologic Survey Division (USGS) topographic maps were used as a base for delineating the priority area. Supplemental information was used to identify sensitive areas. Other sources used included, USDA Soil Surveys, Groundwater Education in Michigan (GEM) ground water studies, the Farrand map of surficial geology, and a Tip of the Mitt Watershed Council survey of shoreline wetlands.

The priority area for Lake Charlevoix includes the following areas:

1. Areas within 1,000 feet of the following features
    A. Lake Charlevoix.
    B. Other inland lakes in the watershed.
    C. Tributary streams (including intermittent drainages).
    D. Contiguous wetlands. For the Lake Charlevoix Watershed, a contiguous wetland is defined as those within 1,000 feet of Lake Charlevoix, or within 500 feet of streams or other lakes within the watershed.
    E. Urban areas which drain to surface waters, typically via storm sewers.

2. Areas of steep slopes contiguous with any priority perimeter described above. Regarding water resources, the definition of a steep slope seems to range widely in the literature (from 8-25%). For this priority area determination, a 10% slope (or 1:10 ratio, or 6 degrees) or greater is recommended.

3. Areas of ground water recharge.

The nonpoint source pollution inventories focused on the priority areas.

Priority Area Map

Chapter Three: Review of Nonpoint Source Pollution Inventories

The inventories conducted to document nonpoint source pollution included field data collecting inventories to identify current sources and causes of pollution as well as potential sources. Below are summaries of the inventories conducted and their results.

1. Stormwater Inventory

Stormwater, also called urban runoff, is that water which flows across the land surface during rainfall or snowmelt. Impervious surfaces (streets, roofs, sidewalks, etc.) generate much more stormwater runoff than natural forested, or even agricultural, land uses.

Lake Charlevoix has three relatively large urban areas on its shorelines--East Jordan, Boyne City, and Charlevoix. A portion of all these cities have paved streets with curbs, gutters, and subsurface drainage pipes called storm sewers. The main purpose of these storm sewers (some of which were installed many decades ago) is to prevent flooding and water damage. Unfortunately, substances (such as bacteria from pet and animal wastes, fertilizer, oil and grease, sediment, heavy metals, salt, etc.) which find their way onto the streets and sidewalks are likely to be washed into Lake Charlevoix or tributary streams by rainfall or snowmelt. A multitude of studies from around the nation and world have documented that urban stormwater is a serious source of pollution.

As part of the Lake Charlevoix Watershed Project, Watershed Council staff conducted an inventory and assessment of the storm sewer systems for each of the three cities. This consisted of identifying the land uses (e.g., commercial, residential) within the city boundaries, reviewing maps of storm sewers provided by each city, delineating different drainage areas, identifying locations of stormwater inlets and outlets, and estimating pollutant loading using models developed during nationwide studies. No water sampling and testing was conducted. However, water quality studies by the Watershed Council have documented that the pollution and water quality impacts of storm sewer effluent from other Northern Michigan communities is similar to the predictive model. Table 7 summarizes the stormwater characteristics of each municipality.

Table 7: Storm Sewer Summary			
	Boyne City	***Charlevoix***	***East Jordan***
Total area of city	2,377 acres	1,280 acres	1,714 acres
Total area draining into city	4,833 acres	1,666 acres	3,425 acres
Percent of Watershed	2.25%	0.78%	1.6%
Land use in cities:			
Percent undeveloped	29.6%	29.8%	55.5%
Percent commercial/industrial	12.5%	16.4%	11.8%

Percent residential	36.2%	48.4%	29.8%
Percent water	1.7%	5.4%	2.9%
Percent impervious area	24.0%	31.0%	22.0%
Area of city draining to lake or river via storm sewers	936 acres	490 acres	360 acres
Percent of city draining to lake or river via storm sewers	39%	39%	21%
Estimated pollution contributions from storm sewers Phosphorus Sediment	 714 lbs. 201,685 lbs.	 435 lbs. 122,976 lbs.	 253 lbs. 71,591 lbs.

The results indicate that the storm sewers are contributing a significant amount of pollution to Lake Charlevoix. All of the municipalities have expressed interest in participating in efforts to reduce impacts.

2. Shoreline Pollution Inventory

A shoreline survey to identify locations of nutrient pollution (using an algae called Cladophora as an indicator), bottom sediment type, and shoreline development characteristics was performed by the Tip of the Mitt Watershed Council during summer, 2000.

Cladophora is a branched, filamentous, green algae that occurs naturally in small amounts in Northern Michigan lakes, mostly on rocky shorelines. The nutrient requirements for Cladophora to achieve large, dense growths are greater than the nutrient availability in lakes with high water quality, such as Lake Charlevoix. Therefore, the presence of Cladophora can indicate locations where relatively high concentrations of nutrients, particularly phosphorus, are entering a lake. Sources of these nutrients can be due to natural conditions, however, the majority of Cladophora growths can be traced to cultural sources (such as lawn fertilization, malfunctioning septic systems, poor agricultural practices, soil erosion, and wetland destruction). These nutrients can contribute to an overall decline in lake water quality. Additionally, malfunctioning septic systems pose a potential health risk due to bacterial and viral contamination.

This was the fourth shoreline algal survey performed on Lake Charlevoix since 1980. Periodic repetition of shoreline algal surveys are important for identifying chronic problem sites as well as recent occurrences. They are also valuable for determining long-term trends of nearshore nutrient inputs associated with land use changes, and for assessing the success of remedial actions.

Approximately 1,653 property parcels were identified. The number is approximate because exact property boundaries and recent lot splits were not always evident. Of these, approximately 1,338 were developed (81%). This represents an increase of 93, and compares to an approximate development rate of 77% in 1996 (the date of the last survey).

In 2000, 133 significant Cladophora growths were identified. Most of the Cladophora growths were in the light category (56%), 38% were more-or-less medium, and only 6% were classified as heavy growths. There were 24% fewer growths of Cladophora than in 1996 (when 175 Cladophora growths were noted), and the growths were lighter in nature. It is possible that the lower number is due to the extremely low water in recent years. (Lake Charlevoix's water level is controlled by the level of Lake Michigan through the Pine River Channel.) In addition, most of the survey was conducted at a later date than was ideal, so some of the Cladophora growths may have been diminished by warm water.

Sandy bottom substrate (generally unsuitable for Cladophora growths) was present in front of 52% of the parcels. However, many lots in areas of sandy bottoms had rock rip-rap placed for erosion control, which allows for the growth of Cladophora if the water is high enough. The remainder of the shoreline was predominantly rocky (27%), or a mixture of rock and sand (20%). Mucky or mucky-sand bottom types were only present on about 1% of parcels.

Table 8: Lake Charlevoix Cladophora Survey Summary		
	1996	***2000***
Shoreline Property Parcels	1,625	1,653
Developed Properties	1,245	1,338 (increase of 93 or 7%)

Cladophora Growths	175	133 (24% decrease)

3. Lakeshore Erosion Inventory

Lakeshores and streambanks are areas of dynamic energy. The powerful forces of waves, currents, and ice move soil particles toward, away from, and along the shoreline.

Streams are continually down cutting into their valley, carrying sediments downstream particle by particle. The current moves from side to side, undercutting banks and causing the stream channel to meander.

The ice of frozen lakes can expand shoreward with a force of many tons per square foot, moving most obstacles in its path (including shoreline soil). Masses of ice put in motion by winds or currents can scour the banks of lakes and streams.

In a lake, the strength of erosive forces depends on its size, the size and direction of waves and currents, ice characteristics, water depth near shore, and the shape and composition of the shoreline.

Erosion and the transport and deposition of sediments is a natural process along shorelines. Typically, natural erosional processes proceed very slowly, and the plants and animals that live along the shoreline can adjust to these slow changes, maintaining a stable, healthy, productive ecosystem. When some catastrophic natural or human disturbance causes this equilibrium to be upset, accelerated erosion can result. Examples of natural disturbances include large trees uprooted by a windstorm, or a flood resulting from a torrential rainstorm. Human disturbances include vegetation removal, dredging or filing, or construction on or near the shoreline.

Erosion and its resulting sediment pollution has many negative impacts. In an aquatic environment, sediment pollution: degrades aquatic and nearshore land habitats, killing aquatic organisms and negatively impacting birds and animals which depend on aquatic habitats; causes warming (which is most serious in cold water trout streams); reduces water clarity and light penetration; and changes bottom substrate which reduces channel capacities that can increase flooding.

Surveys were conducted on lakeshore and streambanks (discussed below) to assess sediment pollution from erosion. The entire shoreline of Lake Charlevoix was surveyed for erosion problems by the Lake Charlevoix Association. Many parcels appeared to have had some actions in the past to control shoreline erosion. Approximately 20% of parcels surveyed had some erosion-related concerns, typically either steep eroding banks, ineffective past erosion control strategies, or creation of artificial beaches. Eight severe sites were identified in Eveline Township, Sections 16, 17, 19, 21, 28, 29, 32, 33. Nine moderate sites were identified in Eveline, Evangeline, and South Arm townships. Many other minor sites were also documented.

4. Streambank Erosion Inventory

Lake Charlevoix's two largest tributaries, the Jordan and Boyne Rivers, are good quality trout streams. They both have been impacted by streambank erosion. Numerous streambank erosion inventories and restoration work have been done on the Jordan River, coordinated by the Antrim Conservation District and the Friends of the Jordan River. However, very little attention has been given to the Boyne River. Conservation Resource Alliance and the Friends of the Boyne River conducted a streambank erosion inventory.

Data was collected on each streambank erosion site on its size, cause, and severity. Four priority sites were identified on the Boyne River.

5. Road/Stream Crossing Inventory

The Road/Stream Crossing Inventory was coordinated by the Conservation Resource Alliance. The Conservation Resource Alliance with support from the Frey Foundation for their River Care program conducted the inventory for the Boyne River subwatershed.They also provided training and coordinated the inventory for the remaining subwatersheds. The Charlevoix Conservation District entered all of the data into an Access database and compiled the final report.

The purpose of the inventory was to comprehensively identify and document all of the road/stream crossing sites on the tributaries in the Lake Charlevoix Watershed.

Potential road/stream crossings were identified using a variety of map sources and field exploration. Each crossing that appeared to have regular flow connected to Lake Charlevoix was inventoried. With the exception of private drives, all vehicle access roads were included. All potential sites were investigated. In some instances, no crossing was present, or there appeared to be no significant flow (and therefore no significant pollutant contribution) during any time of the year. These locations were not identified as numbered crossings and do not appear in the inventory.

Each site was visited to assess potential impacts and problems. Data collected at the crossings included detailed information about the location, road characteristics (width, shoulder, drainage, surface); culvert condition; and erosion and runoff problems. Basic stream characteristics such as width, depth, current, and substrate were also recorded. Field data was collected by both resource professionals and trained volunteers.

In order to help prioritize road/stream crossings for improvement, a severity ranking index was used. The severity ranking system used is identical to that used on a number of previous road/stream inventories completed by Conservation Resource Alliance and other agencies throughout Michigan. Three classifications are used in the severity ranking, severe (30 points or more); moderate (15-29 points); and minor (under 15 points).

The inventory information is organized by subwatershed (Jordan River, Boyne River, Horton Creek, and remaining Lake Charlevoix sites). Volume 1 contains maps showing key information for each crossing. Volume 2 contains the field data forms with site sketches, site severity scoring worksheets, and the cost estimating worksheets used to record all inventory information.

A total of 212 sites were inventoried. Nineteen classified as severe, 140 as moderate, and 53 as minor. Table 9 below summarizes the crossings by each subwatershed.

Table 9: Severity Ranking of Road/Stream Crossings			
Subwatershed	***Severe***	***Moderate***	***Minor***
Boyne River	10	22	15
Horton Creek	0	2	1
Jordan River	6	73	19
Lake Charlevoix (shoreline area, smaller tributaries)	3	43	18

6. Agricultural Inventory

Nonpoint source pollution problems from agricultural areas have been well documented. Agricultural activities in Charlevoix and Antrim Counties are predominantly small farms and are quite diverse. Agricultural land use has been declining in both counties due to a number of social and economic factors. Family farms are not being continued by the younger generation. Many farms are being sold for development as the demand for scenic lands for home sites increases. For the Lake Charlevoix Watershed Project the location and any associated nonpoint source pollution problems were documented for agricultural producers in the Watershed.

The Charlevoix Conservation District conducted an inventory of the agricultural activities within the Lake Charlevoix Watershed. A data sheet was completed for each site that described location and type of farm, distance to nearest tributary, and any obvious nonpoint source pollution problems. Aerial photos, plat maps, topographic maps, along with field checking were used to identify area farms. A ranking of nonpoint source pollution problems of severe, moderate, and minor was given to each site. A total of 41 farms were inventoried (3 severe, 15 moderate, and 23 minor).

The most common problems identified at the farm sites were livestock in streams and lack of animal waste storage areas. The herd sizes at the farms were very low. Many of the farms were identified as “hobby” farms. Interestingly, there were quite a few that appeared to have horses only and were labeled as “hobby horse farms.”

The three severe sites (Site A, B, and C) are all in Charlevoix County and are in need of the following best management practices to reduce nonpoint source pollution:

Site A: Streambank restoration (erosion from livestock), livestock exclusion fencing and cattle crossing, watering sources, animal waste management, and pasture/grazing management.
Site B: Exclusion fencing, alternate water source, and buffer strips.
Site C: Animal waste facility and pasture management including filter strips to reduce runoff.

7. Recreational Impact Assessment

Recreational impacts were assessed on both the Jordan River and Lake Charlevoix. The Jordan River is well-known throughout Michigan as an excellent trout stream and a great canoeing river. The Jordan River Pathway, which crosses the Jordan and follows its banks in many locations, is a popular hiking spot. The expansive waters of Lake Charlevoix are popular for all types of boating by both shoreline residents as well as by transient visitors utilizing the many public access sites. These activities are important for fostering an appreciation of natural resources and supporting the local economy that depends on nature-based tourism. However, recreational activities can be a source of nonpoint source pollution. An inventory to assess the impacts of canoeing and canoe access sites, fishing and angler access sites, hiking on the Jordan River Pathway (by Friends of the Jordan); and boating on Lake Charlevoix (by the Lake Charlevoix Association) was conducted.

Canoeing

The majority of canoes (or other vessels like kayaks or tubes) using the Jordan River are rentals from two local liveries. Numbers of annual rentals were unavailable, but hundreds of canoes float the river on some days. The primary launch site is Graves Crossing. Canoe navigation upstream of this point is difficult. A terraced, gravel launching platform was constructed at this location relatively recently, and has functioned well to protect the streambank. Other popular put-in/take-out spots include the Old State Road crossing, a Michigan Department of Natural Resources (MDNR) public access site just downstream from Websters Bridge, an MDNR access site at the lamprey weir, and an MDNR access site at Rogers Bridge. All of these sites have some problems related to canoe access (or other types of recreational activity).

At Old State Road, a large double culvert unofficially known as “the tubes” creates some standing waves. Canoeists will occasionally take-out just downstream of the tubes and then portage to above the road to float through them again. This is also a popular mid-way stopping point, and the stream banks on the east side of the river downstream of the road are heavily trampled (including on adjacent private property). There is also quite a bit of litter at the site.

Access structures of different types have been constructed at the Websters, Weir, and Rogers Bridge sites. However, due to heavy use, some bank trampling and erosion are still occurring. In addition, surface runoff from the parking areas causes erosion and sedimentation of the river (although recent paving at Websters has reduced the impact somewhat).

In addition to these “official” access sites, there are three sites between roads which are popular take outs for picnicking, bathroom breaks, etc. Two of these are wetlands, and the heavy use is causing severe bank trampling, erosion of organic soils, and widening of the stream channel. A third is a utility pipeline crossing, where steep sandy banks are eroding.

Fishing

In addition to the sites described above, fishing access to the upper part of the river is mostly gained via a series of popular “pull-over” spots off of the system of unpaved roads throughout the Jordan River Valley. Eighteen access sites, including the Michigan Department of Natural

Resources access sites were inventoried and assessed. Some of these sites are linked to short trails to access the river and had campfire circles with accumulations of trash and litter. Streambank erosion was associated with heavily used sites. Since most of the sites are not official access locations, maintenance is not being managed by any government or organization.

Hiking

The Jordan River Pathway crosses the Jordan River and travels through many wetland areas. After many years of use, the cumulative impact of thousands of hikers has led to resource degradation in sensitive areas of the Pathway. Some of these spots are in need of re-routing or some type of repair.

The section of the Pathway most impacting the water resources of the Jordan Valley is along a heavily used portion of the trail which traverses the area below Deadman's Hill. There are several places there where the Pathway crosses spring-fed seeps or feeder streams in wet, mucky areas that are eroding or washing out.

Another location of the Pathway that is routed through wetlands is near the bank of the main stream near the Jordan River Fish Hatchery. There are a few places in that section that are eroding and feeling the impact of Pathway users. In addition, there are a few other minor repairs needed along the trail to reduce erosion and runoff to the Jordan River.

Lake Charlevoix Boat Counts

The Lake Charlevoix Association tabulated the number of boats on Lake Charlevoix and Round Lake in July of 1998 and 1999. Boats were counted early in the morning before there was any significant traffic. Boats and empty trailers were also counted at public access sites. Most of the boats there were power boats and personal water craft–very few sail or paddle boats were seen at public access sites. Boating is known to cause water quality problems in several ways. Discharges from engines contain toxic hydrocarbons, nutrients, and other pollutants. Prop wash from powerful engines can resuspend bottom sediments (especially in shallow areas with soft bottom sediments) causing turbidity and releasing nutrients and toxins. Large wakes can cause accelerated shoreline erosion, especially in the South Arm or protected coves or bays. Boat launching is a vector for exotic organisms. Access sites often have shoreline erosion, litter, and polluted surface runoff.

Table 10: Lake Charlevoix Boat Counts

Type of boats	***7-18-98***	***7-17-99***

Table 10: Lake Charlevoix Boat Counts		
oar/paddle	646	655
sail (all sizes)	692	693
power (<26 feet)	1,824	1,851
power (>26 feet)	454	544
personal water craft	554	592
access sites (power and PWC)	207	148

8. Land Protection
Because Lake Charlevoix is a high quality resource it is essential to work towards reducing future sources of pollution as well as addressing known sources. Protecting valuable shoreline wetlands and maintaining the ecological integrity of the uplands and wetlands in the priority area are particularly important.

There are three land trusts that work in the Lake Charlevoix Watershed: Little Traverse Conservancy, Grand Traverse Regional Land Conservancy, and Charlevoix County Land Conservancy. Working together they identified parcels of land which, if protected, would help to maintain and/or improve the water quality of lakes and rivers in the Lake Charlevoix Watershed.

The criteria used to identify key parcels included:
- Size–over 40 acres in area
- Lands adjacent to protected land such as state land or existing preserves
- Lands containing high value wetlands as inventoried by the Tip of the Mitt Watershed Council
- Land containing at least 1/4 mile of lake, river, or stream frontage

Maps were produced that identify parcels that meet these criteria. Properties that had three or four of the criteria were classified as priority. Secondary properties included those that were 40 acres or greater and met one other criteria. The maps are to be used as a planning document only. A total of 593 properties were identified as important for watershed management (436 Charlevoix County, 157 Antrim County). A database with information on ownership of the parcels has been developed. The database will be used to contact property owners and inform them about voluntary stewardship efforts for land protection and watershed management.

9. Forestry Inventory
Forestlands make up the majority of the Lake Charlevoix Watershed. Unlike other large watersheds in Northern Michigan (e.g., Black and Mullett Lakes) that contain a significant amount of state land, the forestlands in the Lake Charlevoix Watershed are predominantly privately owned. The Charlevoix Conservation District conducted an assessment of private forestlands in the Watershed. The assessment included site visits with property owners and road-side review.

District staff met with 19 property owners to discuss their forest management plans. These on-site assessments looked at more than 750 acres of private forestlands. A drive-by road survey was also conducted throughout the entire watershed. State forest management activities were not inventoried. No adverse impacts from past logging activities were identified in this phase of the assessment. However the potential for impacts is significant and the recommendations address how to prevent future problems.

Table 11: Summary of Forestlands in Charlevoix County			
Township	Total Private Forestland Soils	Acres Fractionalized 1967-2000	2000 Forestland Soils Remaining
Bay	6,692	1,972	4,720
Boyne Valley	12,987	6,999	5,988
Chandler	4,216	826	3,390
Charlevoix	1,159	1,159	-0-
Evangeline	5,695	1,624	4,061
Eveline	6,170	2,914	3,256
Hayes	9,645	4,762	4,883
Hudson	17,250	3,433	13,817
Marion	5,212	2,104	3,108
Melrose	9,162	3,069	6,093
South Arm	9,886	3,496	6,390
Wilson	15,670	4,323	11,347
Totals	103,744	36,681	67,053

10. Zoning Assessment

The primary tool used to regulate land use in the Lake Charlevoix Watershed is zoning. Township zoning ordinances within the Watershed were reviewed for standards that benefit or harm water quality.

Each township within Charlevoix County contains a zoning ordinance, as do the three cities. The Village of Boyne Falls is the only community within Charlevoix County that does not currently have a zoning ordinance in effect. None of the Antrim County townships that are within the Lake Charlevoix Watershed have zoning ordinances. Resort Township in Emmet County and Elmira Township in Otsego County are both covered by county ordinances. The portion of the Jordan River and its tributaries that are south of Rogers Road in Charlevoix County and into Antrim County are all subject to the Jordan River Natural River Zoning Ordinance. The ordinance, while only covering the land directly adjacent to the rivers and streams, does provide some degree of protection which otherwise does not exist in Antrim County.

The review of each ordinance focused upon the following concerns:

- Setbacks of structures from the water's edge (including septic tanks and tile fields)
- Greenbelts and shoreline protection measures
- Greenbelt restoration requirements
- Maximum lot area coverage
- Open space provisions
- Regulations for flood plains, wetlands, and erosion-prone areas
- Property redevelopment regulations for non-conforming uses and buildings •

Sealed floor drains for commercial and industrial properties

- Funneling regulations
- Deck and dock regulations

The review of the ordinances found that most communities do not address all of the issues detailed above. Those that did could use additional information backing up their regulations. The need exists for the development of sound and uniform language that can be included in each zoning ordinance within the Watershed that will be effective in insuring that detrimental land uses and the inappropriate development of property are neither allowed nor encouraged by our zoning ordinances. Consistency of language and enforcement of good zoning ordinances across the watershed is also essential.

11. Build-Out Analysis

One of the questions that was asked as part of this watershed study was–what does the future hold regarding future development in the Watershed? An effective method for answering this question is to do an in-depth build-out analysis and map. A build-out analysis projects what an area will look like if it were completely built-out according to local land use regulations.

To produce a realistic build-out map a number of factors have to be taken into account. These include past and present development trends, projected population changes, natural features and a community's land use regulations. With this information it is possible to produce a realistic picture of the future if present trends continue.

Unfortunately developing such a map for the complete Watershed was impractical given the size of the Lake Charlevoix Watershed and the number of municipalities within in its boundaries. Therefore it was decided to develop a map of one municipality, which would be most typical of the Watershed–Wilson Township. Wilson Township, located in Charlevoix County, is 35 square miles in area. Wilson Township contains portions of Lake Charlevoix and Porter Creek. The rate of growth and nature of land use regulations are representative of most townships in the watershed.

A computer-based geographic information system (GIS) was used to develop the build-out map. The first step involved identifying areas not well suited for development. Using data from the *Soil Survey of Charlevoix County,* all hydric (wetland) soils and areas with slopes greater than 25% were identified. The next step was to outline areas already developed. This was completed using 1983 MIRIS data updated with recent aerial photography. The last step was mapping out the property ownership using data from the Charlevoix County Equalization Department. In this step, public lands were also delineated.

A map showing existing conditions was made using the base data described along with information on prime farmland and timberland soils. The build-out map illustrates how this area would likely appear if completely developed per the provisions of the Wilson Township zoning and private road ordinances.

According to the 2000 census, Wilson Township currently has 2,022 residents, up 32% from 1990. There are 852 housing units within the Township, a 35% increase from 1990. According to the build-out map, if the Township were completely developed there would be an additional 2,764 housing units in the township. Using the current average household size

of 2.65 persons the population would increase to 9,346 residents. At current rates of growth the Township would be completely built out within 45 years.

What will be the impact of this pattern of development on water resources in Wilson Township? Some of the areas most destined for development are the shoreline areas and river corridors. More roads, new road/stream crossings, and increases in impervious surface will contribute additional runoff to Lake Charlevoix and its tributaries.

(Build-out map)

(build-out map)

12. Land Use/Cover Type Inventory

The landscape of the Lake Charlevoix Watershed has changed many times. At one point, the entire Watershed consisted of forest lands. At the turn of the century, much of the forests were clear cut to provide for the export of lumber. Many acres of harvested land were converted to agricultural use. Over the years the amount of land that could be farmed in an economically profitable manner declined. This acreage declined due to any number of the following reasons:• eroding of the top soil;

- farming practices which depleted the soils of necessary nutrients;
- elevating transportation costs; and
- decreasing value of agricultural products.

The Geographic Information Center at Central Michigan University was contracted to develop a current land use/cover type inventory for the Watershed based upon digital ortho-photos taken during 1997 by Michigan Consolidated Gas Company. This work consisted of updating a land use cover type inventory performed in the early 1980s by the county that was based upon infrared aerial photos taken in 1979. In addition, a field survey was conducted to confirm land uses in certain locations.

The changes identified in the land use assessment can be attributed in large part to the development that took place over the past 20 years. In some instances, the difference is not an actual change in the land use or cover type but results from a change in how the cover is classified or by a change in the minimum unit of measurement. The inventory based upon the 1979 photos did not classify individual home sites, but rather areas of residential activity that exceed five acres in size. The inventory based upon the 1997 photos went as small as one-acre sites of residential activity. The number for wetland acreage increased because of a change in what areas were classified as wetlands. For example, cedar swamps and scrub-shrub wetlands were classified as forests, not wetlands, in the 1979 inventory.

The inventory was conducted in a manner that allows a direct comparison of the tabular data on a section-by-section basis. The following maps identify the changes that have occurred in the Watershed over approximately 20 years.

Review of Pollutant Sources and Causes

After the inventories were conducted, the pollutant sources and causes were reevaluated and are described in the Table 12 below.

Table 12: Causes for Each Pollutant Source

Pollutant Source	***Cause***

Lakeshore and streambank erosion (k)	Shoreline development and removal of shoreline vegetation (k), angler and canoeist access (k), road/stream crossings (k)
Road/stream crossings (k)	Undersized and short culverts (k), lack of runoff diversions (k), inadequate fill on road surface (k), lack of vegetation
Livestock in streams (k)	Unrestricted access and no alternative water source (k)
New construction (s)	Lack of proper erosion control and stormwater management measures (s)

Table 12 (continued): Causes for Each Pollutant Source

Logging activities (s)	Inadequate buffer strips near streams (s)
Lawn care on shoreline properties (k)	Use of phosphorus fertilizer (s), over application of fertilizers (k), misuse and over use of pesticides (s), removal of native shoreline vegetation (k)
Septic systems (k)	Outdated, poorly maintained, improperly designed systems (k)

Stormwater discharges in urban areas (k)	Inadequate treatment of stormwater that may contain oils, grease, heavy metals, pet waste, etc. (k)
Manure applications and management (k)	Over application of manure (k), lack of proper storage for manure (k), inadequate testing of soil properties (s)
Golf courses (s)	Heavy applications of fertilizers and pesticides (s) Lack of buffer strips in riparian areas (s)
Agricultural fields (s)	Heavy use of pesticides(s)

* k = known s = suspected

(Insert 1978 Land Use Cover Map)

(Insert 1998 Land Use Cover Map)

(Insert Legend)

Chapter Four: Priority Pollutants and Their Sources and Causes

After the completion of the nonpoint source inventories the project partners and Advisory Committee prioritized the pollutants of concern (Table 13) and how they most affect the designated uses (Table 14). Two pollutants were given a priority ranking of one–nutrients and sediment. Nutrients is the priority pollutant for Lake Charlevoix and sediment is the priority pollutant for its tributaries. Maintaining Lake Charlevoix's low productivity (oligotrophic status) will require minimizing the amount of nutrient pollution that enters the lake from adjacent properties and the tributaries. Nutrients often attach to soil particles directly linking sediment and nutrient pollution.

Table 13: Lake Charlevoix Priority Pollutants

Pollutants	***Priority Ranking***
Nutrients	1
Sediment	1
Oils, grease, and heavy metals	2
Pesticides	3
Bacteria	4

Each pollutant has a differing effect on the primary designated uses. Nutrient and sediment pollution are the primary pollutants of concern for both protecting the cold water fishery and maintaining the diversity of aquatic life.

Table 14: Pollutant Priorities for Each Designated Use

Designated Uses	***Pollutant***	***Priority Ranking***
Aquatic life/wildlife	Sediment Nutrients Oils, grease, heavy metals, and pesticides	1 2 3
Cold water fishery	Sediment (streams) Nutrients (lake) Oils Pesticides	1 1 2 3
Partial and total body contact recreation	Nutrients Bacteria Sediment	1 2 3
Navigation	Sediment	1

Reducing and preventing the pollutants lies in addressing the priority sources. The sources

were first prioritized by category, e.g., all of the road/stream crossing sites were compared and prioritized according primarily to severity. The Advisory Committee discussed and voted on the ranking across the categories. Table 15 describes the results for the ranking of the pollutants and the main sources.

Table 15: Pollutant Information Following the Inventory

Pollutants	***Ranking***	***Sources***	***Ranking***
Sediment	1	Road/stream crossings	1
		Lakeshore/streambank erosion	2
		Stormwater	3
		Recreation	4
		Lakeshore development/construction	5
		Livestock	6
Nutrients	1	Stormwater	1
		Lawn care/shoreline property management	2
		Manure application	3
		Road/stream crossings, erosion	4
		Livestock access	5
		Septic systems	6
		Golf courses	7
Oils, grease and metals	2	Stormwater	1
		Road/stream crossings	2
Pesticides	3	Lawn care	1
		Agriculture fields	2
		Golf courses	3
Bacteria	3	Stormwater	1
		Livestock	2
		Septic systems	3

The next step was to rank the pollutant sources and causes overall throughout the Watershed. A ranking system using a high, medium, and low priority ranking was used at this phase. Table 16 provides a summary of the priority sources and causes for the Lake Charlevoix Watershed.

Table 16: Lake Charlevoix Watershed Priority Sources and Causes			
Pollutant Source	***Rank***	***Cause***	***Rank***
Access sites	medium	Lack of stormwater management and proper erosion control measures	medium
Agricultural fields	high	Over application of manure, lack of proper storage for manure, inadequate testing of soil properties	medium
Agricultural fields	high	Heavy use of pesticides	low
Golf courses	low	Heavy applications of fertilizers and pesticides Lack of buffer strips in riparian areas	low
Lakeshore and streambank erosion	high	Shoreline development and removal of shoreline vegetation, angler and canoeist access, road/stream crossings	high
Lawn care on shoreline properties	high	Use of phosphorus fertilizer, over application of fertilizers, misuse and over use of pesticides, removal of native shoreline vegetation	high
Livestock in streams	medium	Unrestricted access and no alternative water sources, no buffer strips	medium
Logging activities	low	Inadequate buffer strips near streams	low
New construction	medium	Lack of proper erosion control and stormwater management measures	medium
New construction	medium	Varied standards/regulations for riparian setbacks, shoreline vegetation strips, percent of lot allowed to develop, etc.	medium
Road/stream crossings	high	Undersized and short culverts, lack of runoff diversions, inadequate fill on road surface, lack of vegetation	high
Septic systems	medium	Outdated, poorly maintained, and improperly designed systems	medium
Shoreline property management	high	Directing runoff from house, driveway, fire pit, etc. directly to lake or river, increasing impervious surface in riparian areas, etc.	medium
Small horse farms	medium	Inadequate management of manure	medium
Stormwater discharges in urban areas	high	Inadequate treatment of stormwater that may contain oils, grease, heavy metals, pet waste, etc.	high

Chapter Five: Lake Charlevoix Watershed Project Goals and Objectives

1. Goals and Objectives

The following goals were developed based on the priority pollutant rankings.

Goal 1: Aquatic life and wildlife--Protect the diversity of aquatic habitats within the Lake Charlevoix Watershed by reducing the contribution of sediment, nutrient, and toxic pollutants.

Goal 2: Cold water fishery--Reduce sediment and nutrient loads which threaten to harm habitat conditions for the cold water fishery in Lake Charlevoix and its tributaries.

Goal 3: Partial or total body contact--Maintain the excellent recreational opportunities in the rivers and lake by reducing sediment and nutrient contributions.

Goal 4: Navigation--Maintain navigation in the rivers and lake by reducing any sediment inputs.

Table 17 lists the main objectives to accomplish the four primary goals.

Table 17: Lake Charlevoix Watershed Project Goals and Objectives

Goals	Objectives
Aquatic life and wildlife **Cold water fishery** **Recreation** **Navigation**	***Reduce the amount of sediment by:*** Stabilizing erosion at road/stream crossings. Correcting most severe lakeshore erosion sites. Restoring streambank erosion from recreational access. Reducing the pollutant load from stormwater in the urban areas. Restricting livestock from streams.
Aquatic life and wildlife **Cold water fishery** **Recreation**	***Reduce the amount of nutrients by:*** Reducing the pollutant load from stormwater in the urban areas. Reducing the amount of fertilizer used on residential lawns. Educating about manure application rates and improving manure storage. Stabilizing the erosion at road/stream crossings. Restricting livestock from streams. Educating about septic system maintenance.
Aquatic life and wildlife **Cold water fishery** **Recreation**	***Reduce the amount of toxins (oils, grease, heavy metals) by:*** Reducing the pollutant load from stormwater in urban areas. Restoring erosion and diverting runoff at road/stream crossings.
Aquatic life and wildlife **Cold water fishery**	***Reduce the amount of pesticides by:*** Reducing the amount of pesticides used on residential lawns. Improving pesticide application rates on agricultural land.

Recreation	***Reduce the amount of bacteria by:*** Reducing the pollutant load of stormwater in urban areas. Restricting livestock from streams and manure storage and application. Improving the maintenance of septic systems.

2. Recommended Actions to Protect the Lake Charlevoix Watershed

The Lake Charlevoix Watershed Project Advisory Committee developed an integrative approach to reduce existing sources of sediment and nutrient pollution and prevent future contributions. We will work to integrate 1) systems of best management practices (BMPs); 2) partnerships, community consensus building, and work with local governments, and 3) information and education components.

For each action step, we have identified the organizations that are best suited to implement the task, estimated costs to implement the each item, and a task milestone to assess our progress. A timeframe of 10 years was used to determine the scope of activities and the estimated costs for implementing the tasks.

The following actions are organized by topic area and listed in priority order. The action steps were prioritized by considering the pollutant of concern and the ranking.

(Please note that the recommendations were reviewed and updated by the project Advisory Committee in 2006.)

STORMWATER RECOMMENDATIONS

1. Implement media campaign to educate residents and businesses of each city about nonpoint source pollution (including disposal of household hazardous waste) and how to reduce stormwater runoff.

Responsible Organizations: Lake Charlevoix Association, Tip of the Mitt Watershed Council, Charlevoix County Drain Commissioner, WATCH, Charlevoix Conservation District, Charlevoix County Recycling Committee
Estimated Cost: $20,000
Task Milestone: Initiate in year 2

2. Work cooperatively with local units of government to develop stormwater management plans. Develop basic outline of a stormwater management plan to provide as a template for communities.

Responsible Organizations: Tip of the Mitt Watershed Council, City of Charlevoix, City of Boyne City, City of East Jordan, County Drain Commissioners, County Planning Offices
Estimated Cost: $200,000
Task Milestone: Complete plans and begin implementation in year 5

3. Implement priorities identified in stormwater management plans. Work cooperatively with local units of government to improve quality of stormwater runoff using a variety of tools,

including mapping of existing storm sewers; retrofitting problems; working with adjacent townships to manage joint stormwater; and ensure that emergency response plans exist for pollutant spills.

Responsible Organizations:	Tip of the Mitt Watershed Council, Lake Charlevoix Association, Friends of the Boyne, Charlevoix County Building Dept. (Soil Erosion Control Officer), Northwest Michigan Community Health Agency, Local Emergency Planning Committee, Coast Guard, MDEQ
Estimated Cost:	$500,000
Task Milestone:	Complete plans and begin implementation in year 5

4. Develop model stormwater ordinance language for the watershed; support the adoption and enforcement of stormwater ordinances in Charlevoix and Antrim Counties (at the county or township level) by educating and informing developers, engineers, architects, and others. Assess the effectiveness, identify shortcomings and work to improve stormwater ordinances in Charlevoix and Antrim Counties.

Responsible Organizations:	Tip of the Mitt Watershed Council, County Planning Offices, County Soil Erosion Control Offices, County Drain Commissioners, Townships, Charlevoix Conservation District
Estimated Cost:	$20,000
Task Milestone:	Develop language by year 4

5. Sponsor an education program for students that highlight the impacts of stormwater runoff on surface waters.

Responsible Organizations:	Friends of the Boyne, Tip of the Mitt Watershed Council, Friends of the Jordan, WATCH, Charlevoix County Drain Commissioner, Charlevoix Conservation District
Estimated Cost:	$20,000
Task Milestone:	Initiate in year 2; Conduct 5 programs in 5 years

6. Install a demonstration best management practice (BMP) at a residential site, a business site, and a municipal site (e.g., rain garden, rain barrels, etc.) Develop accompanying informational packet to be available via the Internet, at the Freshwater Center, and other appropriate places.

Responsible Organizations:	Tip of the Mitt Watershed Council, Lake Charlevoix Association
Estimated Cost:	$15,000
Task Milestone:	Install the first BMP in year 1

7. Remark storm drains (stencils or special drain markers) to highlight that the drains discharge directly to surface waters in the watershed.

Responsible Organizations:	Friends of the Boyne, Friends of the Jordan, Lake Charlevoix Association, Keep Charlevoix Beautiful, Tip of the Mitt Watershed Council
Estimated Cost:	$5,000

Task Milestone: Hold one drain re-marking event annually

8. Sponsor workshops periodically for contractors to share information on best management practices for soil erosion and stormwater management.
Responsible Organizations: Charlevoix County Building Department, Antrim Conservation District, Friends of the Jordan, Friends of the Boyne, Tip of the Mitt Watershed Council, Charlevoix Conservation District
Estimated Cost: $10,000
Task Milestone: Initiate in year 3; 50% of contractors attend events

9. Conduct and update impervious surface studies on the tributaries and shoreline areas.
Responsible Organizations: Tip of the Mitt Watershed Council
Estimated Cost: $30,000
Task Milestone: 75% of tributaries have completed inventories in 5 years

10. Install a series of BMPs to address stormwater problems for the drainage area from Hawk's Ridge and Wildwood Harbor Road.
Responsible Organization: Tip of the Mitt Watershed Council
Estimated Cost: $25,000
Task Milestone: Install first BMP by year 2

11. Evaluate effectiveness and maintain BMPs implemented in the Court Street area of Boyne City.
Responsible Organization: City of Boyne City, Tip of the Mitt Watershed Council
Estimated Cost: $10,000
Task Milestone: Inspect and perform maintenance if necessary on a yearly basis

SHORELINE POLLUTION INVENTORY RECOMMENDATIONS

1. Repair most severe streambank erosion sites on a cost-share basis.
Responsible Organizations: Tip of the Mitt Watershed Council, Friends of the Jordan, Friends of the Boyne
Estimated Cost: $200,000
Task Milestone: 50% of the severe sites are restored

2. Maintain an up-to-date lakeshore property owner database for recruiting new members for the Lake Charlevoix Association and tracking shoreline development changes.
Responsible Organizations: Tip of the Mitt Watershed Council, Lake Charlevoix Association
Estimated Cost: $2,000
Task Milestone: Database updated annually

3. Repeat the shoreline pollution inventory and associated follow-up actions every five years to document shoreline erosion, habitat, greenbelts, algae, and aquatic invasive species.

Responsible Organizations: Tip of the Mitt Watershed Council, Lake Charlevoix Association
Estimated Cost: $16,000
Task Milestone: Conduct two surveys in 10 years

6. Regularly update new homeowners packages (Living on the Edge folders) to provide to realtors for distribution to shoreline property clients.
Responsible Organizations: Tip of the Mitt Watershed Council, Lake Charlevoix Association
Estimated Cost: $7,500
Task Milestone: Update packets by year 2; develop a database of interested realtors

7. Educate shoreline residents on the importance of near shore habitat, impacts from beach sanding, living in mucky areas, aquatic vegetation, etc.
Responsible Organizations: Tip of the Mitt Watershed Council, Lake Charlevoix Association
Estimated Cost: $25,000
Task Milestone: Initiate in year 1

8. Install demonstration natural vegetation strips (greenbelts) on shoreline properties around Lake Charlevoix and its tributaries.
Responsible Organization: Tip of the Mitt Watershed Council
Estimated Cost: $150,000
Task Milestone: Install 5 sites

9. Monitor for the presence of aquatic invasive species and work to control purple loosestrife, Eurasian watermilfoil, and other species, that impair aquatic habitat.
Responsible Organization: Tip of the Mitt Watershed Council
Estimated Cost: $100,000
Task Milestone: Database established for existing presence of invasives by year 3

10. Restore shoreline wetlands that have been altered.
Responsible Organizations: Tip of the Mitt Watershed Council, Natural Resources Conservation Service, Charlevoix Conservation District, Antrim Conservation District
Estimated Cost: $200,000
Task Milestone: 10 wetland restoration projects in 10 years

ROAD/STREAM CROSSINGS RECOMMENDATIONS

1. Restore road/stream crossings working in cooperation with the Antrim and Charlevoix County Road Commissions.
Responsible Organizations: Conservation Resource Alliance, Charlevoix County Road Commission, Antrim County Road Commission

Estimated Cost: $500,000
Task Milestone: 75% of road/stream crossings are restored

2. Develop and sustain a long-term strategy to work on regularly updating inventories (including new sites or missed locations) and restoring sites on a subwatershed basis. Develop method to keep track of repairs/records of culverts and problems. (Work with road commission to use database).
Responsible Organizations: Conservation Resource Alliance, Antrim County Road Commission, Charlevoix County Road Commission, Friends of the Boyne, Friends of the Jordan
Estimated Cost: $130,000
Task Milestone: Implement LIAA/CRA method in year 2

3. Inventory road commission needs and work closely with road commissions to minimize impacts to water resources by performing better maintenance and utilizing best management practices (BMPs) on road work within the priority areas. Sponsor "Better Back Roads" every five-years for road commission crews.
Responsible Organizations: Conservation Resource Alliance, Antrim County Road Commission, Charlevoix County Road Commission, Friends of the Boyne, Friends of the Jordan, Tip of the Mitt Watershed Council
Estimated Cost: $100,000
Task Milestone: Sponsor "Better Back Roads" workshop by year 5

4. Add Lake Charlevoix data to the BMP database and maintain the system.
Responsible Organizations: Conservation Resource Alliance, Antrim County Road Commission, Charlevoix County Road Commission, Friends of the Boyne, Friends of the Jordan, Tip of the Mitt Watershed Council
Estimated Cost: $50,000
Task Milestone: Add data by year 2

5. Develop a project schedule and fundraising plan to restore the priority road/stream crossings.
Responsible Organizations: Conservation Resource Alliance, Antrim County Road Commission, Charlevoix County Road Commission, Friends of the Boyne, Friends of the Jordan, Tip of the Mitt Watershed Council
Estimated Cost: $10,000
Task Milestone: Develop fundraising plan in year 1

AGRICULTURE RECOMMENDATIONS

1. Implement BMPs for most severe agricultural sites contributing significant amounts of nonpoint source pollution in the priority area.
Responsible Organization: Charlevoix Conservation District

Estimated Cost: $100,000
Task Milestone: Implement BMPs at 50% of the severe agricultural sites

2. Educate horse hobbyists about water quality friendly agricultural practices.
Responsible Organizations: Charlevoix Conservation District, Natural Resource Conservation Service, MSU Extension
Estimated Cost: $5,000
Task Milestone: TASK COMPLETED

3. Investigate moderate and minor sites to determine extent of problems.
Responsible Organizations: Charlevoix Conservation District, Antrim Conservation District, Natural Resource Conservation Service, MSU Extension
Estimated Cost: $25,000
Task Milestone: TASK COMPLETED

4. Cooperate with existing state and federal programs to encourage better nutrient management and other issues that are both a surface water and ground water concern.
Responsible Organizations: Charlevoix Conservation District, Antrim Conservation District, Natural Resource Conservation Service, MSU Extension
Estimated Cost: $2,000
Task Milestone: 25% reduction in fertilizer use on agricultural fields

5. Distribute information to producers on GAAMPs (ie:manure application and Right to Farm issues). Provide assistance to producers via Groundwater Technician to identify and reduce pesticide and fertilizer risks to ground water or surface water.
Responsible Organizations: Charlevoix Conservation District, Antrim Conservation District, Natural Resource Conservation Service, MSU Extension
Estimated Cost: $24,000
Task Milestone: 20% increase in use of BMPs

<u>RECREATION RECOMMENDATIONS</u>
1. Correct recreation related (access) erosion sites along the main tributaries and decrease nonpoint source pollution from stormwater and other conditions at access sites.
Responsible Organizations: Friends of the Boyne, Friends of the Jordan, Michigan Department of Natural Resources, Tip of the Mitt Watershed Council, Canoe Liveries
Estimated Cost: $125,000
Task Milestone: 50% of erosion sites are improved

2. Coordinate a committee of canoe liveries, DNR, local officials and conservation groups to work on reducing impacts and improving the quality of the outdoor experience for canoeists. Specifically implement a canoeist education program that addresses canoeing etiquette, litter,

bank erosion, and natural resource protection.

Responsible Organizations: Friends of the Boyne, Friends of the Jordan, Michigan Department of Natural Resources, Tip of the Mitt Watershed Council, Local Canoe Livery Owners, Charlevoix County, Antrim County
Estimated Cost: $10,000
Task Milestone: Initiate by year 3

3. Monitor the Jordan River for violations and provide information to DNR-Natural Rivers staff to enforce existing rules under the Natural Rivers Act. Also the Advisory Committee may provide comments on future amendments to protect the river.

Responsible Organizations: Friends of the Jordan, Michigan Department of Natural Resources, WATCH, Tip of the Mitt Watershed Council, Conservation Resource Alliance, Charlevoix Conservation District
Estimated Cost: $5,000
Task Milestone: Initiate in year 1

4. Educate boaters and PWC users on Lake Charlevoix about ecologically good boating practices (use existing materials and cooperation of Coast Guard Auxiliary).

Responsible Organization: Lake Charlevoix Association, Tip of the Mitt Watershed Council
Estimated Cost: $2,000
Task Milestone: Initiate by year 2

5. Educate anglers about the relationship of nonpoint source pollution and watershed management to fisheries resources by partnering with bait shops to promote low-impact fishing (e.g., make bait containers biodegradable) and target education activities around fish runs and seasons.

Responsible Organizations: Friends of the Jordan, Friends of the Boyne
Estimated Cost: $5,000
Task Milestone: Initiate by year 3; 50% of bait shops participate

6. Reduce nonpoint source pollution from the Jordan River Pathway by planting vegetation, rerouting the trail, and adding educational signs.

Responsible Organization: Friends of the Jordan
Estimated Cost: $10,000
Task Milestone: Initiate in year 2

7. Update the inventory of the MDNR boat launch/access sites on the Jordan River, Boyne River, Deer Lake, and Lake Charlevoix. Continue to work with the MDNR to assess success of past improvements and continued maintenance at the access sites.

Responsible Organizations: Tip of the Mitt Watershed Council, Lake Charlevoix Association, Friends of the Jordan, Friends of the Boyne
Estimated Cost: $12,000
Task Milestone: Update the inventory by year 5

8. Continue cooperative work with the DNR to continue to implement additional improvements at the access sites.

Responsible Organizations: Lake Charlevoix Association, Friends of the Jordan, Friends of the Boyne
Estimated Cost: $5,000
Task Milestone: Twos sites improved on each water body

9. Research statistics on canoe rentals and review regulations in the Natural Rivers Act for the Jordan River.

Responsible Organizations: Friends of the Jordan, Tip of the Mitt Watershed Council
Estimated Cost: $10,000
Task Milestone: Review regulations by year 3

10. Partner with local marinas and retailers to incorporate etiquette into boater safety.

Responsible Organizations: Lake Charlevoix Association
Estimated Cost: $10,000
Task Milestone: Meet with 25% of marinas by year 2

11. Gather additional data on recreational activities on Lake Charlevoix such as speed limits, sound levels, boater attitudes, angler attitudes, non-motorized recreation attitudes.

Responsible Organizations: Lake Charlevoix Association, WATCH, Tip of the Mitt Watershed Council
Estimated Cost: $10,000
Task Milestone: Complete surveys by year 5

12. Work with marinas to reduce nonpoint source pollution and the spread of aquatic invasive species by using best management practices. Encourage marinas throughout the watershed to participate in the Michigan Clean Marinas Program.

Responsible Organizations: Tip of the Mitt Watershed Council, Lake Charlevoix Association, City of Charlevoix, City of East Jordan, City of Boyne City, local marinas
Estimated Cost: $40,000
Task Milestone: Conduct assessments with marinas

LAND PROTECTION RECOMMENDATIONS

1. Distribute information to land owners about land stewardship and land protection.

Responsible Organizations: Little Traverse Conservancy, Grand Traverse Regional Land Conservancy, Charlevoix County Land Conservancy
Estimated Cost: $5,000
Task Milestone: Initiate by year 2

2. Send follow-up letter to property owners of identified priority parcels and make personal contacts with landowners.

Responsible Organizations: Little Traverse Conservancy, Grand Traverse Regional

Land Conservancy, Charlevoix County Land Conservancy
Estimated Cost: $5,000
Task Milestone: Letters sent bi-annually

3. Seek funding through CMI, CZM, or other state, federal or local funding to protect priority parcels of land through fee acquisition or conservation easement acquisition.
Responsible Organizations: Little Traverse Conservancy
Estimated cost: $0
Task Milestone: Protect 50 acres of land and 1/2 mile of shoreline

4. Continue to work with Michigan Department of Natural Resources on potential assist and transfer projects on priority parcels in the Lake Charlevoix Watershed.
Responsible Organizations: Little Traverse Conservancy, Grand Traverse Regional Land Conservancy, Charlevoix County Land Conservancy, Friends of the Jordan
Estimated Cost: $5,000
Task Milestone: 200 acres protected through assist and transfer

5. Provide support and educational materials to neighborhood groups where appropriate and sustainable as a helpful tool to promote land stewardship and protection.
Responsible Organizations: Little Traverse Conservancy, Grand Traverse Regional Land Conservancy, Charlevoix County Land Conservancy
Estimated Cost: $10,000
Task Milestone: Initiate by year 3

6. Promote sound community planning and development to promote watershed protection (e.g. support open space preservation and approval of PDR ordinance in Charlevoix County). Continue to work on purchase of development rights and transfer of development rights projects.
Responsible Organizations: Little Traverse Conservancy, Grand Traverse Regional Land Conservancy, Charlevoix County Land Conservancy
Estimated Cost: $100,000
Task Milestone: 1000 acres protected through PDR or TDR

7. Review the priority sensitive land parcel on a routine basis to identify additional priority parcels for protection.
Responsible Organizations: Little Traverse Conservancy, Grand Traverse Regional Land Conservancy, Charlevoix County Land Conservancy
Estimated Cost: $10,000
Task Milestone: Priority parcel list generated annually

8. Support Charlevoix County Farm Bureau's Land Use Committee efforts towards an approved PDR ordinance for Charlevoix County,
Responsible Organizations: Charlevoix Conservation District, Little Traverse Conservancy, Charlevoix County Land Conservancy
Estimated Cost: $5,000

Task Milestone: PDR ordinance approved

FORESTRY RECOMMENDATIONS

1. Establish private road standards to improve construction of forestry roads.
Responsible Organizations: Charlevoix County Planning Department, Charlevoix Conservation District, Antrim Conservation District
Estimated Cost: $5,000
Task Milestone: Initiate in year 2

2. Work with Michigan Department of Natural Resources, Forestry Division to review forestry plans within the Watershed and ensure BMPs are required in all contracts and management plans are consistent with Watershed project goals.
Responsible Organizations: Charlevoix Conservation District, Antrim Conservation District, Friends of the Jordan, Friends of the Boyne, Michigan Department of Natural Resources, Mackinac Forest Council
Estimated Cost: $5,000
Task Milestone: Initiate in year 2

3. Send information packet on forestry best management practices to key property owners in the critical areas of the Watershed.
Responsible Organizations: Charlevoix and Antrim Conservation Districts
Estimated Cost: $4,000
Task Milestone: Initiate in year 4

4. Offer development of forest management plans for private landowners in the critical area that emphasize BMPs to protect water quality.
Responsible Organizations: Charlevoix and Antrim Conservation Districts
Estimated Cost: $10,000
Task Milestone: Provide 20 plans in 5 years

ZONING AND LAND USE RECOMMENDATIONS

1. Develop model standards for the Watershed with basic definitions and standards for setbacks, greenbelts, conservation planning, redevelopment of shoreline properties, and other similar measures to reduce pollution. Use scientific data to provide a range of standards for different resource types (streams, wetlands, lakes, etc.) and different levels of protection (most protective to minimum).
Responsible Organizations: Charlevoix County Planning, Antrim County Planning, MSU Extension, Northwest Michigan Council of Governments, Townships, Tip of the Mitt Watershed Council
Estimated Cost: $100,000
Task Milestone: Initiate in year 3

2. Implement annual ongoing education program for local governments on land use planning

tools that can help protect water quality and encourage better coordination amongst neighboring townships (e.g., conservation planning and design and impact coordination rules).

Responsible Organizations: Charlevoix County Planning, Antrim County Planning, MSU Extension, Northwest Michigan Council of Governments, Tip of the Mitt Watershed Council
Estimated Cost: $40,000
Task Milestone: Initiate in year 3

3. Identify nonconforming lots on lakeshore and work with townships to discuss potential water quality impacts and solutions.

Responsible Organization: Charlevoix County Planning Department
Estimated Cost: $10,000
Task Milestone: Initiate in year 1

4. Evaluate the new sanitary regulations (if they are adopted) that require septic system inspections program at the transfer of a property and alternative systems. Implement septic inspection programs and educate about the new requirements.

Responsible Organizations: Northwest Michigan Community Health Agency, Lake Charlevoix Association, Tip of the Mitt Watershed Council
Estimated Cost: $8,000
Task Milestone: Initiate evaluation when regulations adopted

5. Evaluate existing greenbelt regulations and how they are being enforced. Document the conditions of shoreline vegetation on the lakeshores and tributaries. Identify and prioritize locations for greenbelt/shoreline vegetation improvements.

Responsible Organizations: Lake Charlevoix Association, Charlevoix County Planning, Tip of the Mitt Watershed Council
Estimated Cost: $40,000
Task Milestone: Initiate survey by year 3

6. Develop a yearly summary of variances of sanitary code/zoning to determine if there are water quality impacts. Provide training to zoning boards of appeal on the Michigan Zoning Enabling Act and conflicts of interest.

Responsible Organizations: Northwest Michigan Community Health Agency, Tip of the Mitt Watershed Council, Charlevoix County Planning, Antrim County Planning
Estimated Cost: $10,000
Task Milestone: Summary reports produced annually

7. Educate Watershed residents, including students, about land use issues and foster citizen involvement in local land use decision making.

Responsible Organizations: Charlevoix County Planning, Antrim County Planning, Charlevoix County Drain Commissioner, Lake Charlevoix Association, Tip of the Mitt Watershed Council
Estimated Cost: $15,000

Task Milestone: Conduct survey to document current status of knowledge and involvement

8. Publish a handout/brochure that lists information on permits needed and whom to contact when building. Update annually and post on websites.

Responsible Organizations: Charlevoix County Planning, Antrim County Planning, Charlevoix County Drain Commissioner, Lake Charlevoix Association, Tip of the Mitt Watershed Council
Estimated Cost: $10,000
Task Milestone: Brochure completed; update information annually on websites.

9. Sponsor annual education program for lake/river realtors, developers, and builders on special regulations and management for riparian properties.

Responsible Organizations: Charlevoix County Planning, Antrim County Planning, Lake Charlevoix Association, Northwest Michigan Council of Governments, Tip of the Mitt Watershed Council, Little Traverse Conservancy, Grand Traverse Regional Land Conservancy, Charlevoix County Land Conservancy, Michigan Department of Natural Resources
Estimated Cost: $30,000
Task Milestone: 50 realtors attend the event

10. Update land use surveys and build out analysis examples and disseminate to local governments in the Watershed.

Responsible Organizations: MSU Extension, Charlevoix County Planning
Estimated Cost: $5,000
Task Milestone: Initiate in year 2

11. Work with local governments on integrating site plan review process into zoning as a water quality protection tool.

Responsible Organizations: Northwest Michigan Council of Governments, Tip of the Mitt Watershed Council, MSU Extension, Charlevoix County Planning, Antrim County Planning, Charlevoix County, Antrim County, Townships
Estimated Cost: $2,000
Task Milestone: Initiate in year 1

12. Meet with local golf course managers and discuss management techniques to reduce nonpoint source pollution and provide analytical testing for water quality. Encourage enrollment in Golf Course Stewardship Program.

Responsible Organizations: MSU Extension, Tip of the Mitt Watershed Council
Estimated Cost: $6,000
Task Milestone: 50% of golf courses members of MSU Stewardship Program

13. Organize a network of local planning units in the Watershed and work towards developing shared high standards for provisions that protect water quality (e.g. setbacks).

Responsible Organizations:	Charlevoix County Planning, Antrim County Planning, MSU Extension, Townships, Tip of the Mitt Watershed Council, County Drain Commissioners
Estimated Cost:	$10,000
Task Milestone:	25% of local governments adopt similar high standards

GENERAL INFORMATION AND EDUCATION RECOMMENDATIONS

1. Update the Watershed Plan to meet the EPA's Nine Minimum Elements, and obtain DEQ approval of the plan. (Plan approval will make projects eligible for Section 319 funding).

Responsible Organization:	Tip of the Mitt Watershed Council
Estimated Cost:	$60,000
Task Milestone:	Complete updates by year 2

2. Produce an updated summary of the Watershed Plan and distribute to Watershed residents.

Responsible Organizations:	Tip of the Mitt Watershed Council, Charlevoix Conservation District
Estimated Cost:	$4,000
Task Milestone:	Produce summary by year 3

3. Give presentations to promote the projects goals and activities.

Responsible Organization:	Tip of the Mitt Watershed Council
Estimated Cost:	$10,000
Task Milestone:	Conduct 5 presentations annually

3. Develop a program to educate boaters at the marinas to reduce their impacts from invasives, boat washing, tank pumping, litter, and boating practices.

Responsible Organizations:	Tip of the Mitt Watershed Council, Lake Charlevoix Association
Estimated Cost:	$50,000
Task Milestone:	Involve 75% of the marinas in 5 years

4. Using organizational newsletters of the project partners and press releases continue to educate the public about point source and nonpoint source pollution and what they can do to reduce their contributions.

Responsible Organizations:	Tip of the Mitt Watershed Council, Charlevoix Conservation District, Lake Charlevoix Association, Friends of the Boyne, Friends of the Jordan, WATCH, Keep Charlevoix Beautiful
Estimated Cost:	$5,000
Task Milestone:	Print 3 articles annually

5. Develop and present school room programs (slide program) to introduce watershed concepts and specifics of the Lake Charlevoix Watershed to school-aged children and offer

outdoor activities for other groups (Boy and Girl Scouts, environmental groups, clubs, etc.)
Responsible Organizations: Friends of the Jordan, Friends of the Boyne, Lake Charlevoix Association, Charlevoix Conservation District, Little Traverse Conservancy, WATCH, SEE-North
Estimated Cost: $50,000
Task Milestone: Initiate by year 3; conduct 2 programs annually

6. Develop a "place-based" water resource education program for elementary and secondary students.
Responsible Organizations: SEE-North
Estimated Cost: $100,000
Task Milestone Initiate in year 2

7. Produce portable educational displays (i.e. geology or fossils of the watershed; aquatic ecology and water quality; Lake Charlevoix watershed model) to be used for outreach programs throughout the Watershed.
Responsible Organizations: Friends of the Boyne, Friends of the Jordan, Lake Charlevoix Association, WATCH, SEE-North
Estimated Cost: $50,000
Task Milestone: Produce one display by year 4

8. Continue Experience Lake Charlevoix educational program for sixth grade students in Charlevoix County.
Responsible Organizations: Lake Charlevoix Association, Tip of the Mitt Watershed Council
Estimated Cost: $30,000
Task Milestone: Conduct event annually

9. Create a long-term funding source to help fund actions in this plan.
Responsible Organization: Tip of the Mitt Watershed Council
Estimated Cost: $100,000
Task Milestone: Initiate in year 1

EVALUATION

1. Document the before status of all physical improvements with photographs.
Responsible Organizations: Charlevoix Conservation District, Conservation Resource Alliance, Tip of the Mitt Watershed Council, Friends of the Jordan, Friends of the Boyne
Estimated Cost: $5,000
Task Milestone: Initiate in year 1

2. Develop evaluation methods for the variety of information and education programs. Sponsor focus groups where most appropriate.
Responsible Organizations: Charlevoix Conservation District, Conservation Resource Alliance, Tip of the Mitt Watershed Council, Friends of the

Jordan, Friends of the Boyne, Lake Charlevoix Association, MSU Extension
Estimated Cost: $10,000
Task Milestone: Initiate in year 1

3. Conduct annual evaluation and overall evaluation of any implementation activities.
Responsible Organizations: Charlevoix Conservation District, Conservation Resource Alliance, Tip of the Mitt Watershed Council, Friends of the Jordan, Friends of the Boyne, Lake Charlevoix Association, MSU Extension, Advisory Committee members
Estimated Cost: $10,000
Task Milestone: Initiate in year 1

3. Information and Education Strategy

The long-term protection of Lake Charlevoix's water quality will depend on the value and actions of future generations. Educating Lake Charlevoix's Watershed residents about how their actions impact water quality is a priority. Increasing awareness and ultimately changing behaviors is the long-term antidote for water quality protection. Target audiences for education programs are identified in Table 18.

Table 18: I/E Strategy Target Audiences

Sources	*Target Audiences*	*Specific Target Audiences*	*Priority*
Urban stormwater	Homeowners Local government officials	Urban homeowners and residents, riparian property owners, and local government officials (townships bordering cities)	2
Lakeshore erosion	Homeowners	Riparian property owners	5

Table 18: I/E Strategy Target Audiences			
Streambank erosion	Recreational groups	Canoe liveries, canoeists, hikers, anglers	4
Livestock in streams	Agricultural landowners	Agricultural landowners with livestock (cattle, horses, sheep, etc.)	6
Lawn care	Homeowners	Riparian property owners, urban homeowners, and all Watershed residents in priority area	1
Manure management	Agricultural landowners	Agricultural landowners with livestock (cattle, horses, sheep, etc.)	9
Failing septic systems	Homeowners	Riparian property owners	7
Shoreline development	Contractors, Realtors, Homeowners	Shoreline property builders/contractors, realtors, homeowners	8
Road/stream crossings	Road Commissions	Road Commission managers, crew workers	3

The Information and Education Strategy was developed using our existing knowledge of the

target audiences. Consideration of the targeted audiences' perspectives was used to create the message and identify delivery mechanisms. Additional review of the message will be done prior to the implementation of any education programs.

The information and education activities will use a variety of approaches including installing demonstration sites, building partnerships, sponsoring seminars, and distributing education materials.

Table 19: I/E Strategy

Pollutant	*Source/Cause*	*Target Audience*	*Messages*	*Delivery Mechanism*	*Potential Evaluation*
Sediment	Lakeshore erosion	Homeowners, riparian property owners	Protect lake water quality for future generations and your investment.	Use model biotechnical erosion control site to demonstrate restoration, newsletters and brochures.	Photographic and survey to homeowners with erosion
	Streambank erosion	Canoeists, anglers, canoe liveries	Protect the Jordan River.	Build partnership with local canoe liveries, involve local groups with restoration and other creative education approaches.	Interviews
	Livestock in streams	Agricultural landowners	Help protect water quality and save money.	Conservation District and NRCS to meet with contacts and provide assistance.	Photographic and interviews
	Road/stream crossings	Road Commissions	Help protect water quality and save money.	Meet with road commissions to discuss standard designs that reduce pollution and are cost effective.	Photographic and interviews
	Lakeshore development-construction	Contractors, Realtors, Local Government Officials, Homeowners	Protect water quality and property values.	Give presentation at contractors workshop, work with local governments to standardize setback distances, and using print media educate riparians about the importance of setbacks.	Focus group
Nutrients	Lawn maintenance	Landscaping and lawn care companies, homeowners, riparian property owners	Protect water quality and protect your investment.	Sponsor seminars for landscaping companies to learn more about water quality friendly yard maintenance. Sponsor workshops and use print media to reach riparians.	Survey
	Failing septic systems	Riparian property owners	Protect water quality and keep the water safe for swimming.	Meet one-on-one with property owners who may have potential septic system problems. Provide assistance to address problems.	Interview
	Manure application management	Agricultural landowners with livestock	Protect water quality and save money.	Conservation District and NRCS to meet with contacts and provide assistance.	Photographic and interview
Toxins --oil, heavy metals, grease, etc.	Urban stormwater	Homeowners	We are all lakefront property owners (via drains).	Media campaign with local newspapers, radio, and tv. Mail residents information on reducing nonpoint source pollution.	Survey
Pesticides	Lawn maintenance	Homeowners, riparian property owners	Protect lake water quality for future generations and your investment.	Sponsor seminars for landscaping companies to learn more about water quality friendly yard maintenance. Sponsor workshops and use print media to reach riparians.	Focus group and survey
	Agricultural fields	Agricultural landowners	Protect water quality and save money.	Conservation District and NRCS to meet with contacts and provide assistance.	Photographic and interview

Table 19: I/E Strategy					
Bacteria	Stormwater	Urban pet owners	Keep the water safe for swimming and protect water quality.	Implement media campaign about proper disposal of pet waste.	Survey

4. Evaluation Strategy

Implementing the recommended actions will require an evaluation to determine the progress and effectiveness of the proposed activities. Because there are a large variety of tasks, a variety of evaluation methods will be necessary.

Documenting changes with photographs will be used to evaluate the effectiveness and improvements for any components of the project that modify physical features (road/stream crossings, lakeshore erosion, stormwater management improvements, streambank erosion, recreational access sites, etc.)

Because protecting the quality of the resources is a focus of this project, information and education components are very important. A variety of techniques will be used. A written evaluation form will be used for workshops, seminars, or other events where people are gathered for a specific event. For riparian homeowners (both lake and river), interviews and surveys will be conducted after a certain number of the actions have been implemented to see what tools were most effective (personal visits, news articles, booklets, presentations).

Evaluating the effectiveness of programs directed towards improving land use management will require a different approach. Focus groups would be the most effective in learning how helpful the ordinances, programs, materials, maps, and other tools were for changing policy and protecting water resources. Surveys may also be used to assess the progress as the land use tasks are being implemented. Photographic evidence, particularly documenting the status of greenbelts, will be used to evaluate the progress of specific tasks.

Some limited water quality monitoring of biological life in the tributaries may be done to document existing diversity and health as a baseline for future monitoring. This type of monitoring will be most valuable in evaluating the effectiveness of many of our actions on protecting the small tributaries within the Watershed.

The project will also utilize the “Seeking Signs of Success” to assist with evaluation tasks throughout the project for all components, physical improvements, information and education tasks, and land use/local government activities.

The Advisory Committee will be asked to assist with an annual evaluation of any implementation activities. Every three to five years the Committee will be asked to look over the entire list of recommended actions and ranking to assess if changes are necessary in the strategy.

5. Revised Water Quality Summary

The Lake Charlevoix Watershed has four designated uses that are threatened: 1) navigation; 2) aquatic life/wildlife; 3) partial or total body contact; and 4) cold water fishery.

Project Goals: The mission of the Lake Charlevoix Watershed Protection Project is to protect and enhance the water quality of Lake Charlevoix and its tributaries by reducing current and future polluted runoff. Specific goals related to the designated uses are as follows:

1) Maintain navigation in the rivers and lake by reducing any sediment inputs.

2) Protect the diversity of aquatic habitats within the Lake Charlevoix Watershed by reducing the contribution of sediment, nutrient, and toxic pollutants.

3) Maintain the excellent recreational opportunities in the rivers and lake by reducing sediment and nutrient contributions.

4) Reduce sediment and nutrient loads which threaten to harm habitat conditions for the cold water fishery in Lake Charlevoix and its tributaries.

Navigation
Navigation is threatened in the Jordan River, Boyne River, and locations in Lake Charlevoix from increasing sediment. Known sources of sediment pollution include lakeshore and streambank erosion, road/stream crossings, urban stormwater, livestock in streams, new construction, and recreation access sites. One suspected source of sediment that was not confirmed is logging activities.

Lakeshore and streambank erosion is often a result of the removal of shoreline vegetation from residential development. Angler access points are another source of erosion on the Jordan and Boyne Rivers and canoeing access is a source on the Jordan River. Improperly sized culverts and lack of runoff diversions are the main reason for erosion and sedimentation associated with road/stream crossings.

Livestock access to streams for a watering source can destroy the bank and cause erosion and sedimentation. New construction in the shoreline area can also contribute sediment, particularly if inadequate erosion controls are used. Not maintaining buffer strips during logging is also suspected of contributing to erosion and sedimentation.

Habitat Protection for Aquatic Life/Wildlife
Aquatic habitat is threatened throughout the Lake Charlevoix Watershed from sediment, nutrients, and toxic chemicals, such as oils, grease, heavy metals, and pesticides. Sediment impacts aquatic habitat by covering spawning areas, which makes feeding difficult and clogs gills. Nutrients harm wildlife by encouraging excessive aquatic plant growth that can deplete oxygen supplies when it decomposes. Toxic chemicals harm aquatic life by weakening immune systems and making organisms more susceptible to disease. They can also harm reproduction and if concentrations of the toxic materials are high enough they can kill aquatic life.

Sources of sediment pollution are the same as mentioned above under threats to navigation. Known sources of nutrient pollution include lakeshore and streambank erosion, road crossings, septic systems, livestock in streams, stormwater discharges in urban areas, manure application and management, and lawn care on residential properties. Suspected sources of nutrient pollution include golf courses and new construction. Oils, grease, and heavy metals are known to be contributed from stormwater discharges in urban areas and road/stream crossings. Pesticides may be contributed from agricultural fields and lawns.

Nutrients often attach to sediment particles. When erosion from lakeshores, streambanks, and road/stream crossings occurs it contributes not only sediment pollution but also nutrient pollution. Residential properties are a known source of nutrients from septic systems and lawn fertilizers, which can contribute nutrients that encourage nuisance plant and algae growth, and golf courses are a suspected sources of fertilizers.

Recreation (Partial and Total Body Contact)
Nutrient pollution can stimulate nuisance levels of aquatic plant and algae growth which disrupt recreational activities and make swimming and boating undesirable. In addition, high

bacteria counts can make it unsafe for swimming. Although these scenarios do not currently exist for Lake Charlevoix and its tributaries, preventative measures are important to maintain the diversity and quality of recreational opportunities in this Watershed. Recent water quality testing completed by the Northwest Michigan Community Health Agency indicates that bacteria could be a future problem for a few of the beaches in Lake Charlevoix. Improving management of urban runoff is important for maintaining the health for the swimming beaches.

Sources and causes of nutrients have been described previously. Suspected sources of bacteria include–stormwater discharges in urban areas, manure application and storage, and livestock access to streams. Stormwater discharge in urban areas can collect and deposit pet and wildlife waste into Lake Charlevoix. Excessive applications of manure, runoff from manure piles, or livestock access to streams are other known causes of bacteria pollution from agricultural sites.

Cold Water Fishery

Lake Charlevoix is fortunate to be able to support both a warm and cold water fishery. The majority of the rivers and streams in the Watershed also support a cold water fishery. Sediment, nutrient, and toxic pollution (oils, grease, heavy metal, and pesticides) can all be harmful to a cold water fishery.

In the lake, nutrients are the most harmful pollutant. Excessive aquatic plant growth as a result of nutrient pollution can decrease the oxygen available in the bottom of the lake (hypolimnion) during the summer months.

In rivers, sediment was identified as the most harmful pollutant to the cold water fishery. As mentioned previously it destroys habitat and can harm the health of fish.

Appendix A
Advisory Committee Members

Appendix B
Systems of Best Management Practices

Table 20: Best Management Practices		
Source	***BMP Manual***	***Potential Systems of BMPs***
Road/Stream Crossings	Guidebook of BMPs, Better Back Roads	Extend, enlarge culverts, install runoff diversions, direct runoff, install box culverts and bridges
Streambank Lakeshore	Guidebook of BMPs, Understanding, Controlling, and Living with Shoreline Erosion	Biotechnical erosion control, critical area plantings, rock riprap, tree revetments
Stormwater	Stormwater Mgt., I/E, Guidebook, Center for Watershed Protection Materials	Water gardens, runoff diversions, infiltration basins
Recreation	Guidebook of BMPs, Understanding, Controlling, and Living with Shoreline Erosion, Stormwater Management	Runoff diversions, walkways/stairways, parking lot barriers, canoe landings, biotechnical erosion control, rock riprap, tree revetments
Lawn/Shoreline Care	I/E	

Table 20: Best Management Practices		
Agriculture-Livestock	Guidebook of BMPs, Michigan Agriculture BMPs	Fencing, alternative watering devices, vegetative buffer strips
Agriculture-Manure	Guidebook of BMPs, Michigan Agriculture BMPs	Nutrient management, animal waste storage, manure application plan
Septic	I/E	
Golf Courses	I/E Golf Course BMP	Soil testing, fertilizer and pesticide management, vegetative buffer strips

Appendix C
General Lake Charlevoix Watershed Description

General Lake Charlevoix Watershed Description

The Lake Charlevoix Watershed is expansive with over 335 square miles. The Jordan River and Boyne River are the largest tributaries contributing nearly 75% of the discharge of all the tributaries to Lake Charlevoix. The Jordan River, a state designated natural river, flows from Antrim County and discharges into Lake Charlevoix in East Jordan. The Boyne River starts in the east side of Charlevoix County and discharges into Lake Charlevoix in Boyne City. Other significant tributaries include Horton, Stover, Porter, and Loeb Creeks. The outflow of Lake Charlevoix is Round Lake and the Pine River which discharge to Lake Michigan. Ground water and precipitation also account for a portion of water inputs to Lake Charlevoix and its tributaries.

The soils in the Lake Charlevoix Watershed vary greatly from steep sandy soils to wet mucky soils. General soils in the headwaters of the Boyne River subwatershed are in the Kalkaska-Leelanau association, the steepest association in the watershed. These soils are well-drained, mainly sloping to steep on the hilly moraines. The predominant soil type found along the streambanks is the Carbondale-Lupton-Tawas association. These are very poorly drained level to gently sloping organic soils in depressional areas on till plains, outwash plains, and lake plains. These soils are indicative of the commonly found shoreline wetlands which are valuable for water quality protection and overall watershed health. Along the lakeshore the predominant soils found are the Kalkaska-Mancelona association which are well-drained to moderately well-drained sandy soils that are nearly level and common in lake plains. The soils that fill in the areas between the tributaries and the lakeshore are dominated by the Emmet-Leelanau association which includes well-drained, sandy soils on moraines with varying steepness from gently rolling to very steep. The work of the glaciers is visible to the eye in the Lake Charlevoix Watershed. The drumlins and moraines created some 10,000 years ago are an important feature of the landscape. The soil type most common in many of the drumlins and moraines is the Emmet-Onaway association, a more loamy soil found in nearly level to very steep areas. Many of the soils in the Watershed are susceptible to erosion.

The Lake Charlevoix Watershed is one of the few areas in Michigan where drumlins are found. The drumlins and moraines run roughly parallel to the lake and the pattern of the ice movement can be identified when looking at topographic maps or aerial photos. The moraines rise in places to 300 feet above the lake level. The beach ridges or lake plains show evidence of the former Great Lake levels of Lake Algonquin and Lake Nipissing. Taking a drive through the Lake Charlevoix Watershed one sees gently rolling hills, productive farmland, excellent swimming areas, large expanses of forest and wetlands, steeply sloped hills, and relatively flat lake plains.

There are numerous state listed threatened and endangered plant and animal species that are found within the Lake Charlevoix Watershed, specific locations can be found through the assistance of the Michigan Natural Features Inventory. Reducing nonpoint source pollution will be beneficial in helping to address the habitat constraints and other factors that are harming these species. Specifically, the common loon and osprey will both benefit from water quality protection and improvements.

The abundance and diversity of significant natural resources in the Lake Charlevoix Watershed is extensive. From high quality cedar swamps, scenic views, and the home to many threatened and endangered plants and animals–protecting the water quality through watershed management is very important to protecting the overall health of the Watershed.