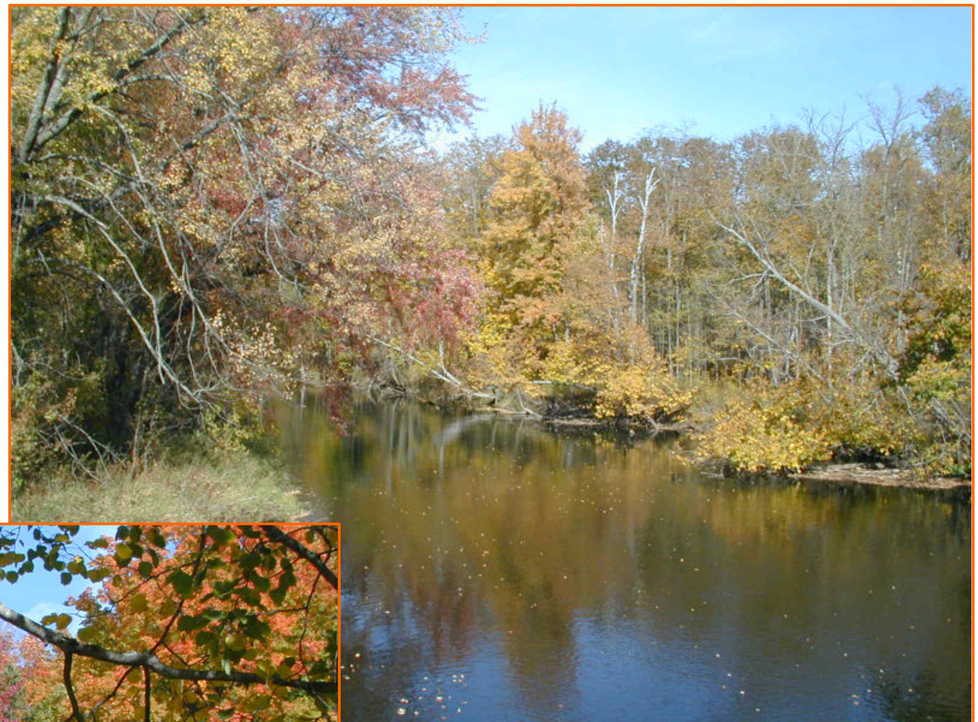
THUNDER BAY RIVER WATERSHED INITIATIVE



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NEMCOG

THUNDER BAY RIVER WATERSHED INITIATIVE

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CHAPTER ONE:
GETTING TO KNOW THE THUNDER BAY RIVER WATERSHED

Overview

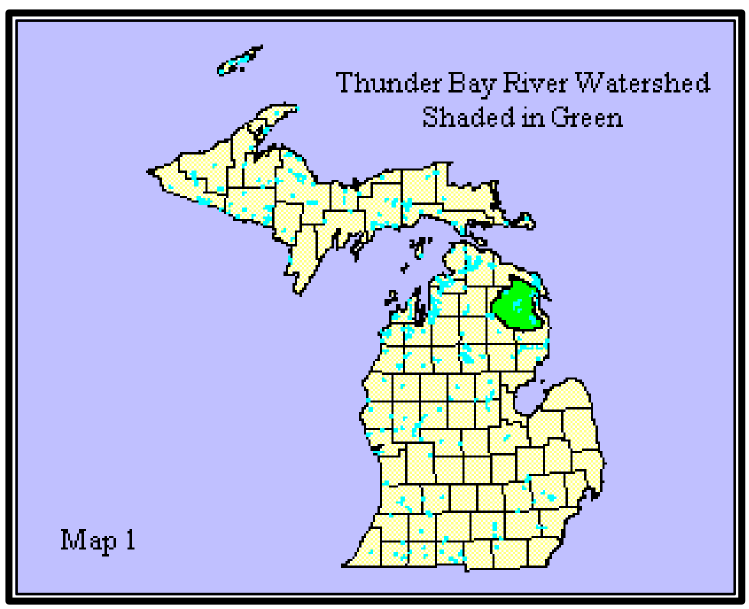
The Thunder Bay River Watershed is a vast river system well known for its high water quality and aesthetically pleasing scenery. Year-round outdoor recreational opportunities within the watershed are seemingly endless and include canoeing, camping, hiking, hunting, fishing, golfing, wildlife viewing, skiing, swimming and snowmobiling. The area is also unique in the fact that the western half of the watershed is host to the only elk herd population in Michigan.

Major portions of the headwater tributaries lie within the Mackinaw State Forest system, which provides the majority of public lands within the watershed. Many of the tributaries are designated as coldwater fisheries and support a viable trout population. Historically, the Thunder Bay River provided a natural corridor between inland fisheries and Lake Huron. The presence of dams throughout the watershed has limited fish passage; however species such as walleye, brown trout, and salmon can still be found in the lower reaches of the Thunder Bay River.

Even though the area is primarily rural, there has been a steady increase in second family and retirement homes. These homes are also being converted into year-round residences as retirees are establishing permanent residency in the area. The major population centers in the watershed are Atlanta, Hillman and Alpena. All three communities are located on the banks of the Thunder Bay River, creating certain development issues from a water quality perspective.

Location

Located in northeastern Michigan, the Thunder Bay River 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).



Size

Due to the vast size of the watershed, this planning phase (Phase One) of the Thunder Bay River Watershed Initiative includes only the Main Branch of the Thunder Bay River, from its headwaters west of Atlanta to its discharge at the City of Alpena. These tributaries which drain directly into the Main Branch are also included: Crooked Creek, Hunt Creek, Gilchrist Creek, Miller Creek, Brush Creek, Truax Creek, Gaffney Creek and Bean Creek. The subwatershed encompasses approximately 600 square miles or 384,000 acres (see *Map 2*). The North Branch, Upper South Branch and Lower South Branch of the Thunder Bay River will be included in a future plan.

Characteristics

Characteristics of the Thunder Bay River Watershed vary greatly. Even though the Watershed still maintains the rural characteristics of the past, there are distinct land patterns that can be seen throughout the region. The watershed exhibits a mix of forests, wetlands, open spaces, agriculture and developed areas.

Located west of Atlanta, the majority of the headwaters lie primarily in undeveloped and forested land, providing this stretch of the river with prime cold-water fisheries and an abundance of wildlife habitat. State land and large tracts owned by private hunt clubs surround the headwater tributaries. *Map 3* shows the distribution of public and private lands. However, little state land can be found adjacent to the Thunder Bay River, which may limit public access to the river. As the river flows downstream to the Village of Hillman, increased residential and commercial development occurs, particularly in, and adjacent to, Hillman. This stretch of the river supports a warm-water fishery. Lowland forests and wetlands are found along the river corridors throughout the watershed and are most heavily concentrated east of Hillman around Truax and Gaffney Creeks. Once through Hillman the landscape begins to change. There is a distinct increase in agricultural activities and open areas. Once old farmsteads, many of these areas have since been converted to large hunt clubs. Pastures and crops are also more evident in this region. As the river flows toward Alpena, development, including residential, commercial and industrial activities, increases.

In addition, there are four hydroelectric facilities along the Thunder Bay River. The Hillman Dam Project is located in the Village of Hillman and has an impoundment of 160 acres. Norway Point Dam and Four Mile Dam, both located near Lake Winyah, have impoundments of 90 acres and 1,700 acres respectively. The Ninth Street Dam located in the City of Alpena maintains an impoundment of 700 acres. All four of these dams are owned and operated by Thunder Bay Power Company. These facilities, along with the Hubbard Lake Dam (located on the Lower South Branch) and the Upper South Dam (located on the Upper South Branch) are capable of providing a total of 7,216 kilowatts of hydroelectric energy.

Demographics

The majority of the year-round and seasonal population in the watershed resides in and around the unincorporated community of Atlanta, the Village of Hillman and the City of Alpena. The highest concentration of population is found at the mouth of the Thunder Bay River, in the city of Alpena and in outlying areas of Alpena Township. Reviewing Census data for the past one hundred years indicates that overall the population has steadily increased throughout the watershed, despite a few periods of population loss. Census data for the year 2000 shows population for the counties of Alpena and Montmorency at 31,314 and 10,315 respectively.

Table 1 shows population for Montmorency and Alpena Counties in ten-year increments beginning in 1900 through the year 2000.

Table 1: Population Trends Montmorency and Alpena Counties: 1900-2000				
Year	**Montmorency**		**Alpena**	
	Population	% Change	Population	% Change
1900	3,234		18,254	
1910	3,755	+16.1%	19,965	+9.4%
1920	4,089	+8.9%	17,869	-10.5%
1930	2,814	-31.2%	18,574	+3.9%
1940	3,840	+36.5%	20,766	+11.8%
1950	4,125	+7.4%	22,189	+6.9%
1960	4,424	+7.2%	28,556	+28.7%
1970	5,247	+18.6%	30,708	+7.5%
1980	7,492	+42.8%	32,315	+5.2%
1990	8,936	+19.6%	30,605	-5.3%
2000	10,315	+15.4%	31,314	+2.3%
Source: U.S. Bureau of the Census				

Table 2: Total Housing Units Alpena and Montmorency Counties: 1980-2000				
Year	**Alpena**		**Montmorency**	
	Total Housing Units	% Change	Total Housing Units	% Change
1980	13,977		7,886	
1990	14,431	+3.2%	8,791	+11.5%
2000.	15,289	+5.9%	9,238	+5.1%
Source: U.S. Bureau of the Census				

Table 3: Seasonal Housing Units Alpena and Montmorency Counties: 1980-2000				
Year	**Alpena**		**Montmorency**	
	Total Seasonal Housing Units	% of Total Housing Units	Total Seasonal Housing Units	% of Total Housing Units
1980	1,506	10.8%	2,927	37.1%
1990	1,810	12.5%	4,873	55.4%
2000	1,658	10.8%	4,390	47.5%
Source: U.S. Bureau of the Census				

Table 4: Households and Persons Per Households Alpena and Montmorency Counties: 1980-2000						
Year	**Alpena**			**Montmorency**		
	Total Households	% Change	Persons Per Household	Total Households	% Change	Persons Per Household
1980	11,151		2.86	2,814		2.66
1990	11,838	+6.2%	2.56	3,600	+27.9%	2.45
2000	12,818	+8.3%	2.40	4,455	+23.8%	2.29
Source: U.S. Bureau of the Census						

Alpena County
Data found in *Tables 1* and *2* 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 3*). 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 4*). While *housing units* is a count of physical residential living structures (whether occupied or not), *households* is a count of occupied housing units. The number of households has gone up in Alpena County, yet the population hasn't increased; this means that there are fewer people residing in each household. The number of persons per household has indeed declined from 2.86 persons per household in 1980 to 2.40 in 2000. This phenomenon of 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 elderly householders moving into the area.

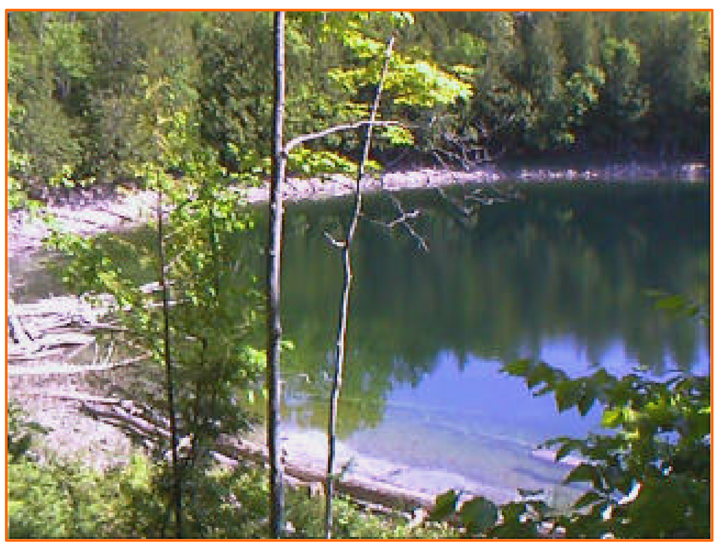
Montmorency County
Montmorency County's demographics show both similarities and differences from those found in Alpena County. The biggest difference is that Montmorency County's population has been growing very rapidly over the last few decades. From 1980 to 2000, for example, the county's population 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 2*, 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 3* 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 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) from 1980 to 2000 (see *Table 4*). 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.

Recreation

Recreational activities within the Thunder Bay River Watershed contribute greatly to the local economies. Outdoor activities such as fishing, hunting, hiking, elk viewing, boating, snowmobiling, cross country skiing, and golfing are enjoyed by both seasonal and year-round residents and bring thousands of tourists to the area each year.

Facilities located within the area which support both seasonal and year-round resident's recreational activities include Briley Township Park, Avery Township Park, Emerick Park (Hillman), Long Rapids County Park,Sytek Park (Alpena), Alpena County Fairgrounds, Sportsmen Park (Alpena) and Riverfront Park (Alpena). Three canoe liveries are located on the Thunder Bay River and numerous parks, picnic areas and campgrounds as well as other recreational amenities are also found in the watershed.

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. 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 and are level areas between moraines consisting of unsorted sand, gravel, rock, and clay. Outwash and lacustrine plains are waterlaid deposits from the melting glacier. Outwash plains are stratified deposits of sand, gravel, silt, and clay and are primarily found in the northern half of Montmorency County. Lacustrine plains are stratified deposits consisting of silt, clay and fine sediments on drained glacial and post glacial lakes. These formations are found in the watershed intermixed with isolated moraines in central and eastern parts of Montmorency County.

A unique geologic feature found in the watershed is karst topography. Karst topography is a result of interaction between glaciers and limestone bedrock and is expressed in surface formations of sinkholes or swallowholes. During the times glaciers covered the area, the massive weight of the glaciers depressed the existing limestone bedrock. When the glaciers melted, the limestone rebounded and cracked. Groundwater moving through the cracks mixed with the limestone to form carbonic acid, enlarging the fissures and forming caverns and domes underground. As the domes grew larger, the weight of the overlying glacial drift collapsed into them forming deep narrow circular depressions – called sinkholes. New sinkholes are constantly being formed, taking several decades to appear on the surface.

In the Thunder Bay Watershed, karst topography is found in northern Alpena County, extending to Montmorency and Presque Isle counties.

Land Use

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. Timber was harvested without controls and the Thunder Bay River was used as a means of transporting the trees. Many landscape changes occurred resulting from the harvesting of the forests.

Currently, northeast Michigan can still be described as a rural landscape with large stands of forests, many undeveloped shorelines and natural habitats. The headwaters of the Thunder Bay River Watershed are primarily upland forests with large tracts of public lands. However, there are areas of residential communities, primarily concentrated around Crooked Lake and Atlanta. Atlanta is experiencing an increase in population as well as industrial development and service operations. There has been a 5.1% increase in the number of housing units from 1980 to 2000. This is generally from retirees or seasonal residents remaining in the area year-round.

Downstream from Atlanta the river again flows through forested areas with an increasing presence of lowland forests and wetlands. Large tracts of land owned and managed by hunt clubs and left primarily undeveloped dominate this region. Once the river reaches Hillman there is again an increase in population and therefore an increase in commercial, industrial and agricultural activities. The Village of Hillman has experienced the highest percentage of population increase in all of the municipalities in Montmorency County.

As the river flows past Hillman, lowland forests and wetlands again dominate the landscape. Near Long Rapids in Alpena County, topography and soil characteristics change and agricultural activities become more prominent. Small livestock operations including dairy cows and beef cattle can be found in this region as well as corn, oats and barley crops. Near the City of Alpena population increases dramatically as does the occurrence of residential houses along the river.

Alpena Township and the City of Alpena combined host more than half of Alpena County's total population. There is a dramatic increase in commercial and industrial activities as well. Industry in the area includes many types of manufacturing companies and small businesses. However, Alpena is experiencing a shift from manufacturing to service-oriented jobs.

A detailed land use classification and a complete inventory can be found in Chapter Four.

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 exhibits relatively stable flow due to the occurrence of groundwater fed streams. The temperaturevariations of a river that is groundwater fed is also moderated throughout the year by the influx of relatively constant temperature of groundwater. This is important during summer when drastic temperature changes can degrade the water quality and harm fish populations.

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. As stated earlier there are four hydroelectric facilities located on the Thunder Bay River. Based on the demand for electricity, these dams regulate how much flow is passed through the turbines.

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 Thunder Bay River still maintains a generous amount of riparian vegetation slowing the amount of runoff and regulating temperature by providing adequate shade.

Soils

Soils information is important in the determination of types and intensity of land uses. Water quality of a river system is partially based on the nature of the soils and the slope of the land within the drainage basin. 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.

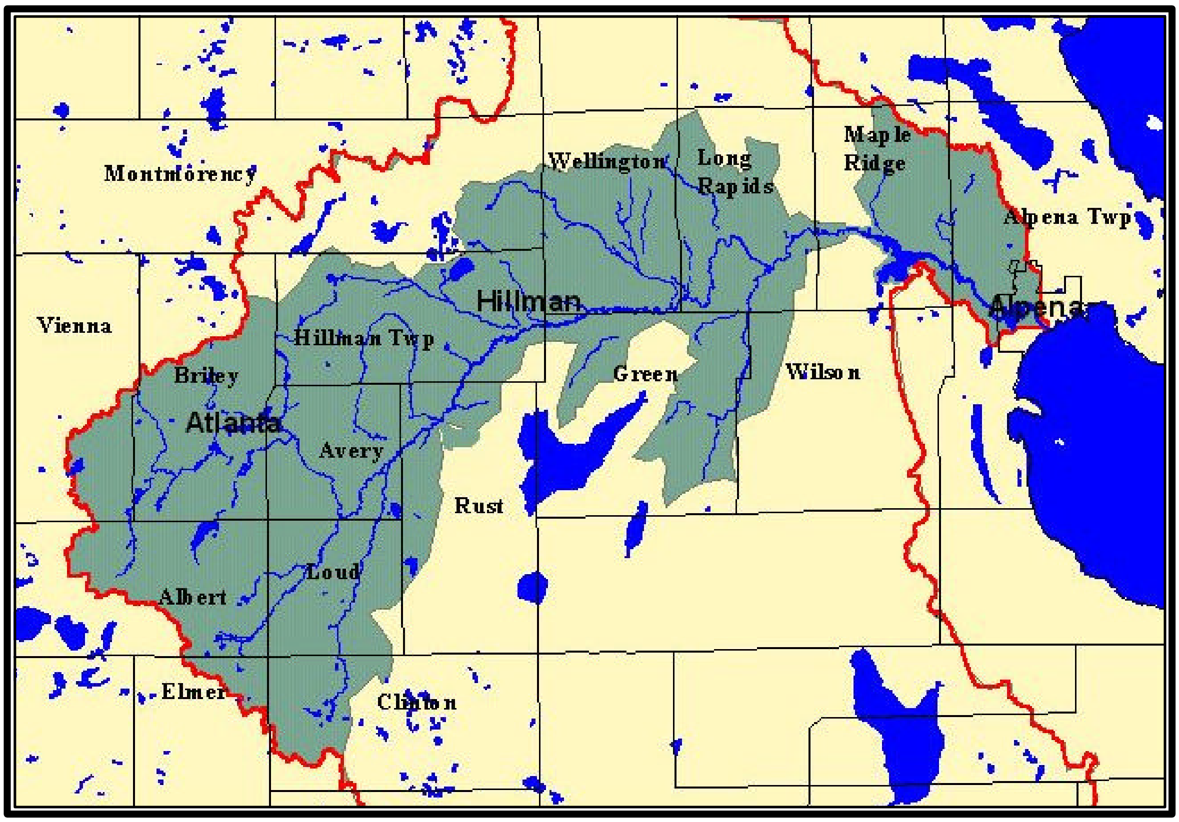
The headwaters region of the Thunder Bay River Watershed exhibits a combination of well-drained sandy soils in upland areas to poorly drained organic soils, which can be found as wetlands and marshes adjacent to the river. Further down the river to the Village of Hillman generally clayey soils on till plains can be found. In the upland areas, well-drained sandy soils persist *(*see *Map 4).*

From the Village of Hillman to the Thunder Bay River's discharge point in Thunder Bay, soils range from clayey to shallow, organic soils located on wet sandy plains. East of Hillman clayey soils change to undulating and gently rolling hills comprised of sandy to loamy soil types. Near and through the City of Alpena the appearance of loamy, poorly drained soils are found. As the river reaches its discharge point into Thunder Bay, poorly drained sandy soils exist due to high water table and low elevation.

Governmental Units

Planning and zoning throughout the watershed is a function of both the countiesand municipalities. Alpena, Montmorency and Oscoda Counties have planning commissions, along with the municipalities of the City of Alpena, Village of Hillman, Briley Township, Alpena Township, Green Township, Long Rapids Township, and Wilson Township. The City of Alpena is the only local unit in the watershed that employs a professional Planner. *Map 5* shows the various townships located within the Thunder Bay River Watershed.

Map 5



Zoning exists in all municipalities throughout the watershed except in Loud and Wellington Townships, Montmorency County and Oscoda County.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.

Agencies involved with environmental programs include District #2 and #4 Health Departments, Alpena, Montmorency, and Oscoda Conservation Districts, DNR, DEQ, Huron Pines RC& D, NEMCOG, USDA NRCS, MSUE, US F&WS, and USDA Farm Bureau. Organizations actively involved with environmental concerns include League of Women Voters, Montmorency County Conservation Club, Northeast Michigan Recycling Alliance Authority, Thunder Bay River Watershed Council, Thunder Bay River Restoration Committee, and Thunder Bay Power.

CHAPTER TWO: DESIGNATED USES AND WATER QUALITY SUMMARY

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 stakeholder commitment, the Thunder Bay Watershed Steering Committee was established. 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 USFWS, NRCS, DNR, DEQ, Huron Pines RC & D, and Alpena and Montmorency Conservation Districts also were active participants on the steering committee.

The steering committee's commitment was fundamental in the creation of the watershed plan. They provided input and guidance to the overall project. Many of the members were actively involved in gathering inventory data. Canoes and other equipment were donated as well as member's time and technical expertise. The steering committee reviewed the results of the inventory and prioritized the pollutants, sources and causes. They were also instrumental in drafting the goals and objectives for the Thunder Bay River Watershed Initiative and providing recommendations for the overall protection of the watershed.

Technical Committee

Technical aspects in the development of the nonpoint source pollution plan for Thunder Bay River Watershed Initiative were addressed by a technical sub-committee. Trained professionals provided technical assistance and expertise with field inventories and the development of recommended Best Management Practices (BMP) for identified sites of concern. Organizations providing technical assistance and expertise included NEMCOG, Huron Pines RC&D, NRCS, Thunder Bay River Restoration Committee, USFWS, and Michigan Department of Agriculture.

NEMCOG prepared the maps necessary to complete the critical area inventory as well as provided personnel for the inventory data collection. Huron Pines RC & D provided technical assistance with the road/stream crossing inventory. Thunder Bay River Restoration Committee, U.S. Fish and Wildlife, Montmorency Conservation District and Thunder Bay Power provided technical assistance with the streambank inventory. Thunder Bay River Restoration Committee also provided canoes and other equipment necessary for the completion of the inventory. The NRCS, Montmorency Conservation District and Alpena Conservation District provided assistance with inventorying agriculture areas of concern.

Meetings

Quarterly meetings were held during the Thunder Bay River WatershedInitiative planning phase. Input was provided from committee members on various issues concerning the Thunder Bay River system as well as overall project direction.

The public meetings were intended to provide an overview of the planning process and to gather input on watershed issues and concerns. The development of the plan was driven by the participation of the steering committee members. The members reviewed the results of the critical area inventory, prioritized the pollutants, assisted in the development of the goals and objectives and finalized the recommendations.

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. This provided committee members and the general public an opportunity to comment on the results of the draft plan.

Designated Uses and Water Quality Summary

Introduction

Numerous water quality studies have been conducted within the Thunder Bay River Watershed. Even though pollutants such as sediment from eroding streambanks and road/stream crossings have been identified, the Thunder Bay River Watershed exhibitsgood to excellent water quality and meets the requirements for all eight designated uses. Active uses for Thunder Bay River include agriculture, navigation, industrial water supply, warmwater fishery, total body contact recreation, and habitat for indigenous aquatic life. Many of the headwater tributaries including Stanniger Creek, Hunt Creek and Gilchrist Creek meet the ninth designated use as coldwater trout streams.

Designated and Desired Uses for the Thunder Bay River

Designated uses are those activities dependent upon good water quality.
The following are the designated uses for the Thunder Bay River and its tributaries, as established in the State of Michigan Rules, R323.1100 of Part4, Part 31 of PA 451, 1994, revised 4/2/99:

1. Agricultural
2. Warmwater Fishery
3. Habitat for other indigenous aquatic life and wildlife
4. Total body contact recreation between May 1 and October 31
5. Industrial water supply
6. Navigation

7. Public water supply at the point of intake
8. Partial body contact recreation
9. Coldwater fisheries apply to select rivers

This guideline was used by the steering committee in an effort to determine whether any of the Thunder Bay River's designated uses are impaired or threatened. In addition, review of existing studies provided valuable information concerning the condition of the watershed. The following documents were referenced and identified sediment, nutrients and stormwater discharge as nonpoint sources of pollution threatening the watershed.

Additional Studies

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.
1. 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.
2. Sedimentation is seen as a major threat to surface water quality. Erosion sources include agricultural cropland, livestock pasture, forest harvest areas, eroding streambanks and lakeshores, road runoff, drainage ditches, and construction activities

Thunder Bay River Biological Survey, 1995 Michigan Department of Environmental Quality
The only unusual characteristics were related to stormwater discharge at the City of Hillman. Nitrogen, phosphorus chemical oxygen demand and suspended solids were elevated at this location.

Biological Survey Smith Creek, 1989 Michigan Department of Natural Resources, Surface Water Quality Division
Smith Creek was impacted by nonpoint source sedimentation and nutrient enrichment resulting from row-crop agriculture and cattle feedlot.

Biological Site Investigation of Truax Creek, 1989 Michigan Department of Natural Resources, Surface Water Quality Division
Some sedimentation and nutrient enrichment was found. These occurrences are localized, with sediment/nutrient transport resulting only during periods of flow. Most of the stream was very low or exhibited no flow.

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.

Initial Water Quality Summary

Existing data were used in conjunction with steering committee input to establish the initial water quality summary for the Thunder Bay River Watershed. Water quality of the tributary headwaters is considered excellent and supports a coldwater fishery. Excellent water quality continues on the Main Branch of the Thunder Bay River to the Village of Hillman, supporting a warm water fishery. From the Village of Hillman to Alpena Township, continued excellent water quality is found. However, as the river flows through the City of Alpena and discharges into Thunder Bay the water quality declines. Increased temperatures are found, as well as point source and nonpoint source pollution, which adversely affects the water quality.
Table 5 lists the five designated uses that are considered threatened.

Table 5: Threatened Designated Uses
➢ Coldwater Fisheries
➢ Aquatic life/wildlife
➢ Total/partial body contact
➢ Public Water Supply
➢ Navigation

Desired uses are those that the community wishes to see within the watershed but are not otherwise required. Due to the lack of legal public access sites, increased recreational opportunities were identified as the number one desired use. *Table 6* shows a complete list of desired uses that were established by the steering committee.

Table 6: Desired Uses
➢ Increase recreational opportunities without adversely effecting the water quality and designated uses of the watershed
➢ Establish responsible stewardship in the watershed, to include a program of land use planning
➢ Establish, or amend zoning ordinances to protect water quality
➢ Protect sensitive areas, such as wetlands, endangered species habitat and riparian corridors

Known and Suspected Pollutants

The steering committee members were asked to develop a list of known and suspected pollutants within the watershed. The following information is based on data gathered from past studies conducted in the watershed and the updated critical area inventory. Overall, the committee identified one or more pollutants that impair each designated use.

Streambank erosion and erosion from road/stream crossings are*known* sources of nonpoint source pollution and are a serious threat to existing water quality. Streambank and road/stream crossing inventories have been conducted which documents this problem. According to streambank inventories, road stream crossing inventories, and biological surveys conducted by the MDNR, the water quality of the Thunder Bay River is threatened primarily by*sediment* and secondarily by *nutrients*. Other pollutants include increased temperature, pesticides, heavy metals, organic compounds, brine and bacteria. *Table 7* shows a detailed list of each pollutant, the source and cause of pollution for the Thunder Bay River Watershed.

Table 7: Known and Suspected Pollutants			
Impaired/Threatened Use	**Pollutants***	**Sources***	**Causes**
Coldwater Fishery **Navigation**	Sediment-K	Road Crossings-K	Short culverts, steep slopes, runoff directed to river
		Stream Banks-K	Road stream crossings, angler access, unrestricted livestock, past logging practices, hydrologic fluctuations
		Stormwater Runoff-K	Injection of untreated runoff directly into the watershed
		Cropland Mgnt.-K	Fall plowing
		Livestock Mgnt.-K	Unrestricted access to the river
		Construction Practice-K	Improper erosion and sedimentation control, removing greenbelts
		Land Clearing-K	Improper erosion and sedimentation control, removing greenbelts
		ORV Crossings-K	Improper stream crossings
		Oil and Gas-K	Improper erosion and sedimentation control, removing greenbelts, stream crossings
Coldwater Fishery **Public Water Supply**	Nutrients-K	Lawn Fertilizers-K	Improper application
		Septic Systems-K	Improperly designed and maintained septic systems
		Livestock Mgnt.-K	Animal waste containment
		Golf Course-S	Improper application
		Cropland Mgnt-K	Winter spreading of manure Improper fertilizer application
		Impoundment-S	Accumulated nutrients
Coldwater Fishery	Increased Temperature-K	Impoundment-K	Man made impoundment's Beaver activity
		Land Development-S	Community wide plans needed, elimination of greenbelts Increased residential and commercial areas
		Forest Management-S	Land fragmentation, lack of adequate shade
		Stormwater Runoff-K	Influence of warmer waters, sedimentation and chemicals into the river
		Water Withdrawal	Loss of water for agriculture, residential practices
		Residential practices-S	Increased lawn fertilization/loss of greenbelts
Indigenous Aquatic Life/Wildlife **Public Water Supply**	Pesticides-S	Lawn Fertilizers-K	Improper application
		Golf Course-S	Improper application
		Cropland-S	Improper application

Impaired/Threatened Use	Pollutants*	Sources*	Causes
Coldwater Fishery **Indigenous Aquatic Life/Wildlife** **Public Water Supply**	Heavy metals/ Organic Compounds-S	Stormwater Runoff-K Sites of Environmental Contamination-S Road Crossings-K	Industrial/Residential toxins in runoff, improper use and/or disposal Accidental spills, unregulated/illegal activities Chemicals from automobiles
Coldwater Fishery	Chlorides-K Brine-K	Road Maintenance-K Runoff-S	Dust control, snow and ice removal Stormwater discharge directly into watershed
Total/Partial Body Contact	Bacteria-K	Livestock Mgnt-K Septic Systems-S	Animal waste directly into watershed Improperly designed and maintained septic systems

* K=Known, S=Suspected

Water Quality Threats or Impairments

In order to understand which designated use was threatened or impaired a list of watershed concerns was created by the steering committee. Each water quality concern corresponds with one or more of the designated uses. A list of watershed concerns and the impaired designated uses are displayed in *Table 8*.

Table 8: Water Quality Threats/Impairments

Watershed Concerns	Impaired or Threatened Watershed Designated Uses
Surface Water Quality	Coldwater fishery, Aquatic life/wildlife, Total body contact, Public water supply
Septic Systems Leaking	Coldwater fishery, Aquatic life/wildlife, Total body contact
Stormwater Runoff	Coldwater fisheries, Aquatic life/wildlife
Sedimentation	Coldwater fishery, Aquatic life/wildlife, Navigation
Nutrient and Pesticide Loading	Coldwater fishery, Aquatic life/wildlife, Total body contact
Road Stream Crossings	Coldwater fishery, Aquatic life/wildlife, Total body contact
Oil and Gas Development	Coldwater fishery, Aquatic life/wildlife
Ground Water Contamination	Coldwater fishery, Aquatic life/wildlife
Decreased Fish and Wildlife Habitat	Coldwater fishery
Decreased Forest Management	Coldwater fishery
Impact of Growth and Development	Coldwater fishery, Aquatic life/wildlife

Initial Thunder Bay River Watershed Goals

Based on the identified pollutants a preliminary list of watershed goals was created and is directed at restoring and protecting each impaired or threatened designated use. *Table 9* provides a list of the initial watershed goals developed by the steering committee.

Table 9: Initial Watershed Goals

Threatened Use	Goal
Coldwater Fisheries	Restore the fishery by reducing the amounts of sediments being discharged into the river Reduce the amount of nutrients, chemicals being discharged into the river Protect and restore the riparian shade vegetation
Aquatic life/Wildlife	Reduce amount of pesticide/fertilizers entering the watershed
Total body contact	Control amount of cattle entering the Thunder Bay River Remediate improperly designed or maintained septic systems
Public water supply	Control amount of cattle entering the Thunder Bay River Remediate improperly designed or maintained septic systems Reduce amount of pesticides entering the watershed
Navigation	Decrease amount of sediment obstructing navigation

CHAPTER THREE:
CRITICAL AREA

Critical Area Determination

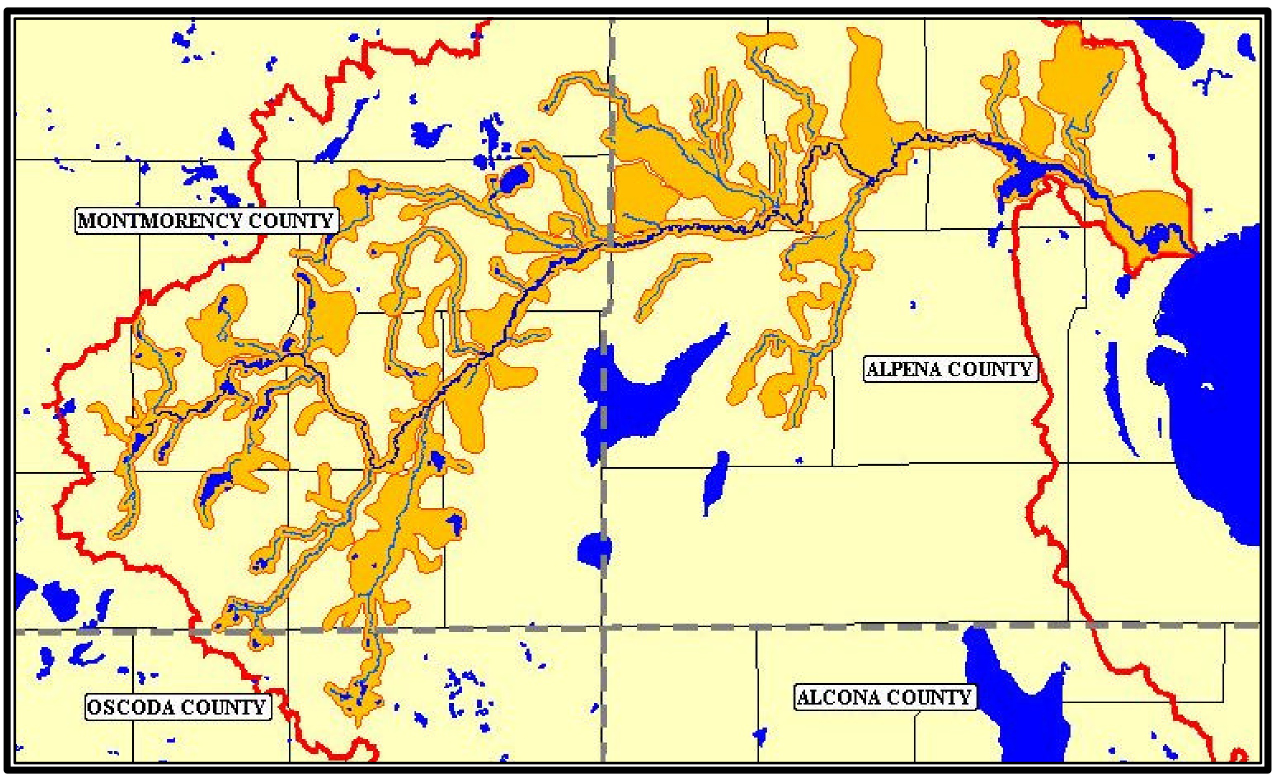
Areas adjacent to waterbodies are considered critical for two reasons. First, they are most likely to be affected by adverse water quality. Second, the critical area is defined in order to narrow the geographic scope, which allows efforts to be focused on areas that may be contributing the majority of nonpoint source pollution.

USGS topographic maps and USDA Soil Surveys were utilized to delineate the critical areas. The criteria used to determine the critical area included the following:

1. Areas within 1000 feet of the Main 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 is approximately 193 square miles (123,735 acres) and served as the main focus of the plan. *Map 6* shows the critical areas shaded in orange for the Thunder Bay River Watershed.

Map 6



CHAPTER FOUR:
THUNDER BAY RIVER NONPOINT SOURCE INVENTORIES

Introduction

In order to determine what pollutants are adversely affecting the designated uses of the watershed, a critical area inventory was performed. The nonpoint source pollution inventory was conducted during the summer of 2000 through the spring of 2001.

Information used in the assessment of the watershed included topographic maps, MIRIS land use maps, plat books, aerial photographs, watershed maps, wetland maps and county road maps. Water quality data, zoning ordinances and information provided by Thunder Bay Power were also used to supplement the spatial data.

A field inventory was conducted in order to identify and verify the pollutants along with their sources and causes. This was accomplished by driving, walking and/or canoeing the watershed. Inventory sheets were utilized to record specific site information, and photographs of each site were taken.

Streambank Erosion Inventory

Methodology

The US Department of Agriculture in 1993 published a streambank erosion inventory for the Thunder Bay River. An updated inventory was conducted in the fall of 2000 with the assistance of the Thunder Bay River Restoration Committee and the Montmorency County Conservation District. Each site was identified, documented and photographs were taken. The data sheet used to record the erosion sites along with the ranking sheet are included in Appendix A. Typical information recorded at each site included extent of erosion, causes of erosion and best management practices needed to repair sites. The ranking of each site was determined based on length of erosion, slope of embankment, soil type, condition of bank, vegetative cover and apparent cause of erosion. This system of site evaluation was used in order to treat the most critical sites first. Data for each site along with the photograph is included in the *Streambank Erosion Inventory for the Thunder Bay River Watershed* and is used as a supplemental source to this plan.

Results

There were a total of 121 streambank erosion sites identified. Of these sites 113are located on the Main Branch of the Thunder Bay River, 1 site on Crooked Creek, 2 sites on Stanniger Creek, 1 site on Sage Creek and 4 sites along Gilchrist Creek. The causes of erosion for each site vary greatly. A few of the erosion sites were naturally occurring from a bend in the river, wildlife access or bank seepage. However, at most of the sites erosion was caused by human activities including the clearing of land, development, foot traffic, livestock access, wave actions and increased current from hydroelectric dams.

Table 10: Streambank Inventory				
River	**Minor**	**Moderate**	**Severe**	**Repaired**
Crooked Creek	1			
Stanniger Creek		2		
Sage Creek		1		
Gilchrist Creek	2	2		
Thunder Bay River	28	31	14	40
Total	**31**	**36**	**14**	**40**

The Thunder Bay River Restoration Committee has repaired the first 40 erosion sites along the river. The committee also provides perpetual care for these repaired sites, which may receive heavy foot traffic from canoers, anglers and swimmers. In addition, Thunder Bay Power Company has scheduled 13 sites for repair along the Thunder Bay River within the next several years.

Of the total 121 sites identified there are 81 sites that have not been repaired. Out of these 81 sites, 31 ranked minor, 36 ranked moderate and 14 ranked severe. Thunder Bay Power is required to repair 13 of these sites in compliance with the Federal Energy Regulatory Commission re-license application. Many of the minor sites are currently healing themselves or are not in need of treatment.

Road/Stream Crossing Inventory

Methodology

The road/stream crossing inventory was conducted in the summer and fall of 2000 with the assistance of Huron Pines RC&D. The inventory was completed using county road maps and topographic maps to identify potential sites. At each site inventory sheets were completed and four photographs were taken. Information that was recorded included culvert description (length, width, condition), road information (surface, width, ditches), erosion conditions, causes of erosion and recommended BMPs. In order to prioritize the road/stream crossings each site was ranked as minor, moderate or severe. Factors used to determine this include road surface, length of approaches, slope of approaches, width of road, extent of erosion, embankment slope, stream depth and current, and vegetative cover. The inventory sheets and ranking sheets are included in Appendix B.

Results
There are a total of 131 road/stream crossing sites. Of these sites 72 are found in Montmorency County and 59 in Alpena County. The complete inventory including photographs are included in the *Road Stream Crossing Inventory for the Thunder Bay River Watershed.*

Of the 72 sites inventoried in Montmorency County, 25 ranked minor, 37 ranked moderate and 10 ranked severe. Of the 59 sites inventoried in Alpena County, 31 ranked minor, 27 ranked moderate and 1 ranked severe.

Table 11: Road/Stream Inventory			
County	**Minor**	**Moderate**	**Severe**
Montmorency	25	37	10
Alpena	31	27	1
Total	**56**	**64**	**11**

Agriculture Inventory

Methodology
An inventory of nonpoint source pollution from agricultural activities was conducted in 2001. Aerial photographs were referenced to determine and locate those lands being used for agricultural practices within the defined critical area of the Thunder Bay River Watershed. These areas were then marked on topographical maps and compared to county plat books to identify the landowners of the agricultural areas. A database was then developed which included Township, Range, Section numbers and the landowner address.

The data that was obtained from aerial photos allowed for field checks of the identified agriculture sites. The updated data from field checks was then used to establish a list of any potential problem areas related to agricultural practices. A field inventory was conducted using inventory sheets and photographs of each site were taken. Inventory data collected included location information, number of acres, type of operation, pollutant sources, recommended treatments and a site sketch. The agriculture data sheets can be found in Appendix C. With assistance from the NRCS, meetings were held with identified landowners to learn of any problems, concerns or ideas they may have regarding farming along the river or its tributaries. Resultant data were used to develop a set of goals and objectives that can be used by the farming community to improve the water quality within the Thunder Bay River Watershed.

Results

Four agriculture sites were identified in the inventory as contributing nonpoint source pollution from current farm practices and as threatening one or more designated use. Unrestricted livestock access was cited as the activity contributing the most significant amount of pollution to various rivers within the watershed. In addition to the Thunder Bay River, tributaries being impacted include Smith Creek, Truax Creek and a tributary to Bean Creek.

Stormwater Inventory

Stormwater, or urban runoff, is water from rain, snow and ice melt which flows across the land. In many cases stormwater carries pollutants such as, oils, grease, fertilizers, animal wastes, trash and heavy metals into the watershed. Impervious surfaces including roads, roof tops, parking lots and driveways generate more stormwater than forested and even agriculture land uses. Various studies including the Thunder Bay River Basin Report have identified stormwater runoff a source of nonpoint pollution.

Methodology

A stormwater inventory was conducted using a combination of map analysis and field inventory. There are three main population centers within the watershed; the unincorporated community of Atlanta, the Village of Hillman and the City of Alpena. The model used to determine urban runoff was obtained from *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*, by Thomas Schueler. An inventory of the current land use in these areas along with specific drainage information was gathered and used to estimate annual runoff pollution entering the watershed from the land. The land use was classified into residential, commercial/industrial and undeveloped. Agriculture was also included in the Village of Hillman calculation since it is the only area with a significant amount of agricultural lands. From these land use types the percent of impervious surfaces was then calculated. The total land area used for the calculations is represented in acres. This figure was then used with the average annual precipitation to determine the estimated amounts of sedimentation, phosphorus and nitrates entering the watershed from each developed area.

Other criteria that were used in this model include annual rainfall, percent impervious surface and total acreage. Coefficients were assigned to each land use based on the potential for runoff. The coefficients used were the Nationwide Urban Runoff Program (NURP) StudyAverage which were obtained from over 2300 monitored storm events. The following equations are derived from the Simple Method model developed to determine storm pollutant exports for urban runoff. Each land use type was given a coefficient based on the amount of imperviousness of the land including pavement, rooftops, sidewalks and driveways. This model is based on storm events over a one-year period. The following is the calculation used to estimate the runoff amounts.

L=[(P) (Pj) (Rv)/12](C) (A) (2.72)

Where: L = Storm pollutant export (runoff amounts)
P = Rainfall depth (inches)
Pj = Factor that corrects P for storms that produce no runoff (.9)
Rv = Runoff coefficient (Based on rainfall and land use types)
C = Concentration of pollutant in urban runoff (NURP data)
A = Area (acres)
12, 2.72 are unit conversions

Results

The community of Atlanta, located in Briley Township has a series of seven storm inlet drains, the majority of which are located on M-32. The outlet pipe discharges stormwater directly into the Thunder Bay River downstream of the impoundment. Since Atlanta does not have village limits the area used to calculate the amount of runoff was determined based on the surrounding critical area of the watershed.

As shown in *Table 12* Atlanta has the highest percentage of residential area (35%) compared to Hillman and Alpena. However, the majority of area is undeveloped (55%) and only 21% of the land is impervious. Based on this information there is an estimated pollutant loading of 1130 pounds of phosphorus, 2359 pounds of nitrates and 399 tons of sediment per year entering the watershed from the Atlanta area.

Table 12: Stormwater Runoff-Atlanta		
Total Land Area of Study	**1636 acres**	
Percent of Watershed	**1.4%**	
Land Use of Atlanta:		
Residential	577 acres	35%
Commercial/Industrial	160 acres	10%
Undeveloped	899 acres	55%
Percent Impervious Area		21%
Estimated pollution contributions from stormwater runoff		
Phosphorus	1130 lbs./yr	
Nitrates	2359 lbs./yr	
Sediment	798,662 lbs. (399 tons/yr)	

The Village of Hillman is experiencing an increase in development and land area due to annexation. The most recent village expansion occurred in 1997. Currently Hillman is in the process of annexing a portion of Green Township (Alpena County) to be included within the village limits. The stormwater calculations for Hillman utilize the same criteria as Atlanta with the exception of using the defined village limits as the geographic area of study. It is important to note that the majority of soils in Hillman are Nester-Kawkawlin-Sims Association which, are poorly drained, clayey soils that may contribute to more stormwater runoff.

As shown in *Table 13* the Village of Hillman has the highest percent of commercial/industrial area (16%) and impervious surface (23%) when compared to Atlanta and Alpena. Based on this information there is an estimated pollutant loading of 444 pounds of phosphorus, 967 pounds of nitrates and 120 tons of sediment per year entering the watershed from the Hillman area.

Table 13: Stormwater Runoff-Hillman		
Total Land Area of Study	**671 acres**	
Percent of Watershed	**<1%**	
Land Use of Hillman:		
Residential	164 acres	24%
Commercial/Industrial	107 acres	16%
Agriculture	49 acres	7%
Undeveloped	351 acres	52%
Percent Impervious Area		23%
Estimated pollution contributions from stormwater runoff		
Phosphorus	444 lbs./yr	
Nitrates	967 lbs./yr	
Sediment	241,430 lbs. (120 tons/yr)	

The City of Alpena has a considerably higher population density and more developed areas than either Hillman or Atlanta. However, due to the shape of the watershed boundary, a major portion of the city lies outside of the watershed and therefore is not included in the calculations. To accurately determine the amount of pollutants associated with runoff, portions of Alpena Township were included in this calculation. Again, the critical area was used as an overlay of the developed areas and the geographic scope was based on this information.

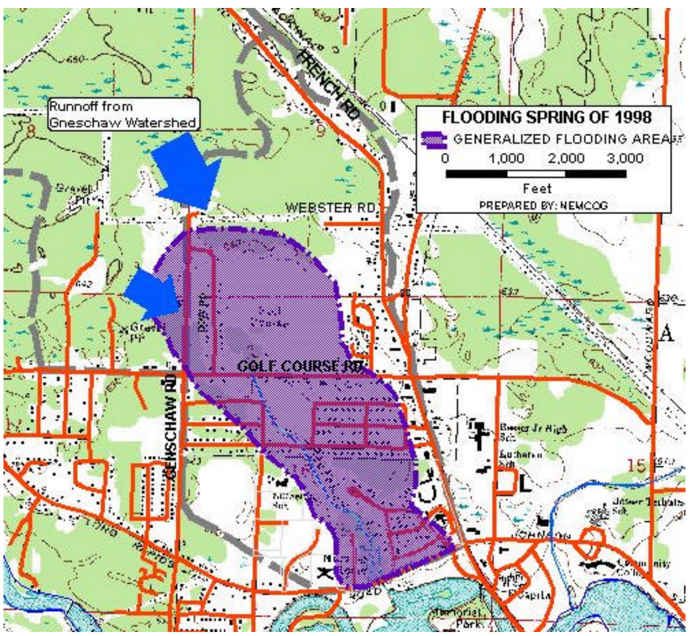
As shown in *Table 14* Alpena covers the largest land area (4760 acres) and has the largest percentage of undeveloped lands (67%) used in the calculations. Based on this information there is an estimated pollutant loading of 2959 pounds of phosphorus, 2959 pounds of nitrates and 1158 tons of sediment per year entering the watershed from the Alpena area.

Table 14: Stormwater Runoff-Alpena		
Total Land Area of Study	**4760 acres**	
Percent of Watershed	**3.9%**	
Land Use of Alpena:		
Residential	1061 acres	22%
Commercial/Industrial	255 acres	5%
Undeveloped	3187 acres	67%
Percent Impervious Surface		20%
Estimated pollution contributions from stormwater runoff		
Phosphorus	2959 lbs./yr	
Nitrates	6863 lbs./yr	
Sediment	2,315,581 lbs. (1158 tons/yr)	

These stormwater calculations are estimates only and serve as a way to quantify pollutant loading. As *Table 14* shows, Alpena is estimated to contribute the majority of stormwater pollutants to the watershed even though the amount of impervious surface is lower than either Atlanta or Hillman. It is important to remember that the land area of the Alpena study is significantly higher than Atlanta or Hillman.

The City of Alpena has experienced frequent flooding with the most recent flood event taking place in 1998. The flooding occurred as a result of a combination of factors including late snowfall, locally heavy rains and a period of warm temperatures resulting in melting snow. Additionally, the natural drainage patterns of the area were disrupted thus enhancing the potential for flooding. The flooding occurred north of Besser Lake in the Fletcher Creek Watershed, which directly discharges into the Thunder Bay River.

Map 7



The following image is a depiction of the extent of flooding that occurred in the Alpena area in 1998. As shown in *Map 7*, surface water flows directly into the Thunder Bay River (bottom portion of map). Any associated pollutants from surface runoff will directly enter the river system.

In 1999, NEMCOG received a grant to conduct an intensive study of Fletcher Creek's stormwater problems and to develop recommendations to remediate present conditions and prevent future flooding from occurring. The *Fletcher Creek Watershed Study* identified numerous stormwater problems ranging from land use changes, increased impervious surfaces, lack of natural drainage patterns and the reliance on natural swallow holes to act as a retention basin.

Land Use Inventory

Developing an accurate representation of existing land use conditions within the Thunder Bay River Watershed critical area is a crucial step of the land use planning process. The type and intensity of land use development may contribute nonpoint source pollution if adequate prevention measures are not incorporated during the development phase.

<u>Methodology</u>
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. These 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. The following table lists categories of land use within the critical area of the Thunder Bay River Watershed. *Map 8* displays the current land use.

Results

Table 15 depicts each land use classification within the critical area in number of acres and percentage of the critical area.

Table 15: Land Use Classifications		
Land Use	**Number of Acres**	**Percentage**
Residential	5131	4.15%
Commercial	475	.38%
Industrial	693	.56%
Institution/Recreational	665	.54%
Agriculture	10,478	8.47%
Nonforest	11,153	9.01%
Upland Forest	36,646	29.62%
Lowland Forest	43,337	35.02%
Wetlands	11,211	9.06%
Surface Water	3,946	3.19%
Total	**123,735**	**100%**

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. The total residential land use in the critical area is 5131 acres (4.15%).

Commercial

The commercial land use category includes classifications related to the sale of products and services such as central business districts, shopping centers/malls, strip commercial, and neighborhood compact groups of stores that are surrounded by noncommercial uses. This category includes parking areas related to the commercial businesses. The total commercial land use in the Thunder Bay River watershed is 475 acres (.38%) of the total.

Industrial

Industrial land use includes manufacturing and industrial parks, light industries that fabricate or package products, oil & gas drilling and production facilities, quarry operations, lumber mills, chemical plants, brick-making plants, large power facilities, waste product disposal areas, areas of stockpiled raw materials, and transportation facilities that normally handle heavy materials.

The total industrial land use in the Thunder Bay River Watershed critical areas is 693 acres (.56%).

Institution/Recreational

Institution/recreational land use includes a variety of classifications such as education, government, religious, health, correctional, and military facilities, all indoor and outdoor recreational facilities, and all cemeteries. The buildings, parking areas, and immediate grounds are included in this category, however all surface water, forest, barren land, and wetlands associated with these facilities are entered into their own respective categories. The total institution/recreational land use in the critical area is 665 acres (.54%).

Agricultural

The agricultural land use category generally includes land that is used for the production of food and fiber, but also includes land used for non-food livestock such as horses. These classes are cropland, orchards (including vineyards and ornamental horticulture), confined feeding operations for livestock of any kind, permanent pasture lands, farmsteads, greenhouse operations, and horse training areas. The total agricultural land use in the Thunder Bay River Watershed critical area is 10,478 acres (8.47%).

Nonforest

Nonforest land includes “open land” and rangeland classifications such as barren land, herbaceous open land, and shrubland. Herbaceous open land is usually subjected to continuous disturbance such as mowing, grazing, or burning, and typically it can have a variety of grasses, sedges, and clovers. Shrubland is land in transition from being open to becoming forested. It contains native shrubs and woody plants like blackberry, dogwood, willow, sumac, and tag alder. The nonforest land in the Thunder Bay River Watershed critical area is 11,153 acres (9.01%) of the total land area.

Upland Forest

Forest land use areas are generally at least 10% stocked by trees of any size. The upland forest category includes upland hardwoods like maple & beech, other upland species like aspen & birch, species of pine like red, white or jack pine, and other upland conifers like white spruce, blue spruce, eastern hemlock, and balsam fir. Upland forest in Thunder Bay River Watershed critical area comprises the majority of land use with a total of 36,646 acres (29.62%) of the land area.

Lowland Forest

Lowland forest areas are dominated by tree species that grow in very wet soils. Lowland hardwoods include ash, elm, soft maple, cottonwood and others. Lowland conifers include cedar, tamarack, black and white spruce, and balsam fir. The lowland forest in the Thunder Bay River Watershed critical area covers 43,337 acres (35.02%) of the total land area.

Wetlands

Wetlands are those areas where the water table is at or near the land surface for a significant part of most years. Examples of wetlands are marshes, mudflats, wooded swamps, shallow areas along rivers or lakes or ponds. Wetlands areas include both non-vegetated mud flats and areas of hydrophytic vegetation. The wetlands category in the Thunder Bay River Watershed critical area covers 11,211 acres (9.06%) of the land.

Surface Water

The surface water category includes areas such as lakes, reservoirs, ponds, rivers and streams. Surface water in the Thunder Bay River Watershed critical area covers 3,946 acres (3.19%) of the total land area.

Summary

Large amounts of lowland forests (35.02%) and wetlands (9.06%) dominate the critical area of the Thunder Bay River Watershed. As shown in *Tables 1* and *2* there has been a steady increase in both population and total housing units in Montmorency and Alpena Counties. 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. There has also been a steady increase in population for both Montmorency and Alpena Counties. Much of the growth has occurred in Atlanta, Hillman and Alpena, all of which are located along the river. The Village of Hillman has experienced a large increase in development and is currently in the process of annexing a portion of Green Township to be included within the village limits. As development increases, it is likely that there will be an increase in riparian and wetland development.

S*eptic System Inventory*

Methodology

Malfunctioning or improperly maintained septic systems can cause increased bacteria and nutrients to enter the Thunder Bay River Watershed. In order to determine whether there was an occurrence of septic problems within the watershed the District Health Department #4 was contacted. Currently a database does not exist that lists malfunctioning septic tanks. However, interviews with health department personnel and review of past studies indicate the presence of septic problems.

Results

As indicated in the literature review old or poorly maintained septic systems that are not up to current code contribute bacteria and nutrients to the watershed. Environmental health professionals also indicated that there is an occurrence of septic problems in developed areas primarily situated along waterbodies including Atlanta, Lake Avalon and Lake Winyah areas.

Areas of Contamination Inventory

Methodology

There is a direct link between surface water quality and ground water contamination. Considering portions of the watershed exhibit karst topography, 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. In addition, abandoned wells that have not been properly closed provide a direct conduit for pollution to enter ground water.

DEQ documents, were reviewed in order to determine the presence of contamination. Leaking Underground Storage Tanks (LUST) and other contaminated sites were identified within the watershed. The following section lists the occurrence of these sites within the watershed.

Results

According to the Michigan Department of Environmental Quality (DEQ), there are 26 Leaking Underground Storage Tank (LUST) sites in Montmorency County, 22 of which are located within the Thunder Bay River Watershed. In Alpena County there are 69 LUST sites, 29 of which are located within the watershed. The majority of pollutants fromLUST's are either gasoline or diesel fuel.

The Environmental Response Division of the (DEQ) publishesthe *Contaminated Sites in Michigan* document. This list includes groundwater contamination other than LUST sites. As of February 2001, there are a total of 23 contaminated sites within the watershed. Sources of these pollutants include landfills, refuse systems, metal processing, auto repair, petroleum products, private households, agricultural services and chemical product manufacturing.

Oil and Gas Inventory

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.

Methodology

Digital information was obtained from the DNR spatial library website. The most current well information that was publicly available was 1998 data. The data show spatial representation of each well site located in northeast Michigan. These well sites were then overlaid on the Thunder Bay River Watershed map and only those sites located within the watershed were mapped. The following section discusses the results of the analysis and the number of wells located in the watershed.

Results

According to 1998 data there are 2196 oil and gas sites located within the Thunder Bay River Watershed. 1215 of these sites are located in Phase One of the plan.*Map 9* shows the occurrence of well sites within the watershed.

CHAPTER FIVE:
PRIORITY POLLUTANTS THEIR SOURCES AND CAUSES

The Thunder Bay River Watershed steering committee reviewed the results of the nonpoint source pollution inventories and based on this information prioritized the pollutants, sources and causes utilizing the nominal group process. Members were allowed six votes (no more than four allowed on one pollutant) 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.

Priority Pollutants

As indicated on *Table 16* sediment and nutrient loading ranked the top two pollutants of concern. Increased temperature, pesticides, heavy metals/organic compounds, brine and bacteria were also identified and being pollutants of concern for the Thunder Bay River Watershed.

Table 16: Thunder Bay River Priority Pollutants

Pollutants	Ranking
Sediment	1
Nutrients	2
Increased Temperature	3
Pesticides	4
Heavy metals/Organic Compounds	5
Brine	6
Bacteria	7

Designated Use Pollutants

The following designated uses were determined by the steering committee to be adversely affected by one or more of the pollutants stated above. Sediment and nutrients are the priority pollutants to control for protecting the coldwater fisheries, total/partial body contact, aquatic life, navigation and public water supply. Increased temperature, bacteria, heavy metals/organic compounds and pesticides were also identified as threatening the designated uses.*Table 17* shows the relationship between the pollutants and their impact on each designated use.

Table 17: Designated Use Pollutants

Designated Use	Pollutant	Ranking
Coldwater Fishery	Sediment Nutrient Increased Temperature Heavy Metals/Organic Compounds Brine	1 2 3 4 5
Indigenous Aquatic Life	Sediment Heavy Metals/Organic Compounds Pesticides	1 2 3
Navigation	Sediment	1
Total/Partial Body Contact	Bacteria	1
Public Water Supply	Stormwater Bacteria Nutrients Heavy Metals/Organic Compounds	1 2 3 4

<u>Sources of Pollution</u>

The main sources of pollution, as identified by the steering committee were road/stream crossings, streambank erosion, stormwater runoff, lawn fertilizers,septic systems and livestock management. Other sources of pollution include cropland management, land clearing, construction practices, golf course maintenance, residential practices, road maintenance and impoundments. Ranking of these sources was then conducted by the steering committee using the same nominal group process with one being the highest concern. *Table 18* lists and ranks these sources of pollutants.

Table 18: Sources of Pollution

Pollutant	**Rank**	**Source**	**Rank**
Sediment	1	Road/stream crossings	1
		Streambank erosion	2
		Stormwater runoff	3
		Cropland management	4
		Livestock management	5
		Construction Practices	6
		Land Development	7
		ORV Crossings	8
		Oil and Gas	9
Nutrients	2	Lawn Fertilizers	1
		Septic systems	2
		Livestock Management	3
		Golf Course	4
		Cropland Management	5
		Impoundments	6
Increased Temperature	3	Impoundments	1
		Land clearing	2
		Forest management	3
		Stormwater runoff	4
		Water withdrawal	5
		Residential practices	6
Pesticides	4	Lawn fertilizers	1
		Golf courses	2
		Cropland management	3
Heavy metals/Organic Compounds	5	Stormwater runoff	1
		Sites of Environmental Contamination	2
		Road/stream crossings	3
Brine	6	Road maintenance	1
Bacteria	7	Livestock management	1
		Septic systems	2

<u>Causes of Pollution</u>

In order to correct existing nonpoint source pollution and prevent future pollution problems from occurring, sources and causes for each pollutant were identified. The steering committee members then identified the causes and provided a rank of high, medium or low priority within the Thunder Bay River Watershed. As shown in *Table 19*, road/stream crossings, streambank erosion and stormwater runoff ranked high. Septic systems, livestock management, residential practices, land development, impoundments, land clearing, brine and construction practices ranked medium.

Table 19: Pollutant Sources and Causes

Pollutant Source	**Causes**	**Rank**
Road Crossings	Short culverts, steep slopes, runoff directed to river, chemicals from automobiles	High
Streambanks	Road stream crossings, angler access, unrestricted livestock, past logging practices, hydrologic fluctuations	High
Stormwater Runoff	Injection of untreated runoff directly into the watershed Industrial/Residential toxins in runoff, improper use and/or disposal Influence of warmer waters, sedimentation and chemicals into the river	High
Livestock Management	Unrestricted access to the river Animal waste containment	Medium
Residential Practices	Increased lawn fertilization/loss of greenbelts Improper application	Medium
Land Development	Community wide plans needed, elimination of greenbelts Increased residential and commercial areas	Medium
Septic Systems	Improperly designed and maintained septic systems	Medium
Impoundments	Man-made impoundments Beaver activity	Medium
Land Clearing	Improper erosion and sedimentation control, removing greenbelts	Medium
Brine	Dust control, snow and ice removal Stormwater discharge directly into watershed	Medium
Construction Practices	Improper erosion and sedimentation control, removing greenbelts	Medium
Golf Course	Improper application	Low
Cropland Management	Fall plowing Winter spreading of manure Improper fertilizer application	Low
ORV Crossings	Improper stream crossings	Low
Forest Management	Land fragmentation, lack of adequate shade	Low
Water Withdrawal	Loss of water for agriculture, residential practices	Low
Sites of Environmental Contamination	Accidental spills, unregulated/illegal activities	Low
Oil and Gas	Improper erosion and sedimentation control, removing greenbelts, stream crossings	Low

CHAPTER SIX:
THUNDER BAY RIVER PROJECTS, PROGRAMS & ORDINANCES

Overview

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.

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 under four state acts:

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

The state also 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

Townships located in a county with zoning can have the option of having the county establish the entire planning and zoning program or administering their own. Alpena and Montmorency counties represent the main watershed of the Thunder Bay River, but do not have county zoning. Most of the townships within these counties administer their own zoning program, although a few do not. Those that do not have zoning and are also within unzoned counties are considered "unzoned." In addition to the townships, the City of Alpena and the Village of Hillman each administer their own zoning program.

To help determine the adequacy of regulatory coverage for aquatic resources within the Thunder Bay River Watershed, local zoning ordinances were reviewed to evaluate what, if any, "environmental provisions" were in place. The ordinances were specifically reviewed for mention of vegetative buffer strips along the riparian corridor (greenbelts), building setbacks along the riparian corridor, septic system regulations (in addition to policies of the District Health Department, such as inspections at the time of sale, maintenance requirements, replacement of faulty systems), management of post-construction stormwater runoff, minimum lot width for riparian lots, and open space provisions. Additional environmental provisions of interest were also noted.

In every instance where a zoning ordinance had been adopted, a check was done to ensure that a current, comprehensive master plan was also in place. The master plan is essential for guiding the planning & zoning process, incorporating public input, and providing the necessary validation for the zoning regulations. For planning efforts to be successful, it is widely recognized that these documents must be kept up to date. Zoning laws that do not have a foundation within a community's master plan generally will not stand up to legal challenges.

Table 20 is a summary of planning & zoning jurisdictional units, with the date of the zoning ordinance and master plan. (The Alpena County Master Plan and Montmorency County Master Plan are currently being updated)

Planning & Zoning Jurisdictional Units within the Thunder Bay Watershed:

Table 20: Zoning and Master Plan Adoptions

Township/City	**Zoning Ordinance** Last Date of Revision or Adoption	**Comprehensive Master Plan** Last Date of Revision or Adoption
Alpena County	**No county zoning**	**1968**
Alpena Township	1999	1993
Green	2000	Not on File
Long Rapids	1999	1975
Wellington	UNZONED	UNZONED
Wilson	1999	1980
Maple Ridge	1992	2001
City of Alpena	2001	1998
Montmorency County	**No County Zoning**	**1979**
Loud Township	UNZONED	1977
Albert Township	2000	1997
Village of Hillman	2001	1990
Hillman Township	2001	1996
Rust	1980s - Currently working on revision	-
Avery	1999	1997
Vienna	1981	1999
Briley	1999	2000
Montmorency	1988	1988

Land Use Regulations

The review of local land use regulations is not intended to be the sole basis for determining the effectiveness of policies regarding water resource management, although it may provide insight into how effective a local unit of government can be at protecting aquatic resources. For some resource issues, such as wetlands and soil erosion/sedimentation, the Michigan Department of Environmental Quality has the lead role in regulation and local government units have typically avoided addressing the issue. (It should be noted that legislation does give them the right to handle those issues, should they choose to do so.) Likewise, a water quality concern such as septic systems is generally handled through the District Health Department, although a local government unit can enact certain policies within their own ordinance.

Relevant state laws for water resource protection:

- 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 almost all work done below the ordinary high water mark)

- Public Act 368 (1978), Aquatic Nuisance Control

In the table on the following page, local zoning regulations are summarized by the governmental unit that has jurisdiction for a particular area. Following the tables, there is a brief summary for each local unit of government, followed by general recommendations for the watershed.

Table 21: Alpena County-Zoning Ordinances

Local Government Unit ----------------- Water Quality Regulations	Alpena Township	City of Alpena	Green Township	Long Rapids Township	Wilson Township	Maple Ridge Township
Vegetative Buffer Strips	25 ft from water (70% is the width recommended for keeping natural)	30 feet from water (25% of vegetation can be removed)	70 ft from water	100 ft from water	70 ft from water	70 ft from water (for most of the waterfront parcels)
Shoreline Setbacks	25 ft	35 ft for residential, 10 ft for commercial	35 ft	20ft (waterfront is not specifically addressed)	70 ft	35 ft (for most of the waterfront parcels)
Stormwater Management	Yes	Requires that no adverse impacts from drainage are transferred to neighboring properties	Not addressed	Not addressed	Not addressed	Not addressed
Septic Systems	References County Health Department	------------------------	References County Health Department	Not addressed	References District Health Department	References County Sanitary Code
Minimum Riparian Lot Width	100 ft	Nothing specified for waterfront	150 ft	300 ft	150 ft	150 ft
Open Space	Not addressed	Not addressed	Not addressed	Not addressed	Yes, under PUD section	Yes, clustering option
Other Notable Items	-----------------------	Setbacks for high-risk erosion areas. 30 ft buffers for wetland & wildlife sanctuary areas	Waterfront provisions are under a special Conservation - Resources Section	Environmental Conservation Overlay District for parcels within 1/4 mile of rivers and streams.	Groundwater regulations & Conservation Resource Dist. w/in 400 ft of water	Conservation Resource District within 400 ft of water

Table 22: Montmorency County-Zoning Ordinance

Local Government Unit ----------------- Water Quality Regulations	Albert Township	Village of Hillman	Hillman Township	Rust Township	Avery Township	Briley Township	Montmorency Township	Vienna Township
Vegetative Buffer Strips	35 ft from water	Not addressed	25 ft from water (Not more than 20% of shoreline length can have natural veg. removed)	30 ft from water	35 ft from water (At least 60% of the length of frontage must be left natural)	Areas within 70 ft of water must be maintained in their natural state	35 ft from water	No more than 30% of the width of the shoreline vegetation can be removed
Shoreline Setbacks	75 ft	Not addressed	35 ft	100 ft	35 ft	70 ft	45 ft	25 ft
Stormwater Management	Not addressed	Not addressed	Yes, stormwater must stay on-site	Not addressed	Yes, stormwater must be managed on site	Not addressed	Not addressed	Not addressed
Septic Systems	References District Health Department	Not addressed	Township Requires inspection before sale of property & corrective action	References state statute	References District Health Department	No septic systems allowed within 70 ft of surface water	Septic Tanks 75 ft and absorption fields 100 ft from high water mark	Not addressed
Minimum Riparian Lot Width	100 ft	66 ft	100 ft	100 ft	100 ft	100 ft	70 ft	Not addressed
Open Space	Not addressed	Not addressed	Yes, 25% of PUD must be open space	Yes, 40% of PUD must be open space	Yes, 40% of PUD must be open space	Not addressed	Not addressed	Not addressed
Other Notable Items	Greenbelt Overlay District w/in 400 ft of water	------------------	Waterfront access/density restrictions (limits "funneling")	Greenbelt Dist. w/in 200 ft of surface water & soil erosion regulations	Groundwater Protection Section	Fertilizer or other chemical use is not allowed within 70ft of surface water	--------------------	-------------------

CHAPTER SEVEN:
THUNDER BAY RIVER GOALS, OBJECTIVES, RECOMMENDATIONS

Goals and Objectives

The following goals and objectives were created based on inventory results and review of existing data, which were presented to the steering committee. Each designated or desired use deemed threatened or impaired was discussed, and the means to protect these uses were developed into goals and objectives. The steering committee input was fundamental at this stage of the planning process. Based on these goals and objectives, recommendations were made to address nonpoint source pollution in the watershed.

Goal One: Improve and protect the water quality for the preservation of coldwater fisheries in the Thunder Bay River and its tributaries by reducing the amount of sediment entering the system.

Objective One: Reduce the amount of sediment by establishing a road/stream crossing improvement program to correct identified problems.

Objective Two: Stabilize priority streambank erosion sites through the installation of corrective measures.

Objective Three: Restrict livestock access to the river

Goal Two: Provide for the protection of aquatic life and wildlife by reducing the amounts of nutrients, sediments and toxic pollutants entering the river.

Objective One: Install corrective measures to reduce runoff at agricultural sites of concern.

Objective Two: Reestablish greenbelts/conservation buffers at identified sites in critical areas.

Objective Three: Promote the use of structural (retention/detention basins) and nonstructural measures (stormwater ordinances) for water resource protection.

Objective Four: Prevent harmful substances from entering stormwater intakes.

Goal Three: Provide for long-term protection of the Thunder Bay River Watershed through the adoption and enforcement of local land use polices and conservation practices.

Objective One: Develop model ordinances and language for adoption intoexisting master plans and zoning ordinances. The ordinances should address proper stormwater management, setback provisions, greenbelts, site plan review requirements and other water quality protection measures.

Objective Two: Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases.

Objective Three: Develop a mechanism for improved enforcement of “no wake” laws.

Objective Four: Sponsor workshops and training sessions to increase local enforcement of regulations.

Goal Four: Enhance recreational access sites to prevent degradation of water quality.

Objective One: Increase the number of legal access sites.

Objective Two: Improve existing sites by creating canoe launch pads, steps, etc.

Goal Five: Provide for the protection and enhancement of the Thunder Bay River Watershed by increasing the public’s understanding of nonpoint source pollution and means of prevention.

Objective One: Develop educational tools for the citizens of the watershed to reduce sediment, nutrient and pesticide contributions from lawncare and wastewater practices, and initiate a landowner education program.

Objective Two: Develop and implement a school education program.

Objective Three: Conduct water quality testing to establish a baseline assessment of the conditions of the watershed.

Objective Four: Conduct tours of the model stormwater site and hold workshops for developers, contractors, local governments and their personnel.

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, road/stream crossing upgrades, stormwater controls and installation of BMP’s at agriculture areas of concern.

In order to provide for the long-term protection of the Thunder Bay River system, proactive measures need to be implemented. Proactive measures include such things 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 Thunder Bay River. The recommendations are an integrated approach and utilize a combination of both reactive and proactive measures. Each recommendation integrates BMP's, Information/Education strategies, partnerships and intergovernmental coordination. Each task targets a specific objective of the plan. Responsible parties, appropriate Best Management Practices, milestones, timeline, estimated costs and evaluation methods are outlined below.

Deciding which recommendations will be implemented first will be based on steering committee input. In many cases the order of implementation activities will be determined by available funds. Considering sediment and nutrients are the highest pollutants of concern, strategies aimed at reducing those nonpoint pollutants will be given higher priority. When installing structural BMP's, the sites that were ranked most severe will be considered first.

Table 23: Streambank Protection Recommendations	
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 9 sites per year--First Quarter Secure funding and organize materials—First and Second Quarter Organize work crew and install BMP's at each of the 9 sites—Second and Third Quarter
BMP's	Bioengineering, re-vegetation, stairways, rock rip-rap, terrace
Responsible Parties	Thunder Bay River Restoration Committee, Montmorency and Alpena Conservation Districts, NEMCOG
Timeline	10 years to complete 83 sites at 9 sites per year
Estimated Cost	$5,000/site (9 sites: $45,000)
Evaluation	Take before and after photographs and document number of sites completed
Timeline	1 to 12 years
Objective Two	Increase number of legal access sites
Task 1	Secure and develop access sites.
Milestones	Obtain current landowner permission to provide public access—1 to 3 years Develop site plans and obtain proper permits—1 to 3 years Secure funding if land purchase is required, purchase and organize materials—1 to 3 years Organize work crew and implement BMP's at select sites—2 to 6 years
BMP's	Provide parking, create launch pads, steps, walkway
Responsible Parties	Thunder Bay River Restoration Committee, Alpena and Montmorency Conservation Districts, Thunder Bay Power, DNR, NEMCOG Thunder Bay River Watershed Council
Timeline	3 to 6 years
Estimated Cost	$10,000/site (4 sites $40,000)
Evaluation	Before and after photograph; document number of sites completed.
Timeline	3 to 8 years
Objective Three	Improve existing access sites by creating canoe launch pads, steps etc.
Task 1	Identify sites where existing access needs improvement.
Milestones	Develop site plans, obtain proper permits and landowner permission for 1 site per year—1 year Secure funding and organize materials—1 to 2 years Organize work crew and implement BMP's at the selected site—2 to 3 years
BMP's	Provide parking, create launch pads, steps, walkway
Responsible Parties	Thunder Bay River Restoration Committee, Alpena and Montmorency Conservation Districts, Thunder Bay Power, NEMCOG
Timeline	2 to 10 years
Estimated Cost	$5,000/site (4 sites $20,000)
Evaluation	Before and after photographs; document number of sites completed
Timeline	2 to 10 years
Total Streambank Protection Cost: $105,000	

Table 24: Road/Stream Crossing Recommendations	
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 road/stream crossings
Milestones	Develop site plans, obtain proper permits and landowner permission for 1 site per year—1 to 2 years Secure funding and organize materials—1 to 2 years Organize work crew and implement BMP's at the selected site—2 to three years
BMP's	Replace culverts, install diversion outlets, pavement, reduce grade of approaches, re-vegetation
Responsible Parties	Huron Pines RC&D, Alpena and Montmorency County Road Commissions, NEMCOG, County Drain Commissions
Timeline	2 to 5 years
Estimated Cost	$80,000/site (5 sites $400,000)
Evaluation	Before and after photographs; document number of sites completed
Timeline	2 to 5 years
Objective Two	Provide local road commissions with BMP information regarding road/stream crossings
Task 1	Sponsor "Better Back Roads" seminars for Montmorency and Alpena County Road Commissions.
Milestones	Obtain or create information to be used by the road commissions—1 year Organize workshop materials and plan seminar—1 year Host seminar for road commissions—1 to 2 years
BMP's	Informational brochures and workshop sessions
Responsible Parties	Huron Pines RC&D, NEMCOG, Alpena and Montmorency County Road Commissions
Timeline	2 to 5 years
Anticipated Products	Program agenda and educational brochures provided to workshop participants
Estimated Cost	$15,000
Evaluation	Interview focus groups and participants of the workshops.
Timeline	2 to 5 years
Total Road/Stream Crossing Cost: $415,000	

Table 25: Agriculture Recommendations	
Objective One	Restrict livestock access to the river
Task 1	Develop site plans, provide alternate means for watering livestock and create proper stream crossings
Milestones	Select sites to be remediated; create site plans—1 year Obtain proper permits and landowner permission—1 year Secure funding and organize materials—1 to 2 years Organize work crew and install BMP's—2 to 5 years
BMP's	Fencing, stream crossings, watering devices, re-vegetation
Responsible Parties	NRCS, NEMCOG, Alpena and Montmorency Conservation Districts
Timeline	2 to 5 years
Estimated Cost	$10,000/site (5 sites $50,000)
Evaluation	Before and after photographs; document number of sites completed
Timeline	2 to 5 years
Objective Two	Install corrective measures to reduce runoff at agricultural sites of concern.
Task 1	Develop plans; install devices to reduce runoff.
Milestones	Select sites and develop plans for identified areas of concern—1 year Obtain proper permits and landowner permission—1 year Secure funding and organize materials—1 to 2 years Organize work crew and install BMP's—2 to 5 years
BMP's	Critical area planting, fencing, filter strips, livestock exclusion, diversions
Responsible Parties	NRCS, Alpena and Montmorency Conservation Districts, NEMCOG
Timeline	5 years
Estimated Cost	$5,000/site (3 sites $15,000)
Evaluation	Before and after photographs; document number of sites completed
Timeline	5 years
Total Agriculture Costs: $65,000	

Table 26: Shoreline Protection-Riparian Landowner Recommendations	
Objective One	Reestablish greenbelts/conservation buffers at identified sites in critical areas
Task 1	Work with volunteer landowners to establish/enhance greenbelts on their property.
Milestones	Complete site plans for ten sites—1 year Obtain landowner permission and any necessary permits—1 year Secure funding, organize work crew and implement BMP's for 5 sites—1 year Secure funding, organize work crew and implement BMP's for 5 sites—Second year
BMP's	Vegetative filter strips
Responsible Parties	NEMCOG, Alpena and Montmorency Conservation Districts, MSUE, Thunder Bay Restoration Committee, Thunder Bay River Watershed Council
Timeline	2 years
Estimated Cost	$400/site (10 sites $4,000)
Evaluation	Before and after photographs; document number of sites completed
Timeline	2 to 5 years
Objective Two	Develop a mechanism for improved enforcement of "no wake" laws
Task 1	Create citizen watch signs in high traffic areas.
Milestones	Design citizen watch signs—1 year Secure funding and produce signs—1 year Post signs along the river and impoundments—1 to 2 years
BMP's	"Citizen Watch" signage along the river
Responsible Parties	Alpena and Montmorency Conservation Districts, local river groups, DNR Law Enforcement, Thunder Bay River Restoration Committee, Thunder Bay River Watershed Council
Timeline	Two years to post signs
Estimated Cost	$1,500
Evaluation	Interviews with riparian landowners to determine whether boaters are slowing down.
Timeline	2 to 5 years
Total Shoreline Protection Costs: $5,500	

Table 27: Stormwater Recommendations	
Objective One	Promote the use of structural (retention/detention basins) and nonstructural measures (stormwater ordinances) for water resource protection.
Task 1	Develop site plans for structural measures
Milestones	Create site plans—1 year Obtain proper permits and landowner permission for model stormwater basin—1 to 2 years Secure funding if land purchase is required, purchase and organize materials—1 to 2 years Organize work crew and implement model stormwater basin—2 to 5 years
Task 2	Draft appropriate stormwater ordinances for local governmental units
Milestones	Work with local officials to create stormwater ordinances for Atlanta Hillman and Alpena—1 to 3 years Adopt stormwater ordinances into local zoning ordinances—2 to 8 years
BMP's	Create detention/retention areas, install filter strips where needed; educate local residents/officials about stormwater practices, establish proper drainage flows
Responsible Parties	NEMCOG, Huron Pines RC&D, County Drain Commissions, County Soil Erosion Officers, Thunder Bay River Watershed Council
Timeline	2 to 5 years for structural devices Long-term management for zoning ordinances
Anticipated Products	Model stormwater ordinances
Estimated Cost	$20,000 for model stormwater basin $10,000 for development and adoption of stormwater ordinances
Evaluation	Before and after photographs; document number of sites completed
Timeline	2 to 10 years
Objective Two	Prevent harmful substances from entering stormwater intakes.
Task 1	Community-wide stenciling program
Milestones	Develop drain stencil—1 year Stencil stormwater intakes in Atlanta, Hillman and Alpena—1 to 3 years
Task 2	Continue efforts for annual collection days of household hazardous waste
Milestones	Designate and promote a day for landowners to properly discard harmful substances—1 to 5 years
BMP's	Drain stenciling, collection of hazardous waste
Responsible Parties	NEMCOG, Northeast Michigan Recycling Alliance, Alpena and Montmorency Conservation Districts
Timeline	2 to 5 years
Anticipated Products	Flyers to promote "Household Hazardous Waste Day"
Estimated Cost	$6,000
Evaluation	Before and after photographs; document number of sites stenciled; document amount of hazardous substances brought in on the collection days.
Timeline	2 to 5 years

Table 27: Stormwater Recommendations Continued

Objective Three	Conduct tours of the model stormwater site; hold workshops for developers, contractors, local governments and their personnel.
Task 1	Organize and hold tours of model stormwater site
Milestones	Development and dissemination of stormwater brochures—1 to 3 years Conduct tours of model stormwater site—2 to 5 years
Task 2	Organize and hold workshops on stormwater management.
Milestones	Gather/create appropriate information for a stormwater workshop program—1 year Organize and promote the stormwater workshop—1 to 2 years Host stormwater management workshops for developers, contractors and local government officials—2 to 10 years
BMP's	Workshops, educational brochures
Responsible Parties	NEMCOG, Alpena and Montmorency Conservation Districts, County Drain Commissions, County Soils Erosion Officers
Timeline	1 to 10 years
Anticipated Products	Educational stormwater brochures
Estimated Cost	$10,000
Evaluation	Survey participants on effectiveness of tours and workshops.
Timeline	1 to 10 years
Total Stormwater Costs: $46,000	

Table 28: Land Use Recommendations	
Objective One	Develop model ordinances and language for adoption intoexisting master plans and zoning ordinances. The ordinances should address proper stormwater management, setback provisions,greenbelts, site plan review requirements and other water quality protection measures.
Task 1	Assist local officials with the drafting of ordinances for the protection of water quality.
Milestones	Gather/create sample water quality ordinances to be presented to local officials—1 year Work with local governments on updating current zoning ordinances for the protection of water quality—1 to 6 years Adoption of water quality protection ordinances—2 to 10 years
BMP's	Provide information regarding water resource protection
Responsible Parties	NEMCOG, MSUE, Huron Pines RC&D, County Drain Commissions
Timeline	2 to 20 years (results may be long-term)
Anticipated Products	Zoning ordinances focusing on water resource protection
Estimated Cost	$20,000
Evaluation	Conduct focus group sessions to evaluate the effectiveness of ordinances.
Timeline	2 to 10 years
Objective Two	Sponsor workshops and training sessions to increase local enforcement of regulations.
Task 1	Work with local communities to provide a means for zoning ordinance enforcement.
Milestones	Secure funding for zoning enforcement—1 to 10 years Host workshops for enforcement personnel—1 to 5 years
BMP's	Host workshops
Responsible Parties	NEMCOG, MSUE, Alpena and Montmorency Conservation Districts, County Drain Commissions, County Soil Erosion Officers
Timeline	2 to 10 years
Estimated Cost	$5,000
Evaluation	Survey attendees to evaluate the effectiveness of the training sessions and document number of violations.
Timeline	2 to 10 years

Table 28: Land Use Recommendations Continued

Objective Three	Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases.
Task 1	Develop and implement land protection programs for sensitive areas.
Milestones	Dissemination of land protection information to landowners—1 to 3 years Work with private landowners to discuss land protection options for their properties—1 to 5 years Secure funds to permanently protect a percentage of sensitive lands—1 to 10 years
BMP's	Disseminate informational brochures to landowners discussing conservation easements, land donations and other means to permanently protect their lands
Responsible Parties	Headwaters Land Conservancy, NEMCOG
Timeline	2 to 10 years
Anticipated Products	Dissemination of landowner protection brochures
Estimated Cost	$30,000
Evaluation	Document number of acres that are permanently protected and conduct interviews with landowners.
Timeline	2 to 10 years
Total Land Use Protection Costs: $55,000	

Table 29: General Education Recommendations	
Objective One	Develop educational tools for the citizens of the watershed to reduce sediment, nutrient and pesticide contributions from lawncare and wastewater practices, and initiate a landowner education program.
Task 1	Provide educational materials "Help Protect Your Watershed" and technical assistance to property owners regarding greenbelts, septic care and proper fertilizer application.
Milestones	Create a watershed logo unique to the Thunder Bay River Watershed Initiative—1 year Develop and assemble educational packet (septic maintenance, maintaining conservation buffers, proper fertilizer application, etc.) to be distributed to riparian landowners—1 to 3 years Help landowners design a site plan to protect their shoreline—1 to 10 years
BMP's	Produce and disseminate educational material, site planning assistance
Responsible Parties	NEMCOG, Alpena and Montmorency Conservation Districts, Huron Pines RC&D, Thunder Bay River Restoration Committee, MSUE, Thunder Bay River Watershed Council
Timeline	1 to 5 years
Anticipated Products	Educational packet including watershed logo, brochures, pencil, note cards, stickers, tote bag
Estimated Cost	$20,000
Evaluation	Survey landowners about the effectiveness of the educational material. Document the amount of information disseminated.
Timeline	1 to 10 years

Table 29: General Education Recommendations Continued

Objective Two	Develop and implement a school education program.
Task 1	Develop and implement programs concerning water quality education.
Milestones	Continued support for the annual Watershed Walk—1 to 10 years Create watershed activities and informational pamphlet to be distributed at local schools—1 year Purchase necessary educational materials—1 to 2 years Coordinate educational program and demonstrations with school officials—1 to 10 years
BMP's	Educational material, hands-on equipment
Responsible Parties	Alpena and Montmorency Conservation Districts, NEMCOG, MSUE, Huron Pines RC&D, Thunder Bay River Restoration Committee, Thunder Bay River Watershed Council, NRCS
Timeline	1 to 10 years
Anticipated Products	Development of a environmental education lesson plan
Estimated Cost	$6,000
Evaluation	Discuss programs with focus groups and interview teachers after the programs were completed.
Timeline	1 to 10 years
Objective Three	Conduct water quality testing to establish a baseline assessment of the conditions of the watershed.
Task 1	Continue testing identified sites within the watershed.
Milestones	Provide support for continued water quality sampling—1 to 10 years Publication of a baseline assessment of the Thunder Bay River Watershed—5 to 10 years
Task 2	Monitor data pertaining to accidental discharges of harmful substances into the watershed and groundwater.
Milestones	Develop a database which contains information on LUST sites, accidental spills and other sites of environmental contamination to either the surface or groundwater--1 year to develop-updated yearly
BMP's	Consistent water quality data collection
Responsible Parties	Alpena and Montmorency Conservation Districts, Thunder Bay Power, NEMCOG
Timeline	1 to 10 years
Anticipated Products	Publication of water quality testing results Development of contaminates database, updated yearly
Estimated Cost	$2,000/year (Five years $10,000)
Evaluation	After a baseline has been established, determine whether water quality has improved.
Timeline	1 to 20 years
Total Education Costs: $36,000	

Total Costs to Implement Recommendations: $727,500

Information/Education Strategy

Education is the key to a successful watershed management program. The overall goal of the Information and Education Strategy component of the watershed plan is to provide educational information to local officials, shoreline residents, contractors and developers, school children and the general public, enabling 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 30 lists the information and education strategies based on the goals and objectives stated earlier. Each educational strategy will be directed towards a specific target audience.

Table 30: Information/Education Strategy

Pollutant	Source	Target Audience	Message	Delivery Mechanism
Sediment	Road crossings	Road Commissions	Explore alternatives to road maintenance when concerned with road/stream crossings	Hold seminars with County Road Commissions
	Streambank Erosion, Land Clearing/ Construction Practices	Riparian Landowners Builders, Contractors	Encourage landowners to leave a conservation buffer, provide attractive landscaping for natural vegetation	Information material disseminated to Real Estate agencies, area business.
	Cattle Access	Agriculture Managers Landowners	Control livestock access, establish fencing, create proper stream crossings, provide alternate funding sources	Brochures, work with NRCS and Conservation Districts, provide information at fairs, trade-shows and events
	Recreational Activities, ORV Crossings	Anglers, canoe groups, ORV users, motor boat users	Protect your river by using stairs when provided and by staying on designated trails, reduce wake speeds	Post signs at access points, Provide information to canoe liveries and at ORV parking
Nutrients	Failing Septic Systems/ Fertilizers	Homeowners Golf Course Managers	Properly maintain your septic system to prevent water quality degradation. Proper application of fertilizers for your lawn. Encourage soil tests and the use of low/no phosphate fertilizers	Create an educational water quality kit for homeowners including various brochures for healthy living along a river

Pollutant	Source	Target Audience	Message	Delivery Mechanism
Nutrients	Agriculture Practices	Agriculture Managers Landowners	By reducing livestock access to surface water you are protecting a resource that is very valuable to everyone	Brochures, work with NRCS and Conservation Districts, provide information at fair, trade-shows and events
Pesticides	Cropland	Agriculture Managers Landowners Golf Course Managers	Brochures, work with NRCS and Conservation Districts, provide information at trade-shows and events	Brochures, work with NRCS and Conservation Districts, provide information at fairs, trade-shows and events
	Lawn Pesticides	Riparian Landowners	Encourage Proper application of pesticides in order to protect various aquatic habitats	Create a kit for homeowners including various brochures for healthy living along a river
Bacteria	Failing Septic Systems	Riparian Landowners	Properly maintain your septic system to prevent water quality degradation.	Create a kit for homeowners including various brochures for healthy living along a river
	Livestock Access	Agriculture Landowners	By reducing livestock access to surface water you are protecting a resource that is very valuable to yourself and others	Brochures, work with NRCS and Conservation Districts, provide information at fairs, trade-shows and events
Toxins	Road Crossings	County Road Commissions	Provide surface runoff control to reduce and filter harmful toxins from entering the river via road/stream crossings and stormwater runoff	Hold seminars with County Road Commissions
	Stormwater Runoff	Local officials, Residents	Protect the waterways by reducing the amount of toxins entering the river, make public aware of where stormwater goes	Drain stenciling, informative seminars for local officials, brochures for the public, tours of model stormwater site
Brine	Road Maintenance	Road Commissions	Seek alternatives for dust and ice control near road/stream crossings	Hold seminars with County Road Commissions

Pollutant	Source	Target Audience	Message	Delivery Mechanism
Chlorides	Stormwater Runoff	Local officials, Residents	Protect the waterways by reducing the amount of toxins entering the river, make public aware of where the stormwater goes	Drain stenciling, informative seminars for local officials, brochures for the public
Increased Temperature	Riparian Loss, Land Development Impoundments	Forest Mangers, Riparian Landowners, Developers	Protect the coldwater fisheries by maintaining riparian vegetative corridor to allow adequate shading	Brochures, provide information at fairs, trade-shows and events

Evaluating Success

In order to determine the overall effectiveness of the implemented management strategies an evaluation process is essential.

The various methods used for evaluation:

- 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

(Information provided by DEQ Handbook: *Developing a Watershed Management Plan for Water Quality*)

Detailed evaluation methods for each task are outlined in the Recommendations chapter. Several different evaluation methods were identified due to the variety of strategies of recommendations considered for implementation. In order to document the installation of BMP’s, before and after photos will be taken at road/stream crossings, streambank restorationsites, 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 in which to complete the evaluations was also stated.

To ensure success in the implementation phase, evaluation of the measures being installed will be conducted annually by the steering committee. This will allow for continued monitoring by the steering committee of the overall progress of the project.

CHAPTER EIGHT: FINAL WATER QUALITY SUMMARY

The Thunder Bay River Watershed currently has five designated uses that are threatened, (1) coldwater fisheries, (2) aquatic life/wildlife, (3) total/partial body contact, (4) navigation and (5) public water supply.

Project Goal: The overall goal of the Thunder Bay River Watershed Initiative is to provide for the protection and enhancement of the high water quality currently exhibited by reducing the amount of nonpoint source pollution from entering the river system.

Coldwater Fisheries
The majority of the headwater tributaries in the Thunder Bay River Watershed currently support a coldwater fishery. However increased sediment, nutrients, heavy metals/organic compounds, brine and increased temperature have threatened this use. Sediment was identified as having the most harmful effect on coldwater fisheries. It may block fish gills, destroy essential spawning habitat and reduce the amount of light available for healthy plant growth. Road/stream crossings, streambank erosion and stormwater runoff are identified as being the most significant sources of sediment.

Increased temperature and nutrients were also identified as being harmful to coldwater fisheries. Loss of riparian vegetation, which provides necessary shade and the presence of impoundments within the watershed are the main causes of increased temperature. Lawn fertilizers, malfunctioning septic systems and inadequate livestock management were the main sources of increased nutrients in the watershed.

Project Goal: Provide for the protection of the coldwater fishery through the reduction of sediments, nutrients and water temperature.

Aquatic Life and Wildlife Habitat
Sediment, heavy metals/organic compounds and pesticides 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 and pesticides can affect the life cycles of aquatic species by decreasing immunity and reproductive viability and, in high enough concentrations, causing death.

Sources of sediment include road/stream crossings, streambank erosion, stormwater runoff, cropland and/or livestock management practices, construction activities, the clearing of land, ORV crossings and activities oil and gas development. 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, paint products and bleaches can be carried directly to the river via storm drains.

Project Goal: Protect aquatic life and habitat by reducing the amount of sediment, heavy metals/organic compounds and pesticides entering the river system.

<u>Recreation Total/Partial Body Contact</u>

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, preventive measures need to be established to protect this designated use. The sources for bacteria includemalfunctioning septic systems, livestock management practices and stormwater discharge.

Malfunctioning septic systems along the waterbodies can allow bacteria to enter the river system. 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 septic maintenance is imperative to reducing the amount of bacteria entering the river system.

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

Project Goal: Enhance recreational opportunities by reducing the amount of bacteria entering the watershed through livestock management, proper septic system maintenance and controlling stormwater runoff.

<u>Navigation</u>

Increased sedimentation is currently threatening navigation in areas of the Thunder Bay River Watershed. Known sources of sediment include road/stream crossings, streambank erosion, livestock management and stormwater runoff. Other sources include cropland management, construction practices, the clearing of land, ORV crossings and oil and gas activities.

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 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. 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

Project Goal: Maintain navigation by reducing the amount of sediment entering the watershed.

Public Water Supply

The City of Alpena's public water supply is threatened by stormwater runoff, bacteria, nutrients and heavy metals/organic compounds. According to *the Source Water Assessment Report for the Alpena Water Supply* prepared by U.S. Geological Survey and Michigan Department of Environmental Quality November 2000, the City of Alpena obtains their drinking water 2000 feet from shore in Thunder Bay, at a depth of approximately 12 feet. Based on the location of the intake pipes, the natural setting of the source water, the storm-sewage drainage areas, soil types and land use, the Alpena source water has been classified as *highly susceptible* to potential contamination. Depending on winds and currents, the discharge from the Thunder Bay River may directly affect the public drinking water supply.

It has been demonstrated that nonpoint source pollution from stormwater runoff, agriculture activities and other nonpoint source pollutants in the Thunder Bay River Watershed can directly affect the quality of the raw water intake. Despite cases of *total* and *fecal coliforms*, organic and inorganic compounds, and microorganisms found in the raw drinking water, the Alpena Water Treatment Plant has effectively treated the source to meet drinking water standards.

Project Goal: Protect the public water supply by treating and reducing the amount of stormwater runoff and bacteria from livestock management.

STREAMBANK EROSION SEVERITY INDEX

THUNDER BAY RIVER WATERSHED

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

Accumulative points indicate extent of erosion:

0-30	**Minor**
30-36	**Moderate**
> 36	**Severe**

ROAD/STREAM CROSSING SEVERITY INDEX

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	0-4 ft: 1 pt 41-1000 ft: 3 pt 1001-2000 ft: 5 pt > 2000 ft: 7 pt	
SLOPE OF APPROACHES	0 %: 0 pt 1-5%: 3 pt 6-10 %: 6 pt >10 %: 9 pt	
WIDTH OF ROAD, SHOULDERS & DITCHES	< 15 ft: 0 pt 16-20 ft: 1 pt > 20 ft. 2 pt	
EXTENT OF EROSION	Minor: 1 pt Moderate: 3 pt Severe: 5 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	
VEGETATIVE COVER OF SHOULDERS & DITCHES	Heavy: 1 pt Partial: 3 pt None: 5 pt	
TOTAL	**0-15 Minor** **16-29 Moderate** **≥ 30 Severe**	

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:____ft. 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 of access:__________
Crop production adjacent to water (poor buffer/filter strip)
Approximated length of production area along waterway:_________
Distance from crops to water:__________ Type of crops:_________
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
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. Other: ____

<u>6) SEVERITY OF SITE</u>

Slight Moderate Severe

<u>7) PERCEIVED LEVEL OF COOPERATION FROM LANDOWNER (if known</u>)

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):