Thunder Bay River Watershed Initiative
PHASE TWO

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DEQ
Michigan's
Nonpoint Source
Program

NEMCOG

Prepared by:
Northeast Michigan Council of Governments
P.O. Box 457
Gaylord, MI 49734

THUNDER BAY RIVER WATERSHED INITIATIVE: PHASE TWO

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PROJECT PARTNERS

STEERING COMMITTEE

Public input is a critical component in the development of a management plan. Involvement in the planning process by stakeholders promotes ownership of the overall project as well as long-term commitment with project implementation.

In order to provide public input and encourage stakeholder commitment, a steering committee was established to help guide the watershed project. Participants involved in the planning process included representatives from city, township, and county governments, road commissions, community action groups, conservation groups, industry, businesses and landowners. Representatives from governmental agencies such as the US F&WS, NRCS, DNR, DEQ, Huron Pines RC&D, and the Alpena, Alcona, Presque Isle and Montmorency County Conservation Districts were also active participants on the steering committee.

The steering committee's commitment was fundamental to the creation of the watershed plan. Committee members provided input and guidance to the overall project, and many were actively involved in gathering inventory data. Committee members generously donated their time and technical expertise, and provided canoes, kayaks, and other equipment for use in conducting the inventories, as well. Steering committee members reviewed the results of the inventories and prioritized the pollutants, sources and causes. They were also instrumental in drafting the goals and objectives for the Thunder Bay River Watershed Initiative, Phase Two, and provided recommendations for the overall protection of the watershed.

TECHNICAL COMMITTEE

A sub-committee was formed to address technical aspects in the development of a nonpoint source pollution plan. The technical committee's experience with field inventories and knowledge of Best Management Practices (BMPs) for identified sites of concern were necessary to the formulation of the watershed plan. Organizations providing technical assistance included:

Conservation Districts/ USDA-NRCS
Responsibilities:

- Assist in organization and provide input and direction at meetings
- Assist in development and dissemination of newsletters and informational materials.
- Conduct Agriculture Site Inventory of critical area
- Participate in Streambank Inventory of tributaries in critical area
- Provide summary of inventories. Include sections on: purpose and importance of inventory, tables summarizing results, description of methods used in data collection including any formulas used in calculations, results, recommendations and BMP's for site improvement

Huron Pines RC&D Council
Responsibilities:

- Assist in organization and provide input and direction at meetings
- Assist in development and dissemination of newsletters and informational materials.
- Conduct Shoreline Inventory of critical area
- Provide technical assistance and equipment (such as kayak) for inventories
- Provide summary of shoreline inventory, describe purpose and importance of inventory, develop tables summarizing results, describe of methods and any formulas used in data collection, make recommendations for site improvement, and provide maps indicating sites inventoried.

NEMCOG
Responsibilities:

- Administered watershed plan
- Organized steering committee meetings, sent out meeting notices and agendas
- Developed/disseminated informational materials
- Provided information/gathered input at township, county and area organization meetings
- Conducted public meetings on draft plan to gather input and provide information
- Conducted Road/Stream Crossing Inventory of critical area
- Drafted results of inventory. Included sections on: purpose and importance of inventory, tables summarizing results, description of methods used in data collection including any formulas used in calculations, results, recommendations and BMP's, and a map indicating sites inventoried.
- Compiled watershed information, drafted final watershed plan
- Compiled zoning and ordinance information for watershed
- Developed maps necessary to complete critical area inventory

Thunder Bay Power Company
Responsibilities:

- Provided technical assistance and information with the streambank inventory

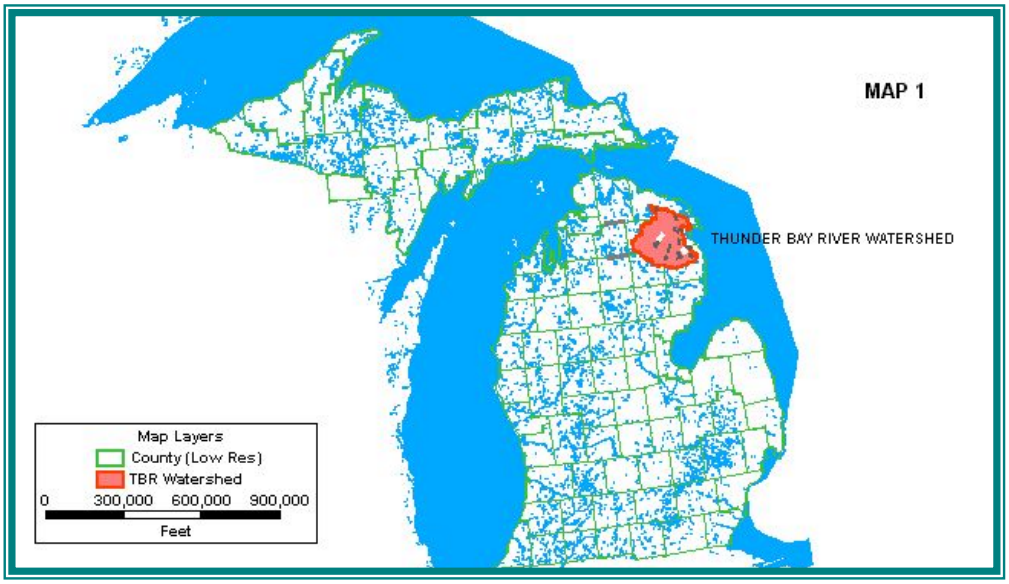
PUBLIC PARTICIPATION

Semi-annual meetings were held during the planning phase. All meetings were open to the public and announcements in local papers and individual mailings were sent to publicize the meetings. Additional meetings were scheduled as deemed necessary by the steering committee. Committee members provided input on various issues concerning the Thunder Bay River system and guided overall project direction. A tour of points of interest within the watershed was conducted for steering committee members, and the technical committee provided information on the various sites visited. Informational presentations on the development of the plan and inventory results were held for local governments, Conservation Districts, Hubbard Lake Sportsmen & Improvement Association, Thunder Bay Power, and other interested groups. Several steering committee members volunteered their time and equipment to assist the technical committee in the inventory process.

A public meeting was held at the end of the two-year planning phase to review and finalize completion of the draft plan. The meeting was publicized locally and members of the community were encouraged to attend. Copies of the draft plan were distributed to attendees and an overview of the plan and the various inventories was presented. An open discussion followed the presentation, providing committee members and the general public an opportunity to comment on the results of the draft plan. Meeting attendees were also invited to study the draft plan at home, and direct any additional comments to the watershed coordinator at a later date.

CHAPTER ONE:
INTRODUCTION TO THE THUNDER BAY RIVER WATERSHED, PHASE TWO

OVERVIEW



The Thunder Bay River Watershed is a vast river system well known for its high water quality and aesthetically pleasing scenery. Located in northeastern Michigan, the Watershed covers two-thirds of Montmorency and Alpena Counties, one third of Alcona County and small portions of Presque Isle County and Oscoda County. The total watershed (see **Map 1)** encompasses approximately 1,200 square miles (768,000 acres) and drains into Lake Huron's Thunder Bay.

Due to the difficulties encountered in developing a manageable non-point source pollution plan for a watershed of this size, the Thunder Bay River Watershed was divided into sub-watersheds (Phase One and Phase Two), based on drainage patterns of the water bodies. Approved in September 2002, Phase One includes the Main Branch of the Thunder Bay River, which flows from its headwaters west of Atlanta through the City of Alpena to its discharge into Lake Huron.

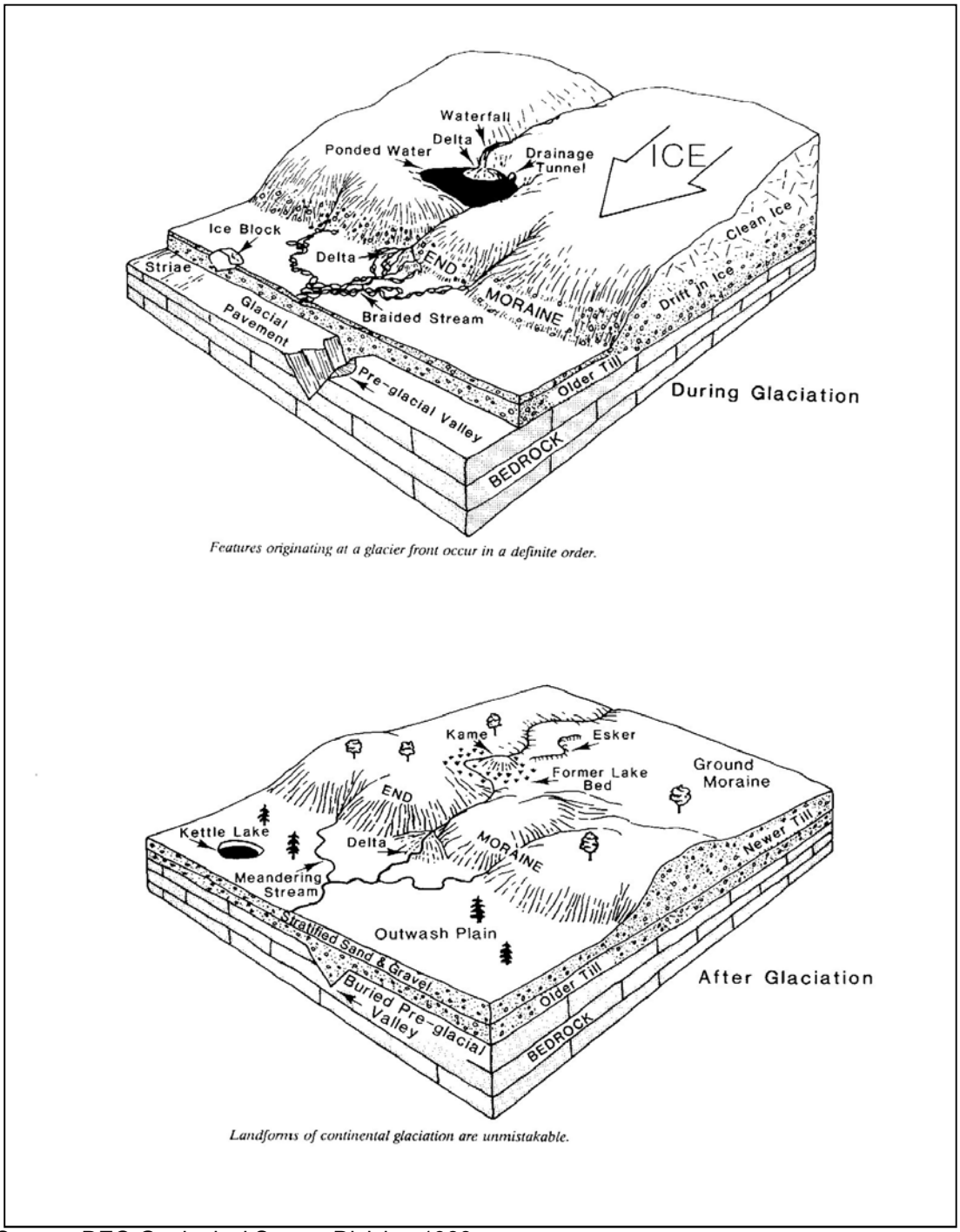
The current watershed plan, Thunder Bay River Watershed Initiative (TBRWI), Phase Two, includes the North Branch, Upper South Branch and Lower South Branch of the Thunder Bay River (see **Map 2**). Tributaries of these water bodies include Quinn Creek, Webber Creek, Cole Creek, Pike Creek, Beaver Creek, McGinn Creek, Silver Creek, Wildcat Creek, Wolf Creek, King Creek, Comstock Creek, Holcomb Creek and Sucker Creek. The two largest lakes in the watershed are Fletcher Pond and Hubbard Lake, which have surface areas of 7,000 acres and 9,280 acres respectively. Water resources include ninety-five lakes with areas greater than 5 acres, and a network of nearly 900 river miles. The Phase Two watershed encompasses nearly 800 square miles (505,412 acres), with the majority of the watershed located in Alpena and Alcona Counties.

Map 2: Thunder Bay Watershed Initiative, Phase Two

GEOLOGY

The Thunder Bay River Watershed's surface geology is a result of the advancing and retreating of glaciers prevalent thousands of years ago. Four geologic features can be used to describe the surface geology of the watershed; *moraines*, *till plains*, *outwash plains* and *lacustrine plains.*

Figure 1: Glacial Landforms



Source: DEQ Geological Survey Division 1988

Moraines are shaped like hilly ridges and were formed by the deposition of unsorted sand, gravel, rock and clay at the margins of the glacier. *Till plains* were also formed from ice deposition; they are the

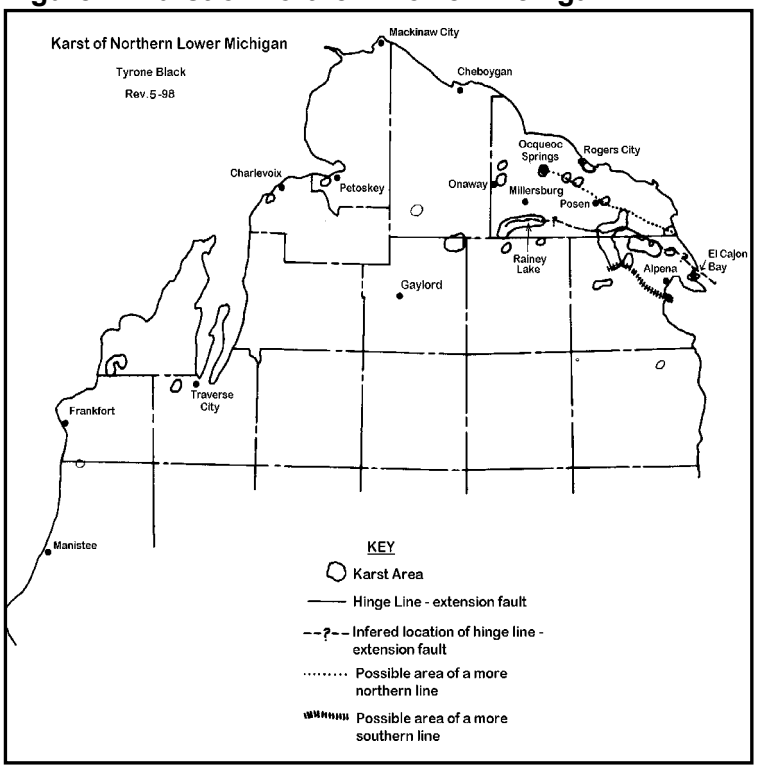
level areas between moraines consisting of unsorted sand, gravel, rock, and clay. *Outwash* and *lacustrine plains* are water-laid deposits from the melting glacier. Found primarily in the northern half of Montmorency County, outwash plains are stratified deposits of sand, gravel, silt, and clay. Lacustrine plains are stratified deposits consisting of silt, clay and fine sediments on drained glacial and post-glacial lakes. Coarse-textured glacial till is the dominant surface geology type found throughout the watershed.

Map 3 shows that the North Branch area is characterized primarily by coarse-textured glacial till with pockets of glacial outwash sand and gravel, as well as areas with *peat and muck*. Peat and muck are both comprised of organic soil material, with muck containing more minerals than peat. In peat, the original plant parts are recognizable, but are indistinguishable in muck.

Other geological features of this portion of the watershed include *drumlins* and *eskers.* Drumlins are low, smooth, spoon-shaped hills or mounds of compacted till. The tail of a drumlin always runs parallel to the glacier flow, so that all the drumlins in a field are oriented in the same direction. An esker is a long, narrow, sinuous, steep-sided ridge composed of irregularly stratified sand and gravel. **Figure 1** shows examples of some of the glacial landforms found in the watershed.

The North Branch area also features several *sinkholes*—an indicator of *karst* terrain. Karst terrain is a result of the interaction between glaciers and limestone bedrock. During periods of glaciation, the massive weight of the glaciers depressed the existing limestone bedrock. When the glaciers melted, the limestone rebounded and cracked. Groundwater moved through the cracks, enlarging the fissures and forming caverns and domes underground. As the domes grew larger, the weight of the overlying glacial drift caused the structures to collapse, forming deep circular depressions called sinkholes. New sinkholes are constantly being formed, taking several decades to appear on the surface.

Figure 2: Karst of Northern Lower Michigan



Map 3 Geology

The Upper South Branch area of the watershed also exhibits coarse-textured glacial till along with glacial and ice-contact outwash sand and gravel. The southernmost portion features end moraines consisting of fine to course textured till which separate the Thunder Bay River Watershed from the AuSable River Watershed.

The Lower South Branch portion of the watershed is predominately coarse-textured glacial till with a small pocket of fine textured till and ice-contact outwash sand and gravel. South of Lake Winyah there are several drumlins. A large esker, which runs north and south, separates lands draining into the Lower South Branch from lands draining into the Main Branch.

The repeated advance and withdraw of glaciers scoured out valleys, and the receding ice flows left vast deposits of eroded bedrock and debris. Except where bedrock is exposed, this glacial debris is susceptible to streambank and shoreline erosion.

SOILS

Soils information is important in the determination of types and intensity of land uses. The nature of the soils and the slope of the land within the drainage basin affect water quality of a river system. These factors determine potential land use, soil infiltration rates, water-holding capacity and soil erodibility and therefore are directly related to the amount of nonpoint source pollution. The construction of roads, buildings, and septic systems on steeply sloped areas or areas with organic and hydric soils require special design considerations. If developed improperly the impacts to natural resources, particularly water quality, can be far-reaching.

The Natural Resource Conservation Service completed a detailed soil survey of Presque Isle, Montmorency, Alpena, and Alcona Counties (detailed soil maps for Oscoda County are not available yet). Digital or computerized versions of the soil survey maps were acquired from the Michigan Department of Natural Resources, MIRIS program. Using information contained within the published soil survey books, a series of maps were developed that depict lands with hydric soils, areas of slopes 15 percent or greater, and soils with septic system limitations.

Hydric Soils

Map 4 is a color thematic map that depicts hydric soils and soils on steep slopes. Lower density and less intensive development should be directed to these areas with severe building constraints. Hydric soils are saturated, flooded or ponded during part or all of the growing season and are classified as poorly drained and very poorly drained. Hydric soils have poor potential for building site development and sanitary facilities. Wetness and frequent ponding are severe problems that are difficult and costly

to overcome. Sites with high water tables may be classified as wetlands and a wetlands permit may be required to develop these areas.

Hydric soils cover large tracts of the Thunder Bay River Watershed. Found in the areas around Rush Lake (Montmorency County), Fletcher Pond (Montmorency and Alpena Counties), Beaver Lake (Alpena County), and Hubbard Lake (Alcona County), hydric soils also cover areas along the North Branch (near its discharge point at Lake Winyah) as well as in lands adjacent to the many creeks found in the southern portion of the watershed.

Steeply Sloped Areas

Hills and steeply rolling terrain may provide opportunities for spectacular views of the landscape. However, steeply sloped sites have severe building constraints and are more difficult to develop. Maintenance costs also tend to be higher on steeply sloped terrain. Special design standards such as erosion control measures, limiting size of disturbed areas, retaining natural vegetation, re-vegetation, slope stabilization and onsite retention of water runoff from impervious surfaces would all serve to minimize resource impacts.

Areas with steep banks, those with a slope greater than 15%, can be found throughout the watershed. As shown on **Map 4**, the most prominent areas can be found in the southern portion of the watershed and near Hubbard Lake. Steep slopes can also be found around Ess Lake and Long Lake in Montmorency County, and south of Fletcher Pond.

Septic Limitations

As shown on **Map 5**[*], the Thunder Bay River Watershed is highly susceptible to septic limitations, with much of its soils exhibiting multiple types of constraints. In order to produce a more readable map, only the most severe threat to water quality in each case was depicted. These threats were classified as *large stones*, *percolates slowly*, *poor filter*, *slope*, *wetness*, and *bedrock close to the surface*. Since they do not absorb septic effluent efficiently, sand, gravel, and fractured bedrock close to the septic field are considered poor filters. This is a problem when the water table is close to the surface or when high-density development occurs. Soils that are hydric, or subject to wetness or ponding are also ill-suited for septic absorption fields due to their excessively slow absorption rate. The presence of conditions such as these increase the watershed's vulnerability to ground water contamination. In many cases, the effect of poor conditions can be diminished with the proper installation of the septic system. For instance, soils subject to slow absorption rates can be made more effective if fill material is used to raise the absorption field above the water table, or if a subsurface drainage system is installed to lower the water table. In the case of poorly filtering soils, alternatives include the application of fill material to the site, and/or the enlargement of the absorption field.

[*] Information shown on **Map 5** indicates the dominant soil type and does not eliminate the need for onsite inspection.

Map 4: Soil Constraints

Map 5: Septic Constraints

HYDROLOGY

Hydrology and flow regime of a river system can be dependent upon the nature of the soils and sub-soils. For the most part, the Thunder Bay River Watershed, Phase Two exhibits relatively stable flow due to the occurrence of groundwater fed streams. The temperature variation of a river that is groundwater fed is moderated throughout the year by the influx of the relatively constant temperature of groundwater. This is important during the summer months when drastic temperature changes can degrade the water quality and harm fish and other aquatic species.

The Lower South and the Upper South Branch of the Thunder Bay River exhibit stream flow moderation by being predominately groundwater-fed streams. In contrast, the North Branch is more subject to drought and evaporation effects resulting in greater stream-flow variability.

Land use also affects the hydrology of the river system. With increasing impervious surfaces and the loss of vegetative buffers, surface runoff enters the river at a faster rate thus increasing the flow of the river. Fortunately, the majority of the watershed still maintains a generous amount of riparian vegetation slowing the amount of runoff and regulating temperature by providing adequate shade.

There are numerous dams throughout the watershed that help control flow of the river. Many of these are small lake level control dams scattered throughout the headwaters. Even though these structures do not significantly alter the flow of the river, the shallow impoundments that are created can increase the overall temperature of the river system.

HYDROELECTRIC DAMS

There are six hydroelectric dams located within the Thunder Bay River Basin, capable of providing a total of 7,216 kilowatts of hydroelectric energy. Two of these dams are located within the TBRWI, Phase Two.

Located on the Upper South Branch of the Thunder Bay River, the Upper South Dam created an impoundment known as Fletcher Pond, which has a total surface water area of 7,000 acres. Historically the original riverbed encompassed only 48 acres of wet area prior to the installation of the dam. Fletcher Pond is 8 miles long with a maximum width of 2.5 miles and a maximum depth of 15 to 18 feet. Base flow for the dam was 19 cfs in September.

The Hubbard Lake Dam is located at the northern most portion of the 9,280-acre Hubbard Lake. The lake is approximately 7 miles long, has a maximum width of 2.5 miles, and a maximum depth of 90 feet. Hubbard Lake is a deep, glacial, natural groundwater (cold water) seepage lake. If the dam were removed the lake levels would drop 6 feet and expose 800 acres of land currently underwater. Base flow for the Hubbard Lake Dam was 30 cfs in September.

Information for calculating base flow, drought flow and flow volume from the Hubbard Lake Dam and Fletcher Pond Dam will be available from Thunder Bay Power Company in December 2005.

The two dams in the TBRWI, Phase Two are both used for seasonal storage and as flood control, storing water during high-flow events and releasing additional water during low inflow periods. Based on the demand for electricity, these dams regulate how

much flow is passed through the turbines to the rivers below. Both dams are owned and operated by Thunder Bay Power Company.

LAND USES

Past

Prior to the 1700s northeast Michigan was covered by virgin timber stands, pristine waterbodies and provided a haven for wildlife. However, the influx of settlers began to put more burdens upon the natural resources of the area.

By the 1850's, European settlement displaced the native population to areas near Hubbard Lake and Mikado during which time the Alpena area became the center for fur trade, logging, and fishing. Timber was harvested without controls and the Thunder Bay River and its larger tributaries were used as a means of transporting the trees. At one point there were over a dozen mills located along the Thunder Bay River near Alpena. However, by the late 1800's the timber supply within the watershed had been depleted. Many landscape changes still evident today occurred as a result of the timber harvesting operations. It was also during this time that settlers realized the existence of rich farming lands located on the North Branch and areas south of Alpena.

Present

Characteristics of the TBRWI, Phase Two vary greatly. The watershed exhibits a mix of forests, wetlands, open spaces, agriculture and developed areas. Even though the watershed still maintains the rural characteristics of the past, distinct land use changes have occurred in the past 100 years, which can be seen throughout the region. In contrast to Phase One, very little public land is located in this portion of the watershed.

The North Branch of the Thunder Bay River flows from Rush Lake in northern Montmorency County in a predominantly easterly direction through southern Presque Isle County and discharges into Lake Winyah located in Alpena County. The upper reaches of the river are dominated by upland forests with pockets of residential development concentrated on local lakes. As the river flows through eastern Montmorency Township there is a dramatic increase in agriculture activities, particularly livestock operations, which continues throughout Presque Isle County. As the river nears its discharge into Lake Winyah there is an increase in wetlands mixed with agriculture and residential developments. Much of the North Branch area is characterized by karst topography. Karst is formed when limestone, dolomite, or gypsum dissolves and creates sinkholes, caves, and underground caverns. Karst areas are very susceptible to pollution as they can serve as a direct conduit for surface runoff to contaminate ground water aquifers.

The Upper South Branch of the Thunder Bay River originates in northern Oscoda County and flows northward through Fletcher Pond to its confluence with the Thunder Bay River east of the Village of Hillman. Upland forests dominate the headwaters of the river and most of the land is held by large private hunt clubs. The largest private holding is the Turtle Lake Club, which owns over 24,000 acres (38 square miles) of land in Alpena, Montmorency and Oscoda Counties. Typically, these large hunt clubs preserve open space and are managed to improve wildlife habitat for game and non-game species including the white tail deer, roughed grouse, woodcock, turkey, bear, loon, eagle, coyote, bobcat, and various fish species.

The Lower South Branch of the Thunder Bay River originates from Hubbard Lake in Alcona County and flows in a northern direction through Alpena County to its discharge in Lake Winyah. As the river flows through Alpena County the presence of agricultural activities increase, particularly in eastern Ossineke

and Wilson Townships. As the river approaches its confluence with Lake Winyah the landscape exhibits an increase in wetland traits. The largest concentration of population within the Phase Two Watershed is in the area around Hubbard Lake and Lost Lake Woods.

Future

Even though the watershed still exhibits rural characteristics, large-parcel land division and farmland fragmentation is anticipated as development and population increases. Each county within the watershed has exhibited increases in both population and total housing units for the past 3 decades and this trend is expected to continue. As in the past, the construction of these seasonal and year-around homes are likely to be concentrated around the numerous lakes and rivers of the watershed.

In addition, northeast Michigan has become a popular year-round vacation destination, a trend that shows no signs of slowing down. It is estimated that over 75 million tourism dollars were spent in the watershed in 1996*. Many of these visitors eventually establish permanent residency in the area. Along with bringing valuable tourist revenue to the region, this influx of vacationers, combined with a growing permanent population, continue to put increased stress on the area's natural resources.

RECREATION

Recreational activities within the Thunder Bay River Watershed contribute greatly to the local economies and are enjoyed by both seasonal and year-round residents. There are 34 recreational sites located within the Phase Two portion of the watershed, with numerous additional recreational opportunities located nearby. Of the 34 recreation sites found in the watershed, 14 are privately owned and operated, while the remaining 20 sites are publicly owned by the state, county or township (see **Table 1**). Outdoor activities such as fishing, hunting, hiking, wildlife viewing, boating, snowmobiling, cross country skiing, swimming, and golfing are found throughout the watershed. There are also numerous campgrounds, pavilions, ball fields, and shooting ranges in the region. Abundant wildlife can be found in the area, including many threatened and endangered species. The western half of the watershed is host to the only elk herd population in Michigan.. These outdoor recreational activities and wildlife viewing opportunities bring thousands of tourists to the area each year. Recreational opportunities in northern Michigan are inseparably linked to high water quality and the aesthetically pleasing environment of the watershed.

Table 1 shows County, Township and State-owned recreational facilities available in the watershed. In addition to those listed, there are many privately owned recreational facilities such as golf courses, parks, campgrounds, marinas in the area, many of which are open to the public.

* Data obtained from the MSU Extension Tourism Area of Expertise

Table 1: Thunder Bay River Recreational Facilities			
Township	**Name**	**Recreation Facilities**	**Ownership**
Alcona County Area Facilities			
Alcona	Hubbard Lake access site	Four boat launch/access sites	Township
Caledonia	Hubbard Lake access site	Two access sites including boat launch	Township
	Hubbard Lake access site	Boat launch, swimming and picnicking	State
	Hickey Hill	Future nature and cross country ski trails	Township
Hawes	West Branch River	Public access site	State
Mitchell	Mitchell Township Park	Swimming, picnic, outdoor pavilion, boat launch	Township
(Source: Alcona County Recreation Plan)			
Alpena County Area Facilities			
Green	Fletcher Pond Public Access Site	Boat launch, fishing, comfort station	State
Maple Ridge	Maple Ridge Township Park	Picnic, hiking trails, canoe launch, pavilion, playground	Township
Ossineke	Beaver Lake Campground/Park	Swimming, boating, fishing, boat launch/rentals, pavilion, showers, picnic, playground, concession stand	State
	Chippewa Hills Pathway	Groomed cross-country ski, hiking	State
Wilson	Thunder Bay River State Forest Campground	Campsites, picnic, canoeing, fishing, hiking	State
(Source: Alpena County Recreation Plan 2003-2007 Draft)			
Montmorency County Area Facilities			
Hillman	Ess Lake	Campsites, boating, fishing, swimming	State
Montmorency	Grass Lake	Boat launch, fishing	State
	Long Lake	Boat launch, fishing	State
	Rush Lake	Boat launch, fishing	State
(Source: Montmorency County Recreation Plan-Revised 1995)			
Oscoda County Area Facilities			
Clinton	McCollum Lake Campground	Campsite, boat launch, swimming, fishing	State
	Bass Lake Park	Swimming, fishing, picnic, shelter, bathhouse	Township
	Clinton Township Park	Basketball court, picnic, playground, ball fields, sledding, snowmobiling, cross country skiing	Township
	Steiner's Museum	Lumbering Era artifacts	County
(Source: Oscoda County Recreation Plan-Revised 1999)			
Presque Isle County Area Facilities			
Posen	Sunken Lake Campground/Park	Fishing, swimming, boating, picnic, camping, playground, ball diamond, pavilion	County
(Source: Presque Isle County Recreation Plan Draft-1995-2000)			

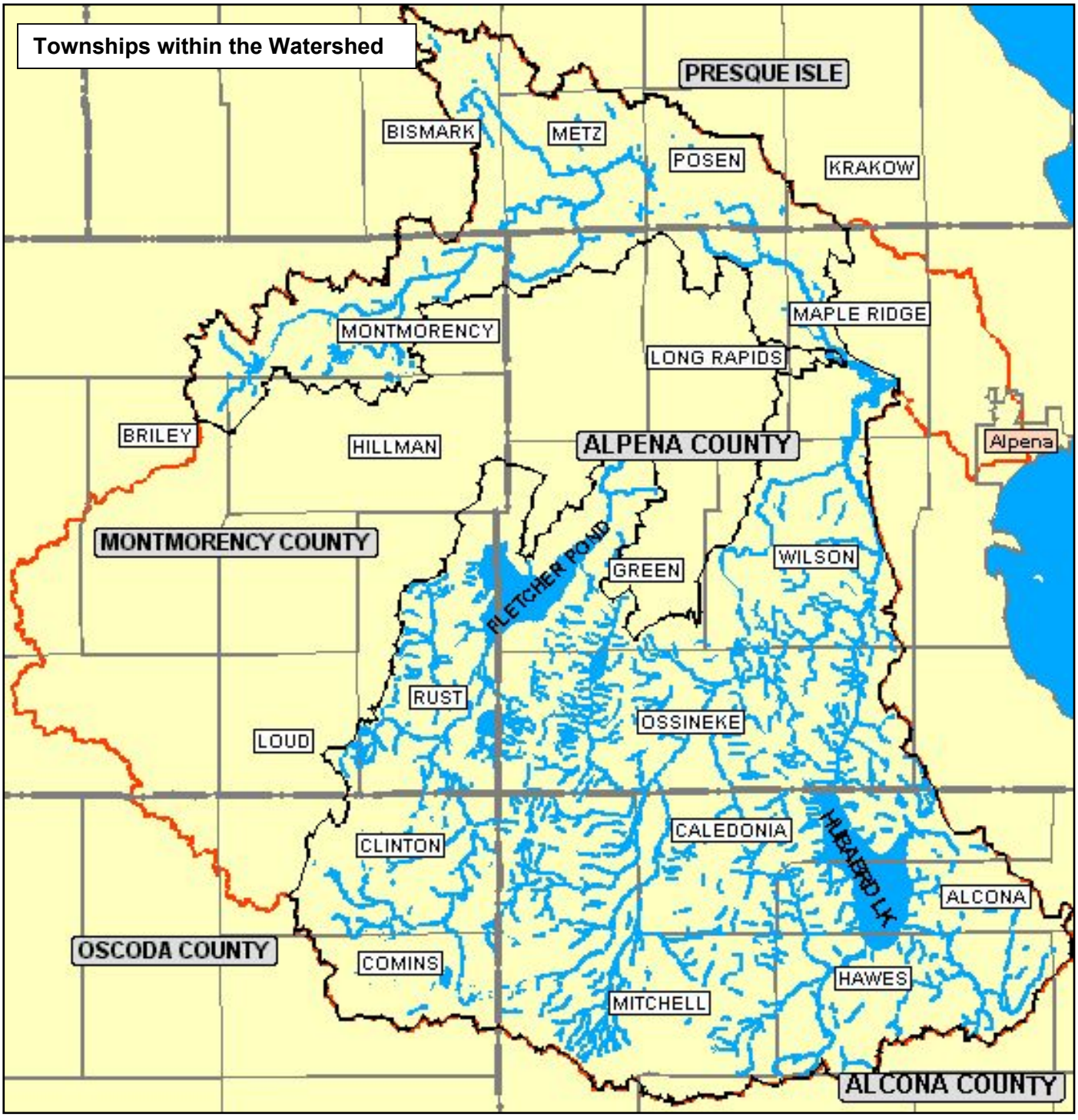
GOVERNMENTAL UNITS

Table 2 shows local units of governments located within the Phase Two watershed, zoning status, and if they have a planning commission. Planning and zoning throughout the watershed is a function of both the counties and municipalities. Alpena, Montmorency and Oscoda Counties have planning commissions, along with the municipalities of Green Township, Long Rapids Township, and Wilson Township. **Map 6** shows the various townships located within the Thunder Bay River Watershed.

Table 2: Governmental Units			
County	Township	Zoning	Planning Commission
Montmorency		No County Zoning	Yes
	Montmorency	Yes	Yes
	Briley	Yes	Yes
	Hillman	Yes	Yes
	Loud	Yes	No
	Rust	Yes	Yes
Presque Isle		Has County Zoning	Yes
	Bismark	No	No
	Belknap	No	No
	Metz	No	No
	Posen	No	No
	Krakow	No	No
Alpena		No County Zoning	Yes
	Long Rapids	Yes	Yes
	Maple Ridge	Yes	No
	Green	Yes	Yes
	Wilson	Yes	Yes
	Ossineke	Yes	Yes
	Sandborn	Yes	Yes
Alcona		No County Zoning	No
	Caledonia	Tri-Township Zoning	Yes
	Alcona		Yes
	Hawes		Yes
	Mitchell	Yes	No
	Millen	Yes	Yes
	Haynes	Yes	No
Oscoda		No County Zoning	Yes
	Clinton	Unzoned	
	Comins	Yes	Yes

With the exception of Presque Isle County, none of the counties in the watershed have zoning. Zoning exists for all townships throughout the watershed except in Clinton Township, Oscoda County which is unzoned at both the county and township level. Zoning ordinances are enforced by the municipalities' zoning administrator. Enforcement of P.A. 347 the Soil Erosion and Sedimentation Control Act, is by the County Enforcing Agent.

Map 6


Townships within the Watershed
PRESQUE ISLE
BISMARK
METZ
POSEN
KRAKOW
MONTMORENCY
MAPLE RIDGE
LONG RAPIDS
BRILEY
HILLMAN
ALPENA COUNTY
Alpena
MONTMORENCY COUNTY
FLETCHER POND
GREEN
WILSON
RUST
OSSINEKE
LOUD
CALEDONIA
CLINTON
HUBBARD LK
ALCONA
OSCODA COUNTY
COMINS
HAWES
MITCHELL
ALCONA COUNTY

AGENCIES AND ORGANIZATIONS

The following agencies and local organizations are involved with environmental programs and concerns within the watershed:

Agencies

Michigan Department of Environmental Quality
Mission Statement: The mission of the Michigan Department of Environmental Quality (DEQ) is to drive improvements in environmental quality for the protection of public health and natural resources to benefit current and future generations. This will be accomplished through effective administration of agency programs, providing for the use of innovative strategies, while helping to foster a strong and sustainable economy.

Huron Pines Resource Conservation & Development Area Council
Huron Pines RC&D Council is a non-profit, non-governmental organization serving the eleven county region of Northeast Michigan. It's goals are:

1.) Sponsor collaboration in the sustainability of renewable natural resources through orderly development and accepted conservation practices.
2.) Foster citizen appreciation through education of the need for healthy ecosystems as critical to the area's long-term social and economic stability.
3.) Improve the quality of life and economic conditions in our service area by helping to nurture land, water, mineral, and living resources as the enduring basis for desirable communities, first-rate tourism, and thriving industry.

US Department of Agriculture
Mission: Enhance the quality of life for the American people by supporting production of agriculture:

- Ensuring a safe, affordable, nutritious, and accessible food supply
- caring for agricultural, forest, and range lands
- supporting sound development of rural communities
- providing economic opportunities for farm and rural residents
- expanding global markets for agricultural and forest products and services
- working to reduce hunger in America and throughout the world.

Natural Resource Conservation Service
Mission Statement: The Natural Resources Conservation Service provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment.

Alcona, Alpena, Montmorency, Presque Isle and Oscoda Conservation Districts
Michigan's Conservation Districts are "unique" local units of State Government, that utilize state, federal and private sector resources to solve today's conservation problems. The guiding philosophy of all Conservation Districts is that decisions on conservation issues should be made at the *local level*, by *local people*, with technical assistance provided by government.

Northeast Michigan Council of Government
Mission Statement: NEMCOG is committed to facilitating the development of intergovernmental cooperation and coordination within the eight-county region of Northeast Michigan. The agency is also committed to providing for a controlled growth policy; to preserve and improve the environment, to pursue greater efficiency and responsiveness of local units of government, and to improve the ecological, social, and economic well being of citizens within the region.

District Health Department #2
Mission Statement
District Health Department #2 is a comprehensive public health agency. A dedicated professional staff provides health promotion, disease prevention, and environmental health services for all individuals in the community in order to maintain or achieve a better quality of life in the health district.

District Health Department #4
Mission Statement:
"It shall be the responsibility of this board to continually and diligently endeavor to prevent disease, prolong life, and promote the public health through organized programs including prevention and control of environmental health hazards; prevention and control of disease; prevention and control of health problems of particularly vulnerable population groups; development of health care facilities and health service delivery systems; and regulations of health care facilities and health service delivery systems to the extent provided by law"

Department of Natural Resources
Mission Statement:
"The Michigan Department of Natural Resources is committed to the conservation, protection, management, use, and enjoyment of the State natural resources for current and future generations."

Michigan State University Extension
Mission
"Michigan State University Extension (MSUE) helps people improve their lives through an educational process that applies knowledge to critical issues, needs and opportunities."

Since its beginning, Michigan Extension has focused on bringing knowledge-based educational programs to the people of the state to improve their lives and communities. Today, county-based staff members, in concert with on-campus faculty members, serve every county with programming focused on agriculture and natural resources; children, youth and families; and community and economic development.

US Fish and Wildlife Service
"The U.S. Fish and Wildlife Service's mission is, working with others, to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."

Groundwater Stewardship Program
Mission:
To provide information and assessment tools for pesticide and nitrogen fertilizer users which help them identify risks to groundwater associated with their pesticide and nitrogen fertilizer use practices and to coordinate local, state, and federal resources to help individuals reduce those risks.

Organizations

Thunder Bay Regional Audubon Society
Mission Statement:
Michigan Audubon Society is a nonprofit organization that promotes the awareness, understanding, enjoyment, and stewardship of the environment and natural resources of the upper Great Lakes region by educating the public, supporting ecological research, maintaining sanctuaries, and by taking part in appropriate advocacy to protect the environment, with emphasis on birds and their habitats.

Hubbard Lake Sportsmen & Improvement Association
"The Hubbard Lake Sportsman & Improvement Association (HLS&IA) is an organization of men and women of the Hubbard Lake who united in 1946 to improve the environment, natural resources, including fisheries and wildlife habitat of Hubbard Lake. These conditions include but are not limit to: monitor, preserve, protect, and enhance the environment, natural resources, wildlife habitat, fisheries, water quality, and natural state of Hubbard Lake and its watershed"

League of Women Voters
Mission Statement:
The League of Women Voters, a nonpartisan political organization, encourages the informed and active participation of citizens in government, works to increase understanding of major public policy issues, and influences public policy through education and advocacy.

Montmorency County Conservation Club
The focus of the Montmorency County Conservation Club is the protection and enhancement of the natural environment through conservation projects such as habitat enhancement, river restoration, and youth conservation education. The club does not maintain a club house and carries no overhead, so all funds raised by the group is cycled back into conservation projects.

Friends of Northeast Michigan Ecosystems
The function of the Friends of Northeast Michigan Ecosystems is to "promote and work for conservation issues in Northeast Michigan and throughout Michigan, and to encourage wise conservation practices of our air, water, forests and wildlife, so we can enjoy the out-of-doors now and to preserve this legacy for future generations."

Northeast Michigan Recycling Alliance Authority

Thunder Bay River Watershed Council
The purpose of the Thunder Bay River Watershed Council is to protect the water quality and quantity necessary for the fisheries, wildlife, recreational uses, aesthetic enjoyment and general enhancement of the environment. The function of the organization is to conduct studies, establish goals and initiate projects and efforts toward developing a viable fishery, to improve or maintain the water quality and aesthetic appearance of the river, to provide education about the river, to coordinate efforts of interested groups throughout the watershed area and to serve in an advisory capacity to other organizations involving the river.

Thunder Bay River Restoration Committee

Thunder Bay Power

Fletcher Pond Improvement Association
Mission Statement:
The mission of the Fletcher Pond Improvement Association is to address invasive species and environmental problems, and to create a lake management plan to preserve, protect and share the recreational wonder that's Fletcher Pond.

DEMOGRAPHICS

Even though the area is primarily rural, there has been a steady increase in second family and retirement homes. Cottages and summer homes, historically used as vacation retreats, are also being converted into year-round residences as retirees are establishing permanent residency in the area. Many of the homes being built or updated are located along river corridors and on lake shores.

The majority of the year-round and seasonal population in the watershed resides in and around Hubbard Lake and Lost Lake Woods (both in Alcona County), and Long Lake and Ess Lake (both in Montmorency County). A Review of census data for the past one hundred years indicates that overall the population has steadily increased throughout the watershed, despite periods of population loss. Not surprisingly, census data for the year 2000 indicates that Alpena, with a population of 31,314, is the most populous county in the watershed, followed by Presque Isle (14,411) Alcona (11,719), Montmorency (10,315) and Oscoda (9,418). **Table 3** and **Table 4** show population changes for all five counties in ten-year increments beginning in 1900 through the year 2000.

Alcona County

Table 3 shows that Alcona County has had a steady increase in population over the past 100 years, with a slight decline between 1930 and 1940 which can be attributed to men leaving for World War II. Between the years of 1980 and 1990, increases of over 10% in total *housing units*[*] (**Table 4**) and nearly 15% of *households** (**Table 6**) were seen. During this same period, the county's total population increased by only 4.2%. This correlates to a trend seen across the nation of fewer people residing in each household. The number of seasonal homes in Alcona County doubled during the same decade, from 2,782 to 5,605 (see **Table 5**), far outpacing the increases of total households and the total population. This is an indication of Alcona County's role as a popular destination for seasonal home buyers. Many of these summer homes are located along Lake Huron, Hubbard Lake and other local lakes and rivers.

Table 3: Population Trends for Alcona and Alpena Counties 1900-2000

Year	Alcona		Alpena	
	Population	% Change	Population	% Change
1900	5,691		18,254	
1910	5,703	+.2%	19,965	+9.4%
1920	5,912	+3.7%	17,869	-10.5%
1930	4,989	-15.6%	18,574	+3.9%
1940	5,463	+9.5%	20,766	+11.8%
1950	5,856	+7.2%	22,189	+6.9%
1960	6,352	+8.5%	28,556	+28.7%
1970	7,113	+11.9%	30,708	+7.5%
1980	9,740	+36.9%	32,315	+5.2%
1990	10,145	+4.2%	30,605	-5.3%
2000	11,719	+15.5%	31,314	+2.3%
1900-2000	+105.9%		+71.5%	
Source: U.S. Bureau of the Census				

[*] The term *housing units* indicates a count of physical residential living structures (whether occupied or not); the term *households* indicates a count of occupied housing units

Alpena County

Data found in **Tables 3** and **4** show that while Alpena County lost 3.1 percent of its population between 1980 and 2000, the number of housing units increased by 9.1 percent. The number of seasonal housing units rose between 1980 and 1990, but declined by the year 2000 to 10.8 percent of the county's total housing units (see **Table 5**). This indicates that a portion of the county's seasonal housing stock is being converted to year round housing as seasonal residents retire and move to the area on a permanent basis. Data further show that the number of households in Alpena County increased by 14.5 percent between 1980 and 2000 (see **Table 6**). Although the number of households has increased in Alpena County, the population has remained fairly stable, indicating that there are fewer people residing in each household. The number of persons per household declined from 2.86 persons per household in 1980 to 2.40 in 2000. This tendency to decreasing household sizes has been found throughout the country in recent decades. It is a reflection of the changing American family life, with adult children setting up their own households, divorced families setting up two separate households, extended families living apart, and the trend in northern Michigan of the elderly population moving into the area.

Table 4: Total Housing Units for Alcona and Alpena Counties 1980-2000

Year	Alcona		Alpena	
	Total Housing Units	% Change	Total Housing Units	% Change
1980	9,376		13,977	
1990	10,414	+11.1%	14,431	+3.2%
2000	10,584	+1.6%	15,289	+5.9%
Source: U.S. Bureau of the Census				

Table 5: Seasonal Housing Units for Alcona and Alpena Counties 1980-2000

Year	Alcona		Alpena	
	Total Seasonal Housing Units	Percent of Total Housing Units	Total Seasonal Housing Units	Percent of Total Housing Units
1980	2,782	29.6%	1,506	10.8%
1990	5,605	53.8%	1,810	12.5%
2000	5,067	47.9%	1,658	10.8%
Source: U.S. Bureau of the Census				

Table 6: Households and Persons Per Household for Alcona and Alpena Counties 1980-2000

Year	Alcona			Alpena		
	Total Households	Percent Change	Persons Per Household	Total Households	Percent Change	Persons Per Household
1980	3,715		2.60	11,151		2.86
1990	4,261	+14.7%	2.35	11,838	+6.2%	2.56
2000	5,132	+20.4%	2.24	12,818	+8.3%	2.40
Source: U.S. Bureau of the Census						

Montmorency County

Montmorency County's demographics show both similarities and differences from those found in Alpena County. The biggest difference is that Montmorency County's population has been growing very rapidly over the last few decades (see **Table 7**). From 1980 to 2000, for example, the county's population increased by 37.8 percent. While this is a large population increase, Montmorency County is still a very rural area, with a population base that is one-third the size of Alpena County. As shown in **Table 8**, the number of housing units constructed in Montmorency County also increased by 17.1 percent over the last 20 years. The housing unit increase did not exceed that of the population growth, as was found in Alpena County. The explanation for this can be found in the seasonal housing data. **Table 9** shows that a great deal of the county's housing stock are seasonal in nature. For example, in 1990 over one-half of the county's total housing stock was classified as seasonal. By the year 2000, however, that percentage had dropped to 47.5 percent. This figure shows that, as seen in Alpena County, many retired individuals have moved into Montmorency County on a permanent basis, converting their seasonal homes into year-round residences. In another similarity to Alpena County, Montmorency County recorded a large increase (over 58%) in the number of households, but a decrease in size from 2.66 to 2.29 persons per household between 1980 to 2000 (see **Table 10**). The increase in the number of households (even larger than the county's population increase for that period) and its decreasing household size are trends reflected in many other parts of the country.

Table 7: Population Trends for Montmorency, Oscoda, and Presque Isle Counties 1900-2000

Year	Montmorency		Oscoda		Presque Isle	
	Population	% Change	Population	% Change	Population	% Change
1900	3,234		1,468		8,821	
1910	3,755	+16.1%	2,027	+38.1%	11,249	+27.5%
1920	4,089	+8.9%	1,783	-12.0%	12,131	+7.8%
1930	2,814	-31.2%	1,728	-3.1%	11,330	-6.6%
1940	3,840	+36.5%	2,543	+47.2%	12,250	+8.1%
1950	4,125	+7.4%	3,134	+23.2%	11,996	-2.1%
1960	4,424	+7.2%	3,447	+9.9%	13,117	+9.3%
1970	5,247	+18.6%	4,726	+37.1%	12,836	-2.1%
1980	7,492	+42.8%	6,858	+45.1%	14,267	+11.2%
1990	8,936	+19.6%	7,842	+14.4%	13,743	-3.7%
2000	10,315	+15.4%	9,418	+20.1%	14,411	+4.9%
1900-2000		+219%	+541.6%		+75.3%	
Source: U.S. Bureau of the Census						

Oscoda County

Table 7 indicates Oscoda County has the lowest population when compared to Alpena, Alcona, and Montmorency Counties. Nonetheless, since 1940 Oscoda County has exhibited the highest and most steady increase in population of all the counties in the watershed. There has also been a greater increase in seasonal housing in Oscoda County than in the other four, with Montmorency County a close second (see **Table 9**). Oscoda County exhibits the same incidence of a gradual decrease in persons per household between 1980 and 1990 that all five counties have shown.

Table 8: Total Housing Units for Montmorency, Oscoda, and Presque Isle Counties 1980-2000

Year	Montmorency		Oscoda		Presque Isle	
	Total Housing Units	% Change	Total Housing Units	% Change	Total Housing Units	% Change
1980	7,886		7,308		8,361	
1990	8,791	+11.5%	8,112	+11.0%	8,917	+6.7%
2000	9,238	+5.1%	8,690	+7.1%	9,910	+11.1%
Source: U.S. Bureau of the Census						

Table 9: Seasonal Housing Units for Montmorency, Oscoda, and Presque Isle Counties 1980-2000

Year	Montmorency		Oscoda		Presque Isle	
	Seasonal Housing Units	% of Total Housing Units	Seasonal Housing Units	% of Total Housing Units	Seasonal Housing Units	% of Total Housing Units
1980	2,927	37.1%	2,648	36.2%	2,550	30.5%
1990	4,873	55.4%	4,520	55.7%	3,044	34.1%
2000	4,390	47.5%	4,174	48.0%	3,278	33.1%
Source: U.S. Bureau of the Census						

Presque Isle County

Presque Isle County and Alpena County have the two highest populations in the watershed (see **Tables 3 and 7**). However, of the five counties in the watershed, they are the only two that had a population decrease between 1980 and 1990 (-3.7 and –5.3 respectively). Presque Isle County has had more years showing decreases than any of the other counties, and though the county has seen growth increases during several decades, these increases have not been as dramatic as those experienced by the rest of the watershed. Presque Isle has the highest increase in total housing units between 1990 and 2000 than any other county, with an increase of 11.1 percent (**Table 8**), and 28.5 percent increase in housing between 1980 and 2000. This significant jump in housing units, combined with the weak population figures, is indicative of the continuing trend of cottages, hunting cabins and summer homes being built by non-permanent residents within the county.

Table 10: Households and Persons Per Household for Montmorency, Oscoda, and Presque Isle Counties 1980-2000

Year	Montmorency			Oscoda			Presque Isle		
	Total Households	Percent Change	PPH*	Total Households	Percent Change	PPH	Total Households	Percent Change	PPH
1980	2,814		2.66	2,517		2.68	5,008		2.82
1990	3,600	+27.9%	2.45	3,160	+25.5%	2.45	5,376	+7.4	3
2000	4,455	+23.8%	2.29	3,921	+24.1%	2.39	6,155	+14.5%	2.31
Source: U.S. Bureau of the Census									

*Persons Per Household

CHAPTER TWO: LAND USE AND WATER QUALITY

INTRODUCTION

Phase Two of the Thunder Bay River Watershed Initiative (TBRWI) contains over 16,000 acres of surface water in its lakes, in addition to hundreds of miles of rivers, streams and tributaries. The quality of these important waterbodies becomes increasingly at risk as development of natural areas continues and forested lands are converted to commercial and residential parcels. As these and other land use changes continue to take place, the associated pollution impacts to lakes, streams and rivers increase. During periods of high runoff (rainstorms, snowmelts, etc.) contaminants such as fertilizers, sediments, nutrients, oil, grease, road salt and toxic chemicals are flushed from streets, parking lots, yards and agricultural lands. The pollutant-laden water can either move overland to the nearest lake, stream or wetland or percolate through the soil into the groundwater. Storm sewers and drains, which increase with development, provide an even more direct route for runoff to reach the water resources.

Numerous water quality studies have been conducted within the Thunder Bay River Watershed that contain information specific to the North, Upper South and Lower South Branches of the Thunder Bay River. Although pollutants such as sediment from eroding streambanks and road/stream crossings have been identified, Phase Two of the TBRWI presently exhibits a *Good to Excellent* water quality rating. With the ever-increasing demands development puts on water resources, however, great care will need to be taken to ensure continued high water quality for the future.

DESIGNATED USES OF THE THUNDER BAY RIVER

Designated uses are those activities which are dependent on good water quality. Part 31 (formerly known as the Water Resources Commission Act) of the Natural Resources and Environmental Protection Act, P.A. 451 of 1994, as amended requires all waters of the State of Michigan to be of the quality to meet seven designated uses:

1.) Agriculture
2.) Industrial water supply
3.) Public water supply at the point of intake
4.) Navigation
5.) Warm or cold water fisheries
6.) Other indigenous aquatic life and wildlife
7.) Partial or total body contact recreation

At the present time, Phase Two of the TBRWI meets the requirements of all seven Designated Uses. As the population within the watershed continues to grow, however, the impact of human activities on the quality of water will become increasingly noticeable. Residential and commercial development, along with increased recreational activities may stress watershed critical areas, threatening some designated uses and degrading the status of others to "impaired".

Table 11 lists the status of the seven Designated Uses and shows the causes and sources of threats to those uses.

Table 11: STATUS OF DESIGNATED USES			
Designated Use	**Impaired?**	**Threatened?**	**Cause or Source of Threat**
Agriculture	No	No	
Industrial	No	No	
Public Water Supply	No	Yes	Inadequate septic systems; Livestock access to streams; Groundwater contamination
Navigation	No	Yes	Sedimentation
Warm or Cold Water Fisheries	No	Yes	Impact of dam; Sedimentation from construction/development sites; Nutrients from lawn care/ agriculture practices
Aquatic Life/Wildlife	No	Yes	Development/ construction along shorelines; Invasive species; Nutrients from lawn care/ agriculture practices
Partial/Total Body Contact	No	Yes	Failing septic systems

DESIRED USES

Desired Uses are those uses not required by law to meet the seven Designated Uses, but which the community has deemed important to the watershed. Although Desired Uses are not required, they are nevertheless an important component of the watershed plan. A list of desired uses for Phase Two of the TBRWI was developed by the steering committee based on input from the technical committee and concerned community members. The Desired Uses selected for the watershed to preserve the "natural " characteristics of the watershed protection measures are listed below:

- Increased opportunities for wildlife viewing
- Enhance the aesthetically pleasing quality of the watershed for scenic enjoyment
- Adequate recreational opportunities such as boating, camping, hiking, skiing, snow-shoeing, hunting and fishing on public lands

INITIAL WATER QUALITY SUMMARY

In conjunction with existing data, steering committee input was used to establish the initial water quality summary. As noted above, the Thunder Bay River system has good to excellent water quality and meets the requirements for all seven designated uses. The river system is actively used for agriculture; navigation; industrial water supply; partial/total body contact recreation; indigenous aquatic life/wildlife and warm/cold water fisheries.

Headwater tributaries that meet the criteria for coldwater fisheries include the Upper South Branch to its confluence with Webber Creek, Cole Creek, Marsh Creek, Pike Creek, Beaver

Creek, McGinn Creek, Silver Creek, Little Wolf Creek, Wolf Creek, Wildcat Creek, Davis Creek, Comstock Creek, Little North Creek, West Branch River, Sucker Creek, Fish Creek, and Pettis Creek. All of the identified trout streams are located in the Upper South and Lower South Branches of the watershed.

Although water quality in the watershed is good, impacts from past and present land use practices can adversely affect the future condition of the water resources. Northern Michigan is experiencing an increase in year-round population and seasonal residents. A population increase relates to an increase in construction activities, which often facilitate the delivery of nonpoint source pollution to adjacent water bodies.

KNOWN AND SUSPECTED POLLUTANTS

A review of the studies listed in *Appendix A: Thunder Bay River Watershed Historical Water Quality Data* assisted steering committee members in the effort to determine threatened or impaired status of designated uses for the Thunder Bay River. Currently all designated uses are being met, however several were found to be threatened that may eventually become impaired if existing and potential nonpoint source pollution causes are not corrected.

A list of known and suspected pollutants was developed and then prioritized by steering committee members. Overall, the committee identified one or more pollutants that impaired or threaten each designated use. Streambank, agriculture, road stream crossing, and lake shoreline inventories were conducted within the watershed. Data from these inventories, as well as from biological surveys conducted by the MDNR, indicate that the water quality of the Thunder Bay River watershed is threatened primarily by *sediment* and secondarily by *nutrients.*

Sediments from road/stream crossings, streambank erosion, and erosion from livestock access/cropland practices are known sources of pollution in the watershed and are a serious threat to water quality. A lake shoreline inventory was conducted which indicated that an increased input of *nutrients* (namely phosphorus) has contributed to an expansion of cladophora growth in Hubbard Lake. Agricultural runoff, livestock access to streams, waterfowl, lawn maintenance practices, inadequate or poorly maintained septic systems, and animal manure are potential sources of nutrients. Other pollutants suspected of impacting the watershed include thermal pollution (increased temperature), pesticides, heavy metals, organic compounds, brine, bacteria, and invasive species. **Table 12** shows a detailed list of each known (k) or suspected (s) pollutant, ranked by steering committee members in the order of most harmful,, and the sources and causes of each pollutant.

Table 12: Known (k) and Suspected (s) Pollutants			
Pollutant	**Sources**	**Causes**	**Threatened/ Impaired Uses**
Sediment (k)	Road/stream crossings (k)	Short culverts; Steep slopes; Runoff directed to river	**Cold Water Fishery; Navigation**
	Stormwater runoff (k)	Untreated runoff into lakes & rivers	
	Streambanks (k)	Road/stream crossings; Angler access; Past logging practices; Unrestricted livestock; hydrologic fluctuations	
	Construction practices (k)	Improper erosion & sediment control, greenbelt removal	
	Land clearing (k)	Improper erosion & sediment control, greenbelt removal	
	Oil & Gas (k)	Improper erosion & sediment control, greenbelt removal; Stream crossings	
	Livestock Management (k)	Unrestricted access to river	
	Cropland management (k)	Fall plowing	
	ORV crossings (k)	Illegal or improper stream crossings	
Nutrients (k)	Septic Systems (k)	Improperly designed/maintained septic systems	**Cold Water Fishery; Public Water Supply**
	Lawn Fertilizers (k)	Improper application	
	Livestock Management (k)	Animal waste containment	
	Stormwater Runoff (k)	Untreated runoff into lakes and rivers	
	Cropland Management (k)	Winter spreading of manure; Improper fertilizer application	
	Impoundment (s)	Accumulated nutrients	
Invasive Species	Cross contamination with other lakes, streams (k) (Eurasian Watermilfoil)	Heavy boat use on shallow waters of Fletcher Pond	**Navigation; Warm Water Fishery**
Thermal Pollution (k)	Stormwater Runoff (k)	Influence of warmer waters; Sediments and chemicals deposited into river	**Cold Water Fishery**
	Land Development (s)	Increased residential & commercial areas; Loss of riparian vegetation; Over-fertilization	
	Impoundment (k)	Man-made impoundments; Beaver activity	
	Forest Management (s)	Land fragmentation; Inadequate shade	
Heavy Metals/ Organic Compounds (s)	Stormwater Runoff (k)	Industrial/Residential toxins in runoff; Improper use/disposal	**Cold Water Fishery; Indigenous Aquatic/ Wildlife; Public Water Supply**
	Road/stream crossings (k)	Chemicals from automobiles	
	Sites of Environmental Contamination (s)	Accidental spills; Unregulated/illegal activities	
Pesticides/ Herbicides (s)	Lawn Fertilizers (k)	Improper application	**Indigenous Aquatic/ Wildlife; Public Water Supply**
	Cropland (s)	Improper application	
Bacteria(k)	Septic Systems (k)	Improperly designed/maintained septic systems	**Total/Partial Body Contact**
	Stormwater Runoff (k)	Runoff from lawns & Impervious surfaces	
	Livestock Management (k)	Animal waste directly into water body	
Chlorides & Brine (k)	Road Maintenance (k)	Dust control; Snow & Ice removal;	**Coldwater Fishery**
	Runoff (s)	Stormwater discharge directly into water bodies	

WATER QUALITY THREATS OR IMPAIRMENTS

Many factors can contribute to the degradation of water quality. A list of factors that are impacting water quality and future uses for the watershed was developed by the steering committee for the Thunder Bay River Watershed. Steering committee members expressed concern over several potential threats to the stability and health of the watershed. Threats cited include: sediments and contaminants introduced to lakes and streams by stormwater runoff; increased development of lake and river shorelines; loss of wetlands and wildlife habitat due to development and other human impacts; inadequate or poorly maintained septic systems and agricultural runoff that contribute bacteria and nutrients to the water system; increased sedimentation from shoreline erosion, erosion at road/stream crossings and impairment of recreation and aquatic/wildlife habitat with the introduction and spread of invasive species. **Table 13** is a compilation of the water quality concerns expressed by the steering committee, and the relationship of each concern to the affected designated use.

Table 13: Threats to Water Quality

Water Quality Threats	Threatened Designated Use
Excessive plant life, log jams, dams	Navigation
Streambank/shoreline erosion	Cold fishery, aquatic/wildlife
Increased turbidity	Aquatic/wildlife
Habitat loss	Aquatic/wildlife
Bio-accumulation of pollutants	Aquatic/wildlife, coldwater/warmwater fishery,
Riparian stewardship	Coldwater fishery, aquatic/wildlife, total body contact
Septic tank management	Coldwater fishery, aquatic life/wildlife, total body contact
Riparian development, construction	Coldwater fishery, aquatic/wildlife
Road maintenance practices	Coldwater fishery, aquatic/wildlife
Manure application	Coldwater fishery, aquatic/wildlife, total body contact, public water supply
Local ordinances/enforcement/ building codes	Coldwater fishery, aquatic/wildlife
Livestock access to rivers	Coldwater fishery, aquatic/wildlife, total body contact, public water supply
Riparian stewardship/Education	Coldwater fishery, aquatic/wildlife, total body contact

INITIAL GOALS FOR THE THUNDER BAY RIVER WATERSHED, PHASE TWO

Watershed goals outline the anticipated future state of the watershed. After reviewing the pollutants found to be threatening the watershed and discussing the watershed concerns expressed by the steering committee, a list of initial goals was drafted. The purpose of the list of goals is to guide the restoration and protection of the designated and desired uses for the watershed and is based on those uses found to be threatened or impaired. **Table 14** shows each threatened use, and the goal developed to alleviate or eliminate the threat.

Table 14: Initial Watershed Goals	
Threatened Use	
Public Water Supply	Develop an emergency first action response plan to reduce reaction time following a hazardous materials spill
	Reduce the amount of stormwater runoff to lakes and rivers of the watershed
	Develop educational tools for citizens of the watershed
	Reduce the amount of chemical, bacterial and nutrient runoff to lakes & streams
Navigation	Establish responsible Land Use practices
	Reduce the amount of erosion and sediments entering water bodies
Warm or Cold Water Fisheries	Improve, restore and protect the coldwater fisheries
	Reduce the amount of stormwater runoff to lakes and rivers of the watershed
	Reduce the amount of chemical, bacterial and nutrient runoff to lakes & streams
	Reduce the amount of erosion and sediments entering water bodies
Habitat	Complete a comprehensive lake assessment of Hubbard Lake
	Establish responsible Land Use practices
	Reduce the amount of chemical, bacterial and nutrient runoff to lakes & streams
	Reduce the amount of erosion and sediments entering water bodies
Partial/Total Body Contact	Develop educational tools for citizens of the watershed
	Reduce the amount of chemical, bacterial and nutrient runoff to lakes & streams

CHAPTER THREE: CRITICAL AREA

CRITICAL AREA DETERMINATION

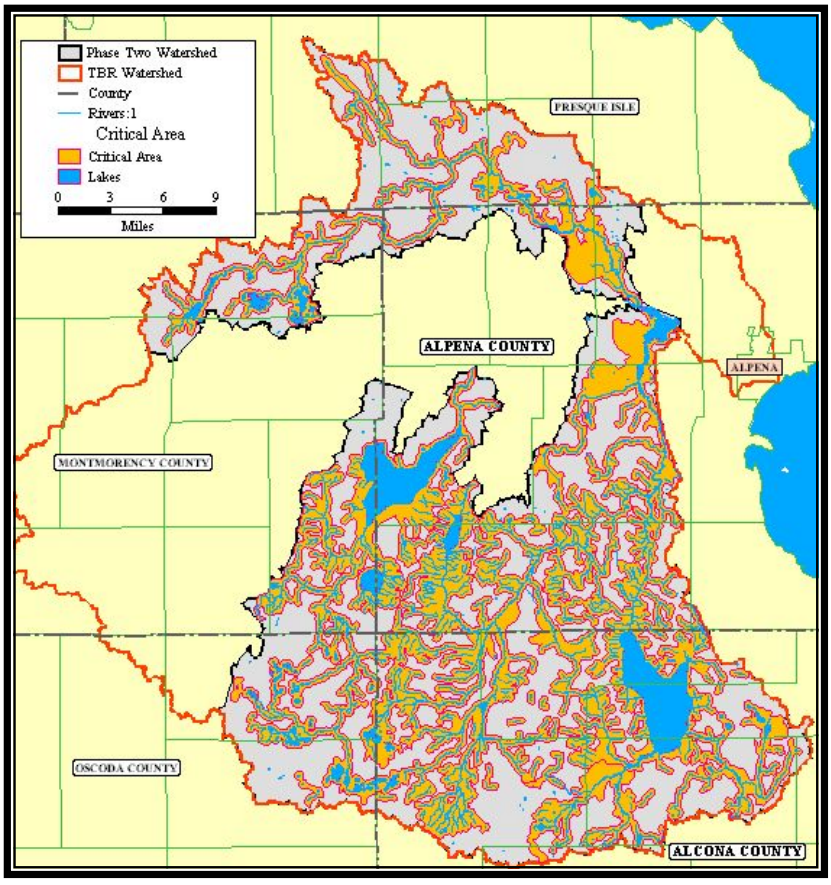
The critical area of the watershed is defined for two reasons. First, areas adjacent to water bodies are most likely to be affected by adverse water quality. Second, narrowing the geographic scope allows pollution management efforts to be focused on areas that may be contributing the majority of nonpoint source pollution.

USGS topographic maps and USDA Soil Surveys were used to delineate the critical areas. Criteria used to determine the critical area include the following:

1. Areas within 1000 feet of the North Branch, Upper South Branch, and Lower South Branch of the Thunder Bay River.
2. Designated tributaries, including intermittent drainages.
3. Inland lakes within the watershed.
4. Contiguous wetlands, defined as being within 1,000 feet of the Thunder Bay River, or within 500 feet of streams or lakes within the watershed.
5. Urban areas which drain to surface waters.
6. Contiguous steep slopes, defined as 10% slope or greater.
7. Areas of ground water recharge.

The critical area for the Thunder Bay River Watershed Phase Two is approximately 400 square miles (255,526 acres) and serves as the main focus of the plan. **Map 7** shows the critical areas shaded in orange.

Map 7: Watershed Critical Area



CHAPTER FOUR:
THUNDER BAY RIVER PHASE TWO NONPOINT SOURCE INVENTORY

INTRODUCTION

Nonpoint source pollution can find its way into a water system through various means. When streambanks and shorelines erode, sediments are deposited into lakes and rivers. Sediments and other pollutants can be washed into streams at road/stream crossings. Agricultural and residential areas contribute fertilizers and pesticides. Several inventories, including streambank, road/stream crossing, and agriculture were conducted during spring through autumn of 2003 to gather information regarding the state of the watershed. Materials used in the assessment of the watershed included topographic maps, MIRIS land use maps, plat books, aerial photographs, watershed maps, and county road maps. Water quality data and zoning ordinances were also used to supplement the spatial data. The field inventories were conducted by car, boat, canoe and/or by walking the watershed. The resulting data sets were used to determine which pollutants are threatening or impairing the watershed's designated and desired uses.

STREAMBANK EROSION INVENTORY

METHODOLOGY

An inventory of streambank erosion sites was conducted in summer 2003. The streambanks were inventoried using a variety of methods, including topographical map review, soils studies analysis, and where navigable, various watercraft were used. For the field inventory, each erosion site was given an identification number, condition of the site was documented, and photographs were taken of the streambank. Information collected at each site included length and slope of the eroded embankment, soil type and amount of vegetation present, the condition of the bank, and the extent and causes of the erosion (**Appendix B** is a sample data collection form; **Appendix C** is the severity scoring sheet used to determine site rank). Using this data, best management practices were then determined for each site inventoried. In order to identify the most critical erosion sites, a ranking system that evaluates the collected data was used, and each erosion site was determined to be either a *Mino*r, *Moderate*, or *Severe* environmental concern. Evaluation of the streambanks in the watershed is critical in determining not only which sites need immediate attention, but also in identifying sites that may pose potential sedimentation problems in the future.

Maps 8-10 indicate sites where streambank erosion is occurring. For more detailed information on erosion sites, see *Support Document: Thunder Bay River Watershed Initiative, Phase Two.*

Map 8 Streambank PI & Alp

Map 9 Streambank Maple Ridge

Map 10 Streambank Ossineke and Caledonia

RESULTS

A total of twenty-seven sites displaying significant amounts of streambank erosion were located within the watershed. Five of the sites show minor amounts of erosion, twenty have moderate erosion, and two sites were considered severe. Three of the minor sites were located on the North Branch of the Thunder Bay River; two were on the Lower South Branch. Four of the moderate sites were located on the North Branch, and the remaining sixteen were located on the Lower South Branch. Both of the Severe sites were located on the Lower South Branch. The causes of erosion varied from site to site. Several of the erosion sites were naturally occurring from a bend or an obstruction in the river. The erosion at many of the sites, however, was the result of human activities. In particular, fishing and boat launch sites, and sites where livestock had access to streams often showed moderate to severe signs of erosion. **Table 15** is a brief summary of the streambank inventory.

Table 15: SUMMARY OF STREAMBANK EROSION INVENTORY

Site ID	County	Township	Stream	Site Score
Minor Sites				
SB04	Alpena	Wilson	Lower South Branch	24
SB05	Alpena	Wilson	Lower South Branch	21
NB01	Presque Isle	Long Rapids	North Branch	23
NB02	Alpena	Posen	North Branch	23
NB05	Alpena	Long Rapids	North Branch	26
Total Minor Sites 5				
Moderate Sites				
SB01	Alpena	Caledonia	Lower South Branch	32
SB02	Alpena	Ossineke	Lower South Branch	31
SB03	Alpena	Wilson	Lower South Branch	33
SB06	Alpena	Wilson	Lower South Branch	33
SB07	Alpena	Wilson	Lower South Branch	32
SB08	Alpena	Wilson	Lower South Branch	35
SB09	Alpena	Maple Ridge	Lower South Branch	32
SB10	Alpena	Maple Ridge	Lower South Branch	32
SB11	Alpena	Maple Ridge	Lower South Branch	32
SB12	Alpena	Maple Ridge	Lower South Branch	32
SB14	Alpena	Maple Ridge	Lower South Branch	36
SB15	Alpena	Maple Ridge	Lower South Branch	32
SB16	Alpena	Maple Ridge	Lower South Branch	34
SB17	Alpena	Maple Ridge	Lower South Branch	33
SB18	Alpena	Maple Ridge	Lower South Branch	33
SB19	Alpena	Maple Ridge	Lower South Branch	34
NB03	Alpena	Long Rapids	North Branch	31
NB04	Alpena	Long Rapids	North Branch	30
NB06	Alpena	Long Rapids	North Branch	30
NB07	Alpena	Long Rapids	North Branch	34
Total Moderate Sites 20				
Severe Sites				
SB13	Alpena	Maple Ridge	Lower South Branch	36
SB20	Alpena	Maple Ridge	Lower South Branch	38
Total Severe Sites 2				
Watershed Total 27				

SHORELINE INVENTORY

A shoreline survey to identify locations of Cladophora growth and other shoreline features was conducted jointly by the Huron Pines RC&D Council and the Northeast Michigan Council of Government in the spring of 2003. Hubbard Lake was the primary focus of the survey, as it is an oligotrophic lake with excellent habit for Cladophora growth, and is almost fully developed with households on septic systems.

Cladophora is a branched, filamentous green algae that occurs naturally in small amounts in Northern Michigan Lakes. Specific environmental requirements for temperature, substrate, nutrients and other factors govern its occurrence. It is found most commonly in the wave splash zone and shallow shoreline areas of lakes, and can also be found in streams. It grows best on stable substrates such as rocks and logs. Artificial substrates such as concrete or wood seawalls are also suitable. The preferred water temperature is 50 to 70 degrees Fahrenheit. This means that late May to early July, and September and October are the best times for its growth in Northern Michigan lakes.

The nutrient requirements for Cladophora to achieve large, dense growths are greater than the nutrient availability in lakes with high water quality, such as Hubbard Lake. Therefore, the presence of Cladophora can indicate locations where relatively high concentrations of nutrients, particularly phosphorus, are entering a lake (it has less usefulness as an indicator of nutrient pollution in streams). Sources of these nutrients can be due to natural conditions, including springs, streams, and artesian wells that are naturally high in nutrients due to the geologic strata they encounter; as well as wetland seepage which may discharge nutrients at certain times of the year. However, past experience has shown that the majority of Cladophora growths can be traced to cultural sources such as lawn fertilization, malfunctioning septic systems, poor agricultural practices, soil erosion, and wetland destruction. These nutrients can contribute to an overall decline in lake water quality. Additionally, malfunctioning septic systems pose a potential health risk due to bacterial and viral contamination.

A shoreline survey can be a valuable lake management tool. Coupled with follow up on-site visits and questionnaires, controllable sources of nutrients to the lake, serious erosion sites, the presence and condition of shoreline greenbelts, and the intensity of algae growth along the waterfront can be identified and documented. Subsequently, a reduction in nutrient loading and other forms of pollution can often be achieved by working with homeowners to solve problems. These solutions are often simple and low cost, such as regular septic system maintenance, proper lawn care practices, and preservation or establishment of a greenbelt along the shoreline. Prevention of problem situations can also be achieved through the publicity and education associated with the survey.

Although the shoreline inventory does not replace the need for more detailed water quality studies, it is a good starting point and a useful tool for watershed management. Data generated by this inventory must, however, be carefully interpreted and is intended only to help characterize the current condition of the lake, help predict future impacts to the lake from shoreline practices, and to serve as an educational tool.

METHODOLOGY

The shoreline inventory for Hubbard Lake was conducted in May 2003 by staff from Huron Pines RC&D and NEMCOG. Using kayaks and generally paddling within 30 ft of the shoreline, technicians documented the entire shoreline of the lake, noting erosion, intensity of Cladophora growth, and greenbelt condition on a parcel by parcel basis.

Parcel data was not available from the County Equalization Department at the time of this study. However, through the use of aerial photographs, county plat books, on-the-lake observations, and using the Geographic Information System (GIS), it was possible to plot the information with accuracy. Shoreline information was entered into a database and used to generate maps depicting areas of vulnerability in Hubbard Lake.

A total of 942 distinct shoreline property parcels were identified around the lake. These were numbered sequentially, starting with the boat launch/township park on the north end of the lake and running counterclockwise around the lake. Parcels included both undeveloped and developed areas. In a few instances there was a relatively long stretch of undeveloped shoreline that was considered one parcel based on the apparent ownership and development status of the parcel. **Table 16** is a general summary of the results of the survey. Maps and specific parcel information are located in *Support Document: Thunder Bay River Watershed Initiative, Phase Two.* **Appendix D** provides a sample Hubbard Lake Shoreline Inventory Form.

Table 16: Hubbard Lake Shoreline Inventory Results: General Summary	
Number of shoreline miles	21.02
Number of shoreline miles undeveloped	2.8
Number of property parcels	942
Percent of shoreline undeveloped	13.3%
Number of parcels with good to excellent greenbelts	128
Number of parcels with poor or no greenbelts	796
Number of parcels with moderate to heavy shoreline erosion	27
Percent of parcels with Cladophora habitat	73%
Cladophora habitat parcels with light, moderate, or heavy growths	68%

RESULTS

Cladophora Habitat and Growth

This form of filamentous green algae requires a hard surface (rock, seawall, or log) to attach to. If this surface is not available, there is no Cladophora habitat and the algae will not be present. In summary, 73.4% (691) of the property parcels exhibited suitable habitat for Cladophora growth.

The survey noted whether Cladophora was present or absent, and whether it was found in light, moderate or heavy growths. In nutrient poor (low productivity) lakes like Hubbard, Cladophora is a reliable indicator of possible nutrient pollution. Of the parcels with habitat, 474 parcels (68%) showed visible signs of growth. Significant (heavy) growths of Cladophora were observed on 127 (18%) of parcels.

Shoreline Erosion

While erosion is a natural process, it can be accelerated by human activities and lead to both property loss and environmental problems. This survey noted only visible erosion, such as bare soil on steep slopes, gullies, undercut banks, and slumping. Erosion was classified as slight, moderate, or severe. Twenty-seven (2.8%) of the 942 sites exhibited significant shoreline erosion, considered to be moderate or heavy.

Shoreline Greenbelts

Greenbelts were scored on a scale of 0 to 3, with *3* being an undeveloped shoreline. A *0.5* signifies removal of all vegetation except for turfgrass, 1 represents some vegetation, but not enough to qualify as a greenbelt zone, and *2* or above is considered “good.” Good greenbelts

will have significant areas of natural vegetation that remain, particularly adjacent to the shoreline. Homes with good to excellent greenbelts can often be difficult to observe from the water. This may be the most subjective of the inventory categories; however, maintaining natural vegetation is perhaps the most significant action a lakefront property owner can take to preserve high water quality. Greenbelts minimize overland runoff, remove nutrients from the soil, minimize the need for intensive lawn maintenance, provide important riparian habitat for wildlife, hold shoreline soils in place and buffer the shoreline from erosion. While 128 parcels were scored good to excellent; 796 scored 1.9 or below.

In addition to Hubbard Lake, shoreline surveys were completed for Ess Lake, Rush Lake, Long Lake and Beaver Lake. None of these lakes had any significant amounts of erosion, and none had good Cladophora habitat. All four of the lakes have quite a bit of development for their size, and are on septic systems. A study of the impacts from wastewater treatment practices should be considered for a future project. **Table 17** compares findings for all five lakes inventoried. Two other lakes important to the watershed, Grass Lake and Fletcher Pond, did not meet the criteria for the survey, due to lack of shoreline development.

Table 17: Shoreline Survey Summary

Lake	Total Number of Parcels	Parcels With Good to Excellent Greenbelts	Parcels With Poor or No Greenbelts	Parcels With Moderate to Heavy Shoreline Erosion	Parcels With Cladophora Habitat	Parcels With Cladophora Present (Light, Moderate or Heavy)
Hubbard	942	128	796	27	691	474
Ess	68	34	22	2	2	0
Rush	81	20	53	3	13	0
Beaver	214	32	171	9	68	0
Long	143	64	68	0	12	1

ROAD/STREAM CROSSING INVENTORY

A road/stream crossing site exists wherever a road or street and a stream intersect. Road/stream crossings can be major contributors of sediments and other pollutants to the water system. Dirt and gravel from shoulders of the roads, and from unpaved roads, can be washed into a stream. The resulting build up of sediments in the stream is called *sedimentation*. Although sedimentation is a natural process, excess amounts of sediments can wreak havoc on the aquatic environment. Some detrimental effects of sedimentation are:

- Destruction of aquatic habitat and the extermination of aquatic wildlife
- Negative impacts on birds and mammals dependent on the aquatic environment
- Restriction of plant productivity due to reduction of sunlight penetration
- Warming of waters, which can lead to destruction of coldwater fisheries
- Release of nutrients into the water system, causing the stimulation of algae growth
- Introduction into the water body of harmful pesticides, toxic metals and bacteria which may adhere to the grains of sediment
- Disruption of fish life cycle (affects fish's ability to feed, spawn, and inhibits gill function.)
- Reduction of stream channel width and depth, and the potential increase in flooding events

Sediment loading occurs when a net import of sediment exceeds annual export, and the consequences of such loading can be detrimental to the biology and structure of the system. Such a situation can lead to the overall degradation of the system. Sediment loading gradually fills in a stream channel, and under the more stable flow regimes associated with northern Michigan trout streams, the water is most typically displaced laterally. Lateral spread of the channel results in an overall decrease in depth with the variability in depth being nearly eliminated, resulting in a homogeneous stream channel. A change in the stream channel can also result in increased streambank erosion thus compounding the problem. The amount of sedimentation experienced by a waterbody depends on several factors, such as the length and slope of the approaches, steepness of the embankment, whether or not the road is paved, the amount of vegetative cover along shoulders and ditches at the site, and the runoff path.

Other components that influence channel morphology, such as large woody debris, cease to function as they become buried with sediment. When these types of structures become covered the result is a loss of scour holes and plunge pools. Additionally, the overall use of large woody debris as cover for fish may be severely reduced depending on the degree of sedimentation that has occurred. Other aspects of habitat are also directly affected, such as riffle areas that are normally dominated by rock and cobble. As sand becomes deposited valuable substrate for invertebrates and fish spawning is lost. Populations of fish are almost always affected more noticeably than the invertebrates, as angling represents one of the more common recreational uses of these types of systems. The reasons for the direct effects on the fishery are twofold; the food resource can be diminished to such an extent as to stunt growth, and unavailable spawning substrate results in poor fish recruitment.

METHODOLOGY

The road/stream-crossing inventory for the Thunder Bay River Watershed Initiative: Phase Two was conducted in the spring and summer of 2003. The inventory was completed using county road maps and topographic maps to identify potential sites. At each site, photographs were taken of upstream, downstream, and left and right approaches. Physical condition and measurements of the culvert and roadway, the length and slope of approach, road width and surface type, stream depth and current, amounts and causes of erosion, and extent of vegetation were recorded. (A sample inventory sheet is included in **Appendix E**.) One of the key functions of an inventory is to aid in the prioritization of sites for improvement. A sample ranking sheet can be found in **Appendix F,** and terms used in ranking and data collection are defined in **Appendix G**. Using the data collected, each site was assigned a ranking of minor, moderate or severe based on the point system found below:

Point Score Total	**Severity Category**
0-15	Minor
16-29	Moderate
>30	Severe

The ranking system is designed to reflect the relative severity of existing and potential erosion conditions at each site. Severity rankings are useful as a quick reference to sites that fall within a specific category. Generally, the severity ranking will be only one of several considerations for improvement decisions. Other variables such as cost, access, funding sources, and logistics will strongly affect implementation decisions. It is expected that resource managers will look carefully at candidate sites' individual scores before selecting sites for improvement.

Cost estimates were developed based on the severity rank and the extent of erosion of each site. To serve as a general guideline the following table (**Table 18**) was created. On certain sites minimal or no repair work was recommended, in this case the cost estimate was adjusted accordingly.

Table 18: Cost Estimate Table	
Rank	**Cost Estimate**
0-10	$0
11-18	$5,000
19-25	$10,000
26-29	$30,000
30-35	$60,000
36-40	$120,000
41-47	$300,000

The technical committee identified several sites as being *priority* (those contributing the most pollutants to the river) and a second site evaluation of those sites was conducted. Site designs were then drafted and more detailed cost estimates were calculated for these high priority road/stream crossings. (See *Chapter 7: Watershed Goals and Recommendations*) Costs and plans should be refined prior to implementing the recommended improvements.

RESULTS

A total of 199 road/stream crossing sites were inventoried for the Thunder Bay River Watershed Initiative, Phase Two. **(**See **Map 11)** The sites were ranked as *Minor, Moderate* or *Severe* contributors of sediments to the river system. A total of 41 sites received a ranking of Minor, the majority of which were found in Alcona and Alpena Counties. Over half of the sites inventoried (135) received a ranking of Moderate; the majority of these sites were located in Alpena County. Only six sites were ranked severe; two in each of Montmorency and Alcona Counties and one in each of Montmorency and Alpena Counties.

Sediment was determined to be the pollutant having the most detrimental effect on water quality in the watershed, and road/stream crossings contribute significantly to the sedimentation process. **Table 19** lists each crossing by site ID, followed by an estimated cost to repair or remediate that site. Where no action was deemed necessary, only the site ID is listed. The table lists sites by county and severity ranking, and includes county and watershed totals.

Road/stream crossing sites assessed during the inventory are identified in a series of maps (***Maps 6-10***) located in *Support Document: Thunder Bay River Watershed Initiative, Phase Two.* Inventoried sites are listed by county and township on **Table 20,** which was developed to simplify locating specific road/stream crossing sites.

Map 11 Road/Stream Crossing Sites

Table 19: ROAD/STREAM CROSSING INVENTORY SUMMARY WITH COST ESTIMATIONS			
Alcona County			**Total**
MINOR	**16**	ALC01 ALC04 ALC06 ALC17 ALC18($3000) ALC19($7000) ALC21($2000) ALC23 ALC24 ALC32 ALC33($2000) ALC34($5000) ALC35($5000) ALC38 ALC40 ALC43	**$24,000**
MODERATE	**35**	ALC02 ALC03($1000) ALC05 ALC07 ALC08($1500) ALC09($5000) ALC10($10,000) ALC11($30,000) ALC13 ALC14 ALC15($30,000) ALC16($5000) ALC20($5000) ALC22($5000) ALC25($5000) ALC26($2000) ALC27 ALC28($5000) ALC30($10,000) ALC31($5000) ALC36 ALC37($2000) ALC39($30,000[$150,000 with bridge replacement]) ALC41 ALC42($10,000) ALC44($2000) ALC45 ALC46 ALC47($1000) ALC48 ALC49($500) ALC50($2000) ALC51 ALC52($1000) ALC53	**$168,000 ($288,000 with bridge replacement)**
SEVERE	**2**	ALC12($60,000) ALC29($30,000)	**$90,000**
TOTAL	**44**	**($402,000 with bridge replacement)**	**$282,000**
Alpena County			**Total**
MINOR	**15**	ALP04($1000) ALP07($5000) ALP08 ALP14 ALP16 ALP18($5000) ALP22 ALP24($5000) ALP28 ALP56 ALP59 ALP77($5000) ALP84 ALP87	**$21,000**
MODERATE	**75**	ALP01($30,000) ALP02($1000) ALP03($10,000) ALP05 ALP06($5000) ALP09($5000) ALP10($2000) ALP11 ALP12($5000) ALP13 ALP15($5000) ALP17 ALP19 ALP20($10,000) ALP21($30,000) ALP23 ALP25($10,000) ALP26($10,000) ALP27($10,000) ALP29 ALP30 ALP31($10,000) ALP32($10,000) ALP33($10,000) ALP34($10,000) ALP35($5000) ALP36($5000) ALP37($5000) ALP38($10,000) ALP39 ALP40 ALP41($10,000) ALP42($1000) ALP43($10,000) ALP44($10,000) ALP45($5000) ALP46($5000) ALP47 ALP48($5000) ALP49 ALP50($10,000) ALP51($30,000) ALP52 ALP53 ALP54($5000) ALP55($5000) ALP57 ALP58 ALP60($5000) ALP61($5000) ALP62 ALP63($5000) ALP64($10,000) ALP66($10,000) ALP67 ALP68($5000) ALP69($5000) ALP70($5000) ALP71($5000) ALP72($10,000) ALP73 ALP74($5000) ALP75($10,000) ALP76 ALP78 ALP79($30,000) ALP80($30,000) ALP81 ALP82($10,000) ALP83($10,000) ALP85($20,000) ALP86($10,000) ALP88($5000) ALP89($10,000) ALP90($10,000) ALP91	**$509,000**
SEVERE	**1**	ALP65($30,000)	**$30,000**
TOTAL	**91**		**$560,000**
Montmorency County			**Total**
MINOR	**1**	MO15($10,000)	**$10,000**
MODERATE	**15**	MO01($30,000) MO02 MO03 MO04($10,000) MO05($50,000) MO06($2000) MO07($10,000) MO08($5000) MO09 MO10 MO11 MO12($10,000) MO16($5000) MO17($5000)	**$137,000**
SEVERE	**2**	MO13($60,000) MO14($10,000) MO18($5000)	**$65,000**
TOTAL	**18**		**$212,000**
Oscoda County			**Total**
MODERATE	**1**	OS02	**$30,000**
SEVERE	**1**	OS01($30,000)	**$0**
TOTAL	**2**		**$30,000**
Presque Isle County			**Total**
MINOR	**9**	PI01 PI03($5000) PI09($2000) PI16 PI17($500) PI18 PI121($10,000) PI124 PI125	**$17,500**
MODERATE	**18**	PI02($20,000) PI04 PI05($5000) PI06($5000) PI07($20,000) PI08 PI10 PI11($20,000) PI12 PI13 PI14 PI15 PI19 PI120 PI122($5000) PI123($2000) PI126 PI127($1000)	**78,000**
TOTAL	**27**		**$95,000**
WATERSHED TOTALS			**Total**
MINOR	**41**		**$72,000**
MODERATE	**144**		**$922,000 ($1,042,000 with ALC39 bridge replacement)**
SEVERE	**6**		**$215,000**
TOTAL SITES	**199**		**$1,175,000 ($1,325,000 with ALC39 bridge replacement)**

Table 20: Road /Stream Crossing Sites by Township

ALCONA COUNTY

Mitchell		Caledonia		Alcona	Hawes	
ALC01	ALC07	ALC12	ALC19	ALC22	ALC25	ALC31
ALC02	ALC08	ALC13	ALC20	ALC23	ALC26	ALC39
ALC03	ALC09	ALC14	ALC21	ALC24	ALC27	ALC40
ALC04	ALC10	ALC15	ALC32	ALC36	ALC28	ALC41
ALC05	ALC11	ALC16	ALC33	ALC37	ALC29	ALC42
ALC06	ALC44	ALC17	ALC34	ALC38	ALC30	ALC43
		ALC18	ALC35			

ALPENA COUNTY

Wellington		Green (west)	Green (east)		Long Rapids		Maple Ridge		Alpena	
AL01	AL11	AL07	AL24	AL30	AL17	AL22	AL39	AL44	AL48	AL54
AL02	AL12	AL08	AL25	AL31	AL18	AL35	AL40	AL45	AL49	AL55
AL03	AL13	AL09	AL26	AL32	AL19	AL36	AL41	AL46	AL50	AL56
AL04	AL14	AL23	AL27	AL33	AL20	AL37	AL42	AL47	AL51	AL57
AL05	AL15		AL28	AL34	AL21	AL38	AL43		AL52	AL58
AL06	AL16		AL29						AL53	AL59
AL10										

MONTMORENCY COUNTY

Vienna	Albert	Loud		Hillman (west)	Hillman (east)	Briley		Montmorency	Avery	Rust
MO01	MO03	MO29	MO36	MO18	MO53	MO04	MO11	MO61	MO17	MO54
MO02	MO08	MO30	MO37	MO19	MO58	MO05	MO12	MO69	MO21	MO55
	MO24	M031	MO38	MO20	MO59	MO06	MO13	MO70	MO22	MO56
	MO25	MO32	MO39	MO46	MO60	MO07	MO14	MO71	MO23	MO57
	MO26	MO33	MO40	MO47	MO62	MO09	MO15	MO72	MO43	
	MO27	MO34	MO41	MO49	MO63	MO10	MO16		MO44	
	MO28	MO35	MO42	MO50	MO64				MO45	
					MO65				MO51	
					MO66				MO52	
					MO67					
					MO68					

OSCODA COUNTY	PRESQUE ISLE COUNTY			
Clinton	Metz	Bismarck	Posen	Belknap
0S01	PI01	PI02	PI20	PI24
OS02	PI11	PI03	PI21	PI25
	PI12	PI04	PI22	
	PI13	PI05		
	PI14	PI06		
	PI15	PI07		
	PI16	PI08		
	PI17	PI09		
	PI18	PI10		
	PI19	PI23		
	PI26			
	PI27			

AGRICULTURE INVENTORY

The welfare of fish and wildlife depends on water quality and the availability of habitat. Public concern over environmental water quality grows as declining populations of fish and wildlife in the Thunder Bay River watershed are noticed. Extensive land use by farmers for agricultural purposes has a direct impact on wildlife habitat and water quality in the watershed. Public desires to protect the lands from extensive farming have been expressed through legislation, including the Clean Water Act, the Endangered Species Act and the Farm Bill.

Sedimentation from agricultural activities can be a sign of nonpoint source pollution in a watershed. Wind and water flowing across the land allows sediment to detach and provides transportation of sediment into a water body, causing a loss of topsoil to the farmer and adding excess sediment to a lake, stream, or river. The loss of topsoil is usually countered by the addition of nutrients into the soil, leading to an excess of nutrients that disturb the natural balance of an ecosystem around a watershed as nutrients collect in the water.

Animal manure also contributes to an excess of nutrients that can be easily transported by water and concentrated into lakes and streams. Nutrient loading has the affect of disturbing the sensitive ecosystem of fish and wildlife while at the same time creating the loss of valuable habitat. Excesses of nutrients can impair the quality of drinking water, aquatic habitat, and the recreational quality of watercourses.

Nonpoint source pollution is a serious issue, but one readily brought under control with proper management of land and resources. The use of Best Management Practices (BMPs) is cost effective in the long run and benefits members of the community as well as wildlife. Healthy fish and wildlife populations are the result of good watershed management and a concerted community effort. Understanding and acting upon the need to correct present, and prevent future, nonpoint source pollution in the watershed, community members and farm operators can cooperatively maintain mutually beneficial high water quality and efficient, well managed agricultural operations. Increased crop and livestock yields for farmers, abundant wildlife habitat, and aesthetically pleasing vistas can be the by-products of a high quality, well-maintained watershed.

METHODOLOGY

An inventory of agricultural operations within the watershed was completed in summer 2003. The inventory was conducted by USDA-NRCS staff and the Montmorency County Conservation District. Agricultural sites within the defined critical area were identified using a variety of maps and aerial photos. Sites were located using topographical maps and county plat books were consulted to identify property owners. A database was then developed to include township, range and section numbers, and landowner addresses. Utilizing the skills of USDA-NRCS personnel, high priority agricultural sites were determined, and field inventories were conducted. Agricultural sites were evaluated on an Agricultural Inventory Field Data Form, such as the one shown in *Appendix H*. Data collected at each site includes location, number of acres, type of operation, pollutant sources, recommended treatments and a site sketch. Field checks were used to establish a list of potential problem areas related to agricultural practices. High priority sites were photographed and a document complete with photos, field data, BMPs, and a cost estimate was developed for each site. This combined form can be found in *Support Document: Thunder Bay River Watershed Initiative, Phase Two.* A series of maps that show locations of agricultural sites is included with this document.

RESULTS

Four counties within the Thunder Bay River Watershed (Alpena, Alcona, Montmorency and Presque Isle) were surveyed for nonpoint source pollution originating from agricultural operations. Of the 157 sites inventoried, 39 sites ranging from *minor* to *severe* were determined to be contributing pollution to the watershed critical area. (For a summary of the agricultural inventory see **Table 21.**) Unrestricted livestock access was cited as the number one source of agriculture-related pollution; other significant sources include improper management of animal waste and improper/overuse of fertilizers and pesticides. Inappropriate agricultural practices are currently threatening several of the state mandated designated uses, as well as negatively impacting economic, aesthetic, and recreational aspects of the watershed.

Table 21 lists agricultural sites of concern by township and severity ranking, and includes cost estimations for each township.

Table 21: SUMMARY OF AGRICULTURAL INVENTORY AND ESTIMATED COSTS			
Total Sites of Concern	**39**	**Total Cost:**	**$535,590**
MINOR SITES	**Township**	**Number of Sites**	**Cost for Township**
Alcona County	Mitchell	1	$3,350
Alcona County Totals		***1***	$3,350
Alpena County	Green	2	$3,765
	Ossineke	6	$32,340
	Wilson	7	$13,860
Alpena County Totals		***15***	***$49,965***
Montmorency County	Rust	1	$150
	Montmorency	3	$20,330
Montmorency County Totals		***4***	***$20,480***
Presque Isle County	Posen	4	$24,095
Presque Isle County Totals		***4***	***$24,095***
Total Minor Sites Inventoried/Total Cost		**24**	**$97,890**
MODERATE SITES	**Township**	**Number of Sites**	**Cost**
Alcona County	Caledonia	1	$3,780
	Mitchell	3	$91,185
Alcona County Totals		***4***	***$94,965***
Alpena County	Ossineke	1	$1,725
	Wilson	3	$135,780
Alpena County Totals		***4***	***$137,505***
Montmorency County	Montmorency	2	$6,600
Montmorency County Totals		***2***	***$6,600***
Presque Isle County	Posen	2	$17,275
Presque Isle County Totals		***2***	***$17,275***
Total Moderate Sites Inventoried/Total Cost		**12**	**$256,345**
SEVERE SITES	**Township**	**Number of Sites**	**Cost**
Alcona County	Mitchell	1	$132,580
Alcona County Totals		***1***	***$132,580***
Alpena County	Ossineke	1	$31,950
	Wilson	1	$16,825
Alpena County Totals		***2***	***$48,775***
Montmorency County	*No Sever Sites*		
Presque Isle County	*No Severe Sites*		
Total Severe Sites Inventoried/Total Cost		**3**	**$181,355**

LAND USE INVENTORY

One of the most important components to the development of a nonpoint source pollution management plan for the Thunder Bay River Watershed is an analysis of land use and the land use planning process. The type and intensity of land use has a direct impact on water quality, and if adequate pollutant controls are not incorporated during the land development phase, costly remediation measures are often required to repair damaged caused by erosion, sedimentation, stormwater runoff or nutrient overload.

METHODOLOGY

The NEMCOG Geographic Information System was used to produce the maps in this report. The digital land use polygons were placed over the 1998 digital aerial photo images and were then modified to reflect the current land use at the time that the aerial photos were taken. The categories of land use were updated using the Michigan Resource Inventory System (MIRIS)

classifications. Those classifications were then merged into 10 categories for map display purposes: Residential, Commercial, Industrial, Institution/Recreational, Agricultural, Nonforest, Upland Forest, Lowland Forest, Wetlands, and Surface Water. **Table 22** lists categories of land use in number of acres and percentage of the critical area for the Thunder Bay River Watershed, Phase two. **Map 12** displays current land use for the watershed.

In addition to the general watershed land use inventory, a detailed inventory of three blocks of land within the critical area was conducted in summer 2003. Each of the three blocks covered approximately six sections, and was selected to represent one of the major land use categories in the Thunder Bay Watershed, Phase Two. One of the blocks, consisting of primarily *Residential land* was located in Alcona County, another block highlights the *Agricultural land* predominate in Alpena County, and the third, representing *Upland and Lowland Forests* was surveyed in heavily forested Presque Isle County. The information gathered indicates trends in general land use changes for the watershed, and will be discussed in the appropriate land use categories below.

RESULTS

Data from the land cover/use inventory shows that over 65 percent of the Watershed's 505,412 total acreage was forested, with another 14 percent in agriculture, 8.5 percent non-forest land, 5.2 percent wetlands and 4.3 percent surface water (see **Table 22**). Less than three percent of the watershed's land was used for urban-type purposes in 1998, which included commercial, industrial, institutional/recreational and residential uses.

Residential

Residential land use includes residential dwelling structures such as single family or duplexes, multi-family low-rise residential, multi-family medium & high rise residential, and mobile home parks. According to the MIRIS Land Cover/Use update, 7677 acres (1.5%) of the watershed's critical land area was used for residential purposes. For the most part, residential development found in the watershed consists of single-family dwellings; however, single family duplexes, multi-family residential, condominiums, mobile homes and mobile home parks are also included in this category. Residential uses are concentrated around the rivers and lakes of the watershed, particularly Hubbard Lake. In addition to new dwellings being built on waterfront property, many of the once seasonal and weekend developments have undergone a transition to year-round residences. Residential development is also occurring along county roads throughout the watershed as larger parcels are split into ten-acre and smaller parcels.

A land use survey covering six sections (sections 1,2,3,10,11,12 and 14, of central Caledonia Township, Alcona County) in the heavily residential area of Hubbard Lake was conducted in 2003. When compared to the 1993 land use data, the updated 2003 data shows a 5.2% increase of residences for that area. This increase coincides with a 13.9% decrease in *Agricultural Land.* The impact of development was illustrated even more strongly in two other areas included in the study. Posen Township (Presque Isle County) and Ossineke Township (Alpena County) show large increases in residential land use, while at the same time showing significant losses of agricultural land. (See **Maps 13** and **14,** and **Table 23**.) Development of forests, agricultural lands and open land is a trend that can be seen not only in the Thunder Bay River Watershed, but also throughout the state.

Map 12 Land Use

Map 13 & 14 Residential

Commercial

Commercial land uses include merchandise and services provided in primary/central business districts, shopping center/malls, and secondary/neighborhood business districts, including commercial strip development. This category includes compact groups of neighborhood stores and parking areas related to the commercial businesses. The 1998 land use inventory identified 211 acres (0.4%) in commercial use in the watershed. While there are no heavily commercial areas in Phase Two of the Thunder Bay River Watershed; commercial service facilities are found clustered in the more urbanized sections of Alpena, Alcona, Presque Isle and Montmorency Counties.

Industrial

Due to the discoveries of new oil and gas reserves and the changes in availability and cost of foreign oil in the 1970s, national attention turned to Michigan's oil and gas industry. The extraction of oil and gas from deep gas reserves has been replaced in recent years by the development of the shallow Antrim shale reserves.

One of the major concerns of well drilling is ground water contamination. A well can serve as a conduit for surface contamination to directly enter the ground water without passing through any natural filter systems.

Another concern is the road access construction and site clearing. Many miles of primitive roads are built that may require extensive topographic changes to the land. In addition, miles of pipeline must be laid to transport the product to a processing and shipping facility. In order to place the drilling rig, an area of one to three acres must be cleared of trees and other vegetation to reduce the fire hazard. These activities can increase the amount of runoff in the watershed as well as the number of road stream and pipeline crossings. **Map 15** shows the location of oil and gas wells within the Thunder Bay River System.

In addition to industrial and extractive development (oil & gas drilling, quarry operations, etc.) this land use category includes transportation, communication and utility facilities, manufacturing and industrial parks, light industries, production facilities, lumber mills, chemical plants, brick-making plants, waste product disposal areas, and areas of stockpiled raw materials. Development falling under this category made up only 0.28 percent (1,418 acres) of the total watershed land area. Much of the industrial development is located near the main community centers.

Table 22: Land Use Classifications

Land Use	Number of Acres	Percentage
Residential	7,677.38	1.52%
Commercial	210.70	0.04%
Industrial	1,418.84	0.28%
Institution/Recreational	1,375.42	0.27%
Agriculture	71,265.05	14.10%
Nonforest	43,141.36	8.53%
Upland Forest	229,406.10	45.39%
Lowland Forest	102,676.08	20.32%
Wetlands	26,465.96	5.24%
Surface Water	21,775.77	4.31%
Total	**505,412.70**	**100%**

Source: 1998 update of 1978 MIRIS Land Cover/Use Inventory

Map 15 Oil & Gas

Institution/Recreational

Land devoted specifically for institutional and recreational purposes amounted to approximately 0.27 percent, or about 1,375 acres of the watershed. Land uses included in this category are public parks and campgrounds, golf courses, schools, churches, cemeteries, correctional and military facilities, and public buildings. Buildings, parking areas, and immediate grounds of these facilities are included in this category, however all surface water, forest, barren land, and wetlands associated with the industrial/recreational sector are entered into their own respective categories.

Open Land

Open-land is defined as areas supporting a "pioneer" stage of plant succession, land that is in transition to forestland. Open land consists of plant communities characterized by grasses or shrubs, and classifications such as barren land, herbaceous open land, and shrub land are included in the *Open Land* category. One type of opening was created by turn of the century logging operations and subsequent wildfires. Other Open Land areas consist of abandoned or idle farm land. Herbaceous open land is often subjected to continuous disturbance such as mowing, grazing, or burning. Typical Open Land grass species are quack grass, Kentucky bluegrass, upland and lowland sedges, reed canary grass and clovers. Shrub species include blackberry and raspberry briars, dogwood, willow, sumac and tag alder. The watershed supports over 4,000 acres of open land (8.5 percent), and the majority of these areas are located within active agriculture lands and upland forests.

Agricultural

The agricultural land use category includes land that is used for the production of food and fiber, and for non-food livestock such as horses. Types of agricultural operations fall into a variety of classes: cropland, orchards (including vineyards and ornamental horticulture), confined feeding operations for livestock, pasture lands, farmsteads, greenhouse operations, and horse training areas. With some 71,265.05 acres (14 percent) classified as farm land, agriculture is one of the watershed's largest land use categories, second to only forested lands. While the bulk of agricultural land is found in Alpena and Presque Isle Counties, significant amounts of land used for agricultural purposes can be found in all of the watershed's counties.

A six-section area (sections 2, 3,4,9,10, and 11) in Ossineke Township, R7E, Alpena County, was updated in 2003, and the results were compared to the 1978 land use update for the same six sections. Although the increase in lands used for residential purposes was slight, agricultural lands experienced a significant 18.4 percent decrease. This apparent discrepancy can be explained when the 8.8 percent increase in Forested land is taken into consideration. In many cases once active farms have ceased operating, and the land has since reverted to it's original forested state. **Maps 13** and **14** below show the land use changes for this updated six-section block experienced the past twenty-five years. (In the 1978 Land Use update, less detailed counts were taken for residential lands than in has been the practice in later updates. This fact should be taken into consideration when comparing 1978 residential land use to the 2003 update.)

Maps 16 & 17: Agricultural update

Upland Forest

Upland forests comprise the majority of land use in Thunder Bay River Watershed critical area, with a total of 229,406 acres, or 45.4 percent of the land area. The following species predominate areas classified as upland forests: sugar and red maple, elm, beech, yellow birch, cherry, basswood, white ash, all aspen types, white, red, jack and scotch pines and any managed Christmas Tree plantations. Other upland conifers include white or black spruce, balsam, or Douglas fir, along with areas covered by larch and hemlock.

Lowland Forest

The land use inventory shows that 102,676 acres, or 20.3 percent of the watershed's surface area consists of lowland forests. Lowland forest areas are dominated by tree species that grow in very wet soils, and contain such species as ash, elm and soft maple, along with cottonwood and balm-of-Gilead. Lowland conifers, such as cedar, tamarack, black and white spruce and balsam fir stands are also included.

The upland and lowland forests combine to encompass 332,082 acres, or 65.7 percent of the watershed's total surface area. Forests, therefore, constitute the largest single land use category for the Thunder Bay River Watershed. Large tracts of forested land can be found throughout the watershed, with especially high concentrations in Alcona County. Of the total forests, 69 percent are upland forests, while 31 percent are lowland forests.

Presque Isle County has 19,510 acres of upland forests, as well as over 10,000 acres of lowland forest. Land use for a six-section block (sections 26, 27, 28, 33, 34, and 35) within Posen Township was updated in 2003, and compared to the 1995 land use patterns for those same six sections (see **Maps 18** and **19**). During the eight years between land use updates, the six sections lost less than one percent of its forests due to changing land uses, this despite a significant increase in residential uses for the area. No Commercial or Institutional/Recreational land uses were recorded during the 1995 survey, however the 2003 survey indicates 1.4 acres of land are being used for commercial purposes, and 3050 acres have been classified Institutional/Recreational. Not surprisingly, the most significant decrease for the updated area (2.1 percent in eight years) was found in the agricultural sector.

Maps 18 & 19 Forested Sections

Table 23 shows changes in residential, forest, and agricultural land uses for three six-section blocks between 1978 and 2003. From these sample sections, it is possible to determine a slow but steady change from agricultural and forested lands to increased residential uses in the watershed.

Table 23: Sample Land Use Changes

	Percent Change Residential Land Use	Percent Change Agricultural Land Use	Percent Change Forested Land Use
Caledonia Sections 1993-2003	5.2% Increase	13.9% Decrease	0.4% Decrease
Ossineke Sections* 1978-2003	1471.4% Increase	18.4% Decrease	8.8% Increase
Posen Sections 1995-2003	49.4% Increase	2.1% Decrease	0.1% Decrease

* The sections updated in 2003 were compared to the most current available data of that county. When comparing land use changes for the various sections, please note the update of the Ossineke sections covers a span of 25 years, while the Caledonia and Posen sections cover a period of ten and eight years, respectively. It should also be noted that land use was tracked in less detail in 1978 than in more recent years.

Wetlands

As can be noted from **Table 22**, 26,465 acres or about 5.2 percent of the Watershed's land area was identified as non-forested wetlands. Wetlands are those areas between terrestrial and aquatic systems where the water table is at, near, or above the land surface for a significant part of most years. The hydrologic regime is such that it permits the formation of hydric soils or it supports the growth of hydrophytic vegetation. Examples of wetlands include marshes, mudflats, wooded swamps and floating vegetation situated on the shallow margins of bays, lakes, rivers, ponds and streams. Wetland categories include shrub wetlands, fresh-water marshes, wet meadows, open bogs, emergent wetlands and aquatic bed wetlands.

In some situations, lands classified as lowland forests are treated as wetlands. Combining the land use types of wetlands and lowland forests for the Thunder Bay River Watershed, Phase Two, reveals that 129,141 acres (over 25 percent of the surface area) could be considered to be wetland types.

It is important to note that existing land use statistics used in this report are based on Michigan Resource Information System (MIRIS) data. Forested and wetland information contained in the MIRIS data was not verified by field inspection when the data was compiled. Thus, areas shown as wetlands on the MIRIS system may not actually meet State and Federal criteria for legally regulated wetlands. However, the information is still valuable for general land use planning decisions.

Surface Water

The Thunder Bay River Watershed Initiative, Phase Two is the home of two significant inland lakes; Hubbard Lake and Fletcher Pond, and is covered by an extensive network of rivers and tributaries. In fact surface water makes up over 4 percent of the watershed's land use types (about 21,776 acres). The combination of wetland types (including lowland forests) and surface water makes up approximately one third of the watershed's surface area.

Land Use Summary

Large amounts of upland forests (45.4%) and lowland forests (20.3%) dominate the critical area of the Thunder Bay River Watershed, Phase Two. **Tables 3** and **7** (Population Trends) and **Tables 4** and **8** (Total housing Units) in Chapter One, show that there has been a steady increase in both population and total housing units in all five counties of the watershed. Compared to past land use maps much of the increase in seasonal and year-round homes has occurred along the riparian corridor and around lakes within the watershed. Much of the population growth has occurred in Montmorency and Oscoda Counties. Montmorency County has experienced a 219% population increase over the past hundred years, with a 38% increase just since 1980. Oscoda County, with a 542% increase since 1900 (37% since 1980) shows the largest percent population increase in the watershed. Although the rate of population growth appears to have slowed considerably since 1980 for Alcona (+20%), Alpena (-3%), and Presque Isle (+1%) Counties, historical data shows that these counties had significant increases over the past century (106%, 72%, and 75%, respectively). As development continues, it is likely that there will be an increase in riparian and wetland development, which in turn will negatively impact water quality in the watershed. Considering the large areas of surface water contained within the watershed, protecting the water and wetland resources should be a major priority in land use planning. Implementing best management practices now will help reduce the amount of stress placed on the Thunder Bay River Watershed in the future

SEPTIC SYSTEM INVENTORY

The health of a watershed can be influenced by the state of the septic and sewer systems within its boundaries. When a septic system malfunctions or overflows, bacteria and nutrients are released and may contaminate the lakes, streams or groundwater of the watershed. Poorly installed, improperly sited or overused systems, and older systems that were installed prior to the adoption of current zoning ordinances are potential contributors of this type of non-point pollution. Another potential problem for the watershed is seasonal homes that are converted for year round use without updating and expanding existing systems. The increased load may cause a septic system failure and as a result, contaminate area wells and waterbodies.

METHODOLOGY

A general survey of septic systems within the Thunder Bay River Watershed Initiative, Phase Two was conducted by NEMCOG in the summer of 2004. Information on septic systems was compiled using data obtained from various sources such as the District Health Department #2, District Health Department #4, the U.S. Bureau of Census, The Environmental Protection Agency, and the Department of Environmental Quality. By comparing data from these various sources and **Map 4: Septic System Constraints,** it was possible to discern generally which areas tend to have the oldest systems, which areas are being heavily developed and areas that are most susceptible to septic problems and therefore least suitable for increased development.

RESULTS

Nearly the entire watershed, and all of the critical area, is under severe constraints for septic systems. The cause for severity varies from section to section, and even from parcel to parcel. Constraints due to wetness and soils that *percolate* (perc) slowly dominate much of the watershed. Percolation is the downward movement of water through the soil. In the western portion of the watershed, particularly in Rust Township, constraints are due mainly to large areas covered by hydric soils. Hydric soils are saturated for most of the year, and when soils are too wet, oxygen is not available for organisms that break down waste. Septic systems

constructed in hydric soils therefore may not operate properly during wet seasons, resulting in groundwater contamination.

Hydric soils and areas of wetness also impact the effectiveness of septic systems in the northern portion of the watershed. In addition, this section contains areas of bedrock and large rocks, particularly in Metz Township, Presque Isle County. In the northwestern portion of the watershed (Montmorency Township in particular) poor filtering soils dominate the landscape. Poor filtering materials such as sand and gravel allow liquids to pass through too quickly to filter out effluents, increasing chances of associated bacteria coming in contact with groundwater. Compounding the problem is the fact that nearly 40 percent of the homes in Montmorency Township (and 35 percent of homes for the county) were built before 1960. Even though a small percentage of these older homes undoubtedly have had their septic systems upgraded due to expansion or system failure, most are using systems that are over forty years old. While the efficiency and effectiveness of a system tends to decrease over time, a well maintained older system is not necessarily on the verge of failure. Many older systems, however, were installed at a time before current water protection requirements were in effect.

The southern portion of the watershed, including parts of Alpena, Oscoda, and Alcona Counties, consists of a hodge-podge of severe limitations such as steeply sloped areas, poor filtering soils, soils that perc slowly, and wet soils (see **Map 4**). This area has seen steady development over the last thirty years. In addition, **Table 24** Shows that the region has a substantial number of homes that were built prior to 1960, before current sanitary codes were in place. Continued development combined with a large number of older systems creates a potential risk to the future health of the watershed.

The Thunder Bay River Watershed, Phase Two area falls under the jurisdiction of two health departments. Alcona and Oscoda Counties are regulated by District Health Department #2, and District Health Department #4 oversees Alpena, Montmorency, and Presque Isle Counties. District #2 has issued approximately 1000 new permits over the last ten years, mostly residential (DEQ writes permits for commercial systems discharging 10,000 gallons or more per day). Health Departments are required to submit to the DEQ an annual report on failed systems. For District #2, 25-30 percent of the permits written each year are for replacement of failed systems. The most common reasons for failure include systems that are too old, too small, have too many people using them, or systems that have been damaged by excavation or driving over them.

Alcona County (which includes the heavily developed Hubbard Lake area) in particular should be monitored closely. In addition to having a large number of septic systems that were installed prior to 1960, Alcona has had a population increase of over 15 percent and a housing increase of nearly 13 percent in the last 25 years. This increase in population and housing development combined with a substantial number of older systems, hydric soils, steep slopes and poor filter material create a potential threat to water quality for the Thunder Bay River Watershed. At this time, the District #2 Health Department is in the process of re-writing its sanitation code to require larger, compartmentalized tanks for new or replacement systems.

TABLE 24: Age Distribution of Homes in the Watershed

County	Total Homes	Built 1960-2000	Built Before 1960
Alcona	14,520	9493	5027
Alpena	8854	6110	2744
Montmorency	5408	3535	1873
Oscoda	1750	1209	541
Presque Isle	1964	1238	726
Total	**32,496**	**21585**	**10911**

Nearly all of the lands designated residential or agricultural for the watershed lie within areas of severe septic constraints due to soils that are hydric, wet, or poor filtering, or that perc slowly, as can be seen when **Map 4: Septic Constraints** is compared to **Map 3: Land Use**. If the trend of expanding residential areas continues as more and more agricultural lands are parceled out for development, increased potential for contamination to the water supply is inevitable. Septic system and soil constraints will need to be considered carefully in any future development in these areas and great care will need to be taken to ensure the continued health of the Thunder Bay River Watershed.

GROUNDWATER INVENTORY

There is a direct link between surface water and groundwater contamination. For the Thunder Bay River Watershed, as well as virtually all of northeast Michigan, groundwater is the only source of drinking water. It is therefore imperative that groundwater be protected from contamination. It is far less costly to use contamination preventative measures than it is to restore a contaminated ground water site to a potable state. Along with pollutants carried into the water system via stormwater drains, road/stream crossings and residential/agricultural runoff, contamination from abandoned wells, leaking underground storage tanks and other industrial sources may also find its way into ground water. Also, portions of the watershed exhibit karst topography and special care needs to be taken in these sensitive areas. The porous geology of limestone bedrock can allow for direct contamination from the surface to ground water resources.

METHODOLOGY

In order to determine the presence and extent of chemical contaminants in the watershed, DEQ and EPA documents were reviewed to identify Leaking Underground Storage Tanks (LUST) and other sites of contamination.

RESULTS

According to the Michigan Department of Environmental Quality Leaking Underground Storage Tank (LUST) Database*, there are twenty LUST sites in Alcona County, one of which is located within the phase two portion of the Thunder Bay River Watershed. In Alpena County there are sixty-three LUST sites, six located within the watershed. Presque Isle, Montmorency, and Oscoda Counties have thirty-six, twenty-eight, and ten sites, respectively. None of the contamination sites of Montmorency County are within the watershed boundary; seven of Presque Isle's contamination sites and six of Oscoda's are located within the watershed critical area. The majority of pollutants from LUST's are either gasoline or diesel fuel.

TABLE 25: WATERSHED CONTAMINATION SITES

COUNTY	Sites with Arsenic	Sites with Nitrates	Sites with VOC	Total Contaminated Sites
Alcona	6	78	1	**85**
Alpena	4	145	10	**159**
Montmorency	1	10	0	**11**
Presque Isle	3	37	3	**43**
Oscoda	8	31	2	**41**
WATERSHED	**22**	**301**	**16**	**339**

*The database, which is updated weekly, was consulted in 2004

The Contamination Investigation Unit of the Department of Environmental Quality (DEQ) conducts a drinking water contamination investigation program, which includes groundwater

contamination from sources other than LUST sites. According to the DEQ WaterChem Database, 1983-2003 samples, contamination has been found at 339 sites tested within the watershed. Pollutants include Arsenic, Nitrates, and Volatile Organic Chemicals (VOC). Some common sources of these pollutants are landfills, refuse systems, metal processing, auto repair, petroleum products, private households, agricultural services and chemical product manufacturing. **Table 25** indicates contamination sites for the watershed, listed by county and type of contaminant.

ARSENIC

Arsenic is a known carcinogen, and has been linked to other health-related problems such as central nervous system disorders, heart damage, birth defects and skin problems. Earth materials such as bedrock, sand, and gravel may contain arsenic bearing minerals, and may enter water from these natural deposits in the earth, from industrial and agricultural operations, or as a by-product of copper smelting, mining or coal burning. In this country, thousands of pounds of arsenic are released into the environment every year by industry alone. Arsenic was found at twenty-two sites within the Thunder Bay River Watershed, Phase Two area. None of the sites exceeded the EPA's Maximum Contaminant Level (MCL) of 0.010mg/L for arsenic in drinking water, and if pollution control measures are strictly adhered to, this dangerous pollutant need never become a threat to the watershed.

NITRATES

Nitrate, one of the most widespread contaminants, can get into water from sources such as livestock waste, septic tank/drainfield effluent, crop and lawn fertilizers, municipal wastewater sludge application, and natural geologic nitrogen. As well as posing health risks to infants and young children, the excessive levels of nitrates in drinking water may indicate potential for the presence of other contaminants. In the Thunder Bay River Watershed, Phase Two , 301 sites tested positive for nitrates. The EPA has established the MCL for nitrates at 10 mg/L. Two of the sites in the watershed were found to have nitrate levels between 10-20 mg/L, and four sites showed levels of over 20 mg/L.

VOLATILE ORGANIC CHEMICALS

This group of contaminants includes a wide range of chemicals found to have detrimental effects on both the environment and the life forms (including humans) that it supports.

TABLE 26: VOLATILE ORGANIC CHEMICALS

Chemical	MCL*	Chemical	MCL	Chemical	MCL
Benzene	0.005 mg/L	Dichloromethane	0.005 mg/L	Ethylbenzene	0.7 mg/L
Carbon Tetrachloride	0.005 mg/L	Monochlorobenzene	0.1 mg/L	o-dichlorobenzene	0.6 mg/L
1,2-dichloroethane	0.005 mg/L	St`yrene	0.1 mg/L	Tetrachloroethylene	0.005 mg/L
Cis-1,2-dichloroethylene	0.07 mg/L	Trichloroethylene (TCE)	0.005 mg/L	Trans-1,2-dichloroethylene	0.1 mg/L
1,1,1-trichloroethane	0.20 mg/L	Toluene	1 mg/L	1,2-dichloropropane	0.005 mg/L
Para-dichlorobenzene	0.075 mg/L	Vinyl Chloride	0.002 mg/L	Xylenes (Total)	10 mg/L
1,1-dichloroethylene	0.007 mg/L	1,2,4-trichlorobenzene	0.07 mg/L	1,1,2-trichloroethane	0.005 mg/L

Sources of Volatile Organic Chemicals (VOC's) include improper storage and waste disposal; solvents; leaking underground fuel storage tanks; petroleum refining; cigarette smoke; several types of fumigants; fire extinguishers; cleaning agents; dry cleaning solvents; metal degreasers; adhesives; varnish; gasoline additive; agricultural runoff; industrial waste; leaking gas tanks;

* The MCL for each of the chemicals listed varies from 0.002 mg/L (Vinyl Chloride) to 10 mg/L (Xylenes). Only the presence of a volatile organic chemical is noted; information concerning the level of contamination for each site is not available.

styrene production; industrial metal; and the manufacture of fluorocarbons, chloro-fluoromethane, plastics, synthetic rubber, insulators, pesticides, resins and solvents. **Table 26** lists each chemical found in the watershed, as well as its MCL as established by the EPA.

The discharge of hazardous substances into water bodies presents one of the serious health threats to the community. Contaminated drinking water contains many substances that cause cancer and interfere with the function of several body organs, including the heart, liver, brain and skin. Contamination of water resources by hazardous substances such as benzene, nitrates, arsenic, mercury, cadmium and petroleum products can affect the health of anyone, but children are especially susceptible. Because their bodies are still developing, children tend to retain more of these substances.

In 1972, Congress passed the Federal Water Pollution Control Act (commonly known as the Clean Water Act) aimed at halting large-scale pollution of the country's lakes and rivers. The Act made it illegal for anyone to discharge pollutants into navigable water bodies without obtaining a permit. There is no question that the Clean Water Act has had a positive impact on the health of the nation's rivers and streams. However, small amounts of pollution from nonpoint sources that enter rivers and streams during a storm event can seriously degrade a water system over time. In order to maintain a high level of water quality, measures such as rain gardens, detention/retention basins, filter strips and effective stormwater ordinances are needed to impede this indirect flow of contaminants to the Thunder Bay River and its tributaries.

Chapter Five:
Priority Pollutants and Their Sources and Causes

Relying on insight gained from the various watershed inventories, steering committee members prioritized the pollutants, sources and causes affecting the watershed. Using the nominal group process, members were given four votes to cast for the pollutant thought to be the most detrimental to the watershed. The same process was then performed for the sources and causes of the pollutants, with steering committee members selecting four of each. The pollutants receiving the most votes were considered highest priority, those receiving few or no votes were considered low or not a priority.

Priority Pollutants

As indicated on **Table 27**, sediments and nutrients were ranked the top two pollutants of concern. Invasive species, increased temperature, pesticides, heavy metals, and bacteria were also identified as impacting the watershed.

Table 27: Priority of Pollutants

Pollutant	Ranking
Sediments	1
Nutrients	2
Invasive Species	3
Increased Temperature	4
Heavy metals/organic compounds	5
Pesticides	6
Bacteria	6
Flow Changes	7
Chlorides/brine	8

Designated Use Pollutants

The waters of the State of Michigan are required by Part 31 of the Natural Resources and Environmental Protection Act, P.A. 451 as amended, to maintain quality sufficient to meet seven designated uses. The designated uses the watershed's lakes and rivers must support are agriculture, industrial water supply, public water supply, navigation (where applicable), warm and cold water fisheries, wildlife and aquatic habitat, and total or partial body contact.

According to the American Heritage dictionary, one of the definitions of pollution is “to make less suitable for an activity, especially by the introduction of unwanted factors”. Although invasive species are not technically a pollutant, Because of the considerable amount of destruction to habitat, their tendency to out-compete native species for food and other resources, and their negative impact on the watershed’s recreational use, this description readily applies to many types of invasive species. Therefore, the decision was made to include them in this section along with pollutants determined to have a detrimental effect on the watershed.

The following designated uses were determined by the steering committee to be adversely affected by one or more of the pollutants stated above. Sediments, nutrients, increased temperature and invasive species are the priority pollutants to control for protecting the

coldwater fisheries, total/partial body contact, aquatic life, navigation and public water supply. Heavy metals/organic compounds, pesticides, and bacteria were also identified as threatening the designated uses. **Table 28** shows the relationship between each pollutant and the designated use it affects.

Table 28: Designated Use Pollutants

Designated Use	Pollutant
Warm and Cold Water Fisheries	Nutrients Bacteria Sediments Invasive Species Heavy Metals/Organics Increased Temperature
Indigenous Aquatic & Wildlife	Sediment Nutrients Heavy Metals/Organics Pesticides Invasive Species
Navigation	Sediment Invasive Species
Public Water Supply	Nutrients Bacteria Heavy Metals/Organics
Total/Partial Body Contact	Bacteria Invasive Species

Table 29: Sources of Pollution

Pollutant	Rank	Source	Rank
Sediments	1	Road/stream crossings	1
		Stormwater runoff	2
		Eroding streambanks	3
		Land development	4
		Oil and gas development	5
		Livestock management	6
Nutrients	2	Septic systems	1
		Lawn fertilizers	2
		Livestock management	3
		Stormwater runoff	4
Invasive Species	3	Recreational boating/bait pails	
		Waterfowl	
Increased Temperature	3	Stormwater runoff	1
		Land development	2
		Impoundments	3
Heavy metals/Organic compounds	4	Stormwater runoff	1
		Road/stream crossings	2
		Contaminated sites	3
Pesticides	5	Lawn fertilizers	1
		Cropland	2
Bacteria	6	Septic systems	1
		Stormwater runoff	2
		Livestock management	3

Sources of Pollution

The main sources of pollution, as identified by the steering committee and based on the results of the nonpoint pollution inventories, were road/stream crossings, septic systems, stormwater runoff, and residential lawns. Other sources of pollution include streambanks, agricultural activities, development sites, oil and gas development and contamination sites. These pollution sources were then ranked by the steering committee using the process described previously, with a ranking of one being the highest concern. **Table 29** above lists these sources by rank and type of pollutant.

Causes of Pollution

In order to correct existing nonpoint source pollution and prevent future pollution problems from occurring, sources and causes for each pollutant were identified, and steering committee members were asked to select the causes of pollution considered most detrimental to the watershed. Causes of pollution in the Thunder Bay River Watershed Phase Two are ranked in **Table 30** below, with a ranking of number one indicating the highest priority cause of pollution. The third and fourth columns, *Pollutants* and *Sources* are included for clarification of the causes.

Table 30: Causes of Pollution

Rank	Cause	Pollutants	Sources
1	Inadequate erosion control	Sediments; Increased temperature	Streambanks; Access Sites; Road/stream crossings; Development sites; Residential lawns; Agriculture operations
2	Undersized/deteriorating culverts	Sediments; Heavy metals/ organic compounds	Road/stream crossings
3	Impervious surfaces (such as parking lots or rooftops)	Sediments; Heavy metals/ organic compounds	Stormwater runoff
4	Loss of greenbelt	Sediments; Increased temperature	Land development, manicured lawns
5	Improper/overuse of pesticides	Pesticides	Residential lawns; agriculture operations
5	Introduction of non-native species	Invasive Species (Eurasian watermilfoil, zebra mussel, etc.)	Bait buckets; Boats, Waterfowl
5	Improper/overuse of fertilizers	Nutrients	Residential lawns; agriculture operations
6	Uncontrolled livestock access	Sediments; Nutrients; Bacteria	Agriculture operations
6	Improper disposal of hazardous household wastes	Heavy metals/organic compounds; Pesticides; Nutrients	Residential sites; Stormwater runoff; Contamination sites
7	Animal manure	Bacteria; Nutrients; Increased Temperature	Agriculture operations; Waterfowl; Pets
7	Leaves, grass clippings	Nutrients	Residential lawns
7	Construction activities	Sediments; Increased temperature	Development sites
7	Improperly sited, designed or maintained septic systems	Nutrients; Bacteria	Residential sites

Table 31 below lists some of the methods commonly used to reduce pollution from a particular source in order to protect or restore a Designated Use.

Table 31: Pollution Reduction Strategies			
Designated Use	**Cause or Source of Threat**	**Pollutant**	**Method of Reduction**
Public Water Supply	Inadequate septic systems	Nutrients; Bacteria	Work with local gov'ts to establish system of septic inspection & upgrades
	Livestock access to streams		Exclusion fencing, proper crossings, watering systems
	Groundwater contamination	Pesticides/ Herbicides	Install corrective measures to reduce runoff at agricultural sites
		Heavy Metals/ Organic Compounds	Encourage landowners to reduce amount of fertilizers/pesticides used
			Encourage use of HHW drop off sites
			Reduce/eliminate direct stormwater runoff to streams/lakes
Navigation	Sedimentation	Sediments	Stabilize erosion at streambank erosion sites
			Stabilize erosion at road/stream crossing sites
		Invasive Species	Educate public to prevent spread of invasive species
Warm/Cold Water Fisheries	Sedimentation from construction/development sites	Sediments	Conservation buffers/greenbelts
			Information to developers, construction companies
	Lawn care/ agriculture practices	Nutrients	Encourage landowners to reduce amount of fertilizers/pesticides used
			Install corrective measures to reduce runoff at agricultural sites
Aquatic Life/Wildlife	Development/ construction along shorelines		Conservation buffers/greenbelts
			Information to developers, construction companies
	Nutrients, chemicals from lawn care/ agriculture practices	Pesticides/Herbicides	Encourage landowners to reduce amount of fertilizers/pesticides/herbicides used
Partial/Total Body Contact	Failing septic systems	Bacteria	Encourage proper installation/maintenance of septic systems through zoning, health codes and landowner education.

Chapter Six:
Watershed Zoning and Ordinances

Overview

Watershed management requires the use of many different techniques in order to be effective. Management tools include proactive elements such as educational outreach programs, voluntary land protection incentives for property owners in critical areas, research and monitoring as well as remedial measures including implementation of Best Management Practices to restore nonpoint source pollution sites and incorporating conservation-friendly design standards into new developments. Land use planning and zoning at the local level, is another important tool for watershed protection. In addition to the direct benefits for aquatic resources, planning and zoning are tools used for ensuring the conservation of wildlife habitat, providing for sustainable development, protecting property values and maintaining community character.

A sound planning and zoning program requires that a community not only "buy-in" to the idea, but dedicate the trained personnel and funding to make the program work; effective planning and zoning thus takes commitment and resources.

In the state of Michigan, planning and zoning are implemented at the township, municipal, or county level. The enabling legislation for land use planning can be found within four state acts:

- Public Act 285 of 1931 -- Municipal Planning Act
- Public Act 168 0f 1959 -- Township Planning Act
- Public Act 282 of 1945 -- County Planning Act
- Public Act 281 of 1945 --Regional Planning Act

Following adoption of a master plan, the local unit of government creates a zoning ordinance. In accordance with these acts, the zoning ordinance must be based on the goals and policies set forth in the master plan.

The state has three legislative zoning acts that enable local units of government to control land uses through regulation of activities on the land:

- Public Act 184 of 1943 -- the Township Rural Zoning Act
- Public Act 183 of 1943 -- the County Zoning Act
- Public Act 207 of 1921 -- the City and Village Zoning Act

In addition to planning & zoning, there are state regulations that are intended to help conserve natural resources. Relevant state laws for water resource protection include (this is only a brief summary, please see the respective law or contact MDEQ for more information):

- Act 451, Part 91, Soil Erosion Control and Sedimentation Act
  (for earth changes within 500 feet of the shoreline)
- Act 451, Part 303, Wetland Protection
  (covers the dredging, draining, or filling of regulated wetlands; however, non-contiguous wetlands in rural counties are generally not regulated wetlands)
- Act 451, Part 301, Inland Lakes & Streams Act
  (covers work conducted below the ordinary high water mark)
- Public Act 368 (1978), Aquatic Nuisance Control

For some of the issues related to watershed management, agencies (beyond the local unit of government) have a regulatory role. In the case of soil erosion & sedimentation, the Michigan Department of Environmental Quality (MDEQ) has jurisdiction; they typically have an agreement

with counties to enforce the program at the local level (thus counties have a Soil Erosion Officer). With regard to regulation of wetlands, MDEQ also has jurisdiction (authorized through the federal Clean Water Act). Regulations for septic systems are handled through the District Health Department. In all three of the areas listed above, a local community may adopt their own programs for managing the resource (standards adopted cannot be weaker than what the state would otherwise use). Such a decision to adopt a local ordinance may lead to more work for the local unit of government and a greater expenditure of fiscal resources; it may also create an opportunity to better achieve the goals identified in the community's comprehensive master plan.

In any event, a local unit of government should develop a master plan (based on public input) that allows planning for future needs while maintaining existing features that are important to the community. The plan becomes the basis for the zoning ordinance. Attention should be paid to whether the standards in the zoning ordinance actually achieve the goals set forth in the master plan; oftentimes they do not. Once local government units have "good" land use policies in place, there is still work that needs to be done -- the governing body must keep their policies up-to-date and make decisions regarding infrastructure and zoning in accordance with their plan.

Oftentimes, volunteers on local zoning boards are pressured to make a decision on a site-specific issue without considering the whole system. Zoning standards and decisions must be made with the comprehensive master plan in mind; it can be extremely difficult to step back from a particular issue and consider the big picture, but that is exactly what trained planning commission officials must do. In addition, zoning regulations need to be enforced and monitored. Without fair and impartial enforcement, the majority who comply with land use regulations are, in effect, penalized, because of the greater effort and expense they have incurred than those who disregard regulations. If enforcement is not consistent and fair, regulations will be come increasingly ineffective as the majority of landowners disregard the rules, or as the court system ceases to uphold the regulations due to discriminatory enforcement

This following review of local land use regulations in the Thunder Bay River Watershed was prepared by the Northeast Michigan Council of Government in April 2004. This review is not intended to evaluate the history of planning and zoning within the watershed, nor is it intended to be the sole basis for determining the effectiveness of policies regarding water resource management. This evaluation should provide insight into how effective local units of government are at protecting aquatic resources and help to identify some of the obvious weaknesses in current zoning ordinances.

Summary of Local Planning & Zoning Efforts

Townships located in a county with zoning have the option of having the county handle the entire planning and zoning program or administering their own. (In two townships of the watershed, neither the county nor the township has a zoning ordinance; these areas are considered "unzoned"). Within the North and South Branch areas of the Thunder Bay River Watershed, only Presque Isle County has a county zoning ordinance, while each of the watershed townships in Alpena, Alcona, Montmorency and Oscoda Counties administers its own program. The exception is Mitchell Township in Oscoda County, which remains "unzoned". **Table 32** lists local government units within the watershed along with the adoption, amendment or revision dates of their master plans and zoning ordinances.

Table 32: Planning and Zoning Jurisdictional Units For the Thunder Bay River Watershed, Phase Two		
Government Unit	**Zoning Ordinance** Date of Adoption, or latest revision/ amendment	**Master Plan** Date of Adoption, or latest revision/ amendment
Presque Isle County	2001	1979 (County is currently updating plan)
Krakow Township	1999	1996
Posen, Metz, & Bismarck Townships are Zoned through County		
Montmorency County	No county zoning	1979
Montmorency Township	1990	1988
Briley Township	1999	2000
Rust Township	1986	2004
Loud Township	2002	1977
Hillman Township	1993	1996
Alpena County	No county zoning	2004
Long Rapids Township	1999	1975
Alpena Township	1999	1993
Wilson Township	1999	1999
Green Township	2000	Master plan drafted, tentative adoption: 2005
Maple Ridge Township	1992	2001
Ossineke Township	2001	1991
Alcona County	No county zoning	2001 (County is currently updating plan)
Caledonia Township	2002	(Tri-Township) 1994
Haynes Township	1994	1979
Mitchell Township	1990	None
Alcona Township	1997	(Tri-Township) 1994
Hawes Township	2004	(Tri-Township) 1994
Millen Township	1989	1989
Oscoda County	No county zoning	1996
Clinton Township	Unzoned	None
Comins Township	1991	1973 (currently being updated)

To determine, in part, the efficacy of regulatory coverage for aquatic resources within the Thunder Bay River Watershed, local zoning ordinances were reviewed to evaluate what, if any, "environmental provisions" are in place that may have an impact on water resources. **Table 33** on pages 71 and 72 can assist local government policy makers in identifying how their ordinances might be amended to better protect water resources. The ordinances were specifically reviewed for the following:

- *Vegetative Buffer Zones* (Greenbelts): With regard to minimizing the impact of residential development along the waterfront, ensuring that natural vegetation is retained along the

shoreline is generally considered one of the most important actions that can be taken. Vegetative buffers help to filter nutrients, reduce erosion, and provide natural habitat. Although much research has been done through the years to verify the effectiveness of vegetative buffers, there are several practical difficulties with having a "greenbelt ordinance." It can be difficult to enforce, many local officials and residents are unaware of what an effective greenbelt consists of, historic patterns of development have already degraded many areas (and these may be "grandfathered" in), zoning language is often poorly worded for proper enforcement, and citizens are often unaware that there is an ordinance in place. Even with the negatives, however, maintaining a greenbelt is essential to protecting water resources – even a 25-foot greenbelt can be effective. A mowed lawn to the water's edge is not a greenbelt.

- *Setbacks of structures* along the waterfront are important for reducing the amount of impervious surface near the water, helping to ensure that a greenbelt can be maintained, and reducing the potential for serious resource problems. A structure that is setback only 30 or 40 feet is more likely to be direct runoff pollutants and sediments into water resources than a structure 75 or 100 feet away from the water's edge. Unfortunately, many local units of government that do have an effective setback for homes will make many exceptions for large decks and boathouses. Such exemptions defeat the intent of the setback, as impervious surface cover will still be present near the water's edge. Furthermore, of the local units of government that have a greenbelt requirement of 50 or 75 feet width, many allow the structure setback to be less than the greenbelt restriction. Such a scenario significantly reduces the effectiveness of the greenbelt requirement. In addition, during the construction period, a structure built less than 50 feet from the water will have construction site disturbances that abut the water's. An unavoidable consequence of this practice is the destruction of the greenbelt during construction. Maintaining the natural greenbelt in the first place is much easier than restoring a greenbelt. Setback requirements should be regarded as a key element for water resource protection.

- *Minimum Lot Width for waterfront parcels* is important for the protection of waterbodies because it ultimately determines the number of homes that will be built on the water. Developed shorelines with less than a 100-ft minimum lot width often experience water resource problems. Generally, smaller lot widths around a lake leads to more homes, resulting in greater wastewater treatment needs; increased user conflicts; fertilizer input to the lake; stormwater runoff; increased site erosion, and loss of native vegetation. A higher density of homes results in an increase in the amount of impervious cover in the critical near-shore areas of surface water.

- *Open space preservation* is used for communities to protect their rural character, as well as maintain prime recreational, farm or forest land. Unfortunately, most zoning ordinances, if implemented as written, will not accomplish those goals. Few local units of government in this watershed have open space guidelines, and many of those that do typically state something to the effect: "At least 40% of the total gross project shall be left as open space." Some only require 25%, which is insufficient to accomplish their community goals.

  An improvement to the open space section of local ordinances would be to require the developer to increase the amount of open space to 50 or 60% and also make sure that some of the set aside acreage is from the developable portion of the site. Steep slopes, surface water, wetlands, etc., should be excluded from this calculation; otherwise only the most undesirable areas will be set aside as open space. Ordinance language should be something such as, "A minimum of 60% of the parent parcel's gross acreage shall be set

aside as permanently protected open space. This area shall include at least half of the parcel's buildable land area."

There are incentive programs that local communities can adopt to encourage open space preservation, such as allowing higher development densities on the remaining land in a development or through setting up a Purchase of Development Rights (PDR) program.

- *Septic Systems* are under the jurisdiction of the District Health Department. Typically, only severe problems are addressed, departments are understaffed, and there are poor records regarding septic systems. Some local units of government have begun to initiate their own programs for inspections, maintenance, or replacement requirements. Generally, such a program is being run as a "Point of Sale" program, whereby inspections of septic systems are required at the time of property transfer. System upgrades are then required for those systems that are not working properly.

- *Wetland Protection* is handled through the state Department of Environmental Quality. For rural northern Michigan, the law does not apply to isolated wetlands. Some communities have addressed this oversight by adopting their own wetland regulatory program, which is authorized through the state wetland act. As can be noted in **Table 33,** no local ordinances include wetland standards *beyond those at the state level*.

Table 33: Summary of Environmental provisions in the Thunder Bay River Watershed, Phase Two

Local Government Unit	Vegetative Buffer Zones/ Greenbelt	Waterfront Setbacks	Min. Lot Width for Riparian Parcels	Open Space	Septic Systems	Wetland Protection provisions	Stormwater Management	Other Environmental Provisions
Presque Isle County	No provision	30 ft.	75 ft.	Yes, in PUD section	Yes	No provision	No provision	No
Krakow Township	75 ft.	75 ft.	75 ft.	Yes, in PUD section	No provision	No provision	No provision	No
The Townships of Posen, Metz and Bismarck are zoned through Presque Isle County								
Montmorency County: No county zoning ordinance								
Montmorency Township	35 ft.	45 ft.	70 ft.	Yes, 70% of parcel	Montmorency Co. Sanitary Code	No provision	No provision	No
Briley Township	70 ft. from waterfront	70 ft.	100 ft.	No provision	Must be no less than 70 ft. from surface water	No provision	No provision	Fertilizers/ chemicals use not allowed in Greenbelt
Rust Township	30 ft. from waterfront	100 ft.	100ft.	Yes, 40% of PUD	Must be no less than 100ft. from water's edge, & comply with State statutes	No provision	No provision	Greenbelt District from 200 ft. to water; soil erosion regulations
Local Gov't Unit	**Greenbelt/ Buffer Zone**	**Waterfront Setbacks**	**Min. Lot Width**	**Open Space**	**Septic Systems**	**Wetland Provisions**	**Stormwater Management**	**Other Environmental Provisions**
Loud Township	35 ft. from waterfront	40 ft. (not specific to waterfront)	100 ft.	No provision	"…must meet applicable health & sanitary codes…"	No provision	No provision	No

Hillman Township	25 ft. from water & vegetation removed from no more than 20% shore length	35 ft.	100 ft.	Yes, 25% of PUD must remain open space	Township requires inspection prior to sale of property & corrective action	No provision	Yes, stormwater must stay on site	Waterfront access/ density restrictions (limits "funneling")
Alpena County: No county zoning ordinance								
Long Rapids Township	100 ft from water	20 ft (not specific to waterfront)	300 ft.	No provision	No provision	Refers to Environmental Conservation Overlay	Environmental Conservation Overlay	
Alpena Township	25 ft.	25 ft.	100ft.	No provision	Refers to Co. Health Dept.	No provision	Yes	No
Wilson Township	70 ft. from water	70 ft.	150 ft.	Yes, in PUD section	Refers to District Health Department	No provision	No provision	No
Green Township	70 ft. from water	35 ft.	150 ft.	No provision	Refers to County Health Department	No provision	No provision	Waterfront provisions under special Conservation-Resources section
Maple Ridge Township	70 ft. from water	35 ft.	150 ft.	Yes, clustering option	Refers to County Sanitary Code	No provision	No provision	Conservation Resource District 400 ft. to water
Ossineke Township	No provision	40 ft. (not specific to waterfront)	150 ft.	Yes, in PUD section	Refers to County Sanitary Code	No provision	No provision	Conservation Resource District 400 ft. to water
Alcona County: No county zoning ordinance								
Caledonia Township	10 ft. row of evergreens ea. side of boat launch	40 ft., 75 ft. for non-residential	100 ft.		Yes	No provision	No provision	Lakes Shore Development District
Haynes Township	No Provision	40 ft. (not specific to waterfront)	80 ft.	No provision	Refers to State Health Department	No provision	No provision	No
Mitchell Township	No provision	30 ft.	100ft.	Yes	Refers to District Health Department	No provision	No provision	No
Alcona Township	40 ft.	40 ft.	100 ft.	No provision	Yes	No provision	No provision	Flood Plain District
Hawes Township	No provision	40 ft.	80 ft.	No provision	Yes	No provision	No provision	No
Millen Township	45 ft.	75 ft.	100 ft.	70% of parcel area	Refers to District Health Department	No provision	No provision	No
Oscoda County: No county zoning ordinance								
Clinton Township is "Unzoned"								
Comins Township	25 ft.	50 ft.	150 ft.	Yes	Yes	No provision	No provision	No provision

Chapter Seven:
Goals, Objectives and Recommendations

GOALS AND OBJECTIVES

At the March 16, 2004 meeting of the Thunder Bay River Watershed Initiative Phase Two steering committee a discussion of possible goals for the watershed was held, and a list of watershed goals was drafted. The goals are intended to enhance, improve, and protect the quality of the watershed, and to ensure the waters meet all seven of the state mandated designated uses and the desired uses proposed by the community (see *Designated Uses* Chapter 2, pp. 25 & 26).

At a subsequent meeting on June 16, 2004 this list of goals was posted and reviewed by committee members. A few last minute changes were made to the list before voting took place.

A simple voting method was used. Each committee member present was given four "sticky dots". Members were asked to attach the dots to the goals on the posted list that they felt were most important. Votes were tallied, and goals received a priority rating according to the number of votes each received. The following table shows the results of this voting process.

PRIORITY NUMBER	GOAL
1	Establish Responsible Land-Use Practices
2	Reduce the amount of erosion and sedimentation entering water bodies.
3	Improve, Restore and Protect the Coldwater Fisheries
4	Reduce the amount of stormwater runoff to lakes and rivers of the watershed
5	Develop Educational Tools for Citizens of the Watershed
6	Complete a comprehensive lake assessment of Lake Hubbard
7	Develop an emergency first action response plan to reduce reaction time following a hazardous materials spill
7	Reduce amount of chemical/nutrient runoff

In order to define the scope of each goal, a list of objectives was drafted. The objectives are the means in which the goals are achieved. **Table 34** lists the watershed goals along with the objectives for reaching those goals.

Each objective is further broken down into specific tasks that will need to be accomplished in order to reach the watershed goals. Milestones that will ensure the tasks are accomplished in a timely fashion will document the progress of the watershed plan. The tasks and milestones for the goals and objectives of each component of the plan are shown in the recommendation section.

TABLE 34: PROPOSED GOALS FOR THE THUNDER BAY RIVER WATERSHED INITIATIVE, PHASE TWO		
Goal 1:	**Improve the quality of watershed lakes and rivers through an enhanced knowledge of the ecological & biological integrity of the water resources.**	**Priority**
Objective 1:	Complete a comprehensive lake assessment of Hubbard Lake	1
Objective 2:	Encourage local governments to develop land use management plans	1
Objective 3:	Protect/restore sensitive areas such as wetlands and riparian corridors	1
Objective 4:	Encourage riparian landowners to maintain/create native conservation buffers	2
Objective 5:	Provide model zoning ordinances and encourage the adoption of zoning laws establishing setbacks	3
Objective 6:	Encourage enforcement of "no wake" laws through signage, working with enforcement agencies and river watch groups	4
Goal 2:	**Reduce the amount of erosion and sediments entering water bodies.**	
Objective 1:	Stabilize eroding streambanks through installation of corrective measures	1
Objective 2:	Reduce sedimentation from road/stream crossings by implementing sound best management practices.	2
Objective 3:	Improve public access sites by creating canoe launch pads, steps etc.	3
Goal 3:	**Improve, Restore and Protect the Coldwater Fisheries of the Thunder Bay River Watershed**	
Objective 1:	Reduce/eliminate sedimentation from road/stream crossings by implementing appropriate BMPs	1
Objective 2:	Stabilize eroding streambanks	1
Objective 3:	Protect and restore the riparian shade vegetation through landowner education and involvement	1
Objective 4:	Restore aquatic habitat in the watershed where impairment is suspected.	2
Objective 5:	Increase fish passage at hydroelectrical dams	2
Objective 6:	Restrict livestock access to the river	3
Objective 7	Educate public as to the importance of using native vegetation when restoring greenbelts	3
Goal 4:	**Reduce the amount of stormwater runoff to lakes and rivers of the watershed**	
Objective 1:	Implement stormwater BMPs to eliminate storm drains discharging directly to water bodies of the watershed	1
Objective 2:	Develop method to conduct water quality testing to ensure the water is suitable for total body contact	2
Goal 5:	**Develop Educational Tools for Citizens of the Watershed**	
Objective 1:	Involve and educate the public on actions they can take to reduce nonpoint source pollution	1
Objective 2:	Create and have installed: watershed signs, logo, drain stenciling etc.	2
Objective 3:	Create a series of detailed water drainage maps, 100 year flood	3
Objective 4:	Create and distribute residential landowner brochures “Protect Your Watershed”	4
Objective 5:	Supply emergency first action response information for accidental spills, educate public on who to call, include contact information in watershed brochures	5
Goal 6:	**Complete a comprehensive lake assessment of Lake Hubbard**	
Objective 1:	Develop plan to assess such indicators of lake water quality as DO, condition of biological communities, temperature, conductivity, pH, flow, trophic state, nutrients, land cover types, types & quality of habitat, presence of invasive species, and presence of metals & chemicals.	1
Objective 2:	Develop an educational component to increase public awareness about causes of and methods to prevent the spread of invasive species.	2
Goal 7:	**Reduce Amount of Chemical and Nutrient Runoff**	
Objective 1:	Educate landowners to identify and correct improperly sited, maintained or installed septic systems	1
Objective 2:	Reduce the amount of nutrients entering the river system from agricultural practices. Encourage Best Management Practices through the use of greenbelts & proper manure storage/utilization.	2
Objective 3:	Encourage residential landowners to reduce the amount of fertilizer used & consider type used (i.e. no phosphorus)	3
Objective 4:	Reduce or eliminate existing stormwater runoff directly in the Thunder Bay River and its tributaries	4
Objective 5:	Eliminate or treat sewage discharge into the watershed on-site	4
Objective 6:	Institute a consistent, reliable water quality monitoring program	5
Goal 8:	**Develop an emergency first action response plan to reduce reaction time following a hazardous materials spill**	
Objective 1:	Include emergency contact numbers in watershed brochures	1
Objective 2:	Work with Local Emergency Planning Commissions on the inclusion of water resource protection measures	

RECOMMENDATIONS

Even though the Thunder Bay River Watershed currently exhibits high water quality, both remedial and proactive measures are necessary to provide for the protection and enhancement of the river system. Remediation of identified areas of degradation should include streambank erosion control measures, road/stream crossing upgrades, stormwater controls and installation of BMP's at agriculture areas of concern. A proactive approach to watershed management would include such measures as information and education programs, land use controls, zoning ordinances, septic maintenance programs and establishment of greenbelts.

Based on inventory results, the Thunder Bay River Watershed steering committee developed the following strategies for reduction of nonpoint sources of pollutants in the river system. The recommendations utilize a combination of both reactive and proactive measures. Each recommendation integrates Best Management Practices (BMPs), information and education strategies, partnerships and intergovernmental coordination. Each task targets a specific objective of the plan. Responsible parties, appropriate BMPs, milestones, a timeline, estimated costs and evaluation methods are outlined below.

The order of implementation of the recommendations will be based on steering committee input, and in many cases the order will be determined by available funds. Considering sediment and nutrients ranked as the highest pollutants of concern, strategies aimed at reducing these nonpoint pollutants will be given higher priority. When installing structural BMP's, the sites ranked most severe will be considered first. **Table 35** indicates the approximate cost of implementation for each inventory, as well as the total for the entire implementation project.

TABLE 35: APPROXIMATE COST OF PROJECT IMPLEMENTATION	
Shoreline Protection Projects	$49,000
Stream Bank Protection Projects	$158,960
Agricultural Treatments	$415,125
Road/Stream Crossing Treatments	$421,000
Land Use Projects	$25,000
Voluntary Land Protection Projects	$10,000
Total Costs of Implementation	***$1,079,085***

Shoreline Recommendations

While the shoreline survey does not replace the need for regular water quality monitoring, results of the survey can give a general overview of water quality. Hubbard Lake appeared to have very high water quality. However, as development of the Hubbard Lake shoreline and subwatershed continues and as seasonal cottages are converted to larger, year-round residences, increased pollution from nonpoint sources can be expected to occur. Minimizing nonpoint source pollution in the years to come will require a pro-active approach to land management by those that live along the riparian corridor, and by local government as well.

The practices listed in **Table 36** have been used with other lake shore communities and are recommended for Hubbard Lake.

TABLE 36: SHORELINE PROTECTION-RIPARIAN LANDOWNER RECOMMENDATIONS		
	Recommendation	**Timeline**
Objective One	Follow up initial shoreline survey with an educational program for property owners around the lake.	
Task 1	Conduct workshops for property owners on proper methods of erosion control, lawn care practices that protect water quality, proper siting, installation, and maintenance of septic systems, maintaining a greenbelt, and reducing runoff.	
Milestones	Send general summary of survey results, brochures on practical & effective actions to protect water quality to shoreline residents. Develop & assemble educational packet (septic maintenance, maintaining greenbelts, proper fertilizer application, etc.) to distribute to riparian landowners Help landowners design a site plan to protect their shoreline. Develop & institute a consistent, reliable water quality monitoring program	◆ 1 yr. ◆ 2 yrs. ◆ 3 yrs. ◆ On-going
BMPs	Produce and distribute educational material, site planning assistance, workshop	
Responsible Parties	NEMCOG, Huron Pines RC&D Council	
Anticipated Products	Educational packet for riparian landowners, workshop	
Evaluation Method	Survey landowners to determine presence or extent of Cladophora growth	◆ 5 yrs.
Estimated Cost	*$10,000*	
Task 2	Educate new riparian landowners in shoreline stewardship practices	
Milestones	Work to familiarize Real estate agents, developers, excavators & landscape/lawn care companies with shoreline stewardship practices for protecting water quality.	◆ 3-5 yrs
BMPs	Educational materials, community outreach	
Responsible Parties	Huron Pines RC&D, NEMCOG, Montmorency Conservation District	
Anticipated Products	Educational materials	
Evaluation Method	Follow up survey of new landowners	
Estimated Cost	*$4,000*	
Objective Two	Complete a comprehensive lake assessment of Hubbard Lake	
Task 1	Develop a plan to monitor water quality for Lake Hubbard	
Milestones	Develop comprehensive list of monitoring activities; include such indicators of lake water quality as DO, condition of biological communities, shoreline algae temperature, conductivity, pH, flow, trophic state, nutrients, land cover types, types & quality of habitat, non-native species, and presence of metals & chemicals. Draft plan for data management & reporting, develop QAPP Pursue funding for implementation of plan	◆ 2 yrs. ◆ 2 yrs. ◆ 2-4 yrs.
BMPs	Field surveys, water testing	
Responsible Parties	Huron Pines RC&D, NEMCOG, Montmorency Conservation District	
Anticipated Products	Water quality database for Lake Hubbard	
Evaluation Method	Plan review by environmental agency/agencies experienced in lake monitoring	◆ 2-3 yrs.
Estimated Cost	*$15,000*	
Task 2	Educate public in ways to identify and deter the spread of invasive species	
Milestones	Develop & provide educational materials to riparian landowners, boaters & fisherman describing species found; effects on native species, habitat, recreation, & water quality; importance of deterring their spread by good lake usage practices	◆ 2-3 yrs
BMPs	Surveys, educational materials, community involvement	
Responsible Parties	Huron Pines RC&D, NEMCOG	
Anticipated Products	List of invasive species present in Hubbard Lake, educational materials	
Evaluation Method	Repeat lake survey, tabulate findings	◆ 10 yrs.
Estimated Cost	*$5,000*	
Objective Three	Add information to database to facilitate identifying the locations of Cladophora growths during repeat shoreline surveys and in making property owner contacts.	
Task 1	Inform those owners of properties with Cladophora growths of the specific results for their property	

Milestones	Conduct landowner survey; use to interpret cause of growth, offer individualized recommendations (keep site specific info confidential to encourage participation) After survey, perform site visits/water testing; analyze survey results Repeat survey every 3-5 years	◆ 2-5 yrs ◆ 3-6 yrs Ongoing
BMPs	Educational materials, questionnaires, informative follow-up mailings after each survey	
Responsible Parties	Huron Pines RC&D Council, NEMCOG, Montmorency Conservation District	
Anticipated Products	Improved documentation of Cladophora, including causes, extent and location; shoreline database	
Evaluation Method	Survey of landowners, recheck of Cladophora sites	◆ 3-5 yrs
Estimated Cost	*$3,500-$8,000*	
Task 2	Compile accurate parcel & ownership information for shoreline database based on knowledge of Association members/shoreline residents & County Equalization Departments within the watershed.	
Milestones	Encourage lake associations in shoreline monitoring activities	Ongoing
BMPs	Shoreline surveys	
Responsible Parties	Huron Pines RC&D, NEMCOG, lake association volunteers	
Anticipated Products	Improved shoreline database for use in managing/monitoring lake shores of the watershed; Water resource information clearinghouse to be shared by agencies and the public	
Evaluation Method	Keep track of number of times database is accessed by agencies; water resource information is accessed by agencies, lake associations and other organizations	◆ 5-10 yrs.
Estimated Cost	*$3,000*	
Objective Four	Reduce amounts of nutrients entering water bodies from septic systems	
Task 1	Encourage inspection of (& upgrades to substandard) septic systems around lake.	
Milestones	Meet with townships to amend ordinances; include a required inspection of septic systems at the time of property sale or transfer Meet with townships to phase in a septic system inspection program	◆ 3-5 yrs ◆ 10 yrs.
BMPs	Zoning ordinances	
Responsible Parties	Huron Pines RC&D Council	
Anticipated Products	Inspection program	
Evaluation Method	Compile and analyze inspection data	◆ 10 yrs.
Estimated Cost:	*$4,000*	
Total Shoreline Protection Costs: $49,000		

Streambank Protection Recommendations

Erosion of streambanks and lake shorelines can result in sedimentation of lakes and rivers. This can lead to a degradation of water quality and to the impairment of designated uses, particularly uses for wildlife/aquatic habitat and navigation, within the watershed. Streambank erosion can occur in several ways such as foot traffic by humans and wildlife, boat and canoe access. Loss of vegetation to anchor streambanks also accelerates the erosion process. **Table 37** lists streambank protection recommendations for the North and South Branches of the Thunder Bay River Watershed.

TABLE 37: STREAMBANK PROTECTION RECOMMENDATIONS		
	Recommendation	**Timeline**
Objective One	Stabilize priority streambank erosion sites through the installation of corrective measures.	
Task 1	Implement structural BMP's to reduce the amount of sediment from entering the river.	
Milestones	Develop site plans, obtain proper permits and landowner permission for 16 sites recommended for treatment (SB01; SB02; SB06; SB08; SB09; SB10; SB11;SB12;SB13; SB14;SB15; SB16; SB17;SB18; SB19; & SB20) Secure funding and organize materials Organize work crew and install BMP's at each of the16 sites	◆ 5 yrs ◆ 1-2yrs ◆ 10 yrs
BMP's	Tree revetment, brush placement, re-vegetation, stairways, fencing, bank sloping	
Responsible Parties	Huron Pines RC&D Council, Conservation Districts, NEMCOG	
Anticipated Products	Site plans for streambank erosion sites	
Estimated Cost	*$128,460*	
Evaluation	Take before and after photographs and document number of sites completed	
Objective Two	Improve existing access sites by creating stairs, walkways, fishing platform, etc.	
Task 1	Develop site plans, obtain proper permits and landowner permission for improvement to/construction of access structures and stairways at sites	
Milestones	Secure funding and organize materials Organize work crew and implement BMP's for 1 site per year	◆ 2-5 yrs ◆ 3-4 yrs
BMP's	Provide parking, create launch pads, steps, walkway	
Responsible Parties	Huron Pines RC&D Council, Conservation Districts, NEMCOG	
Anticipated Products	Site plans for access sites	
Estimated Cost	*$25,100*	
Evaluation	Before and after photographs; document number of sites completed	◆ 3-9 yrs
Objective Three	Protect/restore riparian shade vegetation; restore aquatic habitat where impairment is suspected	
Task 1	Educate landowners as to importance of shade vegetation	
Milestones	Include greenbelt restoration/maintenance information in workshops for riparian landowners, stress connection between loss of vegetation and increased temperatures of coldwater fisheries, and importance of using native vegetation when restoring greenbelts	◆ 1 yr.
BMP's	Educational materials, workshops	
Responsible Parties	Huron Pines RC&D Council, Conservation Districts, NEMCOG	
Anticipated Products	Information packets, workshop	
Estimated Cost	$0 (cost included in shoreline recommendations)	
Evaluation	Re-survey lake shorelines, streambanks; note increase/decrease in presence of shade vegetation	◆ 3-5 yrs.
Task 2	Restore impaired aquatic habitat	
Milestones	Organize river/lake cleanup days, recruit volunteers Conduct yearly river/lake cleanups utilizing volunteers Increase amount of woody debris at suitable sites	◆ 2-5 yrs. ◆ 2-5 yrs.
BMP's	Woody debris, community involvement	
Responsible Parties	Huron Pines RC&D Council, Conservation Districts, NEMCOG	
Anticipated Products	Volunteer database	
Estimated Cost	*$2,400*	
Evaluation	Before and after photos, riparian landowner surveys	◆ 3-6 yrs.
Task 3	Develop plan to increase fish passage at hydroelectric dams	
Milestones	Work with organizations such as Thunder Bay Power & Thunder Bay River Restoration Committee to determine BMP's for fish passage Select best alternative; draft work plan & timetable for implementation	◆ 2-3 yrs. ◆ 2-6 yrs.
BMP's	Compile information on fish passage alternatives for dams	
Responsible Parties	Huron Pines RC&D Council, Conservation Districts, NEMCOG	
Anticipated Products	Plan for fish passage improvement at hydroelectric dams	
Estimated Cost	*$3,000*	
Evaluation	Focus group	◆ 3-6yrs.
Total Streambank Protection Cost: $158,960		

Agriculture Recommendations

The agricultural community is a vital component of the Thunder Bay River Watershed. Crops,and livestock produced locally benefit the area's economy, and provide a rural atmosphere many visitors and permanent residents alike find aesthetically pleasing. Unfortunately, like many other land activities, the agricultural industry can contribute significant amounts of pollution to the watershed. Sediments, nutrients, and bacteria are natural by-products of farming activities. Best Management Practices such as exclusionary fencing to keep livestock out of streams, adequate manure storage facilities, proper livestock crossings, nutrient management and buffers along streambanks can significantly lower the amounts of pollutants entering the water system. In many cases, funding to correct these problems may be available in the form of cost/share funds from various programs and agencies working within the watershed.

Actions recommended to reduce the negative impacts of agriculture on water quality while promoting environmentally sound uses for agricultural lands are listed in **Table 38** below.

TABLE 38: AGRICULTURE RECOMMENDATIONS

	Recommendation	Timeline
Objective One	Restrict livestock access to the rivers and streams	
Task 1	Develop site plans, provide water source for livestock and create proper stream crossings	
Milestones	Create site plans for 11 sites recommended for treatment: ALC 02-04; ALC 06; ALP 01; ALP 04; ALP 16; ALP 19; ALP 21; MO 02; PI 03	◆ 1-3 yrs.
	Obtain proper permits and landowner permission	◆ 1-3 yrs.
	Secure funding and organize materials	◆ 2-3 yrs.
	Organize work crew and install BMP's	◆ 2-6 yrs.
BMP's	Fencing, stream crossings, watering devices,	
Responsible Parties	NRCS, NEMCOG, Conservation Districts, Huron Pines RC&D Council	
Anticipated Products	Site plans for limiting access of livestock to rivers and streams	
Estimated Cost	*$166,580*	
Evaluation	Before and after photographs; document number of sites completed	◆ 3-6 yrs.
Objective Two	Install corrective measures to reduce runoff at agricultural sites of concern.	
Task 1	Develop plans; install devices to reduce runoff.	
Milestones	Develop plans for 14 identified areas of concern: ALC 02-04; ALC 06; ALP 01; ALP 04; ALP 06; ALP 16; ALP 19; ALP 21; MO 02; MO 05; PI 02 and PI 03	◆ 1 yr.
	Obtain proper permits and landowner permission	◆ 1 yr.
	Secure funding and organize materials	◆ 1-4 yrs.
	Organize work crew and install BMP's	◆ 2-7 yrs.
BMP's	Buffer strips, water runoff diversion, runoff basins, waste storage/utilization	
Responsible Parties	NRCS, Conservation Districts, NEMCOG	
Anticipated Products	Site plans for controlling runoff at agricultural sites of concern	
Estimated Cost	*$248,545*	
Evaluation	Before and after photographs; document number of sites completed	◆ 3-8 yrs.
Total Agriculture Costs: $415,125		

Road/Stream Crossing Recommendations

Sediments, including dirt and gravel from shoulders of the roads (especially unpaved roads) can be deposited into the river system wherever a road and stream intersect. Sedimentation of streams is a natural process. Excessive amounts of sediments can, however, negatively impact designated uses such as aquatic wildlife and habitat (including the watershed's cold water fisheries); birds and mammals dependent on an aquatic environment; and aquatic plant/animal

life. Sedimentation can also, by reducing the width and depth of the stream channel, restrict navigation and promote an increase in flooding of the stream. **Table 39** details the recommended actions needed to reduce the effects of the sedimentation process in the watershed.

TABLE 39: ROAD/STREAM CROSSING RECOMMENDATIONS		
	Recommendation	**Timeline**
Objective One	Reduce the amount of sediment by establishing a road/stream crossing improvement program designed to correct identified problems	
Task 1	Stabilize erosion at 16 road/stream crossings recommended for treatment: ALC 11; ALC 12; ALC 15; ALC 29; ALC 52; ALP 01;ALP 21; ALP 51; ALP 65; ALP 66; ALP 80; MO 12; MO 13; MO 16; MO 18; and OS 01	
Milestones	Develop site plans, obtain proper permits and landowner permission for priority sites	◆ 2 yrs
	Secure funding and organize materials	◆ 2 yrs
	Organize work crew and implement BMP's at the selected sites	◆ 2-10 yrs
BMPs	Replace culverts, reduce grade of approaches, pave approaches, pave curb and gutter, re-vegetate, or install erosion control structures at 16 priority sites	
Responsible Parties	Huron Pines RC&D, County Road Commissions, NEMCOG, County Drain Commissions	
Anticipated Products	Site plans for road/stream crossings designed to reduce sediments entering rivers	
Estimated Cost	*$421,000*	
Evaluation	Before and after photographs; document number of sites completed	◆ 5 yrs
Total Road/Stream Crossing Cost: $421,000		

Land Use and Voluntary Land Protection Recommendations

Implementation of land use policies and regulations can be an important strategy used by local, State and Federal units of government for protecting water quality. In addition to their benefits for aquatic resources, planning and zoning are tools used for ensuring the conservation of wildlife habitat, providing for sustainable development, protecting property values, and maintaining community character. **Table 40** lists Land Use Policies recommended for the Thunder Bay River Watershed Initiative, Phase Two. Another avenue for protecting the watershed's natural resources and rural characteristic is through voluntary land protection. Many options are available to those landowners wishing to protect high quality natural areas, critical areas, or areas where development may pose a risk of degrading the high water quality currently exhibited by the Thunder Bay River Watershed. Recommended Voluntary Land Protection projects are listed in **Table 41**.

TABLE 40: LAND USE RECOMMENDATIONS		
	Recommendation	**Timeline**
Objective One	Establish Responsible Land-Use Practices	
Task 1	Develop Thunder Bay Watershed Land Use Development Guidelines; model after the Grand Traverse Bay Guidelines & Recommended Land Use Regulations	
Milestones	Work with local government on the adoption of guidelines & regulations that provide for the protection of the water resources. Develop and distribute at meetings: handouts covering model stormwater management, site plan review standards, recommended setback distances, stormwater management guidelines, greenbelt provision language, and a checklist; include emergency contact number for hazardous materials spill Encourage removal of sewage/storm drains which discharge directly to watershed	◆ 1-2 yrs ◆ 2 yrs ◆ 2-5 yrs.
BMP's	Ordinances; guidelines; educational materials	
Responsible Parties	Huron Pines RC&D Council, NEMCOG	
Anticipated Products	Informational packets	
Estimated Cost	*$10,000*	
Evaluation	Review changes, if any, made to local plans & ordinances in subsequent years	◆ 5-10 yrs
Task 2	Deliver presentations to local units of government	
Milestones	Revise NEMCOG's PowerPoint Presentation on the connection between land use practices, nonpoint source pollution and water quality. Deliver presentations to County Planning Commissions and County Chapters of the Michigan Townships Associations	◆ 1 yr ◆ 2 yrs
BMP's	Educational materials/presentations	
Responsible Parties	Huron Pines RC&D Council, NEMCOG	
Anticipated Products	PowerPoint presentation	
Estimated Cost	*$10,000*	
Evaluation	Interview meeting attendees, analyze feedback	◆ 3 yrs
Objective Two	Protect/restore sensitive areas such as wetlands and riparian corridors	
Task 1	Involve Riparian Landowners in lake and stream protection efforts	
Milestones	Encourage compliance to "no wake" laws through signage explaining reason for "no wake", and by working with enforcement agencies and river watch groups Encourage riparian landowners to maintain/create native conservation buffers	◆ On going ◆ Ongoing
BMP's	Educational materials, cooperation with enforcement agencies & community watch groups	
Responsible Parties	Huron Pines RC&D Council, NEMCOG	
Anticipated Products	"No wake" signs	
Estimated Cost	$5000	
Evaluation	Focus group	◆ 5 yrs
Total Land Use Recommendations Cost $25,000		

TABLE 41: VOLUNTARY LAND PROTECTION PROJECTS		
	Recommendation	**Timeline**
Objective One	Develop database of Priority Parcels within watershed	
Task 1	Identify priority Parcels within the watershed	
Milestones	Develop criteria for determining what constitutes a priority parcel Identify priority parcels of land utilizing GIS data from watershed inventory Develop priority parcel map for watershed Obtain land owner information of priority parcels from County Equalization Department	◆ 1-2 yrs. ◆ 1-2 yrs. ◆ 2 yrs. ◆ 2-3 yrs.
BMP's	Database, priority parcel map	
Responsible Parties	Headwaters Land Conservancy, NEMCOG	
Anticipated Products	Maps, database	
Estimated Cost	*$5,000*	
Evaluation	Review data for accuracy; conduct survey of agencies using data base	◆ 3-5 yrs.
Objective Two	Provide voluntary land protection information to riparian landowners	
Task 1	Develop and/or compile informational materials on easement and land donation programs to priority property owners.	
Milestones	Assemble information packets and distribute to owners of priority land parcels in the watershed	◆ 1-2 yrs.
BMP's	Educational materials	
Responsible Parties	Headwaters Land Conservancy, NEMCOG	
Anticipated Products	Informational packets for riparian landowners	
Estimated Cost	*$1,000*	
Evaluation	Records of participation in programs/voluntary land protection measures taken by land owners	
Task 2	Organize and hold a workshop on voluntary land protection techniques.	
Milestones	Develop and assemble workshop materials Organize workshop Contact priority parcel landowners to participate in workshop	◆ 1-2 yrs. ◆ 1-2 yrs. ◆ 1-2 yrs.
BMP's	Educational materials	
Responsible Parties	Headwaters Land Conservancy, NEMCOG, Alpena & Montmorency Conservation Districts	
Anticipated Products	Workshop materials, workshop	
Estimated Cost	*$2,000*	
Evaluation	Follow up surveys/interviews with workshop participants	
Task 3	Contact and meet with at least ten priority property owners for consideration of conservation easement, and/or land donation.	
Milestones	Contact and meet with at least 5 priority property owners each year	◆ 2 yrs.
BMP's	Community outreach, educational materials	
Responsible Parties	Headwaters Land Conservancy, NEMCOG	
Anticipated Products	Permanently protected priority parcels	
Estimated Cost	*$2,000*	
Evaluation	Detailed records of any voluntary land protection measures taken by property owners contacted	
Total Voluntary Land Protection Program Costs: *$10,000*		

General Education Recommendations

Education is the key to a successful watershed management program. The overall goal of the information and education component of the watershed plan is to provide educational information to local officials, shoreline residents, contractors and developers, school children and the general public, which will enable them to make decisions that will enhance the protection of the Thunder Bay River Watershed. Informed citizens can greatly affect the outcome of a watershed protection program. **Table 42** indicates projects recommended to increase the public's knowledge and understanding of the watershed and it's many components.

TABLE 42: GENERAL EDUCATION RECOMMENDATIONS		
	Recommendation	**Timeline**
Objective One	Encourage Co. Road Commissions to explore maintenance alternatives at road/stream crossings.	
Task 1	Create model road/stream crossing site in cooperation with county road commissions	
Milestones	Meet with road commissions to select model site & plan for implementation	1 yr.
BMPs	Educational materials, model road/stream crossing site	
Responsible Parties	NEMCOG, Huron Pines RC&D Council	
Anticipated Products	Brochure of BMPs; road/stream crossing facts; effects of sediments & road chemicals on designated uses; PowerPoint presentation with comparing pictures of sites in other watersheds using road maintenance alternatives, model site	
Evaluation Method	Follow up with erosion control officer	2-10 years
Estimated Cost	*$30,000*	
Objective Two	Make public aware of importance of using Best Management Practices at road/stream crossings, streambank erosion sites, stormwater runoff and agricultural sites of concern.	
Task 1	Develop watershed protection display to take advantage of educational opportunities at local events	
Milestones	Develop brochures and/or information packets explaining the importance of using BMPs at road/stream crossings, streambank erosion sites, stormwater runoff and agricultural sites of concern	◆ 1-2 yrs.
	Displays will include educational materials, photos, & brochures	◆ 1-2 yrs.
	Set up display and distribute information at fairs and appropriate community events once or more each year	◆ 3-5 yrs.
BMPs	Educational materials	
Responsible Parties	Huron Pines RC&D Council, Conservation Districts, NEMCOG, Headwaters Land Conservancy	
Anticipated Products	Information packets, Watershed display	
Evaluation Method	Survey included with display materials, focus groups	3-5 yrs.
Estimated Cost	*$3,000*	
Objective Three	Develop and implement school programs concerning water quality education.	
Task 1	Implement a water quality program in area schools	
Milestones	Conduct a water resource curriculum review	◆ 1-2 yrs.
	Involve teachers and students in educational water testing/monitoring	◆ 2-5 yrs.
	Establish interactive database to which students can enter classroom data	◆ 2-5 yrs.
	Review and compile existing instructional materials for elementary and secondary students that focus on water resources, include list of water resource web-sites	◆ 2-3 yrs.
	With input from teachers, modify selected materials to make more locally relevant	◆ 2-3 yrs.
	Develop a lesson study project*	◆ 2-5 yrs.
BMPs	Educational materials, hands-on activities	
Responsible Parties	Huron Pines RC&D Council, Conservation Districts, NEMCOG, Headwaters Land Conservancy	
Anticipated Products	Interactive database, water resource library, lesson plan	
Evaluation	Conduct short survey of teachers whose classrooms participated in program to rate overall educational effectiveness of information, materials, presentation and activities	◆ 2-5 yrs
Estimated Cost	*$6,000*	
Objective Four	Develop Educational Tools for Citizens of the Watershed	
Task 1	Involve and educate the public on actions they can take to reduce nonpoint source pollution	
Milestones	Create and have installed: watershed signs, logo, drain stenciling	◆ 1-3 yrs
	Create a series of detailed water drainage maps, 100 year flood	◆ 6 yrs.
	Create and distribute residential landowner brochures "Protect Your Watershed"; include emergency numbers for hazardous substance spills	◆ 1 yr.
BMPs	Educational materials, signage, maps	
Responsible Parties	Huron Pines RC&D Council, Conservation Districts, NEMCOG, Headwaters Land Conservancy	
Anticipated Products	Maps, brochures, signs	
Evaluation	Focus groups, conduct surveys	
Estimated Cost	*$15,000*	
Total Cost of General Education Recommendations: $54,000		

*Teachers from similar grade levels who wish to use the same instructional materials related to water resources can participate in a lesson study. These teachers meet several times and 'dissect' a particular lesson about water resources. One teacher volunteers to teach the lesson while other participants

observe that teacher's class. Then the group meets again to share impressions from the observation and revise the lesson. Another teacher then volunteers to teach the lesson and other teachers in the group observe. The group then meets a second time to discuss the classroom observation and revise the lesson a second time. Lesson study is a powerful form of professional development for teachers, and is one of the professional development strategies used in Japan's educational system.

Information/Education Strategies

The primary function of the Information and Education Strategy portion of the watershed plan is to provide educational information to local officials, shoreline residents, contractors, developers, school children and the general public. The lakes and rivers of the watershed are fundamental to the sustainability of the region's economy and quality of life. Becoming informed of the human impacts and natural processes that influence water resources will enable citizens to make decisions that promote high water quality and provide protection for the waters of the Thunder Bay River Watershed.

Table 43 lists the information and education strategies based on goals and objectives stated earlier. Educational strategies defined for each pollutant source will be directed towards a specific target audience.

TABLE 43: INFORMATION AND EDUCATION STRATEGIES	
Pollutant	**Sediments**
Source	Road/stream crossings
Target Audience	Road Commissions
Message	Explore alternatives to road maintenance at road/stream crossings
Delivery Mechanism	Presentations to County Road Commissions
Source	**Streambank erosion**
Target Audience	Riparian Landowners, developers, construction companies
Message	Encourage landowners to leave a conservation buffer, provide attractive landscaping for natural vegetation, inform developers, construction companies of importance of greenbelts
Delivery Mechanism	Information material distributed to Real Estate agencies, area businesses, riparian landowners
Source	**Uncontrolled livestock access to streams**
Target Audience	Landowners, agricultural operations
Message	Control livestock access, establish fencing, create proper stream crossings, provide information on alternate funding sources
Delivery Mechanism	Brochures, work with NRCS, provide information at fairs, trade-shows and local events
Source	**Lake and stream access sites**
Target Audience	Fishing enthusiasts, kayak/canoe/tube rentals and sales, ORV users, boat owners
Message	Protect river by using designated access sites and stairs when provided, staying on designated trails, and reducing wake speeds
Delivery Mechanism	Post signs at access points, provide information to canoe liveries, sporting goods stores and at ORV parking
Pollutant	**Nutrients**
Source	**Wastewater/ residential septic systems/lawns**
Target Audience	Homeowners, riparian businesses
Message	Properly maintain septic systems to prevent degradation of water quality: Discourage improper/over application of fertilizers on lawns; encourage soil tests and the use of low/no phosphate fertilizers
Delivery Mechanism	Create an educational water quality kit for homeowners including brochures for septic system maintenance, environmentally friendly lawn care
Source	**Agricultural lands**
Target Audience	Agricultural operations; landowners
Message	Unrestricted livestock access to surface water threatens the health of the watershed
Delivery Mechanism	Brochures, work with NRCS, provide information at fair, trade-shows and local events

TABLE 43: INFORMATION AND EDUCATION STRATEGIES, CONTINUED	
Pollutant	**Invasive Species**
Source	**Recreational boats, fishing pails**
Target Audience	Boaters, sports fisherman
Message	Be sure to check boats and bait pails for invasive "hitchhikers" when moving from one body of water to another
Delivery Mechanism	Distribute educational materials to riparian landowners, and to boaters and fisherman through marinas, sporting goods stores and bait shops
Pollutant	**Increased Temperature**
Source	**Stormwater runoff, land development**
Target Audience	Homeowners, riparian businesses, contractors, developers
Message	Inform developers, construction companies of connection between loss of greenbelts and warming water temperatures, and of warming effect of increased sedimentation
Delivery Mechanism	Information packets, watershed protection display & handouts at community events.
Pollutant	**Heavy Metals/Organic Compounds**
Source	**Stormwater runoff**
Target Audience	Riparian landowners and businesses, local government
Message	Provide surface runoff control to reduce and filter harmful substances from entering the river via stormwater runoff
Delivery Mechanism	Brochures covering such topics as hazardous household wastes and where stormwater goes; tours of model stormwater site
Pollutant	**Pesticides**
Source	**Residential lawns; agricultural operations**
Target Audience	Landowners, agriculture managers
Message	Encourage proper application of pesticides to protect aquatic/wildlife habitats; and promote a healthy watershed
Delivery Mechanism	Brochures, work with various agencies such as lake associations, NRCS; provide information at fairs, trade-shows and events
Pollutant	**Bacteria**
Source	**Septic systems**
Target Audience	Riparian landowners and businesses
Message	Properly maintain septic systems to prevent degradation of water quality; Improper septic systems can allow contamination of surface water/groundwater
Delivery Mechanism	Create an educational water quality kit including brochures for septic system maintenance, environmentally friendly lawn care; distribute to landowners and businesses
Source	**Livestock management**
Target Audience	Agricultural operation managers
Message	Restricting livestock access to streams and properly managing animal waste will minimize contamination potential by agricultural operations.
Delivery Mechanism	Watershed protection display, informational packets distributed at community events

Evaluating Success

In order to determine the overall effectiveness of the watershed management plan, an evaluation process is essential. An effective evaluation process will indicate whether watershed management efforts are successful, and implementation methods can be modified or improved as information gathered from evaluations is analyzed. A sound evaluation program will increase the likelihood of continued support from partnering agencies, community organizations and community members if results of the implementation efforts are well documented and made available to the public. Listed below are the evaluation methods for the Thunder Bay River Watershed Initiative, as recommended in the DEQ Handbook*: Developing a Watershed Management Plan for Water Quality.*

- Physical water quality monitoring
- Chemical water quality monitoring

- Biological life measurements
- Photographic or visual evidence, before and after photos
- Documentation of site BMPs installed
- Pollutant loading measurements
- Stakeholder surveys, evaluate knowledge or change in behavior
- Focus groups, to determine effectiveness of project activities

Detailed evaluation methods for each task are outlined above in the Recommendations section. Several different evaluation methods were incorporated into the plan to accommodate the variety of strategies recommended for implementation. In order to document the installation of BMP's, before and after photos will be taken at road/stream crossings, streambank restoration sites, newly installed greenbelts and livestock crossings. Focus groups, interviews and surveys will be used when changing viewpoints and management strategies needed to be documented and structural BMP's were not recommended. A timeline for the completion of the evaluations is included in each recommendation table. **Table 44** below summarizes the evaluation process for the Thunder Bay River Watershed Initiative: Phase Two.

TABLE 44: EVALUATION PROCESS

Evaluation Method	Watershed Concern	Property Measured	Characteristics of Method	Strategy
Public Surveys	Shoreline/Streambank Protection; Information/ Education Program	Knowledge & Awareness, Current Practices, Concerns	Moderate cost; Low response rate	Before & after implementation. Distribute through mailings, displays
Written Evaluations	Land Use Program; Voluntary Land Protection; Information/Education	Knowledge & Awareness	Good response rate; Low cost	Brief evaluations completed on site after event; questions on strengths/weaknesses of program, suggestions for improvement
Field Surveys	Streambank Protection; Agricultural & Road/Stream Crossing Programs	Extent of buffers, flow, erosion, impacts & trends	Time consuming, Moderate cost, Provides current & detailed data	Record observations on inventory sheets, Take Before & After photos, Analyze data
Documentation	All Projects & Programs	Participation; aesthetics; pre-& post-conditions	Low cost; Easy; Provides quick review of progress	Before & after photos, trend tables, database
Communication Records	All Projects & Programs	Public concerns; problem areas; level of community interest/participation	Information is subjective; Limited number of contacts	Keep records of phone calls, e-mails, letters; track trends, concerns, suggestions, complaints
Participation Tracking	All Projects & Programs	Numbers & Geographic distribution of participants, results of participants' efforts	Low cost; Easy to document, Easy to understand	Sign-in/evaluation sheets, document with photos, end results
Focus Groups	Streambank Protection; Land Use Program; Information/Education	Knowledge & Awareness, Perceptions, Current practices	Medium to high cost; Motivations/barriers to change readily identified; Instant feedback	Select 6-8 people randomly from watershed area. Draft questions, facilitate discussion. Record session.
Agency Reviews	Shoreline Protection; Information/Education	Accuracy/validity of data collected, Observations	Low Cost; Valuable insight from experienced professionals	Partnering agency will review data, BMPs, level of improvement & offer input on methods/results

Chapter Eight: Water Quality Summary

The North and South Branch portions of the Thunder Bay River Watershed currently has five designated uses that are threatened:

Warm and Cold Water Fisheries
Aquatic Life and Wildlife
Recreation Total/Partial Body Contact
Navigation
Public Water Supply

Two designated uses, agricultural water supply and industrial water supply, were determined not threatened at this time. The following provides a Water Quality Summary for the five threatened designated uses.

Warm and Cold Water Fisheries

Several of the watershed's streams, including the Upper South Branch of the Thunder Bay River, are designated coldwater trout streams. However increased sediment, nutrients, bacteria, oil/grease, and heavy metals, have threatened this use. Sediments were identified as having the most harmful effect on warm/coldwater fisheries. An over abundance of sediments in rivers and streams may block fish gills, destroy essential spawning habitat and reduce the amount of light available for healthy plant growth. Road/stream crossings are identified as being the most significant sources of sediment, however land development, streambank erosion and agricultural activities were also found to contribute significant amounts of sediment to the river system.

Nutrients ranked second as the pollutant most challenging to the health of the watershed's fisheries. Wastewater, residential lawns and agricultural activities were deemed the most significant sources of nutrients and bacteria. Heavy metals/organic compounds are also considered a threat to the high quality coldwater fisheries, as well as the watershed's warm water fisheries.

Indigenous Aquatic and Wildlife

Sediment, heavy metals/organic compounds, and pesticides/herbicides are currently threatening aquatic life and habitat. Sediment affects aquatic life in the same way it affects coldwater fisheries; by clogging gills and decreasing spawning habitats. Heavy metals/organic compounds such as oil, grease and other toxic substances, as well as herbicides and pesticides can affect the life cycles of aquatic species by decreasing immunity and reproductive viability and, in high enough concentrations, cause death.

Sources of sediment include road/stream crossings, streambank erosion, stormwater runoff, agricultural operations, land development practices and lake and river access sites. Sources of heavy metals/organic compounds include stormwater runoff, sites of environmental contamination and road/stream crossings. Common pollutants such as vehicle fluids (antifreeze, oil, grease, gas), pesticides, fertilizers, cleaners and paint products can be carried directly to the river via storm drains.

Recreation Total/Partial Body Contact

Recreation was identified as threatened by increased bacteria in the Thunder Bay River Watershed. High levels of bacteria can make swimming, canoeing, fishing and other activities, where individuals come in contact with the water, harmful. Although this has not been documented in the watershed in recent years, preventive measures need to be established to protect this designated use. The sources for bacteria include septic systems, livestock management practices and stormwater discharge.

Improperly sited, designed, or maintained septic systems along the waterbodies can allow bacteria to enter lakes and rivers. Increased riparian development requires additional septic systems to be constructed. Also, many seasonal homes are being converted into year-round residences and the size or condition of the septic system may not be adequate to serve the increased use. Proper function of septic systems is imperative to reducing the amount of bacteria entering the river system.

Livestock management practices, including the storage and application of manure, are significant sources of bacteria. Excessive manure application, runoff from standing manure, and unrestricted livestock access to water bodies are all causes of increased bacteria entering the watershed.

Navigation

Sedimentation and invasive species have both been found to be detrimental to navigational use in the Thunder Bay River Watershed. Sedimentation is the process of "filling in" of a lake or stream with particles of matter such as sand and gravel. An increased rate of sedimentation is currently threatening navigation in areas of the Thunder Bay River Watershed. Known sources of sediment include road/stream crossings, streambank erosion, agricultural practices and stormwater runoff. Other sources include land development practices and lake and river access sites.

Sedimentation at road/stream crossings is often a result of short culverts, steep embankments, sand and gravel surfaces and inadequate diversion outlet. Public access sites located at road stream crossings need to have adequate measures in place in order to prevent erosion from occurring.

Streambank erosion, another factor in the sedimentation process, may be caused by foot traffic, lack of vegetation along the bank and natural hydrologic conditions. Unrestricted livestock access to the river can also lead to bank destabilization and sediment delivery to the river. Additionally, inadequate stormwater management can lead to the discharge of sediments into the river system. Oftentimes attached to sediment are other harmful pollutants including heavy metals, toxic substances and pesticides, which threaten other designated uses.

One of the definitions of pollution, according to the American Heritage Dictionary of the English Language is "to make less suitable for an activity, especially by the introduction of unwanted factors". Invasive species, a category not generally considered a pollutant, certainly fit this description. Certain non-native species, such as Eurasian watermilfoil and Hydrilla can make navigation difficult, or even impossible. Once introduced to a water body these species can spread rapidly, forming dense mats of vegetation that not only hamper navigation, but deprive

native aquatic plants and animals access to sunlight. As the plant matter dies and sinks to the bottom of a lake it decomposes and in the process depletes the oxygen supply, further degrading habitat for native species.

Public Water Supply

The Environmental Protection Agency (EPA) is a federal agency that works closely with other federal agencies, state and local governments, and Indian tribes to develop and enforce regulations under existing environmental laws. The Department of Environmental Quality (DEQ) has primary enforcement authority in Michigan for the Federal Safe Drinking Water Act under the Michigan Safe Drinking Water Act. The DEQ has regulatory oversight for all public water supplies including approximately 1,500 community and 11,000 non-community water supplies. The program also regulates drinking water well drilling for approximately 25,000 new domestic wells drilled each year. Michigan has over 1.12 million households served by private wells, more than any other state. In addition to its regulatory activities, the DEQ investigates drinking water well contamination, and oversees remedial activities at sites of groundwater contamination affecting drinking water wells.

Information concerning water systems in Michigan is maintained by the MIDEQ, and can be found on the EPA's *Safe Drinking Water Information Site.* The records at this site go back to 1993. For violations prior to 1993, interested parties may contact the operators of the water system in question, contact the State of Michigan, or file a Freedom of Information Act (FOIA) request.

Drinking Water Quality in the Thunder Bay River Watershed

Water quality data for each of the five counties supporting the Phase Two portion of the Thunder Bay River Watershed was analyzed and is briefly summarized below. Although many of the wells listed in the summary are actually located outside the Phase Two portion of the watershed, data from these sites were included to provide an overview of the regions public water supply.

The EPA divides drinking water wells into four classes:

1. PRIVATE WELLS
   If drinking water comes from a private well, the owner is responsible for the water's safety. EPA rules do not apply to private wells, but recommends that well owners have their water tested annually. To get a list of certified commercial laboratories that test drinking water contact the State Certification Officer at:
   Department of Environmental Quality
   3423 N. Martin Luther King B
   P.O. Box 30195
   Lansing, MI 48909
   (517) 335-8812

2. COMMUNITY WATER SYSTEMS
   Community water systems serve the population year-round, such as in private residences or businesses. There are twenty-two community water systems active in the five counties that make up the Thunder Bay River Watershed, Phase Two. Six of the community water systems are located in Alcona County, four are in Alpena County, three in Montmorency County, four in Oscoda County, and five are located in Presque Isle County. Population centers of the City of

Harrisville, the City of Alpena, Alpena Township, Briley Township, the Village of Hillman, Au Sable Valley, Garland, Onaway, Rogers City, Millersburg, and Posen each have a community water system.

All of the community water systems in the watershed are supplied by groundwater, with the exception of Alpena Township and the City of Alpena, which rely on surface water as a public water supply.

Community wells supply drinking water for 758 people in Alcona County, 16,625 in Alpena County, 1,058 in Montmorency County, 845 in Oscoda County, and 5,461 people in Presque Isle County. Eight wells were cited within the last ten years for violation of the *maximum contamination level* (MCL) allowed. In all cases, the contaminant was *coliform.* Not a health threat in itself; coliform is a bacteria produced by the waste of both plants and animals. It is used to indicate whether other potentially harmful bacteria may be present in drinking water. In all cases but one, the health violations were resolved in a timely manner.

3. NON-TRANSIENT NON-COMMUNITY WATER SYSTEMS

Non-transient water systems serve the same population, but not year-round (for example, schools that have their own water system). There are thirty-four such water systems located in the watershed, serving populations of 1,390 in Alcona County, 1,510 in Alpena County, 1,023 in Montmorency County, 2,206 in Oscoda County, and 395 in Presque Isle County. The non-transient, non-community wells in all five counties are supplied by groundwater.

Eight of the thirty-four non-transient, non-community water systems in the five counties received notices of health violations in the last ten years; in each case the contaminant was coliform bacteria. In all but one instance the violations were resolved in a timely manner.

4. TRANSIENT NON-COMMUNITY WATER SYSTEMS

Transient non-community water systems are systems that do not consistently serve the same population. Rest stops, campgrounds, gas stations, motels and convenience type stores not hooked into a community water supply would be included in this category. Most of the wells in the watershed that are not considered private wells fall into this group. Over three hundred such wells are found in the five counties of the watershed, and all are supplied by ground water. Tens of thousands of people use water from the transient non-community water systems of the watershed region each year. Fifty-nine of these water systems were cited within the last ten years for the presence of coliform bacteria; several systems were cited two or more times during this period, for a total of 97 violations. (Two systems were also cited for unacceptable levels of Nitrates.) In most cases, compliance to the Safe Drinking Water Act was achieved in a timely manner; and only ten cases remain to be resolved.

CHAPTER NINE: EPA NINE REQUIRED ELEMENTS

Beginning with FY03 grants, the United States Environmental Protection Agency (EPA) requires all implementation, demonstration, and outreach-education projects funded under Section 319 of the federal Clean Water Act to be supported by a Watershed Plan which includes the following nine listed elements. To be eligible for Section 319 funding watershed plans must address all nine elements. The nine EPA required elements, and the location of the plan component addressing these elements are listed below.

EPA Nine Required Elements

A. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X numbers of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).

- Tables showing the causes of pollution in the watershed that will need to be controlled are found in Appendix I of the completed watershed plan.

B. An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).

- Estimates of the load reductions expected for the management measures recommended for implementation are found in Appendix I of the completed watershed plan.

C. A description of the NPS management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

- A description of the measures that are recommended for implementation to achieve the estimated load reductions can be found in the *Support Document: Thunder Bay River Watershed Initiative: Phase Two , Phase Two* beginning on each of the following pages:

Streambank recommendations:	1
Shoreline recommendations:	34
Road/stream crossing recommendations:	67

Agricultural recommendations:	319

Maps displaying streambank erosion and road/stream crossing sites are found on pages 8-11 of the Watershed Plan. The Support Document also contains maps of areas in which load reduction measures will need to be implemented. These maps can be found on the following pages:

Hubbard Lake Erosion Sites	64
Alcona Road/stream Crossing Sites	314
Alpena Road/stream Crossing Sites	315
Montmorency Road/stream Crossing Sites	316
Oscoda Road/stream Crossing Sites	317
Presque Isle Road/stream Crossing Sites	318
Alcona Agriculture Sites	359
Alpena Agriculture Sites	360
Montmorency Agriculture Sites	361
Presque Isle Agriculture Sites	362

Measures recommended to achieve other watershed goals can be found in the *Thunder Bay River Watershed Initiative: Phase Two Watershed Plan*, Chapter 7: Goals, Objectives and Recommendations. Recommendations are listed on the following pages of the plan:

Shoreline Protection:	Page 76
Land Use Recommendations:	Page 81
Voluntary Land Protection Projects:	Page 82
General Education Recommendations:	Page 83

D. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

- Estimates of the amounts of technical and financial assistance needed and associated costs for implementation of this plan can be found in **Table 35** on page 75 of the *Thunder Bay River Watershed Initiative: Phase Two*, Chapter 7: Goals, Objectives and Recommendations.

E. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation

in selecting, designing, and implementing the NPS management measures that will be implemented.

- The Information and Education component of the watershed management plan can be found on pages 82-85 in *Thunder Bay River Watershed Initiative: Phase Two*, Chapter 7: Goals, Objectives and Recommendations

F. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

- A schedule for implementing the NPS management measures identified in this plan can be found in Appendix J of the watershed management plan *Thunder Bay River Watershed Initiative: Phase Two.*

G. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

- Shown as bulleted items, a description of interim, measurable milestones for the implementation phase of the watershed plan can be found in Appendix J: Implementation Timeline.

H. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

- Appendix K: Project Summary contains the required set of criteria.

I. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

- The required monitoring component for the watershed plan can be found in *Thunder Bay River Watershed Initiative: Phase Two*, Chapter 7: Goals, Objectives and Recommendations (Table 44, page 86)

APPENDIX A
THUNDER BAY RIVER WATERSHED HISTORICAL WATER QUALITY DATA

Historical data indicates that increased pressure from development, agriculture, and land use practices along with eroding surfaces, lack of resource planning, and enforcement are negatively affecting the water resources in the area. Some of the *known* threats to the watershed were identified as: erosion, sediment, thermal pollution, loss of riparian buffers, coliform bacteria, logging practices, road/stream crossings, livestock access, stormwater discharge, and excess nutrients. A list of *suspected* pollutants and causes include: faulty septic systems, lack of land use planning, improper animal waste facilities, runoff from feedlots, phosphorus, pesticide, and fertilizer application from agriculture and residential applications.

The following is a list of studies completed within the watershed area which highlight known or suspected pollutants threatening the watershed. Some of the studies discuss the source of the pollution and offer recommendations on how to reduce or eliminate the pollutants.

A Biological Survey of the Thunder Bay River Watershed, 2003 MDEQ

- Biological, chemical, and physical habitat conditions of the Thunder River (including the North, Upper South, and Lower South Branches) were assessed.
- It was determined that Hubbard Lake and Beaver Lake were not meeting the Michigan Water Quality Standards (MWQS). Both lakes have been listed on the 303(d) non-attainment list for exhibiting elevated mercury or polychlorinated biphenyl levels in fish.
- The macro-invertebrate community and water chemistry data collected indicated that all stations sampled met the requirements of the MWQS.

Resource Assessment of Alpena County, 2001 Alpena Conservation District

- The County of Alpena was determined to be at risk of groundwater contamination resulting from high water table (50 feet from the surface in some areas) and highly permeable soils. There is also an occurrence of karst topography in parts of the county, potentially serving as direct conduits for surface runoff to contaminate groundwater.
- Erosion has been identified as a major contributing factor to surface water pollution.
- Pollutants and bacteria from faulty septic systems could be a major factor in the County's decline of water quality.
- Agricultural and residential applications may be contributing to the water quality decline.
- Sedimentation and thermal pollution along the riparian corridors and the loss of riparian buffers has contributed to the decline in cold water fisheries in some rivers.

Source Water Assessment Report for the Alpena Water Supply, 2000 U.S. Geological Survey.

- Nonpoint sources of concern to the Alpena water supply are primarily from agriculture and livestock in the Thunder Bay River Watershed, and from residential and commercial sources in Alpena and surrounding communities.
- The periodic presence of coliform bacteria at detectable levels in the water source is indicative of a relationship between runoff and soil conditions.

A Biological Survey of the Thunder Bay River and Selected Tributaries, 1997 MDEQ.

- Macro-invertebrate data collected at selected sites suggested water quality was acceptable and revealed no clear biological integrity impairment.
- Physical habitats at five of eight locations were rated moderately to severely impaired. The study noted that historical logging practice, current road/stream crossings, and livestock access contribute to the impaired habitat conditions.

- Water and sediment chemistry data revealed unusual characteristics related to stormwater discharge at the Village of Hillman, and livestock access near Curran.
- Nitrogen, phosphorus, chemical oxygen demand, and suspended solids were elevated in the eastern branch of Wolf Creek and near the Village of Hillman.

Northeast Michigan Karst Aquifer Protection Plan, 1996 Presque Isle Soil Conservation District.

- A critical area was defined based on aquifer sensitivity and the probability for groundwater contamination. Portions of the North Branch of the Thunder Bay River fall within this sensitive area.
- Priority pollutants identified for the sensitive area include the following: Pathogens, Nitrates, Sediment, Pesticides, Hydrocarbons, Salts, and Heavy Metals.

Thunder Bay River Basin Report, 1995 United States Department of Agriculture, Forest Service and Natural Resources Conservation Service

Local coordinating committees identified the following sources that may potentially threaten water quality.

- Old or poorly maintained septic systems that are not up to current code may be contributing pollutants such as nutrients and bacteria to the watershed.
- Sedimentation is seen as a major threat to surface water quality. Erosion sources include agricultural cropland, livestock pasture, forest harvesting areas, eroding streambanks and lakeshores, runoff from roads, drainage ditches, and construction sites.

Streambank Erosion Inventory, Thunder Bay River Michigan, 1993 USDA Soil Conservation Service

- The inventory identified 11 streambank erosion sites on the Lower South Branch and 23 streambank erosion sites on the North Branch.

Biological Survey of the North Branch, Thunder Bay River Montmorency County Michigan, 1989 MDEQ

- The study found that the North Branch of the Thunder Bay River was impacted by nonpoint source sedimentation and nutrient enrichment originating from cattle access and crop runoff.

Agriculture Areas of Water Quality Concern, 1980 NEMCOG

- Four sites within the watershed were deemed as having the potential to contribute nonpoint source pollution. (The remaining two sites are not located within the scope of this plan)
- Butterfield Creek--Several dairy operations are located within a quarter mile of the river. Erosion of cropland is a concern since over 90% of the watershed is in row crop production.
- Wolf Creek--Three livestock operations are located on the river. Lack of animal waste systems, runoff from feed lots, and livestock access to surface water suggests the possibility of a water quality problem.

Water Quality of the Thunder Bay River, 1980 NEMCOG

- The average Water Quality Index for all 21 stations is 82 on a scale of 100, again suggesting that the overall quality of water in the Thunder Bay River system is good.
- The sources potentially responsible for the decreasing water quality in the vicinity of the City of Alpena includes rural nonpoint source pollution, industrial and sanitary waste discharge and urban runoff.
- In 1981, a study conducted by the Northeast Michigan Council of Governments also identified urban runoff and stormwater runoff as serious threats to the water quality.

A Water Quality Survey of 48 Lakes in Northeast Michigan, 1979 NEMCOG

- This study was conducted to designate a lake classification based on Carlson's Trophic State Index (TSI). This classification is based on secchi depth, total phosphorus, and chlorophyll a levels.
- Hubbard Lake was classified as mesotrophic, whereas, Fletcher Pond was classified as borderline eutrophic.
- The study recommended that lake associations and local communities institute effective lake management programs. Recommendations include decreased nutrient input and proper riparian stewardship.

Hubbard Lake, Alcona County, Michigan-Water Quality Study, 1976 MSU

- Nine of ten stations sampled indicated high counts of Fecal Streptococci Bacteria, evidence of septic system effluent.
- Lakeview Drive canal exhibited higher concentrations of nitrate and organic nitrogen, alkalinity, conductivity, chlorides, total dissolved solids, color, silica, calcium, magnesium, sodium, sulfate and iron.
- The greater visibility of algae and aquatic plant growth indicates higher dissolved phosphorus concentration.

The study recommended strict nutrient control measures, highlighting more stringent septic requirements.

APPENDIX B

Streambank Erosion Inventory

Site Number:_____ Date:_____
County:_____ Map Sheet Number_____
Photo Numbers:_____ Personnel:_____

LOCATION

Township Name:_____ Township Number:_____Range_____Section_____

GPS Coordinates_____N_____W

Owners: FEDERAL COUNTY STATE PRIVATE_____

Landmarks, Features:_____

SITE INFORMATION

BANK--While looking downstream: RIGHT LEFT

Is there access to the site for equipment?: YES NO

If no, distance to nearest road (estimate):_____

CONDITION OF BANK (Circle)

A. TOE IS UNDERCUTTING
B. TOE IS STABLE, UPPER BANK ERODING
C. TOE AND UPPER BANK ERODING
D. PERCENT OF VEGETATIVE COVER ON BANK: 0-10% 10-50% 50-100%
E. OTHER (Describe):_____
F. PROBLEM TREND: INCREASING DECREASING

APPARENT CAUSE OF EROSION (Circle any applicable)

A. LAND USE (MOWING, CLEARCUTTING, DEVELOPMENT)
B. FOOT TRAFFIC, BOAT ACCESS, FISHING SITE
C. PEAKING (THUNDER BAY POWER)
D. SURFACE WATER ENTERING
E. BEND OR OBSTRUCTION IN RIVER
F. WILDLIFE USE
G. WAVE ACTION
H. BANK SEEPAGE
I. OTHER:_____

Streambank Erosion Inventory, continued

AMOUNT OF EROSION AND SLOPE RATIO

A. SIDESLOPE OF BANK (Circle one):
Vertical 1:1 2:1 3:1 4:1 or Flatter
B. LENGTH OF ERODED BANK: _____
C. AVERAGE HEIGHT OF ERODED BANK: _____

RIVER CONDITIONS

A. APPROXIMATE WIDTH OF RIVER:_____
B. DEPTH OF RIE:_____AT_____FROM THE BANK
C. CURRENT: SLOW MODERATE FAST

SOIL TEXTURE

SAND CLAY LOAM GRAVEL STRATIFIED SAND OVER CLAY
OTHER_____

SEVERITY OF SITE: MINOR MODERATE SEVERE

TYPE OF RECOMMENDED TREATMENT (Circle all that apply);

A. ROCK RIP-RAP
B. BIOLOGS/TREE REVETMENTS
C. TREE REVETMENT
D. BANK SLOPING
E. STAIRWAYS
F. BANK SEEDING OR PLANTING
G. BRUSH PLACEMENT
H. FENCING
I. OTHER_____

DRAWING OF SITE, COMMENTS

APPENDIX C

Thunder Bay River Watershed
Streambank Erosion Severity Index

Condition of bank	Points	Soil type or texture	Points
Toe and upper bank eroding	5	Sand	3
Toe undercutting	3	Gravel	2
Toe stable, upper bank eroding	1	Stratified	2
		Clay, loam	1
Problem trend		**Vegetative cover on bank slope**	
Increasing	5	0-10%	5
Decreasing or stable	1	10-50%	3
		40-100%	1
Side-slope of bank		**Apparent cause of erosion**	
Vertical, 1:1	5	Light access traffic	1
2:1, 3:1	2	Obstruction in river	1
4:1 or flatter	1	Bank seepage	1
		Gullying by side channels	1
		Bend in river	2
		Wave action (impoundments)	2
		Road-stream crossing; grade/shoulder runoff	3
		Moderate access traffic	3
		Heavy access (foot, horse, etc.) traffic	5
Length of eroded bank		**Mean height of eroded bank**	
More than 50 ft.	5	More than 20 ft	7
20 to 50 ft.	3	10 to 20 ft	5
Less than 20 ft.	1	5 to 10 ft	3
		less than 5 ft	1
Depth of river		**Current**	
3 ft or over	2	Fast	2
Less than 3 ft	1	Slow	1
		Total Points for Site	

Accumulative points indicate extent of erosion, i. e., the site rating, as follows:

More than 36-----Severe
30 to 36----------Moderate
Less than 30------Minor

Appendix D
Hubbard Lake Shoreline Inventory Form

Date:____________________ Technician:_______________________ Weather:_________________________

Site #	GPS	Description	Cladophora	Clado Habitat	Greenbelt	Erosion
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy

APPENDIX E
ROAD STREAM CROSSING FIELD DATA FORM

Collected By: _____ Field ID:
Date: _____ Site ID:

LOCATION

Stream
Name:_____County:_____RoadName:_____
Crossing Name:_____Township:_____T_____R_____Sec._____

Type of Crossing:
_____Bridge
_____Single Culvert
_____Twin Culvert
_____Triple Culvert
_____Box Culvert
_____Other_____

Adjacent Landowners:
_____USA
_____State
_____Local Gov't
_____Private
_____Other

ROAD DATA

Width at Crossing: _____ft.
Road Surface: _____Paved
_____Gravel
_____Sand
_____Other_____

Approaches:

	Left	Right
Length:	_____ft.	_____ft.
Slope:	_____ 0%	_____
	_____ 1-5%	_____
	_____ 6-10%	_____
	_____ >10%	_____

Maintenance: _____Seasonal
_____Year around

Location of Low Point:
_____At stream
_____Other _____
_____

Ditch Shoulder Vegetation:

Upstream		Downstream
_____	None	_____
_____	Partial	_____
_____	Heavy	_____

Existing Drainage Control Features:

_____None _____Present and Functional
_____Need Repair_____

Width of Grade, including Shoulder and Ditches:_____ft.

Runoff Path:_____Roadway _____Ditch

CULVERT DESCRIPTION

Length: _____ft.
Diameter: _____ft.
Material: _____Galvanized
_____Concrete
_____Other_____

Condition: _____Good
_____Fair
_____Poor

Flow Through Culvert: _____Clear
_____Obstructed

Fish Passage Problems:_____

	Inlet	Outlet
Fill Depth:	_____ft.	_____ft.
Embankment:	_____Vertical	_____
	_____ 1:1	_____
	_____ 1.5:1	_____
	_____ 2:1	_____
	_____ >2:1	_____

STREAM CHARACTERISTICS

	Upstream	Downstream
Ave. Width:	_____ft.	_____ft.
Ave. Depth:	_____ft.	_____ft.
Ave Current:	_____ Slow	_____
	_____ Moderate	_____
	_____ Fast	_____
Predominate Substrate:	_____ Sand	_____
	_____Sand/gravel	_____
	_____ Gravel	_____
	_____ Muck	_____

Adjacent Wetlands:_____Yes _____No
Water Temperature:_____
Visible Down cutting:_____

Comments:_____
_____
_____

CONDITIONS AND TREATMENT

Erosion Conditions:

_____ Streambank Erosion Adjacent to Crossing
_____ Embankment Erosion
_____ Culvert Outlet Erosion
_____ Pool Formation at Culvert Outlet
_____ Shoulder/Ditch Erosion
_____ Sand/Soil Over Crossing
_____ Other_____

Recommended Treatment:

_____Pavement
_____Pave Curb & Gutter
_____Erosion Control Structures ( )
_____Sediment Basins ( )
_____Extend Culvert ( )
_____Diversion Outlets ( )
_____Increase Fill
_____Replace Culverts ( )
_____Other_____

Extent:

_____Minor _____Moderate _____Severe

Reason for Recommendation:_____

Cause: _____
_____

PHOTOS Film Numbers:_____

SITE SKETCH

APPENDIX F

Severity Scoring Worksheet

Road/Stream Crossing Inventory
Thunder Bay River Watershed

Site I. D. _____

Factors Contributing to Severity	Points	Site Score
ROAD SURFACE	Paved: 0 pt Gravel: 3 pt Sand and Gravel: 6 pt Sand: 9 pt	
LENGTH OF APPROACHES	0-40 ft: 1 pt 41-1000 ft (0.008-0.189 mi.): 3 pt 1001-2000 ft (0.19-0.379 mi.): 5 pt > 2000 ft (>0.379 mi.): 7 pt	
SLOPE OF APPROACHES	0 %: 0 pt 1-5%: 3 pt 6-10 %: 6 pt >10 %: 9 pt	
VEGETATIVE COVER OF SHOULDERS & DITCHES	Heavy: 1 pt Partial: 3 pt None: 5 pt	
WIDTH OF ROAD, SHOULDERS & DITCHES	< 15 ft: 0 pt 16-20 ft: 1 pt > 20 ft. 2 pt	
EMBANKMENT SLOPE	Bridges: 0 pt >2:1 slope: 1 pt 1:5-2:1 slope: 3 pt Vertical or 1;1 slope: 5pt	
STREAM DEPTH	0-2 ft: 1 pt >2 ft: 2 pt	
STREAM CURRENT	Slow: 1 pt Moderate: 2 pt Fast: 3 pt	
EXTENT OF EROSION	Minor: 1 pt Moderate: 3 pt Severe: 5 pt	
TOTAL	**0-15 Minor** **16-29 Moderate** **≥ 30 Severe**	

Appendix G:
Definition Of Terms Used In Road/Stream Crossing Data Collection

- *Adjacent Landowners:* Ownership was determined from county plat book maps**,** however recent changes in ownership may not be reflected, and should be re-checked prior to any improvement work.
- *Average Width of Grade:* The distance between and including both ditches and the roadway.
- *CMP:* Corrugated metal pipes of various diameters and lengths, also referred to as culverts.
- *Corrective Measures/Drainage Control Features:* Any best management plan measures used to correct site-specific erosion problems, generally these include diversion outlets, erosion blankets, and sediment basins.
- *Depth of Fill:* A vertical measurement of the amount of soil between the top of the culvert and the grade of the road.
- *Embankment:* The slope associated with the inlet and outlet of a corrugated metal pipe or box culvert, however in the case of bridges, embankment refers to the slope of the stream bank adjacent to the crossing.
- *Extent of Erosion:* An arbitrary estimate of site specific erosion, where if little to no erosion is evident it is considered by default to be minor. Moderate and extreme follow accordingly to the severity of conditions, including grading spoils and gully formation respectively. However, these estimates do not reflect erosion potential.
- *Fish Passage Problem:* This refers to the flow through a culvert and whether or not fish passage is possible, as certain obstructions have the potential to impede passage.
- *Flow through Culvert:* An indication of obstruction to flow. *Clear* indicates that current flow is unaffected by the presence of any type of road/stream crossing. *Obstructed* flow is generally associated with large debris accumulations, such as beaver dams, or due to large sediment inputs associated with run-off or grading.
- *Intermittent:* A stream that flows only temporarily or only at certain times annually, and may remain dry for the majority of the year.
- *Length of Approaches:* The downward slope of a road approaching a stream crossing, where typically the stream is located at the low point.
- *Perennial:* A stream that flows continually year around, however, predictable changes in discharge are observed on an annual basis.
- *Recommended Treatment:* One or more best management practices are recommended for each site. The practices were selected based on proven ability to reduce sedimentation and are generally accepted by road and resource professionals. In some cases, the road commission may select an alternative treatment; the recommendations serve only as a starting point.
- *Run-off Pathway:* The course of run-off to a stream channel, this may be via two general routes, the road or ditch/shoulder. Typically, roads with a surface of either gravel or sand result in run-off traveling down the road, however exceptions exist, especially if the road is convex or crowned.
- *Slope of Approaches:* The ratio of an increase in height over the distance of a given road and is usually expressed as a percentage.
- *Stream Current:* Average upstream and downstream current was observed and classified as slow, medium, or fast. These descriptions correspond to velocities of approximately: slow = 0 to 0.5 ft/sec; medium = 0.5 to 2.5 ft/sec; and fast = >2.5 ft/sec.
- *Vegetation:* Defines the presence, absence, and relative abundance/condition of existing vegetation on the embankments of a given crossing. Generally, vegetation that is at all disturbed by access or road grading is considered to be partial.
- *Visible Down Cutting:* This indicates the scouring of the stream channel at the outlet of the culvert resulting in pool formation.
- *Wetlands:* Any stand of vegetation that is typical of an area of land that is at least partially inundated by water for part of the year.

Appendix H:

Agricultural Inventory for the Thunder Bay River Watershed

(Data form for farm operations within 1000 feet of surface water.)

Date:_____ Observer:_____ Stream:_____

1) LOCATION

County Township No.: Range: Section:
GPS Coordinates:
Property Owner:

2) FARM INFORMATION

Type of operation: □ Livestock □ Crops □ Orchard
Estimated size of farm:_____acres
General topography: □ Flat □Gently rolling □ Moderately rolling □ Steeply rolling
Estimated riparian frontage of farm:_____feet

3) SITE INFORMATION

Soil type: □ Clay □ Organic □ Sand □ Loam
Stream Conditions:

- Approximate width of stream:_____ • Current:____fast ____moderate ____ slow

Are there drains at this site? □ Yes □ No
Are there foreseeable risks to: □ surface water, □ groundwater, or □ wetlands from the farm site?

4) APPARENT POLLUTANT SOURCES

□ Unrestricted Livestock Access to Water

- Approximate length length of access:_____

□ Crop production adjacent to water (poor buffer/filter strip)

- Approximate length of production area along waterway:_____
- Distance from crops to water:_____ • Type of crops:_____
- Conservation tillage (reduced till or no till)_____

□ Feedlot runoff

- Size of feedlot:_____ • Proximity to waterway_____ft. • Slope_____

□ Manure Storage area runoff

- Size of area:_____ • Proximity to waterway_____ft. • Slope_____

□ Manure Application within 150 feet of a waterway
□ Poor storage of fertilizer/pesticides
□ Is the land Irrigated Y N
□ Other (please describe, such as oil & gas operation, silage runoff, milking parlor runoff, mining, farm road runoff, etc.):_____

5) RECOMMENDED TREATMENT

a. Exclusion Fencing
   - Total amount of fencing (for both sides of stream, if necessary) needed:_____ft.
b. Livestock crossing/livestock access
c. Alternate water source
d. Riparian buffer/filter strip
   - Width of buffer strip recommended:_____ft. • Length of buffer strip:_____ft.
e. Fertilizer/pesticide storage
f. Erosion control structures:_____
g. Animal waste facility
h. Feedlot diversion and water retention basin
i. Nutrient Management Plan
j. Other:_____

6) SEVERITY OF SITE

□ Slight □ Moderate □ Severe

7) PERCEIVED LEVEL OF COOPERATION FROM LANDOWNER (if known)

□ Very willing to implement BMPs □ Somewhat willing □ Unwilling □ Unknown

Please sketch map of site, showing direction of runoff, proximity to waterbody, and noting any site-specific concerns.

Additional notes for treatment (cost estimate):

Appendix I

LOAD REDUCTION CALCULATIONS FOR
THUNDER BAY RIVER WATERSHED INITIATIVE: PHASE TWO

Agricultural Load Reduction Estimations

Calculation Formula
Erosion Calculation: Height x Length x Severity Index x Soil Index = Channel Erosion Equation
Nutrient reduced (lb/yr) = Sediment reduced (T/yr) x Nutrient conc. (lb/lb soil) x 2000 lb/T x correction factor

County	Pollutant Source	Management Practice	Total Soil Saved Tons/year	# Phosphorus Saved/year	# Nitrogen Saved/year
Alcona County	4 Livestock feed lots (approximately 410 cattle)	Exclusion Fencing Buffer Strips Watering facility Stream Crossings Waste facility	434.6	182.0	229.9
Alpena County	5 Livestock feed lots (approximately 192 cattle, about 120 of which are dairy)	Buffer Strip Watering Facility Stream Crossing Runoff Diversion Runoff Basin Waste Facility	383.4	360.9	192.6
Montmorency County	1 Livestock feed lot (approximately 100 dairy cattle)	Exclusion Fencing Buffer Strip	8.5	8.5	4.2
Presque Isle County	2 Livestock feed lots (approximately 300 cattle, about 190 of which are dairy)	Runoff Diversion Runoff Basin Buffer Strip Watering facility Stream Crossing	25.5	25.5	12.7

Streambank Load Reductions

Formula Used for Streambank Erosion Calculations:
Erosion Calculation: Height x Length x Severity Index x Soil Index = Channel Erosion Equation

County	Pollutant Source	Cumulative Length of Bank	Management Practice	Average Total Soil Saved Tons/year
Alcona County	1 Moderate erosion site	70 ft.	Install stairway & fishing platform Bank seeding/planting	16.6
Alpena County	14 Moderate erosion sites	1,680 ft.	Install stairways Bank seeding/planting Bio-logs Tree revetments Fencing Rock riprap	232.3
	2 Severe erosion sites	400 ft.	Bio-logs Tree revetments Stairways Bank seeding/planting	118.3

Road/Stream Crossing Load Reductions

Road Stream Crossings Calculations:
Erosion Calculation: Height x Length x Severity Index x Soil Index = Channel Erosion Equation

County	Pollutant Source	Pollutant Cause	Management Practice	Average Total Soil Saved Tons/year
Alcona County	5 Severe Road/Stream Sites	Embankment erosion Sand/soil over crossing Pool formation Culvert outlet erosion	Pave approaches, curb & gutter Erosion control structures Improve/replace/extend culvert Diversion outlet Increase fill over culvert	53.0
Alpena County	1 Severe Road/ Stream Site	Shoulder/ditch erosion Sand/soil over crossing	Pave approaches, curb & gutter Erosion control structures	22.5
	5 Moderate Road/Stream Sites	Streambank erosion Embankment erosion Sand/soil over crossing Shoulder/ditch erosion Pool formation	Pave approaches, curb & gutter Erosion control structures Diversion outlet Sediment basin	7.8
Montmorency County	2 Severe Road/ Stream Sites	Embankment erosion Sand/soil over crossing Shoulder/ditch erosion	Pave approaches, curb & gutter Erosion control structures Increase fill over culvert Diversion outlet	56.3
	2 Moderate Road/ Stream Sites	Embankment erosion Sand/soil over crossing	Pave approaches, curb & gutter Increase fill over culvert Improve/replace/extend culvert Diversion outlet	17.0

Appendix J

The Project Implementation Timeline is a schedule for implementing the NPS management measures identified in this plan. The bulleted items represent interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

THUNDER BAY RIVER WATERSHED INITIATIVE: PHASE TWO **PROJECT IMPLEMENTATION TIMELINE**	
SHORELINE PROTECTION-RIPARIAN LANDOWNER RECOMMENDATIONS	
Follow up initial shoreline survey with an educational program for property owners around the lake.	3-5 yrs.
Conduct workshops for property owners on proper methods of erosion control, lawn care practices that protect water quality, proper siting, installation, and maintenance of septic systems, maintaining a greenbelt, and reducing runoff.	3-5 yrs.
◆ Send summary of survey results, brochures on practical & effective actions to protect water quality to shoreline residents.	1 yr.
◆ Develop & assemble educational packet (septic maintenance, maintaining greenbelts, proper fertilizer application, etc.) to distribute to riparian landowners	2 yrs.
◆ Help landowners design a site plan to protect their shoreline.	3 yrs.
◆ Develop & institute a consistent, reliable water quality monitoring program	On-going
Educate new riparian landowners in shoreline stewardship practices	3-5 yrs.
◆ Work to familiarize Real estate agents, developers, excavators & landscape/lawn care companies with shoreline stewardship practices for protecting water quality.	3-5 yrs
Complete a comprehensive lake assessment of Hubbard Lake	2-4 yrs.
Develop a plan to monitor water quality for Lake Hubbard	2-4 yrs.
◆ Develop comprehensive list of monitoring activities; include such indicators of lake water quality as DO, condition of biological communities, shoreline algae temperature, conductivity, pH, flow, trophic state, nutrients, land cover types, types & quality of habitat, non-native species, and presence of metals & chemicals.	2 yrs.
◆ Draft plan for data management & reporting, develop QAPP	2 yrs.
◆ Pursue funding for implementation of plan	2-4 yrs.
Educate public in ways to identify and deter the spread of invasive species	2-3 yrs.
◆ Develop & provide educational materials to riparian landowners, boaters & fisherman describing species found; effects on native species, habitat, recreation, & water quality; importance of deterring their spread by good lake usage practices	2-3 yrs.
Add information to database to facilitate identifying the locations of Cladophora growths during repeat shoreline surveys and in making property owner contacts.	3-6yrs. +
Inform those owners of properties with Cladophora growths of the specific results for their property	3-6 yrs.
◆ Conduct landowner survey; use to interpret cause of growth, offer individualized recommendations	2-5 yrs.
◆ After survey, perform site visits/water testing; analyze survey results	3-6 yrs.
◆ Repeat survey every 3-5 years	Ongoing
Compile accurate parcel & ownership information for shoreline database based on knowledge of Association members/shoreline residents & County Equalization Departments within the watershed.	Ongoing
Encourage lake associations in shoreline monitoring activities	Ongoing
Reduce amounts of nutrients entering water bodies from septic systems	3-10 yrs.
Encourage inspection of (& upgrades to substandard) septic systems around lake.	3-10 yrs.
◆ Meet with townships to amend ordinances; include a required inspection of septic systems at the time of property sale or transfer	3-5 yrs.
◆ Meet with townships to phase in a septic system inspection program	10 yrs.
STREAMBANK PROTECTION RECOMMENDATIONS	
Stabilize priority streambank erosion sites through the installation of corrective measures.	1-10 yrs.
Implement structural BMP's to reduce the amount of sediment from entering the river.	1-10 yrs.
◆ Develop site plans, obtain proper permits and landowner permission for 16 sites recommended for treatment	5 yrs.

◆ Secure funding and organize materials	1-2 yrs.
◆ Organize work crew and install BMP's at each of the16 sites	10 yrs.

Improve existing access sites by creating stairs, walkways, fishing platform, etc.	2-9 yrs.
• Develop site plans, obtain proper permits and landowner permission for improvement to/construction of access structures and stairways at sites	2-9 yrs.
• Secure funding and organize materials	2-5 yrs
• Organize work crew and implement BMP's for 1 site per year	3-4 yrs
Protect/restore riparian shade vegetation; restore aquatic habitat where impairment is suspected	1-6 yrs.
Educate landowners as to importance of shade vegetation	1 yr.
• Include greenbelt restoration/maintenance information in workshops for riparian landowners, stress connection between loss of vegetation and increased temperatures of coldwater fisheries, and importance of using native vegetation when restoring greenbelts	1 yr.
Restore impaired aquatic habitat	2-5 yrs.
• Organize river/lake cleanup days, recruit volunteers	2-5 yrs.
• Conduct yearly river/lake cleanups utilizing volunteers	2-5 yrs.
• Increase amount of woody debris at suitable sites	2-5 yrs.
Develop plan to increase fish passage at hydroelectric dams	2-6 yrs.
• Work with organizations such as Thunder Bay Power & Thunder Bay River Restoration Committee to determine BMPs for fish passage	2-3 yrs.
• Select best alternative; draft work plan & timetable for implementation	2-6 yrs.
AGRICULTURE RECOMMENDATIONS	
Restrict livestock access to the rivers and streams	1-6 yrs.
Develop site plans, provide water source for livestock and create proper stream crossings	1-6 yrs.
• Create site plans for 11 sites recommended for treatment	1-3 yrs.
• Obtain proper permits and landowner permission	1-3 yrs.
• Secure funding and organize materials	2-3 yrs.
• Organize work crews and install BMPs	2-6 yrs.
Install corrective measures to reduce runoff at agricultural sites of concern.	1-7 yrs.
• Develop plans; install devices to reduce runoff.	1-7 yrs.
• Develop plans for 14 identified areas of concern	1 yr.
• Obtain proper permits and landowner permission	1 yr.
• Secure funding and organize materials	1-4 yrs.
• Organize work crew and install BMP's	2-7 yrs.
ROAD/STREAM CROSSING RECOMMENDATIONS	
Reduce the amount of sediment by establishing a road/stream crossing improvement program designed to correct identified problems	2-10 yrs.
• Stabilize erosion at 16 road/stream crossings recommended for treatment	2-10 yrs.
• Develop site plans, obtain proper permits and landowner permission for priority sites	2 yrs.
• Secure funding and organize materials	2 yrs.
• Organize work crew and implement BMPs at the selected sites	2-10 yrs.
LAND USE RECOMMENDATIONS	
Establish Responsible Land-Use Practices	1-10 yrs.
Develop Thunder Bay Watershed Land Use Development Guidelines; model after the Grand Traverse Bay Guidelines & Recommended Land Use Regulations	1-5 yrs.
• Work with local government on the adoption of guidelines & regulations that provide for the protection of the water resources.	1-2 yrs.
• Develop and distribute at meetings: handouts covering model stormwater management, site plan review standards, recommended setback distances, stormwater management guidelines, greenbelt provision language, and a checklist; include emergency contact number for hazardous materials spill	2 yrs.
• Encourage removal of sewage/storm drains which discharge directly to watershed	2-5 yrs.
Deliver presentations to local units of government	1-3 yrs.
• Revise NEMCOG's PowerPoint Presentation on the connection between land use practices, nonpoint source pollution and water quality.	1 yr.
• Deliver presentations to Co. Planning Commissions & Co. Chapters of the Michigan Townships Associations	2 yrs.
Protect/restore sensitive areas such as wetlands and riparian corridors	Ongoing

Involve Riparian Landowners in lake and stream protection efforts	Ongoing
• Encourage compliance to "no wake" laws through signage explaining reason for "no wake", and by working with enforcement agencies and river watch groups	Ongoing

• Encourage riparian landowners to maintain/create native conservation buffers	On going
VOLUNTARY LAND PROTECTION PROJECTS	
Develop database of Priority Parcels within watershed	1-3 yrs.
Identify priority Parcels within the watershed	1-3 yrs.
• Develop criteria for determining what constitutes a priority parcel	1-2 yrs.
• Identify priority parcels of land utilizing GIS data from watershed inventory	1-2 yrs.
• Develop priority parcel map for watershed	2 yrs.
• Obtain land owner information of priority parcels from County Equalization Department	2-3 yrs.
Provide voluntary land protection information to riparian landowners	1-2 yrs
Develop and/or compile informational materials on easement and land donation programs to priority property owners.	1-2 yrs
• Assemble information packets and distribute to owners of priority land parcels in the watershed	1-2 yrs
Organize and hold a workshop on voluntary land protection techniques	1-2 yrs
• Develop and assemble workshop materials	1-2 yrs
• Organize workshop	1-2 yrs
• Contact priority parcel landowners to participate in workshop	1-2 yrs
Contact and meet with at least ten priority property owners for consideration of conservation easement, and/or land donation.	2 yrs.
• Contact and meet with at least 5 priority property owners each year	2 yrs.
GENERAL EDUCATION RECOMMENDATIONS	
Encourage Co. Road Commissions to explore maintenance alternatives at road/stream crossings.	1 yr.
Create model road/stream crossing site in cooperation with county road commissions	1 yr.
• Meet with Road Commissions to select model site & plan for implementation	1 yr.
Make public aware of importance of using Best Management Practices at road/stream crossings, streambank erosion sites, stormwater runoff and agricultural sites of concern.	1-5 yrs
Develop watershed protection display to take advantage of educational opportunities at local events	1-5 yrs.
• Develop brochures and/or information packets explaining the importance of using BMPs at road/stream crossings, streambank erosion sites, stormwater runoff and agricultural sites of concern	1-2 yrs.
• Set up display and distribute information at fairs and appropriate community events once or more each year. Displays will include educational materials, photos, & brochures	3-5 yrs.
Develop and implement school programs concerning water quality education.	1-5 yrs.
Implement a water quality program in area schools	1-5 yrs.
• Conduct a water resource curriculum review	1-2 yrs.
• Involve teachers and students in educational water testing/monitoring	2-5 yrs.
• Establish interactive database to which students can enter classroom data	2-5 yrs.
• Review and compile existing instructional materials for elementary and secondary students that focus on water resources, include list of water resource web-sites	2-3 yrs.
• With input from teachers, modify selected materials to make more locally relevant	2-3 yrs.
• Develop Lesson Study project	2-5 yrs.
Develop Educational Tools for Citizens of the Watershed	1-6 yrs.
Involve and educate the public on actions they can take to reduce nonpoint source pollution	2 yrs.
• Create and have installed: watershed signs, logo, drain stenciling	1-3 yrs.
• Create a series of detailed water drainage maps, 100 year flood	6 yrs.
• Create and distribute residential landowner brochures "Protect Your Watershed"; include emergency numbers for hazardous substance spills	1 yr.

Appendix K

PROJECT SUMMARY

Task	Recommended Strategy	Scope	Cost	Measure of Success	Recommended Locations
Shoreline Protection	Conduct workshops for property owners	Watershed Critical Area	$10,000	Number of workshop participants	Workshops held in Alpena, Alcona & Montmorency Counties
	Educate new Riparian Land-owners in shoreline stewardship practices	All Riparian parcels in watershed	$4,000	Number of land-owners contacted	Riparian parcels on Hubbard Lake
	Develop plan to monitor water quality	Hubbard Lake Subwatershed	$15,000	Plan approved by year 2, implemented by year 4	Hubbard Lake
	Educate public to identify and deter spread of invasive species	Watershed Critical Area	$5,000	Number of households reached	North, South, and Upper South Branches of Thunder Bay River
	Develop & maintain parcel database for Hubbard Lake to facilitate identification of potential problems on the lake	Riparian parcels on Hubbard Lake	$6,500-$11,000	75%-100% of Riparian parcels entered into database.	Hubbard Lake
	Reduce amounts of nutrients entering waterbodies	Meet with townships to amend/ pass ordinances to include required inspection of septic systems at time of sale. Phase in septic system inspection program	$4,000	Number townships with ordinances so amended.	Posen, Metz, Bismarck Montmorency, Rust, Clinton, Comins, Mitchell, Caledonia, Alcona, Hawes Ossineke, Green, WilsonAlpena, Maple Ridge, and Long Rapids Townships

Task	Recommended Strategy	Scope	Cost	Measure of Success	Recommended Locations
Streambank Protection	Implement structural BMPs to reduce amount of sediment entering river	16 streambank erosion sites	$128,460	Complete 2 sites per year	Sites SB01; SB02; SB06; SB08; SB09; SB10; SB11;SB12;SB13; SB14;SB15; SB16; SB17;SB18; SB19; & SB20
	Improve existing access sites by creating stairs, walkway, fishing platform	14 access sites	$25,100	Complete 1-2 sites per year	Sites SB01; SB02; SB06; SB08; SB09; SB10; SB11; SB12; SB13; SB14; SB15; SB18; SB19; SB20
	Restore impaired aquatic habitat through yearly river/ lake cleanups, increase amount of woody debris at suitable sites	Watershed critical area	$2,400	Sufficient # of volunteers to complete cleanups in critical area of watershed	North, South, & Upper South Branches of TBR
	Develop plan to increase fish passage at hydroelectric dams	Thunder Bay River	$3,000	Draft plan ready to implement 2-6 yrs.	Hubbard Lake Dam, Lower South Branch Dam

Remediate Agricural Impacts	Restrict livestock access to water bodies by installing fencing, proper stream crossings, water devices	Watershed critical area	$166,580	Complete 2-4 sites per year	Sites ALC02-ALC04; ALC06; ALP01; ALP04; ALP16; ALP19; ALP21; MO02; PI03
	Install corrective measures such as buffer strips, water runoff diversion, runoff basins, waste storage/utilization, to reduce runoff at agricultural sites	Watershed critical area	$248,545	Complete 2-4 sites per year	Sites ALC02-ALC04; ALC06; ALP01; ALP04; ALP06; ALP16; ALP19; ALP21; MO02; MO05; PI02; PI03
Remediate Road/Stream Crossing impacts	Reduce amount of sediment entering waterbodies at road/stream crossings	Watershed critical area	$421,000	Complete 2-4 sites per year	Sites ALC11; ALC12; AL 15; ALC29; ALC52; ALP01;ALP21; ALP51; ALP65; ALP66; ALP80; MO12; MO13; MO16; MO18; OS01

Task	Recommended Strategy	Scope	Cost	Measure of Success	Recommended Locations
Increase Watershed-based Land Use practices	Work with local governments to develop TBR Watershed Land Use Development Guidelines	17 local units of government	$20,000	Guidelines implemented by 2-3 units of local government per year	Posen, Metz, Bismarck Montmorency, Rust, Clinton, Comins, Mitchell, Caledonia, Alcona, Hawes, Ossineke, Green, Wilson, Alpena, Maple Ridge, and Long Rapids Townships
	Protect & restore sensitive areas such as wetlands and riparian corridors through sign-age, enforcement agencies, river-watch groups. Encourage use of native conservation buffers	Watershed Critical Area	$5,000	Number of landowners in critical area contacted	All wetlands & riparian corridors in watershed critical area
Voluntary Land Use Protection	Develop database of priority parcels within the watershed	Watershed	$5,000	Data collected for 50% of watershed in 18 months, 100% in 3 yrs.	All counties of watershed
	Provide voluntary land protection information to riparian landowners through educational packets, workshop, meetings with priority parcel landowners	Watershed	$5,000	Workshop attendance; number of landowners receiving educational packets; 5 priority parcel landowners contacted each year.	All priority parcels in watershed

Task	Recommended Strategy	Scope	Cost	Measure of Success	Recommended Locations
General Education Program	Encourage Co. Road Commissions to explore maintenance alternatives at road/stream crossings through presentations & model road/stream crossing site.	All counties of watershed	$30,000	Completed model road/stream crossing site in 18 months	A priority road/stream crossing sites selected in cooperation with the road commissions
	Develop watershed protection display to take advantage of educational opportunities at local events	All counties of watershed	$3,000	Watershed protection display presented at one or more community events each year	County fairs, local festivals & community events, watershed-based conferences
	Develop & Implement school programs concerning water quality education	Schools located in Watershed	$6,000	Complete water resource curriculum review in 18 months. Educational water testing /monitoring in schools in 2 yrs. Develop, implement lesson study project in 2-5 yrs.	Pellston Schools, Cheboygan Area Schools
	Develop educational tools for citizens of the watershed	Watershed		Distribute “Protect Your Watershed” brochures—1yr. Watershed signs, logo drain stenciling projects completed—3 yrs. Create series of water drainage maps, 100-year flood—6 yrs.	Watershed critical area