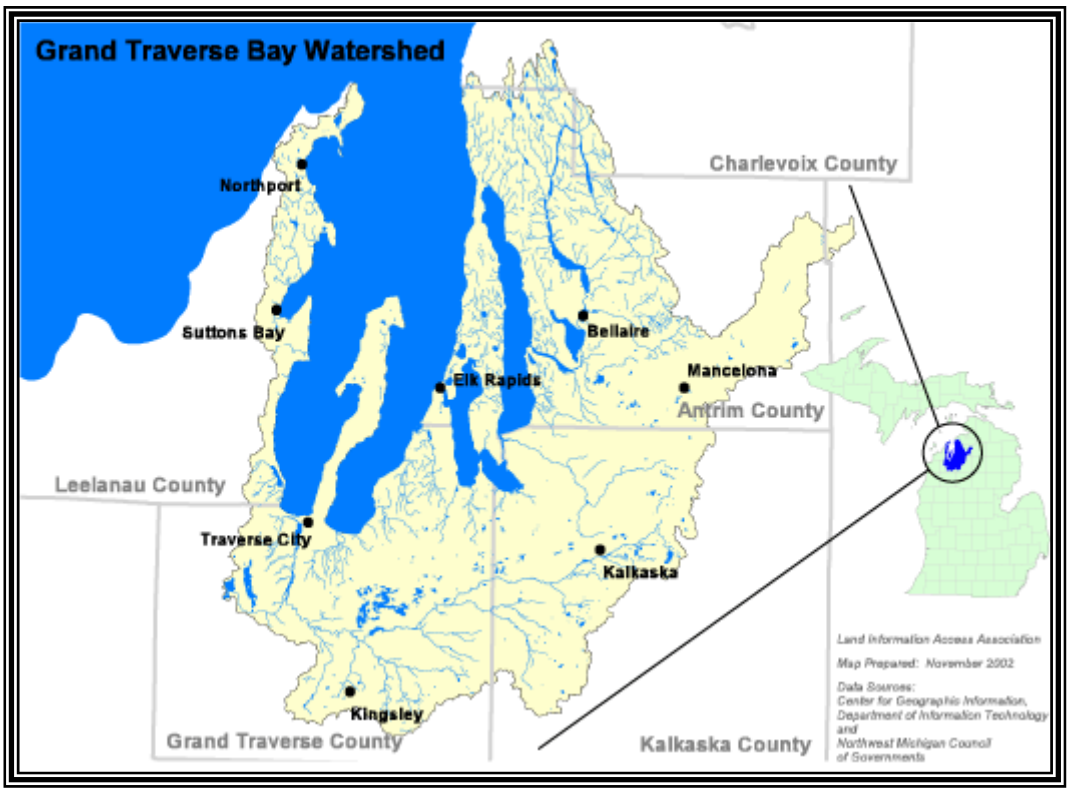
GRAND TRAVERSE BAY WATERSHED PROTECTION PLAN



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GRAND TRAVERSE BAY WATERSHED PROTECTION PROJECT PARTNERS

The Watershed Center Grand Traverse Bay
Michigan Department of Environmental Quality
Conservation Resource Alliance
Land Information Access Association
Peninsula Township
Northwest Michigan Council of Governments
Northwestern Michigan College Business Research Services
Grand Traverse Regional Land Conservancy
Leelanau Conservancy
Grand Traverse Regional Math, Science, and Technology Center
Antrim Conservation District
Grand Traverse Conservation District
Kalkaska Conservation District
Leelanau Conservation District
Natural Resources Conservation Service
Grand Traverse Band of Ottawa and Chippewa Indians
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Michigan State University
Michigan State University – Michigan Sea Grant Program
Michigan Groundwater Stewardship Association
Antrim County
Grand Traverse County
Kalkaska County
Leelanau County
Garfield Township
Acme Township
City of Traverse City
Silver Lake Association
Elk River Chain of Lakes Steering Committee

CHAPTER 1 EXECUTIVE SUMMARY

Introduction

The Grand Traverse Bay watershed is one of the premier tourist and outdoor recreation regions in the State of Michigan. Its natural resource base and beauty contributes significantly to the quality of life enjoyed by year round residents accounting for the area's continued growth and prosperity. However, with the rewards of economic achievement come the telling signs of environmental degradation. The same resource base that contributed to this region's desirability as a place to live and work is now under considerable pressure to support continued development.

Watershed Characteristics

The Grand Traverse Bay watershed is located in beautiful northwest Michigan's lower peninsula and drains approximately 976 square miles of land. The watershed covers major portions of four counties: Antrim, Grand Traverse, Kalkaska, and Leelanau. The largest municipality in the watershed is the City of Traverse City. Other towns and villages in the watershed include Northport, Suttons Bay, Kingsley, Acme, Kalkaska, Mancelona, Bellaire, and Elk Rapids. Grand Traverse Bay comprises 132 miles of Lake Michigan shoreline from its northwest tip at the Leelanau lighthouse to its northeast tip at Norwood. The bay spans 10 miles at its widest point, stretches a lengthy 32 miles to its base in Traverse City, and has its deepest point at 590 feet.

The watershed may be broken up into nine distinctive major drainage basins: Elk River Chain of Lakes, Boardman River, Mitchell Creek, Acme Creek, Ptobego Creek, Yuba Creek, East Bay shoreline and tributaries, West Bay shoreline and tributaries, and the Old Mission Peninsula. Section 3.9 gives more detail on each of these subwatersheds. In addition to the six major rivers and creeks entering the bay (Elk, Boardman, Mitchell, Acme, Ptobego, and Yuba), it has been estimated that there are more than 100 additional small streams that enter the bay draining portions of the watershed.

Rich in land and water resources, the Grand Traverse Bay watershed is home to more than 110,000 people sharing their living space with black bear, deer, great blue herons, lady slippers and trillium. Population densities in Grand Traverse Bay watershed are the greatest in the Traverse City region, along the Bay's shoreline, and along the large lakes in the Elk River Chain of Lakes. By far, Traverse City and its surrounding townships are the most highly populated areas of the entire region, with population densities reaching up to 1,730 people per square mile. The Grand Traverse Bay region is currently experiencing tremendous population growth and development pressure, with a predicted 40% increase in population by 2020. Two of the three fastest growing counties in the state, Grand Traverse and Leelanau, are located within watershed boundaries. In addition, the area is one of the most popular tourist destinations in the Midwest, with growing numbers of visitors each year.

Land use and land cover in the watershed is predominantly forest (50%) and agriculture (20%). Other land uses include: open shrub/grassland, water, wetlands, and urban. Patches of forests occur regularly throughout the watershed with the bulk occurring in the Pere Marquette State

Forest (found in the upper Boardman River watershed) and the headwater areas in the Elk River Chain of Lakes watershed. Agricultural lands in the watershed consist mostly of row crops and orchards and vineyards. Apple and cherry orchards and wine producing vineyards dominate agricultural land uses surrounding the bay while row crops (i.e., potatoes, hay, corn, small grains, etc.) are mainly found in outlying watershed areas of Antrim, Kalkaska, and Grand Traverse Counties.

The Protection Planning Process

In September 2001, The Watershed Center Grand Traverse Bay received a watershed management planning grant for the Grand Traverse Bay watershed from the U.S. Environmental Protection Agency and the Michigan Department of Environmental Quality. The grant and awarded funds were authorized by Section 319 of the federal Clean Water Act and were used to develop this protection plan for the Grand Traverse Bay watershed.

The Grand Traverse Bay Watershed Protection Plan provides a description of the watershed (including such topics as bodies of water, population, land use, municipalities, and recreational activities), summarizes each of the nine subwatersheds to Grand Traverse Bay, and outlines current water quality conditions in the bay. Within the two-year development phase of the protection plan, water quality threats were identified and efforts to address these issues were researched, developed, and prioritized.

Designated Uses and Their Pollutants, Sources, and Causes

Michigan water quality standards and identified designated uses for Michigan surface waters were used to assess the condition of the watershed. Each of Michigan's surface waters is protected by Water Quality Standards for specific designated uses *(R323.1100 of Part 4, Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended)*. These standards and designated uses are designed to 1) protect the public's health and welfare, 2) to enhance and maintain the quality of water, and 3) to protect the state's natural resources. Protected designated uses as defined by Michigan's Department of Environmental Quality include: agricultural, industrial water supply, public water supply (at point of intake), navigation, warm water and/or cold water fishery, other indigenous aquatic life and wildlife support, and partial and total body contact recreation.

None of the designated uses for the Grand Traverse Bay watershed are impaired on a watershed wide scale. However, in some cases, activities and resulting pollutants in the watershed may prove to be a threat to water quality and designated uses. Threatened waterbodies are defined as those that currently meet water quality standards, but may not in the future. The Grand Traverse Bay Watershed Protection Plan will focus on five designated uses to protect in order to maintain water quality throughout the Grand Traverse Bay and its watershed. The designated uses include the cold water fishery, other indigenous aquatic life, total body contact, navigation, and public water supply at point of intake. Threatened designated uses were ascertained through scientific research reports, existing subwatershed management plans, DEQ water quality reports, field observations by the Project Coordinator, steering committee members, and personal contact with watershed residents and scientific experts on the Grand Traverse Bay watershed.

For each designated use to protect in the Grand Traverse Bay watershed there are a number of different pollutants and environmental stressors that adversely affect each of the designated uses, or have the potential to. The term environmental stressor is used to describe those factors that may have a negative effect on the ecosystem, but aren't necessarily categorized as contaminants that change water chemistry. Examples of environmental stressors include changes to hydrologic flow, low dissolved oxygen levels, and loss of habitat.

Sediment and excessive nutrient loading are two of the known factors that are threatening the cold water fishery, aquatic life, and other designated uses in the Grand Traverse Bay watershed. Other pollutants that threaten the watershed's designated uses include thermal pollution, toxins, hydrologic flow, invasive species, pathogens, and loss of habitat. All of these nonpoint source pollutants degrade water quality, destroy aquatic habitat, and reduce the number and diversity of aquatic organisms.

A Comprehensive Watershed Management Table was developed listing sources and causes of watershed pollutants and environmental stressors. This table summarizes key information necessary to begin water quality protection, provides specific targets to act upon for watershed management, and forms the basis for all future implementation projects to protect the quality of the watershed.

It may be used as a reference to distinguish what the major sources of pollutants are on a watershed-wide scale. However, it does not distinguish between pollutants and their sources and causes in individual subwatersheds. Not all of the pollutants listed in the table are a problem everywhere in the watershed. There are differences between the nine subwatersheds making up the Grand Traverse Bay watershed. Each one is unique in the challenges it faces to maintain water quality protection.

An additional Comprehensive Watershed Management Table was developed specifically for the Grand Traverse Bay only. This is because the bay and its watershed are connected, but inherently different. What happens at the extreme outer edges of the watershed will eventually affect the Grand Traverse Bay. However, while the watershed itself encompasses rivers, streams, lakes, and 973 square miles of land, the bay is a large open body of water that is connected to Lake Michigan. Certain pollutants have more of an impact on streams and lakes than on larger bodies of water like the Grand Traverse Bay (i.e., thermal pollution and sediment), but other pollutants are more of a concern for the Grand Traverse Bay and its associated designated uses.

Prioritization of Pollutants

Identified watershed pollutants and sources were ranked and prioritized based on the how they most affect (or have the potential to affect) the watershed's threatened designated uses. Overall, nutrients are a high priority pollutant for both the Grand Traverse Bay and its tributaries, while sediment is a high priority pollutant in the surrounding watershed. Maintaining the low productivity and oligotrophic status for Grand Traverse Bay will require minimizing the amount of nutrients that enter the lake from adjacent properties and tributaries. Nutrients often attach to soil particles, thereby linking sediment and nutrient pollution. Changes to hydrologic flow, mainly due to stormwater inputs are also a concern throughout the watershed. Along with

hydrologic changes, stormwater may carry excessive amount of nutrients, sediments, and toxins to the bay and its tributaries. Additionally, the impact invasive species have on the ecosystem (both currently and in the future) is of great concern for the Grand Traverse Bay. While not a primary concern throughout portions of the watershed just yet, invasive species are already beginning to change the ecosystem and habitat dynamics in Grand Traverse Bay.

The project steering committee noted that it is difficult to rank all the pollutants and their sources in the watershed because all are important and should be priorities for maintaining the health of the bay. The ranking really depends on which area of the watershed is analyzed. In some places, sediment may be the biggest threat, while in others it could be pathogens. Almost always, the pollutants and stressors are interconnected with each other and changes in one causes changes to the others. Additionally, because most of the pollutants and stressors are interconnected, dealing with one source and its causes could actually reduce a number of different pollutants and stressors from affecting a stream or waterbody.

Priority Areas

Priority areas in the Grand Traverse Bay watershed were identified by analyzing the Comprehensive Watershed Management Tables and identifying the major areas where most of the threats to water pollution exist. Priority areas are defined as the portions of the watershed that are most sensitive to environmental impacts and have the greatest likelihood to affect water quality and aquatic habitat. They are areas that may contribute the greatest amount of pollutants to the watershed, either now or in the future, and are considered targets for future water quality improvement efforts. Priority areas for the Grand Traverse Bay watershed include the following areas:

- **Riparian Corridors**: Areas within 1,000 feet of bodies of water.
- **Wetlands**: All wetlands and areas within 1,000 feet of wetlands.
- **City and Village Centers**: Urban areas that drain to surface waters via storm sewers.
- **Headwater Areas**: Areas where there is a greater amount of groundwater recharge.

In addition to the above priority areas, specific priority areas were identified along the Grand Traverse Bay shoreline, throughout the Boardman River watershed, and in Leelanau County. Local land conservancies identified private parcels of land in the Boardman River watershed and Leelanau County for their potential contribution to improving the quality of Grand Traverse Bay and its watershed.

Because of its sheer size and ability to affect the water quality of the bay, the entire shoreline of Grand Traverse Bay is deemed a priority area. As part of the Grand Traverse Bay watershed Planning Project, The Watershed Center (TWC) completed a shoreline inventory of the entire 132-mile shoreline of the Grand Traverse Bay. The Grand Traverse Baykeeper, John Nelson, along with TWC staff and local volunteers, walked and inventoried the bay's shoreline in order to assess the current conditions surrounding the bay. Results for this survey were compiled into a final report and were placed onto TWC's website (www.gtbay.org) into a searchable database.

Watershed Goals, Objectives, and Recommendations

The overall mission for the Grand Traverse Bay Watershed Protection Plan is to provide guidance for the implementation of actions that will reduce the negative impact that pollutants and environmental stressors have on the designated watershed uses. The envisioned endpoint is to have Grand Traverse Bay and all lakes and streams within its watershed support appropriate designated and desired uses while maintaining their distinctive environmental characteristics and aquatic biological communities.

Using suggestions obtained from stakeholder meetings conducted throughout the watershed and examples from other watershed management plans, the project steering committee developed six broad goals for the Grand Traverse Bay watershed. By working to attain these goals and their corresponding objectives, threatened watershed designated uses will be maintained or improved. The watershed goals are as follows:

- Protect the integrity of aquatic and terrestrial ecosystems within the watershed.
- Protect and improve the quality of water resources within Grand Traverse Bay and its watershed.
- Establish and promote land and water management practices that conserve and protect the natural resources of the watershed.
- Enhance the amount and quality of recreational opportunities and support a sustainable local economy.
- Establish and promote educational programs that support stewardship and watershed planning goals, activities, and programs.
- Preserve the distinctive character and aesthetic qualities of the watershed.

In an effort to successfully accomplish the goals and objectives, specific and tangible recommendations, called implementation tasks, were developed based on the prioritization of watershed pollutants, sources, and causes while also looking at the priority areas in the watershed. The implementation tasks represent an integrative approach, combining watershed goals and covering more than one pollutant at times, to reduce existing sources of priority pollutants and prevent future contributions.

Implementation tasks were summarized by the pollutant and/or source it relates to. In this way, organizations may work on a specific issue (i.e., urban stormwater or shoreline restoration) that may contribute more than one type of watershed pollutant and meet more than one watershed goal. The categories are as follows: Shoreline Protection and Restoration; Road Stream Crossings; Agriculture; Hydrology; Habitat, Fish and Wildlife; Stormwater; Wastewater; Human Health; Wetlands; Invasive Species; Land Protection and Management; Development; Zoning and Land Use; Groundwater; Monitoring; Desired Uses; and Evaluation.

Additionally an Information and Education Strategy was developed with specific recommendations which highlight the actions needed to successfully maintain and improve watershed education, awareness, and stewardship for the Grand Traverse Bay watershed. It lays the foundation for the collaborative development of natural resource programs and educational activities for target audiences, community members, and residents.

Priority Tasks and Future Efforts for Implementation

The Watershed Center and other project partners will continue to build partnerships with various groups throughout the watershed for future projects involving the implementation of recommendations made in the protection plan. It is expected that this implementation phase will last 10 years or more. Grant funds and other money sources will be used to 1) continue water quality assessment and monitoring, 2) complete initial implementation tasks and installation of Best Management Practices, and 3) complete initial tasks outlined in the Information and Education Strategy.

Priority tasks that should be conducted over the next 1 – 3 years are as follows, with the most important tasks listed first:

- Establishing stormwater BMPs and ordinances
- Streambank and shoreline erosion surveys and stabilization projects
- Establishing riparian buffers
- Complete road crossing inventories and begin improvements using BMPs
- Inventory current master plans and zoning ordinances; assist townships with developing ordinances that protect water quality and natural resources
- Stormdrain mapping
- Wetland assessment, restoration, and protection
- Initiatives to preserve open space and wildlife corridors
- Continuing monitoring programs
- Developing Conservation Plans for farms

Future efforts for the Grand Traverse Bay Watershed Project include:

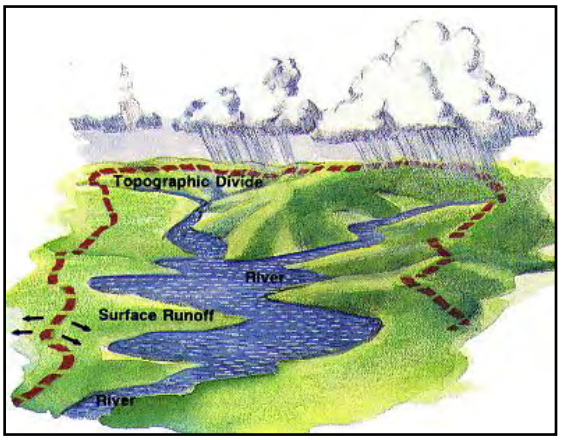
- Building partnerships and seeking funding for implementation activities.
- Completing initial implementation tasks as well as installing BMPs at selected sites.
- Ongoing monitoring to assess environmental conditions.
- Implementing information and education initiatives.
- Compiling results from ongoing research initiatives.

The plan is intended for use by area watershed groups, lake associations, local governments, volunteer groups, and many others and provides recommendations on how to reduce water quality degradation and protect water quality throughout the Grand Traverse Bay watershed.

CHAPTER 2 INTRODUCTION

The Grand Traverse Bay area is one of the premier tourist and outdoor recreation regions in the State of Michigan. Its natural resource base and beauty contributes significantly to the quality of life enjoyed by year round residents, which accounts for the area's continued growth and prosperity. However, with the rewards of economic achievement come the telling signs of environmental degradation. The same resource base that contributed to this region's desirability as a place to live and work is now under considerable pressure from continued development.

The watershed contains major parts of four counties and more than 50 municipalities and townships. In order to maintain the quality of our resource, local governments, concerned citizens, and numerous agencies all need to work together towards a common goal – protecting the Grand Traverse Bay and its watershed from further environmental degradation.



The Grand Traverse Bay watershed itself is defined as the area of land that captures rainfall and other precipitation and funnels it to Grand Traverse Bay.

How does the quality of water in our area affect us individually, and why should we care? These are questions that environmental agencies have been dealing with for years. How can we get people to care and learn about their water quality and consider how their individual actions may affect it? The answer is simple; our lives are tied to water by many different threads. The primary thread is that humans need clean, drinkable water to live. The drinking water that we rely upon may become contaminated by a number of chemicals and pollutants (like fertilizers, pesticides, and gasoline) that we and others use everyday and don't think about. Additionally, new and emerging issues involving pharmaceuticals and other medical wastes in our water supply are just beginning to be researched.

What about the water and watershed that we recreate in? Healthy ecosystems are why people love to live here. Many people live in the Grand Traverse Bay region because of the numerous forms of recreation it provides. But, if pollution is unchecked and degradation of our natural resources continues, many of the activities we like to do will be in jeopardy. Contamination of our streams, lakes, and bay from numerous sources may lead to unsafe swimming and blooms of aquatic plants, which are an annoyance to swimmers and boaters. Recreational fishing is also impacted by water pollution; many inland lakes already have fish consumption advisories due to heavy metal contamination. Other forms of recreation that many of us enjoy on a daily basis are at stake as well, including swimming, kayaking, canoeing, and even hiking.

A public telephone survey conducted in Summer 2002 reveals that 60% of the people living in the Grand Traverse Bay region don't know which watershed they live in. Many don't even know what a watershed is. However, most people in the area use water for recreation, inherently

tying them to our precious resource. It is imperative that we educate our residents and visitors about our watershed, let them know what is impacting our resource, and educate them on what they can do to help make the Grand Traverse Bay watershed a place where they want to live and come back to time and time again.

In September 2001, The Watershed Center Grand Traverse Bay received a watershed management planning grant for the Grand Traverse Bay watershed from the U.S. Environmental Protection Agency and the Michigan Department of Environmental Quality. The grant and awarded funds were authorized by Section 319 of the federal Clean Water Act and were used to develop this protection plan for the Grand Traverse Bay watershed.

The protection plan summarizes existing water quality conditions in and around the bay while also outlining the major watershed pollutants and recommendations on how to reduce the impact and amount of pollution entering the system. The plan provides a description of the watershed including such topics as bodies of water, population, land use, municipalities, and recreational activities; summarizes each of the nine subwatersheds to Grand Traverse Bay; and outlines current water quality conditions in the bay. Within the two-year development phase of the Grand Traverse Bay Watershed Protection Plan, water quality threats were identified and efforts to address these issues were researched, developed, and prioritized. More information on the plan development process can be found in Appendix A. A detailed evaluation of the project's progress is contained in Appendix B.

This plan is intended for use by area watershed groups, lake associations, local governments, volunteer groups, and many others. It provides recommendations on how to reduce water quality degradation and protect our valuable resource, the Grand Traverse Bay watershed.

CHAPTER 3 DESCRIPTION OF THE GRAND TRAVERSE BAY WATERSHED

3.1 Location and Size

The Grand Traverse Bay watershed is located in beautiful northwest Michigan's lower peninsula and drains approximately 976 square miles of land. The watershed is one of the larger ones in the State of Michigan and covers major portions of four counties: Antrim, Grand Traverse, Kalkaska, and Leelanau (Table 1). The largest municipality in the watershed is the City of Traverse City. Other towns and villages in the watershed include Northport, Suttons Bay, Kingsley, Acme, Kalkaska, Mancelona, Bellaire, and Elk Rapids (Figure 1).

TABLE 1: COUNTIES LOCATED IN THE GRAND TRAVERSE BAY WATERSHED

County	Area (mi^2)	Area in Watershed (mi^2)	% County in Watershed	% Watershed per County
Leelanau	375.7	66.6	17.7%	6.8%
Grand Traverse	490.3	296.0	60.4%	30.3%
Kalkaska	571.0	212.6	37.2%	21.8%
Antrim	524.5	378.6	72.2%	38.8%
Charlevoix	453.9	19.0	4.2%	2.0%
Otsego	527.3	3.2	0.6%	0.3%
TOTAL	2942.7	976.0		

Grand Traverse Bay comprises 132-miles of Lake Michigan shoreline from its northwest tip at the Leelanau lighthouse to its northeast tip at Norwood. The bay spans 10 miles at its widest point, stretches a lengthy 32 miles to its base in Traverse City, and has its deepest point at 590 feet (Figure 1). Grand Traverse Bay is one of the few remaining oligotrophic embayments in the Great Lakes and arguably has the highest water quality of the larger Lake Michigan bays. Oligotrophic is a term applied to lakes that are typically low in accumulated nutrients and high in dissolved oxygen, both of which are characteristics of high quality waters. Lakes such as these are clear and blue and most often cold, much like the Grand Traverse Bay.

Figure 1: Location and Size

3.2 Water Bodies

The watershed may be broken up into nine distinctive major drainage basins, referred to as subwatersheds (Table 2, Figure 2). These subwatersheds are the: Elk River Chain of Lakes, Boardman River, Mitchell Creek, Acme Creek, Ptobego Creek, Yuba Creek, East Bay shoreline and tributaries, West Bay shoreline and tributaries, and the Old Mission Peninsula. Section 3.9 gives more detail on each of these subwatersheds. In addition to the six major rivers and creeks entering the bay (Elk, Boardman, Mitchell, Acme, Ptobego, and Yuba), it has been estimated that there are more than 100 additional small streams that enter the bay draining portions of the watershed (Shoreline Inventory, Appendix C).

TABLE 2: SUBWATERSHEDS IN THE GRAND TRAVERSE BAY WATERSHED

Basin	SQUARE MILES	% of Watershed
1. Elk River Chain of Lakes	502.6	51.5
2. Boardman River	283.8	29.1
3. West Bay Shoreline and Tributaries	68.0	7.0
4. East Bay Shoreline and Tributaries	38.8	4.0
5. Old Mission Peninsula	31.3	3.2
6. Mitchell Creek	15.7	1.6
7. Ptobego Creek	14.2	1.5
8. Acme Creek	13.2	1.4
9. Yuba Creek	8.4	0.9
Total	976.0	100.0

Figure 2: Subwatersheds

3.3 Population

Rich in land and water resources, the Grand Traverse Bay watershed is home to more than 110,000 people sharing their living space with black bear, deer, great blue herons, lady slippers and trillium. Population densities in Grand Traverse Bay watershed are the greatest in the Traverse City region, along the bay's shoreline, and along the large lakes in the Elk River Chain of Lakes (Figure 3). By far, Traverse City and its surrounding townships are the most highly populated areas of the entire region, with population densities reaching up to 1,730 people per square mile.

Population in the Grand Traverse Bay region started increasing rapidly in the 1970s. Populations in watershed counties increased by more than 50% between 1970 and 1990, reaching as high as 156% for Kalkaska County (Tables 3 and 4). Between 1990 and 2000, populations in all the surrounding counties increased between 20-27% (Table 3). Going back further, populations in counties containing major portions of the watershed (Antrim, Grand Traverse, Kalkaska, and Leelanau) have increased an average of 153% since 1900. Grand Traverse County alone has seen a startling 280% increase in population, almost tripling its inhabitants since 1900 (Table 4). It is evident that the fastest population growth, and corresponding development, is currently occurring along major lakefront areas (i.e., Grand Traverse Bay, Elk Lake, and Torch Lake) as well as in townships located just outside major city and village boundaries, indicating increasing sprawl in those areas (Figure 4).

TABLE 3: PERCENT POPULATION CHANGE FOR SELECTED YEARS

County	% Change 1900 - 1950	% Change 1950 - 1970	% Change 1970 - 1990	% Change 1990 - 2000
Antrim	35.3	17.6	44.2	27.1
Grand Traverse	39.7	37.0	64.1	20.8
Kalkaska	35.6	14.7	156.0	22.8
Leelanau	18.1	25.7	52.0	27.8
Total	4.0	29.2	65.6	23.1

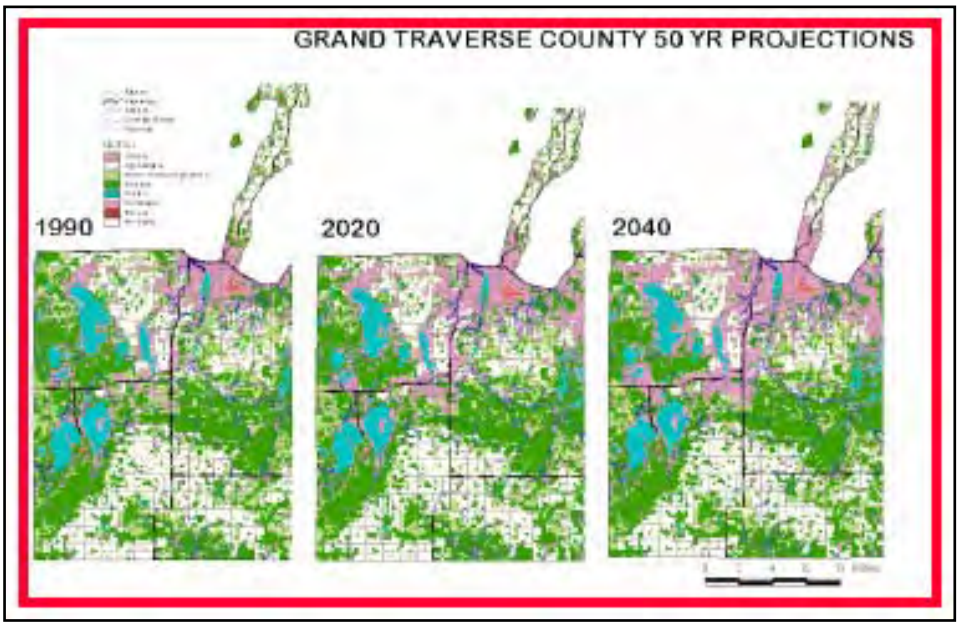
TABLE 4: CURRENT AND HISTORIC POPULATION BY COUNTY

County	1900	1950	1970	1990	2000	% Change 1900 - 2000
Antrim	16,568	10,721	12,612	18,185	23,110	39.5
Grand Traverse	20,479	28,598	39,175	64,273	77,654	279.2
Kalkaska	7,133	4,597	5,272	13,497	16,571	132.3
Leelanau	10,556	8,647	10,872	16,527	21,119	100.1
Total	54,736	52,563	67,931	112,482	138,454	153.0

*Note: Since US Census Data does not follow watershed boundaries, populations from the four major counties making up the Grand Traverse Bay watershed were used to illustrate changes in population.

The Grand Traverse Bay region is currently experiencing tremendous population growth and development pressure, with a predicted 40% increase in population by 2020. Two of the three fastest growing counties in the state, Grand Traverse and Leelanau, are located within watershed boundaries. In addition, the area is one of the most popular tourist destinations in the Midwest, with growing numbers of visitors each year.

A recently developed model by researchers at Michigan State University has projected future urban land uses and development in the Grand Traverse Bay watershed through 2020 and 2040. Termed the Land Transformation Model, it couples Artificial Neural Network (ANN) routines to GIS databases containing information on population growth, transportation factors, and locations of important landscape features such as rivers, lakes, recreational sites, and high-quality vantage points to forecast future land use patterns. The model then predicts where development will occur and how much area will be classified as urban in the future. For more information on the Land Transformation Model, see the following publications: Pijanowski et al. (in press); Pijanowski et al., 1996; Pijanowski et al., 2000; and Boutt et al. 2001.



Urban land use projections for Grand Traverse County using MSU's Land Transformation Model. Urban use is illustrated in pink. (From Figure 4 in Pijanowski et al. 2001)

Future urban development in Grand Traverse County is anticipated along the US 31 highway that runs east-west past the large lakes in the county. In addition, urban development up the Old Mission Peninsula is also possible. Urban development along the northwestern portions of the county, near 3 and 4 Mile Roads, is also anticipated.

Urban growth puts tremendous pressure on the area's natural resources, particularly its water resources. Many of the threats to our watershed's environmental health are a direct result of this growth.

Figure 3: Population Density (Census 2000) by Minor Civil Divisions

Figure 4: Population Change from 1990-2000 by Minor Civil Divisions

3.4 Jurisdictions

There are 44 townships and 11 municipalities that have all or some of their boundaries located within the Grand Traverse Bay watershed (Table 5, Table 6, Figure 5). Since the watershed crosses so many political boundaries, it is important for local governments to know and understand watershed boundaries and to plan on a watershed scale with neighboring townships and municipalities.

How communities manage their land use has a direct impact on the community's water resources. Zoning, master plans, and special regulations are a few of the more commonly used land management tools. Zoning ordinances establish the pattern of development, protect the environment and public health, and determine the character of communities. Since protecting water quality requires looking at what happens on land, zoning is an important watershed management tool.

Zoning's effectiveness depends on many factors, particularly the restrictions in the language, the enforcement, and public support. Many people believe the law protects sensitive areas, only to find otherwise when development is proposed. Zoning can be used very effectively for managing land uses in a way that is compatible with watershed management goals.

Michigan has six planning and zoning enabling acts that provide broad authority for the use of a wide range of local planning and zoning techniques. In addition, a community can sometimes draw authority from a regulatory act or a charter, or a general police power statute.

Statewide Survey of Elected and Township Officials (by MSUE Victor Institute)

In spring 2002, Michigan State University Extension conducted a statewide survey of local officials to assess their perspectives on land use issues and decision-making as well as educational needs. One set of surveys was sent to county commissioners, county planning and zoning commissioners, township supervisors, trustees, and other township personnel (Suvedi et al. November 2002). Another set was sent to just township officials including: supervisors, administrators, trustees, and other personnel (Suvedi et al. December 2002). Results of these surveys indicate that more than 75% of all respondents expect growth pressures to increase significantly in the next five years. When indicating the top ten future problems facing local governments, seven of the top ten were related to growth and water resource issues, indicating a strong concern for protection of natural resources by local officials:

Growth issues

- Loss of open spaces for other uses
- Loss of forestland
- Loss of farmland
- Beginning of suburban sprawl

Water Resource Issues:

- Ground water quality
- Surface water quality
- Over development of lakeshores

As far as barriers to meeting land use challenges in local governments, more than 60% of both survey respondents ranked "poor public understanding of land use issues" and "poor public

support for difficult land use decisions" as the top two reasons. This clearly indicates a strong need for public education to increase awareness of land use issues throughout local governments in the state.

TABLE 5: TOWNSHIPS AND MUNICIPALITIES IN THE GRAND TRAVERSE BAY WATERSHED

County	TOWNSHIPS	Municipalities
Leelanau	4	2
Grand Traverse	12	3
Kalkaska	9	1
Antrim	15	5
Charlevoix	3	0
Otsego	1	0
Total	44	11

TABLE 6: SUBWATERSHEDS AND AREAS OF TOWNSHIPS AND MUNICIPALITIES IN THE GRAND TRAVERSE BAY WATERSHED

Township or Municipality	Subwatershed	Total Area (mi^2)	Total Area in Watershed (mi^2)	% of Township or Municipality in Watershed
Leelanau County				
Bingham	West Bay Shoreline	26.09	10.22	39.2%
Elmwood	West Bay Shoreline	20.67	10.49	50.7%
Leelanau	West Bay Shoreline	41.17	26.76	65.0%
Suttons Bay	West Bay Shoreline	23.96	15.89	66.3%
Village of Northport	West Bay Shoreline	1.89	1.89	100.0%
Village of Suttons Bay	West Bay Shoreline	1.02	1.02	100.0%
Kalkaska County				
Boardman	Boardman River	36.22	35.35	97.6%
Clearwater	Chain of Lakes	33.79	33.79	100.0%
Coldsprings	Boardman River Chain of Lakes	36.31	16.82	46.3%
Excelsior	Boardman River	36.21	7.90	21.8%
Garfield	Boardman River	106.73	0.37	0.3%
Kalkaska	Boardman River Chain of Lakes	69.56	65.95	94.8%
Orange	Boardman River	34.79	8.08	23.2%
Rapid River	Boardman River Chain of Lakes	35.24	35.24	100.0%
Springfield	Boardman River	35.56	7.41	20.8%
Village of Kalkaska	Boardman River Chain of Lakes	1.66	1.66	100.0%

TABLE 6: SUBWATERSHEDS AND AREAS OF TOWNSHIPS AND MUNICIPALITIES IN THE GRAND TRAVERSE BAY WATERSHED CONT'D

Township or Municipality	Subwatershed	Total Area (mi^2)	Total Area in Watershed (mi^2)	% of Township or Municipality in Watershed
Grand Traverse County				
Acme	Acme Creek Chain of Lakes East Bay Shoreline Ptobego Creek Yuba Creek	24.17	24.17	100.0%
Blair	Boardman River Mitchell Creek	36.04	19.21	53.3%
East Bay	Acme Creek Boardman River East Bay Shoreline Mitchell Creek Old Mission Penin.	42.56	42.56	100.0%
Fife Lake	Boardman River	35.18	10.79	30.7%
Garfield	Boardman River Mitchell Creek Old Mission Penin. West Bay Shoreline	28.08	27.28	97.2%
Green Lake	Boardman River	36.41	0.91	2.5%
Long Lake	Boardman River	35.54	2.35	6.6%
Mayfield	Boardman River	36.05	7.05	19.5%
Paradise	Boardman River	52.11	34.24	65.7%
Peninsula	Old Mission Penin.	28.02	28.02	100.0%
Union	Boardman River	36.00	36.00	100.0%
Whitewater	Acme Creek Boardman River Chain of Lakes Ptobego Creek Yuba Creek	54.63	54.63	100.0%
Village of Fife Lake	Boardman River	0.76	0.01	0.9%
City of Traverse City (City is partially located in Leelanau County)	Boardman River Mitchell Creek Old Mission Penin. West Bay Shoreline	8.31	8.31	100.0%
Village of Kingsley	Boardman River	0.81	0.81	100.0%

TABLE 6: SUBWATERSHEDS AND AREAS OF TOWNSHIPS AND MUNICIPALITIES IN THE GRAND TRAVERSE BAY WATERSHED CONT'D

Township or Municipality	Subwatershed	Total Area (mi^2)	Total Area in Watershed (mi^2)	% of Township or Municipality in Watershed
Antrim County				
Banks	Chain of Lakes East Bay Shoreline	45.03	43.52	96.6%
Central Lake	Chain of Lakes	30.46	30.46	100.0%
Chestonia	Chain of Lakes	35.58	11.11	31.2%
Custer	Chain of Lakes	35.14	35.14	100.0%
Echo	Chain of Lakes	35.34	26.13	73.9%
Elk Rapids	Chain of Lakes East Bay Shoreline Ptobego Creek	8.96	8.96	100.0%
Forest Home	Chain of Lakes	32.85	32.85	100.0%
Helena	Chain of Lakes	22.71	22.71	100.0%
Jordan	Chain of Lakes	35.19	0.51	1.4%
Kearney	Chain of Lakes	34.63	34.38	99.3%
Mancelona	Chain of Lakes	70.40	33.32	47.3%
Milton	Chain of Lakes East Bay Shoreline	41.14	41.14	100.0%
Star	Chain of Lakes	34.33	21.67	63.1%
Torch Lake	Chain of Lakes East Bay Shoreline	20.65	20.65	100.0%
Warner	Chain of Lakes	35.59	9.52	26.8%
Village of Bellaire	Chain of Lakes	1.44	1.44	100.0%
Village of Central Lake	Chain of Lakes	1.25	1.25	100.0%
Village of Elk Rapids	Chain of Lakes East Bay Shoreline Ptobego Creek	1.99	1.99	100.0%
Village of Ellsworth	Chain of Lakes	0.82	0.82	100.0%
Village of Mancelona	Chain of Lakes	1.00	1.00	100.0%

TABLE 6: SUBWATERSHEDS AND AREAS OF TOWNSHIPS AND MUNICIPALITIES IN THE GRAND TRAVERSE BAY WATERSHED CONT'D

Township or Municipality	Subwatershed	Total Area (mi^2)	Total Area in Watershed (mi^2)	% of Township or Municipality in Watershed
Charlevoix County				
Marion	Chain of Lakes	26.49	7.40	27.9%
Norwood	East Bay Shoreline	18.28	0.88	4.8%
South Arm	Chain of Lakes	33.05	10.70	32.4%
Otsego County				
Elmira	Chain of Lakes	36.27	3.23	8.9%

Figure 5: Townships, Cities, and Villages

3.5 Land Use/Land Cover

Land use and land cover in the watershed is predominantly forest (50%) and agriculture (19%). Other land uses include: open shrub/grassland, water, wetlands, and urban (Figure 6, Table 7). Patches of forests occur regularly throughout the watershed with the bulk occurring in the Pere Marquette State Forest (found in the upper Boardman River watershed) and the headwater areas in the Elk River Chain of Lakes watershed.

Agricultural lands in the Grand Traverse Bay watershed consist mostly of row crops and orchards/vineyards (Table 8). Fruit orchards of cherries and apples as well as vineyards dominate agricultural land uses surrounding the bay (Figure 7). Row crops (i.e., potatoes, hay, corn, small grains, etc.) are mainly found in outlying watershed areas of Antrim, Kalkaska, and Grand Traverse Counties.

Cherries are a major agricultural crop in the Grand Traverse Bay Watershed.

Land use and land cover percentages for each of the nine subwatersheds in the Grand Traverse Bay watershed were calculated (Table 9). Old Mission Peninsula has the highest percentage of orchards and vineyards, which cover almost 45% of its area. Ptobego Creek has the highest percentage of croplands (28%), however, 26% is also covered by orchards and vineyards, making more than half of the subwatershed covered by agriculture. By far, the Boardman River and Acme Creek watersheds contain the highest percentage of forested lands compared to its watershed size, 64% and 68% respectively.

Urban areas are centered on Traverse City, Kalkaska, Mancelona, and Elk Rapids. Additionally, waterfront property along the bay and many inland lakes has also been a hotspot for the development of residential housing and businesses (Figure 6). Highly urbanized areas such as Traverse City, Elk Rapids, Acme and East Bay Townships may cover more than one subwatershed. Because of this, local governments should be aware of watershed boundaries when planning for future development and stormwater issues.

Municipality	Watersheds Encompassed
Traverse City	Boardman River, Mitchell Creek, Old Mission Peninsula, West Bay Shoreline
Village of Elk Rapids	Chain of Lakes, East Bay Shoreline, Ptobego Creek
Acme Township	Acme Creek, Chain of Lakes, East Bay Shoreline, Ptobego Creek, Yuba Creek
East Bay Township	Acme Creek, Boardman River, East Bay Shoreline, Mitchell Creek, Old Mission Peninsula

TABLE 7: LAND USE/LAND COVER IN THE GRAND TRAVERSE BAY WATERSHED

Land Use/Cover Type	Percentage of Watershed
Forested	49.8
Agriculture	19.4
Open Shrub and Grassland	14.8
Urban (Residential, Commercial, etc.)	6.8
Water (Lakes, Ponds, Rivers, etc.)	6.6
Wetlands	2.6
Barren (Beach, Sand Dune, Exposed Rock, etc.)	0.1

TABLE 8: AGRICULTURAL LAND USE IN THE GRAND TRAVERSE BAY WATERSHED

Type of Agriculture	Percentage of Watershed
Cropland	13.8
Orchards and Vineyards	4.9
Confined Feeding	0.0
Permanent Pasture	0.6
Other Agricultural Lands	0.1

TABLE 9: PERCENT LAND USE/LAND COVER IN SUBWATERSHEDS

LAND USE	West Bay	Old Miss.	East Bay	Boardman	Mitchell	Acme	Yuba	Ptobego	ERCOL
Agriculture	26.4	45.5	26.8	14.5	29.4	7.1	36.9	55.7	17.7
Cropland	*6.2*	*0.5*	*15.8*	*13.2*	*20.1*	*3.0*	*17.4*	*28.0*	*15.5*
Orchard and Vineyard	*20.0*	*44.8*	*9.0*	*0.6*	*8.4*	*4.1*	*18.1*	*26.4*	*1.5*
Confined Feeding	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*	*0.2*	*0.0*	*0.0*
Permanent Pasture	*0.2*	*0.1*	*1.7*	*0.5*	*0.7*	*0.0*	*1.1*	*1.3*	*0.6*
Other Agric.	*0.0*	*0.1*	*0.3*	*0.1*	*0.1*	*0.1*	*0.1*	*0.0*	*0.1*
Urban	11.3	20.0	10.8	6.5	16.0	11.5	10.7	4.0	4.7
Open Shrub or Grassland	19.8	10.6	14.7	10.3	25.4	9.8	22.7	11.7	16.7
Forested	35.1	22.5	40.8	64.8	23.1	69.3	23.0	19.8	47.3
Water	1.3	0.2	2.3	2.1	0.1	0.1	0.0	1.2	11.2
Wetlands	6.1	1.0	4.3	1.7	5.9	2.1	6.6	6.8	2.4
Barren	0.1	0.1	0.3	0.1	0.0	0.0	0.1	0.7	0.0

<u>Note on Land Use Data:</u> The age of land use data for the watershed varies from county to county. The most recent data available for Antrim and Kalkaska Counties is from 1978. However, Antrim County updated their land use in 1998; improvements are being made to this data and it will be available to the public in January 2004. Publicly available data for Grand Traverse County is from 1990, with 2000 data available for a fee. Otsego and Charlevoix

Counties have data from 1998, and Leelanau County has data as recent as 2000. Since the age of land use data varies so much, it is important to note that the land use percentages in the above tables may be slightly different from what is actually seen on the ground today. For example, some of the agricultural land may now be fallow and some agricultural and forested lands may now be developed.

Additional Wetland Data

An additional study to identify potential wetland areas, combining different sources of wetland information using Geographic Information Systems (GIS) software, was recently completed by the NWMCOG through the Special Wetland Area Management Project (SWAMP), coordinated by the Michigan Department of Environmental Quality (DEQ). The dataset is a composite of three sources of wetland information:

1. The National Wetland Inventory (NWI), conducted by the U.S. Fish and Wildlife Service.
2. The U.S. Soil Conservation Service Soil Survey, which identifies hydric soils and soils with hydric inclusions and/or components.
3. The Michigan Resource Inventory System (MIRIS) Land Cover interpretation from aerial photographs.

Looking at the data below, the total wetland area in the Grand Traverse Bay watershed is approximately 126 mi^2 or 12.6% of the total watershed area, compared to only 2.6% using only the county land use data (Table 10, Figure 8). These data provide a useful tool in determining the location of potential wetland areas, but because the data has not been field checked, it does not guarantee the presence or absence of a wetland. It should be used only for general planning purposes.

TABLE 10: COMPOSITE WETLAND AREAS IN THE GRAND TRAVERSE BAY WATERSHED

Subwatershed	Area (mi^2)	% Composite Wetlands from SWAMP Survey	% Wetlands from County Land Use Data
West Bay Shoreline	10.89	16.0	6.1
Old Mission Peninsula	1.40	4.5	1.0
East Bay Shoreline	11.46	29.6	4.3
Boardman River	43.55	15.3	1.7
Mitchell Creek	3.68	23.5	5.9
Acme Creek	0.93	7.1	2.1
Yuba Creek	1.90	22.7	6.6
Ptobego Creek	2.93	20.6	6.8
Elk River	48.78	9.7	2.4
TOTAL	**125.50**	**12.9**	**2.6**

NWMCOG Disclaimer: The composite wetland data has not been field checked and should only be used for general planning purposes. This data should be used to supplement a field inventory by a qualified wetland expert. This data is not a complete inventory of all the wetlands in this area. Regulated wetlands areas may exist that are not included on this dataset.

Figure 6: Land Use and Land Cover

Figure 7: Agricultural Land Use

Figure 8: Composite Wetlands (from SWAMP)

History of Land Use in the Grand Traverse Region*:*

(Excerpted portions from The Watershed Center's "State of the Bay 2000 CD Resource Guide.")

The land known today as the Grand Traverse region began to be settled by Europeans in the mid-19th century. The new settlers joined the Ojibwa (also referred to as Chippewa, an English mispronunciation) and Ottawa (pronounced O-dah-wah) who made this land their home for generations prior, subsisting on hunting, fishing, gathering wild foods, and raising crops such as beans, corn, and squash.

The opening of the Erie Canal in 1825 between Albany and Buffalo created a new water highway, making the largely undeveloped lands of Michigan accessible to those traveling along the all-water route between Buffalo and Chicago.

The new settlers of the region found wealth in the land's virgin forests. Ancient forests of white pine, white cedar, maple, beech, and hemlock were cut, taken to sawmills, and then used for construction, tools, barrels, and fuel. Hardwoods were also used for processing steel. Fueling docks were established along the region's shoreline to supply passing steamships with wood for fuel. The forest products industry dominated the region's economy until the turn of the century, when it became apparent that the logging industry could not be sustained at its previous levels.

Photos courtesy of the Leelanau Historical Museum and Grand Traverse Pioneer & Historical Society

The abundance of fish in the waters of Lake Michigan and the inland lakes provided an important source of food both for the Native American and pioneer settlers. The Native peoples fished using fiber nets, spears and hooks. Offshore shoals were spawning grounds for lake trout and whitefish in the spring and sturgeon and northern pike in the fall. In the warmer waters of the inland lakes were yellow perch, largemouth and smallmouth bass, and northern pike. Later, residents harvested these fish for everyday use and later caught and exported lake trout and whitefish to cities in the east. Commercial fishing was one of the region's first industries, and sport fishing became a popular pastime of residents and visitors.

Photo Courtesy of the Leelanau Historical Museum

Agriculture began as an industry in the Grand Traverse Region in the late 1800s. Over the years, the major crops have included potatoes and a wide variety of fruits including apples, cherries, peaches, raspberries, cranberries, and more recently, grapes for wine.

Photos Courtesy of the Grand Traverse Pioneer & Historical Society

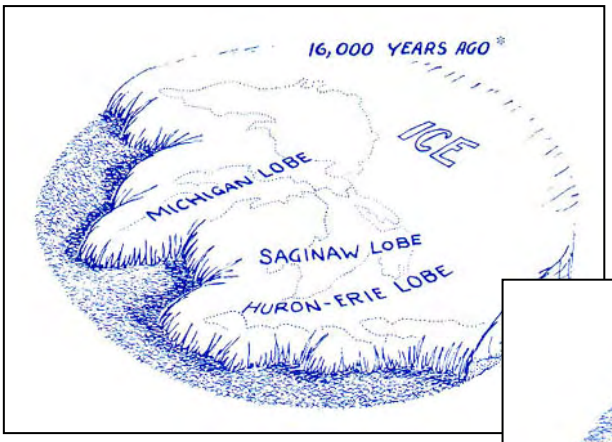
Food processing developed around the region's crops; Hannah Lay & Co. established a grist mill on the Boardman River, canning factories were needed for the cherry harvest, and apples were turned into cider, juice, jelly, and butter.

Photos Courtesy of the Grand Traverse Pioneer and Historical Society

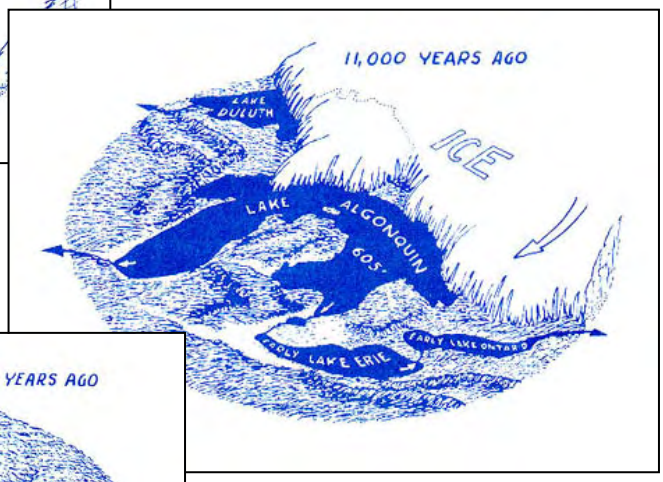
3.6 Geology, Soils, and Topography

The watershed has a rich and complex geologic history. During the last glacial advance, glaciers carved deep valleys into the shale and limestone bedrock and deposited enormous sediment accumulations, some as thick as 1197 feet. Sediment characteristics vary widely throughout the watershed, in some areas changing from thick, lacustrine clay to a coarse grained moraine within a hundred meters (Boutt et al. 2001). Predominant soils in the watershed are sandy. Bedrock geology formations include Antrim Shale, Berea Sandstone, Ellsworth Shale, Traverse Group, and many others (Figure 9a). Glacial topology ranges from broad and pitted outwash plains to moraine ridges with kettle lakes and flat lake plains (Figure 9b). Elevation in the watershed ranges from a low of 484 feet above sea level to a high of 1,543 feet above sea level (Figure 10). Both the highest and steepest sections of the watershed are located in the headwater areas of the Elk River Chain of Lakes and Boardman River.

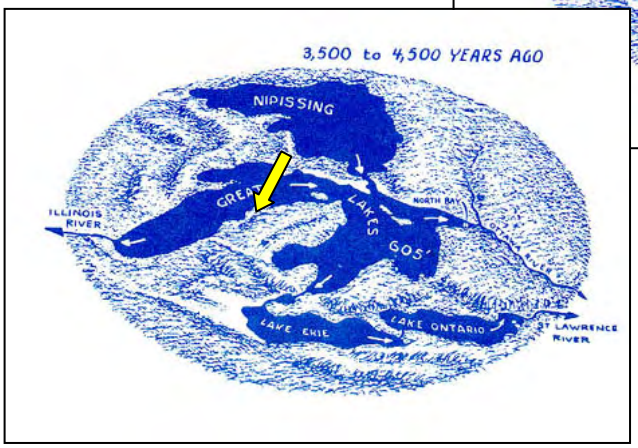
The following text and drawings illustrate the geological history of the Grand Traverse Bay Region and are excerpted from "The Glacial Lakes Around Michigan" by R.W. Kelley and W.R. Farrand (Kelley and Farrand 1967) and The Watershed Center's "State of the Bay 2000 CD Resource Guide."



Grand Traverse Bay was formed by Pleistocene glaciers that moved across Michigan, covering the land one mile thick in places.



When the last of the glaciers retreated, water filled the valley left by the glaciers…



…forming the Great Lakes and the Grand Traverse Bay.

Figure 9a: Bedrock Geology

Figure 9b: Glacial Topology

Figure 10: Topology/Digital Elevation Model

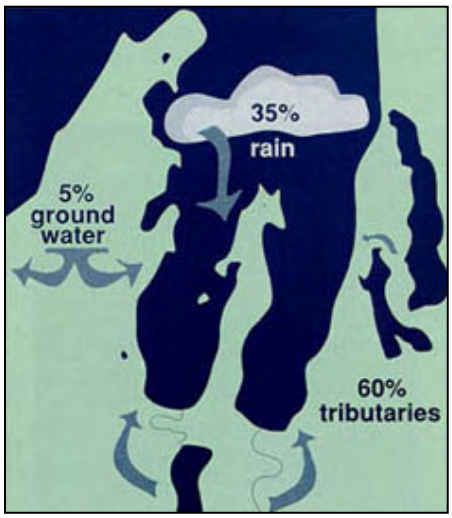
3.7 Hydrology and Climate

The Grand Traverse Bay region receives an average annual rainfall of 42”, of which approximately 16” is recharged to the water table, 20” is evapotranspired, and the other 6” becomes overland flow to streams (Boutt et al. 2001, Holtschlag 1997).

The majority of water entering the bay comes from surrounding tributaries, approximately 604 million gallons of water a day. These tributaries carry replacement water, oxygen, and nutrients. They provide habitat for waterfowl, insects, and fish spawning. They are a source of shelter and food for the bay’s inhabitants. Tributaries also carry our wastes such as trace metals, road salts and solvents, excessive nutrients, and wastewater from drains (State of the Bay 2000 CD Resource Guide).

The two principal river systems of the Grand Traverse Bay watershed are the Boardman River and the Elk River-Chain of Lakes. The Elk River delivers 60% of the surface flow to the bay, and the Boardman delivers 30%. The remaining 10% of surface water flow to Grand Traverse Bay comes from other small tributaries draining directly to the bay.

Most of the rainfall and snowmelt falling on watershed lands seeps into the soil and recharges the groundwater. This groundwater flows into rivers, lakes and streams, which then flow to the bay. A smaller portion of the groundwater flows go directly into the bay in the form of seeps (about 7% of the total discharge of water to the bay) (State of the Bay 2000). Of all the water entering the bay annually, 35% is from rain or snowfall, 60% is from tributaries, and the other 5% is from direct groundwater flow (State of the Bay 2000 CD Resource Guide).

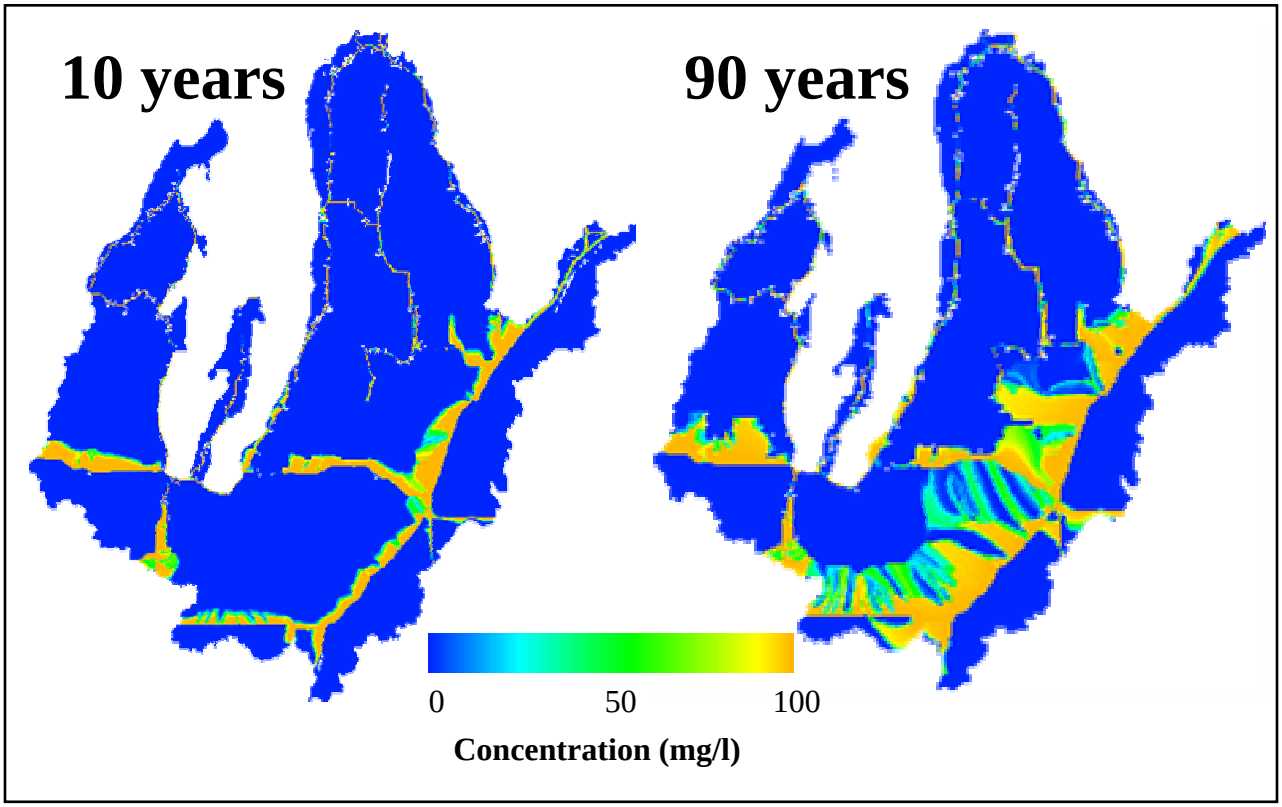


Inflow of Water to Grand Traverse Bay

A total of 373 billion gallons of water leaves Grand Traverse Bay annually. Outflow to Lake Michigan accounts for 70% of the water leaving the bay, with evaporation taking the remaining 30%. On average, twenty-six inches of water evaporate from the bay’s surface area each year (State of the Bay 2000 CD Resource Guide).

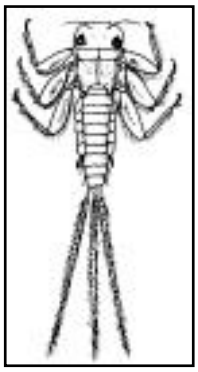
Outflow of Water from Grand Traverse Bay

Data from a study by MSU and USGS to model the impacts of land use changes on the region's water quality indicate that modeled hydraulic heads, which denote where the groundwater table is, in the watershed vary from 177 meters above sea level along the Grand Traverse Bay to more than 350 meters above sea level in the eastern high topography area (Pijanowski et al. 2001, Boutt et al. 2001). The Boardman River southeast of Traverse City is noted as a dominant groundwater discharge area due to the significant slopes of the water table in the region (Boutt et al. 2001). The study also demonstrates that groundwater processes have a major role in the hydrology within the watershed and that there is a considerable legacy of land use on surface water quality. For example, the model demonstrates that "solutes that are applied to portions of the watershed will likely take over 50 years to move through the shallow groundwater, thus current human activities will have an impact on water quality for several decades to come," (State of the Bay 2000). Additionally, research from MSU show that modeled data from road salt application (using chlorides as tracers) can have a considerable temporal impact across the Grand Traverse Bay watershed; even after a fifty-year simulation, chloride only travels 40-50 miles. In some cases, the temporal legacy of land use can exceed 100 years (Pijanowski et al. 2001, Boutt et al. 2001).

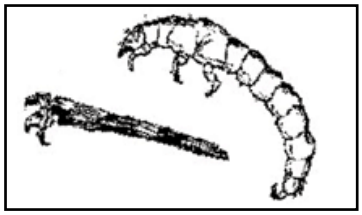


Chloride concentrations across the watershed based on halite application to roads and dispersed through the groundwater system. These maps represent a computer model simulation of groundwater chloride concentration for a scenario where 100 mg/L of chloride (through road salt) is applied to the major highways across the Grand Traverse Bay region at a constant rate over the 90 year simulation period.
Figure courtesy of David Hyndman, Michigan State University

How does hydrology affect aquatic life in the watershed?



Aquatic insects such as mayflies (above) and caddisflies (below) depend on stable flows, high water quality, and sufficient in-stream habitat for survival.



The hydrology of a river system, which is mainly determined by soils, geology, and land use, is a critical physical factor to aquatic life (O'Neal 1997). In streams where groundwater is the principal water source, stable flow patterns occur, characterized by low seasonal and daily fluctuations in discharge. Stable flows promote stable habitat for aquatic life in the form of diverse bottom substrates, secure in-stream cover, and moderate water velocities and temperatures.

Unstable water flow patterns occur in streams with high contributions of surface water runoff and are characterized by high seasonal and daily fluctuations in discharge. During periods of heavy rain or snow melt, flows increase quickly and to high levels, which then lead to increases in water velocities and streambank erosion, the removal of in-stream cover, and decreased bottom substrate diversity due to scouring. Additionally, during drought conditions, excessively low flows occur that cause extremes in water temperatures and expose and reduce in-stream cover and bottom substrates. Some factors contributing to increases in stream flow are urban and agricultural land development, logging, drains and irrigation, water discharges, hydroelectric dams, and lake-level control structures.

The stream pictured here has downcut several feet in elevation because of increased stormwater flow. In this case, the forested wetland in the floodplain is now hydraulically disconnected from the stream that sustained it.

Photo Copyright 1999, Center for Watershed Protection

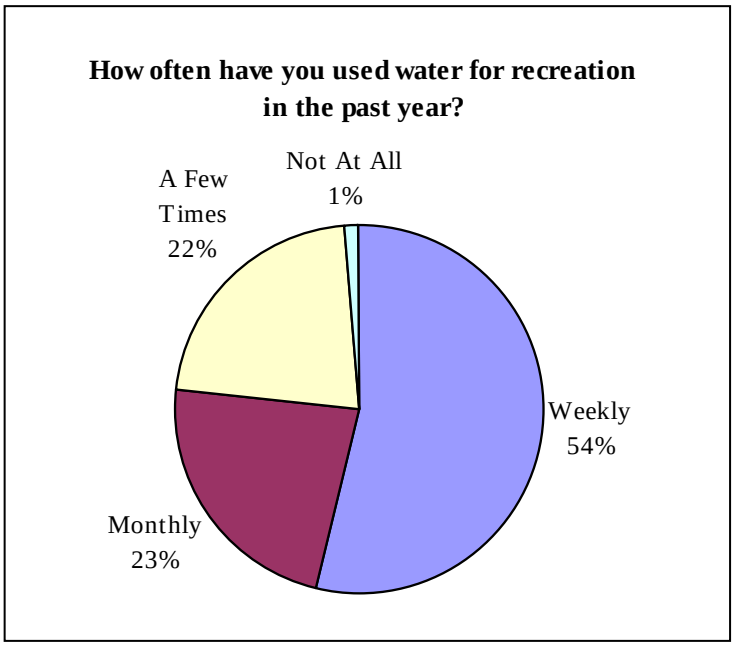
3.8 Economy, Tourism, and Recreation

Traditional uses of watershed resources have included agriculture, tourism and recreation. Cherries and other fruit crops dominate agricultural production in the Traverse Bay region, and are harvested for the global market. Northwestern Michigan, also known as the Cherry Capital of the World, produces half the state's tart cherry crop and more than 80% of its sweet cherries.

The National Cherry Festival in Traverse City attracts more than 500,000 participants each year who celebrate the harvest and revel with festivities over an eight-day period each summer. Other tourism and recreational activities include: boating, biking, swimming, golfing, fishing, camping, and skiing. Attracted to the natural beauty of Grand Traverse Bay and its surroundings, tourists from around the world come to enjoy the pleasures of the region, away from the busy rush of more urban areas. These recreational opportunities can be quite profitable for businesses like marinas, rental shops (for activities such as water recreation, biking, and skiing), ski resorts, golf resorts, hotels, restaurants, and bed and breakfasts.

The area also supports a thriving regional business community representing many economic sectors including banking, healthcare, retail, light industry and others.

While many tourists come to the Grand Traverse Bay watershed to recreate, there are also year-round residents who benefit from the many recreational opportunities the bay and watershed offer. A public telephone survey conducted in Summer 2002 revealed that more than 1/3 of residents in the region use the Grand Traverse Bay as their primary water recreation source. More than half those surveyed use the bay at least a few times a year and at least 1/3 use it monthly. As far as using any type of water body for recreation, almost all of those surveyed indicated that they use water for recreation at the very least a few times per year (see chart).

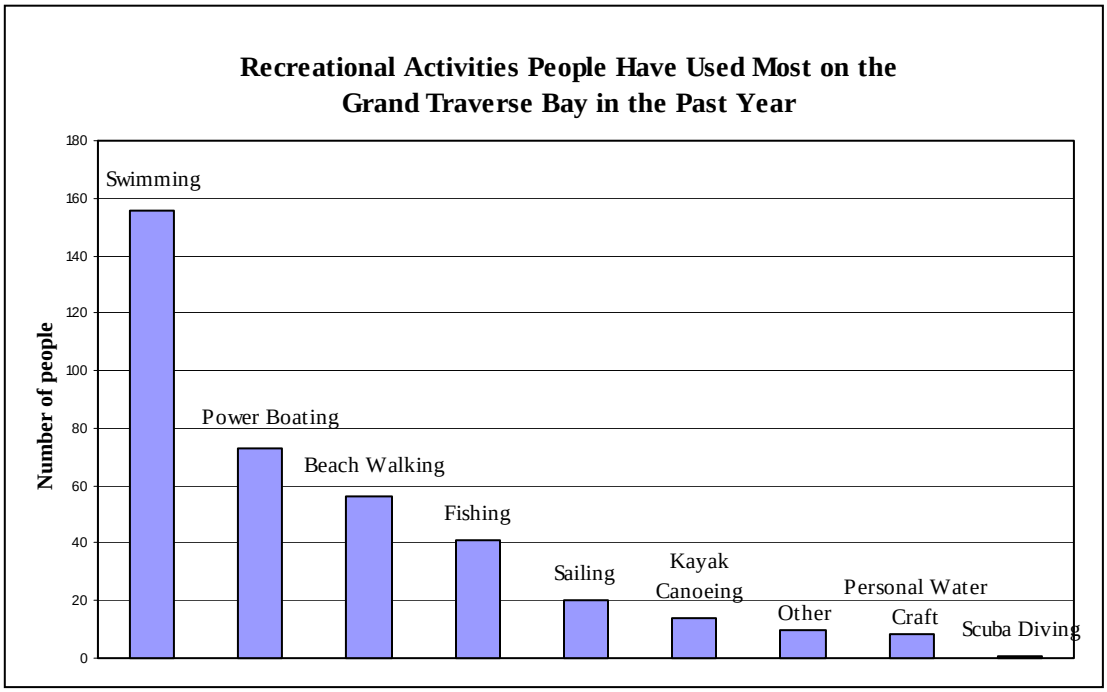


Data taken from 2002 Household Telephone Survey

The survey found that while more people think the water quality in the Grand Traverse Bay has worsened rather than improved, the bulk of respondents indicated they felt water quality has not

changed at all, nor has it affected recreational use on the bay. More than three quarters of the survey respondents indicated that they felt current water quality conditions in the bay make it safe to both eat the fish and swim.

Swimming is by far the recreational activity used by most people living around the bay. Other highly used recreational activities include boating, walking and hiking, fishing and sailing (see chart below).



Data taken from 2002 Household Telephone Survey

3.9 Subwatershed Summaries

Elk River Chain of Lakes

The Elk River Chain of Lakes (ERCOL) is the largest subwatershed in the Grand Traverse Bay watershed, spanning an impressive 500 mi^2. Villages in the ERCOL include Elk Rapids, Kalkaska, Bellaire, Mancelona, Central Lake, and Ellsworth. The ERCOL is a unique series of 14 interconnected lakes and rivers in Antrim and Kalkaska counties (Figure 11). This 'Chain of Lakes' empties into East Grand Traverse Bay through the Elk River in Elk Rapids, providing 60% of the bay's input of surface water. The ERCOL watershed area has more than 200 streams, with 138 miles as designated trout streams. Of the 500 mi^2 of watershed, more than 10% is covered by water. From the uppermost lake in the chain, the waters flow 55 miles and drop 40 feet in elevation on their way to the bay (Fuller 2001). With the exception of two dams, you can travel from Elk Lake all the way up to Beals Lake, which is the headwater area for the Chain of Lakes.

The Northwest Michigan Council of Governments (NWMCOG) developed a management plan for the ERCOL watershed in 1989, which the Conservation Resource Alliance updated in July 2001. Water quality threats and concerns identified in the management plan for the watershed include: planning and zoning for development; septic tanks; loss of wetlands, natural areas, and open space; use conflicts; stormwater runoff; erosion and sedimentation; industrial pollution; oil, gas, and brine wells and underground storage tanks; and low and fluctuating water levels in upper Chain of Lakes area. Some of the major conclusions in the plan are that the headwaters are just as important as the more visible lakes and streams, maintaining the natural vegetation and wetlands is important to maintain the quality of the watershed, and that inputs from septics, stormwater, and other chemicals should be reduced (NWMCOG 1989). The ERCOL project's steering committee has come up with a series of six goals with specific objectives and actions, aimed at preserving, protecting, and enhancing the land and water resources of the watershed (CRA 2001).

The ERCOL steering committee still meets on a quarterly basis and is overseeing a Clean Michigan Initiative grant (ending December 2004) through Tip of the Mitt Watershed Council to conduct stream restoration and educational activities in the watershed.

Boardman River

The Boardman River is the largest tributary to the west arm of Grand Traverse Bay and contributes 30% of the water to the surface water input for the entire bay. Its watershed comprises 284 mi^2 and covers portions of Grand Traverse County on the west and Kalkaska County to the east (Figure 12). Urban areas in the Boardman River watershed include Traverse City, Kingsley, and Kalkaska. The Boardman River is a state-designated "Blue Ribbon" trout stream and a state designated natural river. The Boardman River and its watershed provide immense recreational opportunities in the area; residents and visitors alike inject hundreds of thousands of dollars into the local economy (Largent 1991). More than 60% of the watershed is forested (most of which is located in the Pere Marquette State Forest), with the majority of the remainder being dedicated to agriculture and open space; urban land uses occur in 7% of the watershed (Table 9, Figure 12).

The Boardman River watershed has an in-depth management plan written for it, as well as a large, ongoing project by the Grand Traverse Conservation District (GTCD) to "restore, enhance and protect the "Blue Ribbon" integrity of the Boardman River watershed as a recreational resource, rural greenbelt, and economic resource for the use and enjoyment of this and future generations". The Boardman River Restoration and Protection Project was started in 1991 by the GTCD with an erosion inventory of the entire Boardman River watershed. It has since identified nearly 600 erosion sites on the Boardman, 85% the result of human activity. To date, nearly 200 erosion sites have been restored and five sand traps installed. The GTCD currently (2003) has a Clean Michigan Initiative Project to continue restoration on the Boardman as well as conduct educational activities.

Aerial view of Boardman Lake; Grand Traverse Bay can be seen at the top of the photo.

The following is a collection of excerpts taken from the Boardman River Watershed Management Plan (Largent 1991):

> "Michigan Department of Natural Resources (MDNR) Procedure 51 biological surveys conducted from 1993-96 revealed that 54% of the (13) index stations rated "good" and 46% rated only "fair". The experience of many long-term river users indicates that this data reflects a downward trend that has continued for many years. Given the rapid population growth of the area, many are concerned about the further degradation of the River's water quality, aquatic habitat, and other recreational values.
>
> "Although most of the Boardman River supports its state designated use as a cold water fishery, the river's productivity was severely impacted by increased sedimentation. Over 600 individual erosion sites were documented throughout the Boardman River watershed. Several potential sites were also noted in the inventory in an attempt to stop a problem before it becomes worse. Also noted within the inventory were the sites that contribute obvious nutrient loading or thermal pollution to the river system. The primary causes of sediment in their order of importance are: streambank erosion (~40%), road/stream crossings (~35%), high flow velocities (~15%), and agricultural activities (~10%). Eighty five (85%) of these sites are either directly, or indirectly, the result of human activity.
>
> "Although the primary pollutant of concern in the watershed is sedimentation, there are other pollutants contributing to the overall decline of water quality. Instances of nitrates in private wells are well documented and gas and oil

extraction within the watershed has introduced hydrocarbons into ground water aquifers. This problem is expected to be widespread but has been only recently discovered. Nearly all residents within the watershed outside of Traverse City rely on groundwater for their domestic water supply."

Boardman River's Importance as a Trout Stream

As a "Blue Ribbon" trout stream and one of the top ten trout streams in Michigan, the Boardman River system has excellent water quality. However, the Boardman River Watershed Report (1991) indicates that the habitat conducive to good trout production is being threatened by sediment inputs at nearly 600 erosion sites along the river. Gravel important for trout growth and reproduction is being covered up by sand. Gary Marek, Trout Unlimited member and former state chapter president, remembers how the Boardman River, not too long ago, used to "teem with trout, but not anymore". According to Ralph Hay, MDNR Fisheries Biologist, "if current trends continue the Boardman River will lose its top rate status as a trout stream" (Largent 1991).

Documented erosion site along the Boardman River. Photo courtesy of the Grand Traverse Conservation District

"In a report to the MDNR titled "Economic Value of Damages to the Pigeon River" (1988) Theodore Graham-Tomasi noted that the Pigeon River was reduced from a top rate to a second rate trout stream when the Lansing Club Dam was removed too quickly, flushing thousands of tons of sediment downstream. Graham-Tomasi determined that the capitalized value of a "top rate" trout stream is $10,000 per mile, a figure that was upheld in court when the downstream landowners sued.

"Doug Jester, MDNR Economist stated that, with a $10,000/mile capitalized value and figuring a 7% discount rate, a one-time expenditure of up to $142,800 per-stream mile could be made for restoration efforts and still result in a positive cost/benefit ratio.

"The economic benefit of trout streams is amply demonstrated by Kalkaska County's annual National Trout Festival, which draws nearly 8,000 participants. Unfortunately, the North Branch of the

> Boardman River, which flows through the heart of the Village of Kalkaska, is heavily impacted by human activity. Shifting sands cover up the once exposed and productive cobble substrate threatening the very purpose of the trout festival" (Largent 1991).

Boardman Lake

In addition to a management plan written for the Boardman River watershed, The Watershed Center has compiled a management plan specifically for the Boardman Lake watershed. Historically, Boardman Lake has been the target of industrial pollution and in January 2003 The Watershed Center contracted with Ball Environmental Associates and Great Lakes Environmental Center (GLEC) to research historic data, complete a water quality, macrophyte, and macroinvertebrate assessment, and to inventory the city's storm drain system to determine the actual watershed boundaries. The data collection assisted in the compilation of specific recommendations and actions for reducing existing and future threats to pollution for the Boardman Lake watershed. Recommendations and actions specific to the Boardman Lake will be included in the management plan, which will be completed in January 2004 and made available at The Watershed Center's office. When results from this plan are available they will be incorporated into the Grand Traverse Bay Watershed Protection Plan.

Mitchell Creek

Mitchell Creek, located at the southern end of East Bay, is the third largest single tributary watershed to the Grand Traverse Bay (Figure 13). Draining approximately 16 mi^2 of land, the watershed is principally located in East Bay and Garfield Townships and contains 16 miles of high quality trout stream.

From its outlet next to the Traverse City State Park, the Mitchell Creek watershed has a significant portion of its downstream area in an urban setting. Headwater areas in Blair, Garfield and East Bay Townships are mostly agriculture (26%) or forested (31%) and contain steep slopes (Table 9, Figure 13). The middle and lower portions of the watershed are flatter and contain a greater amount of wetland areas. Mitchell Creek is classified as a gaining stream because of significant groundwater contributions to its flow. The watershed is experiencing increased pressure from development and land use in the area and is beginning to shift from agriculture and forest to urban and residential.

In 1991, Gosling Czubak Associates and the Great Lakes Environmental Center completed a Nonpoint Source Pollution Study for Mitchell Creek watershed (GCA and GLEC 1991). This study found water quality and aquatic diversity to be 'good' in spite of obvious signs of degradation. The study recommended measures to further protect the natural integrity of Mitchell Creek by controlling soil erosion, sedimentation and thermal impacts.

Upon completion of the Nonpoint Source Pollution Study, the Grand Traverse County Drain Commissioner's Office (GTCDC) launched a 45-month Implementation Project on the creek from 1991-1995 (GTCDC August 1995, GTCDC February 1995). This project focused on correcting existing nonpoint source problems and maximizing the potential for long-term water resource protection on the Mitchell Creek watershed. Major accomplishments of the Implementation Project included:

- The development of a Watershed Protection Strategy that, among other things, offered recommendations to local governments to assist in watershed planning (GTCDC February 1995). One such recommendation is the concept of a special 'watershed overlay zoning district' that would establish minimum creek setbacks and wildlife corridors as well as provide provisions to encourage appropriate development in ecologically sensitive areas.
- Implementation of Best Management Practices throughout the watershed focusing on four areas: urban, agricultural, recreational facilities, and streambank erosion from road/stream crossings.
- Land protection activities coordinated by the Grand Traverse Regional Land Conservancy including educational programs and the promotion of voluntary land protection options. As part of the activities, a landowner's handbook was developed and 158 acres of land in the watershed were protected through conservation easements and gifts of land.
- Information and Education Program including: watershed clean-ups, tree plantings, placement of roadside watershed signs, watershed festival, distribution of a landowner's handbook, and an educational video which describes threats to surface water quality in the Mitchell Creek due to urbanization.

Research by the Grand Traverse County Drain Commission shows that 8.9% of the Mitchell Creek watershed is covered by impervious surfaces (Harrison and Dunlap 1998). (This study was also conducted on the Acme and Yuba Creek watersheds.) Impervious surfaces are those areas on land that cannot effectively absorb or infiltrate rainfall. Areas such as these may include: roads, streets, sidewalks, parking lots, and rooftops. Research suggests that there is a threshold to the amount of impervious cover that can occur within a watershed at which aquatic systems degradation occurs. Findings reveal that stream degradation consistently occurs when impervious surface levels in a watershed reach between 10-20% (Center for Watershed Protection 1994).

Acme Creek

Acme Creek covers 13 mi^2 and is located at the southern end of East Grand Traverse Bay. It covers portions of three townships in Grand Traverse County: Acme, East Bay, and Whitewater (Figure 13). Along with Mitchell Creek, the Acme Creek watershed is under increasing pressure from urbanization. The Acme Creek and its tributaries originate from groundwater seeps in a near-pristine area at the southern end of the watershed in East Bay and Whitewater Townships (GTCDC June 1995). Land use in this watershed consists of 62% forest, 12% urban, 10% open, and 9% wetlands (Table 9, Figure 13). The Acme Creek system, which is replenished mostly from groundwater, is designated as a cold water trout stream (GTCDC June 1995). A GTCDC study shows that the percent impervious coverage in the Acme Creek watershed in 1995 was 4.2% (Harrison and Dunlap 1998). *(Please see the section on Mitchell Creek for a discussion regarding impervious surfaces.)*

A Watershed Planning Project for Acme Creek was completed in 1995 by the GTCDC. The project listed the following as the most significant current and future water quality and quantity impacts on Acme Creek: sedimentation; nutrient loading from golf courses, residential and agricultural lands; and stormwater runoff resulting from increased impervious surfaces.

In addition to noting threats to water quality, the project also completed a number of other tasks. A watershed database was developed that included information on wetlands, parcel lines, slopes, land cover, township zoning, and potentially sensitive areas. Local township ordinances were reviewed and found to be weak and not targeted to the protection of the creek and its fisheries habitat. Specific streambank erosion sites and inadequate culverts were identified for future restoration and remediation. Also, public input sessions were held where concerns were raised regarding golf course practices, road construction, and the current level of protection for public and private lands near the creek's headwaters (GTCDC June 1995).

An Implementation Project was also conducted by the GTCDC from April 1997 – March 2000 that included restoration efforts in Acme Creek as well as Yuba Creek (GTCDC 2000). This report is further described in the next section.

Yuba Creek

Yuba Creek watershed is the smallest subwatershed to the Grand Traverse Bay, covering just 8 mi^2. It is adjacent to the Acme Creek watershed and located almost entirely in Acme Township, on the outskirts of Traverse City (Figure 13). Much like Acme Creek, the Yuba Creek watershed is in the rapidly developing area outside of Traverse City. Most of the land use in the Yuba Creek watershed is agriculture, with significant amounts of forest and open space (Table 9, Figure 13). As of 1995, the percent impervious coverage in the Yuba Creek watershed was only 2.4% (Harrison and Dunlap 1998). *(Please see the section on Mitchell Creek for a discussion regarding impervious surfaces.)*

No management plan has been developed for the Yuba Creek watershed, but preliminary protection and monitoring work has been completed as part of a GTCDC Implementation Project in conjunction with Acme Creek from April 1997 – March 2000.

The project successfully completed the following tasks (GTCDC 2000):

- Promoted use of stream buffers as primary water resource management tool in Acme and East Bay Townships. (NOTE: As of June 2003, East Bay Township, which houses Acme and Mitchell Creeks, had just enacted a model ordinance that established a riparian buffer overlay zone for the township.)
- Protected the following parcels of land:
    - Deepwater Point Natural Preserve: 17 acres and 2000 feet of East Bay shoreline
    - Frost Property: 465 acres at the headwaters of Acme Creek
    - Spindrift property: 'Yuba Creek Natural Area'; top priority for protection in Yuba Creek watershed; 456 acres of wetlands, scenic ridges, and active orchards along Yuba Creek
- Increased public awareness of water resource issues in Acme and Yuba Creek watersheds including the development of the following:
    - Watershed landowner's handbook
    - Watershed road signs marking the entrance to each watershed
    - Articles, press releases and announcements
- Corrected all severe runoff erosion sites through the use of streambank erosion Best Management Practices and prevented 73 (Acme Creek) and 70 (Yuba Creek) tons of sediment/year from entering watershed

Ptobego Creek

The Ptobego Creek watershed is widely considered by some to be the most beautiful wetland area in the entire Grand Traverse Bay watershed. The majority of the 14 mi^2 watershed area is located in Grand Traverse County's Whitewater and Acme Townships, with a smaller portion in Antrim County's Elk Rapids Township (Figure 13). Also spelled *Tobego* or *Tobeco*, the Ptobego Creek watershed includes a vast complex of wetlands near its outlet to the Grand Traverse Bay and is home to a thriving wildlife population.

Aerial View of Lower Ptobego Pond entering Grand Traverse Bay

Approximately 55% of the watershed is covered by agriculture, 26% consists of orchards near downstream areas along US-31, and 28% is croplands in headwater areas (Table 9, Figure 13).

The watershed is made up of a single creek that flows lazily into the Upper Ptobego Pond and then meanders through a wetland complex into the Lower Ptobego Pond, which then outlets into the bay. The Ptobego Creek Wildlife Preserve and State Game Area, an approximate 400-acre parcel of land, is centered on these two ponds in Grand Traverse County. Additionally, the Grand Traverse Regional Land Conservancy recently secured a deal to establish the Maple Bay Farms Natural Area in the watershed, a 400+ acre parcel of land adjacent to the wildlife preserve.

West Bay Shoreline and Tributaries

This 68 mi^2 watershed area stretches along a small sliver of Leelanau County on the west side of Grand Traverse Bay and encompasses the land draining all tributaries and groundwater seeps entering the bay (Figure 14). Tributaries along the West Bay shoreline include: Cedar, Leo, Lee, Belanger, Weaver, Ennis, and Northport creeks. Villages along this portion of the watershed include Suttons Bay, Omena, Northport, and Peshawbestown, which is the governmental seat of the Grand Traverse Band of Ottawa and Chippewa Indians (GTBOCI). The Leelanau State Park is located at the tip of this watershed. Most of the land use along this area is either forested or agriculture, with developed areas along the shoreline (Table 9, Figure 14).

The GTBOCI has conducted extensive water quality monitoring along the West Bay shoreline since 1999, as well as completing a road stream crossing survey in 2003. Water quality sampling sites include: Ennis Creek, Belanger Creek, and several sites in West Grand Traverse Bay (Lee Point, Suttons Bay, Peshawbestown, Northport, Omena Bay). Overall, results from their monitoring suggest that water quality in these streams and at the West Bay locations is good, although it is noted that habitat diversity in Ennis and Belanger Creeks is being threatened by sedimentation (Personal Communication with Mary Wilson, GTBOCI Aquatic Biologist, March 2003). Results from the road stream crossing survey identify 8 sites with severe erosion

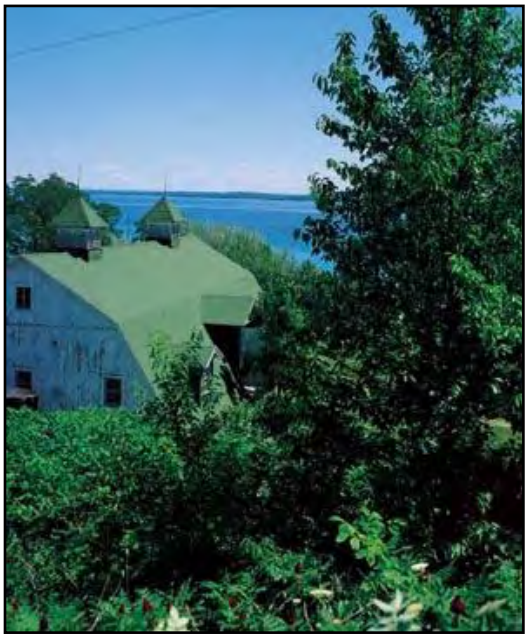
problems and 19 sites with moderate erosion (Personal Communication with Mary Wilson, GTBOCI Aquatic Biologist, September 2003).

East Bay Shoreline and Tributaries

The East Bay Shoreline watershed encompasses 39 mi^2 of mostly forested land along the east side of East Grand Traverse Bay in Antrim and Grand Traverse Counties (Figure 15). Major tributaries in this watershed include: Baker Creek in Grand Traverse County, and Guyer and Antrim Creeks in Antrim County. A recent shoreline inventory along the Antrim County portion of East Bay (Appendix C) reveals that there are a total of twenty-four small streams and many groundwater seeps entering the bay from the Village of Elk Rapids up to Norwood. The most interesting and beautiful seeps were observed north of Eastport seeping from the blue Antrim Shale Bluffs. Also, the Antrim Creek Natural Area is located in the northern section of this watershed.

Old Mission Peninsula

The watershed of the Old Mission Peninsula is perhaps one of the most unique of the smaller subwatersheds to the bay. Located in the middle of Grand Traverse Bay, forming the East and West Bays, the 31 mi^2 watershed area is covered extensively by orchards and vineyards (about 45%) and is known for its exquisite beauty (Table 9, Figure 16). Only 3 miles at its widest point, the peninsula offers breathtaking panoramic views of both East and West Bay from its highest ridges. The tip of the peninsula, Old Mission Point, is largely a public accessible area with township and state parks. The watershed has no major streams or lakes, and its water flows or seeps into either West or East Grand Traverse Bay.



View of Grand Traverse Bay from Old Mission Peninsula

Figure 11: ERCOL Watershed

Figure 12: Boardman River Watershed

Figure 13: Mitchell, Acme, Yuba, and Ptobego Creek Watersheds

Figure 14: West Bay Shoreline Watershed

Figure 15: East Bay Shoreline Watershed

Figure 16: Old Mission Peninsula Watershed

3.10 OTHER CONSIDERATIONS: GROUNDWATER

Groundwater is an important source of hydrologic input throughout the Grand Traverse Bay watershed. It should be valued and managed efficiently not only for its quality but for its quantity as well. It is important to note that most groundwater will eventually become surface water; it only depends on how long it will take. By protecting groundwater quality, we will also be protecting surface water quality. Additionally, protecting groundwater resources is important due to the vast majority of watershed residents (most everybody except for City of Traverse City residents) using groundwater for their drinking water source. There are some significant groundwater contamination issues within the Grand Traverse Bay watershed related primarily to underground storage tanks that have leaked or poor historical waste disposal practices.

There are a number of other pollutants to groundwater in the Grand Traverse Bay watershed as well. For example, commercial agricultural fertilizers, if applied excessively, also have the potential to leach into the ground and eventually contaminate drinking water wells, as is the case in parts of Old Mission Peninsula in Grand Traverse County. Past fertilization practices in orchards on the peninsula have led to high nitrate levels in groundwater wells, leading some residents to consider pumping water from Traverse City to use for drinking water. Additionally, pesticides and other types of toxic compounds used at agricultural facilities have the potential to be spilled and leach into the ground. Agricultural areas that irrigate their waste and wastewater onto land can introduce excessive nutrients to the ground, mostly in the form of nitrogen. Examples of this type of pollutant include irrigation from milkhouse wastewater and manure lagoons.

Abandoned wells and oil wells are other examples of potential ways pollutants can reach groundwater. When a well is drilled and abandoned, however many years later, and either capped improperly or not at all, it leaves an open conduit to groundwater. Pollutants can either reach groundwater sources down through the drilled well shaft itself or down along the outside of the well shaft. In this same way, existing wells may be potential sources for groundwater pollution. Wellhead protection programs are important where a threat to groundwater exists if there is a pollutant spill, such as oil or gasoline, which can seep down along the sides of a well shaft into the aquifers below.

Other sources of pollutants to groundwater are from leaking septic systems. Places in the Grand Traverse Bay watershed that have a high density of residents utilizing septic systems pose an increased threat to groundwater contamination.

Overall, groundwater is a precious resource and it must be protected. Sound management decisions must be made to protect groundwater contamination wherever and whenever possible. In Conservation Districts and MSU-Extension offices throughout the State of Michigan, there is a groundwater stewardship resource person to educate the public on these specific issues.

In addition, it is important to manage the quantity of groundwater supplying the Grand Traverse Bay watershed. Many businesses, agricultural operations, and local residents draw water from lakes, rivers, and groundwater for a variety of purposes. The issue of drawing groundwater from underground aquifers is contentious in parts of the state.

Groundwater quantity and its withdrawal from the watershed is an issue that goes beyond the scope of the Grand Traverse Bay Watershed Protection Plan. However, it is an issue that should and will be debated in the near future by watershed residents, local governments, local and national businesses, watershed groups, and state and federal agencies. Combined, these groups must come to a general consensus and determine guidelines for proper groundwater management.

Recommended actions to reduce the risks to groundwater contamination are found in Sections 7.2 and 7.3.

3.11 EXISTING WATER QUALITY INFORMATION AND RESULTS FOR GRAND TRAVERSE BAY

Overall, the prevailing opinion among experts is that the water quality in the Grand Traverse Bay is excellent, but there are several potential threats to that quality. Excessive nutrients and toxic contaminants from runoff are just two examples of potential threats to the bay. For the most part, the Grand Traverse Bay is typical of other oligotrophic embayments in the Great Lakes; deep, clear, cold, with an overall low productivity.

The following tables highlight some of the most recent findings on various aspects of water quality in the Grand Traverse Bay. The information was summarized from the following publications:

- State of the Bay 2000
    - A collection and summary of publications and ongoing research studies and information about the Grand Traverse Bay and its watershed; please see publication for specific details and references (State of the Bay 2000).

- Integrated Habitat and Water Quality Inventory for the Grand Traverse Bay – 2000
    - Research Great Lakes Environmental Center (GLEC) completed for The Watershed Center

      Included historical information from the following reports:
        - The Limnology of Grand Traverse Bay, Lake Michigan (Auer et al., 1975)
        - Some Aspects of the physical Limnology of Grand Traverse Bay (Lauff, 1957)
        - Final Report for the Grand Traverse Bay Watershed Initiative: Part II, Water Quality of the Bay and Tributaries (Shuey et al., 1992) (Note: The Grand Traverse Bay Watershed Initiative has changed names to The Watershed Center Grand Traverse Bay)
        - The Acme Creek Ecological Project: Natural Features Inventory and Land Management Plan (GLEC 1994)
        - Peshawbestown and Omena Bay Baseline Water and Sediment Quality Study (GLEC 1998)

- Stormwater Source Identification, Sampling and Analysis at Select Storm Drains and Tributaries to Grand Traverse Bay (Lake Michigan) – 2001
    - A stormwater and stormdrain study GLEC completed for The Watershed Center

- Information obtained from other sources is noted where necessary.

An additional summary of these and other reports, by document, is found in Appendix D. Results from these and other research projects in the Grand Traverse Bay are also found in The Watershed Center's online interactive water quality database at www.gtbay.org/wqquery.asp. This database was designed to provide a comprehensive storehouse of available water quality data, collected by The Watershed Center, volunteer monitoring projects, researchers from universities, and other organizations, for the entire Grand Traverse Bay watershed. Users can search for specific results by parameter (nitrogen, phosphorus, etc.), report, or location.

Water Clarity (Dissolved Oxygen – DO, Temperature, Secchi Disk)
• DO and temperature indicate little stratification • DO at or near saturation most of year • Secchi Disk, Transparency – The Secchi disk is a measure of water transparency, which is directly linked to inorganic suspended solids and plankton abundance. Transparency and secchi disk readings vary throughout year, with generally greater readings in Spring. o Transparency exceeds 7-8m o Average water clarity increased 20% from 1990-2000 in West Arm of Bay o 1957-10.5m (34ft); 1975-7.0m (23ft); 1992-5.7m (19ft); 1999-8.5m (28ft); Spring 2000 (Inland Seas Education Association): 9.8m (32ft) lower West Bay, 11.6m (38ft) Suttons Bay; Summer 2002 (GT Bay Power Squadron): 12.2-14.3m (40-47ft) o Increase in water clarity attributed to decrease in plankton community and introduction and proliferation of zebra mussels in the bay

Sediment
• Quality is good, typically coarse sand with numerous areas of cobble and gravel; at 100+ft depth the bottom is silt and clay • Increases in silt and organic detritus along nearshore bottom • Isolated areas that are relatively rich in inorganic matter (i.e., Omena Bay) • Sediment does not contribute significant concentrations of nutrients to water column; most of the phosphorus in the sediment is organically bound • There are few rooted macrophyte beds (possibly due to lack of suitable substrate) • Seiche events (which are large scale periodic movements of water) can re-suspend sediments in deeper portions of the bay. If carried into the water column, they can release contaminants deposited decades ago.

Nutrients
• Nutrients are relatively low (have continually declined since the 1970's), overall productivity low • Urban tributaries and stormwater drains are a significant source of nutrients to the bay • *Total Phosphorus(TP):* Growth limiting nutrient for the bay o TP higher at nearshore than offshore: nearshore average = 4.6ug/L, offshore average = 2.8ug/L o Continued decline since early 1970's: 1975 - 7.8ug/L, 1992 – 5.4ug/L, 1994 – 4.9ug/L, 1998 – 3.8ug/L, 1999 – 3.0ug/L o Significant differences between offshore surface and bottom samples in Omena Bay (due to sediment quality and incomplete mixing of Omena Bay with GT Bay): Spring 1999- 2ug/L at surface; 64ug/L at 80ft o Significantly higher levels of TP at mouth of Boardman River and Acme Creek o Highest concentration of TP are found at stormwater outfalls, *See Table 2 in State of the Bay 2000*

Nutrients Cont'd

- *Nitrate:* Not a growth limiting nutrient for the bay, sufficient quantities for growth
  - Generally higher in offshore near bottom than surface samples (except in Omena Bay)
  - 1998 – 0.2mg/L (0.25mg/L in W Bay), measurements similar to historical readings

Weed and Macrophyte Beds

- Weed bed numbers have nearly doubled from 64 growth areas (in 1991) to 124 areas (in 1998). These numbers are still low overall compared to the size of the bay, however, there should be some concern that numbers have doubled in the span of 8 years.
- Growth is most concentrated at South end of West Bay (an area with higher amount of phosphorus entering the bay) which is influenced by rapid development; nutrient inputs and the amount of water flushing an area were most important determinants for locations of beds

Escherichia coli

Note: EPA recommends measuring recreational water quality by the abundance of Escherichia coli (E.coli): Water is unsafe for swimming if measurements are either 1) 130+colonies/100mL in 5 samples over 30-day period or 2) 300+colonies/100mL in any 1 sample

- *E. coli is common intestinal organism so its presence indicates that fecal pollution has occurred. However, the kinds of E. coli measured in water don't generally cause disease. Organisms from fecal pollution that do cause disease are called* ***pathogens*** *and include a variety of other bacteria, viruses, protozoa, and small worms.*
- *EPA studies indicate that when E. coli exceeds set standards, there is an increased risk of gastroenteritis from pathogens carried in fecal pollution.*

- Sources of *E. coli* and fecal pollution include: urban runoff, inadequately treated wastewater, agricultural runoff, illegal sewage discharge from boats, and animal waste (house pets, waterfowl, etc.)
- Significant potential for fecal contamination following storm events; extremely high concentrations of *E. coli* and *Enterococci* were noted during some wet weather samples (For example: November 2000 *E. coli* = 15,300 colonies/100mL in Bryant Park; 80,000 colonies/100mL in East Bay Park) *See Table 2 in State of the Bay 2000*
- Summer storm events have potential for significant public health risk at local beaches because of stormwater outfalls and urban tributaries: At risk= West End, Clinch Park, and Bryant Park Beaches; East Bay Park; Elk Rapids City Park; Northport Beach; Southshore Park Beach (Suttons Bay); and waterfront homes near urban areas such as Traverse City

Climate

• Significant changes in dates of freeze-up and break-up of Grand Traverse Bay between 1851-1993
  o Average freeze-up date is 12 days later
  o Average break-up date is 19 days earlier
  o The bay did not freeze over in 2001, marking the 5th consecutive year of the bay not freezing over in past hundred years of record

Endangered and Exotic Species
• Five federally listed endangered or threatened species in the watershed (+1 candidate): Bald Eagle, Kirtland's Warbler, Piping Plover, Pitcher's Thistle, Michigan Monkey Flower, Eastern Massasauga Rattlesnake • Two new exotic species found in Bay since 1999: Fishhook Water Flea and Rusty Crayfish (since 2000, the Spiney Water Flea has been discovered) • Other current exotic species in the bay include: sea lamprey, zebra mussels, Eurasian Ruffe, alewife

Minerals
• Levels of Calcium, Magnesium, Sulfates, and Chlorides are typical of high quality freshwater lakes, no suggestion of water quality degradation • Concentrations are all consistent among sampled sites and years

Heavy Metals
• Cadmium, Chromium, Lead, Zinc, Nickel: all relatively low, consistent with other lakes • Copper decreased by 60% => 1ug/L (1975), 0.4ug/L (1998) • Mercury levels low => 0.26ng/L, slightly higher at South end of West Arm and North end of East Arm; because of loadings from Boardman and Elk River

Silica
• Found in colloidal and suspended matter or in biomass (diatoms) • Declined dramatically in past 40yrs: 1957 - 3.6mg/L, 1976 - 0.423mg/L, 1992 - 0.410mg/L, 1998/9 - 1.06mg/L *Silica occurs naturally in the water; it is an essential element used by diatoms (planktonic organisms) for cell structure.*

Chlorophyll a
• Pigment found in plants that is necessary for photosynthesis. Measurements of chlorophyll a indicate the amount of suspended algae • Relatively low readings, varies with seasons • No significant change since 1975 • Overall Bay chlorophyll a average = 1.04ug/L • Even though slight increases have been shown for chlorophyll a, the bay is still oligotrophic with overall low productivity

Phytoplankton, Zooplankton, and Fish

• Phytoplankton
  o Greatest abundance in Spring, 21 total species observed in study; dominant ones typical of oligotrophic systems
  o Historically: Auer 1957 stated West Arm transitioning towards eutrophication
  o Current: West Arm has more organisms/liter than East Arm in late summer, this *suggests* more nutrients available in West Arm and a higher level of eutrophication
  o Overall samples taken have been typical of oligotrophic systems and there is no suggestion of eutrophication
• Zooplankton
  o Assemblages are similar to those typically found in Lake Michigan and Great Lakes
  o Diporeia: As in the rest of Lake Michigan, there are declining levels in Grand Traverse Bay (correspondence with Inland Seas Education Association), however, they have not been studied extensively here.
  ▪ Diporeia is a quarter-inch long shrimp-like creature that lives in the sediment at the bottom of most of the Great Lakes. They are considered one of the basic building blocks of the Great Lakes food chain. Researchers used to find 10,000 diporeia in a square yard of sediment. Today researchers are finding only hundreds in a square yard and sometimes finding none at all. Severe declines in diporeia populations will have an effect on Lake Michigan food webs and fish populations (like whitefish or lake trout), either starving some of them or resulting in lower fish weights and size.
• Fish
  o Approximately 39 species of native and non-native fish live in Bay; diverse assortment of other insects and invertebrates

CHAPTER 4 DESIGNATED AND DESIRED USES

4.1 Designated Uses in the State of Michigan

Each of Michigan's surface waters is protected by water quality standards for specific designated uses (Table 11). These standards and designated uses are designed to 1) protect the public's health and welfare, 2) to enhance and maintain the quality of water, and 3) to protect the state's natural resources.

TABLE 11: DESIGNATED USES FOR SURFACE WATERS IN THE STATE OF MICHIGAN

All surface waters in the state of Michigan are designated for and shall be protected for all of the following uses:
1. Agricultural 2. Industrial 3. Public water supply at point of intake 4. Navigation 5. Warmwater or coldwater fishery 6. Other indigenous aquatic life and wildlife 7. Partial body contact recreation 8. Total body contact recreation between May 1 – October 31 *Citation: R323.1100 of Part 4, Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended*

If a body of water or stream reach is not meeting the water quality standards set for a specific designated use, then it is said to be in 'nonattainment'. An annually published listing of the bodies of water and stream reaches in the state of Michigan that are in nonattainment can be found in the DEQ's Section 303(d) Report (DEQ 2002).

The DEQ uses a rotating watershed cycle for surface water quality monitoring where each of the 58 major watersheds in the state is scheduled for monitoring at least once every five years. The Grand Traverse Bay watershed was last monitored in the summer of 2003, and results should be available shortly. Results from the 1998 monitoring indicate that there are no widespread impairments to the designated uses in the Grand Traverse Bay watershed. The only stream in nonattainment is a small section of Kid's Creek, a tributary to the Boardman River (Table 12).

TABLE 12: RIVER SEGMENT IN GRAND TRAVERSE BAY WATERSHED IN 'NONATTAINMENT'

Stream or Lake	Designated Uses Not Met	Reason for Nonattainment Status
Kid's Creek *(From confluence with Boardman River u/s to M-37/US-31)*	Cold water fishery Other aquatic life	Macroinvertebrate community rated poor

However, due to widespread mercury contamination and public health fish consumption advisories, all of Michigan's inland lakes, including those in the Grand Traverse Bay watershed, are included on the Section 303(d) list (MDNR 1997). For further information on mercury sources in the environment and mercury pollution prevention strategies, please refer to publications by Sills (1992) and Mehan (1996), respectively. These two reports resulted from two specific DEQ task force investigations into mercury in the environment, sources, and prevention. The problem of mercury contamination and other related widespread toxic contamination problems in the Grand Traverse Bay watershed will not be discussed in this Management Plan. The DEQ has taken the lead to develop pollution prevention and abatement strategies throughout the State of Michigan for mercury contamination and other related toxins.

4.2 Impacted Designated Uses in the Grand Traverse Bay Watershed

None of the designated uses for the Grand Traverse Bay watershed are impaired on a watershed wide scale. However, in some cases, activities and resulting pollutants in the watershed may prove to be a threat to water quality and designated uses. Threatened waterbodies are defined as those that currently meet water quality standards, but may not in the future. The Grand Traverse Bay Watershed Protection Plan will focus on five designated uses to protect in order to maintain water quality throughout the Grand Traverse Bay and its watershed. The designated uses include the cold water fishery, other indigenous aquatic life, total body contact, navigation, and public water supply at point of intake (Table 13). Threatened designated uses were ascertained through scientific research reports, existing subwatershed management plans, DEQ water quality reports, field observations by the Project Coordinator, steering committee members, and personal contact with watershed residents and scientific experts on the Grand Traverse Bay watershed.

TABLE 13: THREATENED DESIGNATED USES IN THE GRAND TRAVERSE BAY WATERSHED

Designated Uses	
Public Water Supply at Point of Intake	Threatened *(For Traverse City municipal intake on East Bay only)*
Navigation	Threatened
Coldwater Fishery	Threatened
Other Indigenous Aquatic Life	Threatened
Total Body Contact Recreation (May1-Oct 31)	Threatened

4.3 Desired Uses

In addition to researching regulated designated uses, the project's steering committee has also identified a number of locally determined desired uses for the watershed. Desired uses can be defined as the ways in which people use the watershed and think should be protected and/or preserved for future generations. They may be very general or very specific, or somewhere in between. Desired uses for the Grand Traverse Bay watershed include uses for recreational, aesthetic, and ecosystem preservation purposes (Table 14).

TABLE 14: GENERAL DESIRED USES FOR THE GRAND TRAVERSE BAY WATERSHED

Desired Use Category	Goal
Recreation	• Maintain high quality areas in the watershed for recreation such as fishing, canoeing, boating, hiking, camping, and birding. • Develop additional Designated Natural Areas throughout the watershed for recreation and education. • Increase the number of boardwalks, gardens, and public parks along rivers and lakes in urban settings.
Aesthetics	• Preserve the distinctive aesthetic character and inherent beauty of the bay and its watershed. • Design and promote development that supports privacy, security, visual quality throughout the watershed.
Ecosystem Preservation	• Maintain and preserve wildlife corridors throughout the watershed.

CHAPTER 5 WATER QUALITY PROBLEMS

5.1 Threatened Designated Uses: Pollutants, Sources, and Causes

For each designated use to protect in the Grand Traverse Bay watershed there are a number of different pollutants and environmental stressors that adversely affect each of the designated uses, or have the potential to (Table 15). The term environmental stressor is used to describe those factors that may have a negative effect on the ecosystem, but aren't necessarily categorized as contaminants that change water chemistry. Examples of environmental stressors include changes to hydrologic flow, low dissolved oxygen levels, and loss of habitat.

TABLE 15: POLLUTANTS AFFECTING DESIGNATED USES IN THE GRAND TRAVERSE BAY WATERSHED

Pollutant or Environmental Stressor	Designated Uses Affected
Sediment	Coldwater Fishery Other Indigenous Aquatic Life Navigation
Nutrients	Coldwater Fishery Other Indigenous Aquatic Life Total Body Contact Public Water Supply
Thermal Pollution	Coldwater Fishery Other Indigenous Aquatic Life
Toxins **(Pesticides, Herbicides, Oils, Gas, Grease, Salt/Chlorides)**	Coldwater Fishery Other Indigenous Aquatic Life
Changes to Hydrologic Flow	Coldwater Fishery Other Indigenous Aquatic Life Navigation
Invasive Species	Coldwater Fishery Other Indigenous Aquatic Life Navigation Total Body Contact Public Water Supply
Pathogens **(*E. Coli* and Fecal Coliform indicators)**	Total Body Contact Public Water Supply
Loss of Habitat	Coldwater Fishery Other Indigenous Aquatic Life

It should be noted that this is a general list that encompasses pollutants for the entire Grand Traverse Bay watershed. Not all reaches in the watershed are impacted by all of the pollutants listed above.

Sources and Causes of Pollutants

A Comprehensive Watershed Management Table was developed listing sources and causes of watershed pollutants and environmental stressors (Table 16). This table summarizes key information necessary to begin water quality protection, provides specific targets to act upon for watershed management, and forms the basis for all future implementation projects to protect the quality of the watershed. Sources and causes were identified using a wide variety of methods including: streambank erosion and road stream crossing inventories; physical inventories that note specific sources along stream reaches (such as locations of soil erosion, stormwater drains, presence of waterfowl, lawns mowed to edge of stream, etc.); review of existing subwatershed management plans; meetings with steering committee members; and personal contact with watershed residents and scientific experts on the Grand Traverse Bay watershed.

TABLE 16: POLLUTANTS, SOURCES, AND CAUSES TO WATER QUALITY DEGRADATION IN THE GRAND TRAVERSE BAY WATERSHED

(COMPREHENSIVE WATERSHED MANAGEMENT TABLE)

Environmental Stressor or Pollutant	Impaired or Threatened Use	Sources K = known, S = suspected, P = potential	Causes K = known, S = suspected, P = potential
Sediment	*Coldwater Fishery *Other Indigenous Aquatic Life *Navigation	Road Stream Crossings (k)	Poor design/construction/maintenance (k) Lack of erosion/surface runoff controls (k) Steep approaches (k) Culverts not aligned to streambed (k) Undersized culverts (k) Failing/eroding culverts/bridges (k)
		Bank/Shoreline Erosion (k)	Removal of riparian vegetation (k) Boat traffic/wakes (k) High flow velocities (k) Recreational activities (k) Sandy soils (k)
		Construction (k)	Poor soil erosion practices (p)
		Urban/Agricultural/ Rural Storm Water (k)	Poor storm water management practices (k)
		Livestock (p)	Unlimited access to streams (p)
		Oil and gas well development (k)	Stream crossings for new access roads (k) Clearing for wellhead sites (k)
		Dams, Lake-level Control Structures (p)	Physical failures (p) Improper dredge spoil disposal (p)
		Wetland Filling (k)	Poor storm water management practices (k) Non-compliance with permits (k) Development (k)

TABLE 16: POLLUTANTS, SOURCES, AND CAUSES TO WATER QUALITY DEGRADATION IN THE GRAND TRAVERSE BAY WATERSHED CONT'D

(COMPREHENSIVE WATERSHED MANAGEMENT TABLE)

Environmental Stressor or Pollutant	Impaired or Threatened Use	Sources K = known, S = suspected, P = potential	Causes K = known, S = suspected, P = potential
Nutrients	*Coldwater Fishery *Other Indigenous Aquatic Life *Total Body Contact *Public Water Supply	Residential or Commercial Fertilizer Use (k)	Improper application (amount, timing, frequency, location, method, P content) (k)
		Septic Systems (s)	Poorly designed, sited, and maintained (s) High density/age of systems (s)
		Urban/Agricultural/ Rural Storm Water (k)	Poor storm water management practices (k) Development (k)
		Lack of Riparian Buffer (k)	Development (k) Clearing by landowner (k) Lack of adequate shoreline setbacks (p)
		WWTP (p)	Discharge of nutrients in waste water (p)
		Agriculture (p) (fertilizer, manure, & livestock)	Improper manure application (amt., timing, freq., location) (p) Improper storage/handling/application (p) Close proximity to Bay/Tributaries (p) Grazing near stream edge (p)
		Animal Waste (k)	Geese/ducks along shore & beach areas (k)
		Reduction of Wetlands (k)	Development and filling (k)
Changes to Hydrologic Flow	*Coldwater Fishery *Other Indigenous Aquatic Life *Navigation	Fluctuating Water Levels (k)	Dams and lake-level control structures (k) Urban storm water runoff (k) Inc. development & imperv surfaces (k) Loss of terrestrial vegetation (k) Global warming (p)
		Reduction of Groundwater Recharge (k)	Increasing develop. on recharge areas (k) Loss of terrestrial vegetation (k) Global warming (p)
		Sedimentation (k)	Erosion (k)
		Dams, Lake-level Control Structures (k)	Dam removal (p) Changes in operation (p) Creation/destruction of beaver dams (k)
		Road Stream Crossings (k)	Road crossing flow obstructions or restrictions (k)
		Reduction of Wetlands (k)	Development on wetlands (k)
		Lowland Filling	Erosion from 1) improper shoreline stabilization, 2) improper dredge spoil disposal, and 3) increase peak flood flows Development

TABLE 16: POLLUTANTS, SOURCES, AND CAUSES TO WATER QUALITY DEGRADATION IN THE GRAND TRAVERSE BAY WATERSHED CONT'D

(COMPREHENSIVE WATERSHED MANAGEMENT TABLE)

Environmental Stressor or Pollutant	Impaired or Threatened Use	Sources K = known, S = suspected, P = potential	Causes K = known, S = suspected, P = potential
Invasive Species **(Eurasian Milfoil Only – Clam River)**	*Coldwater Fishery *Other Indigenous Aquatic Life *Navigation	Connected Waterways (k)	Unrestricted movement thru waterways (k)
		Boat Hulls and Bilges (k)	Lack of restrictions on boat travel (k) Lack of public knowledge on impact (k)
		Other Biota (i.e. birds, frogs) (k)	'Hitching' a ride (k)
Loss of Habitat	*Coldwater Fishery *Other Indigenous Aquatic Life	Development (including 're-development') (k)	Poor development and design practices (k) Lack of knowledge on impact (k) New construction (p) Inadequate laws or regulations (p) Lack of adequate enforcement (p) Habitat fragmentation (k) Wetland loss (k)
		Shoreline Erosion & Stabilization (k)	Wave/ice action (k) High lake/river levels (k) Improperly designed/sited sea walls (k) Removal or lack of riparian vegetation (k)
Thermal Pollution	*Coldwater Fishery *Other Indigenous Aquatic Life	Urban/Agricultural/ Rural Storm Water (k)	Poor storm water management practices (k)
		Impervious Surfaces (k)	More roads, roofs, and parking lots due to development (k)
		Lack of Streamside or Shoreline Canopy and Riparian Buffer (k)	Development (k) Clearing by landowner (k)
		Dams, Lake-level Control Structures (k)	Top draw structures (k) Hydrology – low flows at times (k)

TABLE 16: POLLUTANTS, SOURCES, AND CAUSES TO WATER QUALITY DEGRADATION IN THE GRAND TRAVERSE BAY WATERSHED

(COMPREHENSIVE WATERSHED MANAGEMENT TABLE)

Environmental Stressor or Pollutant	Impaired or Threatened Use	Sources K = known, S = suspected, P = potential	Causes K = known, S = suspected, P = potential
Toxins **(Pesticides, Herbicides, Oils, Gas, Grease, Etc.)**	*Coldwater Fishery *Other Indigenous Aquatic Life	Water Wells (p)	Abandoned Wells (leaking, uncapped) (p)
		Industrial/Municipal Discharges (k)	Discharge limit violations(k) Contaminated sediments (k)
		Contaminated Sediments (k)	Historical spills, disposals, discharges (k)
		Oil, Gas, Hydrocarbon, and Underground Injection Wells (p)	Maintenance (p), Accidents (p), Brine Storage (p) Abandoned Wells (leaking, uncapped) (p)
		Underground Storage Tanks (p)	Leaking tanks (p)
		Urban/Agricultural/ Rural Storm Water (k)	Poor storm water management practices (k)
		Motor Boats (k)	Inefficient (2cycle) or poorly maintained watercraft motors (k) Fuel spills (p)
		Improper Chemical Use and Disposal (s)	Poor public knowledge of consequences (s) Lack of disposal facilities and/or limited hours of operation (s)
		Road Salt and Airport De-icing in Winter (k)	Runoff from roads and airport de-icing (k)
		Air Deposition (k)	Vehicle combustion (k) Industrial/comm./municipal facilities (k)
Pathogens (*E. Coli* and Fecal Coliform indicators)	*Total Body Contact	Urban/Agricultural/ Rural Storm Water (k)	Poor storm water management practices (k)
		Animal Waste (k)	Geese/ducks along shore & beach areas (k) Riparian Grazing (p)
		Septic Systems (p)	Improperly designed and maintained (p)
		WWTP (p)	Overflowing sewer systems in high flow (p) Hydrology (p)

Sources and Causes of Pollutants in the Grand Traverse Bay Only

An additional Comprehensive Watershed Management Table was developed for pollutants, sources, and causes to the Grand Traverse Bay only (Table 17). Why differentiate between the two? First, it is important to realize that the bay and its watershed are connected, but inherently different. What happens at the extreme outer edges of the watershed will eventually affect the Grand Traverse Bay. However, while the watershed itself encompasses rivers, streams, lakes, and 973 square miles of land, the bay is a large open body of water that is connected to Lake Michigan. Certain pollutants have more of an impact on streams and lakes than on larger bodies of water like the Grand Traverse Bay (i.e., thermal pollution and sediment), but other pollutants are more of a concern for the Grand Traverse Bay and its associated designated uses. For example, the East Arm of Grand Traverse Bay is the main source of drinking water for Traverse City and fulfills the designated use of providing a public water supply. The rest of the watershed residents mainly get their water from wells (not surface water). Additionally, invasive species are a greater concern for the Grand Traverse Bay than for areas in its watershed. *(It should be noted that all of the information contained in Table 17 is also contained in Table 16, which deals with the entire watershed.)*

TABLE 17: POLLUTANTS, SOURCES, AND CAUSES TO WATER QUALITY DEGRADATION IN THE GRAND TRAVERSE BAY ONLY

(COMPREHENSIVE WATERSHED MANAGEMENT TABLE)

Environmental Stressor or Pollutant	Impaired or Threatened Use	Sources K = known, S = suspected, P = potential	Causes K = known, S = suspected, P = potential
Nutrients	*Coldwater Fishery *Other Indigenous Aquatic Life *Total Body Contact *Public Water Supply	Residential or Commercial Fertilizer Use (k)	Improper application (amount, timing, frequency, location, method, P content) (k)
		Septic Systems (s)	Poorly designed, sited, and maintained (s) High density/age of system (s)
		Urban/Agricultural/ Rural Storm Water (k)	Poor storm water management practices (k) Development (k)
		Lack of Riparian Buffer (k)	Development (k) Clearing by landowner (k) Lack of adequate shoreline setbacks (p)
		WWTP (p)	Discharge of nutrients in waste water (p)
		Agriculture (p) (fertilizer, manure, & livestock)	Improper application (amt., timing, freq., location, method, P content) (p) Improper storage/handling/application (p) Close proximity to Bay/Tributaries (p)
		Animal Waste (k)	Geese/ducks along shore & beach areas (k)
		Reduction of Wetlands (k)	Development and filling

TABLE 17: POLLUTANTS, SOURCES, AND CAUSES TO WATER QUALITY DEGRADATION IN THE GRAND TRAVERSE BAY ONLY CONT'D

(COMPREHENSIVE WATERSHED MANAGEMENT TABLE)

Environmental Stressor or Pollutant	Impaired or Threatened Use	Sources K = known, S = suspected, P = potential	Causes K = known, S = suspected, P = potential
Invasive Species	*Coldwater Fishery *Other Indigenous Aquatic Life *Navigation *Total Body Contact *Public Water Supply	Connected Waterways (k)	Unrestricted movement thru waterways (k)
		Boat Hulls and Bilges (k)	Lack of restrictions on boat travel (k) Lack of public knowledge on impact (k)
		Purposeful & Accidental Human Intro (k)	Aesthetics (k) Development in wetlands and undisturbed habitat (p) Lack of public knowledge on impact (k)
		Other Biota (i.e. birds, frogs) (k)	'Hitching' a ride (k)
		Zebra Mussels (k)	Sharp shells washing onshore (k)
Loss of Habitat	*Coldwater Fishery *Other Indigenous Aquatic Life	Development (incl. Re-development) (k)	Poor development and design practices (k) Lack of knowledge on impact (k) New construction (p) Inadequate laws or regulations (p) Lack of adequate enforcement (p) Habitat fragmentation (k) Wetland loss (k)
		Shoreline Erosion and Stabilization (k)	Wave/ice action (k) High lake/river levels (k) Improperly designed/sited sea walls (k) Removal or lack of riparian vegetation (k)
Toxins **(Pesticides, Herbicides, Oils, Gas, Grease, Salts/Chlorides, Etc.)**	*Coldwater Fishery *Other Indigenous Aquatic Life	Urban/Agricultural/ Rural Storm Water (k)	Poor storm water management practices (k)
		Motor Boats (k)	Inefficient (2-cycle) or poorly maintained watercraft motors (k) Fuel spills (p)
		Improper Chemical Use/Disposal (s)	Poor public knowledge of consequences (s) Lack of disposal facilities and/or limited hours of operation (s)
		Air Emissions (k)	Vehicle combustion (k) Industrial/comm./municipal facilities (k)
		Illegal Dumping (p)	Lack of restrictions and enforcement (p)
		Road Salt in Winter (k)	Runoff from roads (k)

TABLE 17: POLLUTANTS, SOURCES, AND CAUSES TO WATER QUALITY DEGRADATION IN THE GRAND TRAVERSE BAY ONLY CONT'D

(COMPREHENSIVE WATERSHED MANAGEMENT TABLE)

Environmental Stressor or Pollutant	Impaired or Threatened Use	Sources K = known, S = suspected, P = potential	Causes K = known, S = suspected, P = potential
Pathogens **(*E. Coli* and Fecal Coliform indicators)**	*Total Body Contact *Public Water Supply	Urban/Agricultural/ Rural Storm Water (k)	Poor storm water management practices (k)
		Animal Waste (k)	Geese/ducks along shore & beach areas (k) Livestock-access to streams near Bay (p)
		Illegal Discharges from Boats (p)	Lack of enforcement (p) Lack of public knowledge on impact (k)
		Septic Systems (s)	Improperly designed and maintained septic systems (s)
		WWTP (p)	Overflowing sewer systems in high flow (p) Hydrology (p)

The Comprehensive Watershed Management Tables (Tables 16 and 17) may be used as a reference to distinguish what the major sources of pollutants are on a watershed-wide scale. However, they do not distinguish between pollutants and their sources and causes in individual subwatersheds. And, as stated earlier, not all of the pollutants listed are a problem everywhere in the watershed. There are differences among the nine subwatersheds making up the Grand Traverse Bay watershed. Each one is unique in the challenges it faces to maintain water quality protection. For example, the Ptobego Creek watershed is mainly a wetland type area and does not contain much development. In contrast, the Mitchell Creek watershed, just a few miles down the bay, faces extreme pressure from future development. Each must face water quality protection measures in its own way. See Section 3.9 for a discussion of each subwatershed.

5.2 Pollutants of Concern

Sediment

Sediment is fine inorganic soil or sand particles and sedimentation is the process whereby sediment is deposited in a stream or lake bottom. It occurs naturally in all stream and lake environments due to land erosion by wind and water. However, excessive sedimentation can severely degrade an entire riparian system (Waters 1995) and has been identified as a major cause of degradation to aquatic life in many Michigan streams and rivers (DEQ 1998). Excessive sediment deposition in many of Michigan's streams also severely impacts the amount of suitable habitat needed to support healthy and diverse communities of fish and fish food organisms. When sediment enters a stream it covers gravel, rocky, and woody habitat areas, thereby leading to decreases in habitat diversity and aquatic plant production. Sedimentation caused by streambank erosion may increase channel widening and cause changes in stream water temperatures.

Significant sources of sediment to streams include activities that cause streambank erosion such as road/stream crossings, increased flow levels (rapidly changing stream levels), boat traffic, removing streamside vegetation, users entering and exiting the river, recreational trails that cross streams and historical logging practices. Other sources are clearing land for agriculture, development, or other purposes. This also creates a host of other erosion related problems including flooding, polluted runoff, loss of topsoil from surface runoff, and a reduction in fisheries and channel depth. Any kind of excavation, earth moving, drainage, bridging, tunneling, or other activity in which soil is disturbed can result in sediment transport to nearby streams. Alexander and Hansen (1988) report that increases in sediment erosion from development are detrimental to aquatic communities. Increased sediment loads also will continue past the development construction phase due to the resulting increase in stormwater runoff from the newly created impervious surfaces. Roads, rooftops, and parking lots are examples of impervious surfaces that replace rural and forestland during development. Development results in decreased water-retention capacities, increased flood frequencies, and rapid filling of stormwater detention systems.

During construction, vegetation is cleared and the development site is graded to prepare for construction. With the trees and topsoil removed, soils are particularly susceptible to erosion. Photo Copyright 2000, Center for Watershed Protection

Agricultural grazing on or near streambanks also may contribute to increased sedimentation in streams. Most effects of grazing in riparian areas include increased fine-sediment generation and channel widening caused by bank exposure and animal access, sediment entering from slumping streambanks, increased deposition on the streambed, and much greater streambank damage from storm events (Kauffman et al. 1983, Sheffield et al. 1997).

Sediment is identified as a pollutant present in the Grand Traverse Bay watershed based on field inspections and inventories conducted throughout the watershed, as well as through existing research and historical evidence. Significant known sources of sediment include streambank erosion and road/stream crossings (Table 18, Figure 17), surface runoff, and construction zones.

Road stream crossings, like this one shown on the Rapid River in Kalkaska County, are a common source of sediment to streams. Photo courtesy of the Kalkaska Conservation District

TABLE 18: ROAD STREAM CROSSING AND STREAMBANK EROSION INVENTORIES IN THE GRAND TRAVERSE BAY WATERSHED

Inventory	Organization	Results
Boardman River and Tributaries – 1991 Streambank Erosion & Road Stream Crossing Inventory	Prepared by: Grand Traverse Conservation District	596 erosion sites identified (Grand Traverse County = 485; Kalkaska County = 58; Silver Lake = 53) Severe: 105 Moderate: 166 Minor: 103 Else: 169 Silver Lake: 53 *See report for details*
Elk River Chain of Lakes – 1997-98 Shoreline Survey Summary *(Includes a shoreline erosion inventory on only lakes and major connecting rivers in the Chain of Lakes system)*	Prepared by: Tip of the Mitt Watershed Council	Identified 269 shoreline property sites that had evidence of *visible, accelerated erosion.* (*Results do not include pictures or specific measurements. See report for other details.*)
Mitchell Creek – 1993 Streambank Erosion & Road Stream Crossing Inventory	Prepared by: Northwest MI RC&D For: GT County Drain Commission	Road Stream Crossings (20 total) Severe: 1 Moderate: 14 Minor: 5 Streambank Erosion Sites (10 total) Severe: 0 Moderate: 5 Minor: 5 *See report for details, most of the streambank erosion sites were stabilized during the Mitchell Creek Implementation Project in 1995.*

TABLE 18: SEDIMENTATION INVENTORIES IN THE GRAND TRAVERSE BAY WATERSHED CONT'D

Inventory	Organization	Results
West Bay Shoreline and Tributaries – 2003 Road Stream Crossing Inventory	Prepared by: Grand Traverse Band of Ottawa and Chippewa Indians	Severe = 8 Moderate = 19 *Contact the GTBOCI for details*
Acme Creek – 1995 Streambank Erosion & Road Stream Crossing Inventory	Prepared by: Northwest MI RC&D For: GT County Drain Commission	Road Stream Crossings (17 total) Severe: 0 Moderate: 14 Minor: 2 Other: 1 Streambank Erosion Sites (4 total) Severe: 0 Moderate: 3 Minor: 1 *See report for details* *Since inventory, 5 moderate road stream crossings sites and 1 moderate streambank erosion site have been remediated.*
Yuba Creek – 1995 Nonpoint Source Pollution Inventory *(Noted sites where erosion from road stream crossings and streambanks was occurring)*	Prepared by: Grand Traverse Conservation District For: GT County Drain Commission	Road Stream Crossings 3 sites experiencing erosion to some extent: (1 is severe, others not rated) Streambank Erosion Sites 3 sites experiencing erosion to some extent (sites not rated) *See report for details*

Typical Impacts from Sedimentation

Impact #1: *Sand and sediment harm aquatic life by covering natural stream and lake substrate, which fish and prey species rely upon for spawning and feeding.*

Impact #2: *Sediment also increases turbidity, decreasing visibility and clogging fish and insect gills. Turbid stream flow also dislodges fish eggs and insect prey.*

Impact #3: *When more sand and sediment is deposited than can be moved by stream flow, water levels are raised, causing streambank erosion and potential flooding. Excessive sedimentation may also fill lakes, ponds, and wetlands.*

Impact #4: *Nutrients, heavy metals, and other pollutants can attach to finer sediment particles and enter the water when suspended.*

Figure 17: Road Stream Crossings

Nutrients

Nutrients are elements such as nitrogen, phosphorus, carbon, sulfur, calcium, potassium, iron, manganese, boron, and cobalt that are essential to the growth of living things. In particular, nitrogen and phosphorus are critical nutrients for all types of plants, including aquatic species. In Michigan, rooted aquatic vegetation and algal growth are most commonly limited by the amount of phosphorus in the water column. Ordinarily, as the amount of phosphorus in the water column increases, rooted plant and algal growth increase as well. When elevated levels of phosphorus occur in the water column, rooted plant and algae growth can be excessive, resulting in nuisance conditions. Blooms of algae resulting from nutrient enrichment eventually die and decompose, removing oxygen from the water and potentially leading to levels of dissolved oxygen that are insufficient to sustain aquatic life (Allan 1995). Generally, in terms of water quality, nutrients have a negative impact on the system when their concentrations exceed natural background levels. This condition can effectively reduce the recreational value of the waters by making the water unpleasant and undesirable for swimming, fishing, or boating due to increased algae and aquatic plant growth.

Nutrients speed up the natural aging process of lakes and ponds. This process is called eutrophication. The signs of an aging water body are deeper bottom sediments and heavy weed growth. This aging process would normally be measured in hundreds of thousands of years if not for the added sediments, fertilizers, and other organic wastes supplied by runoff from a developed watershed.

Sources of nutrients to the Grand Traverse Bay watershed resulting from human activities include stormwater runoff (from agricultural, residential, and urban areas), commercial fertilizer use (by residents, businesses, golf courses, and agricultural operations), and runoff from animal waste (from both residential and agriculture sources).

Fertilizers from residential lawns are a source of nutrient input in the watershed.

Evidence of locally increased concentrations of nutrients in the bay is seen by the increase in the amount of weed and macrophyte beds, which nearly doubled from 1991 (64 areas) to 1998 (124 areas). These numbers are still low overall compared to the size of the bay, however, the growths are most concentrated at the south end of West Grand Traverse Bay due to rapid development and nutrient flushing from stormwater inputs, and a higher amount of phosphorus entering the bay.

Another potential source of nutrient enrichment in the Grand Traverse Bay watershed is from septic systems. Although not identified as a known pollutant in the watershed, poorly maintained septic systems are a concern in rural places with no sewer systems and increasing development such as in the Elk River Chain of Lakes. More in-depth research is required to get a better idea of the amount of excessive nutrient pollution from poorly maintained and failing septic systems in the watershed.

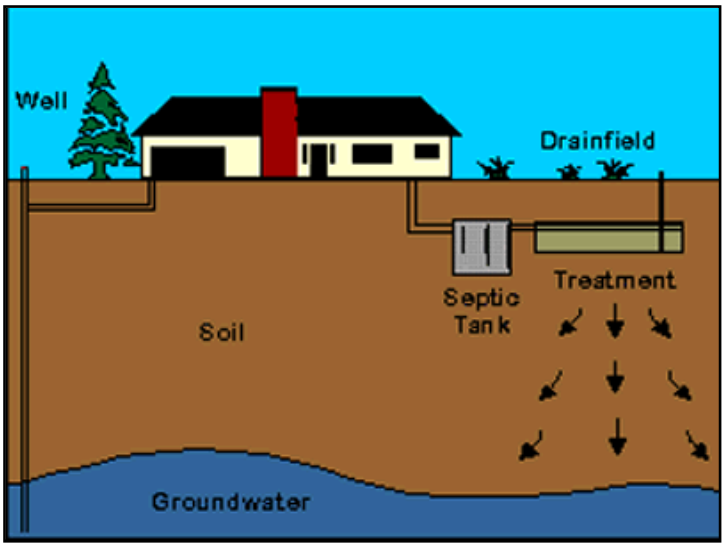


Image courtesy of MSU Institute for Water Research:
www.iwr.msu.edu/edmodule/water/septic.htm

A septic system consists of two basic parts: a septic tank and a soil absorption field or drainfield. Wastes flow from the house into the septic tank where most solids are separated to the bottom and are partially decomposed by bacteria to form sludge. Some solids float and form a scum mat on top of the water. The liquid effluent from the septic tank, carrying disease-causing organisms and liquid waste products, is discharged into the soil absorption field. In the absorption field, the water is further purified by filtration and decomposition by microorganisms in the soil. The semi-purified wastewater then percolates to the groundwater system.

Typical Impacts from Excessive Nutrients

Impact #1: *Increased weed and algae growth impact water recreation and navigation.*

Impact #2: *Decomposition of algae and weeds removes oxygen from lakes, harming aquatic life and reducing the recreational and commercial fishery.*

Impact #3: *Exotic plant species like Eurasian Watermilfoil and Purple Loosestrife can better compete with native plants when nutrients are abundant.*

Impact #4: *Some algae (i.e., blue-green algae) are toxic to animals and humans and may cause taste and odor problems in drinking water.*

Impact #5: *High nitrogen levels in drinking water are a known human health risk.*

Thermal Pollution

Not normally thought of as a pollutant, heated stormwater runoff and elevated stream temperatures are a concern in developing watersheds like the Grand Traverse Bay watershed. When water temperature increases, its ability to hold dissolved oxygen decreases, thereby reducing the available amount of oxygen in the water to fish and other aquatic life. Temperature also influences the rate of physical and physiological reactions such as enzyme activity, mobility of gases, diffusion, and osmosis in aquatic organisms. For most fish, body temperature will be almost precisely the temperature of the water. So, as water temperature increases, a fish's body temperature increases, which changes their metabolic rate and other physical or chemical processes as well. When thermal stress occurs, fish cannot efficiently meet these energetic demands (Diana 1995).

By far, the greatest amount of thermal pollution in the Grand Traverse Bay watershed is the result of heated runoff from paved surfaces and the removal of shade vegetation along streams and lake shorelines. Thermal pollution also occurs through industrial discharges of warmed process water, solar warming of stagnant pond water and stormwater, and from discharges of warmed water behind dams and other lake-level control structures. Major dams in the Grand Traverse Bay watershed include hydro-electric dams along the Boardman River and in the Elk River Chain of Lakes. However, there are many more lake-level control structures located throughout the entire Grand Traverse Bay watershed.

Excessive inputs of sediment into streams and lakes may also contribute to thermal pollution. Sediment inputs can fill stream pools and lakes, making them shallower and wider and, consequently, more susceptible to warming from solar radiation.

Changes in climate due to global activities also may enhance the degree of thermal pollution in a watershed. Average global surface temperatures are projected to increase by 1.5^{o}C to 5.8^{o}C by the year 2100 (Houghton et al. 2001). Increases in surface temperatures may increase stream water temperatures as well, although impacts will vary by region. Overall, increases in stream water temperature will negatively affect cold-water aquatic species. For example, cold-water fish, such as trout and salmon, are projected to disappear from large portions of their current geographic range in the continental United States due to an increased warming of surface waters (Poff et al. 2002).

Typical Impacts from Thermal Pollution

Impact #1: *Surges of heated water during rainstorms can shock and stress aquatic life, which have adapted to cold water environments. Aquatic diversity is ultimately reduced. Constant heating of rivers and lakes ultimately changes the biological character and thus the fishery value.*

Impact #2: *Thermal pollution decreases the amount of oxygen available to organisms in the water, potential suffocating them.*

Impact #3: *Warm water increases the metabolism of toxins in aquatic animals.*

Impact #4: *Algae and weeds thrive in warmer waters.*

Toxins

Toxic substances such as pesticides, herbicides, oils, gas, grease, and metals often enter waterways unnoticed via stormwater runoff. These types of toxins are perhaps the most threatening of all the watershed pollutants because of their potential to affect human and aquatic health. It is highly probably that at any given moment, somewhere in the watershed there is a leaking automobile radiator, a landowner applying herbicides or pesticides to their lawns, or someone spilling gasoline while filling up their car. Every time it rains, these toxic pollutants are washed from the roads, parking lots, driveways, and lawns into the nearest storm drain or road ditch, eventually reaching nearby lakes and streams. Each winter, hundreds of tons of road salt and sand are spread over area roadways; when spring rolls around, it all gets washed into the nearest waterway. Additionally, farms, businesses, and homes throughout the watershed are potential sites of groundwater contamination from improperly disposed and stored pesticides, solvents, oils, and chemicals. Two examples of noted toxic pollution to groundwater in the watershed from businesses are the trichloroethylene (TCE) plume in Mancelona (Skillings 1982) and the Cone Drive Textron site in Traverse City.

Most of the pollution from toxic substances in the Grand Traverse Bay watershed comes from stormwater and urban runoff containing oils, grease, gasoline, and solids. Urban areas with high amounts of imperviousness such as those found in Traverse City, Elk Rapids, Suttons Bay, Northport, and Kalkaska all contribute toxic substances to the watershed during storm events when water runs off streets, parking lots, and roofs, and enters storm drains leading to the area streams and lakes, and eventually, Grand Traverse Bay.

There is also widespread atmospheric mercury deposition into Michigan's surface waters. The organic form of mercury, methylmercury, is a highly bioaccumulative toxic pollutant that is hazardous to wildlife and human health. Elemental mercury is converted to the organic form through natural processes, particularly in inland lakes. This has caused elevated mercury concentrations in inland lake sediments (Evans et al., 1991) and fish tissues (Day 1997) throughout the state. As a result, there is a statewide, mercury-based fish consumption advisory that is applied to all of Michigan's inland lakes (MDNR 1997).

Typical Impacts from Toxins

Impact #1: *Toxic chemicals entering waterbodies harm stream life, potentially causing entire reaches of a stream to be killed off if the concentrations of contaminants are high enough.*

Impact #2: *Persistent toxic pollution in a stream may put human health and recreation at risk.*

Impact #3: Contaminated groundwater may pose a problem for homes and businesses throughout the watershed that rely upon groundwater wells for their drinking water. This poses a risk to human health and often requires difficult and costly cleanup measures.

Changes to Hydrologic Flow

Sometimes excessive hydrologic flow in a watershed system may cause problems. The term hydrologic flow encompasses all the factors affecting the stream flow and discharge in a watershed. By far, the most notable and significant alteration in stream flow is caused by urban and stormwater runoff. Stream channel shape, meander pattern, base flow, and storm flow characteristics are largely determined by watershed runoff characteristics. Hydroelectric facilities, lake-level control structures, excessive sedimentation, and channelization by road culverts are additional sources of fluctuations in hydrologic flow. Surges of water from dams and lake-level control structures may cause peak stream flows to increase, leading to unstable bottom substrates, flooding and sedimentation which destroys aquatic habitats and causes property damage (while also changing stream hydrology further).

Changes in hydrologic flow may also be affected by the amount of groundwater recharge in the watershed. As more and more development paves over forests and fills wetlands, valuable recharge areas are cut off, and stream base flows may eventually be affected. Freshwater ecosystems, such as the Grand Traverse Bay watershed, have specific requirements in terms of the quantity, quality, and seasonality of their water supplies. In order for the system to be sustainable, it must fluctuate within a range of natural variation. If the quantity of the water flow through a system is disrupted, long-term sustainability within the system will be lost.

Typical Impacts from Changes to Hydrologic Flow

Impact #1: *Deviations in storm flow caused by increased runoff from paved surfaces or channeled flow through culverts often causes erosion of the stream channel, which leads to sedimentation problems.*

Impact #2: *In some stream reaches, storm surges can spill over banks causing localized flooding, endangering humans and causing widespread economic damage.*

Impact #3: *Severe fluctuations in stream flow may disrupt aquatic habitat and strand aquatic organisms, while also interfering with recreational uses of the river.*

Invasive Species

Invasive species (also called exotic or non-native species) have threatened the Great Lakes ever since Europeans settled in the region. Exotic species are organisms that are introduced into areas where they are not native. While many exotic species are introduced accidentally, others are intentionally released, often to enhance recreational opportunities such as sport fishing. The Pacific salmon, which was purposely stocked in the Great Lakes, is an exotic species, but they are not a "nuisance" species. Species are considered a nuisance when they disrupt native species populations and threaten the ecology of an ecosystem as well as causing damage to local industry and commerce. Without pressure from the competitors, parasites, and pathogens that normally keep their numbers in check, invasive species, may undergo large population increases.

Since the 1800s, more than 140 exotic aquatic organisms of all types, including plants, fish, algae, and mollusks have become established in the Great Lakes. As human activity has increased in the Great Lakes watershed, the rate of introduction of invasive species has increased as well. More than one-third of the current invasive species have been introduced in the past 30 years, a surge coinciding with the opening of the St. Lawrence Seaway. Once introduced, invasive species must be managed and controlled as they are virtually impossible to eradicate (GLIN 2001).

While many non-native species have no serious ecological impact, the introduction of a single key species, such as the sea lamprey, can cause a sudden and dramatic shift in the entire ecosystem's structure. New species can significantly change the interactions between existing species, creating ecosystems that are unstable and unpredictable.

A few of the exotic aquatic animal species found in the Grand Traverse Bay and its watershed include the rusty crayfish (*Orconectes rusticus*), zebra mussels (*Dreissena polymorpha*), spiny water flea (*Bythotrephes cederstroemi*), and the fishhook water flea (*Cercopagis pengoi*).

Rusty Crayfish

Rusty crayfish are native to streams in the Ohio, Kentucky, and Tennessee region. Spread by anglers who use them as bait, rusty crayfish are prolific and can severely reduce lake and stream vegetation, depriving native fish and their prey of cover and food. They also reduce native crayfish populations (GLIN 2001). Rusty crayfish were spotted in the West arm of Grand Traverse Bay in Spring 2000.

Rusty Crayfish

Zebra Mussels

Zebra mussels are small, fingernail-sized mussels native to the Caspian Sea region of Asia and a stark example of the explosive growth potential of the introduction of a non-native species. They are believed to have been transported to the Great Lakes via ballast water from a trans-oceanic vessel. The ballast water, taken on in a freshwater European port, was

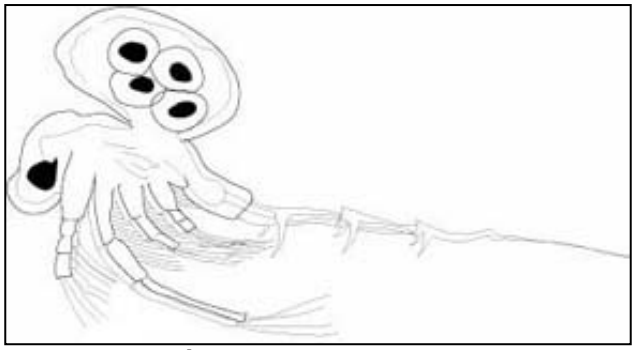
Zebra Mussels

subsequently discharged into Lake St. Clair near Detroit, where the mussel was discovered in 1988. Since that time, they have spread rapidly to all of the Great Lakes and waterways in many states, as well as Ontario and Quebec.

The zebra mussel out competes native organisms and clogs water-intake systems of power plants. Large water users on the Great lakes spend an annual average of $350,000 to $400,000 per user just to clear zebra mussels from their intake pipes. The organisms are most likely spread through microscopic larvae carried in livewells or bilgewater and as adults attached to boats or boating equipment moved from lake to lake (and rivers) (GLIN 2001). Larvae may also drift downstream through connecting channels. Diving ducks and freshwater drum eat zebra mussels, but will not significantly control them. The U.S. Fish and Wildlife Service estimate the potential economic impact of zebra mussels over the next ten years at $5 billion to U.S. and Canadian water users within the Great Lakes region alone (USGS-Great Lakes Science Center website, www.glsc.usgs.gov/). Excessive amounts of zebra mussels have been located in Grand Traverse Bay as well as lakes throughout the watershed.

Spiny Water Flea

Originally limited to lakes in Eastern and Western Europe and China, the spiny water flea (*Bythotrephes cederstroemi)* is a crustacean that invaded North America in the 1980s and is now established in all the Great Lakes. The spiny water flea is a small shrimp-like zooplankton that grows to an average of 10 millimeters (0.4 inch) in length and feeds on other small aquatic animals. It has powerful limbs for swimming and grasping food items, and a large pigmented eye for seeing light and images in the water. When *Bythotrephes* captures a food item, it inserts its mouthparts into its victim and, much like a vampire bat, sucks out all the fluids.



Spiny Water Flea

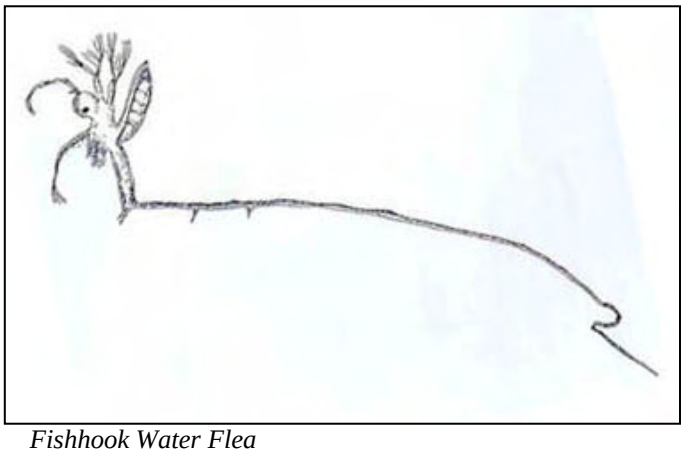
A carnivorous zooplankton such as *Bythotrephes* could have profound effects on Great Lakes fish because it feeds on other zooplankton that small fish depend on for survival. Although *Bythotrephes* itself is tasty to fish, it is protected from small fish predators by an unusually long tail spine with up to four pairs of protruding barbs. Because of its long tail spine and barbs, both small and young fish have great difficulty ingesting the spiny creature, potentially causing them to starve to death.

Fish shift their habitats and food preferences as they grow -- often feeding on zooplankton when they are young and eating other fish when they are older. Food that is difficult for a young or small fish to swallow may not be difficult for a larger fish to swallow. This may be why scientists find large numbers of *Bythotrephes* in the stomachs of adult fish in the Great Lakes. However, all fish start out small, and so at some point in their lives are vulnerable to the presence of *Bythotrephes* in the Great Lakes. Smaller fish depend heavily on zooplankton and are vulnerable to predators. Although older fish might benefit from eating *Bythotrephes*, the losses in energy, resources and time younger fish experience as a result of *Bythotrephes* may be greater

than any later benefits (Michigan Sea Grant Program, Inland Seas Education Association, State of the Bay CD 2000).

Fishhook Water Flea

Students aboard the Great Lakes Schoolship *Inland Seas* discovered a new invader to Lake Michigan and Grand Traverse Bay in September 1999, the fishhook water flea or, *Cercopagis pengoi*. This discovery was the first reported sighting of the animal in Lake Michigan since it was found in Lake Ontario in July of 1998. The fishhook water flea is known by its long tail spine (up to ½ inch) and by the kink near the end of this tail.



Fishhook Water Flea

Cercopagis originates from the Caspian, Black, Azov, and Aral Seas. Ocean-going freighters most likely carried this invader in their ballast water to Lake Ontario. Within a year, ships traveling within the Great Lakes probably carried it to Grand Traverse Bay.

Cercopagis is expected to further upset the current food chain in Lake Michigan. Like the well-known spiny water flea, *Cercopagis* is a predator on smaller zooplankton. Small fish that feed upon zooplankton are discouraged from eating *Cercopagis* because of its long spiked tail spine (Michigan Sea Grant Program and Inland Seas, State of the Bay CD 2000).

Invasive Plant Species

Nonindigenous aquatic plants, such as Eurasian watermilfoil (*Myriophyllum spicatum*), purple loosestrife (*Lythrum salicaria*), and curly leaf pondweed (*Potamogeton crispus*), quickly establish themselves and can displace native plants. Environmental and economic problems caused by these plants include impairment of water-based recreation, impairments to navigation and flood control systems, degradation of water quality and fish and wildlife habitat, and accelerated filling of lakes and reservoirs.

Eurasian Watermilfoil

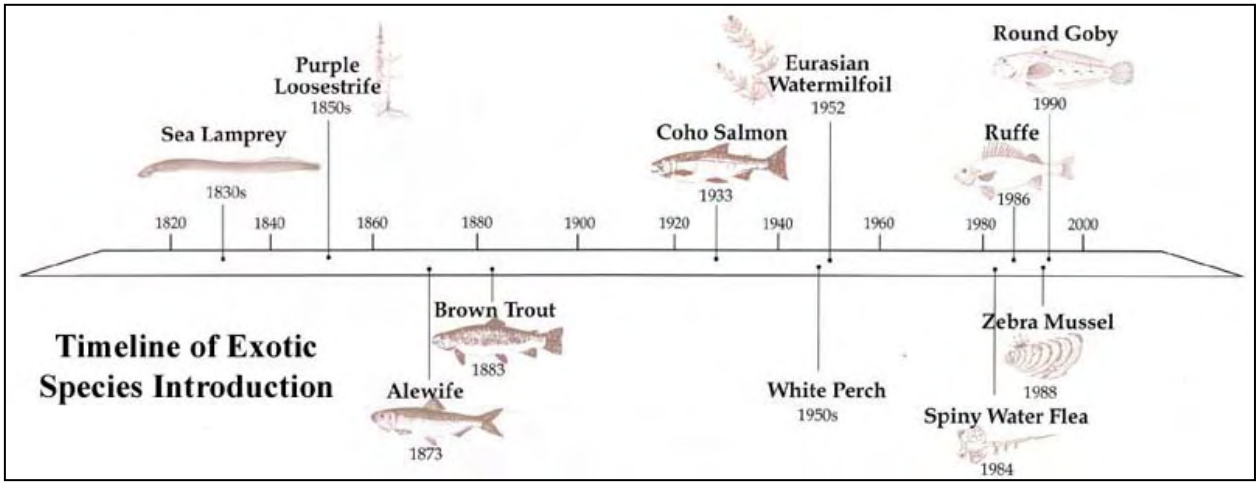
For example, Eurasian watermilfoil was accidentally introduced to North America from Europe, spread westward into inland lakes (primarily by boats and waterbirds) and was first seen in Midwestern states by the 1950s. In nutrient-rich lakes, it forms thick stands of tangled stems underwater and vast mats of vegetation at the surface of the water. In shallow areas, the plant can

interfere with water recreation such as boating, fishing, and swimming. The plant's floating canopy can also crowd out important native water plants (GLIN 2001).

A key factor in the success of Eurasian watermilfoil is its ability to reproduce through stem fragmentation and underground runners. Single segments of stems and leaves are able to root and form new colonies when broken off. Fragments that cling to boats and trailers spread the plant from lake to lake. Watershed residents trying to mechanically clear weed beds for beaches, docks, and landings unintentionally create thousands of new stem fragments and end up forming more new plants. Eurasian watermilfoil has difficulty becoming established in lakes with healthy populations of native plants. In some lakes the plant appears to coexist with native flora and has little impact on fish and other aquatic animals (GLIN 2001).

Excessive amounts of Eurasian watermilfoil have been located in lakes throughout the Grand Traverse Bay watershed as well as in the bay itself.

Below is a timeline listing the introduction of some major invasive species into the Great Lakes.



Typical Impacts from Invasive Species

Impact #1: *Invasive species often have no natural predators and can out-compete native species for food and habitat.*

Impact #2: *Introduction of a single key species can cause a sudden and dramatic shift in the entire ecosystem's structure. New species can significantly change the interactions between existing species, creating ecosystems that are unstable and unpredictable.*

Impact #3: *In some instances invasive species can interfere with recreation in the watershed For example, rows of zebra mussel shells washed up on shore can cut beach walkers' feet, and Eurasian watermilfoil can get tangled up in boat propellers.*

Pathogens

Pathogens are organisms that cause disease and include a variety of bacteria, viruses, protozoa and small worms. These pathogens can be present in water and may pose a hazard to human health. The US Environmental Protection Agency (EPA) recommends that freshwater recreational water quality be measured by the abundance of *Escherichia coli* (*E. coli*) or by a group of bacteria called *Enterococci*. Michigan has adopted the EPA's *E. coli* water quality standards. *E. coli* is a common intestinal organism, so the presence of *E. coli* in water indicates that fecal pollution has occurred. However, the kinds of *E. coli* measured in recreational water do not generally cause disease; rather, they are an indicator for the potential presence of other disease causing pathogens. EPA studies indicate that when the numbers of *E. coli* in fresh water exceed water quality standards, swimmers are at increased risk of developing gastroenteritis (stomach upsets) from pathogens carried in fecal pollutions. The presence of *E. coli* in water does not tell us what kinds of pathogens may be present, if any. If more than 130 *E. coli* are present in 100mL of water in 5 samples over 30 days, or if more than 300 *E. coli* per 100mL of water are present in a single sample, the water is considered unsafe for swimming.

Fecal pollution entering the Grand Traverse Bay watershed may come from urban stormwater runoff, inadequately treated wastewater, agricultural runoff, illegal sewage discharge from boats, or from animals on the land or in the water. Different sources of fecal pollution may carry different pathogens. Peak *E. coli* concentrations often occur during high flow periods when floodwater is washing away possible contaminants along the streambank such as waste from ducks and geese. Streams such as Kid's Creek, Boardman River, Suttons Bay Creek and Northport Creek have exhibited high *E. coli* counts at times during storm events (The Watershed Center's *E. coli* monitoring program; please see interactive water quality database for specific information: www.gtbay.org/wqquery.asp). There are a number of public beaches on the bay near the outlets of these streams and high counts of *E. coli* pose a risk to beachgoers in these areas. Each year the amount of swimming beaches in the state closing due to high *E. coli* levels increases.

Stream or Beach	*E. coli* (colonies/100mL)	Date
Kid's Creek	1,986	8/26/03
Boardman River	517	5/14/03
Suttons Bay Creek	727	8/26/03
Northport Cr.	770	8/18/03
TC State Park Beach	518	6/9/03
Milliken Park Beach	2,419	6/9/03

Another source of possible *E. coli* contamination is from improperly functioning septic systems within the Grand Traverse Bay watershed. Due to the unknown nature of groundwater flow in some watershed areas and the relatively random location of septic systems, it is very difficult to accurately assess their impact to the watershed. Failing septic systems are a suspected source of contamination for parts of the Grand Traverse Bay watershed, especially where there is a high density of residential development using septic systems, such as in the Elk River Chain of Lakes watershed.

Typical Impacts from Pathogens

Impact: *High levels of potential pathogens in the water pose a threat to human health and can reduce the recreational value of lakes and the bay.*

5.3 Special Sources of Concern

Stormwater

One of the major pathways by which many types of pollutants get to lakes and streams is through stormwater runoff. Stormwater runoff results when drops of rain fall to the ground, or snow melts, and the resulting water that does not infiltrate into the ground flows over the surface of the land. This stormwater flow often dislodges and carries soil or sediment particles (causing streambank erosion in some places) to which many pollutants are attached. The stormwater flow may also directly move the pollutant itself (i.e., garbage, oils, grease, gas, pesticides, etc.). The amount of stormwater runoff that occurs is dependent upon a variety of conditions including storm intensity and duration, topography, time of year, soil moisture levels, soil permeability, vegetative cover types, the extent of vegetated cover, and the amount of impervious surfaces.

Road and roof runoff are two sources of stormwater. Photo Copyright 1999, Center for Watershed Protection

Urban locations, like Traverse City, Elk Rapids, and Suttons Bay, often produce greater amounts of stormwater flow due to the increased amount of impervious surfaces in these urban areas relative to more rural settings within the watershed. Impervious surfaces are those areas on land that cannot effectively absorb or infiltrate rainfall. Areas such as these may include: roads, streets, sidewalks, parking lots, and rooftops. Research suggests that there is a threshold to the amount of impervious cover that can occur within a watershed at which the degradation of aquatic systems occurs. Findings reveal that stream degradation consistently occurs when impervious surface levels in a watershed reach between 10-20% (Center for Watershed Protection 1994).

CITY OF TRAVERSE CITY STORM DRAIN OUTLETS
51 total storm drain outlets into: Grand Traverse Bay Boardman River Kid's Creek

Due to a high amount of impervious surfaces, the City of Traverse City generates large amounts of stormwater during rain and snow melt events and city officials consider stormwater to be a high priority issue. Kid's Creek, a tributary to the Boardman River located in Traverse City, experiences severe changes in flow due to stormwater inputs during storm events. The creek exhibits signs of flashiness and causes regular flooding upstream of a number of culverts within the city limits. This flashiness has led to scoured stream bottoms and increased sedimentation (from eroding stream banks) within the stream. This is one of the main reasons that Kid's Creek is on the state impaired waters list and is said to be in "nonattainment" (Section 4.1).

Stormwater also contributes directly to thermal pollution. As stormwater runs over the land, it can be warmed by the land surface and may cause significant increases in water temperatures when it is deposited into a stream or other body of water. Spikes of warm temperatures in streams can be fatal to fish and other aquatic life.

Stormwater can increase stream velocities and carry pollutants (like sediment) downstream.

Any reductions to stormwater flow, as well as better management of stormwater, will decrease the amount of sediment, nutrients, thermal pollution, toxins, and pathogens that enter area waterbodies.

Lack of Riparian Buffer

Riparian buffers are widely considered one of the best ways to control and reduce the amount of non-point source pollution entering a water body. Also called vegetated stream buffers, filter strips, or greenbelts, these buffers consist of strips of trees, shrubs, and other vegetation lining a stream corridor or lakefront. These linear strips of vegetation serve as a stream's last line of defense against human activities such as agriculture, grazing, and urban development.

Riparian buffers help to reduce the impact of almost all of the pollutants that currently threaten the Grand Traverse Bay watershed: sediment, nutrients, toxins, thermal pollution, pathogens, changes to hydrology, and loss of habitat.

Benefits of riparian buffers include:
Stabilization of Streambanks – The deep rooted vegetation binds the soil along streambanks, which prevents bank erosion during periods of high runoff.

Improved Water Quality – Trees, shrubs, and grasses along streams remove sediment, nutrients, pesticides, pathogens, and other potential pollutants before they enter surface water. Fertilizers and other pollutants that originate on the land are taken up by tree roots and stored in leaves, limbs and roots of the vegetation instead of reaching the stream. Studies have shown dramatic reductions of 30% to 98% in nutrients (nitrogen and phosphorus), sediment, pesticides, and other pollutants in surface and groundwater after passing through a riparian forest buffer (Chesapeake Bay Program website: www.chesapeakebay.net).

Reduced Flooding and Sedimentation – Trees and shrubs help to retain runoff longer, improve infiltration, and filter out sediment that might otherwise be delivered downstream during floods.

Reduction of Thermal Pollution (Stream Warming) – The canopy provided by the leaves of the vegetation provide shading to the stream, which moderates water temperatures and protects against rapid fluctuations that can harm stream health and reduce fish spawning and survival. Cool stream temperatures maintained by riparian vegetation are essential to the health of aquatic species. Elevated temperatures also accelerate algae growth and reduce the amount of dissolved oxygen the water can hold, further degrading water quality. In a small stream, temperatures may rise 1.5 degrees in just 100 feet of exposure without a leaf canopy. The leaf canopy also improves air quality by filtering dust from wind erosion, construction or farm machinery.

Enhanced Wildlife Habitat – The trees and shrubs contained in a riparian buffer supply a tremendous diversity of habitat and travel corridors for many wildlife species in both the aquatic and upland areas. Travel corridors are particularly important where habitat is limited. In addition, woody debris (fallen trees and limbs) in the stream provides both habitat and cover for fish and other macroinvertebrate species. Leaves that fall into a stream are trapped on woody debris and rocks where they provide food and habitat for small bottom-dwelling creatures (i.e. crustaceans, amphibians, insects and small fish), which are critical to the aquatic food chain.

Improved Scenery (Desired Uses) – Strips of trees and shrubs along streams add diversity and beauty to the landscape.

Riparian buffers vary in character, effectiveness, and size based on the environmental setting, proposed management, level of protection desired and landowner objectives. To protect water quality, a buffer at least 55 – 100 feet wide should be preserved or created around all bodies of water and wetlands, with strip widths increasing with increasing slope. Research shows that when the buffer is less than 100 feet, stream quality begins to diminish (DEQ 2001).

Most riparian buffers are composed of three zones, the width of each determined by site conditions and landowner objectives. This three-zone concept provides a conceptual framework in which water quality, habitat, and landowner objectives can be accomplished. The picture and accompanying text on the next page describes the components of each zone.

Streamside areas lacking a riparian buffer have a reduced filtering capacity and do not effectively filter out watershed pollutants. While the lack of a riparian buffer along a stream or lakefront does not *add* any pollutants to the watershed and is technically not a *source* of pollution, the lack of a buffer significantly increases the possibility of pollutants reaching a body of water. The actual sources of the pollution are coming from another place and the buffer only reduces their effects on the watershed. Therefore, for the purposes of this protection plan, the lack of a riparian buffer (and streamside canopy) is referred to as sources of pollution and environmental stress in the watershed, with the general understanding that increases in the amounts of riparian buffers will decrease the amount of various pollutants entering the watershed.

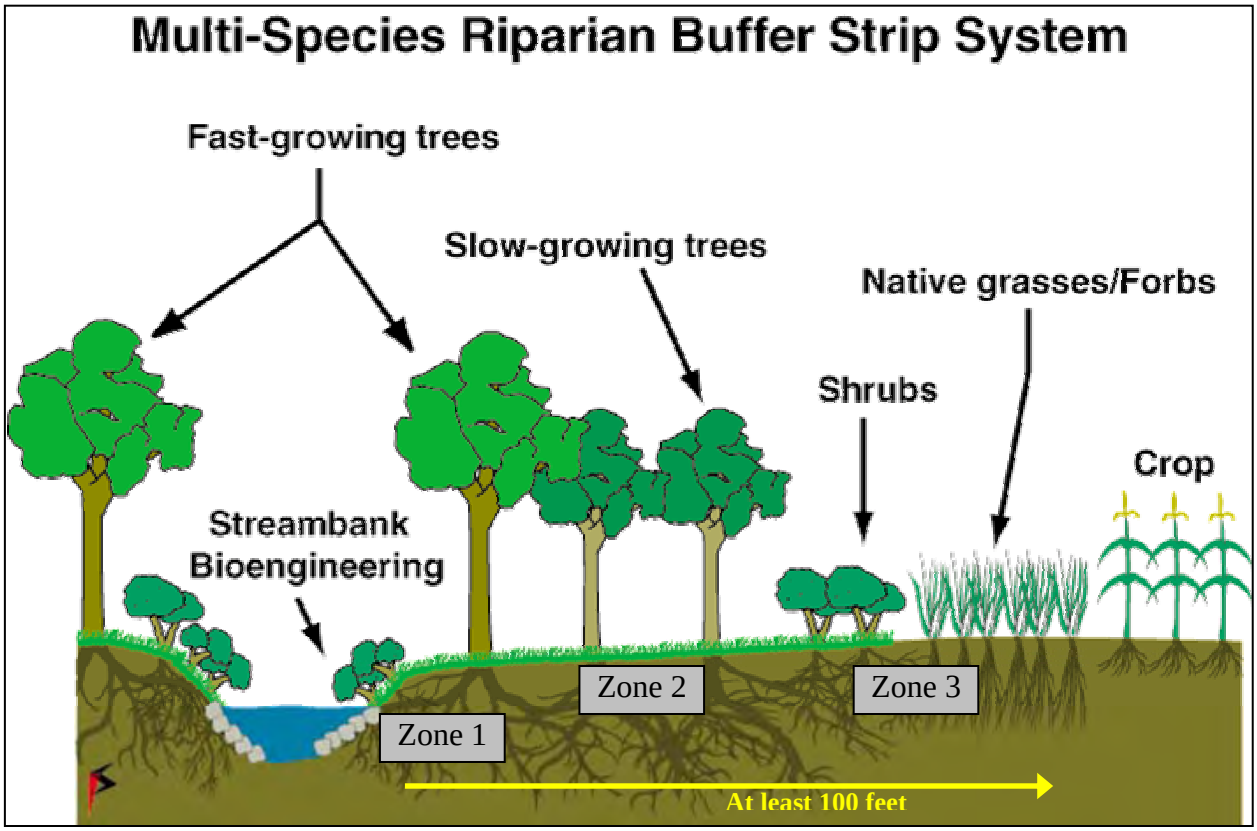


Illustration courtesy of the ISU Forestry Extension Website

Zone Description from the DEQ's Guidebook of Best Management Practices for Michigan Watersheds & the USDA – NRCS website (www.mi.nrcs.usda.gov):

Zone 1 – The Streamside Zone: This zone is usually made up of mature trees and shrubs that provide shade, leaf litter, and woody debris to the stream, as well as erosion protections. The minimum width of this zone is 15 – 25 feet. Land uses in this zone should be limited to footpaths and well-designed watercourse crossings (for utilities, roads, etc.). The mature forest along the edge of the water maintains habitat, food, and water temperature and helps to stabilize streambanks, reduce flood impact, and remove nutrients.

Zone 2 – The Middle Zone: This zone extends from the outer edge of the streamside zone and protects the stream's ecosystem by providing a larger protective area between the stream and upland development. Ideally, this zone will also be composed of mature trees and shrubs and will be between 20 – 50 feet, with widths increasing to ensure the 100-year floodplain. A primary function of Zone 2 is to filter runoff by removing sediment, nutrients and other pollutants from surface and groundwater.

Zone 3 – The Outer Zone: The outer zone extends from Zone 2 to the nearest permanent structure and is composed of grass and other herbaceous cover. This is the main filtering part of the riparian buffer strip. The vegetation included in this zone is useful in spreading and filtering runoff that may be transporting sediment, nutrients, or pesticides.

5.4 Priority Pollutant Ranking

The pollutants listed in the Section 5.1 were ranked and prioritized based on the how they most affect (or have the potential to affect) the watershed's threatened designated uses (Tables 19, 20, and 21). Overall, nutrients are a high priority pollutant for both the Grand Traverse Bay and its tributaries, while sediment is a high priority pollutant in the surrounding watershed (Table 19). Maintaining the low productivity (oligotrophic status) for Grand Traverse Bay will require minimizing the amount of nutrient pollution that enters the lake from adjacent properties and tributaries. Nutrients often attach to soil particles, thereby linking sediment and nutrient pollution. Changes to hydrologic flow, mainly due to stormwater inputs are also a concern throughout the watershed. Along with hydrologic changes, stormwater may carry an excessive amount of nutrients, sediments, and toxins to the bay and its tributaries.

Additionally, the impact invasive species have on its ecosystem (both currently and in the future) is of great concern for the Grand Traverse Bay. While not a primary concern throughout portions of the watershed just yet, invasive species are already beginning to change the ecosystem and habitat dynamics in Grand Traverse Bay.

TABLE 19: POLLUTANT PRIORITIES FOR THE GRAND TRAVERSE BAY WATERSHED

Pollutant	Priority Ranking for GT Bay Watershed	Priority Ranking for GT Bay ONLY
Sediment	1	--
Nutrients	2	1
Changes to Hydrologic Flow	3	--
Loss of Habitat	4	4
Toxins (Pesticides/Herbicides, Oils, Gas, Grease, Salt/Chlorides)	5	3
Invasive Species	6	2
Pathogens (*E. Coli* and Fecal Coliform indicators)	7	5
Thermal Pollution	8	--

NOTE: Even though the bay is oligotrophic and low in nutrients overall, excessive nutrient loading is still a threat, especially in shallow, near shore areas where excessive nutrients cause increased algae and plant growth. As the nutrients get washed out into the deeper bay areas, there is some dilution; therefore nutrient levels still remain low. However, if excessive inputs of nutrients continue, nutrient levels in the deeper, open water areas of the bay could increase, causing drastic and harmful changes to the bay's ecosystem. Additionally, excessive nutrients

may accumulate in the sediment lining the bottom of the bay, causing sharp increases in plant growth.

Each pollutant has a different effect on the threatened designated uses for the Grand Traverse Bay watershed (Table 20). For example, large amounts of bacteria in the water make the water unsafe for swimming and total body contact, but bacteria has little if any effect on navigation.

TABLE 20: POLLUTANT PRIORITIES FOR THREATENED DESIGNATED USES

Threatened Designated Use	Pollutant or Environmental Stressor	Priority Ranking
Coldwater Fishery	Sediment Changes to Hydrologic Flow Loss of Habitat Nutrients Thermal Pollution Toxins Pathogens Invasive Species	1 2 3 4 5 6 7 8
Other Indigenous Aquatic Life	Nutrients Sediment Loss of Habitat Changes to Hydrologic Flow Toxins Thermal Pollution Pathogens Invasive Species	1 2 3 4 5 6 7 8
Navigation	Sediment Changes to Hydrologic Flow Invasive Species	1 2 3
Total Body Contact	Pathogens Nutrients Invasive Species	1 2 3
Public Water Supply	Nutrients Invasive Species Pathogens	1 2 3
In Grand Traverse Bay Only		
Coldwater Fishery & Other Indigenous Aquatic Life	Nutrients Invasive Species Loss of Habitat Toxins Pathogens	1 2 3 4 5

The project steering committee noted that it is difficult to rank all the pollutants and environmental stressors in the watershed because all are important and should be priorities for maintaining the health of the bay. The pollutant ranking really depends on which area of the watershed is analyzed. In some places, sediment may be the biggest threat, while in others it could be pathogens. Almost always, the pollutants and stressors are interconnected with each other and changes in one causes changes to the others. For instance, increasing the hydrologic flow in a stream could increase the amount of sedimentation and erosion, which may then increase thermal pollution and the amount of nutrients entering the system. Additionally, losing valuable habitat in a stream could itself be the result of excessive sedimentation and subsequently affect the amount of nutrients and toxins entering the stream, as well as pave the way for invasive species to populate the area.

The project steering committee has decided that the specific sources for each pollutant and stressor are the most important items to rank and prioritize in this protection plan because that is where one can actually stop pollution from entering waterways (Table 21). Additionally, as noted above, because most of the pollutants and stressors are interconnected, dealing with one source and its causes could actually reduce a number of different pollutants and stressors from affecting a stream or waterbody.

TABLE 21: POLLUTANT SOURCE PRIORITY RANKING

Environmental Stressor or Pollutant	Sources	Priority Ranking
Sediment	Road Stream Crossings (k)	1
	Bank/Shoreline Erosion (k)	2
	Urban/Agricultural/Rural Storm Water (k)	3
	Construction (k)	4
	Oil and gas well development (k)	5
	Wetland Filling (k)	6
	Livestock (p)	7
	Dams, Lake-level Control Structures (p)	8
Nutrients	Residential/Commercial Fertilizer Use (k)	1
	Urban/Agricultural/Rural Storm Water (k)	2
	Lack of Riparian Buffer (k)	3
	Reduction of Wetlands (k)	4
	Septic Systems (s)	5
	Agriculture (p) (fertilizer, manure, & livestock)	6
	Animal Waste (k)	7
	Wastewater Treatment Plants (p)	8

TABLE 21: POLLUTANT SOURCE PRIORITY RANKING CONT'D

Environmental Stressor/Pollutant	Sources	Priority Ranking
Changes to Hydrologic Flow	Fluctuating Water Levels (k)	1
	Sedimentation (k)	2
	Road Stream Crossings (k)	3
	Lowland Filling (k)	4
	Reduction of Wetlands (k)	5
	Dams, Lake-level Control Structures (k)	6
	Reduction of Groundwater Recharge (k)	7
Loss of Habitat	Development (k)	1
	Shoreline Erosion and Stabilization (k)	2
Toxins (Pesticides, Herbicides, Oils, Gas, Grease, Etc.)	Urban/Agricultural/Rural Storm Water (k)	1
	Air Emissions (k)	2
	Road Salt and Airport De-Icing in Winter (k)	3
	Improper Chemical Use/Disposal (s)	4
	Illegal Dumping (p)	5
	Contaminated Sediments	6
	Industrial/Municipal Discharges (p)	7
	Underground Storage Tanks (p)	8
	Motor Boats (k)	9
	Oil, Gas, Hydrocarbon & Underground Injection Wells (p)	10
	Water Wells (p)	11
Invasive Species	Connected Waterways (k)	1
	Boat Hulls and Bilges (k)	2
	Purposeful and Accidental Human Introduction (k)	3
	Other Biota (i.e. birds, frogs) (k)	4
Pathogens (E. Coli and Fecal Coliform indicators)	Urban/Agricultural/Rural Storm Water (k)	1
	Animal Waste (k)	2
	Septic Systems (p); Wastewater Treatment Plants (p)	3
	Illegal Discharges from Boats (p)	4
Thermal Pollution	Impervious Surfaces (k)	1
	Urban/Agricultural/Rural Storm Water (k)	2
	Lack of Streamside and Shoreline Canopy and Riparian Buffer (k)	3
	Dams, Lake-level Control Structures (k)	4

5.5 Priority Areas

Priority areas in the Grand Traverse Bay watershed are defined as the portions of the watershed that are most sensitive to environmental impacts and have the greatest likelihood to affect water quality and aquatic habitat. They are areas that may contribute the greatest amount of pollutants to the watershed, either now or in the future, and are considered targets for future water quality improvement efforts.

The priority areas were identified by analyzing the Comprehensive Watershed Management Tables (Tables 16 and 17) and identifying the major areas where most of the threats to water pollution exist. Other resources used to identify the priority areas include; scientific research reports, existing subwatershed management plans, DEQ water quality reports, Grand Traverse Bay shoreline survey, field observations by the Project Coordinator, steering committee members, and personal contact with watershed residents and scientific experts on the Grand Traverse Bay watershed.

The priority areas for the Grand Traverse Bay watershed include the following areas (Table 22, Figure 18):

- **Riparian Corridors**: Areas within 1,000 feet of bodies of water (i.e. Grand Traverse Bay, rivers and streams, lakes)
- **Wetlands**: All wetlands and areas within 1,000 feet of wetlands identified in the SWAMP (done by NWMCOG)
- **City and Village Centers**: Urban areas that drain to surface waters via storm sewers.
- **Headwater Areas**: Areas where there is a greater amount of groundwater recharge.

  (Data on exact delineation of these areas are still needed for the entire watershed. These areas are not included in Figure 18.)

TABLE 22: PRIORITY AREAS IN THE GRAND TRAVERSE BAY WATERSHED

Priority Area		Top Priority Pollutant(s) Contributing	Priority Causes
Riparian corridors	GT Bay	Nutrients	Fertilizer, Stormwater, Lack of buffers
	Tributaries & Lakes	Sediment Nutrients	*Sediment*: Road crossings, Bank erosion, Stormwater, Wetland filling *Nutrients*: Fertilizer, Stormwater, Lack of buffers
Wetlands		Sediment Nutrients	*Sediment*: Wetland filling *Nutrients*: Reduction of wetlands
City and Village Centers		Sediment Nutrients Changes to Hydro Flow	Stormwater
Headwater areas		Sediment Changes to Hydro Flow	Development

Figure 18: Priority Areas

Specific Priority Areas: Boardman River Watershed and Leelanau County

In order to maintain the high quality resources of the Grand Traverse Bay watershed, it is essential to address known sources of pollution while at the same time working towards the reduction of future sources of pollution and watershed disturbance. Protecting priority areas associated with Grand Traverse Bay and its tributaries through purchase, donation, or conservation easement are excellent strategies to meet this objective. There are two local land conservancies using these strategies to protect land in the Grand Traverse Bay watershed: the Grand Traverse Regional Land Conservancy and the Leelanau Conservancy. In cooperation with these entities, private parcels of land in the Boardman River watershed and Leelanau County were reviewed for their potential contribution to improving the water quality of Grand Traverse Bay and its watershed. Both conservancies utilized geographic information systems (GIS) to assist in delineating priority parcels. The reports are summarized below, for a complete copy of each report please contact The Watershed Center.

Boardman River

The Grand Traverse Regional Land Conservancy developed three primary goals for the parcel prioritization of the Boardman River watershed, which spans both Grand Traverse and Kalkaska counties. These goals included preserving water quality, conserving the diversity and quantity of vital ecological areas, and promoting the spatial integrity of the landscape. Identifying which areas are vital to meeting these goals was accomplished by taking into account a variety of key factors, called conservation drivers. Areas of high ecological importance with significant water quality impact were determined on a parcel by parcel basis by considering the following conservation drivers: acreage; unfragmented landscapes; the spatial location of both small and extensive tracts of wetland and riparian ecosystems; adjacency to protected lands; endangered or threatened flora and fauna; and groundwater recharge areas. Additionally, the threat of development and the history of landowner contact were considered in order to determine the feasibility of pursuing a land conservation option.

After each conservation driver was considered and a score was awarded for every parcel, all conservation driver scores were then summed for every parcel, resulting in a final prioritization scheme which shows the most desirable geographic areas, as high, medium, or low priority, for proactive land preservation efforts within the Boardman River Watershed (Figure 19).

The Grand Traverse Regional Land Conservancy emphasizes that the results are an accurate representation of parcel prioritization in the Boardman River watershed since seven of the top thirteen scored parcels are already active land protection projects through the GTRLC and an additional five priority parcel landowners have already been contacted by conservancy staff. These results prove through an organized method that the parcels already targeted by earlier, intuitive methods are, in fact, priority areas in the Boardman River watershed.

Leelanau County

The Leelanau Conservancy identified areas of Leelanau County whose protection is integral to maintaining the high water quality of Grand Traverse Bay and its associated tributaries. To determine priority areas for land conservation efforts that will most effectively maintain and improve water quality, several key parameters were investigated on a parcel by parcel basis and compared across the watershed: size; proximity to wetlands; proximity to surface water; and

proximity to permanently protected land (i.e., conservation easements or Leelanau Conservancy Natural Areas). These factors were all considered to be vital in determining the priority protection areas.

Parcels that were found to contain surface water and wetlands were designated as 'High' priority for land protection. Parcels that were found to contain surface water and wetlands while in addition to being adjacent to permanently protected areas were given the 'Highest' level of priority for land protection efforts. Priority protection areas were identified by incorporating the results of the parcel prioritization process with on-the-ground investigations and aerial photograph review of the high and highest priority parcels (Figures 20a – 20d). In some cases, areas were identified as having a high priority for protection but when looked at from an aerial photograph or by walking the property, it was determined that land protection efforts would not be appropriate for such areas. In some cases there were also parcels that were not identified as being the highest land protection priorities through the GIS process due to the fact they were not considered to be adjacent to permanently protected areas, but after further analysis, they were then determined to be part of highest protection areas.

Land Protection staff from the Leelanau Conservancy will attempt to establish landowner contact and work with the highest priority parcels followed by the high priority parcels within each of the priority protection areas. Land protection options will emphasize the donation or purchase of conservation easements on parcels within the priority protection areas.

Specific Priority Area: Grand Traverse Bay Shoreline

Because of its sheer size and ability to affect the water quality of the bay, the entire shoreline of Grand Traverse Bay is deemed a priority area. As part of the Grand Traverse Bay Watershed Planning Project, The Watershed Center (TWC) completed a shoreline inventory of the entire 132-mile shoreline of the Grand Traverse Bay. The Grand Traverse Baykeeper, John Nelson, along with TWC staff and local volunteers, walked and inventoried the bay's shoreline in order to assess the current conditions surrounding the bay. Results for this survey were compiled into a final report (Appendix C) and were also placed onto TWC's website (www.gtbay.org) into a searchable database.

During the survey, inventory field sheets were used in conjunction with 1992 series USGS digital ortho-quad aerial photographs and the shoreline was divided into segments containing similar characteristics. Features such as nearshore substrate (clay, sand, stones, rock, macrophytes, etc.), endangered and exotic plant species, streams, seeps, public access, human impact (shore hardening, beach alterations), and beach characteristics (sand/stone/rock, bluffs, dunes, wetland, beach width) were noted as either specific points or as general segment characteristics. A

Example of shore hardening using large rock rip-rap.

specific point was noted if it was only seen a few times along a segment, otherwise, if a feature was common it was noted as a segment characteristic. Features and beach segments were indicated by letters on the photos and keyed by letter on the inventory sheets.

The inventory found significant increases in shoreline hardening compared to a similar study done in 1958 by the MSU Department of Resource Development's Agricultural Experiment Station. Other changes include the building of groins and the "creation" of beaches by moving the stones into groins, as well as the construction of marinas, both public and private, with their associated dredging. Also noted were considerable increases in algae growth on benthic substrates in the bay over the past 10 years, including significant carpets (or mats) of cladophora and chara growing on the substrate. More than one hundred small streams were observed flowing into the bay.

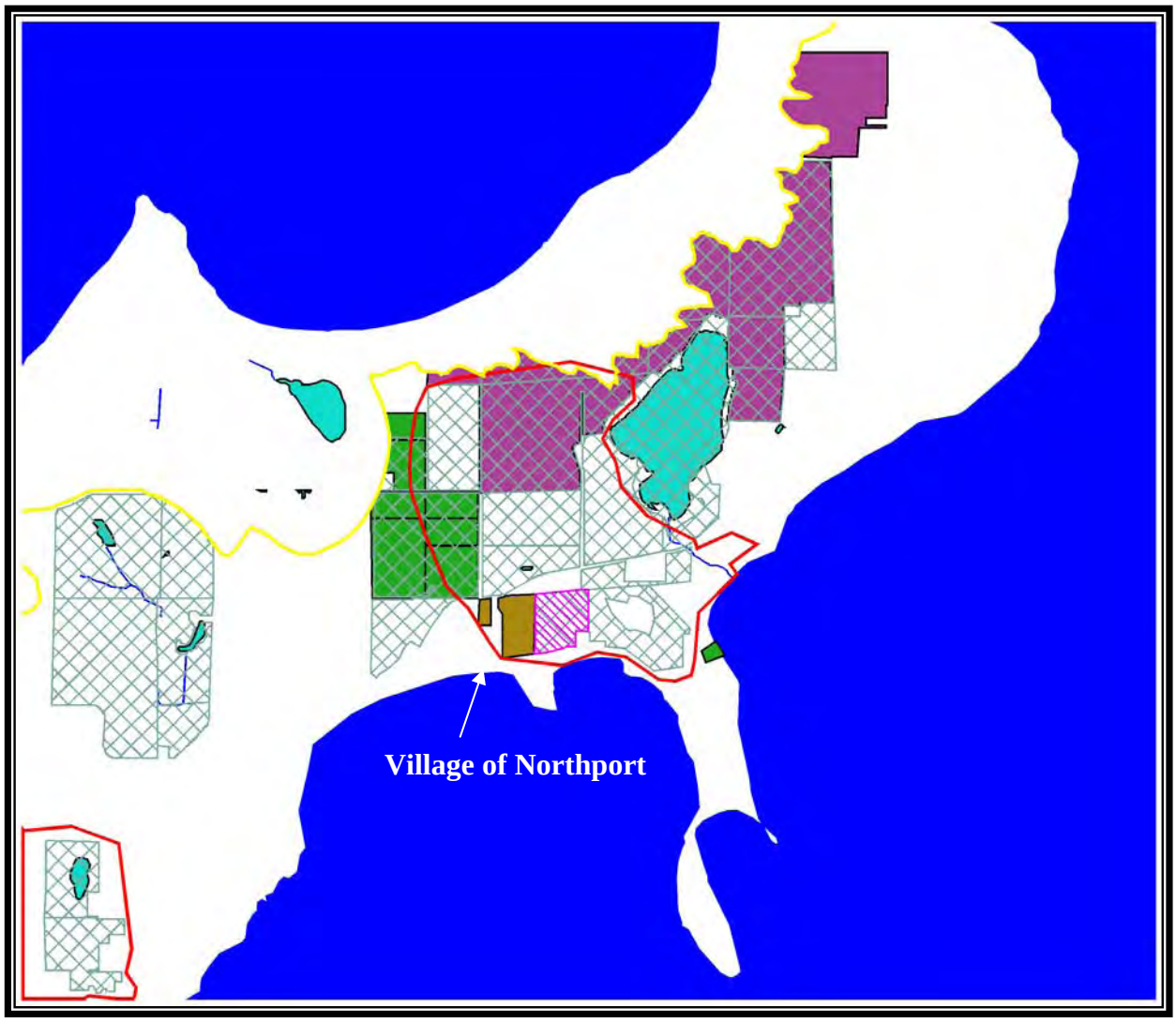
Both land development as well as economic development place pressure on the need for small shoreline communities to properly dispose of their wastewater. The discharge of wastewater, from both failing septic systems and over-taxed treatment facilities, has the potential to dramatically degrade the water quality of the bay. Added nutrients from wastewater would increase the amount of algae and plants noted in the water, causing even more of an increase than what was noted in this survey.

Intense development increases the amount of stormwater discharge to the bay, due to increases in impervious surfaces. Numerous stormwater discharge pipes were noted entering the bay in Traverse City, as well as significant increases in the amount of impervious surfaces covering land adjacent to the bay.

"In the past many activities have been undertaken in these beach areas with little or no awareness of the dynamic, ever changing properties of a shoreline area. Use must be planned in accordance with the natural characteristics and natural changes; otherwise the user may expect problems that are not only unpleasant, but expensive," (MSU 1958 historical shoreline inventory).

Figure 19: Boardman River Watershed Priority Parcels

FIGURE 20A: LEELANAU COUNTY PRIORITY PROTECTION AREAS – NORTHERN SECTION, CATHEAD POINT



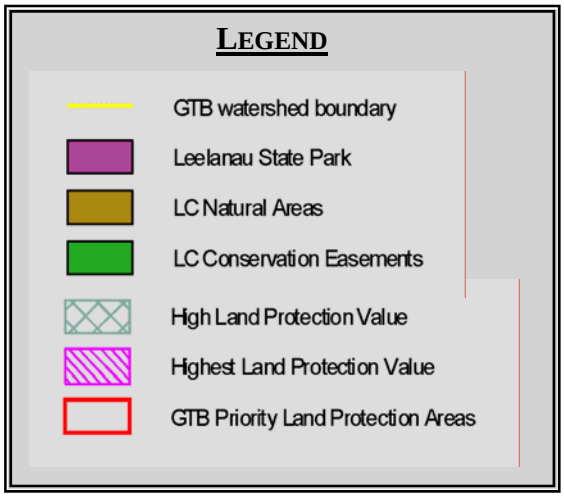


FIGURE 20B: LEELANAU COUNTY PRIORITY PROTECTION AREAS
OMENA BAY AREA

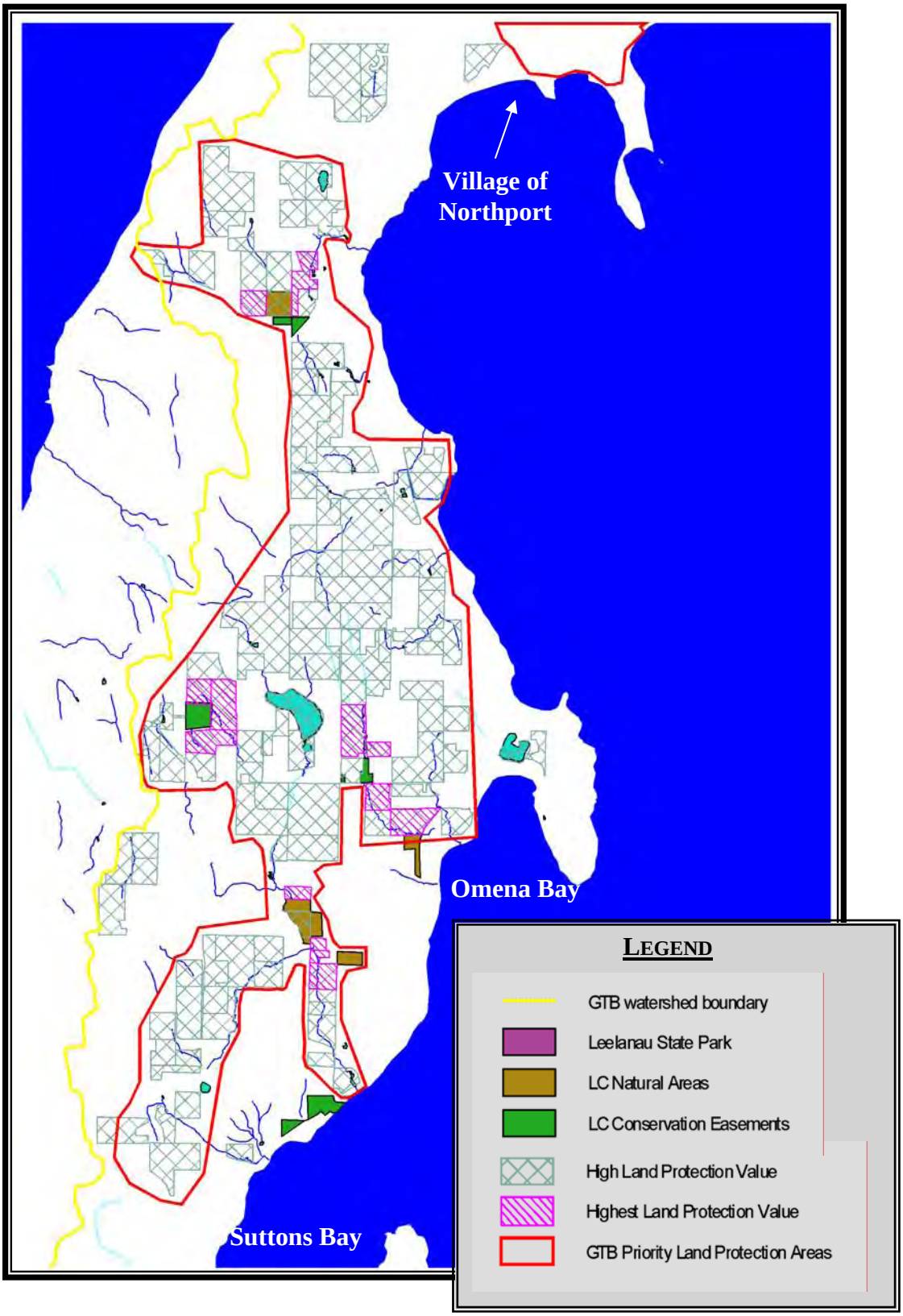


FIGURE 20C: LEELANAU COUNTY PRIORITY PROTECTION AREAS – SUTTONS BAY AREA

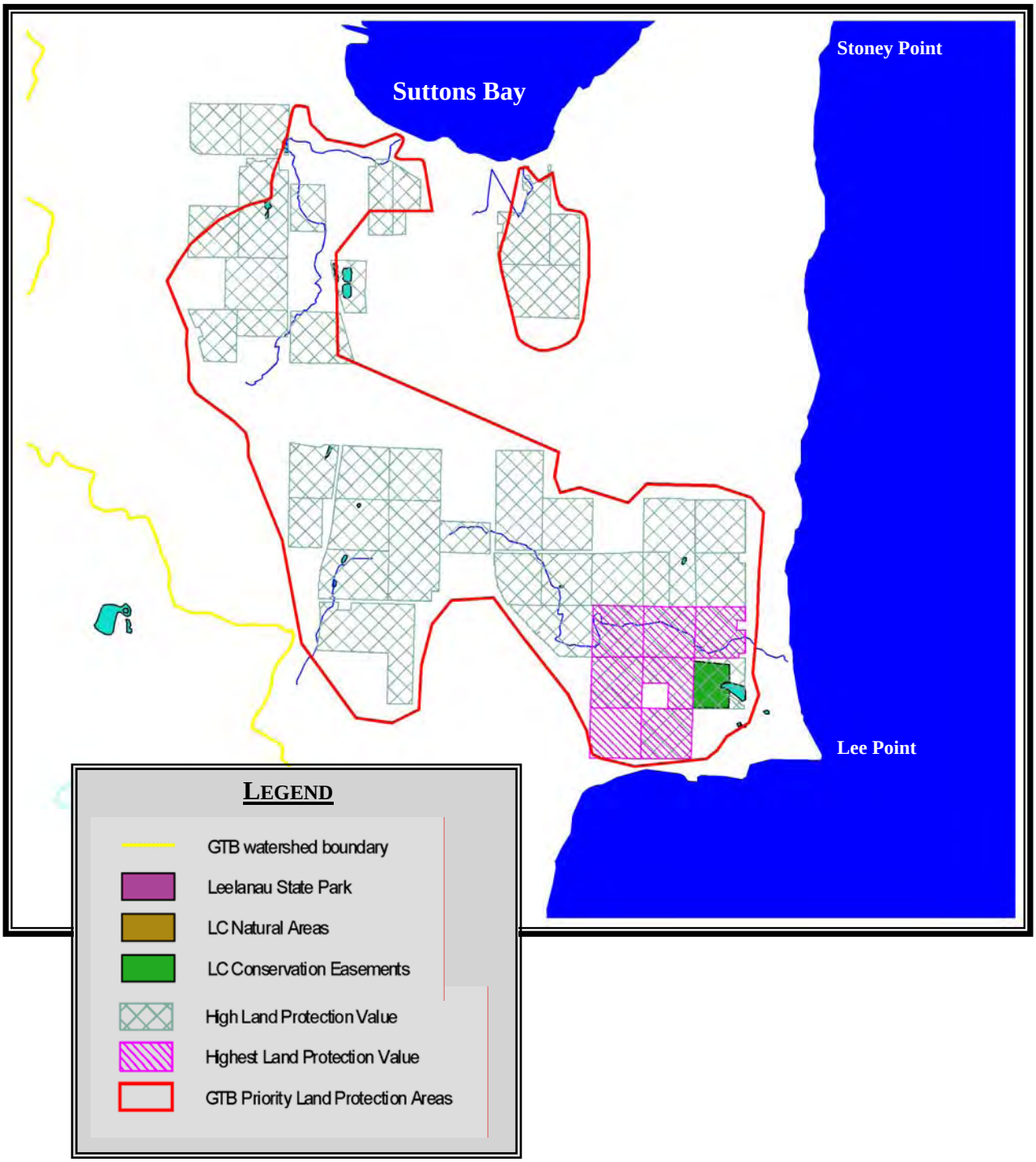
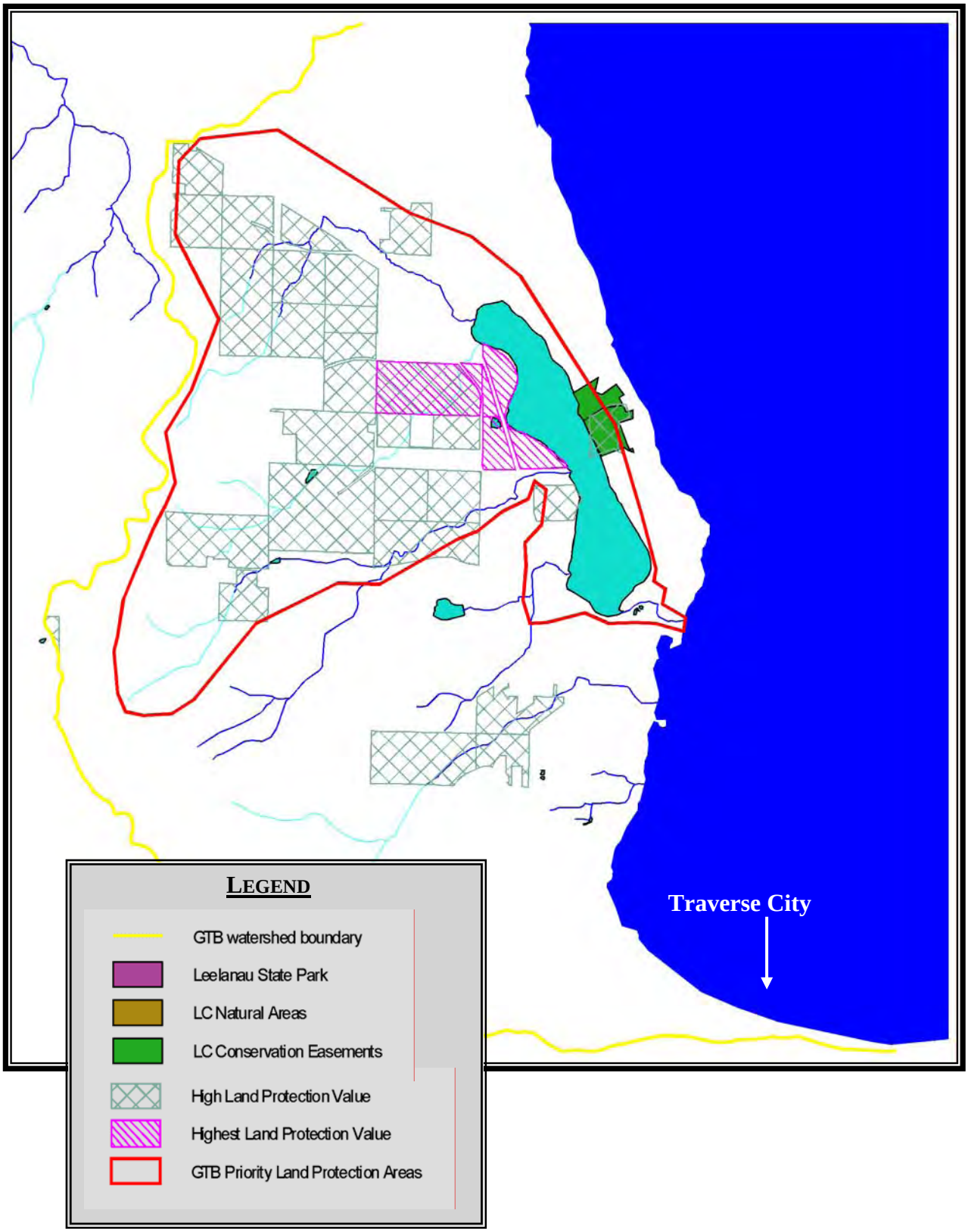


FIGURE 20D: LEELANAU COUNTY PRIORITY PROTECTION AREAS – SOUTHERN SECTION, CEDAR LAKE AREA



CHAPTER 6 WATERSHED GOALS AND OBJECTIVES

The Grand Traverse Bay watershed is a high quality waterbody of international significance and should be protected and maintained as such. The overall mission for the Grand Traverse Bay Watershed Protection Plan is to provide guidance for the implementation of actions that will reduce the negative impact that pollutants and environmental stressors have on the designated watershed uses. The envisioned endpoint is to have Grand Traverse Bay and all lakes and streams within its watershed support appropriate designated and desired uses while maintaining their distinctive environmental characteristics and aquatic biological communities.

Using suggestions obtained from stakeholder meetings conducted throughout the watershed and examples from other watershed management plans, the project steering committee developed six broad goals for the Grand Traverse Bay watershed (Table 23). By working to attain these goals, we will ensure that the threatened designated uses described Chapter 4 are maintained or improved.

TABLE 23: GRAND TRAVERSE BAY WATERSHED GOALS

Goal	Designated or Desired Use Addressed	Pollutant(s) Addressed
1. Protect the integrity of aquatic and terrestrial ecosystems within the watershed.	Coldwater Fishery Other Aquatic Life Desired Use: Ecosystem Preservation	Sediment Nutrients Changes to Hydro Flow Invasive Species Thermal Pollution
2. Protect and improve the quality of water resources within Grand Traverse Bay and its watershed.	Coldwater Fishery Other Aquatic Life Public Water Supply Total Body Contact	Nutrients Thermal Pollution Toxins Pathogens
3. Establish and promote land and water management practices that conserve and protect the natural resources of the watershed.	Coldwater Fishery Other Aquatic Life Navigation	Sediment Nutrients Thermal Pollution Toxins Changes to Hydro Flow Pathogens
4. Enhance the amount and quality of recreational opportunities and support a sustainable local economy.	Desired Use: Recreation	All
5. Establish and promote educational programs that support stewardship and watershed planning goals, activities, and programs.	All	All
6. Preserve the distinctive character and aesthetic qualities of the watershed.	Desired Use: Aesthetics	All

Goal #1
Protect the integrity of aquatic and terrestrial ecosystems within the watershed.

Designated Use: Coldwater Fishery and Other Aquatic Life
Desired Use: Ecosystem Preservation
Pollutant or Stressor Addressed: Sediment, Changes to Hydrologic Flow, Invasive Species

Objective 1 Protect and restore desirable habitat areas for aquatic organisms in streams and lakes throughout the watershed and the Grand Traverse Bay and preserve the biodiversity of populations and communities of aquatic organisms in the watershed.

- *Maintain and enhance stream canopy of trees and shrubs.*
- *Prevent spread of disease between animal, fish, and avian populations by utilizing latest research and techniques.*
- *Promote proper riparian land management and bank stability practices to reduce the amount of sediment influxes to protect aquatic habitat.*
- *Promote and maintain naturally reproducing native fish populations.*
- *Manage fish and other animal populations for species appropriate for the area, with an attempt to maintain the diversity of species already present (i.e., stocking, fishing/hunting/trapping regulations, species introductions and reintroductions, habitat improvement efforts).*

Objective 2 Protect shoreline habitats by minimizing artificial shoreline alteration, including hardening and grooming.

- *If shoreline erosion protective measures are needed, make sure they are sited, designed, and installed properly to minimize the impact on beaches, nearshore sand drift, and habitat. Support shoreline stabilization procedures that are as natural as possible.*
- *Support proper beach grooming techniques that do not disrupt the natural habitat.*

Objective 3 Minimize hydrologic flow fluctuations from the following sources:

- *Dams and lake-level control structures*
- *Stormwater*
- *Road stream crossings*
- *Beaver dams*
- *Other sources*

Objective 4 Work to stop wetland and other types of lowland filling.

Objective 5 Reduce the magnitude of overland stormwater runoff to streams.

Objective 6 Promote the reduction of potential global warming factors to limit projected evaporative losses from the bay and inland lakes (through education initiatives?).

Objective 7 Reduce and/or minimize sediment inputs to streams and lakes in watershed from the following sources:

- *Stream bank and lakeshore erosion – Survey erosion sites and stabilize banks*
- *Road steam crossings – Replace or repair road crossing and/or culvert problems*
- *Recreational access*
- *Boating*
- *Agricultural access*
- *Land use practices*

Objective 8 Prevent the spread of existing invasive species and the introduction of new ones in area watersheds.

- *Boat hulls and bilges*
- *Other biota*
- *Connected waterways*
- *Purposeful and accidental human introductions*

Objective 9 Maintain terrestrial habitat and preserve the biodiversity of populations and communities of terrestrial organisms in the watershed.

Objective 10 Minimize the negative effects of recreational boating and other types of watercraft from pollutants such as sediment, toxins, and pathogens.

Goal #2
Protect and improve the quality of water resources within Grand Traverse Bay and its watershed.

Designated Use: Public Water Supply, Coldwater Fishery, Other Aquatic Life, Total Body Contact
Pollutant or Stressor Addressed: Nutrients, Thermal Pollution, Toxins, E. Coli and Pathogens

Note: One of the major pathways by which many pollutants get to lakes and streams is through stormwater runoff. Stormwater runoff results when drops of rain fall to the ground, or snow melts, and water flows over the surface of the land. This stormwater flow often dislodges and carries soil or sediment particles to which many pollutants are attached, or directly moves the pollutant itself. The amount of stormwater runoff that occurs is dependent upon a variety of conditions including: storm intensity and duration, topography, time of year, soil moisture levels, soil permeability, vegetative cover types, the extent of vegetated cover, and the amount of impervious surfaces (surfaces that water cannot penetrate such as paved roads, parking lots, and roofs). Urban locations like Traverse City and Suttons Bay often produce greater amounts of stormwater flow due to the increased amount of impervious surfaces in urban areas relative to more rural settings. Stormwater contributes directly to thermal pollution as well; as the water runs over the land, it can be warmed by the land surface and may cause significant increases in stream temperatures. Any reductions to stormwater flow will decrease the amount of sediment, nutrients, thermal pollution, toxins, and pathogens that enter area waterbodies. See Section 5.3 of the Protection Plan for further details regarding stormwater.

Objective 1 Control and/or minimize the input of nutrients, pathogens, and toxic compounds (herbicides, pesticides, heavy metals, etc.) into surface water and groundwater (see Comprehensive Management Table).

Objective 2 Control and reduce thermal pollution in the watershed resulting from stormwater inputs, impervious surfaces, lack of stream canopy, dams and lake-level control structures, and reduced groundwater inputs.

Objective 3 Maintain dissolved oxygen levels that support cold-water fish and other aquatic species in cold-water lakes and streams.

- *Excessive Nutrients and Eutrophication: increases dissolved oxygen use from plant respiration as well as from decaying plants*

Objective 5 Protect groundwater and surface water recharge areas and discourage water withdrawals that negatively impact the sustainability of the aquatic system and water supply.

Objective 6 Minimize air deposition into surface water from sources including vehicles and industrial, commercial, and municipal facilities.

Goal #3
Establish and promote land and water management practices that conserve and protect the natural resources of the watershed.

Designated Use: Navigation, Coldwater Fishery, Other Aquatic Life
Pollutant or Stressor Addressed: Sediment, Nutrients, Thermal Pollution, Toxins, Changes to Hydrologic Flow, E. Coli and Pathogens

Objective 1 Establish and promote land management practices that conserve natural resources and protect water quality throughout the watershed.

- *Avoid development that encroaches upon sensitive or biologically important areas*
- *Preserve open space, sensitive/important natural areas, wetlands, and desirable species of aquatic vegetation*
- *Protect critical riparian areas*
- *Minimize the change of terrestrial vegetation types from forest/shrub species to turf or cropland species*
- *Limit habitat fragmentation by maintaining compact communities*
- *Properly manage working lands such as farms and woodlots*

Objective 2 Promote voluntary arrangements and regulatory tools that help prevent degradation of natural resources.

Objective 3 Assist townships with zoning and master plans in developing ordinances to protect water quality and natural resources, where an interest has been expressed. Examples of items to address include:

- *Adequate setbacks for buildings*
- *Minimize development clearings by landowners*
- *Establish riparian buffers along waterways*
- *Protecting wetlands*

Objective 4 Establish and support stormwater best management practices that reduce the amount and harmful effects of stormwater entering waterways. Improve stormwater management throughout the watershed.

Objective 5 Reduce the amount of impervious surfaces in the watershed, especially in areas of high groundwater recharge.

Objective 6 When new or redevelopment of existing property takes place along shoreline and residential areas, encourage appropriate provisions for water quality and natural resources in the approval process.

Objective 7 Increase awareness of developers and townships on the impacts of development on natural resources and biological communities from development.

Objective 8 Develop new and maintain existing wildlife corridors; minimize habitat fragmentation due to development, dams/lake-level control structures, and other sources.

Note: *Consider the private property rights of public citizens when developing and implementing tasks.*

Goal #4
Enhance the amount and quality of recreational opportunities and support a sustainable local economy.

Desired Use: Recreation
Pollutant or Stressor Addressed: Invasive Species, E. Coli and Pathogens

Objective 1 Watershed lakes and streams will support appropriate designated and desired uses while maintaining their distinctive environmental characteristics and aquatic biological communities.

Objective 2 Maintain desirable sport, commercial, and tribal fishing quality throughout watershed and Grand Traverse Bay.

- *Have fishing regulations that support a diverse fishing experience.*
- *Ensure sufficient public access to fishing sites.*
- *Maintain natural environments for fish habitat.*

Objective 3 Increase the amount of connected trails for pedestrian use.

Objective 4 Increase the number of boardwalks, gardens, and public parks along rivers and lakes in urban settings.

Objective 5 Ensure sufficient access to beaches, lakes, and streams for public use that does not jeopardize the integrity of the resource.

Objective 6 Ensure safe and clean areas for public swimming and other types of water recreation.

Objective 7 Ensure sufficient access for recreational boating.

Objective 8 Reduce the impact of invasive species on recreation in the watershed.

Objective 9 Focus on promoting a balance between environmental, local economy, and societal needs.

Note: *Consider the following items when developing and implementing tasks:*

- *Tourism is a major source of revenue for all areas in the watershed.*
- *The private rights of individuals must be protected while at the same time providing ample opportunity for public recreation.*
- *Weigh the factors between supporting a sustainable economy and protecting the environment.*
- *Be sensitive to businesses' rights to profit.*

Goal #5
Establish and promote educational programs that support stewardship and watershed planning goals, activities, and programs.

Public I/E Campaign
Pollutant or Stressor Addressed: All

Objective 1 Establish a successful public information and education (I/E) program throughout the Grand Traverse Bay Watershed. This public I/E strategy is outlined in Section 7.3 in the protection plan.

Objective 2 Educate watershed users and the general public about the value of the watershed and bay to the community and of their responsibility to be stewards of this community asset;

Objective 3 Regularly inform public about the watershed, activities, study findings, success/example projects, and opportunities for contribution (organization to public).

Objective 4 Provide focused information to residents, visitors, local governments, and other target groups on priority topics (organization to individual).

Objective 5 Involve the citizens, public agencies, user groups and landowners in implementation of the watershed plan through meetings and workshops with individuals or groups.

Objective 6 Develop 'tourism ethic' for area businesses to pass on to tourists. Market the fact that residents and businesses of the Grand Traverse Bay watershed are committed to protecting the watershed and that tourists who come here to enjoy the bay and watershed should do the same. "If you come here, you must protect it too."

Goal #6
Preserve the distinctive character and aesthetic qualities of the watershed.

Desired Use: Aesthetic Character
Pollutant/Environmental Stressor Addressed: All

Objective 1 Support public and private needs while promoting economic sustainability and a sense of community. Preserve existing settings of particular historical and/or cultural importance.

Objective 2 Maintain the visual quality of desirable viewsheds while supporting landowner desires for property use, privacy, and security.

Objective 3 Maintain open space, parks, greenways, and natural areas to allow for aesthetic enjoyment and to sustain the perception of the high quality of life that brings people to the area.

Objective 4 Increase access to recreational lands and viewsheds through local land trusts.

CHAPTER 7 IMPLEMENTATION TASKS

7.1 Summary of Implementation Tasks

In an effort to successfully accomplish the goals and objectives listed in Chapter 6, specific and tangible recommendations were developed based on the prioritization of watershed pollutants, sources, and causes while also looking at the priority areas in the watershed (Tables 16, 17, 21, and 22). These implementation tasks are listed in Section 7.2 and represent an integrative approach, combining watershed goals and covering more than one pollutant at times, to reduce existing sources of priority pollutants and prevent future contributions.

The project steering committee found it helpful to summarize the implementation tasks by the pollutant and/or source it deals with, placing all implementation tasks into various categories. In this way, organizations may work on a specific issue (i.e., urban stormwater or shoreline restoration) that may contribute more than one type of watershed pollutant and meet more than one watershed goal.

The categories are as follows:

1. Shoreline Protection and Restoration
2. Road Stream Crossings
3. Agriculture
4. Hydrology
5. Habitat, Fish and Wildlife
6. Stormwater
7. Wastewater
8. Human Health
9. Wetlands
10. Invasive Species
11. Land Protection and Management
12. Development
13. Zoning and Land Use
14. Groundwater
15. Monitoring
16. Desired Uses
17. Evaluation

For each action step, the organization(s) best suited to help implement the task along with estimated costs to implement each item has been identified where possible. A timeframe of 10 years was used to determine the scope of activities and the estimated costs for implementing the tasks. Tasks that should be done in the short term were given a timeframe of 3 years. Tasks that should be undertaken annually were given a timeframe of “ongoing.”

A Note About Best Management Practices

Best Management Practices (BMPs) are any structural, vegetative, or managerial practices used to protect and improve surface water and groundwater (DEQ 2001). For Best Management Practices to be effective, the correct method, installation, and maintenance need to be considered for each site. Addressing each of these factors will result in a conservation practice that can prevent or reduce nonpoint source pollution. Table 24 lists potential systems of commonly used Best Management Practices (BMPs) that deal with various types of pollutant sources, as well as where to find more information about each type of BMP.

TABLE 24: BMP EXAMPLES BY SOURCE

Source	Potential System of BMPs (not inclusive)	BMP Manual
Animal Waste	Watercourse crossings Riparian buffers	Michigan Ag BMP Manual Guidebook of BMPs for Michigan Watersheds
Bank/Shoreline Erosion	Stream bank stabilization	Guidebook of BMPs for Michigan Watersheds
Construction	Construction barriers Staging and scheduling	Guidebook of BMPs for Michigan Watersheds
Development Along Shoreline and Wetlands	Workshops, Brochures, Flyers, Videos, Etc.	Public Information and Education Strategy
Lack of Streamside Canopy and Riparian Buffer	Riparian buffers	Guidebook of BMPs for Michigan Watersheds Natural Resources Protection Strategy for Michigan Golf Courses
Purposeful & Accidental Human Intro of Exotic Spp	Workshops, Brochures, Flyers, Videos, Etc.	Public Information and Education Strategy
Reduction of Groundwater Recharge	Infiltration basins Grassed waterways	Guidebook of BMPs for Michigan Watersheds Stormwater Management Guidebook
Residential/Commercial Fertilizer Use	Workshops, Brochures, Flyers, Videos, Etc.	Public Information and Education Strategy
Septic Systems	Workshops, Brochures, Flyers, Videos, Etc.	Public Information and Education Strategy
Stormwater and Impervious Surfaces	Check dams Grassed waterways Stormwater conveyance outlets Infiltration basins Porous asphalt pavement	Stormwater Management Guidebook Guidebook of BMPs for Michigan Watersheds Public Information and Education Strategy

7.2 List of Implementation Tasks by Category

IMPLEMENTATION TASKS

Categories:

1. Shoreline Protection and Restoration
2. Road Stream Crossings
3. Agriculture
4. Hydrology
5. Habitat, Fish and Wildlife
6. Stormwater
7. Wastewater
8. Human Health
9. Wetlands
10. Invasive Species
11. Land Protection and Management
12. Development
13. Zoning and Land Use
14. Groundwater
15. Monitoring
16. Desired Uses
17. Evaluation

Organization Acronyms:

A-CD – Antrim Conservation District
CDs – All Conservation Districts
City of TC – City of Traverse City
County Gov. – County Governments
CRA – Conservation Resource Alliance
DEQ – Michigan Department of Environmental Quality
DNR – Michigan Department of Natural Resources
EPA – Environmental Protection Agency
FERC – Federal Energy Regulatory Commission
GLEC – Great Lakes Environmental Center
GTBOCI – Grand Traverse Band of Ottawa and Chippewa Indians
GT-CD – Grand Traverse Conservation District
GT County – Grand Traverse County
GTRLC – Grand Traverse Regional Land Conservancy
Health Depts. – Local Health Departments
ISEA – Inland Seas Education Association
K-CD – Kalkaska Conservation District
LC – Leelanau Conservancy
L-CD – Leelanau Conservation District
Local Gov. – Local Governments
M-DOT – Michigan Department of Transportation
MLUI – Michigan Land Use Institute
MSU-E – Michigan State University Extension
NRCS – USDA Natural Resources Conservation Service
RCs – County Road Commissions
TART – Traverse Area Recreational and Transportation Trails Inc.
TCLP – Traverse City Light and Power
TOMWC – Tip of the Mitt Watershed Council
TWC – The Watershed Center Grand Traverse Bay
OWTTF – Onsite Wastewater Treatment Task Force
USGS – United States Geological Survey

Other Organizations:

Audubon society
Coast Guard
Convention Visitors Bureau
East Bay Township
Economic Development Corporation
GT County Resource Recovery Office
Lake Associations
Land Conservancies
MI Agricultural Stewardship Assoc.
MSU-E Groundwater Stewardship
New Designs for Growth
Northern Lakes Economic Alliance
Trash Haulers
Schools, Universities

Estimated Costs and Timeframe:

For costs associated with salaries, an average watershed technician rate of $35/hour was applied. For tasks to be completed by a specialized consultant, a rate of $50/hour was used. Tasks that will be done on a yearly or site by site basis are noted as such ($X/yr or $X/site). Appendix E lists average rates for costs associated with purchasing materials for and installing standard BMPs. Further details are noted where applicable. Tasks that should be completed in the short-term were given a timeframe of 3 years; long-term tasks were given a timeframe of 10 years; tasks that should be undertaken annually were given a timeframe of "ongoing."

Shoreline Protection and Restoration

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources
3) Land and water management

Task 1: Inventory riparian corridors to determine priority areas where riparian vegetated stream and lakeshore buffers should be installed. (See Section 5.3 of protection plan for a discussion about buffers.)
Estimated Cost: $50,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CRA, DNR, CDs, GTBOCI, TOMWC, Lake Associations

Task 2: In areas that have already been inventoried, work with interested landowners to install riparian buffers in priority areas.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Toxics, Sediment
Estimated Cost: $50,000/yr
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, CDs, GTBOCI, TOMWC, Lake Associations

Task 3: Work with municipalities and other government organizations to install riparian buffers on publicly owned property in the watershed.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Toxics, Sediment
Estimated Cost: $50,000/yr
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, CDs, GTBOCI, TOMWC, Lake Associations, DNR, Local Gov.

Task 4: Establish shoreline riparian buffer demonstration sites to show riparian landowners how to create buffers that are both aesthetic and effective.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment
Estimated Cost: $5,000/site
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CDs, MSU-E Groundwater Stewardship, TOMWC

Task 5: Conduct or evaluate existing streambank and shoreline erosion surveys to determine sites where bank stabilization and restoration is needed and compile list of priority areas.

Boardman River*: need update: 1991 – River and major tributaries completed*
ERCOL: *need update/survey: 1998 – Initial inventory of major lakes and interconnecting rivers completed (descriptive site data still needed); Rapid River and major tributaries need survey*
Mitchell Creek*: need update: 1993 – surveyed all sections and sites stabilized since*
East Bay Shoreline Tributaries*: needs evaluation: Antrim Conservation District has done extensive parts, data not published or in report form yet*
Acme Creek*: need update: 1995 – surveyed all sections and some sites stabilized since*
Yuba Creek*: need update: 1995 – surveyed all sections*
Ptobego Creek*: need survey*
West Bay Shoreline Tributaries*: need survey*

Estimated Cost: $90,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CRA, CDs, GTBOCI, TOMWC

Task 6: Stabilize streambanks at priority sites and use biotechnical methods where possible. Include costs and time for maintenance of stabilized sites. (Note: There are many more sites that need streambank stabilization than what is listed here.)
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Toxics, Sediment

Boardman River watershed (Union Street Dam to Bay) – 10 sites

Estimated Cost: $25,000 ($2,500/site)
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, GT-CD, City of Traverse City

Elk River Chain of Lakes – 20 sites

Estimated Cost: $160,000 ($80/ft x 100ft lot x 20 lots)
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, A-CD, TOMWC

Task 7: Continue current streambank restoration efforts in Kid's Creek and its tributaries. Work with municipalities and the Conservation District to stabilize eroding streambanks identified in 1991 erosion survey and install stormwater and road crossing BMPs where necessary. Work with residents and municipalities to install riparian buffers where possible.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Toxics, Sediment

Estimated Cost: $300,000/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, GT-CD, City of Traverse City, Garfield Twp.

Task 8: Identify and work with landowners along portions of the Grand Traverse Bay identified in the 2002 shoreline inventory (Appendix C in Protection Plan) to stabilize the shoreline using biotechnical and soft engineering techniques. (Work with and gain permission from MDOT and private property owners.)

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Toxics, Sediment

Estimated Cost: $15,000/year
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, CRA, CDs, GTBOCI, M-DOT

Task 9: Install barriers, signage, or stairs where needed to manage human access to stream and lakeside banks at risk of erosion (steep slopes, sandy soils) from recreational foot traffic.

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Toxics, Sediment

Estimated Cost: $35,000/year
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, CRA, DNR, CDs, Local Gov., TOMWC, Lake Associations (Also: canoe, hiking, fishing and sportsman groups)

Task 10: Work with area marinas to install and promote BMPs (like spill response carts containing brooms, pads and absorbents; bilge sponges; emergency shut-off valves; and stormwater detention areas and buffer strips) that will reduce the amount of pollution coming from boat fuels, wastewater, erosion, and lack of riparian buffers.

Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens, Toxics, Sediment, Invasive Species

Estimated Cost: $10,000/year
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, GTBOCI, TOMWC, CDs

Task 11: Minimize stormwater contamination from vehicle fuel by installing and maintaining spill containment kits for gas and other fueling stations where necessary.

Pollutant/Environmental Stressors Reduced: Toxics

Estimated Cost: $5,000/year
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, NRCS, CDs, GTBOCI, Local Gov.

Task 12: Continue Home*A*Syst, Lake*A*Syst, and Lawn*A*Syst programs in watershed and encourage residents to utilize them.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment
Estimated Cost: $35,000/yr
Timeline: 10 years
Priority: Medium
Potential Project Partners: MSU-E Groundwater Stewardship, CDs, TWC, NRCS

Task 13: Work with Conservation Districts to include native plants for riparian buffers in annual plant sales.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment
Estimated Cost: $2,500
Timeline: 10 years
Priority: Medium
Potential Project Partners: CDs, TWC

Task 14: Work with appropriate agencies to identify key areas where 'no boat wake' zones should be implemented and support enforcement of those zones.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Toxics, Sediment
Estimated Cost: $5,500/year
Timeline: 3 years, supporting enforcement is ongoing
Priority: Low
Potential Project Partners: TWC, DNR, CDs, Local Gov.

Task 15: Assist local and state government groups in enforcing shoreline regulations where applicable.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment
Estimated Cost: $5,500/year
Timeline: Ongoing
Priority: Low
Potential Project Partners: TWC, Lake Associations, CDs

Task 16: Work with area businesses and property owners to encourage proper maintenance and monitoring of underground fuel storage tanks and replace them when there is a risk of leakage from tank age, poor maintenance, or damage.
Pollutant/Environmental Stressors Reduced: Toxics
Estimated Cost: $5,500/year
Timeline: Ongoing
Priority: Low
Potential Project Partners: TWC

Road Stream Crossings

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources

Task 1: Identify road stream crossings needing remediation work and compile list of priority areas.

Subtask A: Obtain DEQ completed road stream crossing inventory and expand the inventory of priority ranked areas to include a greater level of detail equal to other inventories in the area.
Estimated Cost: $5,500
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CRA

Subtask B: Obtain data regarding road stream crossing inventories and improvement projects completed by other organizations; determine priority areas.
Estimated Cost: $5,500
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CRA

Subtask C: Complete inventory on road stream crossings that have not been surveyed; determine priority areas.
Estimated Cost: $5,500
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CRA

Task 2: Where priority road stream crossings have been identified, improve, repair, or replace outdated, failing, or eroding road stream crossings by implementing the appropriate BMPs from the following;

1. Road Crossings
   a) Remove obstructions that restrict flow through the culvert
   b) Replace undersized (too small or too short) culverts
   c) Remove and replace perched or misaligned culverts to avoid erosion and provide for fish passage
   d) Install bottomless culverts and bridges where possible
   e) Replace culverts with a length that allows for $\geq$ 3:1 slope on embankments
   f) Revegetate all disturbed or bare soils on embankments

(Task 2 continued on next page)

2. Road Approaches
    a) Create diversion outlets and spillways to direct road runoff and stormwater away streams
    b) Pave steep, sandy approaches where feasible
    c) Dig or maintain ditches where needed and construct check dams if required
3. Road Maintenance
    a) Encourage Road Commissions to look at the long-term savings of crossing improvements over cumulative maintenance costs
4. Road Construction and Closure
    a) Minimize the number of access roads needed for oil, timber and gas exploration.
    b) When constructing new roads, avoid streams if possible and maintain natural channels to greatest extent possible.
    c) Close private roads that are no longer needed and restore stream channel to natural condition if feasible.

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment

West Bay Shoreline and Tributaries – 8 sites

Estimated Cost: $83,000 (obtained from road crossing report and includes costs for revegetation only)
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, L-CD, GTBOCI, RCs

Boardman River watershed – 10 sites

Estimated Cost: $1,465,000 (1,600 ft/ea x $91/ft; includes costs for culvert replacement)
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, GT-CD, RCs

Kalkaska County (excluding Boardman River) – 5 sites

Estimated Cost: $309,000 (costs obtained from Kalkaska Conservation District)
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, K-CD, RCs

Antrim County – 7 sites

Estimated Cost: $295,000 (costs obtained from Antrim Conservation District)
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, K-CD, RCs

Task 3: Map oil and natural gas well sites, pipelines, access roads that cross streams, and processing facilities and disseminate to city and township planning commissions.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Thermal Pollution, Toxics, Sediment
Estimated Cost: $11,000 (consultant rate)
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, CRA, CDs, TOMWC

Task 4: Work with planning commissions to establish minimum setback of oil and gas wells and access roads from lakes and streams in zoning ordinances.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment
Estimated Cost: $2,500
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, TOMWC

Agriculture

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources
3) Land and water management
6) Distinctive character and aesthetic qualities of watershed

Task 1: Develop Conservation Plans, Resource Management Plans, or Progressive Plans for all farms in the watershed that do not currently have one. As appropriate, information should be included on: crop nutrient management, weed and pest management, grassed waterways, sod centers in orchard rows, conservation buffers, proper manure management, conservation tillage, fencing off stream access to livestock, installing watercourse crossings, planting cover crops, and crop rotation. In addition, Conservation Plans that are more than 3 years old should be reviewed and updated to keep them eligible for USDA cost-share programs.

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment

Estimated Cost: $200,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: NRCS, CDs, TWC, MSU-E

Task 2: Work with agricultural producers that have an approved Conservation Plan to implement USDA-NRCS cost-share programs that provide cost incentives and/or rental payments to farmers who implement eligible conservation practices on their land. Examples of these types of programs include: Environmental Quality Incentives Program (EQIP), Conservation Security Program (CSP) and the Conservation Reserve Program (CRP). More information on these and other cost-share programs are on the USDA-NRCS website at http://www.nrcs.usda.gov/.

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment

Estimated Cost: $200,000/year
Timeline: 10 years
Priority: High
Potential Project Partners: NRCS, CRA

Task 3: Where appropriate, work with farmers to plant cover crops in fall on agricultural lands vulnerable to runoff (i.e., corn, potatoes, etc.).

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Nutrients, Thermal Pollution, Toxics, Sediment

Estimated Cost: $5,500 (salary costs only)
Timeline: Ongoing
Priority: High
Potential Project Partners: NRCS, CDs, TWC

Task 4: Minimize water contamination from farm vehicle fuel by installing and maintaining spill containment centers for above ground fueling stations where necessary and possible.

Pollutant/Environmental Stressors Reduced: Toxics

Estimated Cost: $5,500/station
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, NRCS, CDs, GTBOCI

Task 5: Fence livestock and other animals out of streams and wetlands and establish riparian buffers where needed in agricultural areas (Boardman River Valley and Elk River Chain of Lakes).

Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens, Thermal Pollution, Sediment

Estimated Cost: Varies with length of fence and buffer, the type of watercourse crossing, and water supply needed
Timeline: 10 years
Priority: Medium
Potential Project Partners: NRCS, CDs, TWC

Task 6: Continue Farm*A*Syst program in watershed and encourage farmers to utilize it.

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Nutrients, Thermal Pollution, Toxics, Sediment

Estimated Cost: $35,000/yr
Timeline: 10 years
Priority: Medium
Potential Project Partners: MSU-E Groundwater Stewardship, NRCS, CDs, TWC

Task 7: Promote sustainable agriculture (both financial and ecological) and value-added ventures (taking a raw commodity and making their own product) for farmers. Value added ventures may include: bottling your own milk or operating a farm market/road side stand.

Pollutant/Environmental Stressors Reduced: Nutrients, Toxics

Estimated Cost: $2,500/yr
Timeline: Ongoing
Priority: Low
Potential Project Partners: NRCS, CDs, MI Agricultural Stewardship Assoc., Northern Lakes Economic Alliance, MLUI, Economic Development Corporation, TWC

Task 8: Explore the benefits, need for, and feasibility of developing local ordinances to ensure appropriate management of and to protect against the negative water quality impacts of confined animal feeding operations (CAFOs) of 1,000 animal units or more.

Pollutant/Environmental Stressors Reduced: *Changes to Hydrology, Nutrients, Thermal Pollution, Toxics, Sediment*

Estimated Cost: $1,500
Timeline: 10 years
Priority: Low
Potential Project Partners: MSU-E Groundwater Stewardship, NRCS, CDs, TWC

Task 9: Promote local agriculture and encourage watershed residents to buy locally made/grown agricultural products.

Pollutant/Environmental Stressors Reduced: *Changes to Hydrology, Nutrients, Thermal Pollution, Toxics, Sediment*

Estimated Cost: $2,500/yr
Timeline: 10 years
Priority: Low
Potential Project Partners: MSU-E Groundwater Stewardship, NRCS, CDs, TWC, MLUI, Convention Visitors Bureau, Economic Development Corporation

Hydrology

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources
3) Land and water management

See also: Road Stream Crossings; Stormwater

Task 1: Map groundwater flow and major aquifers in the watershed.
Estimated Cost: $350,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, USGS, County Gov., Universities

Task 2: Install BMPs where needed to constrain unnaturally wide channels and concentrate channel flow into deeper, narrower channels.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Sediment
Estimated Cost: $25,000/year
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, DNR, CDs, TOMWC

Task 3: Inventory and map existing dams and lake-level control structures to identify inoperative, failing, or economically unfeasible dams that should be removed.
Estimated Cost: $5,500
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CRA, DNR, TCLP, City of TC, GT County

Task 4: Work with owners and operators of dams and lake-control structures to ensure these structures are operated so that they mimic natural flow conditions of the river.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Sediment
Estimated Cost: $2,500/year
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, FERC

Task 5: Remove inoperative, failing, or economically unfeasible dams as well as priority dams that are blocking fish passage.

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Thermal Pollution, Sediment

Estimated Cost: $1,000,000/removal

Timeline: 10 years

Priority: Low

Potential Project Partners: TWC, DNR, CDs, TCLP, City of TC, GT County

Habitat, Fish, and Wildlife

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources
3) Land and water management
6) Distinctive character and aesthetic qualities of watershed

Task 1: Conduct inventories of aquatic habitat conditions (debris, substrate, channel form, riparian corridor, erosion, etc.) throughout the watershed where needed to track trends in habitat condition.
Estimated Cost: $35,000/yr
Timeline: Ongoing
Priority: High
Potential Project Partners: CRA, DNR, CDs, GTBOCI

Task 2: Collect information that exists, and conduct stream inventories where needed, to evaluate appropriate sites for in-stream habitat improvement projects such as lunker structures, island structures, half-log structures or log jams. Criteria to be assessed includes: woody debris, bank stability, riparian vegetation, in-stream cover, flow dynamics, and fish population structure
Estimated Cost: $35,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CRA, DNR, CDs, GTBOCI

Task 3: Install in-stream habitat improvements where appropriate, according to the inventory in Task 2
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Thermal Pollution
Estimated Cost: $100,000/year
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, CRA, DNR, CDs, GTBOCI, TOMWC

Task 4: Continue to implement the Conservation Resource Alliance's Wild-Link program in the Grand Traverse Bay watershed to protect and enhance fish and wildlife habitat on private property within ecological corridors throughout the watershed.
Pollutant/Environmental Stressors Reduced: Loss of Habitat
Estimated Cost: $72,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: CRA

Task 5: Assist local land conservancies with protection of lands that maintain or expand wildlife corridors, protect sensitive wildlife and fisheries habitats such as wetlands, riparian corridors, etc., and protect habitat for threatened and endangered species.
See Land Protection and Management Tasks

Task 6: Work with local units of government to explore feasibility of a locally funded purchase of development rights/conservation easement acquisition program focused on preserving lands critical to water quality and wildlife habitat preservation. Use Peninsula Township as an example.
See Land Protection and Management Tasks

Task 7: Work with owners and operators of dams and lake-control structures to 1) prevent structural failures that often result in the release of sediments behind the dams and to ensure the proper disposal of dredge spoils, 2) install fish ladders where appropriate and necessary, and 3) install cold water withdrawals/outlets where needed.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Toxics, Sediment
Estimated Cost: $2,500/year
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, DNR

Stormwater

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources
3) Land and water management

Task 1: Form an area-wide Stormwater Task Force to tackle urban stormwater issues and to provide a forum for discussing and finding solutions to problems by implementing stormwater BMPs and education initiatives.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment
Estimated Cost: $15,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Local Gov.

Task 2: Conduct impervious surface assessments in the following subwatersheds: West Bay Shoreline and Tributaries, Boardman River (upstream of Sabin Pond and Kid's Creek), Old Mission Peninsula, Ptobego Creek, East Bay Shoreline and Tributaries, and the Elk River Chain of Lakes.
Estimated Cost: $100,000 (consultant rate)
Timeline: 3 years
Priority: High
Potential Project Partners: TWC

Task 3: Map and count number of culverts/storm drain outlets in villages and other municipalities that drain to major rivers, lakes, streams, and the Grand Traverse Bay. This has already been completed for the Boardman Lake watershed downstream of Sabin Pond, excluding Kid's Creek, and for the rest of Traverse City.
Estimated Cost: $100,000 (consultant rate)
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Local Gov.

Task 4: Work cooperatively with local units of government to develop stormwater management plans and/or ordinances for each community using a variety of tools including mapping of existing storm sewers; identifying locations where retrofitting is needed; working with adjacent townships to manage joint stormwater; and ensure that emergency response plans exist for pollutant spills.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment
Estimated Cost: $25,000
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, Local Gov.

Task 5: Work with local governments, area businesses, and property owners to install the following stormwater BMPs in urban areas where appropriate:
From the Center for Watershed Protection's Approaches to Stormwater Treatment and Stormwater Practice and Design CDs, Watershed Leadership Kit Volumes 4 and 5.

1. Vegetative Filter Strips: Filter Strips/Aquatic Buffers, Wet Swales, Dry Swales, Grass Channels
2. Stormwater Filtering Systems: Bioretention and Surface, Perimeter, Organic, Underground, Pocket Sand Filters
3. Infiltration Practices: Infiltration Trench or Basin, Porous Pavement
4. Retention and Detention Ponds
5. Other Low Impact Design Elements: Rain/Roof Gardens, Native Plantings, Riparian Buffers

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment

Estimated Cost: $25,000/year (salary costs only)
>$10,000,000 (BMP costs)
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, Local Gov.

Task 6: Implement stormwater BMPs in Kid's Creek within the urban areas of Traverse City including low impact design elements (i.e. rain gardens), riparian buffers and filter strips, and stormwater filtering and retention systems.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment

Estimated Cost: >$1,000,000 (BMP costs)
Timeline: 3 years
Priority: High
Potential Project Partners: ISEA

Task 7: Construct wetland area in Suttons Bay at Inland Seas Education Association property to filter out pollutants from stormwater coming from downtown Suttons Bay.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment

Estimated Cost: $40,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: ISEA

Wastewater and Septics

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources
3) Land and water management

Task 1: Complete shoreline cladophora survey (follow TOMWC project conducted in Chain of Lakes) to determine potential sites where there may be improperly working septic systems. Work with landowners to conduct dye testing to determine which septic systems are leaking, if any, in potential sited areas.
Estimated Cost: $72,000
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, TOMWC, Local Gov.

Task 2: Offer advice and assistance to riparian landowners to help identify malfunctioning septic systems.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $2,500/year
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, Health Depts., DEQ, OWTTF

Task 3: Select and install demonstration projects utilizing alternative onsite wastewater treatment systems.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $100,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, OWTTF, Health Depts.

Task 4: Develop regulatory and financial mechanisms to assure adequate financing at reasonable rates for onsite wastewater treatment systems, community collection and treatment systems, operation and maintenance.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $25,000
Timeline: 10 years
Priority: High
Potential Project Partners: OWTTF, Health Depts., MLUI, Local Gov.

Task 5: Advocate for higher water quality standards (like those for Outstanding State Designated Resource Waters) for new and updated wastewater treatment systems.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $5,500/year
Timeline: 10 years
Priority: High
Potential Project Partners: TWC

Task 6: Work with local governments and health departments to establish regular, mandatory septic system inspections (through ordinances or by other means) in priority areas.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $2,500/year
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, Health Depts., Local Gov., OWTTF

Task 7: Work with DEQ and local governments to support actions to minimize nutrient and pathogen discharges from municipal wastewater treatment plants, industrial/commercial facilities, and sanitary sewer overflows.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment
Estimated Cost: $2,500/year
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, Local Gov., Health Depts., DEQ, EPA

Task 8: Evaluate the water quality merits of replacing septic systems with a community wastewater conveyance and treatment system where there is a high density of old or improperly working septic systems. Use the community wastewater treatment system being constructed at Northpoint Point as an example.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $2,500/year
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, Health Depts., OWTTF

Task 9: Work with local health department officials who issue permits for new septic systems to ensure property owners implement proper septic system design for the site conditions and consider their proximity to lakes, streams, and water table levels.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $1,500/year
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, Health Depts., OWTTF

Task 10: Work with DEQ, DNR, and the Coast Guard to help monitor enforcement to prevent illegal boat (recreational and commercial) discharges of sewage and gray water.

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Pathogens, Thermal Pollution, Toxics, Sediment

Estimated Cost: $2,500/year
Timeline: Ongoing
Priority: Low
Potential Project Partners: TWC, Local Gov., DEQ, DNR, Coast Guard

Task 11: Work with DEQ to address improper land application of septage from pumped septic tanks.

Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens

Estimated Cost: $1,500/year
Timeline: Ongoing
Priority: Low
Potential Project Partners: TWC, Health Depts., DEQ

Human Health Issues

Goal(s) Accomplished:
2) Quality of water resources

See also: Wastewater and Septics; Monitoring

Task 1: Develop and promote Integrated Pest Management plans for agriculture, industrial facilities, businesses, golf courses, schools, and residences. (These plans generally begin with preventative measures for reducing pest infestations and involve less toxic treatment of infestations when they do occur, such as natural native predators.)
Pollutant/Environmental Stressors Reduced: Toxics, Nutrients
Estimated Cost: $50,000/year
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, MSU-E, Audubon Society (they certify golf courses that are using IPM, chemical and pesticide free, or environmentally friendly)

Task 2: Establish air quality monitoring stations to detect trends in air quality.
Estimated Cost: $75,000/each
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, GTBOCI, DEQ, GLEC

Task 3: Initiate burn barrel exchange program where people can trade in their burn barrels for a discount on waste hauling and/or garbage bags, or free or discounted compost bins.
Pollutant/Environmental Stressors Reduced: Toxics, Nutrients
Estimated Cost: $75,000
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC, GTBOCI, Health Dept., Trash Haulers GT County Resource Recovery Office

Task 4: Work with local authorities to develop ordinances that ban trash burning.
Pollutant/Environmental Stressors Reduced: Toxics
Estimated Cost: $25,000
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC, Local Gov

Wetlands

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources
3) Land and water management

See also: Land Protection and Management; Development; Zoning and Land Use

Task 1: Work with local governments and lake associations to ground-truth existing wetland maps throughout the watershed and put information into a GIS format.
Estimated Cost: $100,000 (consultant rate)
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, CDs

Task 2: Identify wetlands of particularly high value, based on plant/animal species, etc.
Pollutant/Environmental Stressors Reduced: All
Estimated Cost: $100,000 (should be combined with Task 1)
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Local Gov.

Task 3: Work with local governments, landowners, land conservancies, and other organizations to restore wetland areas where appropriate. Enroll landowners in the NRCS Wetland Reserve Program.
Pollutant/Environmental Stressors Reduced: All
Estimated Cost: $35,000/year
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, NRCS, CRA, CDs, TOMWC, Land Conservancies

Task 4: Monitor enforcement of possible wetland filling violations.
Pollutant/Environmental Stressors Reduced: All
Estimated Cost: $3,500/year
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, Local Gov.

Invasive Species

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
4) Recreational opportunities and quality, sustainable local economy

Task 1: Work with local governments and businesses to install boat washing stations at area marinas and public boat launches to avoid spread of invasive species.
Pollutant/Environmental Stressors Reduced: Invasive Species
Estimated Cost: $10,000/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Local Gov.

Task 2: Support Great Lakes United efforts toward reducing spread of invasive species throughout the watershed.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $2,500/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC

Task 3: Monitor the spread of specific types of invasive species in the watershed (i.e., purple loosestrife, Eurasian watermilfoil, zebra mussels).
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $5,500/year
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, CRA, TOMWC, CDs

Task 4: Work with local service organizations and governments to clean up zebra mussels on beaches.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $2,500/year
Timeline: Ongoing
Priority: Low
Potential Project Partners: TWC, Local Gov.

Task 5: Develop purple loosestrife eradication program as done in the Grass River Natural Area.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens
Estimated Cost: $100,000
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC

Land Protection and Management

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources
3) Land and water management

Task 1: Work with local units of government to develop and promote local initiatives that preserve open space and sensitive/important natural areas.
Pollutant/Environmental Stressors Reduced: All
Estimate Cost: $120,000/initiative (one per county)
Timeline: 10 years
Priority: High
Potential Project Partners: GTRLC, LC

Task 2: Assist local land conservancies with protection of lands that maintain or expand wildlife corridors, protect sensitive wildlife and fisheries habitats such as wetlands, riparian corridors, etc., and protect habitat for threatened and endangered species.
Pollutant/Environmental Stressors Reduced: All
Estimated Cost: $5,500/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, TOMWC, CRA, CDs

Task 3: Continue to implement the Conservation Resource Alliance's Wild-Link program in the Grand Traverse Bay watershed to protect and enhance fish and wildlife habitat on private property within ecological corridors throughout the watershed.
See Habitat, Fish, and Wildlife Tasks

Task 4: Create an endowment fund to assist the local land conservancies in purchasing conservation easements on key priority parcels within the Grand Traverse Bay watershed. Parcels targeted for protection would contain sensitive physical and hydrologic features that are essential to preserving water quality (e.g. wetlands, water frontage, groundwater recharge, steep slopes, etc.).
Pollutant/Environmental Stressors Reduced: All
Estimated Cost: $1,500,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: GTRLC, LC

Task 5: Develop a Revolving Conservation Land Acquisition Fund for conservancies to purchase lands for conservation easement implementation and resale. This would be for critical properties that are on the market or in cases where landowners are unwilling to sell the conservation easement, but would rather sell the land outright. This would provide a mechanism to allow local land conservancies to purchase the land, restrict the land with a conservation easement prohibiting or severely limiting building/development, and then resell the land to "conservation buyers" at its restricted value. This would require funds to cover the cost of the conservation easement. (i.e. difference in value).

Pollutant/Environmental Stressors Reduced: All

Estimated Cost: $1,500,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: GTRLC, LC

Task 6: Assist local units of government and the State of Michigan in acquiring land for preservation of water quality and sensitive ecological features.

Pollutant/Environmental Stressors Reduced: All

Estimated Cost: $70,000/year
Timeline: Ongoing
Priority: Medium
Potential Project Partners: GTRLC, LC

Task 7: Work with local units of government to explore feasibility of a locally funded purchase of development rights/conservation easement acquisition program focused on preserving lands critical to water quality and wildlife habitat preservation where public support exists. Use Peninsula Township as an example. *This task should include a public opinion poll to determine the likelihood of voters to accept the program.*

Pollutant/Environmental Stressors Reduced: All

Estimate Cost: $120,000 per initiative
Timeline: 10 years
Priority: Low
Potential Project Partners: GTRLC, LC

Task 8: Develop additional Designated Natural Areas throughout the watershed for recreation and education.

Estimated Cost: $100,000
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC, Local Gov., CDs, CRA, TOMWC, Lake Associations, Land Conservancies

Development

Goal(s) Accomplished:
1) Aquatic and terrestrial ecosystems
2) Quality of water resources
3) Land and water management

Task 1: Work with homebuilders associations, contractors, developers, real estate agencies, local government entities, and other appropriate organizations to 1) encourage 'watershed friendly' design, construction and maintenance of new and existing developments in the watershed and 2) to stress the importance of avoiding shoreline hardening where possible. Where shoreline hardening is necessary, make sure the structures are sited, designed, and installed properly to minimize the impact on beaches and nearshore sand drift.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Nutrients, Thermal Pollution, Sediment
Estimate Cost: $11,000/yr
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, Local Gov., CDs

Task 2: Work with appropriate local government agencies (i.e., County Drain Commission) to recommend BMP's for developers on construction sites and to ensure compliance with those BMP's. Potential systems of BMPs to require include: access roads, construction barriers, grading, staging, and proper scheduling for other BMPs.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Nutrients, Thermal Pollution, Sediment
Estimate Cost: $11,000/yr
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, Local Gov., CDs

Task 3: Work with counties and other appropriate local government entities to implement proper soil erosion control measures at construction sites.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Nutrients, Thermal Pollution, Sediment
Estimate Cost: $11,000/yr
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, Local Gov.

Task 4: Keep track of Soil Erosion and Sedimentation construction permits to determine the amount and location of new developments throughout the watershed.

Estimate Cost: $1,500/yr
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, County Gov.

Zoning and Land Use

Goal(s) Accomplished:
3) Land and water management

Task 1: Inventory current Master Plans and Zoning Ordinances for counties, townships, and municipalities to determine the types of protection given to water quality and natural resources.
Estimated Cost: $17,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Local Gov.

Task 2: Assist townships with zoning and master plans to develop ordinances that protect water quality and natural resources. Examples of topics to cover in the model ordinances include: mandatory building setbacks from bodies of water, minimizing development clearings by landowners, stormwater management, establishing riparian buffers along waterways, and protecting wetlands.
Pollutant/Environmental Stressors Reduced: All
Estimated Cost: $70,000/yr
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, Local Gov.

Task 3: Provide financial assistance to local units of government to amend or revise master plans and adopt zoning ordinances designed to protect water quality (i.e. cluster zoning, vegetation buffers, etc.) and provide public recognition for those that do.
Pollutant/Environmental Stressors Reduced: All
Estimated Cost: $189,000 (estimate 50% of local units [27] at $7,000 each)
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, Local Gov., New Designs for Growth

Task 4: Develop workable and practical strategies to strengthen enforcement of existing land use regulations, soil erosion programs, and ordinances by appropriate local government bodies.
Pollutant/Environmental Stressors Reduced: All
Estimated Cost: $50,000
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, Local Gov.

Task 5: Evaluate local zoning ordinances to determine the extent of use of the New Designs for Growth Guidebook for all development projects (including re-development) and provide financial incentives and public recognition of those that comply with the guidelines.

Pollutant/Environmental Stressors Reduced: All

Estimated Cost: $17,000 (can be combined with Task 1)

Timeline: Ongoing

Priority: Low

Potential Project Partners: TWC, Local Gov., New Designs for Growth

Task 6: Work with local units of government to explore feasibility of a locally funded purchase of development rights/conservation easement acquisition program focused on preserving lands critical to water quality and wildlife habitat preservation. Use Peninsula Township as an example.

See Land Protection and Management Tasks

Groundwater

Goal(s) Accomplished:
2) Quality of water resources
3) Land and water management

See also: Wetlands

Task 1: Identify priority groundwater discharge and recharge areas and distribute maps to local governments and other organizations in the watershed.
Estimated Cost: $100,000
Timeline: 10 years, map distribution ongoing
Priority: High
Potential Project Partners: TWC, DEQ, USGS, Universities

Task 2: Map groundwater flow and major aquifers in the watershed.
See Hydrology Tasks

Task 3: Support groundwater/wellhead protection programs for municipal drinking water supplies.
Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Nutrients, Thermal Pollution
Estimated Cost: $2,500/year
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, FERC

Task 4: Eliminate improperly capped abandoned wells to prevent contaminants from moving into and among groundwater aquifers via this route. Tasks will be to 1) inventory existing abandoned wells through surveys, well logs, and landowner interviews and 2) properly plug the abandoned wells.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens, Toxins
Estimated Cost: $25,000 (well inventory only)
Timeline: Ongoing
Priority: Low
Potential Project Partners: MSU-E Groundwater Stewardship, Health Depts.

Task 5: Abandon wells properly to prevent contaminants from moving into and among groundwater aquifers via this route.
Pollutant/Environmental Stressors Reduced: Nutrients, Pathogens, Toxins
Estimated Cost: $750/each (includes equipment and staff costs)
Timeline: Ongoing
Priority: Low
Potential Project Partners: MSU-E Groundwater Stewardship, Health Depts., DEQ

Monitoring

Goal(s) Accomplished:
All

Task 1: Continually update The Watershed Center's interactive water quality database (for the Grand Traverse Bay watershed) as new studies are completed each year.
Estimated Cost: $7,000/yr
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC

Task 2: Continue Stream Search program twice a year and expand to other areas of the watershed (currently in Traverse City region).
Estimated Cost: $15,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, Lake Assoc., Schools

Task 3: Continue annual beach E. coli monitoring program for public beaches in the Grand Traverse Region.
Estimated Cost: $40,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, Health Depts., Lake Assoc., Local Gov.

Task 3: Update shoreline inventory of Grand Traverse Bay every 5 years.
Estimated Cost: $35,000/inventory
Timeline: 10 years
Priority: High
Potential Project Partners: TWC

Task 4: Conduct initial inventory of near- and offshore areas along Grand Traverse Bay by boat and reassess every 5 years. Include sediment analysis of nearshore areas. Revisit aquatic weed (macrophyte) beds previously identified in 1991 and 1998 macrophyte surveys, as well as identify newly formed weed beds.
Estimated Cost: $35,000/inventory (salary cost only)
Timeline: 10 years
Priority: High
Potential Project Partners: TWC

Task 5: Annually inventory creeks (by walking/visual assessment) threatened by development to document ongoing land use and water quality changes due to increasing development in the greater Traverse City region. Creeks that should be inventoried include: Baker Creek, Mitchell Creek, Kid's Creek, Acme Creek, Boardman River in Traverse City and Garfield Township.

Estimated Cost: $2,500/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC

Task 6: Monitor and track the changes to habitat and hydrology on area beaches due to the newly passed Beach Grooming laws (in Summer 2003).

Estimated Cost: $2,500/yr
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC

Task 7: Annually evaluate monitoring results gathered from other groups conducting work in the watershed and assist with efforts when needed. (Update results in TWC water quality database – See Task #1).

Estimated Cost: $2,500/yr
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, ISEA, GTBOCI, USGS, DEQ

Desired Uses

Goal(s) Accomplished:
4) Recreational opportunities and quality, sustainable local economy
6) Character and aesthetic qualities

See also: Shoreline Protection and Restoration; Habitat, Fish, and Wildlife; Wetlands; Land Protection and Management; Development

Task 1: The Watershed Center Grand Traverse Bay and local governments will pursue designation of Grand Traverse Bay as an Outstanding State Resource Water under Michigan's Water Quality Standards.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC

Task 2: Continue to implement the Conservation Resource Alliance's Wild-Link program in the Grand Traverse Bay watershed to protect and enhance fish and wildlife habitat on private property within ecological corridors throughout the watershed.
See Habitat, Fish, and Wildlife Tasks

Task 3: Extend planned recreational trail systems in watershed (includes TART and Kalkaska County trails).
Estimated Cost: $2,000,000
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, TART, Kalkaska CD

Task 4: Develop additional Designated Natural Areas throughout the watershed for recreation and education.
See Land Protection and Management Tasks

Evaluation

Goal(s) Accomplished:
All

Task: Utilize the evaluation strategy (below) to annually measure progress and the effectiveness of the Grand Traverse Bay Watershed Protection Plan implementation.
Estimated Cost: $2,500/year
Timeline: Ongoing
Potential Project Partners: TWC, CRA

Evaluation Strategy for Plan Implementation
The following evaluation strategy was developed to measure progress and provide feedback during the implementation phase of the watershed protection plan. The evaluation will be ongoing and will be conducted through the existing Steering Committee. The Steering Committee will meet 2 times per year to assess progress on plan implementation and to learn about existing projects throughout the watershed. In addition, the plan tasks and priorities will be assessed every 5 years to ensure that the plan remains current and relevant.

A number of different evaluation tools will be utilized due to the variety of tasks involved in the watershed plan. They will include but are not limited to the following:

- ✓ Utilizing the existing watershed management plan goals and objectives to measure progress on plan implementation.
- ✓ Document the effectiveness of BMP implementation by taking photographs, completing site data sheets and gathering physical, chemical and/or biological data. Work with partners to develop a standardized methodology implementation.
- ✓ Incorporating feedback forms into educational and public events and posting them on The Watershed Center website www.gtbay.org.
- ✓ Utilizing specific focus groups to evaluate specific projects throughout plan implementation as needed.
- ✓ Conduct targeted surveys by direct mail, phone or by website.
- ✓ Maintain a current list of future target projects, the status of ongoing projects and accomplishments.

The purpose of the evaluation strategy is to provide a mechanism to the Steering Committee to learn whether or not the plan is being implemented and what can be done to improve the implementation process. Additional development of the strategy will occur as the implementation phase unwinds.

Additionally, individual grant projects conducted throughout watershed that are not overseen by the Steering Committee should include relevant evaluation components. The Steering Committee will work to establish an evaluation checklist for these projects to utilize. The Watershed Center will request a copy of all project evaluations to keep at their office for other projects to take advantage of.

7.3 Information and Education Strategy

This Information and Education (I/E) Strategy addresses the communication needs associated with implementing the Grand Traverse Bay Watershed Protection Plan.

During the planning process, a variety of means were used to not only inform the public and other stakeholders regarding the planning process and outcomes, but to assess stakeholders' knowledge of watershed issues and concerns (Appendix A).

Newsletters, public meetings, presentations to clubs and civic groups, a project website and other tactics were used to keep stakeholders up-to-date with the planning process. At a series of meetings for both the public and governmental officials, a couple of simple assessment tools were used to gather input that was used in developing the plan. In addition, a phone survey was conducted regarding watershed residents' knowledge, behaviors and attitudes about the watershed and watershed issues. A series of focus groups were conducted with participants from various market segments (industry, small business, agriculture, etc.) to assess the attitudes of the business sector regarding water quality issues, barriers to protecting water quality from a businessperson's perspective and other relevant topics.

Other research, both regional and national, was utilized to develop this plan (Biodiversity Project 2003, Dement 1995, Roper 2001, Wolf HRWC).

Local Research Findings

During summer 2002 nearly 400 local residents were interviewed via phone utilizing a survey instrument developed by Northwestern Michigan College's MTEC Research Services and Watershed Center staff.

The most significant finding of the survey was the identification of a major gap in knowledge amongst watershed residents. 60% of the respondents answered "don't know" when asked which watershed they lived in. This basic fact indicates that watershed partner organizations have a long way to go in informing and engaging the public in watershed issues.

Although many area residents routinely express concern about environmental issues, there is a lack of understanding of the key issues that face our watershed. Residents perceive that business and industry (17%) and sewage treatment plants (16%) are the main causes of water pollution to the bay. In truth, our area is dominated by non-smokestack industries and comparatively few discharge permit holders. While there have been problems in the last few years with accidental and deliberate partially treated sewage discharges in both Traverse City and the Village of Suttons Bay and a looming problem with septic systems and wastewater treatment in the Village of Northport, the primary input source of excess nutrients in the bay are from non-point sources.

Additionally, when asked what they believe to be the "least cause of water pollution in the Bay, and area lakes, streams and rivers," respondents indicated the "day to day actions of individuals" as the second least likely pollutant. These two findings would seem to indicate that the general public sees sources outside their individual control to be more responsible for existing and potential water quality problems.

Information Source	Percent
Newspaper	46.6%
TV News	13.7%
Environmental organization newsletters	7.3%
Friends, neighbors, coworkers	5.2%
Other organizations (churches, clubs, etc)	2.6
Magazines	2.3
Radio	1.6
Schools	1.3

Other key findings relevant to the development of this plan include data regarding where respondents get their information about the environment and water quality.

When this question was cross-tabulated with the respondents' age, more detail was revealed about where specific age demographic groups obtain their information about the environment.

Age Range	Preferred Source		Education Level	Preferred Source
18-25	Schools		**Graduate Degree**	Environmental newsletters or friends, neighbors and relatives
26-35	TV News		**Some post grad**	Environmental group newsletters, newspapers
36-55	Newspapers		**College degree**	Environmental group newsletters, newspapers
56-65	Environmental Newsletters		**Some college, high school or some high school**	Television news
66+	Newspapers			

Additional cross-tabulations were run to determine links between existing "environmentally-friendly" behaviors or education level and the respondents' perceptions and level of knowledge about water quality issues. The results indicate a correlation between existing environmentally-conscious behaviors and the depth of understanding about regional water quality issues.

- Respondents indicating they do recycle materials, other than cans or bottles, were more likely to indicate they think lawn fertilizers are the main cause of water pollution. Those who do not recycle materials other than cans or bottles were more likely to indicate they think either sewage treatment plants or recreational boating are the main cause of water pollution.

- Respondents that recycle materials other than cans or bottles were also more likely to indicate they think sewage treatment plants are the least cause of water pollution. Respondents who do not recycle think excavation and construction are the least causes of pollution.

- Respondents reporting some post-graduate study were more likely to indicate they think sewage treatment plants are the least cause of pollution. Respondents reporting some college were more likely to indicate they think agriculture and the day to day actions of individuals were the least cause of water pollution. Respondents reporting some high school were more likely than other educational groups to indicate they think recreational boating, exotic species and lawn fertilizers are the least cause of water pollution.

Other Research Findings

Recent regional and national research surveys regarding the environment confirm the basic findings of the Grand Traverse Bay surveys. A recent Roper study (Roper 2001) indicates that while there is increasing public concern about the environment, the majority of the public still does not know the leading causes of such issues as water pollution, air pollution and solid waste. This finding was also confirmed in work done by The Biodiversity Project as part of their Great Lakes Public Education Initiative. Their research involved both a public opinion poll and a survey of organizations, agencies and institutions engaged in public education efforts on Great Lakes topics. An excerpt follows:

> "...organizations are making a concerted effort to provide reliable information to people who can make a difference when it comes to improving the environmental conditions in the Great Lakes Basin. However, the public opinion poll shows that, for the most part, people are just not grasping the importance of the issues facing the Great Lakes in three important ways: the seriousness of the threats, the need for urgency in taking action to address the threats, and ways that individuals can make a difference. This led us to examine the discrepancy between the level and focus of current communications and public education efforts and the gaps in public awareness. Because of this discrepancy, we concluded that the public knowledge gaps are likely to be attributed to other factors besides the content and volume of materials. Likely factors include the following three points.
>
> - Limited use of targeting (tailoring messages and delivery strategies to specific audiences).
> - Heavy reliance on printed materials and the Web – reaching already interested knowledge seekers; limited use of television and other communication tools that reach broader audiences.
> - Multiple, complex, detailed information as opposed to broad, consistent unifying themes."

The report goes on to conclude that educators need "to pay attention to a full spectrum of factors that act as barriers to the success and impact of public outreach." Factors to be considered include:

- **Targeting** – Avoid the one-size-fits-all approach.
- **Delivery** – As resources allow, use the mediums and venues that best reach the target audience. Brochures are easy, the web is cheap, but television is the most used source of information about the environment.
- **Content** – Facts and figures are important to validate a point, but it is important to address the emotional connection needed to address why people should care, why the issue is relevant, effective solutions and what your audience can do about it.
- **Context** – Many environmental threats are viewed by the public as long term issues. Issues need to be communicated in a way that makes them more tangible. Beach closings, toxic pollution, sewage spills and water exports tend to feel more immediate than loss of habitat, land use planning and other big picture issues that citizens feel more disconnected from.

The study identified a list of educational needs and actions that should be incorporated consistently in educational efforts:

- Promote understanding of the system.
- Make the connection to individuals.
- Be local and specific.
- Include a reality check on "real threats." (For example, industrial pollution was a hot topic ten years ago but, many organizations have shifted their education focus to other current and emerging threats, such as stormwater runoff, biodiversity, etc, but the public has not caught up with this shift.)
- Emphasis on "why is this important to you" messages.
- Make the connection to policy.

Research Summary

Both local and regional research indicates that there are considerable gaps in the public's knowledge and understanding of current environmental issues. But, this knowledge gap is tempered by keen public interest and concern for the environment. Watershed organizations need to do a better job of making issues of concern relevant to their audiences. There is a need for ongoing, consistent and coordinated education efforts targeted at specific groups, addressing specific threats.

The following I/E strategy addresses some of these concerns. Both local and regional opinion research findings will be considered carefully when developing messages and delivery mechanisms for I/E strategy implementation.

Goals and Objectives

The goal of the I/E strategy is to ***"Establish and promote educational programs that support effective implementation of watershed planning goals, objectives and tasks; and increase stewardship."*** Fixing an erosion problem at a road stream crossing does not involve a high degree of public involvement. But, developing and carrying out a regional vision for stewardship of our water resources will require the public and community leaders to become more knowledgeable about the issues and solutions, more engaged and active in implementing solutions and committed to both individual and societal behavior changes.

The objectives of this plan focus on building awareness, educating target audiences, and inspiring action. Five major objectives have been identified:

- To raise community awareness and knowledge of the bay and the entire watershed, the interconnectedness of the system and the role that an individual's day-to-day activities play in protecting the resource.
- To develop a set of consistent messages that can be used by partners in a variety of communications.
- To involve citizens, public agencies, user groups and landowners in the implementation of the watershed protection plan.
- To regularly inform stakeholders about the watershed, implementation activities and successes and opportunities to participate.
- Motivate target audiences to adopt behaviors and implement practices that result in water quality improvements.

Target Audiences

A number of diverse regional audiences have been identified as key targets for I/E strategy implementation. The targets are divided into user groups and decision-making groups.

User Groups

Households – The general public throughout the watershed.

Riparian Landowners – Due to their proximity to a specific waterbody, the education needs of riparian landowners are different.

Agriculture Industry – Agriculture represents a significant economic segment within the Grand Traverse Bay watershed. Fruit orchards and vineyards dominate significant portions of the landscape and row crops, like potatoes and corn, are also well represented.

Business and Industry – There is a fairly diverse mix of business and industry segments within the watershed, although, luckily, very little traditional "smokestack" type industry is present. Tourism, agriculture, retail and other service industries dominate the mix, with manufacturing and construction following.

Tourists – Tourism is the number one industry in the Grand Traverse region. Our area is known for its scenic beauty and recreational opportunities and it is estimated that we play host to more than hundreds of thousands of visitors in any given year. This influx of people puts a noticeable strain on area infrastructure and often the environment. There is a growing concern that this important economic segment is possibly destroying the very reason why it exists, and that we may be reaching the region's tourism "carrying capacity." Steering committee members and attendees at both public and government stakeholder meetings cited the need to "educate tourists about their role in protecting our environment."

Builders/Developers/Real Estate – The Grand Traverse region is one of the fasting growing areas in Michigan in terms of population and land use. The area has enjoyed a boom in both residential and commercial development that has lasted more than a decade and shows no signs of slowing down significantly, despite the economic problems much of the nation is experiencing. Members of the development industry segment play a crucial role in this growth and providing ongoing education opportunities about their role in protecting water quality and environmental health is critical.

Education – Area educators and students, primarily K-12.

Partner Organizations – Our region boasts an impressive list of watershed partner groups with a broad range of expertise and important ongoing protection, restoration and education programs. Providing ongoing learning opportunities to watershed partner organizations regarding current research, BMPs, emerging issues and trends is important to keep implementation work moving forward.

Special Target Audiences: In addition to the above, certain user groups such as recreational boaters, other sports enthusiasts, garden clubs or smaller audience segments may be targeted for specific issues.

Local Government Decision Makers

Elected and Appointed Officials – Township, village, city, and county commissioners; planning commissions; zoning board of appeals; road commissioners; drain commissioners; etc.

Governmental Staff – Planners, managers, township supervisors, zoning administrators, etc.

Message Development

General message outlines have been established for each target audience. These messages will be refined as implementation moves forward. They may also be modified or customized depending on the message vehicle.

Target Audience	Messages
Households	• Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • Water quality-friendly lawn and garden practices • Housekeeping practices and the disposal of toxic substances • Septic maintenance • Managing stormwater on your property
Riparian Landowners	• Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • Riparian land management including the importance of riparian buffers • Water quality-friendly lawn and garden practices • Septic system maintenance • Housekeeping practices and the disposal of toxic substances
Agriculture Industry	• The importance of establishing sound agricultural BMPs • Advantages of and opportunities for buffer and filter strips • Impacts of fertilizer/pesticide use and mitigation options • Impacts of livestock waste and mitigation options • Farmland conservation opportunities
Business and Industry	• Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • Proper toxic chemical use, storage and disposal • Advantages of and opportunities for innovative stormwater management • The leadership role area businesses can play in protecting our watershed

Target Audience	Messages
Tourists	• Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • Help us protect the beauty that you enjoy when you are our guests • Clean boating practices • Their role in controlling the spread of aquatic invasive species
Builders, Developers, Real Estate	• Advantages of and opportunities for Low Impact Development • Identification and protection of key habitats and natural features: aquatic buffers, woodlands, wetlands, steep slopes, etc. • Advantages of and opportunities for open space protection and financial incentives for conservation • Impact of earthmoving activities, importance of soil erosion and sedimentation control practices, construction BMPs • Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed
Education	• Adoption and promotion of a state-approved watershed curriculum in K-12 schools. • Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • The connection between watershed organization's programs and school activities • Active participation in watershed protection activities and stewardship
Partner Organizations	• Consistent communication about key watershed issues to members and residents • Active participation in watershed activities and stewardship projects • Sharing data and developing comprehensive assessments of the health of the watershed

Communication Strategies and Tasks

A complete list of tasks by category follows this narrative; the categories are the same as those used to outline the implementation tasks in Section 7.2. Over the next year, these tasks will be further organized by target audience.

Action Plan to Implement Strategies

Several priority areas for the Grand Traverse Bay watershed have been identified and the plan for rolling out the IE Strategy will correspond to these priority areas (Table 22, Figure 18). Additionally, the IE Strategy will support other implementation efforts to control nutrient loading, sedimentation, the impacts of stormwater throughout the watershed and other pollutants outlined in Section 7.2.

In the first year or two of implementation, considerable time and effort will be put toward introducing stakeholders to the watershed protection plan and its various findings and conclusions. Work to build awareness of basic watershed issues, pollutant sources and how individual behaviors impact the health of the watershed will also be completed.

The IE Strategy tasks use a diverse set of methods and delivery mechanisms. Workshops, presentations, demonstration projects, brochures, public and media relations, web sites and other communications tools will be used for the different tasks and target audiences. Broadcast media, most importantly television, is beyond the reach of most area partner organizations – at least at a level of reach, frequency and timing that can be expected to have any impact on awareness and behavior. This is a barrier to utilizing this effective medium, but effort will be placed on building coalitions that can pool resources to address larger picture issues through broader-based, more long-term communications efforts. It is our hope that this plan may be used to stimulate more and better collaboration in the area of public education.

INFORMATION AND EDUCATION STRATEGY IMPLEMENTATION TASKS

GOAL 6: Promote and establish educational programs that support watershed planning goals, objectives and tasks, and increase stewardship.
Pollutants Addressed: All

Categories:

1. General
2. Shoreline Protection and Restoration
3. Road Stream Crossings
4. Agriculture
5. Hydrology
6. Habitat, Fish and Wildlife
7. Stormwater
8. Wastewater
9. Human Health
10. Wetlands
11. Invasive Species
12. Land Protection and Management
13. Development
14. Zoning and Land Use
15. Groundwater
16. Monitoring

Organization Acronyms:

All – indicates a task appropriate for any partner group
CDs – All Conservation Districts
Chambers – Chambers of Commerce
City of TC – City of Traverse City
County Gov. – County Governments
CRA – Conservation Resource Alliance
DEQ – Michigan Department of Environmental Quality
DNR – Michigan Department of Natural Resources
GRNA – Grass River Natural Area
GTBOCI – Grand Traverse Band of Ottawa and Chippewa Indians
GTCD – Grand Traverse Conservation District
GT County – Grand Traverse County
GTRLC – Grand Traverse Regional Land Conservancy
Health Depts. – Local Health Departments
ISEA – Inland Seas Education Association
LC – Leelanau Conservancy
LIAA – Land Information Access Association
Local Gov. – Local Governments
Local Papers – Area Newspapers (i.e., Record Eagle, Antrim County News)
NWMCOG – Northwest Michigan Council of Governments
MLUI – Michigan Land Use Institute
MSU-E – Michigan State University Extension
NRCS – USDA Natural Resources Conservation Service
Sea Grant – Michigan State University Sea Grant Program
OWTTF – Onsite Wastewater Treatment Task Force
TADL – Traverse Area District Library
TCCVB – Traverse City Convention and Visitors Bureau
TOMWC – Tip of the Mitt Watershed Council
TWC – The Watershed Center Grand Traverse Bay

Other Organizations:

Area Business Sponsors
Board of Realtors
Boat/Marine Retailers
Coast Guard
Convention Visitors Bureau
County Resource Recovery Departments
County Park Departments
Garden Centers
Home Builders Association
Lake Associations
Land Conservancies
Landscaping Companies
Marine Patrol
MSU-E Groundwater Stewardship
Newcomer's Club
New Designs for Growth
Neighborhood Associations
Road Commissions
Realtors

Target Audiences Include:
Agriculture
Builder/Developer/Realtor
Business and Industry
Education
Households
Local Governments
Partner Organizations
Riparian Landowners
Tourists
General

Estimated Costs and Timeframe:
For costs associated with salaries, an average watershed technician rate of $35/hour was applied. For tasks to be completed by a specialized consultant, a rate of $50/hour was used. Tasks that will be done on a yearly or site by site basis are noted as such ($X/yr or $X/site). Further details are noted where applicable. Tasks that should be completed in the short-term were given a timeframe of 3 years; long-term tasks were given a timeframe of 10 years; tasks that should be undertaken annually or continuously were given a timeframe of "ongoing."

Information and Education Strategy: General

Task 1: Regularly inform the public about activities, study findings, successful example projects, and opportunities for contribution in the Grand Traverse Bay watershed.

Subtask A: Publish quarterly newsletter.

Estimated Cost: $3,500 each
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC
Target Audience: General

Subtask B: Publish annual *Freshwater Focus* (State of the Watershed) tabloid summarizing the overall condition of the region's water resources and highlighting current research, implementation accomplishments, monitoring programs and other topics relevant to the water quality of the bay.

Estimated Cost: $10,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC
Target Audience: General

Subtask C: Provide watershed information and news to the local and regional media on a regular basis in the form of press releases, PSAs, feature stories, story ideas, editorials, etc.

Estimated Cost: $25,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: All
Target Audience: General

Subtask E: Develop TV and radio ads, public service announcements, print ads, etc., focusing on relevant water quality issues and basic watershed messages.

Estimated Cost: $25,000 development/$100,000-200,000 per year in media placement costs
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, GTCD, CRA, others
Target Audience: General

Task 2: Maintain and promote a comprehensive website containing information about the watershed along with activities, events, ways to get involved, plan documents, links to relevant organizations and resources, etc.
Estimated Cost: $7,500/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, LIAA
Target Audience: All

Task 3: Host annual, regional "Water Summit" for regional stakeholders to address priority issues impacting water quality, review implementation efforts and accomplishments, share resources, etc.
Estimated Cost: $10,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, TOMWC, NMC, NWMCOG, MSU-E
Target Audience: Local Government, Partners, General Public, Community Leaders (special target audience)

Task 4: Establish educational signage and kiosks throughout the watershed at parks, demonstration projects, beaches, marinas, boat launches, etc.
Estimated Cost: $250,000
Timeline: 10 years
Priority: Medium
Potential Project Partners: CDs, TWC, TOMWC, MDNR, County Park Departments, Road Commissions
Target Audience: General

Task 5: Develop "tourist stewardship" brochure for dissemination at area hotels and tourist attractions regarding key watershed issues and desired visitor behaviors (i.e., keep the beach clean, don't dump waste, etc.).
Estimated Cost: $5,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TCCVB**,** Chambers
Target Audience: Tourists

Task 6: Operate 1-800-BAYKEEPER hotline to provide concerned citizens with a means to report known or suspected environmental regulation violations, seek help or guidance, get questions answered, etc.
Estimated Cost: $2,500/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Area Business Sponsors
Target Audience: General

Task 7: Develop comprehensive set of watershed maps and make available to landowners, local governments and others.
Estimated Cost: $5,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, LIAA, County Gov.
Target Audience: Local Governments, General Public, Partner Organizations

Task 8: Create a set of resources such as publications, maps, and other references re watershed issues to be housed at Traverse Area District Library (TADL) for public use. Examples include Clean Water Act references, watershed plans, maps, land use planning and land protection information, limnology, relevant periodicals, research, government reports, etc.
Estimated Cost: $7,500 first year, $1,000 year after
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TADL
Target Audience: General

Task 9: Create small displays that would include a watershed brochure and a suggestion/concern box that could be placed in high tourist traffic areas.
Estimated Cost: $2,500
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TCCVB**,** Chambers
Target Audience: Tourists, Households

Task 10: Provide training to local citizens regarding environmental advocacy and the Clean Water Act.
Estimated Cost: $7,500
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TOMWC
Target Audience: Households, Riparians

Task 11: Publish watershed or region-wide "Environmental Resource Directory" on a regular basis including mix of resources lists, simple tips, and advertising to support. (TWC/Record Eagle)
Pollutant/Environmental Stressors Reduced: Toxics
Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, Local Papers, MSU-E
Target Audience: General

Task 12: In partnership with area tourism industry reactivate hotel program encouraging guests to re-use towels and sheets to conserve water resources using brochures, tent cards, etc,
Estimated Cost: $10,000 first year, $5,000 annually
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TCCVB, Chambers
Target Audience: Tourists

Task 13: Host annual "Get to Know Your Watershed" guided and/or self-guided tours.
Estimated Cost: $5,000
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC, TOMWC, CDs, Land Conservancies
Target Audience: General

Task 14: Develop a watershed-wide speaker's bureau as a resource for civic clubs and organizations, workshops, conferences, etc.
Estimated Cost: $2,500
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC
Target Audience: General

Task 15: Develop educational 10-12 minute video about priority watershed issues for use in presentations.
Estimated Cost: $15,000
Timeline: 3 years
Priority: Low
Potential Project Partners: TWC
Target Audience: All

Information and Education Strategy:
Shoreline Protection and Restoration

Task 1: Educate the public about environment-friendly lawn care, maintenance, and the application and use of fertilizers and pesticides.

Subtask A: Provide education materials (brochures, door hangers, pamphlets, etc.) and conduct landowner workshops regarding 1) the need for soil testing prior to fertilizer application, 2) the proper use of residential and commercial fertilizers with respect to the application amount, timing, frequency, location, method, and phosphorus content, and 3) the appropriate use of pesticides, etc.

Estimated Cost: $25,000/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, TOMWC, MSU-E
Target Audience: Household, Riparians

Subtask B: Increase public knowledge of the consequences of improper disposal of lawn and garden chemicals through news articles, workshops, and other media sources.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, TOMWC, MSU-E
Target Audience: Households, Riparians

Subtask C: Provide information to the public regarding environment-friendly lawn care contractors, where to buy low-phosphorous fertilizers, alternatives pest management practices and products, etc.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E
Target Audience: Households, Riparians

Subtask D: Develop promotions with landscaping and garden centers to provide educational brochures and workshops regarding native planting, "green landscaping," etc.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, Garden Centers
Target Audience: Households, Riparians

Subtask E. Develop a certification or recognition program for "earth-friendly" landscapers and related businesses.
Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E
Target Audience: Households, Riparians

Task 2: Conduct shoreline and riparian landowner workshops to stress the benefits and importance of riparian buffers to protect water quality.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, TOMWC, MSU-E
Target Audience: Riparians

Task 3: Develop native landscaping education program including workshops, demonstrations, and brochures.
Estimated Cost: $50,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, Landscaping Companies
Target Audience: Households, Riparians

Task 4: Produce or distribute existing riparian and/or shoreline landowners' guidebooks.
Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, Lake Associations
Target Audience: Riparians

Task 5: Establish or identify already existing shoreline buffers for demonstration projects and invite the public for tours; produce accompanying brochure.
Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, Lake Associations
Target Audience: Riparians

Task 6: Develop comprehensive composting education program including workshops and demonstrations.

Estimated Cost: $25,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, GTBOCI, Lake Associations
Target Audience: Households, Riparians

Task 7: Educate boaters and marina operators regarding environmentally-friendly boating and fueling practices including: avoiding illegal sewage and graywater discharges, fuel spills, engine maintenance, etc.

Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, DNR, Marine Patrol, Boat/Marine Retailers**,** Coast Guard
Target Audience: Recreational Boaters, Marinas (special target audience)

Task 8: Develop a realtor and developer educational program aimed at providing new homeowners with information regarding water quality and watershed issues at the point-of-sale.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TOMWC, Board of Realtors
Target Audience: Builder/Developer/Realtor, Households

Information and Education Strategy:
Road Stream Crossings

Task 1: Host workshops for County Road and Drain Commissions to provide education regarding possible BMPs to establish at road crossings to reduce the harmful effects of sedimentation and stormwater runoff.

Estimated Cost: $5,000
Timeline: 10 years
Priority: Medium
Potential Project Partners: CDs, TWC, TOMWC, CRA
Target Audience: Local Governments

Information and Education Strategy: Agriculture

Task 1: Identify existing farms with conservation practices to serve as a demonstration site. Invite the public for tours and workshops.
Estimated Cost: $10,000
Timeline: 10 years
Priority: Medium
Potential Project Partners: MSU-E, CDs, NRCS
Target Audience: Agriculture, Households

Task 2: Educate farmers using manure about proper manure management for their fields. Stress the use of 1) properly designed, constructed, and sited (including consideration of the proximity to surface waters) manure storage facilities, 2) properly maintained and operated manure storage facilities to prevent leaks, overflows, and the need for untimely emptying, and 3) applying manure to properly designated fields at appropriate times
Estimated Cost: $15,000
Timeline: 10 years
Priority: High
Potential Project Partners: NRCS, CDs
Target Audience: Agriculture

Task 3: Encourage farm market vendors to provide information about BMPs they are using on their farms.
Estimated Cost: $2,500
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, City of TC, Local Gov.
Target Audience: Households

Information and Education Strategy:
Hydrology

Task 1: Work with public officials to educate affected residents and others regarding key issues surrounding the removal of dams along the Boardman River.
Estimated Cost: $2,500
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, DNR, DEQ, MLUI
Target Audience: Riparians

Task 2: Work with local officials when needed to educate them and affected citizens regarding key issues and benefits surrounding the removal of dam and other water control structures in the watershed.
Estimated Cost: $2,500 per occurrence
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC, CDs, DNR, DEQ, MLUI
Target Audience: Riparians

Information and Education Strategy:
Habitat, Fish, and Wildlife

Task 1: Provide education to the general public on the importance of maintaining diverse wildlife habitats and developing wildlife corridors on their property.
Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: CRA, CDs, NRCS
Target Audience: Households, Agriculture, Local Government

Task 2: Educate the public regarding CRA's Wild-Link program through 1) conducting tours to existing lands enrolled in Wild-Link program and 2) mailed packets of information to potential landowners.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: CRA
Target Audience: Households, Agriculture, Local Government

Task 3: Educate public officials through workshops, demonstration tours, and information packets regarding the impacts of increased land fragmentation on wildlife habitat and corridors.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: CRA, CDs, NRCS
Target Audience: Local Government

Information and Education Strategy:
Stormwater

Task 1: Develop comprehensive public education program regarding the control of stormwater including the following components: door hangtags, utility bill inserts, workshops, brochures, newspaper articles, PSAs, radio and TV advertisement campaigns, radio talk shows, and print advertising.

Estimated Cost: $100,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, TOMWC, CDs, Local Gov.
Target Audience: Households, Riparians

Task 2: Provide general stormwater education for local units of government that stresses the benefits of 1) managing the amount of impervious surfaces in the watershed, 2) reducing the filling and development of wetlands, which provide temporary holding of stormwater, and 3) implementing stormwater BMPs and low-impact design practices to minimize stormwater flows. Examples of BMPs and low-impact design practices include:

- Vegetative Filter Strips: Filter Strips/Aquatic Buffers, Wet Swales, Dry Swales, Grass Channels
- Stormwater Filtering Systems: Bioretention and Surface, Perimeter, Organic, Underground, Pocket Sand Filters
- Infiltration Practices: Infiltration Trench or Basin, Porous Pavement
- Retention and Detention Ponds
- Other Low Impact Design Elements: Rain/Roof Gardens, Native Plantings, Riparian Buffers

(From the Center for Watershed Protection's Approaches to Stormwater Treatment and Stormwater Practice and Design CDs, Watershed Leadership Kit Volumes 4 and 5.)

Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, MDEQ, TOMWC, NWMCOG
Target Audience: Local Governments

Task 3: Implement an annual watershed-wide storm drain stenciling event involving municipalities, neighborhood associations, and other volunteer groups.

Estimated Cost: $10,000/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Local Gov., Neighborhood Associations
Target Audience: Households, Riparians

Task 4: Partner with neighborhood associations to host presentations and workshops on controlling stormwater on their properties, etc.

Estimated Cost: $5,000
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, Neighborhood Associations
Target Audiences: Households, Riparians

Information and Education Strategy:
Wastewater

Task 1: Develop comprehensive public education program regarding septic systems including:

- Using proper septic system design for the site conditions and considering the proximity to bodies of water when siting them,
- Properly maintain existing septic systems, and
- Providing education regarding the development of alternative onsite wastewater treatment systems.

The following components will be used: door hangtags, utility bill inserts, workshops, brochures, newspaper articles, PSAs, radio and TV advertisement campaigns, radio talk shows, and print advertising.

Estimated Cost: $75,000/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, Health Depts., OWTTF
Target Audience: Households, Riparians

Information and Education Strategy:
Human Health

Task 1: Implement a 'Do Not Feed the Waterfowl or Seagulls' campaign in watershed including PSAs, signage, articles, brochures, etc.
Estimated Cost: $100,000
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, City of TC (and other municipalities)
Target Audience: Households, Tourists

Task 2: Implement a 'Pick Up Your Pet Waste' program in urban areas throughout the watershed.
Estimated Cost: $100,000
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, City of TC (and other municipalities)
Target Audience: Households, tourists

Task 3: Print and distribute brochures regarding beach monitoring and factors affecting public health at swimming beaches.
Estimated Cost: $5,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Health Depts.
Target Audience: Households, Riparians, Tourists

Task 4: Educate the public regarding health risks associated with backyard trash burning and encourage alternative methods of disposal such as composting, recycling and utilizing hazardous materials disposal facilities and drop-off events.
Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: GTBOCI, TWC, Health Depts., County Resource Recovery Departments
Target Audience: Households, Riparians, Agriculture

Task 5: Provide education regarding health risks to individuals and communities from improper disposal of hazardous wastes. Provide information regarding proper disposal and alternative products and methods and promote participation in household hazardous waste collection events.

Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: GTBOCI, TWC, Health Depts., County Resource Recovery Departments
Target Audience: Households, Riparians

Task 6: Encourage and promote the proper disposal of used electronic devices; provide information regarding disposal options and promote periodic drop off events.

Estimated Cost: $5,000
Timeline: Ongoing
Priority: High
Potential Project Partners: County Resource Recovery Departments, TWC, GTBOCI
Target Audience: Households, Riparians, Business and Industry

Information and Education Strategy:
Wetlands

Task 1: Educate local governments, developers, contractors, and others through workshops and presentations, press releases, brochures, etc, regarding the ecological consequences of developing unregulated wetland areas, especially in headwater/recharge areas and along the Grand Traverse Bay shoreline.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC
Target Audience: Local Governments, Builder/Developer/Realtor

Task 2: Educate the public and public officials regarding the benefits of wetlands through workshops, demonstrative site tours, newspaper articles, PSAs, radio and TV advertisement campaigns, radio talk shows, print advertising, etc.
Estimated Cost: $100,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC
Target Audience: Households, Riparians, Local Governments, Builder/Developer/Realtor

Task 3: Educate and communicate to Great Lakes shoreline owners the current beach maintenance regulations, the value and proper care of emergent coastal wetlands, and the benefit of keeping these wetlands in a natural state. Disseminate existing brochures, mail letters, host 'town meetings', etc.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC
Target Audience: Riparians, Tourists, Local Governments

Task 4: Host a series of workshops and seminars throughout the watershed to educate public officials regarding appropriate and successful methods for restoring wetlands.
Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TOMWC
Target Audience: Local Governments

Information and Education Strategy:
Invasive Species

Task 1: Educate local residents and visitors regarding the negative impacts of and appropriate control and eradication measures for both aquatic and terrestrial invasive species (including Eurasian water milfoil, purple loosestrife, zebra mussels, etc).
Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, GRNA, MSU-E, ISEA, CDs, Sea Grant
Target Audience: Households, Riparians, Tourists

Task 3: Develop simple fact sheet or brochure to use as a handout at garden centers regarding terrestrial invasive species, including photos, drawings and eradication methods.
Estimated Cost: $5,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, MSU-E, Sea Grant
Target Audience: Households, Riparians

Task 4: Create and distribute a resource list for native plant species.
See related tasks under Shoreline Protection and Restoration category.
Estimated Cost: $5,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, MSU-E, CDs
Target Audience: Households, Riparians

Information and Education Strategy:
Land Protection and Management

Task 1: Provide landowner education regarding voluntary conservation easements and other available land protection measures utilizing direct mail, publications, etc. Schedule bus tours of areas already in conservation easements to provide examples of successful efforts.
Estimated Cost: $50,000
Timeline: 10 years
Priority: High
Potential Project Partners: GTRLC, LC
Target Audience: Households, Riparians

Task 2: Develop a public awareness program to inform the public of ecologically sound riparian and coastal wetland land management practices.
See related tasks under Shoreline Protection and Restoration category.
Estimated Cost: $50,000
Timeline: 3 years
Priority: High
Potential Project Partners: GTRLC, LC
Target Audience: Households, Riparians

Information and Education Strategy:
Development

Task 1: Host workshops, seminars, and site tours to educate developers and contractors on proper stormwater and sediment management at construction sites.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Home Builders Association, Realtors
Target Audience: Builder/Developer/Realtor

Task 2: Compile information packet and host workshops, luncheons, or small seminars for area realtors providing them with basic information regarding environmental laws (wetlands, beach maintenance, onsite wastewater treatment, etc.) that might impact new homeowners.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC
Target Audience: Households, Riparians, Builder/Developer/Realtor

Task 3: Develop watershed information packet for realtors, developers, and other businesses to hand out to customers, new homeowners, and others on activities the can do to improve/protect water quality on their property.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, Chambers, Newcomers Clubs
Target Audience: Households, Riparians, Builder/Developer/Realtor

Task 4: Encourage design, construction and maintenance of new and existing development in the watershed that utilizes Best Management Practices to protect water quality.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Home Builders Association, TOMWC, New Designs for Growth
Target Audience: Builder/Developer/Realtor, Local Government

Information and Education Strategy:
Zoning and Land Use

Task 1: Provide key elected/appointed public officials (planning commissioners, etc.) with summary version of Grand Traverse Bay Watershed Protection Plan and basic recommendations relevant to local units of government.
Estimated Cost: $2,500
Timeline: 3 years
Priority: High
Potential Project Partners: TWC
Target Audience: Local Governments

Task 2: Educate and inform local planning and zoning officials regarding up-to-date information on planning, zoning, and design innovations relating to the protection of water quality.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Local Gov., NWMCOG
Target Audience: Local Governments

Task 3: Develop an information packet for Zoning Boards of Appeals and Planning Commissions to assist them in developing reasonable conditions to place on requests for variances (i.e., installing or providing riparian buffers and/or other BMPs on site).
Estimated Cost: $10,000 initial year; $2,500/yr after packet is completed
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Local Gov., NWMCOG
Target Audience: Local Government

Task 5: Facilitate meetings between townships regarding the sharing of model ordinances that protect water quality and natural resources.
Estimated Cost: $5,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, Local Gov., NWMCOG
Target Audience: Local government

Information and Education Strategy:
Groundwater

Task 1: Educate local governments, developers, contractors, and others regarding headwater and groundwater recharge areas (how they work, soils, vegetation, etc.) and why it is important to protect them and avoid overdeveloping them.

Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, MSU-E Groundwater Stewardship, CDs
Target Audience: Local Government, Builder/Developer/Realtor

Information and Education Strategy:
Monitoring

Task 1: Expand marketing and promotion efforts for TWC's Stream Search program utilizing public relations, giveaways for participants, sponsorships, etc.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC
Target Audience: General

Task 2: Provide ongoing information to stakeholders regarding research and monitoring efforts conducted by the TWC and various partner organizations in the watershed and what it means to various target audiences (through documents such as the annual *Freshwater Focus* newspaper insert, TWC website, press releases, etc).
Estimated Cost: $5,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, ISEAS, TOMWC, GTBOCI
Target Audience: All

Task 3: Enter results of water quality testing into TWC's online, interactive water quality database.
Estimated Cost: $5,000/year
Timeline: ongoing
Priority: High
Potential Project Partners: TWC
Target Audience: All

CHAPTER 8 FUTURE EFFORTS

8.1 What Comes Next?

The Watershed Center and other project partners will continue to build partnerships with various groups throughout the watershed for future projects involving the implementation of recommendations made in this protection plan. Funding sources for these projects will be pursued aggressively over the next 1– 2 years. Government, foundation, and corporate grants will be researched as possible funding sources. It is expected that this implementation phase will last 10 years or more. Grant funds and other money sources will be used to 1) continue water quality assessment and monitoring, 2) to complete initial implementation tasks and installation of Best Management Practices (Section 7.2), and 3) complete initial tasks outlined in the Information and Education (IE) Strategy (Section 7.3). The Grand Traverse Bay Watershed Project Steering Committee will continue to meet during this implementation period.

NOTE:

A one-year transition period is scheduled from January 2004 to December 2004 for the continuation of the Grand Traverse Bay Watershed Project between DEQ funding cycles.

Over the next year, further investigation into pollutants and sources in the Grand Traverse Bay watershed will be done in order to provide a greater level of detail on watershed pollutants. When this research is finished, the Grand Traverse Bay Watershed Protection Plan will be updated to reflect this new information.

Additionally, implementation of the Information and Education Strategy will start during this transition phase of the Grand Traverse Bay Watershed Project.

Priority tasks that should be conducted over the next 1 – 3 years are as follows, with the most important tasks listed first:

- Establishing stormwater BMPs and ordinances
- Stormdrain mapping
- Streambank and shoreline erosion surveys and stabilization projects
- Establishing riparian buffers
- Inventory current Master Plans and Zoning Ordinances and assist with developing new ones with more water quality protection
- Complete road crossing inventories and begin improvements using BMPs
- Wetland assessment, restoration, and protection
- Initiatives to preserve open space and wildlife corridors
- Continuing monitoring programs
- Developing Conservation Plans for farms

Environmental awareness, education, and action from the public will grow as the IE Strategy is implemented and resident awareness of the watershed is increased. Implementing the IE Strategy is perhaps the most critical and important task to accomplish over the next 5–10 years. The strategy is designed to be used by a wide variety of organizations, not just by The Watershed Center. In the first year or two of implementation, considerable time and effort will be put toward introducing stakeholders to the watershed protection plan and its various findings and conclusions. Work to build awareness of basic watershed issues, pollutant sources and how individual behaviors impact the health of the watershed will also be completed.

8.2 Current Work and Projects

There are a wide variety of current and ongoing projects taking place in the Grand Traverse Bay watershed. Results from these research initiatives will be continually assessed and reviewed and incorporated into watershed recommendations and implementation activities. Some of these projects include:

- Monitoring
  - TWC – monitoring E. Coli in tributaries and beaches
  - Bi-annual Stream Search volunteer monitoring for macroinvertebrates
  - Grand Traverse Band of Ottawa and Chippewa Indians – monitoring water quality in streams in Leelanau County and some Antrim County lakes
- Education and Outreach
  - TWC developing an interactive water quality database
  - TWC installing educational watershed signage throughout watershed
  - Boardman River Project – expanding awareness and education regarding the Boardman River watershed
  - ERCOL Implementation Project – developing watershed signs
- Best Management Practices
  - Boardman River Project – stabilizing streambanks (on Boardman River and Kid's Creek)
  - ERCOL Implementation Project – stabilizing streambanks
  - TWC – Kid's Creek Restoration and demonstration project behind Great Wolf Lodge
  - Conservation Districts completing road stream crossing and streambank erosion improvement projects
- Others
  - CRA's WildLink program
  - MSU/UM/Purdue: mapping and modeling groundwater flow and land use

CHAPTER 9 CONCLUSIONS

A project evaluation, completed by the Conservation Resource Alliance is included as Appendix B.

The Grand Traverse Bay Watershed Protection Plan was developed to address water quality concerns in the watershed. The two-year planning phase has allowed some of the key decision-makers, organizations, agencies, and the public to understand the dynamics of the watershed in which they live. The recommendations outlined in the Grand Traverse Bay Watershed Protection Plan will provide guidelines for taking action during the transition and implementation phases of the project and will be a useful tool in addressing current and future water quality threats to the watershed.

The five threatened designated uses identified in this protection plan are the cold water fishery, other indigenous aquatic life, total body contact, navigation, and public water supply at point of intake (Table 13). Excessive nutrient loading and sedimentation are two of the known pollutants that are threatening these designated uses in the Grand Traverse Bay watershed. Other issues that threaten these designated uses include loss of habitat, changes to hydrologic flow, invasive species, toxic substances, pathogens, and thermal pollution. All of these factors degrade water quality, destroy aquatic habitat, and reduce the number and diversity of aquatic organisms. A list of watershed pollutants was developed in a Comprehensive Watershed Management Table (Table 16 and 17) to identify water quality problems and provide guidance for future implementation projects to protect the quality of the watershed. Priority areas also were delineated to identify specific areas in the watershed that are most sensitive to environmental impacts and have the greatest likelihood to affect water quality and aquatic habitat.

The Grand Traverse Bay Watershed Protection Plan provides recommendation on how to reduce the negative impact that pollutants and environmental stressors have on the threatened designated uses in the Grand Traverse Bay watershed. The Plan also assists decision-makers, landowners, residents, and others in the watershed in making sound decisions to help improve and protect water quality in their area.

The Grand Traverse Bay Watershed Information and Education Strategy highlights the actions needed to successfully maintain and improve watershed education, awareness, and stewardship for the Grand Traverse Bay watershed. It lays the foundation for the collaborative development of natural resource programs and educational activities for target audiences, community members, and residents.

Future efforts for the Grand Traverse Bay Watershed Project include:

- Building partnerships and seeking funding for implementation activities.
- Completing initial implementation tasks.
- Ongoing monitoring to assess environmental conditions.
- Implementing information and education initiatives.
- Compiling results from ongoing research initiatives.

A Message from the Grand Traverse Baykeeper: Outstanding State Resource Water

Grand Traverse Bay should be designated as an Outstanding State Resource Water (OSRW). In fact, the bay was designated as one prior to 1996. Under the Clean Water Act and the Michigan Anti-degradation Rules, water can now be discharged into Grand Traverse Bay of a quality less than that existing in the bay without meeting a feasible, prudent, and reasonable alternative standard. The pressure of development on Grand Traverse Bay is intense. The development will happen. How it happens can be planned so that the resource is not impaired. It may cost more to do it right, but the value of the resource by far exceeds any increased cost. An OSRW designation would require that any National Pollutant Discharge Elimination System Permit Program discharges must meet or exceed the existing water quality or show a feasible, prudent and reasonable alternative standard, allowing for the public input. This designation is prudent, feasible and reasonable. It is also essential. The Watershed Center will meet with local and other public officials to pursue this designation for the Grand Traverse Bay Watershed within the next three years.

REFERENCES CITED

Alexander, G.R., and E.A. Hansen. 1988. Decline and recovery of a brook trout stream following an experimental addition of sand sediment. State of Michigan Department of Natural Resources. Fisheries Division Research Report No. 1943. Ann Arbor, Michigan.

Allan, J. David. 1995. Stream Ecology. Chapman & Hall: London.

Auer, M.T., R.P. Canale, and P. Freedman. 1975. The Limnology of Grand Traverse Bay, Lake Michigan. Technical Report No. 47. MICHU-SG_76-200. Michigan Sea Grant Program.

Beyer, Amy S., Cheryl K. Contant, Michael J. Donahue. 2001. Seeking Signs of Success: A guided approach to more effective watershed programs. Harbor House Publishers: Boyne City, MI.

Biodiversity Project. October 2003. Great Lakes Basin Communications and Public Education Survey, Final Report.

Boutt, D.F., D.W. Hyndman, B.C. Pijanowski, and D.T. Long. 2001. Identifying Potential Land Use-derived Solute Sources to Stream Baseflow Using Ground Water Models and GIS. Ground Water 39 (1): 24-34.

Center for Watershed Protection. 1994. The Importance of Imperviousness. Watershed Protection Techniques. 1,3:100-107.

Conservation Resource Alliance (CRA). July 2001. Elk River Chain of Lakes Watershed Management Plan: Revision.

Day, R. 1997. Michigan Fish Contaminant Monitoring Program 1997 Annual Report. Michigan Department of Environmental Quality Surface Water Quality Division. Report #MI/DEQ/SWQ-95/087.

Dement, Polly. December 1995. River Talk! Communicating a Watershed Message. River Network.

Diana, James. 1995. Biology and Ecology of Fishes. Cooper Publishing Group LLC: Carmel.

Evans, E., M. Wilson, and W. Creal. 1991. Assessment of Mercury Contamination in Selected Michigan Lakes, 1987-90: Historical Trends, Environmental Correlates, and Potential Sources. Michigan Department of Natural Resources, Surface Water Quality Division.

Fuller, Doug. 2001. Fish of the Elk River Chain of Lakes: A Watershed Perspective. Tip of the Mitt Watershed Council: Petoskey, MI.

Grand Traverse County Drain Commissioner's Office (GTCDC). June 1995. Acme Creek Watershed Planning Project – Final Report. Prepared for Michigan Department of Natural Resources Nonpoint Source Program (now the Michigan Department of Environmental Quality's Water Division).

Grand Traverse County Drain Commissioner's Office (GTCDC). August 1995. Mitchell Creek Watershed Implementation Project: Final Report. Prepared for Michigan Department of Natural Resources Nonpoint Source Program (now the Michigan Department of Environmental Quality's Water Division).

Grand Traverse County Drain Commissioner's Office (GTCDC). February 1995. Mitchell Creek Watershed Protection Strategy. Prepared as part of the Mitchell Creek Watershed Implementation Strategy.

Grand Traverse County Drain Commissioner's Office (GTCDC). April 2000. Acme and Yuba Creek Watersheds Nonpoint Source Implementation Project – Final Report.

Great Lakes Environmental Center (GLEC). 1996. The Acme Creek Ecological Project: Natural Features Inventory and Land Management Plan. Prepared for the Grand Traverse Regional Land Conservancy, Traverse City, MI.

Great Lakes Environmental Center (GLEC). 1998. Peshawbestown and Omena Bay Baseline Water and Sediment Quality Study. Prepared for the Grand Traverse Band of Ottawa and Chippewa Indians. Suttons Bay, MI

Great Lakes Environmental Center (GLEC). 2000. Integrated Habitat and Water Quality Inventory of Grand Traverse Bay. Prepared for The Watershed Center Grand Traverse Bay funded through The Michigan Great Lakes Protection Fund.

Great Lakes Environmental Center (GLEC). 2001. Stormwater Source Identification, Sampling, and Analysis at Select Storm Drains and Tributaries to Grand Traverse Bay (Lake Michigan). Prepared for The Watershed Center Grand Traverse Bay as part of an DEQ, Coastal Zone Management Study. (Principal Contact at GLEC: Dennis McCauley)

Great Lakes Information Network (GLIN). 2001. Website: http://www.great-lakes.net/envt/flora-fauna/invasive/invasive.html and http://www.great-lakes.net/teach/pollution/ans/ans_1.html. (Some information from: A Field Guide to Aquatic Exotic Plants and Animals, University of Minnesota Sea Grant Program).

Gosling Czubak Associates (GCA) and Battelle Great Lakes Environmental Center (GLEC). November 1991. Final Report: Mitchell Creek Watershed Non-Point Source Pollution Study. Commissioned by Grand Traverse County Drain Commissioner's Office under a grant from the Michigan Department of Natural Resources.

Harrison, Ron and Jeremy Dunlap. 1998. Mapping Impervious Surface Coverage for Watershed Monitoring and Land Use Planning. Project for: Grand Traverse County Drain Commissioner's Office (GTCDC) and GIS Department.

Holtschlag, D.J. 1997. A generalized estimate of groundwater recharge rates in the Lower Peninsula of Michigan. USGS: Water Supply Paper 2437.

Houghton, J.T., Y. Ding, D.J. Griggs, P.J. van der Linnen and V. Xiasou, eds. 2001. Climate Change 2001: The Scientific Basis Intergovernmental Panel on Climate Change: Working Group. Cambridge University Press, Cambridge, U.K.

Kauffman, J.B., W.C. Krueger, M.Vaura. 1983. Impacts of cattle grazing streambanks in northeastern Oregon. Journal of Range Management. 36:683-685

Kelly, R.W., and W.R. Farrand. 1967. The Glacial Lakes Around Michigan: Michigan Geological Survey Bulletin, 23 p.

Largent, Steve. 1991. Boardman River Watershed Report. Grand Traverse Conservation District.

Lauff, G.H. 1957. Some Aspects of the Physical Limnology of Grand Traverse Bay. Great Lakes Research Institute, The University of Michigan, Ann Arbor, MI.

Mehan, G. 1996. Mercury Pollution Prevention in Michigan: Summary of Current Efforts and Recommendations for Future Activities. University of Michigan Press, Ann Arbor.

Michigan Department of Environmental Quality (DEQ). 1998. (Reprint 2001) Guidebook of Best Management Practices for Michigan Watersheds. Lansing, Michigan.

Michigan Department of Environmental Quality (DEQ). 1998. Water Quality and Pollution Control in Michigan. 1998 Section 305(b) Report. Report# MI/DEQ/SWQ-98/030.

Michigan Department of Environmental Quality (DEQ). 2002. Clean Water Act Section 303(d) List. Report # MI/DEQ/SWQ-02/013.

Michigan Department of Natural Resources (MDNR). 1997. Michigan Fishing Guide. Michigan Department of Natural Resources, Fisheries Division.

Northwest Michigan Council of Governments (NWMCOG). July 1989. Elk River Chain of Lakes: Watershed Master Plan.

O'Neal, Richard P. 1997. Muskegon River Watershed Assesssment. State of Michigan Department of Natural Resources. Fisheries Division Special Report No. 19.

Pijanowski, B.C., D. Brown, B. Shellito and G. Manik. In press. Using neural networks and GIS to forecast land use changes: A Land Transformation Model. Computers, Environment and Urban Systems.

Pijanowski, B.C., S.H. Gage, D.T. Long & W. C. Cooper. 2000. A Land Transformation Model: Integrating Policy, Socioeconomics and Environmental Drivers using a Geographic Information System; In *Landscape Ecology: A Top Down Approach*, Larry Harris and James Sanderson eds.

Pijanowski, B.C., T. Machemer, S.H. Gage, D. T. Long, W. E. Cooper and T. Edens. 1996. The GIS syntax of a spatial-temporal land use change model. In Proceedings of the Third Conference on GIS and Environmental Modeling. GIS World Publishers - CD-ROM.

Pijanowski, Bryan, David Hyndman, and Bradley Shellito. 2001. The Application of the Land Transformation, Groundwater Flow and Solute Transport Models for Michigan's Grand Traverse Bay Watershed. Presented at the National American Planning Association Meeting. New Orleans, Louisiana, March 14, 2001.

Poff, N.L., M.M. Brinson, and J.W. Doy, Jr. 2002. Aquatic ecosystems and global climate change: Potential impacts on inland freshwater and coastal wetland ecosystems in the United States. Pew Center on Global Climate Change. 45pp.

Roper Report. May 2001. Roper Report 2000: Lessons from the Environment. National Environmental Education Task Force.

Sheffield, R.E., S. Mostaghimi, D.H. Vaughon, E.R. Collins, V.G. Allen. 1997. Off-stream water sources for grazing cattle as a stream bank stabilization and water quality BMP. American Society of Agricultural Engineers. 40: 595-604.

Sills, R. ed. 1992. Mercury in Michigan's Environment: Causes and Extent of the Problem. Michigan Department of Natural Resources, Surface Water Quality Division.

Skillings, D.M. 1982. Report on groundwater contamination in Mancelona and Cold Springs Township, Michigan. Michigan Geological Survey Division OFR 82-3. Lansing, Michigan: Michigan Geological Survey Division.

Shuey, J.A., C.A. Harris, and G.M. DeGraeve. 1992. Final Report for the Grand Traverse Bay Watershed Initiative: Part II, Water Quality of the Bay and Tributaries. Great Lakes Environmental Center, Traverse City, MI. (Note: The Grand Traverse Bay Watershed Initiative is now known as The Watershed Center Grand Traverse Bay.)

State of the Bay 2000. Published by: The Watershed Center Grand Traverse Bay.

State of the Bay 2000 CD Resource Guide. Published by: The Watershed Center Grand Traverse Bay.

Suvedi, Murari, Phillip Davis, Gary Taylor, Erin Hogarth. November 2002. Growth Pressures Emphasize Need for Better Information and Access to Planning Tools for Local Officials. Newsletter from the Victor Institute for Responsible Land Development and Use. Michigan State University Extension.

Suvedi, Murari, Phillip Davis, Gary Taylor, Erin Hogarth. December 2002. Township Officials Recognize Need for Better Information and Access to Planning Tools. Newsletter from the Victor Institute for Responsible Land Development and Use. Michigan State University Extension.

Waters. 1995. Sediment in Streams: Sources, Biological Effects, and Control. American Fisheries Society.

Wolf, Jennifer. Marketing Your Message: Implementing Effective Information & Education. Huron River Watershed Council (HRWC).