CHAPTER 4 – NATURAL RESOURCES

The greatest attraction for residents and visitors of northern Michigan is the area's environment and the rural nature of this portion of the State. Recreational activities such as hunting, fishing, snowmobiling, boating and a multitude of other outdoor activities are enjoyed by residents and visitors alike. Given the abundance of water features, wetlands, forests and farm resources; the community's natural environment is a major part of the economic base and an income generator. At the same time, the environment places constraints on human activities. Certain critical and sensitive parts of the natural landscape cannot be altered without creating problems that are not easily corrected. Increased flooding and soil erosion due to the indiscriminate filling of wetlands and clearing of land are but two examples. Therefore, it is essential that any future development respect the different characteristics of the natural environment. This is important in preserving the attractiveness of this part of the State, preventing potential hazards related to undue alteration of the land, and maximizing the economic benefits of the tourist and recreation industry.

Climate

The climate is a factor, which contributes to Krakow Township's appeal as a place to live and spend leisure time. The Township's climatic conditions are best described as long cold winters and moderate warm summers. The year round climate is heavily influenced by Lake Huron, particularly in coastal communities like Krakow Township. Lake Huron acts like a large hot water bottle in the fall, warming the nearby land area and prolonging the growing season. In the spring, Lake Huron has the opposite effect of cooling the adjacent land area and depressing the springtime warm-up. Further inland, the lake moderating effect diminishes. Local topography can influence temperatures and associated frost conditions. For example, low areas and depressions will often experience earlier frosts than surrounding uplands. **Table 4.1** contains weather statistics recorded at weather reporting station in Onaway. As mentioned above the weather conditions do vary across the County, depending upon topography and proximity to Lake Huron.

Table 4.1
Average Annual Weather Statistics, Presque Isle County

January average minimum temperature	9.7° F
January average maximum temperature	26.7° F
July average minimum temperature	55.0° F
July average maximum temperature	81.1° F
Average daily temperature for the year	43.9° F
Average annual precipitation	30.98 inches
Average annual snowfall	98 inches
Source: Weather Reporting Station at Onaway, Michigan	

The frost-free season is typically June 1st to September 12th, which provides for an average 104-day growing season. The mean annual temperature for Presque Isle County is 43.9° F. In the winter the average temperature is 20.1° F, with the average minimum daily temperature of 11.7° F. The lowest temperature on record is minus 35° F. In the summer the average daily temperature is 78.8° F. The highest recorded summer temperature is 107° F. The average annual precipitation,

including snowfall, is 31 inches; nearly 19 inches of the precipitation occurs as rainfall during the growing season of April through September. The average annual snowfall is 98 inches.

Geology and Landforms

The geology of Krakow Township, as well as the entire northern Lower Peninsula, can be described in terms of the surface geology (glacial landforms created thousands of years ago) and bedrock geology (sedimentary bedrock laid down over 300 million years ago). The hills, valleys, wetlands, forests, lakes and rivers all attribute their presence and location in the township to the surficial and bedrock geology. This section will describe the quaternary geology (glacial and postglacial landforms) and the underlying bedrock geology.

Bedrock Geology

The foundation of the Lower Peninsula, beneath the mantel of glacial deposits, consists of sedimentary bedrock formed in ancient seas between 200 and 500 million years ago. The upper layers of bedrock within the Township are from the upper and lower Devonian ages of the Paleozoic Era (345 to 405 million years ago). Over the 60 million years, alternating layers of silt, clay, sediments, marine animals, plants, coral, and other calcareous materials were deposited in the shallow marine seas. Subsequently, these deposits formed shale, limestone, and dolomite bedrock.

The youngest bedrock, Traverse Group, covers the southern three quarters of Krakow Township. Traversing the township in a northerly direction, formations include Bell Shale, and Dundee Limestone, **see Figure 4.1.** As shown in Figure 4.8, Depth of Soils to Bedrock, significant areas of the township are greatly influenced by presence of sedimentary bedrock at or near the surface. Soil formation, surface and subsurface water drainage, and vegetation types and well as activities like forest management, and construction of roads and structures are influenced by the bedrock geology.

Limestone and dolomite, extracted from Michigan Limestone and Stoneport quarries, are fine-grained, finely crystalline, very pure and high quality. The presence of limestone bedrock at or near the surface influences the hydrology and vegetation within the Township. For example, northern white cedar thrives on shallow soils that cover the limestone bedrock and is a common forest species on both wet and dry sites. "Karst" is the scientific term used to describe a type of topography that is formed in dissolved limestone, dolomite or gypsum bedrock, and is characterized by sinkholes, caves and underground drainage systems. Karst is also a term used to describe a very distinct terrain as well as the process by which it formed. **Figure 4.2** illustrates karst features. Limestone bedrock and karst geology influences the surface drainage by impeding water percolation into the ground in some locations and by rapidly draining water through bedrock cracks called

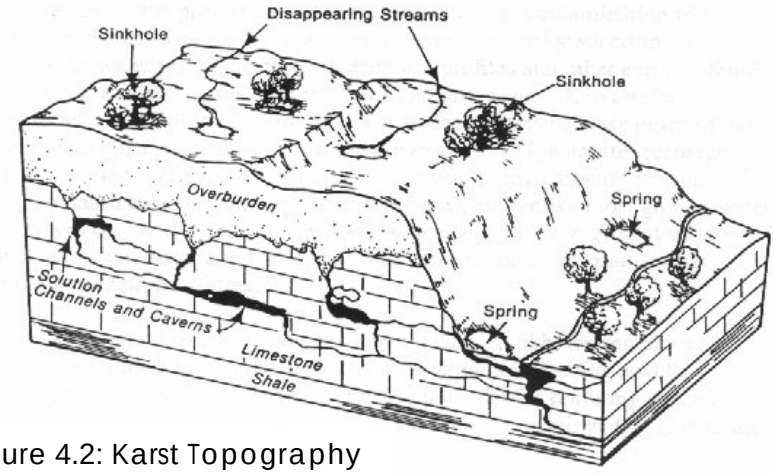
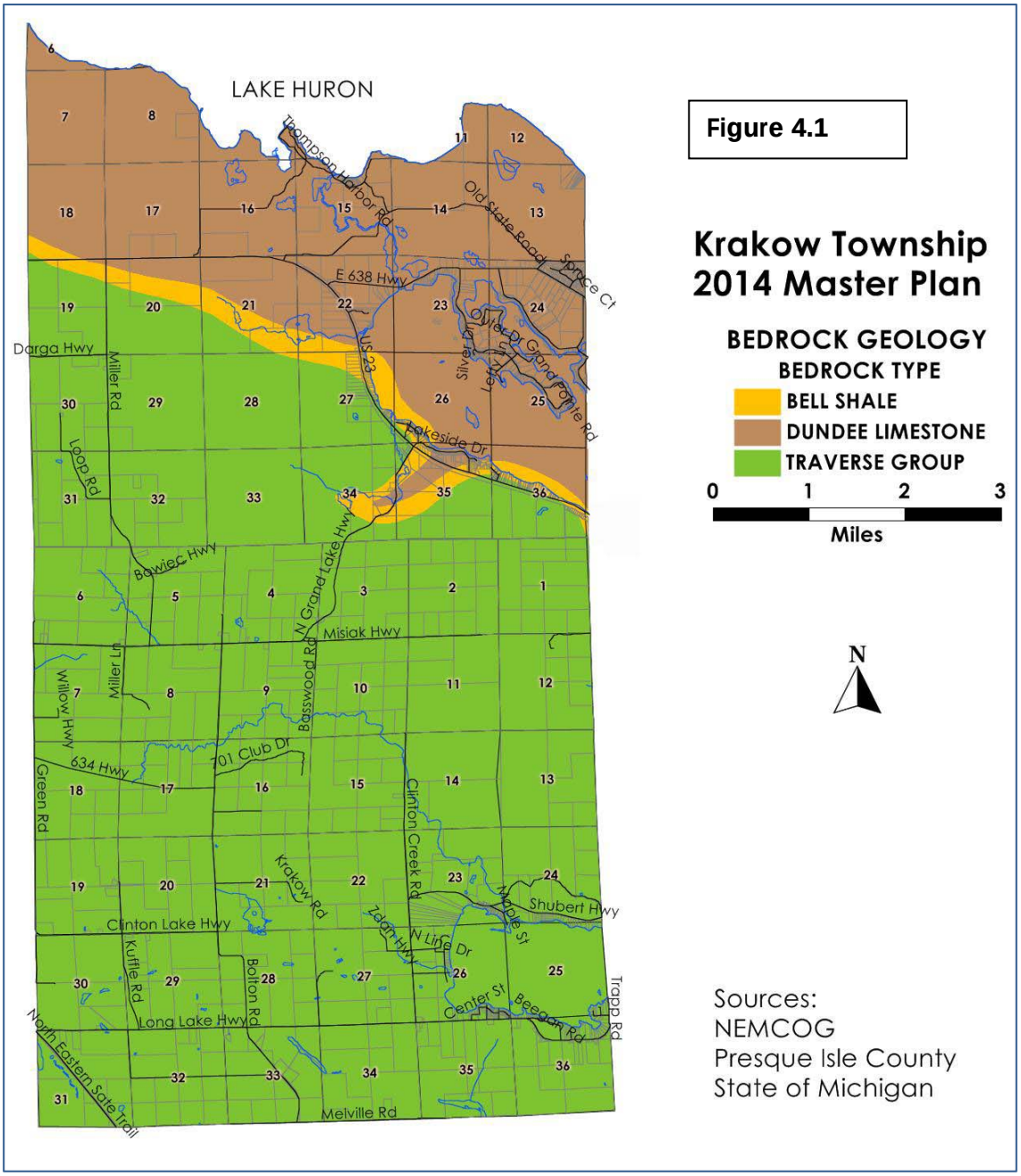


Figure 4.2: Karst Topography

swallow holes. Large volumes of water can drain into these swallow holes entering cracks and porous stone in bedrock aquifers. Water flowing through fractured bedrock will slowly dissolve the limestone, enlarging the network of cracks into subterranean channel ways and caves. In some instances the rock above the cavern collapses forming sinkholes.

With bedrock at or near the surface in the township, karst features such as swallow holes, earth cracks, porous stone aquifers and bedrock lakes can be found. Trapp Lake, Mindack Lake and Fitzgerald Lake (south of the Township) are karst solution lakes. Several smaller unnamed lakes in the vicinity are likely formed in the same fashion. A grouping of sinkholes is located in the Rockport State Park in adjacent Presque Isle Township. The largest sinkhole forms a small lake, deep enough to support a fish population of pan fish and bass.



Glacial Geological and Landforms

Starting some 2 million years ago, during the Pleistocene era, continental glaciers formed in the Hudson Bay area. Four times over this two million year period, the massive sheets of ice built up and inched their way south across what is today Michigan. The massive ice sheets, more than one mile thick, advanced in a southerly direction and bulldozed their way across the landscape. The glacier pushed material in front of it, incorporated rocks and soil into the debris laden ice; and ground and broke apart the sedimentary bedrock of the Michigan Basin.

Each advance and retreat of the continental glaciers took tens of thousands of years. This reoccurring process shaped and reshaped the land; first obliterating and then creating hills, valleys, rivers and lakes, swamps and marshes. The last glacial period, called the Wisconsin era, created the landscape we know today. The glacier left behind boulders, rocks, cobble, sand, gravel, silt, clay and loam. In some areas material was deposited in unsorted masses called till plains, ground moraines and end moraines. Water flowing from melting glaciers also sorted materials, creating outwash channels, sand deltas, kames and eskers. Fine materials, captured in fast moving glacial melt water, settled to the bottom of expansive glacial lakes creating lacustrine clay and silt plains. According to W. A. Burgess and D. F. Eschman, Krakow Township is located in the Devils Lake Karst Topography, a landform characterized by fractured limestone bedrock, overlain with a relatively thin mantle of lacustrine sand and gravel.

As the continental glaciers melted and retreated from the landscape, deep basins carved out of bedrock filled with water. These emerging lake basins were the beginnings of our Great Lakes. During different periods, the pro and post glacial Great Lakes were both much higher and much lower than the lake levels we have grown accustomed to in recent times. Geologists have identified and named the different pro-post glacial great lakes stages: Warren, Algonquin, Nipissing and Algoma. Landforms and soils adjacent to Lake Huron were heavily influenced by these different lake stages. Ancient glacial lake shorelines from Glacial Lakes Nipissing and Algoma can be found in the Township. During the high water periods of Glacial Lake Algonquin, much of the township was flooded. Strong waves eroded glacial deposits like such Krakow Island (see **Figure 4.3**) and deposited the water borne soils as sand spits in the glacial lake. The Lake Augusta Spit is located east of the lake with Loop Road and Miller Road running north-south along the spit. .[1] **See Figure 4.4**

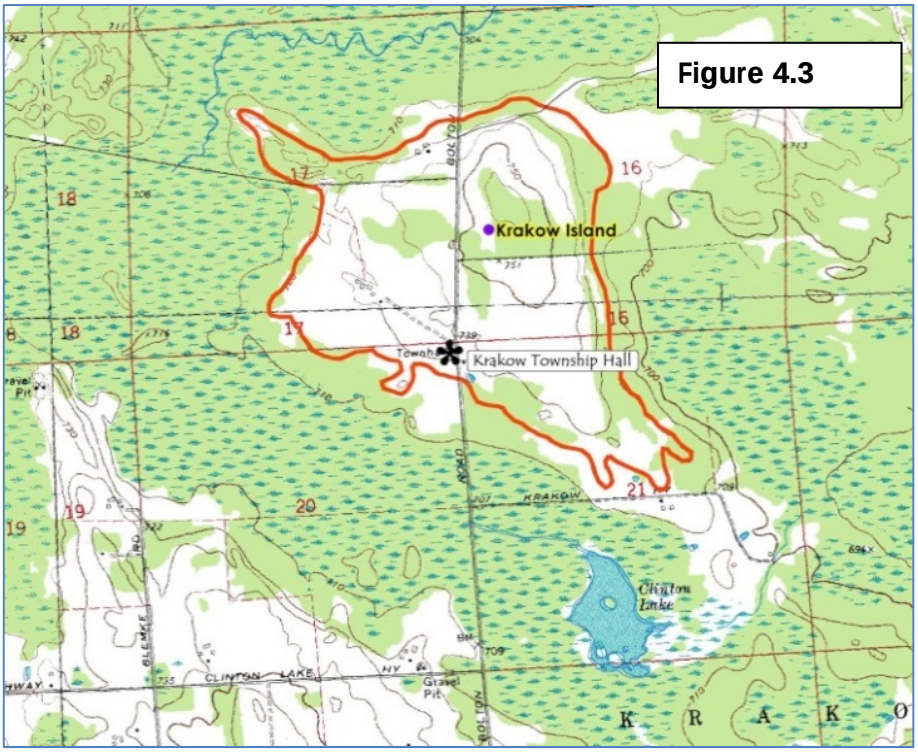


Figure 4.3

[1] Paleowind 11,000 BP/ directions derived from lake spits in Northern Michigan, Frank Krist Jr., Randall J. Schaetzl

The Township is located in a two to eleven mile wide lake plain formed from lacustrine sand and gravel deposits runs along the coastal area of Alpena and Presque Isle Counties. The mantle of glacial deposits is very thin and as a result the limestone bedrock is close to the surface and outcrops are frequent. A review of the Quaternary Geology map of Southern Michigan (W.R. Farrand & D.L. Bell, 1982) finds much of the study area classified as lacustrine sand and gravel, materials formed as beaches and near-offshore deposits in glacial great lakes. These deposits are primarily quartz sands with a calcium carbonate component ranging from minimal to a maximum of 40 percent. Beds or lenses of small gravel, rich in igneous and metamorphic rocks can be found in these lacustrine deposits. Deposits of muck, silt loam and sandy loam soils can also be found. The veneer of lacustrine deposits is discontinuous ranging from several feet thick to nonexistent. Limestone bedrock is at or near the surface with occurrences of alvar (limestone pavement), earth cracks, outcrops and sinkholes.

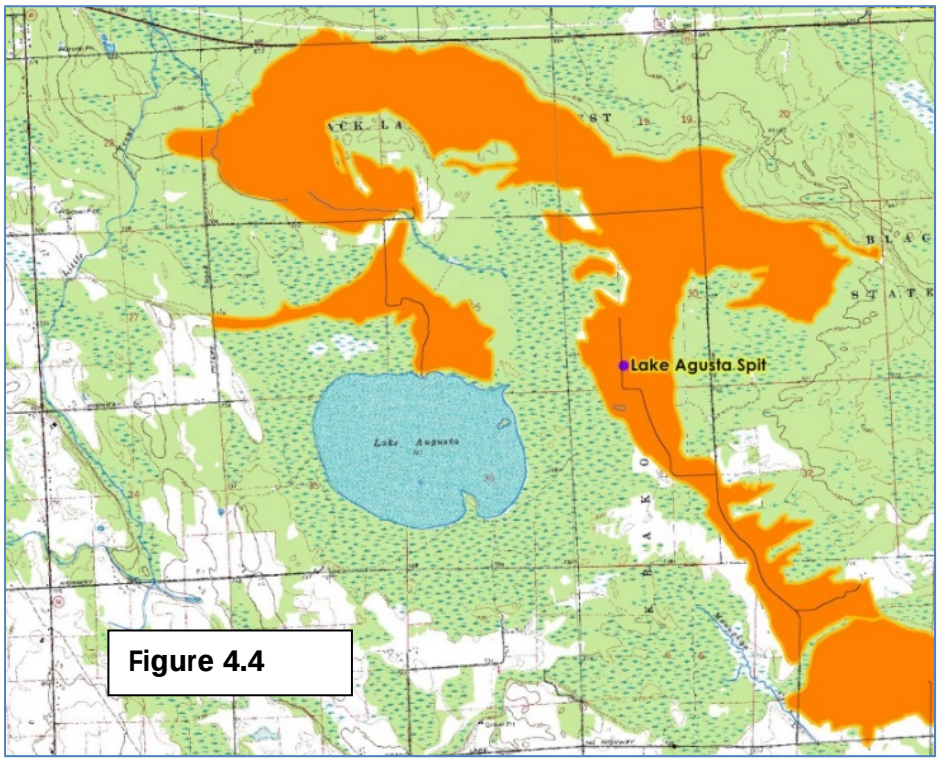


Figure 4.4

According to the map there is one area classified as dune sand which consists of fine to medium sand deposits, chiefly quartz with some heavy minerals. These were created by wind action during the post glacial Lake Nipissing (605 feet above mean sea level) and Lake Algoma (595 feet) stages. The continental glacier provided the source, along-shore water currents and wave actions moved sands on shore and wind action piled the sands into low dunes. This process is still occurring today along undisturbed sections of the shoreline. Active low sand dunes can be found in Thompson's Harbor State Park.

Topography

The topography consists of low hills and a coastal lake plain that slopes gently towards Lake Huron. As a result, elevation variations in the Township are not extreme. The average elevation of Lake Huron is 580 feet above sea level, while the highest land elevation (820 feet above sea level) is located in the southeastern corner of the Township. Low ridges and hills range in elevations of 720 to 750 feet above sea level.

Soils

When planning for types and intensity of future land uses, it is important to consider the carrying capacity of the land. Whether resource based activities such as farming, and forestry; residential

and commercial development; or recreation and park development, an analysis of soil types and slopes will provide an understanding of the land's suitability for different types of uses.

Soils most suitable for development purposes are well drained and are not subject to a high water table. Adequate drainage is important in minimizing stormwater impacts and the efficient operation of septic drain fields. Adequate depth to the water table is necessary to prevent groundwater contamination from septic systems or other non-point source runoff. Construction of roads, buildings and septic systems on steeply sloped areas, areas with bedrock at or near the surface or areas with organic and hydric soils require special design considerations. In addition, costs for developing these sensitive areas are greater than in less constrained parts of the landscape. If developed improperly, the impacts to natural resources can be far reaching.

The Natural Resource Conservation Service (NRCS) has completed a detailed soil survey of Presque Isle County. A digital or computerized version of the soil survey maps was acquired the Michigan Center for Geographic Information (CGI). Using information contained within the published soil survey book, a series of maps is presented that depict hydric soils, slopes 18 percent and greater, and areas where the bedrock is close to the surface. While soil constraints discussed in this section can be used as general guides for the planning process, it should not be used for development of specific sites. Detailed, on-site investigations should be conducted prior to development.

Hydric Soils and Steep Slopes

Figure 4.5 is a color thematic map that classifies hydric soils and steep slopes. Lower density and less intensive development should be directed to areas with severe building constraints. There are limited areas with slopes 15 percent or greater. These short-steep slopes are colored in red on the map. While hills and steeply rolling terrain provide opportunities for spectacular views of the landscape, steeply sloped sites have identified building constraints and therefore are more difficult and costly to develop and maintain. Special design standards such as erosion control measures, limiting size of disturbed areas, retaining natural vegetation, re-vegetation, slope stabilization and on-site retention of water run-off from impervious surfaces would all serve to minimize resource impacts. There are very few sites with slopes 15 percent.

Hydric soils are saturated, flooded or ponded during part of the growing season and are classified as poorly drained and very poorly drained. Due to wetness and frequent ponding, hydric soils have poor potential for building site development and sanitary facilities. Areas with hydric soils are best suited for forestlands, wetlands, wildlife habitat, wildlands recreation and low density residential development. Additionally, sites with high water tables may be classified as wetlands. Functioning as the backbone of a community's green infrastructure, this network of hydric soils/wetlands is often associated with lakes and streams. The system of hydric soils/wetlands can function as natural water quality buffers by accepting and retaining stormwater runoff from developed lands. **Figure 4.5** shows extensive areas of hydric soils within the Township**.** .

Building Site Development

The USDA soil surveys rate soils for various uses such as building site development and identifies the limiting factors such as steep slopes or high water table. The rating system is slight, moderate and severe limitations. Using the rating system developed by USDA, soil limitations for buildings without basements have been mapped and are displayed in **Figure 4.6.** Areas with well drained soils and slopes less than 10 percent tend to have no limitations for building development. Soils with no limitations or somewhat limited are scattered throughout the Township, and tend to be concentrated in agricultural areas and within the Presque Isle Harbor Association. Areas with

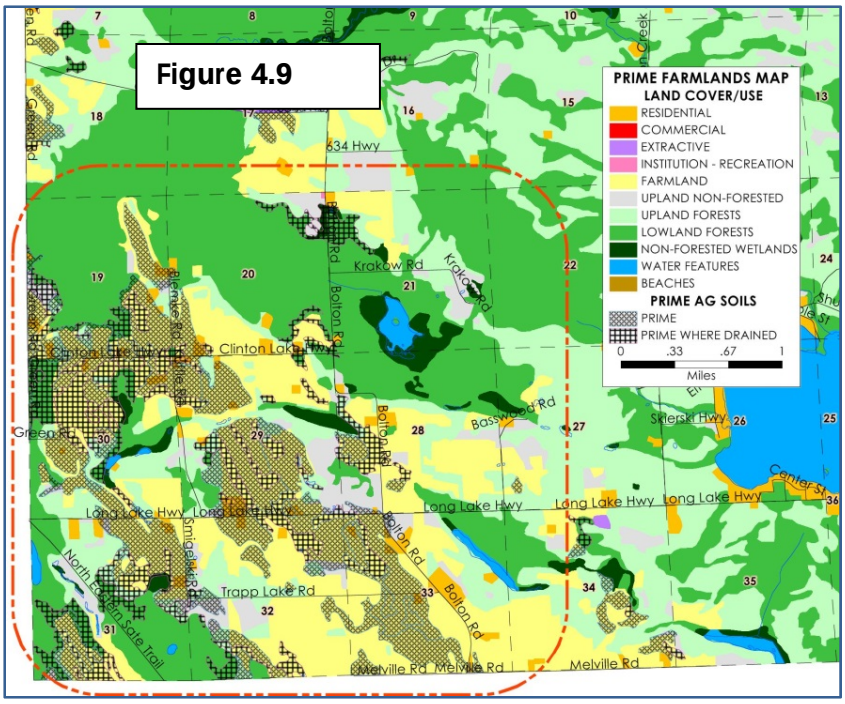
slopes greater than 15 percent, high water tables, bedrock near the surface, large stones and organic soils are considered very limited for building development. Lands with severe constraints are quite extensive and are primarily represented by wetness and bedrock at or near the surface. Some bedrock influenced areas also have constraints from high water tables.

Septic System Limitations

Figure 4.7 is a color thematic septic system limitations map that show soils constraints ranging from no limitations to very limited. Criteria for determining limitations include depth to water table, wetness, filtering capacity, bedrock, large stones, and ability to infiltrate water. Much of the study area is classified as having severe limitations. Clearly, the greatest limiting factors are the prevalence of high water tables followed by depth to bedrock. Areas with no limitations and somewhat limited are found primarily in the southwest parts of the township. Septic systems constructed in shallow soils over bedrock and sandy soils with high water tables can negatively impact groundwater and surface water resources, particularly when close to lakes and streams. Limiting types and density of development or making public water and/or sewer available for high density development are likely the best options for protecting the groundwater and surface water resources in these areas. Soils around the major lakes are classified as being very limited for septic systems. Since lands around Grand and Long Lakes have already be subdivided, limiting density is not an option. In addition, there are no plans to construct community sewer systems in the Township. Therefore, proper installation and maintenance of septic systems is the best option. As well, upgrading older poorly functioning system to newer technologies and engineered systems will help sustain water quality.

Depth to Bedrock

The soil survey of Presque Isle County identifies soils where the karst bedrock is near the surface. Areas with these shallow soils have severe constraints to development. Of particular concern is that bedrock aquifers are highly vulnerable to surface contamination from septic systems. Effluent from drain fields is treated as it percolates down through the soil. If there is a lack of filtration from the drain field to the bedrock, the effluent is not treated properly by the soil, and it will contaminate the bedrock aquifers with pathogens. In areas influenced by bedrock, it is critical to have properly engineered septic systems. The Northeast Michigan Karst Protection Plan described in the sections on groundwater will further explain the issues. **Figure 4.8** (see page 2-15) show areas with shallow soils over limestone bedrock.



Prime Farmland

Farming is important to the local economy and is part of the lifestyle of many long-term residents in the area. Furthermore, farmland is an integral part of the rural landscape in the Township. While the amount of land being farmed has decreased, generally the land is converting

to less intensive uses of open lands and is not being converted to subdivisions and commercial uses. **Figure 4.9** shows the active farmland and prime farmland soils in the Township.

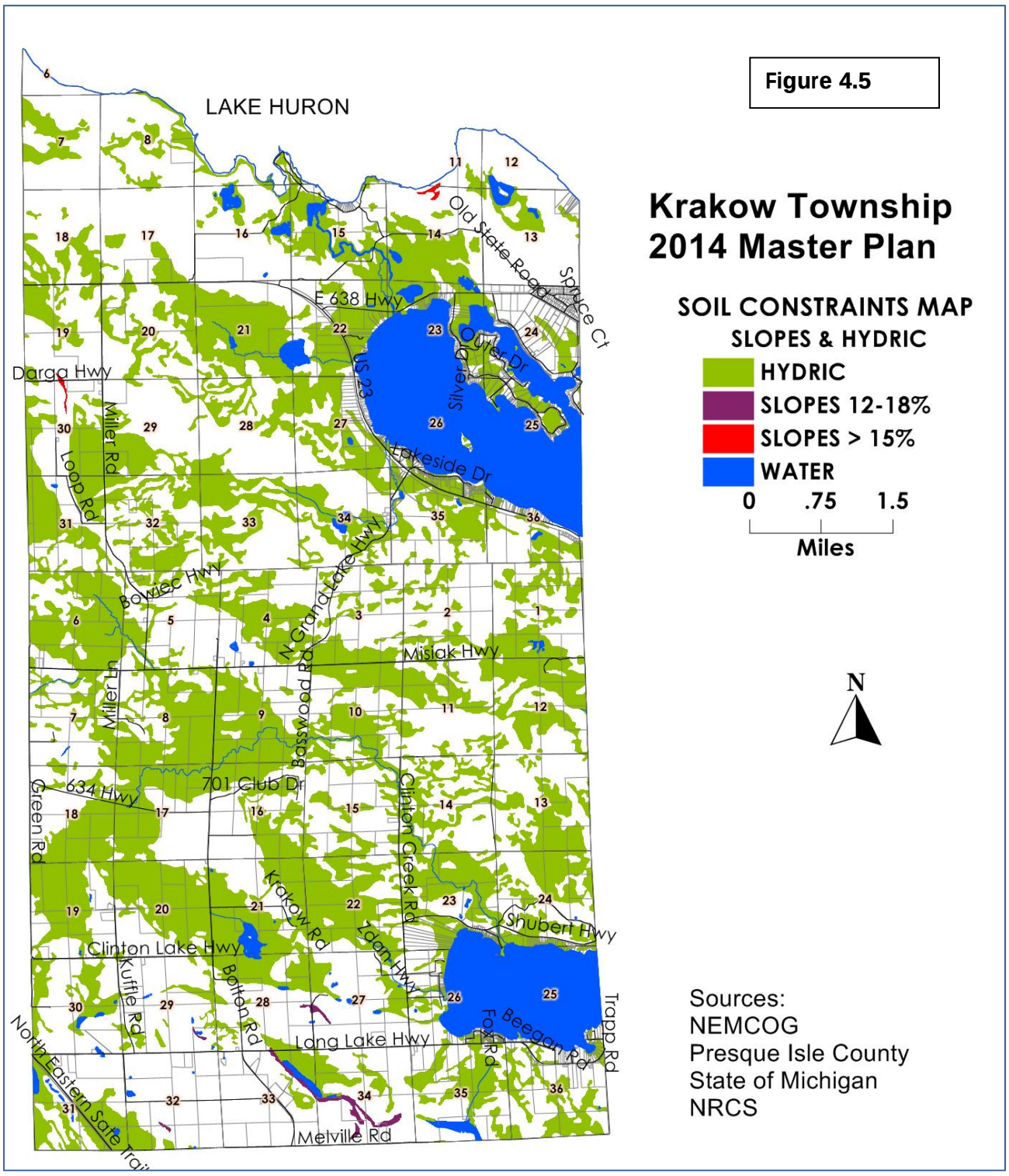
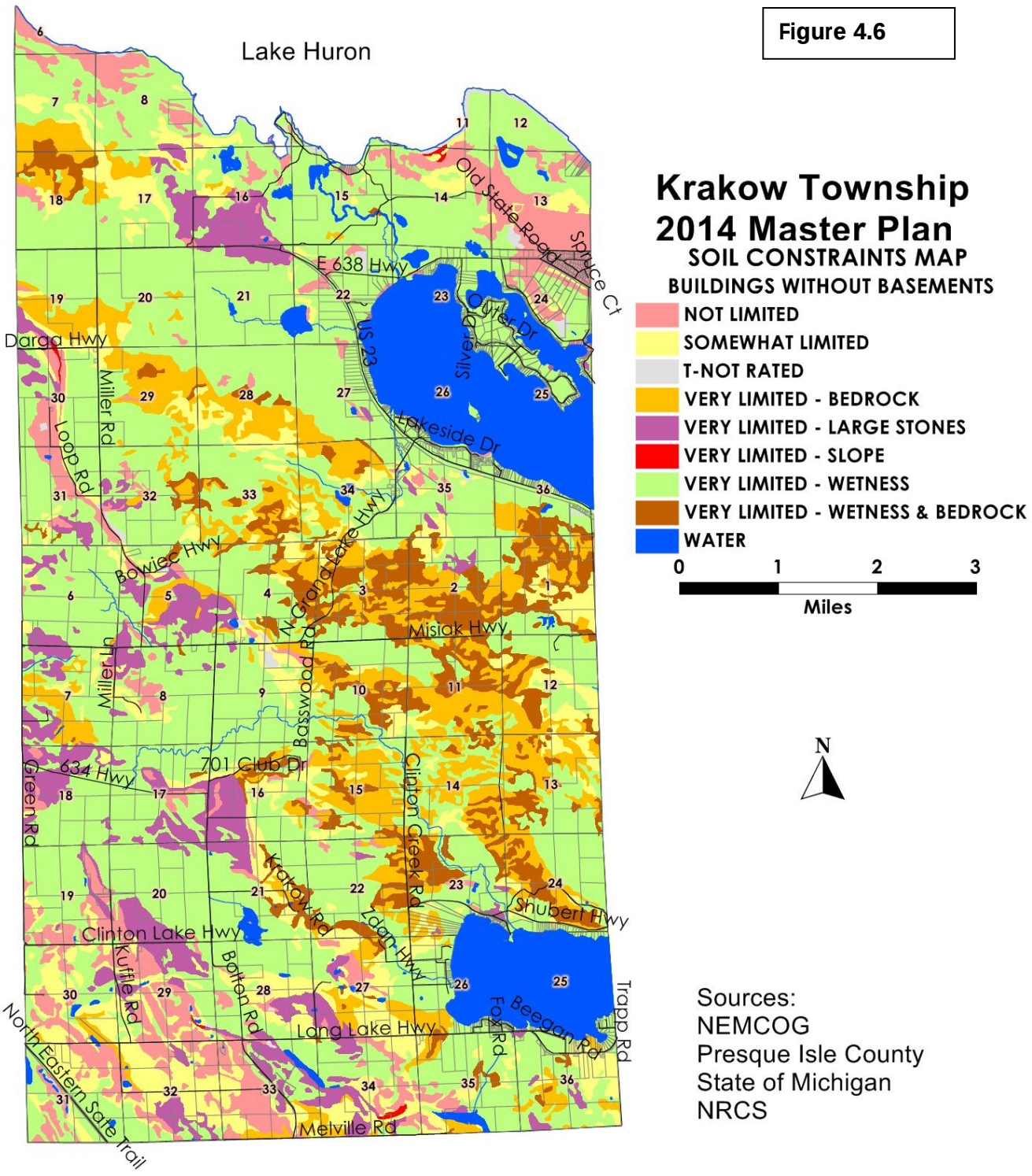


Figure 4.6


Lake Huron
Old State Road
Spruce Ct
E 638 Hwy
Oyster Dr
Grayling
US 23
Darga Hwy
Miller Rd
Loop Rd
Lakeside Dr
Bowiec Hwy
N Grand Lake Rd
Misiak Hwy
Miller Ln
Basswood Rd
701 Club Dr
634 Hwy
Green Rd
Clinton Creek Rd
Krakow Rd
Zaar Hwy
Shubert Hwy
Clinton Lake Hwy
Kuffle Rd
Bolten Rd
Lang Lake Hwy
Fox Rd
Beegan Rd
Trapp Rd
North Eastern Safe Trail
Melville Rd
Krakow Township
2014 Master Plan
SOIL CONSTRAINTS MAP
BUILDINGS WITHOUT BASEMENTS
NOT LIMITED
SOMEWHAT LIMITED
T-NOT RATED
VERY LIMITED - BEDROCK
VERY LIMITED - LARGE STONES
VERY LIMITED - SLOPE
VERY LIMITED - WETNESS
VERY LIMITED - WETNESS & BEDROCK
WATER
0 1 2 3
Miles
N
Sources:
NEMCOG
Presque Isle County
State of Michigan
NRCS

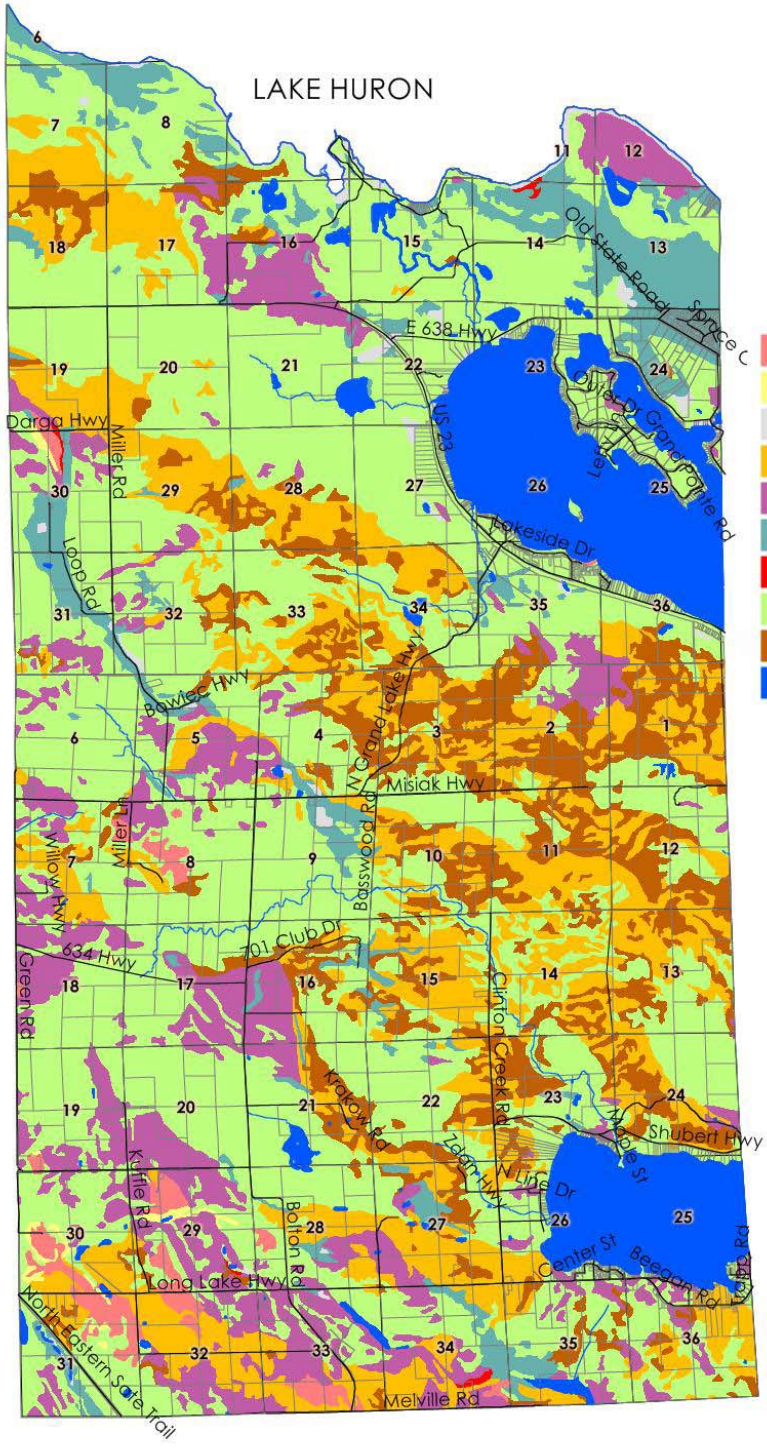


Figure 4.7

Krakow Township 2014 Master Plan

SOIL CONSTRAINTS MAP

SEPTIC LIMITATIONS

- NOT LIMITED
- SOMEWHAT LIMITED
- T-NOT RATED
- VERY LIMITED - BEDROCK
- VERY LIMITED - LARGE STONE
- VERY LIMITED - POOR FILTER
- VERY LIMITED - SLOPE
- VERY LIMITED - WETNESS
- VERY LIMITED - WETNESS & BEDROCK
- WATER

0 1 2 3

Miles

N

Sources:
NEMCOG
Presque Isle County
State of Michigan
NRCS

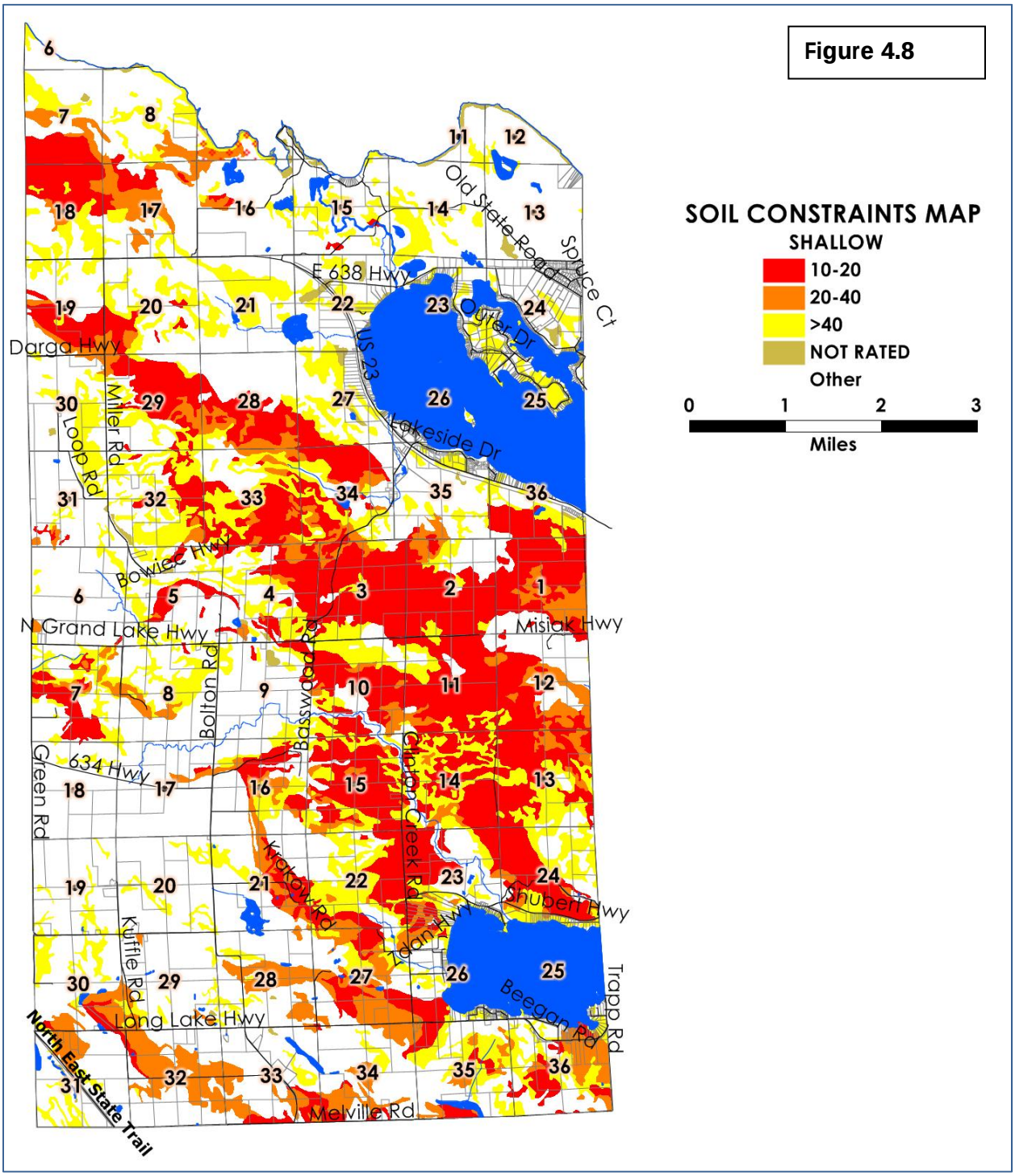


Figure 4.8
SOIL CONSTRAINTS MAP
SHALLOW
10-20
20-40
>40
NOT RATED
Other
0 1 2 3
Miles
E 638 Hwy
Old State Road
Spruce Ct
Outer Dr
Lakeside Dr
US 23
Darga Hwy
Miller Rd
Loop Rd
Bowler Hwy
N Grand Lake Hwy
Misiak Hwy
Bolton Rd
Basswood Rd
Clinton Creek Rd
634 Hwy
Green Rd
Krakow Rd
Shubert Hwy
Kuffle Rd
Long Lake Hwy
Beegan Rd
Trapp Rd
North East State Trail
Melville Rd

Water *Resources*

Groundwater

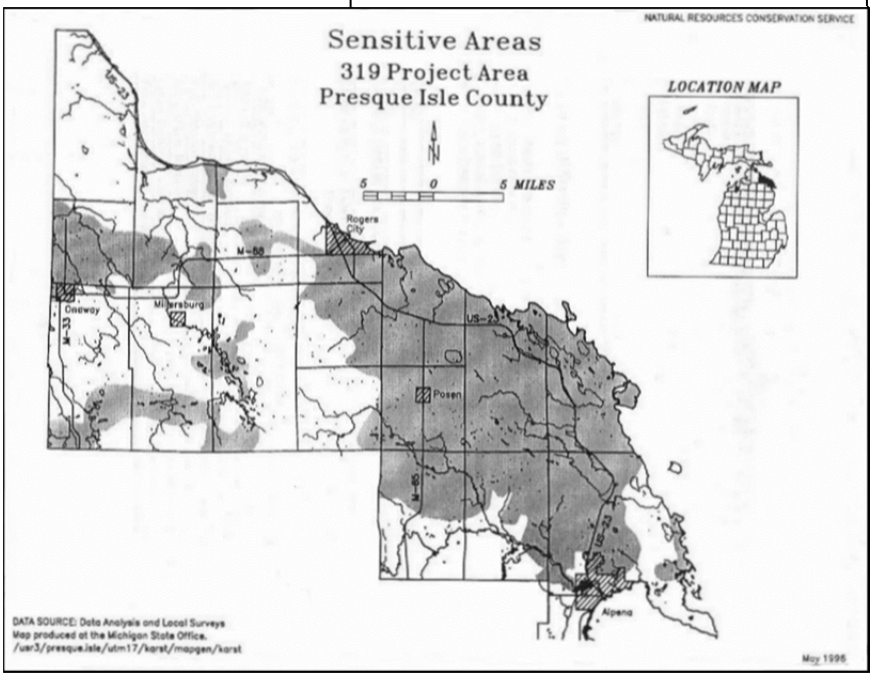
Maintaining high quality groundwater and surface water is vital to the long term sustainability of the community. Residents and visitors must rely on groundwater for drinking water. All of the drinking water in Presque Isle County, whether municipal or individual private wells, is derived from groundwater in subsurface aquifers. *Groundwater* is water beneath the earth's surface that fills openings *(pore spaces)* in sand or gravel or in fractures of sand, gravel, or rock. It begins as rain or snow and passes through the soil and bedrock. An *Aquifer* is an underground layer of rock, sand, or gravel containing enough groundwater to supply a well.

Groundwater is generally available in adequate quantities throughout Krakow Township. Water wells are developed in glacial deposits and the underlying bedrock. Since the bedrock is close to the surface in many areas, most water wells are developed in limestone bedrock. Overall, Krakow Township has good water quality. According to the Health Department, in general groundwater is quite hard containing high concentrations of calcium and magnesium. On average, concentrations range from 250-700 mg/l. Nitrate concentrations in the range of less than 2 mg/l are common. In localized areas the levels can be much higher and are attributed to septic systems, fertilizers, manure and septage spreading. Fluoride is fairly common in wells in Presque Isle County with levels averaging around 1 ppm.

Given the karst geology and sandy soils that are prevalent throughout the Township, groundwater in Krakow Township is a resource at risk. The Presque Isle Soil and Water Conservation District, in cooperation with a number of agencies, has developed the Northeast Michigan Karst Aquifer Protection Plan. The primary objective of the plan is to protect the area's drinking water by correcting the sources of pollution. A secondary objective is to increase awareness of the connection between different land use pollutants and drinking water in karst areas.

The Karst Aquifer Protection Plan covers Presque Isle County and parts of Alpena County. **Figure 4.9** shows karst sensitive areas within the County. According to the plan, "much of the project area is characterized by karst. Karst is defined as a type of topography that is formed over limestone, dolomite, or gypsum by dissolving or solution; and is characterized by sinkholes, caves and underground drainage through fractures in bedrock. Karst waters are just as susceptible to contamination as surface waters because much of

Figure 4.9 Karst Sensitive Areas



the water moves through open channelways, resulting in extremely high aquifer recharge rates. Consequently, the shallow aquifers of the project area are extremely vulnerable to contamination from surface and subsurface sources."

According to the study, "District Health Department #4 has documented 490 cases where domestic water supplies have been adversely affected due to direct migration of pathogens (432), nitrates (54), hydrocarbons (2), sediment (2) from surface sources into aquifers through improper wells and karst features. In addition, although the cost of testing creates a lack of data, professional judgment is that pesticides, heavy metals and salts also have the potential to contaminate area aquifers. Prioritized pollutants are as follows: pathogens, nitrates, sediment, pesticides, hydrocarbons, salts, and heavy metals." The study further states, "There are four known sources of pollutants. These are agriculture including barnyards, feedlots, pastures, and croplands; residential including septic systems and abandoned wells; illicit dumps; and road corridors".

Surface Water

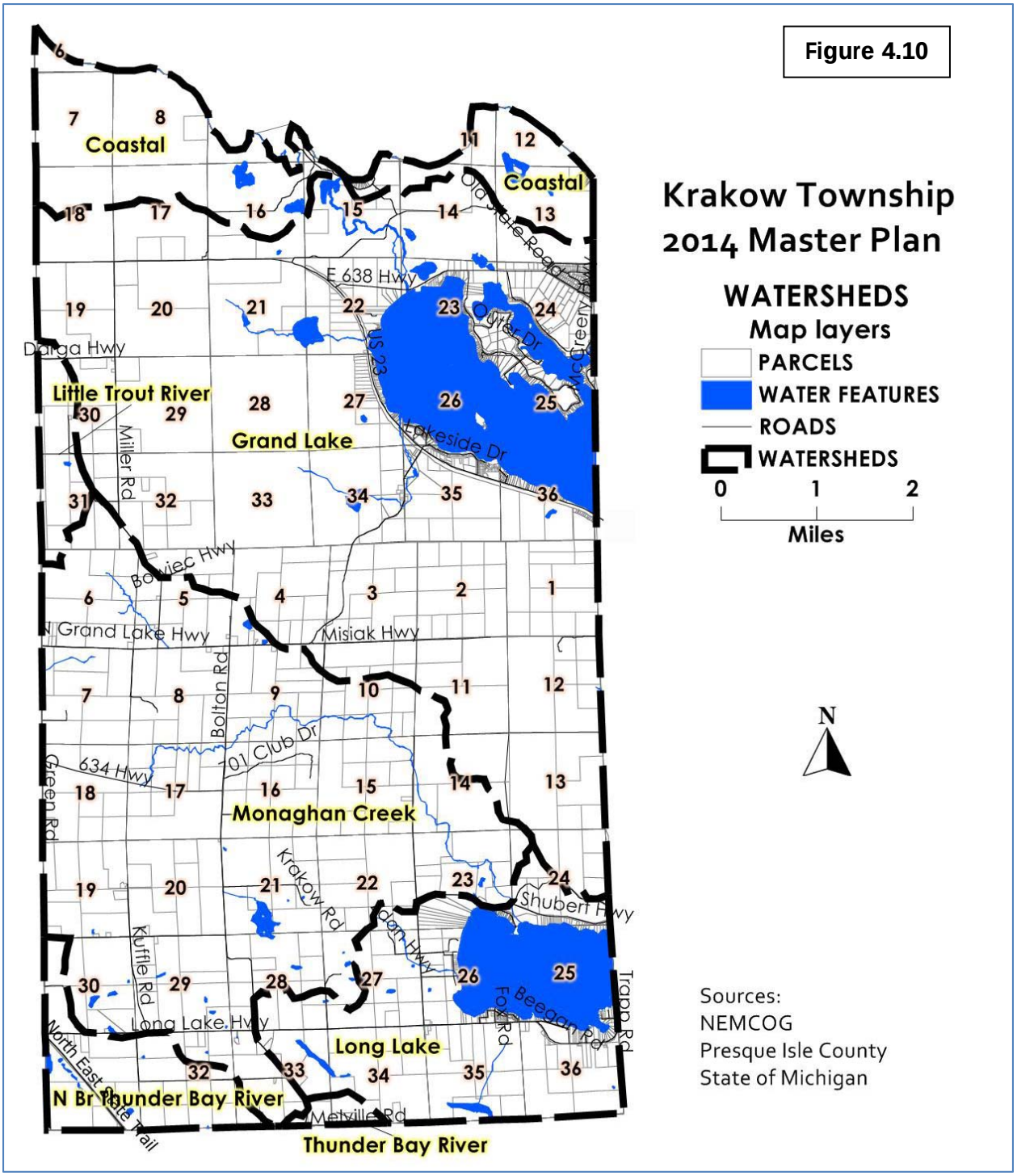
Quality of life and economic base are directly linked to surface water resources. Maintaining high quality surface water is integral to the long term well being of the community. Streams and lakes provide scenic values and recreational opportunities for residents and visitors as well as critical habitat elements for a wide range of fish and wildlife species. In fact, the tax base and economic base are directly attributed to the abundance of surface water resources in the community. Numerous lakes, streams and swamps are found in Krakow Township. These smaller bodies of water are characterized by seasonal water level fluctuations and various stages of vegetation encroachment. Streams function as resource connections between lakes and wetlands.

Of course, the largest surface water resource in the county is Lake Huron. The Great Lakes are the largest system of fresh, surface water on Earth, containing roughly 18 percent of the world supply. Only the polar ice caps contain more fresh water. Lake Huron is the second largest of the five Great Lakes in surface area (23,000 square miles). However, due to its many islands and inlets, it has the greatest length of shoreline at 3,827 miles, over 1,000 miles more than Lake Superior, which is the largest in surface area.

Two primary water features are Grand Lake (5,821 acres) and Long Lake (5,652 acres), both partially located in the Township. Both lakes have legal lake levels established by the circuit courts. Other named lakes include Clinton Lake (32 acres), Duck Lake (7 acres), Mindack Lake (35 acres),and Trapp Lake (13 acres). According to map files there are an additional 61 small lakes, ponds and floodings in the Township that account for another 177 acres of water and open marshes. See **Figure 4.10** for a map of the water features and watersheds.

Grand Lake and Long Lake have origins different than the typical kettle lakes in Northeast Michigan. Fault lines in the sedimentary bedrock were weak points. Acting like large bulldozers, the glaciers exploited these weak points, broke apart the level sedimentary bedrock and scoured out the long linear lake basins we know today. **Figure 4.11** shows is a graphic rendition of the fault lines and how they influenced the configurations of both Long and Grand Lakes. The jagged coastline with the many bays and points along with numerous shoals in near shore areas reflect the influence of bedrock and determined work of the glaciers.

Grand Lake has a surface area of 5821 acres and a maximum depth of 30 feet. Its lake shape factor (also known as the Shoreline Development Factor) of 3.59 shows a large amount of shoreline in relation to surface area. Round lakes have a factor of 1.00, while irregular shaped



lakes with a much greater shoreline development potential have a factor of 4.00. According to the 1979 regional lake study[i] Grand Lake was classified as borderline between oligotrophic and mesotrophic. Grand Lake's TSI value of 41.42 was heavily influenced by the high Secchi transparency TSI of 50. The low Secchi transparencies of 6.9 ft. (spring) and 6.6 ft. (summer) may be attributed more to marl turbidity than to the phytoplankton (algae).

Long Lake was classified as mesotrophic. Long Lake's TSI value of 47.05 was heavily influenced by the high Secchi transparency TSI of 60. The low Secchi transparencies of 14.1 ft. (spring) and 3.3 ft (summer) may be attributed more to marl turbidity than to the phytoplankton (algae). No current data is available for both lakes.

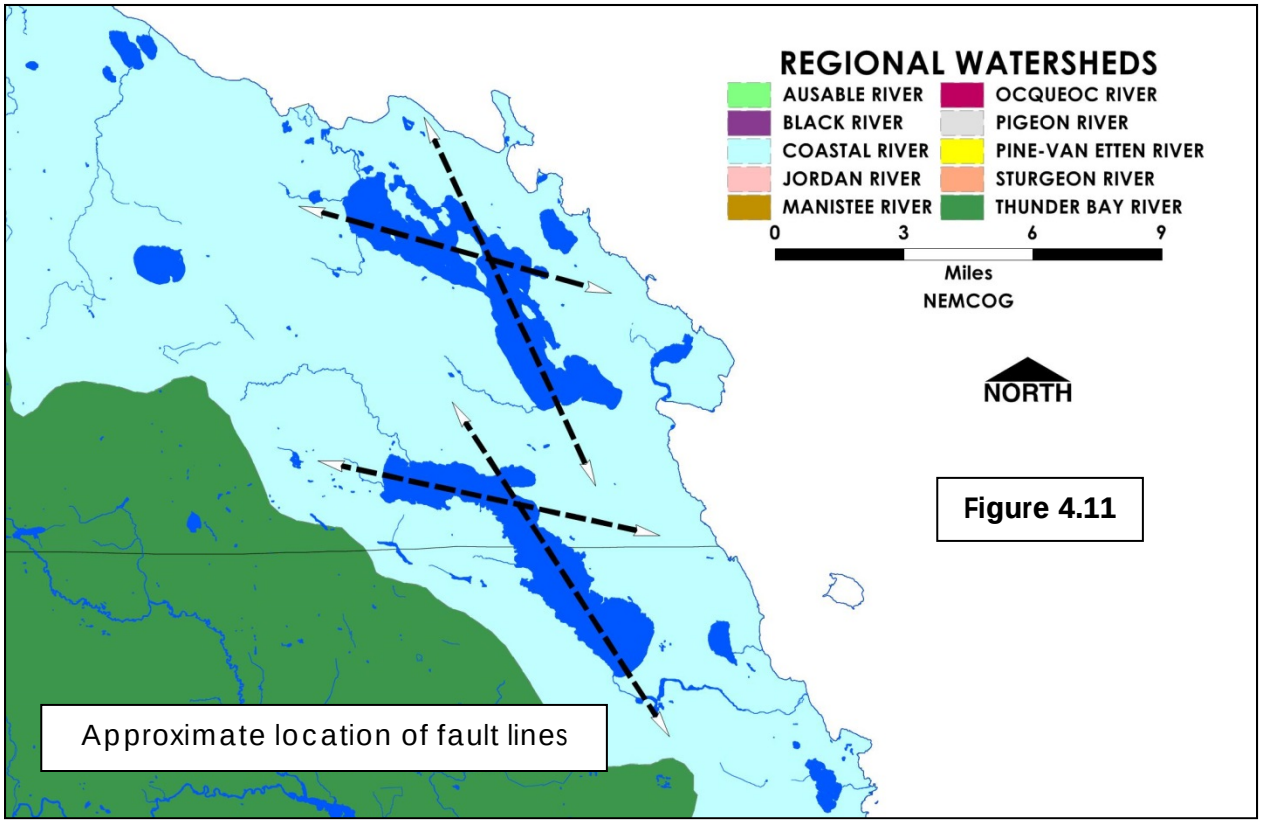


Figure 4.11

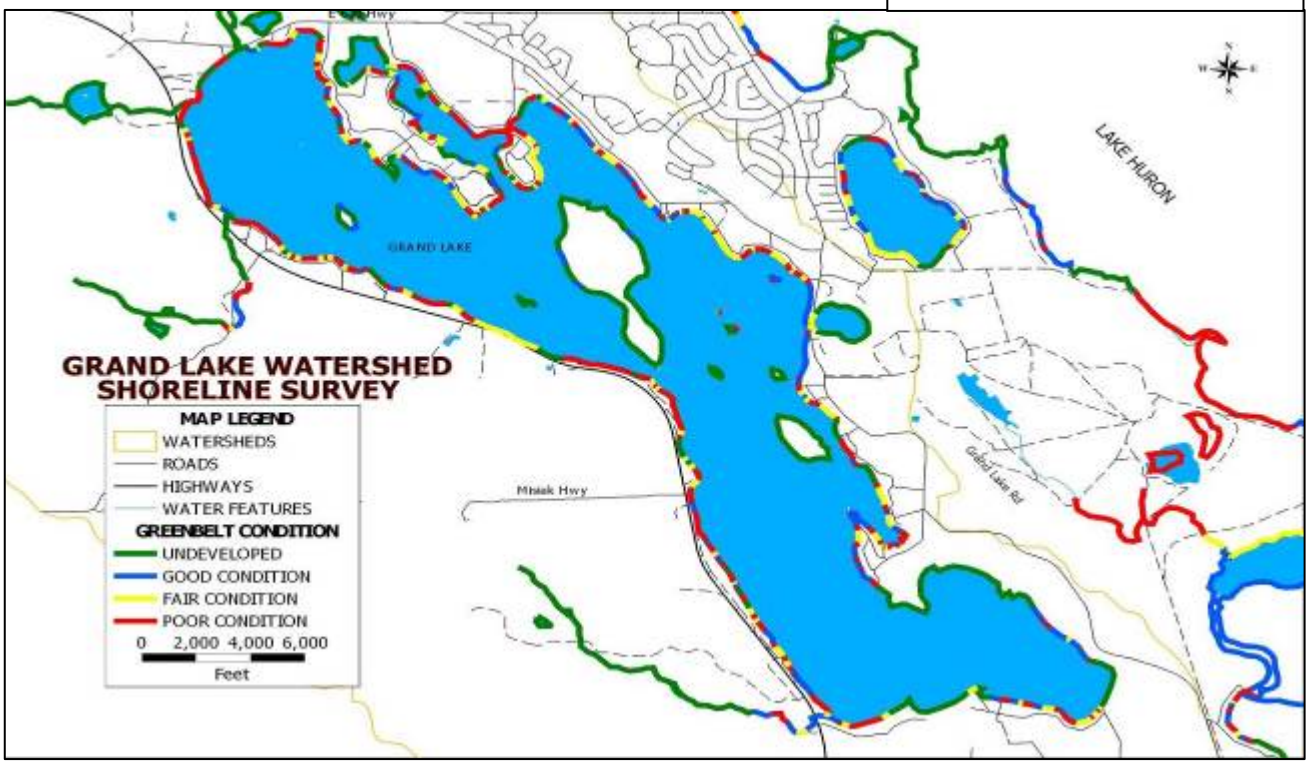
NEMCOG, with funding support from Michigan's Coastal Management Program, developed the Grand Lake and Coastal Watershed Plan. During the fall of 2005, a shoreline greenbelt survey was conducted. Field visits and aerial photo interpretation techniques were used to conduct the survey. The Grand Lake survey was conducted by boat. Small lakes, creeks and developed areas of the Lake Huron shoreline were viewed from accessible locations. Aerial photo interpretation methods were employed to refine field surveys and inventory inaccessible locations. Shorelines were classified into four categories: undeveloped, developed good condition, developed fair condition and developed poor condition. **Figure 4.12** shows the results of the shoreline condition survey.

A summary of the Grand Lake shoreline is provided in **Table 4.2** below. Nearly, 40 percent of Grand Lake's shoreline is undeveloped. With the exception of the islands, much of the undeveloped lakefront property is low and likely wetlands. Approximately, 50 percent of waterfront properties were found to be lacking in adequate greenbelts. Thirty-one percent of the shoreline was classified as having poor greenbelt conditions. Lakeshore properties dominated by manicured, green lawns do not provide proper water quality buffers or needed wildlife habitat. Education programs should focus on these properties to restore wildlife habitat and water quality buffers.

Results of watershed plan's water quality inventories show that there is relatively little erosion occurring in the watershed. However a severe lack of greenbelts in the developed areas of the

lake allows significant amounts of pollutants such as phosphorus and nitrogen to enter the lake. Below is a brief summary of the findings.

Figure 4.12



- At road/stream crossings, damaged, ineffective or perched culverts, embankment erosion and culvert outlet erosion were some of the factors impacting the watershed's streams.

- Many of the access sites to Grand Lake are not paved and heavy foot, boat and trailer traffic is taking its toll on the shoreline.

- Sediments and nutrients are the pollutants of greatest concern in the watershed. To maintain the high level of water quality expected by the watershed community, best management practices will need to be implemented at sites of concern. Educating the public to the importance and benefits of greenbelts and shoreline buffers should be considered a priority component of the watershed plan.

The southern half of Long Lake is located in Alpena County's Alpena Township, while the northern half is in Presque Isle County's Presque Isle and Krakow Townships. Information regarding Long Lake is referenced from a water quality study prepared in 2001 by Dr. Wallace E. Fusilier of Water Quality Investigators. Long Lake has a surface area of 5,652 acres and has a shoreline length of nearly 29 miles. The maximum depth is 25 feet with a mean depth of 12.5 feet. Long Lake is 7.8 miles in length at its longest dimension, and the elevation of the lake is 649 feet above sea level. The size of the Long Lake drainage area, including the lake, is approximately 52 square miles. Water samples were collected during the spring and summer of 2001 at five different sampling stations. Tests performed included total phosphorus, total nitrate nitrogen, total alkalinity, pH, conductivity, chlorophyll, Secchi disk depth, temperature and dissolved oxygen. Analysis of the factors tested was presented in graphic form showing the

total Lake Water Quality Index (LWQI). On a scale of 0-100, Long Lake's LWQI scores ranged between 94 and 98, depending on the time of year and location where the test samples were collected. According to Dr. Fusilier's study, these scores indicate Long Lake has excellent water quality.

There are numerous small creeks and drainages. The named waterways include Clinton Creek, Monaghan Creek, Warren Creek, Schalks Creek, Schaut Creek, Schubert Creek and the outlet of Grand Lake. No water quality data is available for the streams.

Table 4.2
Grand Lake Shoreline Survey

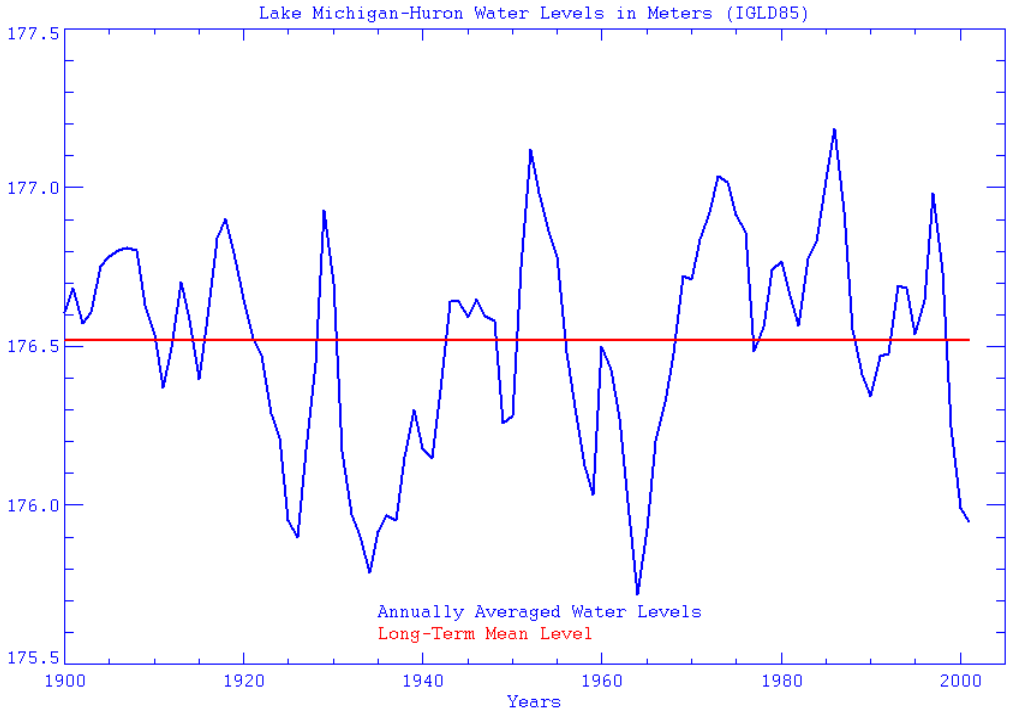
		All Shoreline		Shoreline w/o Islands	
Undeveloped	Natural vegetation intact.	79,340 ft.	39%	45,150 ft.	28%
Developed Good Condition	Trees, shrubs and herbaceous plants covering much of shoreline; lawn not to water's edge.	28,619 ft.	14%	25,462 ft.	16%
Developed Fair Condition	Trees, shrubs and herbaceous plants present but mowed lawn covering less than 60 percent, no hardened shoreline.	32,602 ft.	16%	32,408 ft.	20%
Developed Poor Condition	Trees and shrubs limited, mowed lawn covers much of the lake yard; hardened shore of rocks, concrete or metal retainer walls may be present.	61,705 ft.	31%	60,709 ft.	37%

Source: Northeast Michigan Council of Governments

Fluctuating Lake Level

The U.S. Army Corps of Engineers have maintained lake level records for Lake Huron since 1900. **Figure 4.13** shows Lake Huron-Lake Michigan Lake levels from 1900 to 2000. During periods of high water levels, shoreline erosion is problematic, particularly where development is close to the lakeshore and on bluffs. Coastal wetlands change in size and species composition as Lake Huron water levels rise and fall. During periods of low water levels, wetland herbaceous vegetation expands out into the exposed bottomlands. Woody plants such as northern white cedar and balsam poplar march outward from the forests edge onto now dryer sites. As the lake level rises, the newly established vegetation is inundated and the plant communities are pushed back inland. The flooded vegetation creates critical habitat for fish and wildlife, in addition to protecting shore areas from erosion. The ebb and of lake levels creates a constant see-saw of early succession plant communities along the zones. **Figure 4.14** from "Filling the Gaps" publication by Michigan Department of Environmental Quality[ii], depicts the fluctuations of lake levels and the ever changing coastal landscape.

Figure 4.13: Lake Huron – Michigan Historic Water Levels



Fish and Wildlife Resources

The predominance of forests, wetlands and surface water makes Krakow Township home to many species of fish and wildlife. The Lake Huron fisheries have undergone significant shifts over the last century. Construction of the Wellington Canal in 1919 both opened the Great Lakes to ocean going vessels and opened the door to aquatic non-native and invasive species. First, the sea lamprey decimated native species such as lake trout, lake whitefish, chub, and lake herring, which were already under stress from over fishing and pollution. Loss of these predators allowed alewives, another invasive species, to explode in population and further upset the lake's ecosystem by negatively impacting other native species. Introduction of salmon into the Great Lakes brought the alewives population under control and reestablished an important sport and commercial fisheries. The numerous salmon tournaments and charter fishing businesses on Lake Huron were a testament to this high quality fishery.

However as new stressors have been introduced into Lake Huron, the food web has once again been altered. Continued introduction of aquatic invasive species, such as zebra mussels, quagga mussels and round goby, from ship ballast water caused the collapse of plankton, alewives, perch, brown trout and salmon populations during the last decade. The lake's most productive zones have shifted from historic offshore to nearshore areas. This shift combined with critical habitat protection, habitat restoration and efforts to rehabilitate native species has resulted in increased populations of perch, whitefish, lake trout smallmouth bass and walleye. In the short term, commercial and sport fishing shows promise, but what the future may bring is still uncertain. Continued introduction of aquatic invasive species from ship ballasts or worse introduction of Asian carp through connected waterways will continue to have negative impacts on the fisheries.

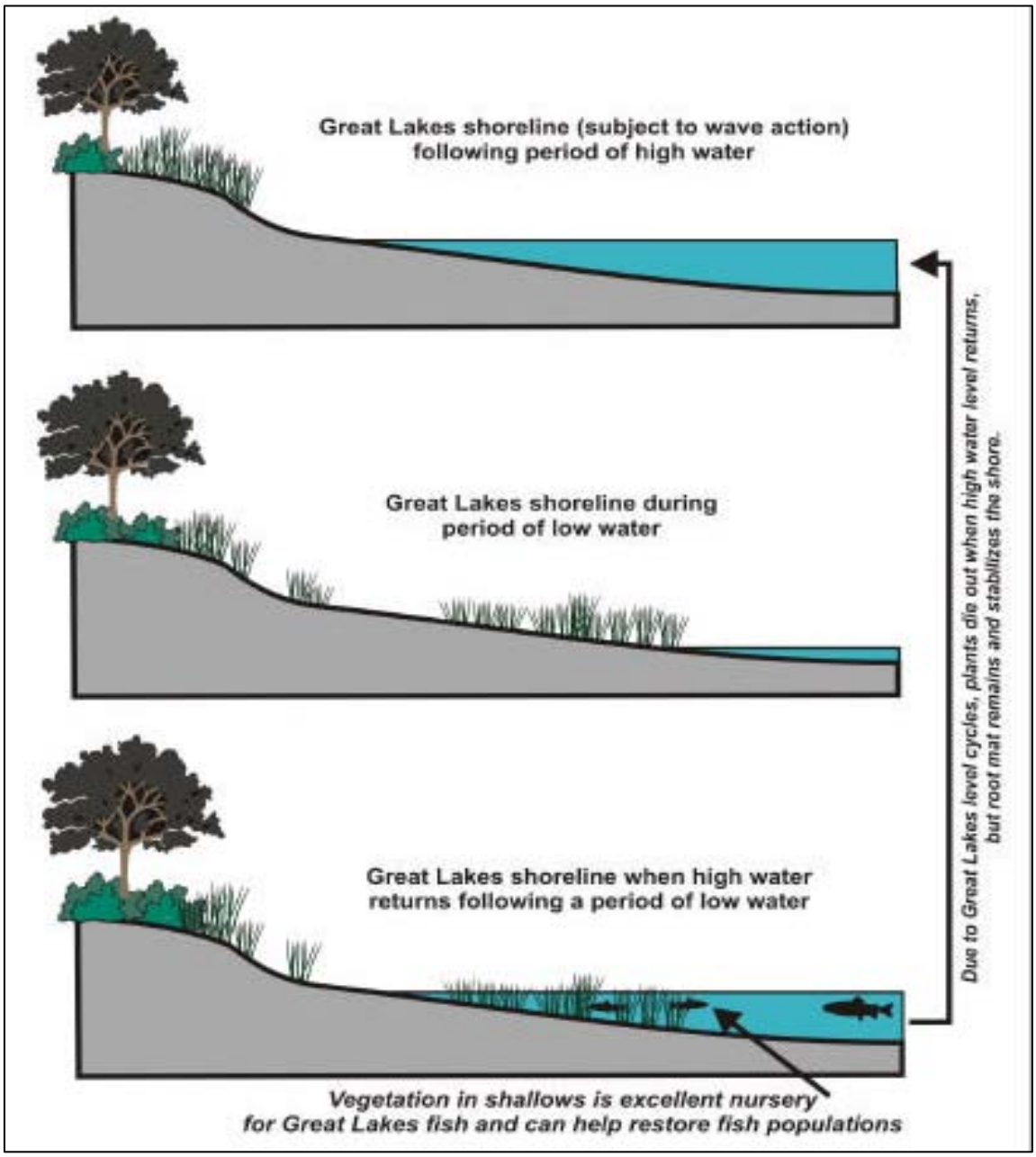


Figure 4.14: Josh Warbach, Planning and Zoning Center, Inc

The Fisheries Division of Michigan Department of Natural Resources periodically conducts fish collections in order to determine the species population numbers and the size and health of fish in inland waters. Grand and Long Lakes are managed under the MDNR's Large Lakes Program. The most recent work for Grand and Long Lakes was completed in 2004-2005. As part of the Large Lakes Program, the MDNR also surveyed Grand Lake (Hanchin 2011) using methods and gear similar to those employed on Long Lake. Thus, it should be reasonable to

compare fish community composition indices for Long Lake to Grand Lake.The following information includes excerpts from MDNR reports available on their web site. [2]

Grand Lake

Grand Lake has a relatively long survey history that describes the fish community since 1950. The current 2004 survey of Grand Lake was the most comprehensive fisheries survey of the lake given that more fish were collected than any previous survey. The percent composition of major predators (walleye, northern pike, and smallmouth bass) by number decreased from 51.5% in 1981, to 40.6% in 1995, and finally to 27.1% in 2004. This was especially apparent for northern pike, which had percentages by number of 12.3%, 2.7%, and 1.1% for 1981, 1995, and 2004, respectively.

The apparent trend for predators was contrasted by a trend of increasing prey abundance (Figure 8). The total percentage of suckers, panfish, and minnows (combined, by number) increased from 47.9% in 1981, to 52.1% in 1995, to 70.7% in 2004. Yellow perch are the only individual prey species that showed a distinct trend over the three surveys, making up 0.7%, 0.8%, and 18.4% by number, respectively. Although suckers did not show a trend across the three surveys, they made up the highest percentage of the total catch in 2004 at 36.3%.

In general, walleye size structure in Grand Lake was below average when compared to other large lakes. Based on the observed distribution of lengths, walleyes in Grand Lake are unlikely to attain lengths much greater than 24 inches, though there is the potential to reach 28 inches. There was an apparent positive trend in the size structure of northern pike from the time of the historic (1981 and 1995) spring surveys to the 2004 survey. The percentages of northern pike 24 inches or larger were 15%, 35%, and 49%, respectively. Currently, the size structure of northern pike in Grand Lake is above average. The size structure of smallmouth bass in Grand Lake appeared to be very good. Smallmouth bass in Grand Lake are likely to attain lengths of 17 inches, and have the potential to reach 20 inches.

Angler Survey: The fishery of Grand Lake is dominated by yellow perch, which comprised 85% of the total annual harvest, and 88% of the released fish. Smallmouth bass offer the best angling opportunity for a large predator, and were the second most commonly harvested and released species, comprising 6% of the total annual harvest, and 8% of the released fish. Walleye and northern pike do not appear to present much angling opportunity, though some anglers likely target them at certain times of the year.

The number of fish harvested per acre in Grand Lake was below average for other large lakes in Michigan, which is a result of low fishing effort on a lake with low productivity. Grand Lake is primarily a smallmouth bass and perch fishery, with less important walleye and northern pike fisheries. The yellow perch fishery in Grand Lake is rather good, but is still less productive (harvest = 1.55 per acre) than the average (3.46) and median (2.15) for twelve large lakes surveyed recently. Given the relatively high abundance of prey such as yellow perch and white suckers, the predator population could tolerate some type of augmentation. Since the smallmouth bass population is adequate, and the walleye population has slow growth, it would

---

[2] Status of the Fishery Resource Report, Long Lake, Alpena/Presque Isle Counties, Tim A. Cwalinski, Senior Fisheries Management Biologist, Michigan DNR.
SR54 - The Fish Community and Fishery of Grand Lake, Presque Isle County, Michigan in 2004-05 with Emphasis on Walleye, Northern Pike, and Smallmouth Bass, Patrick A. Hanchin, May 2011.
SR53 - The Fish Community and Fishery of Long Lake, Presque Isle and Alpena Counties, Michigan in 2004-05 with Emphasis on Walleye, Northern Pike, and Smallmouth Bass Patrick A. Hanchin and Tim A. Cwalinski, May 2011.

make sense to supplement the northern pike population. This may be achieved through more frequent operation of the spawning marsh, though there may be another longer-term solution.

Long Lake

Fish community surveys and observations are noted for Long Lake dating back to the 1920s. Field investigations in 1925 and 1926 found a fish community similar to what is found in Long Lake today. Bluegills were noted as rare, while some sunfish (pumpkinseeds) were present. Rock bass, northern pike, walleyes, and yellow perch were common. Interestingly, reports of lake whitefish spearing were noted. Overall, the fish community of Long Lake has displayed consistent species composition over the last eighty years. In our spring 2004 survey, we likely caught more large, mature fish of several species than would normally be caught in surveys that have historically been conducted later in spring or summer. This includes spring spawners such as walleyes, northern pike, white sucker, and smallmouth bass. Additionally, because of the mesh-size bias, smaller fish were not represented in our sample in proportion to their true abundance in the lake.

The size structure of walleyes in our spring survey (86% legal size) was above the average of legal-size walleyes (69%) in spring surveys for 14 populations surveyed under the Large Lakes Program. Based on past surveys and the current survey, walleyes in ong Lake rarely attain lengths much greater than 25 inches. The size structure of northern pike in our spring survey (35% legal size) was near the average (28%) of legal-size northern pike in spring surveys for thirteen populations surveyed under the Large Lakes Program. While we did not collect a large number of northern pike, the number of large (≥36 inch) fish was notable, and northern pike in Long Lake have the potential to reach trophy size. The size structure of smallmouth bass in our spring survey (66% legal size) was similar to the average percentage (65%) of legal-size smallmouth bass in spring surveys for twelve populations surveyed under the Large Lakes Program. Currently, smallmouth bass in Long Lake are likely to attain lengths of 18 inches and have the potential to reach 20 inches.

Angler Survey: Summary.–The fishery of Long Lake is dominated by yellow perch and smallmouth bass, which comprised 93% of the total annual harvest. The open-water period accounted for 74% of the annual yellow perch harvest, and harvest was highest in September/October. Smallmouth bass were harvested primarily during the open-water period, and provided consistent catch rates throughout the year. Walleye and northern pike contributed to the fishery of Long Lake, but to a much lesser extent than yellow perch and smallmouth bass. Walleyes were harvested throughout the year, but most readily from July through October. Catch rate for walleye was highest in September/October and overall it was low. Overall, the fishery of Long Lake is not very diverse, especially in the winter when yellow perch, walleye, and northern pike were the only species harvested. A few other species provide angling opportunity throughout the year, though not to any large degree.

Walleyes are the second most abundant large predator in Long Lake. However, the walleye fishery in 2004–05 was below-average with respect to other large lakes in Michigan. Northern pike had the lowest abundance of the three predator species targeted in this survey. The population in Long Lake has an average density of legal-size northern pike, but a low density of adult northern pike. Contrary to the walleye and northern pike fisheries, the smallmouth bass fishery in Long Lake is exceptional.

Stocking does not appear to be necessary to maintain any of the fish populations or fishery in Long Lake even though both the walleye and northern pike populations are currently at low densities. It would appear that the predator population could tolerate augmentation given the

relatively high abundance of prey such as yellow perch and white suckers; however, the only predator species with distinctly above-average growth is northern pike. Thus, augmenting the northern pike population would be the most biologically sound option, though the social acceptance of this action would need to be assessed. If walleye stocking were considered as a management option, it should be kept at a level that will prevent potential harmful effects from density-dependent interactions such as increased competition for food or cannibalism.

Michigan Department of Natural Resources is generally responsible for stocking and monitoring fish resources in Lake Huron and surrounding waters. In some cases, they allow local groups or individuals to oversee fish management projects. Long Lake Stocking of walleye since 2004 1,637,500 Most of the fish were planted by the state when 1,550,000 walleye fry were planted in May of 2006. The Long Lake Association has sponsored a number of fall plantings of fingerlings. Schalks Creek Pike Marsh, connected to Grand Lake, is used to supplement natural production of pike in the lake by enhancing natural production. Essentially, a volunteer who for decades helps some of the naturally running northern pike get up Schalks Ck into the manmade (flooded) spawning marsh.

Deer, rabbit, grouse and woodcock are abundant in the Township. Bear, coyote, bobcat, fox and turkey have small to moderate populations that are growing. Wildlife is a resource that brings in hunters and tourists. October and November bring many hunters to the Township for small game hunting, bear and bow season (deer), peaking sharply in mid-November with the opening day of deer (rifle) season.

In 1994, a Bovine Tuberculosis (TB) infected deer was killed by a hunter in Alpena County. Unfortunately, large deer populations combined with indiscriminate feeding practices were contributing factors to the spread of Bovine Tuberculosis (TB) in Presque Isle County and across northern Michigan. TB is a serious disease caused by bacteria attacking the respiratory system. There are three main types of TB - human, avian and bovine. Human TB is rarely transmitted to non-humans, and avian TB is typically restricted to birds. Bovine TB, also known as 'cattle TB', is the most infectious of the three and is capable of infecting most mammals. Although primarily found in hoofed animals and not considered a health risk to humans, humans can and have contracted Bovine TB. The disease has been found in coyotes, raccoons, black bear, bobcat, red fox and opossum.

In 2011, bovine tuberculosis (TB) was found in 17 wild white-tailed deer from five counties in Michigan: Alcona, Alpena, Montmorency, Oscoda and Presque Isle. Statewide 6,021 deer were tested. Since 1995, a total of 703 deer have been found positive from 195,061 deer sampled in Michigan. As a part of Michigan's strategy to eliminate TB in deer and elk, hunting regulations in the six-county area (DMU 487), which includes Alcona, Alpena, Iosco, Montmorency, Oscoda and Presque Isle counties, have been designed to reduce the deer population, which will help decrease possible transmission of the disease. Feeding and baiting deer and elk also remains illegal in the six-county bovine TB zone or DMU 487.

The diverse assortment of upland hardwoods and pines, lowland hardwood forests, conifer swamps, coastal marshes, fens, cobble beaches, swamps, bogs, streams and lakes provide endless opportunities for viewing birds, waterfowl, reptiles, and even insects. Thompson’s Harbor State Park and Rockport State Park are popular birding sites. Coastal fens and marshes are great areas for amateur entomologists, especially those looking for dragonflies. Migrating songbirds follow the coastline in the spring and rely on a unique food source to sustain their energy for the long flight further northward. Conifer forests along the shoreline, warmed by the spring sun, produce massive hatches of midges (a small flying insect), which the song birds

feast upon. The richness in biodiversity of the coastal regions is demonstrated in the following section on rare species.

Natural Features Inventory

Table 4.2 is the Presque Isle County Element Lists from the Natural Features Inventory. According to the Natural Features Inventory, "*The lists include all elements (species and natural communities) for which locations have been recorded in MNFI's database. Information from the database cannot provide a definitive statement on the presence, absence, or condition of the natural features in any given locality, since much of the state has not been specifically or thoroughly surveyed for their occurrence and the conditions at previously surveyed sites are constantly changing. The County Elements Lists should be used as a reference of which natural features currently or historically were recorded in the county and should be considered when developing land use plans. Included in the list are scientific name, common name, element type, federal status, and state status for each element*." Research has found Great Lakes coastal areas to be biologically rich with the high number of species and communities of special interest (rare, special concern, threatened and endangered). If extensive field surveys were conducted, it is expected a greater number of elements would be identified.

Wetlands and Woodlands

Wetlands

Wetlands are often referred to as marshes, swamps or bogs. The US Army Corps of Engineers defines wetlands as "those areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Residents of Michigan are becoming more aware of the value of wetlands. Beyond their aesthetic value, wetlands improve water quality of lakes and streams by filtering polluting nutrients, organic chemicals and toxic heavy metals. Wetlands are closely related to high groundwater tables and serve to discharge or recharge aquifers. Additionally, wetlands support wildlife, and wetland vegetation protects shorelines from erosion.

National Wetlands Inventory

The U.S. Fish and Wildlife Service developed National Wetlands Inventory (NWI) program in the 1980's. The data provide consultants, planners, and resource managers with information on wetland location and type. The purpose of this survey was not to map all wetlands and deepwater habitats, but rather, to use aerial photo interpretation techniques to produce thematic maps that show, in most cases, the larger types that can be identified by such techniques. The objective was to provide better geospatial information on wetlands than found on the USGS topo-quads. A national wetlands inventory map was compiled for Krakow Township using digital data acquired from the Center for Geographic Information, State of Michigan. **Figure 4.15** is a map depicts forested and non-forested wetlands.

Forested wetlands are the most common wetlands type. The NWI classified 18,365 acres of forested wetlands. Poorly drained, lowland areas support northern white cedar, tamarack, balsam fir, black spruce, eastern hemlock, white pine, balsam poplar, trembling aspen, paper birch, black ash, speckled alder and shrub willows. Northern white cedar dominates the wetland areas where there is good lateral water movement in organic soils and shallow soils over limestone bedrock. Lowland forests are typically located adjacent to water features and function as riparian forests and water quality buffers. The network of lowland forests, associated with

rivers and creeks, also function as wildlife corridors and the backbone of large regional ecological corridors. Lowland forests adjacent to rivers and streams may be prone to flooding during the spring snow melt, particularly when combined with heavy spring rains. The NWI identified some 1,580 acres of shrub-scrub wetlands and 422 acres of emergent wetlands. Land use planning activities should focus on protecting and preserving these limited and critical resources.

Table 4.3
Presque Isle County Threatened and Endangered Species

Scientific Name	Common Name	Type	Federal Status*	State Status**
Adlumia fungosa	Climbing fumitory	Vascular Plant		SC
Alvar	Alkaline scrub/grassland	Community		
Appalachia arcana	Secretive locust	Invertebrate		SC
Armoracia lacustris	Lake cress	Vascular Plant		T
Astragalus neglectus	Cooper's milk-vetch	Vascular Plant		SC
Buteo lineatus	Red-shouldered hawk	Bird		T
Cacalia plantaginea	Prairie indian-plantain	Vascular Plant		SC
Calypso bulbosa	Calypso or fairy-slipper	Vascular Plant		T
Carex concinna	Beauty sedge	Vascular Plant		SC
Carex richardsonii	Richardson's sedge	Vascular Plant		SC
Carex scirpoidea	Bulrush sedge	Vascular Plant		T
Cirsium hillii	Hill's thistle	Vascular Plant		SC
Cirsium pitcheri	Pitcher's thistle	Vascular Plant	LT	T
	Cobble beach	Community		
Cypripedium arietinum	Ram's head lady's-slipper	Vascular Plant		SC
Dendroica discolor	Prairie warbler	Bird		E
Devonian earth history	Geographical feature	Geologic		
Drosera anglica	English sundew	Vascular Plant		SC
Drumlin	Geographical feature	Geologic		
Eleocharis engelmannii	Engelmann's spike-rush	Vascular Plant		SC
Emydoidea blandingii	Blanding's turtle	Reptile		SC
Esker	Geographical feature	Geologic		
Gavia immer	Common loon	Bird		T
Great blue heron rookery	Great blue heron rookery	Other Element		
Great lakes marsh		Community		
Haliaeetus leucocephalus	Bald eagle	Bird	(PS:LT, PDL)	T
Incisalia henrici	Henry's elfin	Invertebrate		SC
Intermittent wetland	Infertile pond/marsh great lakes	Community		
Iris lacustris	Dwarf lake iris	Vascular Plant	LT	T
Juncus militaris	Bayonet rush	Vascular Plant		T
Karst	Geographical feature	Geologic		

Source: Michigan Natural Feature Inventory, Michigan Department of Natural Resources, Wildlife Division
*LE = Listed endangered, LT = Listed threatened, PDL = Proposed delist, PS = Partial status (federally listed in only part of its range), C = Species being considered for federal status.
** E = Endangered, T = Threatened, SC = Special concern.

Table 4.3 *Continued*				
Scientific Name	Common Name	Type	Federal Status*	State Status**
Lanius ludovicianus migrans	Migrant loggerhead shrike	Bird		E
Mesodon sayanus	Spike-lip crater	Invertebrate		SC
Northern fen	Alkaline shrub/herb fen	Community		
Notropis anogenus	Pug-nosed shiner	Fish		SC
Pandion haliaetus	Osprey	Bird		T
Pinguicula vulgaris	Butterwort	Vascular Plant		SC
Pitted outwash	Geographical feature	Geologic		
Potamogeton hillii	Hill's pondweed	Vascular Plant		T
Prosapia ignipectus	Red-legged spittlebug	Invertebrate		SC
Pterospora andromedea	Pine-drops	Vascular Plant		T
Pyrgus wyandot	Grizzled skipper	Invertebrate		SC
Rich conifer swamp		Community		
Sistrurus catenatus catenatus	Eastern Mississauga	Reptile	C	SC
Solidago houghtonii	Houghton's goldenrod	Vascular Plant	LT	T
Somatochlora hineana	Hine's emerald	Invertebrate	LE	E
Sterna hirundo	Common tern	Bird		T
Tanacetum huronense	Lake Huron tansy	Vascular Plant		T
Trimerotropis huroniana	Lake Huron locust	Invertebrate		T
Wooded dune and swale complex		Community		

Source: Michigan Natural Feature Inventory, Michigan Department of Natural Resources, Wildlife Division
*LE = Listed endangered, LT = Listed threatened, PDL = Proposed delist, PS = Partial status (federally listed in only part of its range), C = Species being considered for federal status.
** E = Endangered, T = Threatened, SC = Special concern.

Woodlands

In addition to the scenic characteristics of woodlands, forested areas provide habitat for wildlife, protect the soil from erosion and acts as a buffer from noise on heavily traveled highways. Forested lands are the predominant land cover in the Township and account for 69 percent or 26,957 acres of the Township. Upland forests cover 13,710 acres or 35 percent of the Township. Of the forested lands, aspen-birch forests comprise over one third of the upland forested lands, (8,690 acres). The aspen-birch type is quite variable in species component and depending upon forest age and soils, other tree species such as white pine, balsam fir, northern white cedar, red maple and sugar maple are mixed with the forest type. Northern hardwoods include species such as sugar maple, red maple, American beech, basswood and yellow birch. Bigtooth aspen, quaking aspen, white birch, white pine, balsam fir and red maple are the primary tree species found in the aspen-birch type. White and red pine trees are found in the pine forest category.

Lowland forests occupy slightly over 34 percent or 13,247 acres of the Township. Lowland forests grow on soils with a seasonally high water table and are often classified as wetlands. Lowland forests include lowland hardwoods like elm, black ash, red maple, balsam poplar, and quaking aspen, which are estimated to cover around 6,500 acres. Lowland conifers, such as northern white cedar, black spruce, balsam fir, white spruce and eastern tamarack are estimated to cover around 6,757 acres. It is common to find both hardwoods and conifers growing in mixed forests. **Figure 4.16** depicts the forest types according to the update of the MIRIS Land Cover/Use Data.

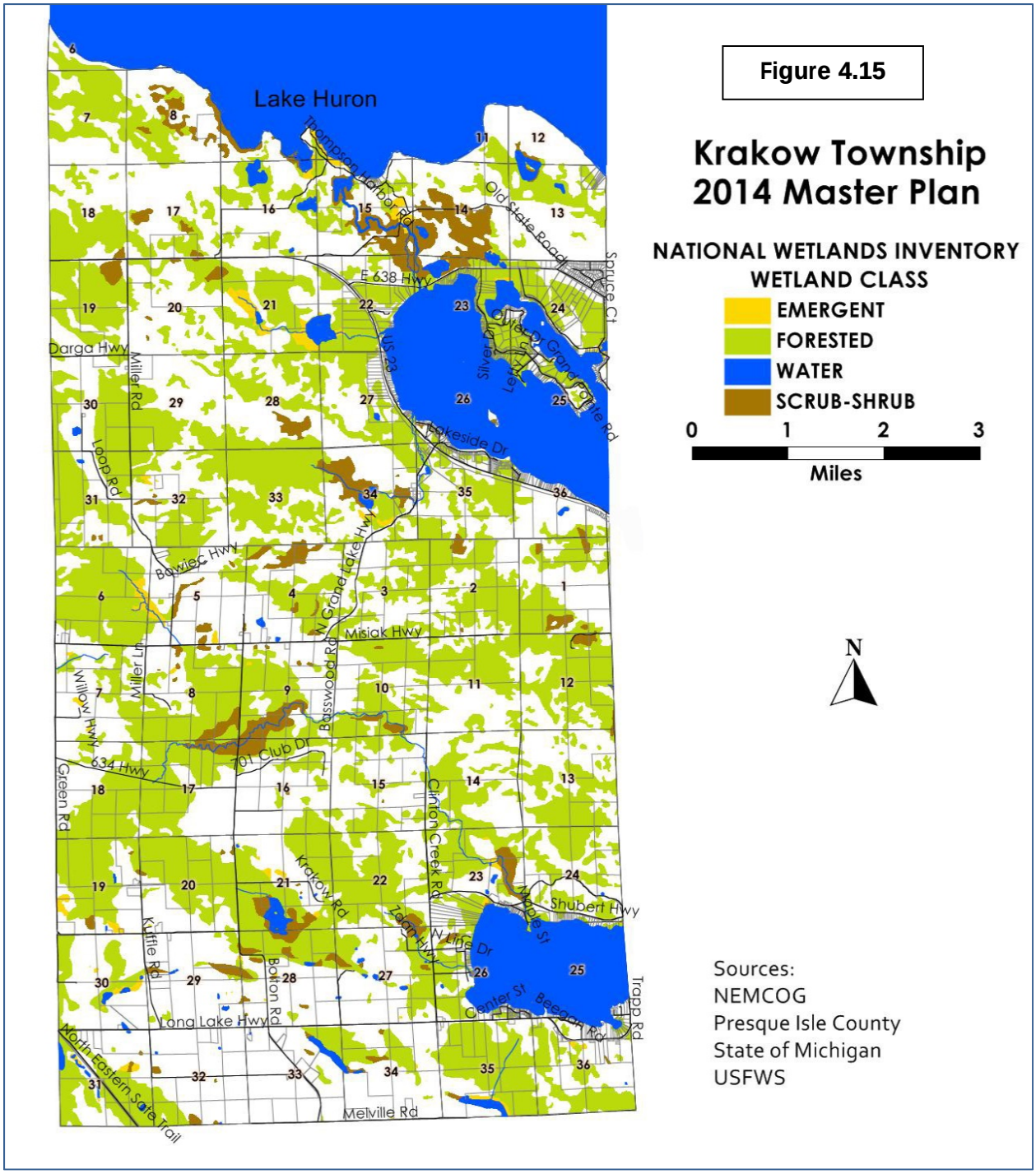
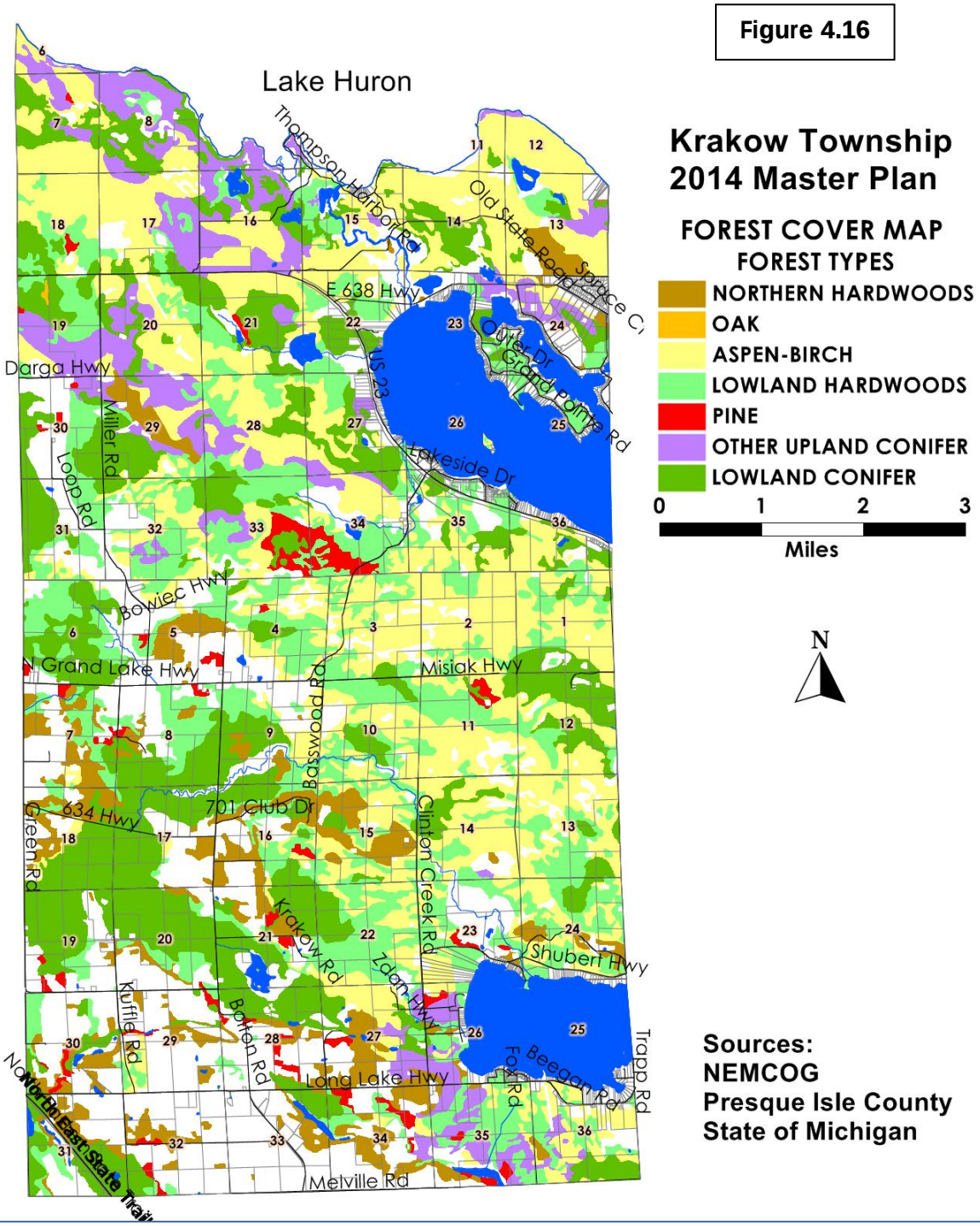


Figure 4.15
Krakow Township
2014 Master Plan
NATIONAL WETLANDS INVENTORY
WETLAND CLASS
EMERGENT
FORESTED
WATER
SCRUB-SHRUB
0 1 2 3
Miles
N
Sources:
NEMCOG
Presque Isle County
State of Michigan
USFWS
Lake Huron
Thompson Harbor Rd
Old State Road
Spruce Ct
E 638 Hwy
Darga Hwy
Miller Rd
Loop Rd
US-23
Silver Creek Trl
Clover Dr
Grand Lake Rd
Lakeside Dr
Bayview Hwy
N Grand Lake Hwy
Misiak Hwy
Miller Ln
Willow Hwy
634 Hwy
Basswood Rd
201 Club Dr
Green Rd
Clinton Creek Rd
Krakow Rd
Maple St
Shubert Hwy
Zaenz Hwy
W Line Dr
Kuffle Rd
Bolton Rd
Center St
Beegan Rd
Trapp Rd
Long Lake Hwy
North Eastern State Trail
Melville Rd

Figure 4.16


Lake Huron
Thompson Harbor Rd
Old State Road
Spruce Ct
E 638 Hwy
Outer Dr
Grand Pointe Rd
Darga Hwy
US 23
Miller Rd
Loop Rd
Lakeside Dr
Bowiec Hwy
N Grand Lake Hwy
Misiak Hwy
Bossmood Rd
634 Hwy
701 Club Dr
Green Rd
Clinton Creek Rd
Krakow Rd
Shubert Hwy
Zdan Hwy
Kuffle Rd
Bolton Rd
Long Lake Hwy
Fox Rd
Beegan Rd
Trapp Rd
Melville Rd
Krakow Township
2014 Master Plan
FOREST COVER MAP
FOREST TYPES
NORTHERN HARDWOODS
OAK
ASPEN-BIRCH
LOWLAND HARDWOODS
PINE
OTHER UPLAND CONIFER
LOWLAND CONIFER
0 1 2 3
Miles
N
Sources:
NEMCOG
Presque Isle County
State of Michigan

Pre-settlement Vegetation

The Michigan Department of Natural Resources has compiled pre-settlement vegetation maps of counties in Michigan. The maps were generated from information contained in the first government land survey notes in the 1800's along with information such as current vegetation, landforms and soils. A review of the pre-settlement vegetation map (**Figure 4.17**) of Krakow Township shows extensive areas were covered with lowland forests types of mixed conifer swamps, cedar swamps, and mixed conifer swamps. Beech-sugar maple-hemlock forests were growing on well drained sites that today support farms. White pine-red pine forests hugged the Lake Huron coastal areas on lands now part of Thompson's Harbor State Park. Another interesting feature found on the maps is the linear ridgeline of exposed bedrock that runs in a southeast direction from Section 19 to Section 27 in the northern half of the Township.

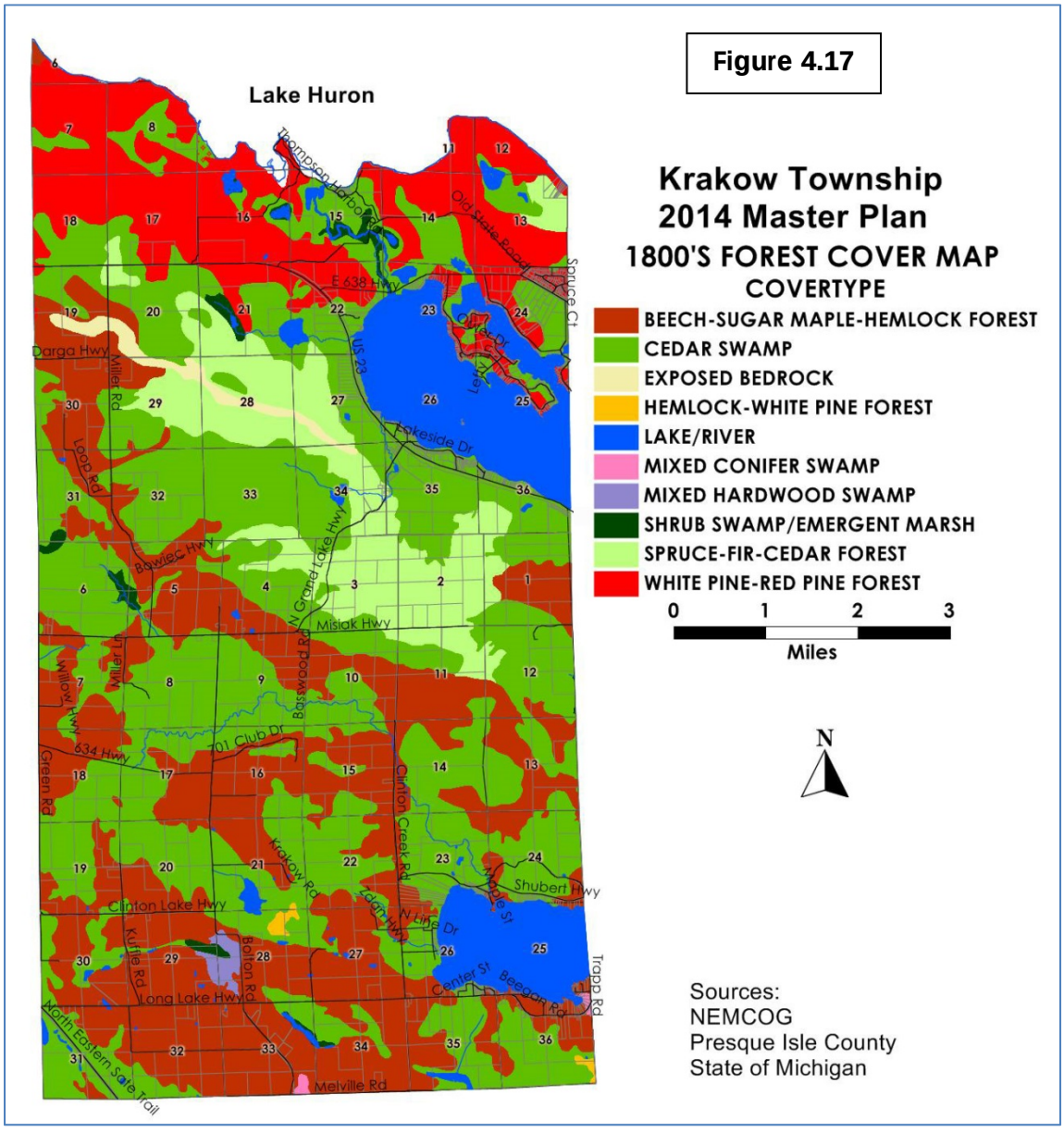
Two major events have resulted in major conversions and loss of these pre-settlement forest types. Logging and subsequent wildfires 100 years ago resulted in the shifting of forests from pines and mixed forest swamps to aspen-birch forests. In addition, early settlers sought out "better soils" to establish their farmsteads. Since northern hardwood forests (sugar maple-beech) were the dominate forest type on soils most suitable for agricultural purposes, such as sandy loam, land clearing for farming resulted in a significant reduction in the amount of acres covered by this forest type.

Sites of Environmental Contamination

The Michigan Environmental Response Act (Part 201 of PA 451 of 1994, as amended) provides for the identification, evaluation and risk assessment of sites of environmental contamination in the State. The Environmental Response Division (ERD) is charged with administering this law. A site of environmental contamination, as identified by ERD, is "a location at which contamination of soil, ground water, surface water, air or other environmental resource is confirmed, or where there is potential for contamination of resources due to site conditions, site use or management practices. A search of the Department of Environmental Quality's web site database found no sites of environmental contamination in Krakow Township.

Surface Water Discharge Permits

National Pollutant Discharge Elimination System (NPDES) permits are issued to any entity (public or private) discharging, or proposing to discharge, waste or wastewater into the surface waters of the State is required to obtain a NPDES permit. The NPDES program is intended to control direct discharge into the surface waters of the State by imposing effluent limits and other conditions necessary to meet State and federal requirements. The NPDES program regulates pollutants discharged directly into waterways from wastewater sources. A search of the DEQ database found no sight specific permits, just a general countywide permit for the Presque Isle County Road Commission, which doesn't list specific sites.



[i] Northeast Michigan Council of Governments, A Water Quality Study of 48 Lakes in Northeast Michigan, 1979.

[ii] Michigan Coastal Management Program, Filling the Gaps, Environmental Protection Options for Local Governments, K. Ardizone and M. Wyckoff, 2003.