STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

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Cheboygan River Assessment

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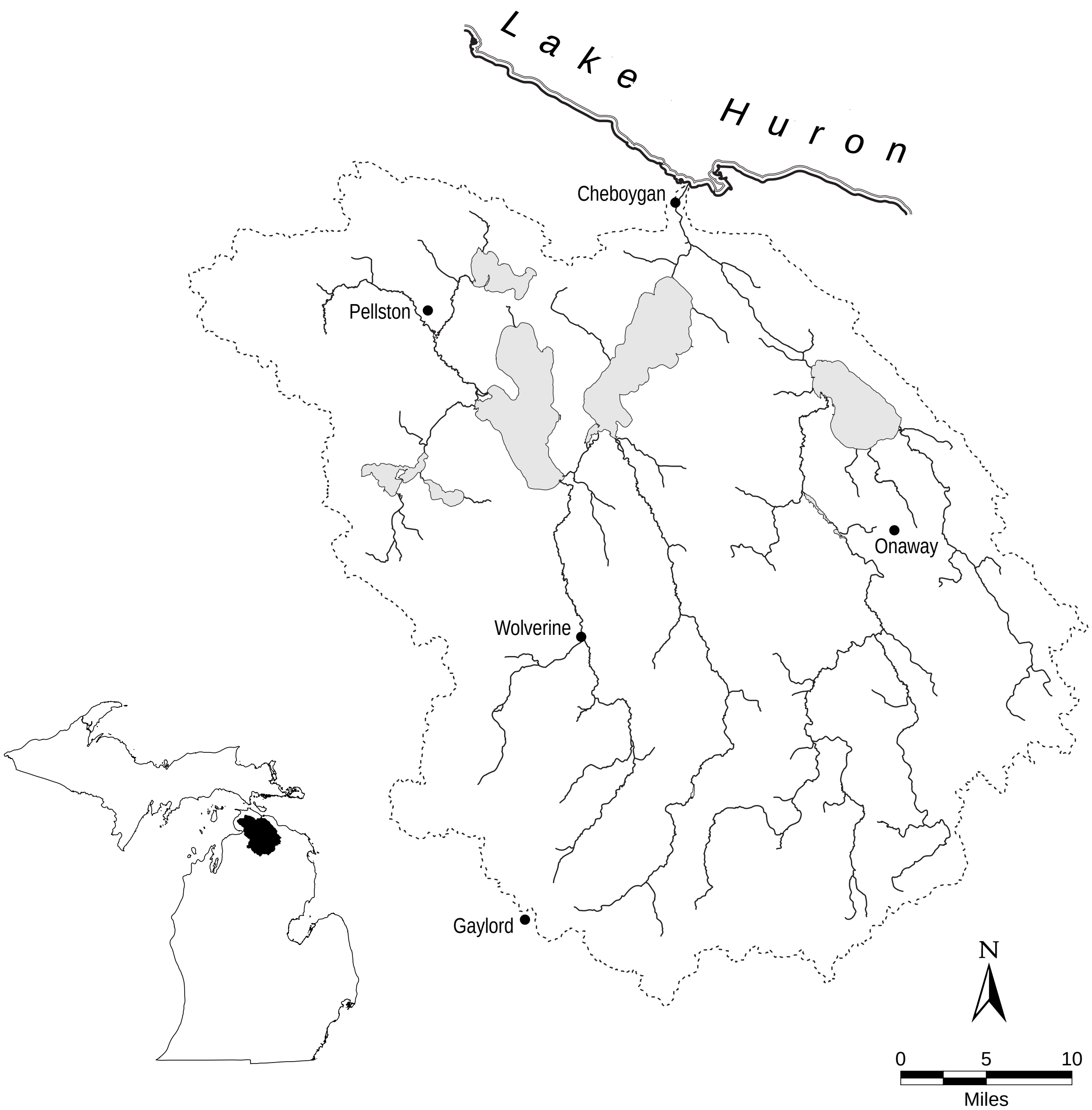

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EXECUTIVE SUMMARY

This is one of a series of river assessments being prepared by the Michigan Department of Natural Resources, Fisheries Division for Michigan rivers. This report describes the physical and biological characteristics of the Cheboygan River, discusses how human activities have influenced the river, and serves as an information base for future management of the river.

River assessments are intended to provide a comprehensive reference for citizens and agency personnel who need information about a river. By pulling together and synthesizing existing information, river assessments show the intertwined relations between the river, watershed landscapes, biological communities, and humans. These assessments will provide an approach to identifying opportunities and solving problems related to aquatic resources in the Cheboygan River watershed. We hope it will encourage citizens to become more actively involved in decision-making processes that provide sustainable benefits to the river and its users. Assessments also identify the types of information needed to better understand, manage, and protect the river.

This document consists of four parts: an introduction, a river assessment, management options, and public comments (with our responses). The river assessment is the nucleus of each report. It provides a description of the Cheboygan River and its watershed in thirteen sections: geography, history, geology, hydrology, soils and land use, channel morphology, dams and barriers, water quality, special jurisdictions, biological communities, fisheries management, recreational use, and citizen involvement.

The **Management Options** section of the report identifies a variety of actions that could be taken to protect, restore, rehabilitate, or better understand the Cheboygan River and its watershed. These management options are categorized and follow the main sections of the river assessment. They are intended to provide a foundation for public discussion, setting priorities, and planning future management activities for the watershed.

The Cheboygan River drains 1,493 square miles of the northern Lower Peninsula. Its basin comprises portions of six counties: Emmet, Cheboygan, Presque Isle, Charlevoix, Otsego, and Montmorency. The Cheboygan River is only a very small portion of the river system. For purposes of this assessment, the watershed is divided into eighteen segments, each reflecting the characteristics of the river and its tributaries as they flow across different landforms, receive tributaries, and pass through impoundments. There is a variety of stream types present from coldwater to warmwater. A multitude of lakes can be found within the watershed, including three of the largest inland lakes in Michigan. The diversity of water types leads to the incredible aquatic biodiversity of the watershed.

Much of the Cheboygan River watershed was formed during the last glaciation. Ice sheets scoured the land and deposited material in the form of moraines and other glacial features. This glacial activity determined, to a large extent, the character of our streams today. The river system, or Inland Waterway, was used by Native Americans and early settlers as a transportation and trading corridor. Later, the waterways were used to transport trees cut from the watershed during the logging era of the late 1800s and early 1900s. Instream substrate and fish cover are still recovering from those logging days. Tourism, hunting, and fishing have long been an important part of the economy in the watershed.

The geology of the Cheboygan River watershed results in high groundwater inputs to many of the tributaries, particularly in the upper (headwater) reaches. The more permeable surficial (glacial) geology types, combined with elevation changes, produce the most groundwater input. These areas typically have stable flows and colder summer water temperatures.

Groundwater inflows are directly linked to the characteristics of biotic communities in rivers because of their effects on physical habitat features including temperature, flow stability, and channel morphology. Although the groundwater loading to the Cheboygan River watershed is the highest of any watershed in Michigan, actual groundwater inflows into particular segments vary considerably due to variation in soil type (permeability) and topographical relief. Small, coldwater streams and medium coldwater rivers (such as the Sturgeon and Pigeon rivers) have higher groundwater inflow due to the presence of permeable soils and large changes in topography. The soil types and moderate to flat topography of the landscape in segments such as the East Branch Maple, Lower Black, and Cheboygan rivers lead to lower groundwater inflows in these reaches. Groundwater inflow is even less in the areas of the watershed with the lowest topographical relief, such as the Rainy River. Annual flow regimes are also variable among segments due to soil types and the surrounding landscape; daily flow regimes generally are stable, but extreme fluctuations in stream flow occur on the Pigeon River due to operation of the Golden Lotus Dam.

Soil type and slope determine potential land use, infiltration rates, water-holding capacity, and erodibility, and are therefore directly related to the amount of non-point-source pollution (such as sedimentation) in the watershed. Soils in the Cheboygan River watershed range from well-drained, sandy soils to poorly-drained organic soils. Although most of the watershed is forested with wetlands scattered throughout, anthropogenic activities such as residential and commercial growth, high levels of oil and gas development, and the accompanying road construction and maintenance contribute to increased rates of erosion and sedimentation, which can negatively affect aquatic communities.

Gradient (the general slope, or change in vertical elevation, of a river's channel) is directly related to a stream's habitat features, and accordingly, the biological community that is present. Many of the major tributaries in the Cheboygan River watershed are steep and contain some of the highest gradient in the Lower Peninsula. Such reaches generally receive higher groundwater inflow, have good to excellent hydraulic diversity, are colder, and are more likely to support coldwater fish community assemblages than the low to moderate gradient areas located within the downstream reaches of the basin.

Channel cross sections can be used to monitor the quality of fish habitat since the width of a stream channel can be influenced and modified by a number of factors. Deviations from the expected widths can indicate alterations such as direct disturbance (dredging or channelization) or changes within the watershed due to deforestation, poor agricultural land practices, and construction of road-stream crossings. Three-quarters of the measured channel widths in the watershed were within the expected range, while the remaining quarter were narrower than the expected range of values. This is not surprising given the abundance of coldwater streams in the watershed and their stable flow nature.

There are 48 dams in the Cheboygan River watershed. Dams effectively act as a barrier, disrupting natural flows, and preventing fish passage and movement of other biota. Structures other than dams can act as barriers as well, including undersized or poorly placed culverts at road-stream crossings. Some barriers are intentionally placed in rivers to preclude undesirable fish species from a reach of river; sea lamprey barriers, for instance, have become important in the control of this invasive species. Dams can also affect water temperatures, stream substrate, channel morphology, and nutrient transport.

A major consequence of these barriers is making a large amount of habitat unavailable to migratory fish species, such as steelhead, Chinook salmon, lake sturgeon, and brown trout. Production of many of these species could be greatly enhanced if they were able to access habitat upstream of dams.

Overall water quality in the Cheboygan River watershed is good. Water quality is evaluated by the Michigan Department of Environmental Quality (MDEQ) through rapid biological surveys throughout the watershed, and application of standardized water quality metrics to the survey data. Water chemistry data and fish contaminant monitoring are also important measures of water quality. The Cheboygan River watershed has relatively few point source pollutant sources. Non-point-source pollution, particularly sediment, is a threat to the watershed. Sedimentation can cover substrate suitable for fish spawning and nursery habitat, change channel shape, decrease habitat heterogeneity, and decrease invertebrate diversity and density. Airborne pollutants also are deposited in the watershed, and contribute to fish consumption advisories.

Federal, state, and local units of government are all involved, in varying capacities, with the administration of environmental regulations and the management of natural resources in the watershed. The Federal government regulates three hydroelectric facilities located on the Black River, and one facility on the Cheboygan River. Local governments are involved with planning and zoning. The state has the most environmental regulatory responsibility in the watershed—administering a wide range of regulations that includes water quality standards, Natural River zoning, and wetlands protection. In addition, thirty-six percent of the land in the watershed is under the state's ownership and is managed by the Michigan Department of Natural Resources (MDNR). In the physical sense, navigability in the watershed is partially influenced by the work of Federal and state agencies involved with waterway management. However, the legal navigability of a particular water body is largely determined by Michigan courts.

Currently, 78 fish species are known to inhabit the Cheboygan River watershed. Coldwater fish communities, typically with brook/brown trout and sculpin, are found primarily in the headwater reaches of this watershed. The remainder of the riverine portion contains a mix of coolwater and some warmwater species whose distribution is a function of the amount of water warming. Some subwatersheds such as the Maple, Sturgeon, and Pigeon have relatively cooler waters in the downstream reaches while other watersheds (Black, Rainy) are warmer in the downstream reaches. The lower reaches of the Black River and Black Lake are home to a threatened fish species, the lake sturgeon. This species can also be found in Burt and Mullett lakes.

The biological communities of the Cheboygan River watershed are affected by numerous dams. These dams serve as significant barriers to migrating fish, and fragment the biotic communities of the inland watersheds. These structures, as well as poorly designed culverts and beaver dams, can restrict the movement of important native fishes such as walleye, lake sturgeon, and brook trout and have prevented the passage of important naturalized species such as salmon, steelhead, and brown trout. It is likely that the removal of certain dams in the watershed would drastically change the dynamics of certain fish populations in this region. Such management practices would reduce the reliance on high-cost stocking programs to maintain popular trout and salmon fisheries.

Aquatic invertebrates in the watershed have been sampled by Michigan Department of Environmental Quality (MDEQ) during water quality surveys. These surveys show a diverse and abundant macroinvertebrate community in most locations sampled. Diversity and abundance scores were lower where habitat has been degraded. A variety of amphibians, reptiles, birds, and mammals inhabit the Cheboygan River watershed. Habitat loss threatens some of the rare species that have specific habitat requirements. Aquatic nuisance species such as round goby, zebra mussels, and Eurasian milfoil have also colonized parts of the watershed and compete with native species.

The Cheboygan River watershed contains a diverse array of warm, cool, and coldwater rivers, and a multitude of lake types. Due to this diversity and wealth of fishery resources, a substantial amount of fisheries management activities have occurred within the watershed. Past management activities have included fish stocking, habitat improvements, fishing regulations, chemical reclamations, and numerous fish surveys. A multitude of fish species have been stocked at various times and locations throughout the watershed. The watershed supports several blue ribbon trout streams for brook, brown, and rainbow trout, as well as fishing opportunities for cool and warmwater fish species in many inland lakes. The large lakes within the watershed, including Crooked, Pickerel, Douglas, Burt, Mullett, and Black lakes, provide great fishing opportunities for a variety of species. There are ongoing stocking efforts at various lakes in the watershed.

Recreational opportunities are abundant in the Cheboygan River watershed due to the large amount of publicly-owned land and the variety of lakes, streams, and rivers within its boundaries. Public access to these water bodies can be found throughout the watershed and includes state-owned canoe and boat launches as well as many informal, publicly-owned access points. Many water bodies may also be accessed through state forest lands and at road-stream crossings where not precluded by law. Recreational activities include fishing, biking, bird watching, berry and mushroom picking, camping, cross-country skiing, horseback riding, hunting, off-road vehicle (ORV) riding, and trapping. Four state parks and 18 state forest campgrounds exist within the watershed, most of which are located in close proximity to a river or lake.

Citizen involvement in management of the natural resources within the Cheboygan River watershed occurs primarily through interaction with government agencies that manage the resource, or involvement with nongovernmental or not-for-profit organizations that work in the area. Lake associations and sportsmen's clubs also provide an opportunity for citizen involvement at the local level. Public involvement provides the opportunity to open a dialogue on natural resources issues and promotes the exchange of experiences, ideas, and proposals among individuals, communities, interest groups, and government agencies. Numerous opportunities exist for concerned citizens to become involved in issues affecting the watershed; citizens are encouraged to take advantage of these opportunities for participation.

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Fisheries Report ##, 201#

CHEBOYGAN RIVER ASSESSMENT

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INTRODUCTION

This river assessment is one of a series of documents being prepared by the Michigan Department of Natural Resources (MDNR), Fisheries Division, for rivers in Michigan. We have approached this assessment from an ecosystem perspective, as we believe that fish communities and fisheries must be viewed as parts of a complex ecosystem. Our approach is consistent with the mission of the MDNR, Fisheries Division, namely to "protect and enhance the public trust in populations and habitat of fishes and other forms of aquatic life, and promote optimum use of these resources for benefit of the people of Michigan".

As stated in the Fisheries Division Strategic Plan, our aim is to develop a better understanding of the structure and functions of various aquatic ecosystems, to appreciate their history, and to understand changes to systems. Using this knowledge, we will identify opportunities that provide and protect sustainable aquatic benefits while maintaining, and at times rehabilitating, system structures or processes.

Healthy aquatic ecosystems have communities that are resilient to disturbance, are stable through time, and provide many important environmental functions. As system structures and processes are altered in watersheds, overall complexity decreases. This results in a simplified ecosystem that is less able to adapt to additional change. All of Michigan's rivers have lost some complexity due to human alterations in the channel and on surrounding land. Therefore, each assessment focuses on ecosystem maintenance and rehabilitation. Maintenance involves either slowing or preventing losses of ecosystem structures and processes. Rehabilitation is putting back some of the original structures or processes.

River assessments are based on ten guiding principles in the Fisheries Division Strategic Plan. These are: 1) recognize the limits on productivity in the ecosystem; 2) preserve and rehabilitate fish habitat; 3) preserve native species; 4) recognize naturalized species; 5) enhance natural reproduction of native and desirable naturalized fishes; 6) prevent the unintentional introduction of invasive species; 7) protect and enhance threatened and endangered species; 8) acknowledge the role of stocked fish;

9) adopt the genetic stock concept, that is protecting the genetic variation of fish stocks; and 10) recognize that fisheries are an important cultural heritage.

River assessments provide an organized approach to identifying opportunities and solving problems. They provide a mechanism for public involvement in management decisions, allowing citizens to learn, participate, and help direct decisions. They also provide an organized reference for Fisheries Division personnel, other agencies, and citizens who need information about a particular aspect of the river system.

The nucleus of each assessment is a description of the river and its watershed, using a standard list of important ecosystem components. These include:

Geography–a brief description of the location of the river and its watershed; a general overview of the river from its headwaters to its mouth, including topography. This section sets the scene.

History–a description of the river as seen by early settlers and a history of human uses and modifications of the river and watershed.

Geology–a description of both the surficial and bedrock geology of the area.

Hydrology–patterns of water flow, over and through a landscape. This is the key to the character of a river. River flows reflect watershed conditions and influence temperature regimes and habitat characteristics.

Soils and Land Use Patterns–soils and land use in combination with climate determine much of the hydrology and thus the channel form of a river. Changes in land use often drive change in river habitats.

Channel Morphology–the shape of a river channel: width, depth, and sinuosity. River channels are often thought of as fixed, apart from changes made by people. However, river channels are dynamic, constantly changing as they are worked on by the unending, powerful flow of water. Diversity of channel form affects habitat available to fish and other aquatic life.

Dams and Barriers–affect almost all river ecosystem functions and processes, including flow patterns, water temperature, sediment transport, animal drift and migration, and recreational opportunities.

Water Quality–includes temperature, and dissolved or suspended materials. Temperature and a variety of chemical constituents can affect aquatic life and river uses. Degraded water quality may be reflected in simplified biological communities, restrictions on river use, and reduced fishery productivity. Water quality problems may be due to point-source discharges (permitted or illegal) or to non-point-source runoff.

Special Jurisdictions–stewardship and regulatory responsibilities under which a river is managed.

Biological Communities–species present historically and today, in and near the river; we focus on fishes, however associated mussels, mammals and birds, key invertebrate animals, special concern, threatened and endangered species, and pest species are described where possible. This component is the foundation for the rest of the assessment. Maintenance of biodiversity is an important goal of natural resource management. Species occurrence, extirpation, and distribution are important clues to the character and location of habitat problems.

Fishery Management–goals are to provide diverse and sustainable game fish populations. Methods include management of fish habitat and fish populations.

Recreational Use–types and patterns of use. A healthy river system provides abundant opportunities for diverse recreational activities along its mainstem and tributaries.

Citizen Involvement–an important indication of public views of the river. Issues that citizens are involved in may indicate opportunities and problems that Fisheries Division or other agencies should address.

Throughout this assessment we use data and shape files downloaded from the Michigan Geographic Data Library (2007), maintained by the Michigan Center for Geographic Information. These data provide measures of watershed surface area for numerous categories (e.g., soil types, land use, surficial geology), measures of distance (e.g., stream lengths), and facilitatecreation of associated figures. We used Arc View GIS 3.2a or Arc GIS (Environmental Systems Research Institute, Inc.) to display and analyze these data, and create the landscape figures presented in this report. Unless otherwise referenced, all such measures and associated figures reported within the sections of this report were derived from these data.

Management options follow the river assessment sections of this report, and list alternative actions that will protect, rehabilitate, and enhance the integrity of the river system. These options are intended to provide a foundation for discussion, setting priorities, and planning the future of the river system. Identified options are consistent with the mission statement of Fisheries Division.

Copies of the draft assessment were distributed for public review beginning February 10, 2011. One public meeting was held at Tuscorora Township Hall in Indian River on February 23, 2011; 13 people attended. Written comments were received through March 11, 2011. Comments were responded to in the Public Comment and Response section.

A fisheries management plan will now be written. This plan will identify options chosen by Fisheries Division, based on our analysis and comments received. In general, a Fisheries Division management plan will focus on a shorter time, include options within the authority of Fisheries Division, and be adaptive.

Individuals who review this assessment and wish to comment should do so in writing to:

Michigan Department of Natural Resources
Fisheries Division
1732 M-32 West
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Comments received will be considered in preparing future updates of the Cheboygan River Assessment.

RIVER ASSESSMENT

Geography

The Cheboygan River drains an area of the northern Lower Peninsula encompassing 1,493 square miles (Figure 1). The watershed drains all or parts of six counties: Emmet, Charlevoix, Otsego, Montmorency, Presque Isle, and Cheboygan. The basin is approximately 37 miles wide, 44 miles long, and is composed of 68% forested, 6% agricultural, less than 2% urban land use, with the remaining 24% wetlands and surface water (NOAA 2001).

The Cheboygan River watershed is unique in Michigan in that it has many headwater reaches that flow through large lakes. The main river systems in this watershed that form the Cheboygan River include the Maple, Crooked, Sturgeon, Indian, Pigeon, Black, and Rainy rivers. The Crooked and Indian rivers are connecting waterways between large lakes whereas the other rivers have a more typical structure and primarily originate from groundwater sources. In fact, the relative groundwater loading to this watershed is the highest for any watershed in the Lower Peninsula (Gooding 1995). The larger lakes of the watershed include: Douglas, Crooked-Pickerel, Burt, Mullett, and Black lakes.

There are many rivers within the Cheboygan River watershed. The Maple River drains the northwest portion of the watershed. The West Branch Maple River drains extensive swamps while the East Branch Maple River begins as the outlet of Douglas Lake. The Crooked River is composed of a group of large lakes and small streams that drain the highlands on the western edge of the watershed. The Sturgeon, Pigeon, and Black rivers begin in the southern half of the watershed, where groundwater inflow is particularly high, and all flow in a northerly direction into Burt, Mullett, and Black lakes, respectively. The relatively short section comprising the Cheboygan River leaves Mullett Lake on the north end and flows a short distance before being joined by the lower Black River. The Cheboygan River empties into Lake Huron at the port of Cheboygan.

The character of the Cheboygan River watershed and its associated biota varies considerably throughout this region. We will discuss the Cheboygan River and its watershed (Table 1, Figure 1) using a variation of the Valley Segment Ecological Classification System described by Seelbach et al. (1997). They defined 69 valley segments within the Cheboygan River watershed that were relatively distinct in terms of geological setting, hydrology, channel morphology, and temperature regime. We pooled continuous valley segments into larger geographic units to simplify the description of the watershed. We used criteria such as confluences with tributaries and lakes, and dams to set boundaries for our larger units. Consequently, this assessment is organized around 19 segments (Figure 2). We defined three segments each for the Maple, Sturgeon, and Pigeon river watersheds, six for the Black River watershed, and one for the Cheboygan River. Segments were defined for each of the largest lakes in the watershed (Black, Burt, and Mullett) and their smaller tributaries. A more detailed discussion of each segment follows.

West Branch Maple River—Headwaters to Maple River Dam

The 16 mile long West Branch Maple River arises from the extensive Pleasantview Swamp, a 6,544-acre uninterrupted expanse of organic soils in central Emmet County (Tip of the Mitt Watershed Council 2006). This rich coniferous swamp is surrounded by hardwood ridges that direct the river flow to the north, then east, and then south. The West Branch Maple River drains 93 square miles of land. Tributaries include Brush Creek and Cold Creek. Brush Creek is the outlet of Larks Lake and the most notable tributary to the West Branch Maple River. The only population center in this catchment is the town of Pellston.

East Branch Maple River—Headwaters to Maple River Dam

The East Branch Maple River arises from Douglas Lake. Douglas Lake drains nearly 63 square miles of land near the tip of Michigan's Lower Peninsula. Three major tributaries flow into Douglas Lake and drain a 6,000-acre mosaic of wetlands, particularly along the lake's west and north shores (Fuller 2006). The East Branch Maple River flows for approximately six miles from its source to Lake Kathleen where it joins the West Branch. The East Branch Maple River flows mainly through private forested land and crosses two main roads. The only significant tributary to the East Branch is Van Creek.

Maple River—Maple River Dam to Burt Lake

The Maple River main stem begins from the confluence of the East Branch Maple River and West Branch Maple River at the Maple River Dam in eastern Emmet County near the town of Pellston. This segment begins from cascading top water at the dam and flows for approximately seven miles south through a forested riparian corridor of private and public land to Burt Lake. This river is known to carry a heavy sand bedload which helps to form a natural delta near its mouth at Burt Lake. Vast wetlands are located along the lower river reaches and Burt Lake shoreline (Fuller 2006).

Sturgeon River—Headwaters to confluence with West Branch Sturgeon River

The Sturgeon River is one of the most pristine and high gradient streams in the Lower Peninsula and is one of the largest free-flowing trout streams in Michigan. It arises from a series of springs and groundwater-fed swamps near the high ground of Gaylord, Michigan and flows over deep sandy glacial deposits and limestone bedrock (Fuller 2006). This segment drains approximately 192 square miles of land and flows in a northerly direction through a heavily forested region until it meets the West Branch Sturgeon River in the town of Wolverine. Land relief is dramatic in this segment. Most of the riparian corridor is privately owned but there are reaches of the river that flow through public forest land. Tributaries to the Sturgeon River in this segment include Mossback, Pickerel, and Stewart creeks, and Club Stream.

West Branch Sturgeon River

West Branch Sturgeon River arises from a series of upper watershed lakes in southeastern Charlevoix County and flows northeast for approximately 18 miles to its confluence with the main stem in the town of Wolverine. This segment drains approximately 30 square miles. The riparian corridor is entirely forested with a mixture of public and private land. Riparian development is more prominent along the downstream reaches of the West Branch Sturgeon River. Various small tributaries enter the stream as small springs, with the largest being Marl Creek. Lakes are relatively abundant in this catchment.

Sturgeon River—Confluence with West Branch Sturgeon River to Burt Lake

The main stem Sturgeon River flows fast and deep from the town of Wolverine to its confluence with Burt Lake. The river originally flowed into the Indian River where it deposited vast amounts of sand that became a navigational hazard. The river was redirected and now flows directly into the southeast side of Burt Lake and has a drainage area of approximately 244 square miles. Other than the West Branch, tributaries are few and include Beebe Creek. The river flows through meadows and forested corridors and is surrounded by high valley walls. Riparian ownership is primarily private, yet fair amounts of public land can also be found along the river.

Burt Lake

Burt Lake, at more than 17,000 acres, is the largest inland lake in the Cheboygan River watershed and the fourth largest inland lake in the state. Its watershed includes more than 250,000 acres and has 32 miles of shoreline (NEMCOG 1987). Major tributaries entering Burt Lake include the Little Carp, Maple, Crooked, and Sturgeon rivers. The Crooked River enters Burt Lake at the west shoreline and drains moderate sized lakes (Round, Crooked, Pickerel) and various smaller tributaries (Table 1). The Indian River leaves Burt Lake on the southeast shore and flows to neighboring Mullett Lake as part of the popular Inland Waterway. The lake's shoreline is mostly developed with private and commercial residences (Hanchin et al. 2005a). Some public land exists along the lake in the form of state forest or park.

Pigeon River—Headwaters to Golden Lotus Dam

The Pigeon River begins northeast of the town of Gaylord, Michigan and flows in a northerly direction to Mullett Lake. It is formed by an extensive series of groundwater tributaries along with the South Branch Pigeon River which keep the upper river cold throughout the year. The majority of the riparian corridor of the Pigeon River in this upper segment is under private ownership and is heavily forested. A few inland lakes exist in this segment (Table 2) including Lansing Club Pond which is an impounded portion of the river.

Pigeon River—Golden Lotus Dam to confluence with Little Pigeon River

The Pigeon River from Golden Lotus Dam to the confluence with the Little Pigeon River is approximately 15 miles long. Tributaries are few but include Cornwall, Bird Tally, and Grindstone creeks. The riparian zone is heavily forested with some meadows present. Stream velocity in these middle reaches is moderate. This river segment drains a few lakes larger than 10 acres and many smaller lakes are present.

Pigeon River—Confluence with Little Pigeon River to Mullett Lake

The lower 14 miles of the Pigeon River begin at the confluence of the Little Pigeon River and end at Mullett Lake. The Little Pigeon River is the major tributary and a source of cold water. Other waters in this segment include Wilkes Creek and various unnamed tributaries. The riparian corridor throughout this segment is heavily forested with little development. Few lakes exist in this portion of the watershed.

Mullett Lake

Mullett Lake, at just less than 17,000 acres, is the second largest inland lake in the Cheboygan River watershed and the fifth largest inland lake in Michigan. Its watershed includes more than 162,000 acres (not including Burt Lake) and has 28 miles of shoreline (Tip of the Mitt Watershed Council 2002). Major tributaries entering Mullett Lake include the Indian, Pigeon, and Little Pigeon rivers, as well as Mullett and Ballard creeks. The Indian River flows from Burt Lake for 4 miles with an elevation drop of less than one foot and enters Mullett Lake at the south end. The Little Sturgeon River and Crumley Creek are tributaries to the Indian River (Table 1; Figure 1). The Cheboygan River leaves Mullett Lake on the north shore and flows to Lake Huron to complete the Inland Waterway (Figure 1). The lake's shoreline is mostly developed and private. Few other inland lakes exist within the Mullett Lake segment (excluding Burt Lake drainage).

Black River—Headwaters to Clark Bridge Road

The Black River arises from a series of groundwater fed springs east of the town of Gaylord. The entire Black River upstream of Black Lake is commonly referred to as the Upper Black River and is 57 miles long. The river begins at an elevation of around 1,060 feet and is 800 feet above sea level at Clark Bridge Road, a distance of 28 miles downstream. This upstream segment is fed by various tributaries such as Saunders, Tubbs, Hardwood, Stewart, and Little McMasters creeks, as well as the East Branch Black River. Approximate drainage for this segment is 232 square miles (Hendrickson and Doonan 1971). The riparian corridor is heavily forested with an equal amount of public and private ownership. Only a handful of small lakes are present in the drainage (Table 2).

East Branch Black River

The East Branch Black River is the major tributary to the Upper Black River. The drainage area is 48 square miles. It arises from a vast coniferous swamp rich with groundwater flow. This wetland is known as the Green Swamp and is located north of Johannesburg, Michigan. The river flows for approximately 20 miles to the north until it meets the main stem Black River and nearly doubles in volume. Two significant tributaries include Foch and Rattlesnake creeks. The East Branch Black River flows through a heavily forested corridor of both private and public land. There is only one lake 10 acres or larger present in this area.

Black River—Clark Bridge Road to Kleber Dam

This 19 mile segment of stream begins as coldwater and ends as cool- to warmwater at Kleber Dam. Significant tributaries include McMasters, Canada, Tomahawk, Gregg, and Bowen creeks. The Black River flows through a forested corridor in this reach of private and public land. Two hydropower dams are located near the end of the segment (see **Dams and Barriers**) that effectively block upstream fish passage. Tower Dam is smaller and impounds 65-acre Tower Pond. Downstream only a small distance and at the end of this segment lies Kleber Pond Dam, which impounds 257-acre Kleber Pond. These impoundments are partially developed along their shorelines. A good number of other natural lakes and impoundments exist in this part of the watershed.

Canada Creek

Canada Creek is the second largest tributary to the upper Black River. It is a 20-mile long stream that begins from a series of lakes in northwest Montmorency County. Its drainage is 67 square miles and flows through a mixture of private and public land and has a heavily forested stream corridor. Major tributaries include Van Hetton, Montague, and Oxbow creeks. Lakes 10 acres or larger are quite common in the Canada Creek drainage.

Black River—Kleber Pond Dam to Black Lake

The Black River flows for approximately 9.5 miles from Kleber Dam to Black Lake and drains 33 square miles of land. Milligan Creek drains most of this area and flows for eight miles. The river flows through a forested corridor with steep valley walls paralleling the river for many miles. Riparian ownership is almost completely public. Five lakes 10 acres or greater occur in this Black River segment.

Black Lake

Black Lake, at more than 10,000 acres, is the third largest lake in the watershed and the tenth largest inland lake in Michigan. Its watershed includes more than 350,000 acres and has 18 miles of shoreline. The Black Lake watershed comprises 38% of the entire Cheboygan River watershed. Black Lake has a much higher watershed size to surface area ratio when compared to neighboring Mullett and Burt lakes. This means that it is much more vulnerable to nutrient enrichment (Huron Pines Resource Conservation and Development Council 2002). The lake's shoreline is mainly developed. Major tributaries which enter Black Lake include the Black and Rainy rivers, as well as Stewart, Mud, and Stony creeks. The outlet of Black Lake is the Black River, commonly referred to as the Lower Black River. The Rainy River flows for approximately 24 miles in a northerly direction and enters Black Lake on the southeast shore. A moderate number of other lakes exist in the area drained by the Black Lake segment (Table 2).

Lower Black River

The Lower Black River leaves the north shore of Black Lake, flows approximately 11 miles to its confluence with the Cheboygan River, and drains approximately 44 square miles. One large hydroelectric dam is located halfway in this segment (see **Dams and Barriers**). Major tributaries that empty into the river include Long Lake Outlet and Myers and Owens creeks. Only a small number of lakes exist within this river segment drainage (Table 2).

Cheboygan River

The Cheboygan River leaves the north shore of Mullett Lake, flows approximately 7 miles north to Lake Huron, and excluding upstream inputs, drains 10 square miles. A large dam and state-owned lock system operate on the lower reaches of this river in the town of Cheboygan. The riparian corridor is mainly developed throughout the river and industrialized in the town of Cheboygan. The major tributary to the Cheboygan River is the Lower Black River and other, smaller tributaries include Laperell Creek and a multitude of city drains and creeks.

History

The name "Cheboygan" is a Native American term meaning "through passage," referring to the Inland Waterway route (Olson and Turner 1989). The Inland Waterway route allows travel from Lake Huron, up the Cheboygan River, through Mullett Lake and Indian River. From the Indian River, one can travel through Burt Lake and up the Crooked River, to Crooked Lake. This inland route enables travel from Lake Huron to within 8 miles of Lake Michigan. The Cheboygan Lock and Dam, originally built in 1869, allowed larger commercial vessels to use the Inland Waterway.

Archaeological information for the Cheboygan River watershed has been documented at only a few sites. Late prehistoric native culture is documented in the region at the Juntunen site (on nearby Bois Blanc Island), representing the Woodland Algonquian Association (Tanner 1987). Fishing is documented in the region as early as the late Archaic period (3000-1000 B.C.), as evidenced by barbless copper fishhooks and gorges found at sites in northern Michigan (Cleland 1982). The Juntunen site shows the importance of fish to that society, which used multibarbed harpoons and copper and bone gorges between 800 A.D. and 1350 A.D. Seines or small mesh gill nets were also presumably used (Cleland 1982). McPherron (1967) describes the use of natural resources at this site as an inland fishing complex.

Much of the Cheboygan River's recent history relates to the natural resources and use of the river as a transportation corridor. The region was occupied by both the Ottawa and Ojibwa tribes, with an Ojibwa village at Cheboygan around 1810 (Tanner 1987). Fur bearing animals and the proximity to an established fur trading post (Mackinac Island) brought early European settlers to the area in the late 1770s (Olson and Turner 1989). Not only did the watershed provide abundant fur bearing animals and a means to transport them through the Inland Waterway, but Cheboygan was also close to Mackinac Island and its French fur traders (Strudley 2002).

The vast lumber resources of the region attracted permanent European settlers to the watershed during the lumbering era of the mid- to late-1800s. The area was surveyed by William Austin Burt in the early 1840s, along with deputy surveyor, John Mullett (Guth and Guth 1975). The forests and their logging potential brought permanent European settlers to Cheboygan by 1845, while Duncan City (part of present day Cheboygan) became one of the busiest ports in the Great Lakes (Olson and Turner 1989, Strudley 2002).

The village of Quick was established around the turn of the century in the Pigeon River area east of Gaylord to take advantage of that area's vast timber resources (Warner and Gilardy 1996). Quick was home to a number of logging companies but ceased to exist after the timber resources had been harvested. Vanderbilt, settled around 1880, had three saw mills, and a planing and shingle mill (Warner and Gilardy 1996). The railroad was an important means of settling the headwaters area of the watershed, as well as for transporting timber products south.

Michigan Log Marks (Michigan State College 1942) describes the logging activity in the watershed as follows:

> On the Cheboygan system of waters…, many mills and booms were built on Burt, Mullet, and Black lakes. A problem arose because of the great rapids over which that river dropped after leaving Mullet Lake. This was solved by building a lock and canal, 18 feet wide, 85 feet long, with a lift of nine feet, through which the company annually passed millions of feet of logs and lumber, besides the operating tug boats. A large sluice dam at the outlet of Black Lake took care of a like problem there, controlling the level of the lake for booming logs at the Black Lake mouth of the Upper Black.

The dams discussed above are the Cheboygan Dam and Alverno Dam (on Black River). The dams were built to allow navigation and log transport through the rapids of those areas.

Central to the logging of the region was the use of the rivers for transporting the logs. A report by the US Army Corps of Engineers (1979) indicated that the Cheboygan River, the Inland Waterway, and several of its tributaries were used for transporting logs from the lumbering regions upstream. Black River and Black Lake were used for transporting logs to the mills in the Cheboygan area. According to an 1871 report, "logs are now run for an extent of 45 miles in the Pigeon River" (quoted in USACE 1979). The Maple River and Douglas Lake also were used for transporting timber and supported a number of mills, and the Crooked River carried logs to mills in Alanson (USACE 1979). The USACE (1979) report also describes the magnitude of the logging industry in the Cheboygan River drainage and the importance of the river:

> That the Cheboygan River itself was used follows from the discussion above. A booming company operated at Cheboygan, (Rector, 1953, p. 128) and for the year 1887, the company on the Cheboygan handled 76,000,000 board feet (Maybee, 1960, p. 36). In 1893, Cheboygan reached its peak of 200,000,000 board feet of lumber and overall, more than 25,500,000,000 board feet of white pine were cut in the Cheboygan River valley (Hudgins, 1961, pp. 62-63).

Other natural resources of the region were important during the watershed's history, including fishery resources, passenger pigeon populations, and recreation and tourism.

Commercial fisheries were established in the nearshore areas of Lake Huron during the fur trading and lumbering eras (O'Neil 1977). O'Neil (1977) reports that during the peak years of the fishery, up to five refrigerated railroad cars would leave Mackinaw City daily for larger markets. The fishing industry, along with lumbering, would contribute to Cheboygan's "boomtown" status until the late 1890s (Olson and Turner 1989). A state fish hatchery was established at Oden, near Crooked Lake in 1920 to raise trout for stocking throughout the state. The facility was renovated in 2002 and is the current home of the Sturgeon River brown trout broodstock.

The Cheboygan River watershed was well known for its pigeon population; indeed, the Pigeon River and the Pigeon River Country State Forest are within the bounds of this watershed. In the late 1800s, large numbers of passenger pigeons arrived, with some colonies up to 30 miles long and 3-4 miles wide (O'Neil 1977, Franz 1985). "[Passenger pigeons] preferred cedar stands, common in the wetlands along the Sturgeon, Pigeon, and Black rivers…. Sometimes there were 90 nests in a single tree" (Franz 1985). Harvest of these birds was high, resulting in the extirpation of the species from Michigan in 1898.

The village of Cheboygan was also the transportation hub of northern Michigan, as described by Olson and Turner (1989):

> Cheboygan was the center for most all of Northern Michigan land and water transportation. The D&C boats came regularly to Cheboygan. We had a horse drawn street car running from Lincoln Ave to Duncan City. The Michigan Central Railroad (Jackson, Lansing and Saginaw division) reached Cheboygan in 1881. Five State Roads, which serviced three stagecoach lines, connected Cheboygan with the outside world.
>
> Cheboygan had as many as five steamboat lines at one time. They regularly took passengers to Mackinac Island, St. Ignace, Les Cheneaux Islands, DeTour Village, and Sault Ste. Marie. Several Inland Route ferryboats daily took freight and passengers from Cheboygan to Oden.

For many years, the Cheboygan River watershed has been a popular destination for tourists. As reported by O'Neil (1977),

> An adventuresome traveler might explore the area on a Circular Water Route trip, boarding an excursion boat at Petoskey, Harbor Springs, or Charlevoix to travel through Lake Michigan to Cheboygan. The trip then joined an Inland Water Route steamer to travel through Mullett Lake, Indian River, Burt Lake, Crooked River and finally Crooked Lake. Passengers could then board dummy trains at Conway and return to their original destinations. Less rugged visitors often chose only the Inland Water Route trip. Boats journeyed back and forth daily between Conway and Cheboygan.

The abundance of public land, inland lakes, and blue ribbon trout streams attracts many visitors to the watershed each year, and tourism continues to be an important part of the local economy.

Geology

Geology is a primary factor determining watershed character. Channel shape, drainage network density, quantity of groundwater inflow, stream temperatures, water chemistry, and the biota found in a stream are all influenced by geology (Wiley and Seelbach 1997, Bedient and Huber 1992, Wehrly et al. 2003).

Much of the Cheboygan River watershed was formed about 11,000 years ago during the Wisconsinan Glaciation, the last major glacial advance and retreat in the Great Lakes region (Farrand 1988). Glacial deposits form the surficial geology of the watershed, affecting the flow of groundwater and surface water in the watershed today (See **Hydrology**).

Surface Geology

The surficial geology of the Cheboygan River watershed was formed during the last glaciation. Glaciers deposited two main types of material when they melted: till and outwash. Deposited directly by the ice, till is unsorted and unstratified, and is typically found in several types of moraines. Outwash, on the other hand, refers to material that is sorted and stratified as it is deposited by flowing glacial meltwaters (Dorr and Eschman 1970).

The various types of surficial materials have different permeability and therefore different interactions with groundwater. The surficial geologic types in the Cheboygan River watershed, from highest permeability (and most groundwater interaction) to lowest permeability are: ice-contact terrain, coarse-textured till, dunes, glacial outwash, lacustrine sand, organic deposits, thin till over bedrock, medium-textured till, fine-textured till, and lacustrine clay (Baker et al. 2003a, b). The relative permeability of each material has a direct relationship to the groundwater inflow to a stream (see **Hydrology**).

The Cheboygan River watershed is dominated by coarse-textured glacial till (38%), glacial outwash sand and gravel and postglacial alluvium (21%), and lacustrine sand and gravel (17%) (Figure 3). The catchments associated with each segment, however, differ in their surficial geology composition (Table 3).

Headwaters of the Pigeon, Sturgeon, and Black rivers originate near Gaylord in an area characterized by steep end-moraines and ground moraines. The steep topography, combined with the high hydraulic conductivity of coarse-textured materials, result in high groundwater potential for these streams.

The upper reaches of the Sturgeon River, West Branch Sturgeon River, Pigeon River, and Black River (segments D, E, H, and L of Figure 2) are composed of 24.2%, 50.6%, 12.9%, and 16.4%, respectively, of end moraines of coarse-textured glacial till (Figure 3). Large portions of these reaches are also associated with coarse-textured till.

Lower reaches of these streams are composed of high percentages of coarse till but also include ice-contact outwash sand and gravel. The geology of the Sturgeon River, from its confluence with the West Branch Sturgeon River to Burt Lake, is composed of 52.7% ice-contact outwash sand and gravel. Lower portions of the Pigeon River are also dominated by coarse-textured glacial till.

The headwaters of the Maple River originate in coarse-textured glacial till, glacial outwash sand and gravel, and postglacial alluvium (West Branch Maple River) and coarse-textured glacial till and lacustrine sand and gravel (East Branch Maple River). The Maple River catchment is composed almost entirely of lacustrine sand and gravel (82.1%).

Bedrock Geology

Lying beneath the surficial geology is bedrock. Formations comprising the majority of bedrock within the Cheboygan River watershed include Traverse Group Reef, Antrim Shale, and Detroit River Group (Michigan Geographic Data Library 2007; Figure 4). The propensity of these rock types to contain oil and natural gas make the bedrock of this region economically important (see **Soils and Land Use**).

Karst Topography

The Cheboygan River watershed contains some unique Karst topography and land features. Karst features are formed when groundwater dissolves underlying limestone bedrock to form subterranean caves. When these caves collapse, sinkholes are formed on the surface (Dorr and Eschman 1970). There are a number of sinkhole lakes having fairly stable water levels in the Pigeon River Country State Forest (see **Fisheries Management**). Dorr and Eschman (1970) describe a sinkhole lake where water levels are not so constant:

> Rainy Lake, about ten miles southeast of Onaway, has had an especially interesting history. It apparently occupies a sinkhole depression…, the bottom drainage exit of which is usually plugged with sediment. On occasion, however, the "plug" is naturally released, allowing the lake waters to drain away underground.

Hydrology

The United States Geological Survey (USGS) collected and reported discharge records at nine gauge locations in the Cheboygan River watershed during various time periods between 1942 and 2006 (Table 4). Seven of these locations are now discontinued, while two (Sturgeon River at Wolverine and Pigeon River near Vanderbilt) are currently in operation. USGS records indicate that both of these gauges were previously operated at different sites in close proximity to their existing locations before being moved in the early 1990s.

The Sturgeon and Rainy rivers are the only reaches with data available where discharge is unaffected by dams. Mean annual discharge at these locations ranged from 26 cubic feet per second (cfs) in the Rainy River near Onaway to 216 cfs in the Sturgeon River near Wolverine, which equates to an annual runoff of 0.33 $ft^3 \cdot s^{-1} \cdot mi^{-2}$ and 1.13 $ft^3 \cdot s^{-1} \cdot mi^{-2}$, respectively. Mean annual discharge at other sites in the watershed ranged from 42 cfs in the Rainy River near Ocqueoc to 822 cfs in the Cheboygan River near Cheboygan (Table 5).

The seasonal discharge pattern for all gauge locations in the watershed is typical for streams in Michigan's Northern Lower Peninsula, even though seven of the nine sites are affected by dams. Seasonally, with few exceptions, the highest discharges occur in April and the lowest discharges in August (Table 4, Figure 5). High spring flows coincide with runoff from melting snow, while low summer flows correspond to seasonally low precipitation levels.

Base Flow and Groundwater Inflows

Although the groundwater delivery and recharge in the Cheboygan River watershed are the highest of any watershed in Michigan (Gooding 1995, Neff et al. 2005), groundwater inflows into particular segments vary considerably due to variation in geology (permeability) and topographical relief (Figure 6). Streams that flow through coarse-textured glacial deposits with high differences in elevation have higher groundwater inflows (Wiley et al. 1997), since these conditions are favorable for down-slope transport of groundwater to the river channel. Streams with high groundwater inflows have higher summer base flow and cooler summer water temperatures compared to streams with low groundwater inflow. Because of its effects on physical habitat features including temperature, flow stability, and channel morphology, groundwater inflows are directly linked to the characteristics of biotic communities in rivers (Zorn et al. 1997, 2002).

A measure of groundwater inflow to streams is low-flow yield, which is calculated by dividing the 90% exceedence flow by the drainage area of the watershed. Small, coldwater streams and medium coldwater rivers have higher groundwater inflow, and thus higher low-flow yields, than other river segments in the watershed. For example, USGS gauge data indicate that the catchment of the Sturgeon River from the headwaters to Wolverine has a low-flow yield of 0.82 $ft^3 \cdot s^{-1} \cdot mi^{-2}$, which is high compared to other similar-sized catchments in Michigan (Figure 7). This segment receives high groundwater inflows due to extensive deposits of permeable soils (glacial outwash sand, gravel, and postglacial alluvium), and large variation in elevation (see **Geology**). Low-flow yield for the Pigeon River headwaters to Lansing Club Pond, the only other coldwater segment with gauge data available, cannot be calculated due to peaking operations of the Golden Lotus Dam (see *Streamflow variability* below). However, we infer that groundwater inflows are high in this and other similar segments (Table 1), including their tributaries, due to the observed July and August water temperatures (Table 6).

The operation of dams within many of the coolwater segments within the watershed renders the USGS gauge data inappropriate for calculating low-flow yield. Low-flow yield for these segments is undoubtedly lower than that of the coldwater segments within the watershed, due in part to less permeable soil types present in segments such as the East Branch Maple, Lower Black, and Cheboygan rivers and the moderate to flat topography of the landscape. Modest groundwater inflow in portions of these segments can be inferred from the cool to cold July and August water temperatures observed for some tributaries (Table 6).

Groundwater inflow for stream reaches and tributaries located within large lake segments is variable depending upon soil type and topography. Low-flow yield for the Rainy River near Ocqueoc (within the Black Lake catchment) is extremely low (0.03 $ft^3 \cdot s^{-1} \cdot mi^{-2}$) compared to other similar sized catchments within Michigan (Figure 8). Although this reach flows through an area of considerable coarse-textured glacial till, the flat topography does not provide the hydraulic head needed to drive significant lateral movement of groundwater to the stream channel. Due to flow regulation from dams, gauge data appropriate for calculating low-flow yield are unavailable for any locations within the Burt and Mullett lake catchments. High groundwater inflow can be inferred for some tributaries within lake segments such as Berry Creek, Cedar Creek, and portions of Mullett Creek. These tributaries flow through permeable soils with considerable changes in topography and have cold summer water temperatures. Conversely, groundwater inflow for tributaries that flow through less permeable soils and flatter topography is lower as indicated by warmer observed water temperatures. Examples of these tributaries include the main stem and North Branch of the Little Pigeon River (Table 6).

Streamflow Variability

Annual Streamflows

Annual flow regime, the seasonal discharge pattern of flow over a year, strongly influences the abundance and composition of biotic communities in streams (Hynes 1970). For example, the stability, timing, and volume of stream flows influence the reproductive success of fish (Nuhfer et al. 1994; Strange et al. 1992; Bovee et al. 1994; Zorn and Nuhfer 2007a, b) as well as their abundance, growth, and survival (Coon 1987, Seelbach 1986). Streams with a stable flow regime, or uniform flow throughout the year, typically have more stable channel morphology and fish assemblages compared to streams with variable flow regimes (Leopold et al. 1964; Poff and Allan 1995). Channel morphology in streams with variable flow regimes, which experience more frequent high-flow events, is less stable because the erosive power of a stream increases in proportion to its discharge. In Michigan, streams with variable flow regimes are typically runoff (rather than groundwater) driven, warm in summer, and have high year-to-year variability in fish reproductive success.

We described annual flow stability at USGS gauged sites within the Cheboygan River watershed using the 10:90% exceedence flow ratio. The 10% exceedence flow is the discharge that is exceeded 10% of the time (i.e., high flows) and typically occurs in conjunction with peak snowmelt runoff and high precipitation levels present during March and April in northern Michigan. The 90% exceedence flow is the discharge exceeded 90% of the time (i.e., base flows) and is representative of typical summer or winter low-flow conditions. Higher 10:90% exceedence ratio values indicate flashiness, or lower flow stability.

The Sturgeon River from its headwaters to the USGS gauge at Wolverine has the most stable annual flow regime of any segment within the watershed. The 10:90% exceedence ratio at this location was 1.8, which is lower than the ratio found in other Michigan catchments of similar size (Figure 9) and comparable to the average 10:90% exceedence ratio of 1.9 for all gauged sites on the Au Sable River, a renowned trout stream (Zorn and Sendek 2001). The stable flow regime in the headwaters of the Sturgeon River is due to the high ground water inflow resulting from the permeable soils and variable topography present in this catchment.

Annual flow regimes at most other gauge locations within the watershed are also stable. The 10:90% exceedence flow ratios for sites on the Indian River, Pigeon River, Cheboygan River, and Black River near Tower ranged from 2.0 to 3.2 (Table 5), which are low compared to the ratio found in other similar-sized Michigan catchments (Figures 10-13). Permeable soils in the Pigeon River catchments, the buffering capacity of large lakes, and run-of-river operation of dams near the Cheboygan and Black river gauge locations (see **Dams and Barriers**) all contribute to stable annual flow regimes. The annual flow regime of the Black River near Cheboygan is slightly less stable than the Black River near Tower. The 10:90% exceedence flow ratio of 6.7 at this gauge is moderate compared to other catchments of similar size in Michigan (Figure 14).

In contrast to the stable annual flow regimes at most gauge locations within the Cheboygan River watershed, the 10:90% exceedence flow ratio at the two Rainy River sites is very high. Although the data set is relatively small and dated compared to other gauges, the flow regime of the Rainy River near Onaway appears to be unstable, with a 10:90% exceedence flow ratio of 64.0. More recent data collected from the Rainy River near Ocqueoc also show an unstable annual flow regime, with a 10:90% exceedence ratio of 33.3 (Table 5). This is high compared to other similar-sized catchments in Michigan (Figure 15), even those such as the River Rouge at Southfield and Lower River Rouge at Dearborn, which are influenced by urban development. Very low minimum flows in the Rainy River (Table 5) result from the flat, karst topography of the catchment (see **Geology**), and limit fisheries management potential.

Daily streamflows

USGS gauge data indicate that daily flow regimes are stable throughout most of the watershed. The exception is at the Pigeon River near Vanderbilt, where the gauge is located one mile downstream of Golden Lotus Dam (see **Dams and Barriers**). In natural systems, or impounded systems that operate at run-of-river flow, changes in daily discharge are usually gradual. However, dramatic changes in discharge occur over a very short period in impounded systems with peaking operations, where sudden releases of impounded water occur to meet increased power demands. This is the case in the

Pigeon River, where the Golden Lotus Dam at Lansing Club Pond is peaked to generate electricity for the Song of the Morning Ranch.

The peaking operation of the Golden Lotus Dam causes extreme flood and drought conditions daily, which is stressful to aquatic organisms. Alteration in daily flow regimes creates unnatural changes in the hydrological function of the river with accompanying changes in erosion, sedimentation, shape of the channel (see **Channel Morphology**), and ultimately instream habitat. High flow conditions during the time of incubation and fry emergence negatively impact survival of eggs and young fish, and reduces the density of older age classes, for salmonids such as brown trout in Michigan (Nuhfer et al. 1994, Zorn and Nuhfer 2007a, Zorn and Nuhfer 2007b) and elsewhere (Strange et al. 1992; Jensen and Johnsen 1999; Spina 2001; Cattanéo et al. 2002; Lobón-Cerviá 2004).

Zorn and Nuhfer (2007b) estimated the 50% swim-up dates for brown trout fry in several northern Michigan streams during a ten-year period (1995–2006) and found that the average date varied from mid-April to mid-May, depending upon winter severity. The time period of elevated streamflows due to increased runoff from spring snowmelt and seasonally high precipitation levels overlaps these emergence dates in Northern Michigan; thus peaking operations in the Pigeon River further exacerbate the problem of fluctuating stream flows during a time when young fry are already at risk from natural variability in discharge. For example, daily stream flows in the Pigeon River below Golden Lotus Dam fluctuated as much as 519% in a 24-hr time period during April 2006 (USGS 2007). Daily flow fluctuations in the neighboring Sturgeon River, which is unaffected by dams, were much more gradual (Figure 16). Such extreme fluctuations undoubtedly have a negative effect on the habitat quality and aquatic community (particularly salmonid populations) in the Pigeon River.

Climate

The 115 to 120-day average growing season in the Cheboygan River watershed is short compared to other climate districts in the Northern Lower Peninsula (Albert et al. 1986). Since less evapotranspiration occurs due to the shorter growing season, more rainfall can contribute to streamflow. Mean annual precipitation is about 30.3 inches, but there is considerable local variation in climatic conditions such as snowfall, rainfall, and temperature due to the watershed’s proximity to the Great Lakes, large inland lakes, and variable topography (Albert et al. 1986).

Soils and Land Use

Soils and Sedimentation

The water quality of a river is determined, in part, by soil types and slopes present within the watershed. Soil type and slope determine potential land use, infiltration rates, water-holding capacity, and erodibility, and are therefore directly related to the amount of non-point-source pollution (such as sedimentation) in the watershed (NEMCOG 2003). Soils in the Cheboygan River watershed range from well-drained, sandy soils to poorly-drained organic soils. Sand and loamy-sand soils are most common (Figure 17), and located throughout the entire watershed. Other soil types are less common and are distributed sporadically throughout the watershed (Figure 18). Detailed soil information is available from the local county Conservation District.

Natural erosion and sedimentation are inherent to a sandy watershed such as the Cheboygan, and are of less concern than extreme erosion events influenced by human activity. Historic logging activities (see **History**) dramatically increased erosion, and accordingly, sedimentation rates in the watershed. Clear-cutting forests and transporting the logs downstream to sawmills increased erosion rates and introduced tremendous amounts of sediment into river systems throughout northern Michigan. Runoff from cutover land increased due to reduced evapotranspiration by the remaining plant cover, exacerbating the problem. After the construction of hydropower dams in the watershed (see **Dams and Barriers**), peaking operations increased the discharge and erosive power of rivers and further destabilized raw stream banks, many of which continue to contribute sediment in some areas of the watershed.

In addition to diminishing water quality, excess sediment may result in reduced areas suitable for fish spawning (Alexander and Hansen 1983, Alexander and Hansen 1986), less diverse fish communities (Alexander et al. 1995), reduction of aquatic insect abundance and diversity (Alexander and Hansen 1986), and reduced recreational opportunities. To correct these problems, streambank erosion inventories have recently been conducted by local non-profit organizations, county Conservation Districts, and watershed councils to identify priority sites for repair by scoring them with a severity index based upon the size and cause of erosion. Although Best Management Practices (BMPs) such as stairways, seeding or planting banks, fencing, and rip-rap used to correct erosion problems are fairly straightforward to implement, they are costly. Costs for streambank erosion repairs at priority sites in the Maple and Sturgeon river catchments alone were estimated at $150,000 (Tip of the Mitt Watershed Council 2001).

Present activities such as residential and commercial development, oil and gas development, and the accompanying road construction and maintenance contribute to increased rates of erosion and sedimentation. Road-stream crossings are of special concern, because they provide access and a path for sediment and other pollutants to enter surface waters. There are 779 road-stream crossings in the Cheboygan River watershed (Figure 19). Similar to streambank erosion sites, local not-for-profit organizations and their partners have inventoried many of these crossings to characterize their potential to deliver sediment to the streams and rivers of the watershed. These inventories use a severity ranking index based upon the soil type, steepness of approaches, impacts to habitat, and other conditions present at each site to help determine priority sites for repair. Again, such repairs are costly; for example, repair costs to install BMPs at 127 road-stream crossings inventoried in the Black Lake catchment were estimated at nearly six million dollars (Huron Pines RC&D 2002).

Reducing erosion and sediment contributions from human development involves not only funding, but also education. Erosion and sediment control can protect aquatic resources within the watershed by minimizing erosion and off-site sedimentation through a practical combination of procedures, BMPs, and people (MDEQ 2005). Incorporation of BMPs for reducing erosion and sedimentation requires public education on the ecological and economic effects of sediment on streams; proper site planning; soil erosion prevention practices; sediment control practices; and site inspection, maintenance, and follow-up. Although incorporation of some BMPs may involve more upfront costs, they can protect a stream and save money in the long run (Zorn and Sendek 2001). Educating riparian owners about erosion and sedimentation is important, as many of the erosion sites will be on private property.

Past and Present Land Cover

Land cover in the Cheboygan River watershed has changed over the last 200 years. Historical land cover data circa 1800 (Figures 20a and 21) show the watershed was almost entirely covered by forests (75%) and wetlands (19%). Forests and wetlands still predominate today (68% and 18%, respectively), although some of the land has been converted to agriculture or urban development (Figures 20b and 22). This loss of forest and wetland is less severe than in other watersheds within the region. For example, in the neighboring Thunder Bay River watershed, wetlands comprised 34% of the watershed in 1800, but decreased to 18% by 1983, a 47% net loss (Cwalinski et al. 2006).

The distribution of current land cover types across the Cheboygan River watershed is similar to historical patterns. The majority of the watershed is forested, with wetland scattered throughout. Agriculture is also scattered throughout the entire watershed, and is most common in the Maple River, lower Cheboygan River, and Mullett Lake catchments as well as the headwaters of the Sturgeon and Pigeon rivers (Figure 22).

Land Use

Slightly more than 63% of the Cheboygan River watershed is under private ownership. The remaining public land is within state forest (94.1%), followed by general state ownership (5.7%) and state parks and hatcheries (less than 1% each, Michigan Geographic Data Library 2007). The largest parcel of public land is the Pigeon River Country State Forest, which comprise 180 square miles of southeastern Cheboygan, northeastern Otsego, and northwestern Montmorency counties.

Even though urban or developed land comprises less than 2% of the watershed (Figure 20b), it can affect aquatic resources in many ways. Hay-Chmielewski et al. (1995) noted:

> Landscape development for urban use also has dramatic effects on the aquatic environment (Leopold 1968; Booth 1991; Toffaleti and Bobrin 1991). Development noticeably increases the percentage of impervious land area, resulting in more water reaching the stream channel more quickly as surface runoff. Urban and higher-density suburban areas typically have 50-100% and 25-45% impervious surface areas, respectively (Toffaleti and Bobrin 1991). Impervious surfaces include pavement (roads and parking lots) and roofs of buildings. These have runoff coefficients 6-14 times greater than for undisturbed land (Toffaleti and Bobrin 1991). Engineered storm water runoff systems also speed surface runoff. Increased runoff causes greater peak flows, harmful to reproduction and survival of many aquatic organisms, more erosion, decreased groundwater recharge and thus base flow, increased summer temperatures, and decreased available habitat (Leopold 1968; Booth 1991). Development that brings the construction of wells reduces groundwater table levels and stream summer base flows, with a resulting increase in water temperature and decrease in available stream habitat. Following use, most of this water returns to the system as heated surface water, causing increased and more variable water temperatures.

Although the majority of the Cheboygan River watershed is currently forested, residential growth and development is expected to increase (Michigan Society of Planning Officials 1995). For example, the populations of Montmorency and Otsego counties are projected to grow by more than one-third between 2005 and 2020 (Michigan Information Center 1996). This population increase is of concern because the headwaters of the Sturgeon, Pigeon, and Black rivers are located within these two counties. The overall health of a river system is often dependent upon its headwater stream network, which plays a critical role in sediment and nutrient control as well as the hydrologic and biological processes that supply water and food for aquatic organisms. Residential or commercial development within the watershed that is concentrated in close proximity to surface waters, particularly in headwater areas, may stress aquatic systems.

Increased residential development is not solely attributable to an increase in the number of full-time residents within the watershed. The six counties within the Cheboygan River watershed (see **Geography**) are also popular locations for second homes, including summer residences and cottages, due to the natural resources and abundant recreational opportunities that are present. The number of second homes is expected to increase at least 41% in these counties between 1990 and 2020 (Michigan Society of Planning Officials 1995).

Agricultural land use also can alter the quality of aquatic resources. Intensive farming practices such as heavy applications of fertilizers, pesticides, and herbicides; high densities of livestock in pastures; and stream channelization and wetlands drainage to expand agricultural acreage intensify the degradation of aquatic communities (Wang et al. 1997). Although the total area of agricultural development within the Cheboygan River watershed is small (6%, Figure 20b), efforts to reduce nutrient inputs, sedimentation, and runoff from agricultural practices through education and the use of BMPs, particularly in headwater and tributary reaches, will help protect these sensitive areas.

Oil and Gas Development

Oil and gas development can have adverse effects within a watershed. The disturbance of soils from road construction, clearing well pads, and drilling and laying subsurface pipelines contributes to increased runoff and sedimentation. Illegal use of pipeline right-of-ways and access roads by all-terrain vehicles further exacerbates this problem. Pollution from spills of drilling fluids and cuttings, equipment lubricant, and deteriorating flow lines also threaten aquatic resources, including groundwater. In addition to these environmental concerns, noise pollution from facilities such as compression stations detracts from a peaceful outdoor experience for recreationists.

Recent efforts to minimize the adverse effects of oil and gas development have met with some success (Zorn and Sendek 2001):

> Improved techniques have been developed for drilling and laying subsurface pipelines. Replanting work areas has reduced sedimentation, but work is needed to ensure that disturbed soils are quickly re-vegetated. Problems with excess noise from facilities have been addressed with varying degrees of success. Density of future [Antrim] wells is limited to one well per 80 acres. Increased spacing of wells and use of angular drilling techniques would reduce the density of well pads and resulting sedimentation. Regulations have been passed that require on-site containment of accidental spills. Most spills from the past (20-40 years ago) have been, or are nearly, cleaned up.

There are currently 2,980 oil and gas wells within the Cheboygan River watershed (Figure 23), many of which are in the Antrim formation. The oil and gas deposits in the Cheboygan River watershed are near full development. Development is most intense and nearing capacity in the southern portion of the watershed near the headwaters of the Sturgeon, Pigeon, and Black rivers in southern Cheboygan and northern Otsego and Montmorency counties. Development is much less intense in the northern portion of the watershed, where the Antrim formation disappears and seismic information from Niagaran exploration has ruled out drilling further exploratory wells (Figure 4). Very little future development is likely to occur in this area (A. Sullivan, MDEQ Office of the Geological Survey, personal communication).

New technologies have allowed increased development of natural gas deposits in a deeper geological formation in Michigan, the Utica/Collingwood formation. The spacing for wells drilled into this formation are still under development. The Michigan Department of Environmental Quality (MDEQ) is currently collecting data from exploratory wells being drilled into the formation to determine that spacing which is the most environmentally efficient yet still effective in not causing waste of the resource. Public concerns regarding drilling for these deposits have primarily centered around the use of hydraulic fracturing, or “fracking.” Fracking is “a process used to extract natural gas by pressurizing underground wells with water and sand and chemicals to break up formations and maximize well production” (MDEQ 2011). Depending on the horizontal length of the borehole, three to six million gallons of water are used to “frack” a horizontal well drilled in the Utica/Collingwood formation. MDEQ is implementing new regulations to address public concerns regarding water withdrawal and the reporting of chemicals used in the fracking process.

Channel Morphology

Channel Gradient

Gradient is the general slope, or change in vertical elevation, of a river's channel (usually in feet per mile). The gradient of a river is directly related to its habitat features; accordingly, the biological community that is present is directly related to gradient. Zorn and Sendek (2001) summarize the importance of gradient to the hydrological and biological function of a river:

> River gradient, together with flow volume, is one of the main controlling influences on the structure of river habitat. Steeper gradients allow faster water flows with accompanying changes in depth, width, channel meandering, and sediment transport (Knighton 1984). In the glaciated Midwest, high stream gradients often occur where streams cut through end moraine deposits. When the deposits are coarse-textured (e.g., sands or gravels) and elevation changes are large, stream channels receive high inflows of groundwater (Wiley and Seelbach 1997). In this way, stream gradient is related to other important variables such as stream temperature, current velocity, bottom substrate, and flow stability, and is especially important to coldwater fishes (Zorn et al. 1997). Gradient has also been used to describe habitat requirements of cool- and warmwater fish species including smallmouth bass (Trautman 1942; Edwards et al. 1983), largemouth bass (Stuber et al. 1982), northern pike (Inskip 1982), white sucker (Twomey et al. 1984), black crappie (Edwards et al. 1982), blacknose dace (Trial et al. 1983), and creek chub (McMahon 1982).

In general, gradient decreases in a downstream direction with a commensurate increase in stream flow and corresponding decrease in sediment size (Rosgen 1996). However, as the landscape within a river's watershed changes from its headwaters to its mouth, some portions of the river drop more rapidly than others. These changes in gradient create a diversity of habitat types for fish and other aquatic life. Typical channel patterns in relation to gradient for Michigan are shown below (G. Whelan, MDNR Fisheries Division, unpublished data):

Gradient class	Value (ft/mi)	Channel characteristics
Low	0–2.9	Mostly run habitat with low hydraulic diversity
Medium	3–4.9	Some riffles with modest hydraulic diversity
High	5–9.9	Riffle-pool sequences with good hydraulic diversity
Very high	10–69.9	Well-established regular riffle-pool sequences with excellent hydraulic diversity
	70–149.9	Chute and pool habitats with only fair hydraulic diversity
	>150	Falls and rapids with poor hydraulic diversity

Hydraulic diversity refers to the variety of water velocities and depths found in a river. The best habitat offers high hydraulic diversity with a wide array of depths and velocities (e.g., pools, riffles, and runs) to support the various life stages of different species (Zorn and Sendek 2001). Fish and other life are typically most diverse and productive in those parts of a river with gradient between 10 and 69.9 feet per mile (G. Whelan, MDNR Fisheries Division, unpublished data). Such gradients are rare in most areas of Michigan because of the low relief of the landscape and because these areas were typically where dams were constructed. In the high-relief landscape of the Cheboygan River watershed, however, very high gradient reaches are fairly common.

Gradient in the Cheboygan River watershed was estimated using a geographic information system (GIS) and methods used by Brenden et al. (2006). The spatial data layers used included a digital elevation model (DEM) and the National Hydrography Dataset for streams (USGS 2000). Gradient was calculated using elevation in meters from the DEM of the upstream and downstream nodes of each stream reach in the NHD layer. This method produces a conservative estimate of gradient, and was the most efficient technique for calculating gradient across a watershed. The results are not intended for detecting fine-scale changes, as they depend upon the location of the beginning and ending nodes for each stream reach and the elevation where each node was located. For example, an impoundment may cover some higher gradient reaches of river that may not be accurately depicted using this methodology. Rather, the results are intended for broad-scale use and interpretation of gradient.

Only about 18% of the nearly 842 miles of stream and river channel in the entire Cheboygan River watershed are classified as low gradient when both tributaries and main stem river segments are considered (Table 7). Slightly less than 5% of the watershed is moderate gradient, while about 16% is high gradient. The majority of the watershed, over 62%, is classified as very high gradient (including chutes, pools, falls, and rapids), which is not surprising given the high relief of the landscape. However, the inclusion of small headwater streams in the GIS model may overestimate the amount of channel in the very high gradient classes. Nevertheless, many of the major tributaries in the Cheboygan River watershed are predominantly high-gradient or steeper (Figures 24-28). In fact, Gooding (1995) noted that the watershed contains some of the highest gradient in the Lower Peninsula. Such reaches generally receive higher groundwater inflow, have good to excellent hydraulic diversity, are colder, and are more likely to support coldwater fish assemblages than low to moderate gradient reaches within the basin.

The gradient within specific segments varies due to local topology and the position of different segments within the landscape. For example, beginning in the Maple River subwatershed the 16-mile long segment of the West Branch Maple River from its headwaters to Maple River Dam is nearly 60% low gradient, while the remainder is high gradient. The greatest hydraulic diversity in this reach occurs downstream of the segment’s origin in the Pleasantview Swamp where the river accrues groundwater as it flows downstream and ends with high gradient, high groundwater, and cold temperatures. Conversely, almost three-quarters of the 6.2-mile reach of the East Branch Maple River from its headwaters at Douglas Lake down to the Maple River Dam is very high gradient with less low-gradient habitat (low-gradient habitat is found primarily between Douglas Lake and the confluence of Van Creek). The East Branch Maple River is similar to the West Branch in that it starts as low gradient (in this case as a lake outlet) with little groundwater and warm temperatures, but also ends with high gradient, high groundwater input, and cold temperatures (Table 6). Moving further downstream, the 6.8-mile long segment of the main stem Maple River from the dam at Lake Kathleen to its mouth at Burt Lake is classified as over 50% high gradient, with the remainder of this segment classified as either medium or very high gradient (Table 8). The combination of high gradient and moderate groundwater inflows throughout this reach create high-quality coldwater habitat.

Moving east to the Sturgeon River and Burt Lake segments, the gradient in 24.6 river miles of the main stem Sturgeon River from its headwaters to the confluence with the West Branch Sturgeon River, as well as 14.1 miles from the West Branch Sturgeon River to Burt Lake, is considerable. More than 90% of both reaches are high or very high gradient. The riffle-pool sequences that are characteristic of this high-gradient habitat create good to excellent hydraulic diversity, which in combination with the high groundwater inflows contribute to exceptional coldwater habitat in these segments. Excellent hydraulic diversity and high-quality coldwater habitat are also present in the West Branch Sturgeon River, where more than 95% of the segment’s 17.8 miles are very high gradient (the only low gradient portion of this reach occurs in the vicinity of Hoffman Lake in Charlevoix County). Besides the Sturgeon River, the most notable tributary within the Burt Lake segment is the Crooked River. This 5.2 mile-long section of the Inland Waterway is low-gradient habitat that is dredged by the U.S. Army Corp of Engineers to support navigation and, therefore, has little hydraulic diversity (Table 8).

Further east in the Pigeon River and Mullet Lake segments, the mainstem Pigeon River flows for 14.3 miles from its headwaters to Golden Lotus Dam and another 15.4 miles from Golden Lotus Dam to the confluence of the Little Pigeon River. Due to the considerable relief of the landscape, the majority of both segments flow through a channel classified as either high or very high gradient with substantial groundwater inflows and good to excellent hydraulic diversity (although a small amount of this reach near Lansing Club Pond is classified as low gradient). Moving downstream, nearly two-thirds of the Pigeon River from its confluence with the Little Pigeon River to its mouth at Mullett Lake has a channel classified as very high gradient. The remainder of this 14.5-mile segment is low gradient, which occurs due to the decreasing relief of the landscape as the river approaches the "spreads" at Mullett Lake. Coldwater habitat is available in the upper portions of the segment but becomes less abundant as gradient and groundwater inflow decline in the lower portion of the river. The other major tributary in the Mullet Lake subwatershed, the 4 mile-long Indian River, is dredged by the U.S. Army Corp of Engineers to support navigation within the Inland Waterway. The Indian River drops less than one foot over its length and the entire river is classified as 100% low gradient with little hydraulic diversity (Table 8).

In the upper Black River more than 70% of the two upstream-most main stem reaches (the 28-mile long stretch of the Black River from its headwaters to Clark Bridge Road, and the 19-mile segment from Clark Bridge Road to Kleber Dam) have high or very high gradient. Groundwater inflows are high throughout most of these two segments (but not as substantial as the Sturgeon or Pigeon rivers) and create good hydraulic diversity and abundant coldwater habitat. The exception is the lower portion of the segment from Clark Bridge Road to Kleber Dam, where groundwater inflows decrease and cause in an increase in water temperature and coolwater habitat. Gradient decreases downstream, where nearly 90% of the 9.5-mile segment of the main stem Black River between Kleber Dam and Black Lake is composed of medium gradient (Table 8). Groundwater inflow throughout this entire segment is low, creating mostly coolwater habitat with modest hydraulic diversity.

The gradient of the two major tributaries in the upper Black River are somewhat different. The 20 mile-long East Branch Black River segment is classified as high or very high gradient. Groundwater inflows in the East Branch Black River are substantial and contribute to good coldwater habitat with good to excellent hydraulic diversity. In contrast, the gradient of Canada Creek is more variable. Less than 5% of this 20.4-mile segment is low gradient, while 80% of the segment is composed of medium and high gradient. The remaining portion of Canada Creek has very high gradient (Table 8). Groundwater inflows increase from upstream to downstream and are not as significant as the East Branch Black River, creating cool- to cold-water habitat with modest to good hydraulic diversity.

The most notable tributary within the lower Black River watershed (beginning in the Black Lake segment) is the Rainy River. More than 80% of the Rainy River is classified as high or very high gradient. However, groundwater inflows are very low due to the local karst geology. Thus, the Rainy River has little fishery management potential. Gradient in the Lower Black River from Black Lake to its mouth at the Cheboygan River is mostly low to moderate gradient (Table 8). There is one very high gradient reach located about two miles downstream from Black Lake, which extends downstream to the area currently impounded by Alverno Dam. Due to the proximity of Black Lake and the local geology, warmwater habitat with low to moderate hydraulic diversity is common throughout the 11-mile segment.

In the most downstream portion of the Cheboygan River watershed, the majority of the Cheboygan River from its outlet at Mullett Lake to the mouth at Lake Huron is classified as low gradient, although some moderate gradient exists (Table 8). The surrounding low-relief landscape in this segment combined with the influence of large lakes, overall watershed size, and dredging create warmwater habitat with low to modest hydraulic diversity.

Channel Cross Sections

Channel cross sections vary as a function of annual flow regime, sediment bedload, size and type of bed material (substrate), and bank materials (Rosgen 1996). Since the width of a stream channel can be influenced and modified by a number of factors such as direct disturbance (i.e., dredging or channelization) or changes within the watershed (deforestation, poor agricultural land practices, construction of road-stream crossings, etc.), channel cross sections can be used to monitor the quality of fish habitat.

Changes in width, or deviation from an expected value, often indicate disturbance or change to a river. For example, dredging, channelization, and bridge construction may artificially deepen a river by creating an overly narrow channel. Sedimentation from eroding streambanks, poor road-stream crossings, and deforestation can fill a channel, causing it to become overly wide in order to accomodate the volume of water being transported. Some changes in width occur because of characteristics inherent to the channel, such as bank or bed materials that are naturally resistant to erosion, while others occur due to human-made materials added to streambanks to provide extra stabilization. Monitoring stream width can identify where changes are occurring, or have occurred in the past.

We evaluated channel characteristics by comparing the average width of rivers within the watershed to that of similar-sized rivers using equations developed by Leopold and Maddock (1953) and Leopold and Wolman (1957). Channel widths within the Cheboygan River watershed were measured by the MDNR and the USGS while measuring stream discharge. Representative cross sections were measured when possible; every effort was made to ensure that measurements taken near road crossings were completed in a manner to avoid the constriction in flow caused by bridges or culverts.

Channel cross section and discharge were measured at 20 locations within the Cheboygan River watershed (Table 9) during low-flow periods between 2001 and 2007. We calculated expected cross-sectional width (ft) from measured discharge (cubic feet per second; CFS or ft^3/s) with the following equation:

$$\text{Log (Width)} = 0.741436 + 0.498473 * \text{Log (mean daily discharge)}.$$

We used actual (measured) discharge rather than mean daily discharge data at many of the sites because long-term data were not available. Some caution is advised when interpreting such single-point measurements because they do not incorporate the natural variability inherent to river channels.

Three-quarters of the measured channel widths in the watershed were within the expected range, while the remaining channel widths were narrower than expected. This result is not surprising given the abundance of stable-flow streams in the watershed. Comparisons of observed and expected widths for each segment are discussed below.

West Branch Maple River—Headwaters to Maple River Dam

One channel cross section was measured within the West Branch Maple River. Width at the site 200 ft upstream of Robinson Road was within the expected range at the estimated discharge (Table 9). This particular stretch of the river segment flows through a tag alder riparian zone with stable banks and a predominantly sand substrate.

East Branch Maple River—Headwaters to Maple River Dam

Width at the only cross-sectional measurement in the East Branch Maple River was well within the expected range (Table 9). The riparian zone at this site, 400 ft downstream of C64 (Mills Road), is primarily small deciduous forest, which in combination with the stable banks contributes to a stable channel.

Maple River—Maple River Dam to Burt Lake

Channel cross section data were available for one site in the Maple River located approximately 1,100 ft below the dam at Lake Kathleen. The measured width at this location was slightly narrower than expected (Table 9), which is not surprising given the proximity of the dam. The dam constricts flow and contributes to the narrow channel, which is protected from further destabilization by the vegetated banks in the forested riparian zone and the abundant gravel substrate.

Sturgeon River—Headwaters to confluence with West Branch Sturgeon River

One channel cross section was measured in this segment of the Sturgeon River in 2005. Width in a 1,000 ft stretch of river downstream of the ATV/snowmobile bridge near Trowbridge Road was narrower than expected given the estimated discharge (Table 9). Numerous bridges occur in this particular reach, including the all-terrain vehicle (ATV) / snowmobile bridge, Trowbridge Road, and I-75. The bridges constrict flow, which narrows the channel. Excessive downcutting (deepening) of the channel is prevented by the firm cobble and gravel substrate.

Sturgeon River—Confluence with West Branch Sturgeon River to Burt Lake

The USGS collects cross-sectional width measurements at the gauging station located in Wolverine, just below the confluence of the West Branch Sturgeon River and towards the upstream end of the catchment for this segment. The width of the river at this location is well within the expected range of values for the given discharge (Table 9).

West Branch Sturgeon River

Width at the only cross-sectional measurement in the West Branch Sturgeon River was within the expected range of values. The proximity of the bridge at Old 27 Highway, which is located midway through the sampling station where discharge was measured, may explain why the measured value was on the narrow end of the expected range (Table 9). The vegetated riparian zone, stable banks, and firm substrates present at this location help to stabilize the channel.

Burt Lake

Channel cross section data were available for one stream within the Burt Lake segment, the West Branch Minnehaha Creek. The width of the stream 150’ downstream of Berger Road was within the expected range of values (Table 9).

Pigeon River—Headwaters to Golden Lotus Dam

No cross-sectional data were available for the segment of the Pigeon River from its headwaters to Golden Lotus Dam. We assume that the width of the river in this reach is within the expected values due to the stable flows, forested riparian corridor, and infrequent road-stream crossings. The exception is the impounded reach of the river above the dam itself, which would cause the river (impoundment) to be wider than expected.

Pigeon River—Golden Lotus Dam to confluence with Little Pigeon River

Width was measured at three locations in this segment of the Pigeon River. Two sites were in the main stem river; the first at the USGS gauge station at Sturgeon Valley Road near Vanderbilt, 1 mile below Lansing Club Pond and at the upstream end of the catchment for this reach. The second location was at Elk Hill Campground, located approximately 3.5 miles further downstream. A third site was located in the Little Pigeon River upstream of Burls Road.

At the USGS gauge near Vanderbilt, the width of the channel was within the expected range of values for the given discharge. However, width at the Elk Hill Campground was narrower than expected (Table 9). The peaking operation of Golden Lotus Dam (see **Dams and Barriers**) causes stream flow (and accordingly, expected width) to vary widely within this reach, depending upon when discharge measurements are observed. Thus, actual width measurements likely fall above and below the expected range of values throughout the day as the water from Lansing Club Pond is released or held by the dam. These abrupt changes in flow create a disturbance that is devastating to the stream channel and aquatic community, as excessive flows can erode stream banks and increase sedimentation while extremely low flows can leave important spawning and nursery habitat high and dry.

Width at the Burls Road station was within the expected range of values (Table 9). The heavily forested riparian corridor, stable banks, and abundant woody habitat contribute to a stable channel at this site.

Pigeon River—Confluence with Little Pigeon River to Mullett Lake

Data are available for two sites within the segment from the confluence of the Little Pigeon River to Mullett Lake: at the discontinued USGS gauge station at Afton, and within the Agnes Andreae Nature Preserve, north of M-68 and directly east of Indian River. Measured cross-sectional width was within the expected range of values at Afton, but was slightly narrower than expected (Table 9) further downstream at the nature preserve where the local topography confines the channel. Coarse bed materials composed of mostly small and large cobble prevent excessive downcutting at this site.

Mullett Lake

No cross-sectional data were available for any of the small tributaries in the Mullett Lake segment. We assume that width of coldwater tributaries to Mullett Lake (such as the upper reaches of Mullett Creek) are within the expected range due to stable flows created by groundwater inflows. Other tributaries that do not receive substantial groundwater inflows may deviate from expected widths due to their flashy nature.

Black River—Headwaters to Clark Bridge Road

Channel cross sections were measured in three locations of the headwaters segment of the Black River upstream of Clark Bridge Road. The first site is referred to as the "springs area" and is located midway through the segment off of Black River Road. The second site was located off of Sids Drive in the former Blue Lakes Club, and the third was downstream of the Main River Bridge on Blue Lakes Road. The width at each site was within the expected range of values for the observed discharge (Table 9). The forested riparian zone and groundwater inflows in this segment contribute to a stable channel.

East Branch Black River

One channel cross section was measured in the East Branch Black River in 2007. Width in a reach located 1,400 ft downstream of the old railroad grade crossing near Huff Road was within the range expected (Table 9). Similar to other coldwater segments, high groundwater inflow, a forested riparian zone, stable banks, and few road-stream crossings lead to a stable channel.

Black River—Clark Bridge Road to Kleber Dam

Cross section data were not available for the segment of the Black River from Clark Bridge Road to Kleber Dam. Due to the heavily forested riparian zone (particularly in the upper reaches of this segment) we assume that the channel is relatively stable upstream of the influence of Tower and Kleber ponds.

Black River—Kleber Dam to Black Lake

The USGS collected cross-sectional width measurements at a gauge station located near Tower, just below Kleber Dam. The width of the river at this location was narrower than expected (Table 9). This is not surprising given the proximity of the dam, which constricts flow and contributes to the narrow channel.

Canada Creek

Three cross sections were measured in Canada Creek within the boundaries of the Canada Creek Ranch. Width at each location (Geodetic Road, Doty Trail, and Wilson Bridge) was within the expected range of values (Table 9).

Black Lake

No cross-sectional data were available for any of the notable tributaries in the Black Lake segment. We assume that width of tributaries within this segment, such as the Rainy River, may deviate from expected because of their flashy nature, a product of the local geology and landscape.

Black River—Lower Black River

Channel cross sections were not available for the Lower Black River. Due to flow regulation from Alverno Dam, width likely deviates from expected values.

Cheboygan River

There were no cross section data available for the main stem Cheboygan River. Given the operation of a large dam and lock system in the lower portion of this segment, and the dredging activities that occur to ensure navigability of the Inland Waterway, we assume that actual width probably is narrower than expected.

We did not directly calculate hydraulic diversity of stream channels in the Cheboygan River watershed because data available for analysis were all collected from sites where discharge was estimated. Stream cross sections used to estimate discharge were selected because they had more laminar (smooth) flow than other cross sections in the same reach. Such cross sections are very likely to have less hydraulic diversity than randomly selected cross sections and therefore are not appropriate for calculating hydraulic diversity.

Dams and Barriers

There are more than 2,500 dams in Michigan, over 300 of which are located on main stem rivers. Dams were built for a number of different reasons, including log transportation (see **History**), milling operations, hydroelectric generation, recreation, flood control, navigation, for irrigation or domestic water supply, or to hold mine tailings. State and federally-owned dams in Michigan provide water control for waterfowl and fisheries management.

Cwalinski et al. (2006) discuss issues associated with aging and deteriorating structures:

> The majority of dams in Michigan were built decades ago and many have deteriorated due to age, erosion, poor maintenance, flood damage, and poor designs (S. Hanshue, personal communication). Dams in disrepair that are not removed are at a significant risk of failure, particularly during high flow events. Hydropower dams that are no longer economical to operate for power generation are often sold to local government or community organizations interested in protecting the recreational uses or park lands associated with the impoundment. These dams are often taken on without adequate funding budgeted for structure maintenance. Maintenance and licensure can be costly. Many dams are eventually abandoned since local governments and community organizations are not financially prepared for the long-term costs associated with dam ownership.

Dams act as a barrier, disrupting natural flows, and preventing fish passage and movement of other biota. Structures other than dams can act as barriers as well, including undersized or poorly placed culverts at road-stream crossings. Some barriers are intentionally placed in rivers to preclude undesirable fish species from a reach of river; sea lamprey barriers, for instance, have become critical in the control of this invasive species.

There are 48 dams in the Cheboygan River watershed (Table 10, Figure 29). Of the 48 dams in the Cheboygan watershed, 33% are in the Black River drainage (3 dams on the main stem Black); 22% are in the Pigeon River drainage (one dam on the main stem); and 21% are in the Sturgeon River drainage (none on the main stem). Other major dams in the system include a dam on the main stem Maple River. The remaining dams are on various tributary streams. Twenty-six dams (54%) have a head of less than 6 feet, including small impoundments lacking head information; 10 have a head of 6-10 feet; 9 have a head of 11-20 feet; and 3 dams have a head of greater than 20 feet. Most of these dams do not have a large storage capacity for water: 30 dams (62.5%) have a water storage capacity of less than 100 acre-feet; 7 have a storage capacity of 100-999 acre-feet; and 11 can store over 1,000 acre-feet of water.

Dams in the Cheboygan River watershed are of varying age. All of the hydropower dams (Tower, Kleber, Alverno, Cheboygan, and Golden Lotus) were built between 1904 and 1955. Most of the dams built for recreational purposes were constructed since 1950, including a private dam built as recently as 2000 in the Black River watershed. Four dams in the watershed have a high or significant hazard rating. High hazard dams could cause loss of life (MDEQ-LWMD, unpublished data). The Golden Lotus Dam on the Pigeon River failed in 1984, releasing a pulse of sediment and water downstream (Franz 1985, Kelley v. Golden Lotus 1984, Fisheries Division files). This failure resulted in a substantial fish kill (Alexander and Ryckman 1986). An even larger fish kill occurred in conjunction with a significant release of sediment from the Golden Lotus Dam in 2008 (Nuhfer et al. 2009a). On April 5, 2010, an interim order was entered with the 46th Circuit Court calling for removal of the Golden Lotus Dam after a plan for dam removal is developed and monitoring is conducted.

In the Cheboygan River watershed, the State of Michigan regulates 16 dams that impound five or more acres and have a dam height of greater than six feet (J. Pawloski, MDEQ, personal communication). Legal lake levels have been established on two lakes in the watershed (see **Special**

Jurisdictions). The Federal Energy Regulatory Commission, with assistance from the State of Michigan, regulates four dams: Cheboygan Dam, Alverno Dam, Tower Dam, and Kleber Dam.

Effects of Dams on Ecosystems

Dams have the potential to alter hydrological, geological, and biological processes of a watershed. Dams can alter hydraulic characteristics such as width, depth, and velocity; affect temperature and dissolved oxygen; alter sediment and nutrient transport dynamics; and result in habitat alteration and fragmentation (Cushman 1985, Brooks et al. 1991, Burroughs 2007, Godby 2000, Lessard 2001, Woldt 1998).

Temperature/Dissolved Oxygen

Dams have a major influence on water temperatures. Depending on the location of the outflow mechanism and the degree of stratification in the impoundment, the downstream effect can be either warming or cooling. If the reservoir is deep enough, it will stratify like a natural lake, resulting in a warmer epilimnion (top layer) and a colder hypolimnion (bottom layer). Top-draw dams will generally result in warmer downstream water temperatures during summer months, while bottom-draw dams will generally result in cooler downstream water temperatures during summer months if the impoundment stratifies (Cushman 1985, Petts 1984, Woldt 1998).

Lessard (2001) reports that even small dams can increase downstream temperatures by more than 9°F. A significant impact of warm water discharge is that it elevates temperatures around the clock. In free-flowing rivers, water temperatures typically fall at night as the ambient temperature decreases. Below top-draw impoundments, however, there is little cooling at night, so no thermal relief is provided to downstream biota (Woldt 1998).

In the Cheboygan River watershed, dams can affect downstream water temperatures. The Maple River Dam warms the water 4-5°F, based on mean July water temperatures. Tower and Kleber Dams on the Black River have a thermal effect, enough to change the river from a cold-transitional stream above Tower Pond to a warm-transitional stream below Kleber. This thermal effect is magnified in warm summers. While this longitudinal warming of river systems is natural, the presence of the two dams accelerates that warming trend.

Another dam that changes stream temperatures is Golden Lotus Dam on the Pigeon River. In 2005, the reach of river that included the impoundment warmed 0.49°F per river mile, compared with an increase of 0.18 to 0.26°F per river mile in unimpounded reaches of the Pigeon River (MDNR Fisheries Division, unpublished data).

Flow/Substrate

Dams significantly alter a river’s flow upstream and downstream of the barrier. Dams are usually placed in high-gradient areas to capture the potential energy of the elevation change. Upstream of the dam, the water is obviously slowed, and turns a previously lotic, or flowing, system, into a lentic, or standing water, system. When water is slowed at a dam, it also drops most of the sediment that it has carried. In this manner, the impoundment acts a giant sediment trap, capturing the silts and sands that are deposited. Alverno Dam on the lower Black River is an example of a dam that impounds a previously high-gradient reach of river. Downstream of the dam, the changes to substrate can vary, depending upon the flow regime. The artificial fluctuation of flows can create highly unstable habitat (Bain et al. 1988).

Dams that operate in a peaking mode are typically hydropower dams, and operate by holding water back (ponding) when energy demand is lower, and discharging high volumes of water (peaking) when energy demand is higher. Changes in streamflow result in changes to water depth and velocity, as well as a change in the overall aquatic habitat available to fish (Bain et al. 1988). These changes can either flush finer substrate (and incubating fish eggs and fry) downstream, or dewater productive riffle areas within a stream.

Golden Lotus Dam, located on the main stem Pigeon River, is an example of a hydropower dam operating under a peaking mode. As discussed in the **Hydrology** Section of this report, monthly and seasonal flows in the Pigeon River are not inconsistent with other rivers of similar size. The unnatural flow regime becomes obvious, however, when actual flows are examined over a shorter time period. In the Pigeon River below Golden Lotus Dam, regular flow fluctuations are characteristic of a stream below a peaking dam (Figure 30, USGS unpublished data). Flow changes of 100–300% over intervals of just 6 to 12 hours are common, while flow increases of 300–480% and flow decreases of 70–90% over a 6 to 12 hour time period also occur. August 2005 saw even larger fluctuations downstream of Golden Lotus Dam: flow increased 1,100% in a day, then dropped 90% in 12 hours (Figure 31, USGS unpublished data). The nearby, unimpounded Sturgeon River increased only 290% and then dropped 3% over the same time period. The extreme fluctuations in discharge at this dam were also experienced in May 2006, when flows dropped from a peak of about 145 cfs to a low of less than 21 cfs in a six-hour time period (Figure 32, USGS unpublished data). Extreme daily flow variation of 100% downstream of Golden Lotus Dam occurs about 25% of the time whereas similar variation in daily flow occurs only about once every 2 years in the adjacent unregulated Sturgeon River.

A quote form Nuhfer et al. (2009b) summarizes the contrast in flow variation for these neighboring streams:

> MDNR's analysis of flow data collected from October 1989 through September 2007 showed that in the Pigeon River daily flow varied by over 100% about 24% of the time, or 1,388 out of 5,818 days. In the adjacent Sturgeon River, daily flow varied over 100% on only 9 days out of 5,812 days of flow records (0.15% of days). The contrast in daily flow variation between the two rivers was even more striking when MDNR examined how much higher daily maximum flows were than daily minimum flows. From October 1989 through September 2007 daily maximum flows in the Pigeon River averaged 2.2 times higher than daily minimum flows and in one instance daily maximum flow was 17.8 times higher than minimum flow. By contrast, in the Sturgeon River daily maximum flow averaged only 1.1 times higher than daily minimum flows and the most extreme difference was only 4.0 times higher than daily minimum flow during the same 18-year period from 1989 to 2007. On June 23, 2008 the daily maximum discharge of 170.7 cfs in the Pigeon River was 23.4 times higher than the daily minimum flow of 7.3 cfs. In the Sturgeon River, the maximum discharge of 225.4 cfs on June 23, 2008 was only 1.16 times higher than the minimum discharge of 195.1 cfs.

Flow changes of this magnitude can exert extremes in erosive force within the river channel. These forces also affect the biota, as discussed below in the aquatic community section. A large log, approximately 14 feet long and about 42 inches in diameter, moved approximately ¼ mile downstream in the upper Pigeon River during one high-flow event. This log was assumed to be left over from the logging era.

Walker (2008c), described siltation below Golden Lotus Dam and its likely source:

> It is probable that the… siltation is associated with the [Golden Lotus] dam and its operation. The siltation could be caused by the widely fluctuating flow regimes eroding the banks upstream of Station 10 and/or from the export of accumulated impoundment

> silts which are mobilized during periods of rapid impoundment drawdown. When the dam gates are closed, the river discharge and velocity decrease which lets the silt particles settle out. The presence of such a ubiquitous silt coating without much of the main or lateral channel area showing the typical associated thicker depositional areas suggests the silts are regularly exported during rising flows and redeposited during falling flows. During a high flow event in early August 2005, the river was opaque and dark brown… as one would expect with a large concentration of suspended silts.

Golden Lotus Dam is not regulated (licensed) by the Federal Energy Regulatory Commission (FERC). Out of concerns that the project was negatively impacting fish populations and other aquatic resources of the Pigeon River, the State of Michigan requested a FERC jurisdictional review in April 2005. FERC licenses generally require run-of-river (ROR) flow regimes, which provide more stable flows downstream. A FERC order finding that licensing of the Golden Lotus Dam was not required was issued in January 2006. This order identified the circumstances under which a non-federal hydroelectric project must be licensed. Specifically, a license is required if the project:

- is located on a navigable water of the United States;
- occupies lands of the United States;
- uses surplus water or waterpower from a government dam; or
- is located on a body of water over which Congress has Commerce Clause jurisdiction, project construction has occurred on or after August 26, 1935, and the project affects the interests of interstate or foreign commerce [Appendix A].

The order indicated that the project was not connected to an interstate grid, and that no evidence was found "to document past or present usage of the Pigeon River for navigation in interstate commerce from above and past the project site." The navigation in interstate commerce generally refers to whether the river was used to float logs during the logging era.

In February 2006, the MDNR submitted a request for rehearing of the commission's order finding licensing of the hydroelectric project was not required. In addition to correcting some factual inaccuracies in the FERC order, the request contained additional information to support the contention that Golden Lotus Dam is subject to FERC jurisdiction. The request referenced a Michigan Supreme Court case determining that the Pigeon River was deemed navigable based on floating logs 40 miles upstream of Mullet Lake; a 1910 deed for a dam at that location which specifically referenced use of the property for a dam to float timber; and a US Army Corps of Engineers report which indicates that the Pigeon River was used to float logs from its sources (USACE 1979). The request also indicated that the project was in fact connected to the interstate grid at the time of the jurisdictional review, but was allowed to disconnect from the grid for the sole purpose of avoiding jurisdiction.

FERC issued an order denying rehearing in June 2006, with a detailed response to each argument the Department made in its request. Among other items, the order indicated that it is acceptable for an operator of an unlicensed hydroelectric project to disconnect from the interstate grid to avoid jurisdiction. FERC also indicated that although a deed was issued for a dam at that location for use to float logs, no evidence was provided that indicates logs were actually floated there. The jurisdictional review correspondence is provided in Appendix A.

Other dams in the watershed are operated as ROR dams, and do not have the extreme daily flow fluctuations observed at the Golden Lotus facility. Specific flow data for these locations are not presented because flow gauges are not present on those other rivers.

Morphology

Rivers can shape landscapes through erosion, transport, and deposition of sediment (Cushman 1985). Morphology refers to the structure and form of stream and river channels including width, depth, and bottom type. By altering fluvial processes, including sediment transport and flow characteristics, fundamental changes to a river's morphology can result. Because of the large, immediate change in elevation at a dam's discharge, erosion is increased immediately downstream of dams, particularly those that operate in a peaking mode.

Nutrient Flow

Dams can also affect the flow of nutrients downstream, since they impound not just water, but hold back woody debris and other organic matter as well. Many stream ecosystems are dependant upon leaves and other coarse particulate matter for the base of the food chain. Dams may prevent downstream transport of debris, resulting in food web changes. Nutrient availability generally decreases downstream of an impoundment because production within the impoundment uses available nitrogen and phosphorous (Petts 1984).

Effects of Dams on Biota

Migration/Movement

Dams present a barrier to fish movement and fragment available habitat. When barriers are present, resident stream fish may not have access to important habitats such as overwinter refugia. Dams and other barriers can also block access to habitats important for various life stages, such as spawning and nursery habitat. Potamodromous fish populations, or those that migrate from fresh water lakes up fresh water streams to spawn, can be greatly affected by dams and perched or undersized culverts. Important potamodromous sport fish species such as lake sturgeon, Chinook salmon, and steelhead (lake-run rainbow trout) depend on coarse gravel or cobble river substrate for spawning. One reason for the threatened status of lake sturgeon is the loss of access to historic spawning grounds (Hay-Chmielewski et al. 1997).

The Cheboygan Dam is a hydroelectric facility and is the first barrier upstream from Lake Huron. Because there is a lock at the dam that enables larger vessels to use the Inland Waterway, Cheboygan Dam is not a complete barrier. Sea lamprey are able to get upstream around the dam (through the locks), so the USFWS treats the upstream waters with lampricide. The dam, however, does effectively block most fish species from passing upstream. Removal of the Cheboygan Dam would give access to the Sturgeon River watershed and much of the Pigeon River watershed, as well as some of the large lakes (Burt and Mullett). The Cheboygan Dam blocks the upstream migration of species such as lake sturgeon, walleye, Chinook salmon, white suckers, and various redhorse species. Migratory runs and potential production of these species have been severely curtailed or eliminated because of the Cheboygan Dam.

Removal of the dams in the Black River system would increase available sturgeon spawning habitat. Alverno Dam, in particular, impounds a high gradient reach known as Smith Rapids, which historically provided sturgeon spawning habitat (Hay-Chmielewski et al., 1997). Tower and Kleber dams have a negative effect on water quality, inhibit fish passage, and impound an area that would likely be suitable lake sturgeon spawning habitat.

Other major dams in the watershed are significant barriers to fish movement. The East and West Branches of the Maple River have a barrier, Maple River Dam, which isolates those streams from migrating fish populations. The Golden Lotus Dam on the Pigeon River also blocks suitable spawning and nursery habitat for potamodromous fish species.

Barriers to movement of some fish species may have desirable effects. Sea lamprey are a parasitic invasive species and barriers are an important tool for controlling lamprey populations. Lamprey barriers are low-head dams that block access to spawning grounds for sea lamprey, yet most jumping fish species are able to pass these barriers.

Aquatic Community

Dams can affect aquatic communities in a variety of ways. Water depth, current velocity, and substrate are important components of physical habitat that influence fish community composition, and all are parameters that can be affected by dams (Bain et al. 1988, Cushman 1985). Since community composition is primarily dependant upon temperature, dams that alter thermal regimes can change riverine communities. As Lessard (2001) reports,

> Increasing temperatures below impoundments resulted in lower densities of coldwater fish species, specifically brown trout, brook trout, and slimy sculpin, while fish species richness generally increased downstream…. Macroinvertebrates responded to warming with shifts in community composition below dams that significantly increase summer temperature.

An example of the shift in aquatic communities is seen at the Maple River Dam, which forms Lake Kathleen. The West Branch Maple River and the main stem contain good trout populations, and the East Branch Maple has trout at least seasonally. Lake Kathleen reportedly has a northern pike population, which can prey upon trout in the upstream coldwater areas. Dams and their impoundments also contribute warmwater and coolwater species to downstream coldwater habitat.

The Pigeon River macroinvertebrate community was assessed by the MDEQ Water Bureau in 2005 as part of that agency's water quality monitoring program. While water quality was still high downstream of the dam, a shift in the composition of the macroinvertebrate community composition was obvious to the investigator (Walker 2008c).

> …At the first road crossing downstream of the dam [Golden Lotus Dam], the macroinvertebrate community had the highest percentage of tolerant organisms (Isopoda, snails, leeches) out of all the 2005 Pigeon River [and it] was the only station which did not receive a +1 score for the percent tolerent metric. While recognizing the excellent Station 10 [Sturgeon Valley Road] macroinvertebrate metric indicates there is not a water chemistry issue at this location, the elevated numbers of tolerant organisms suggests that the overall conditions at this location are somewhat degraded. Additionally, this was the only station in the survey where Isopoda were found. Compared to the macroinvertebrate community at Station 11, the next upstream location, the Station 10 macroinvertebrate community contained fewer mayfly, stonefly, and caddisfly taxa, it had lower community percentages of mayflies and caddisflies, and it had a higher percentage of air breathing taxa. Additionally, organisms in the taxon Mollusca showed a notable increase at Station 10 compared to Station 11. It is not uncommon below lake or impoundment outflows to find increased numbers of macroinvertebrate community taxa, including increased numbers of Mollusca, below lake or impoundment outlets.

The impact of peaking flow regimes on rivers is even more pronounced. High flows can flush fish eggs, juvenile fish, and invertebrates downstream, while low flows can strand fish and invertebrates in pools, or completely dewater productive riffle habitats. The pools associated with dewatering usually have dissolved oxygen levels that are greatly reduced. Downstream of Golden Lotus Dam, steelhead redds are dewatered at 51.7 cfs (MDNR, unpublished data); flows have been documented as low as 20 cfs there (Figure 32). Peaking operations can result in lower biotic productivity downstream (Cushman 1985). Not only are fish communities affected by peaking operations, but the diversity, density, and type of macroinvertebrate communities are also diminished or changed downstream (Cushman 1985). Gislason (1985) reported that abundance of benthic insects was 1.8-59 times higher under a stable flow pattern compared to abundance in the same river when hydroelectric power peaking induced large daily flow fluctuations.

Dam Removal

Removal of the Cheboygan Dam on the main stem; Alverno, Kleber, and Tower Dams on the Black River; Maple River Dam; and Golden Lotus Dam on the Pigeon River would open a significant amount of spawning and nursery habitat to migratory fish species, and has the potential to increase production of Chinook salmon and steelhead smolts.

The potential increased production of potamodromous species illustrates the benefits that restoring connectivity to the Great Lakes could provide. Removing all dams within the watershed is unrealistic, however, and may not be desirable from a fisheries management perspective. Fisheries Division Policy on Dams and Barriers (Policy Number 02.01.002; April 2005) states that “dam removal will be considered where the dam serves little or no purpose and there is a reasonable expectation that dam removal will benefit the environment or aquatic resources. If the dam is likely to cause significant damage to public health, safety, welfare, property, natural resources, or the public trust in those natural resources, Fisheries Division will recommend that MDEQ order its removal.” The policy also identifies that some dams function as a sea lamprey barrier or serve other fisheries management objectives. Removal may not be the preferred option for dams that are functional sea lamprey barriers or serve other fisheries management objectives. For example, the Cheboygan Dam is considered a barrier to the movement of viral hemorrhagic septicemia (VHS), a fish disease that has been documented in Lake Huron. Because of the Cheboygan Dam, waters upstream of the dam are considered somewhat protected from the transport of the disease by fish movement.

The Cheboygan Dam also helps Fisheries Division with management of certain species within the watershed. The Sturgeon River, for instance, is a premier brown trout stream. The Sturgeon River also serves as a broodstock source for the Sturgeon River strain of brown trout reared in MDNR fish hatcheries (see **Fisheries Management**). The Cheboygan Dam limits migration of Lake Huron steelhead and salmon, which may have adverse effects on brown trout to age-1 (A. Nuhfer, MDNR, personal communication). Because of the locks, however, the Cheboygan Dam it is not a complete barrier. Sea lamprey and an occasional salmon are found upstream in the Cheboygan River.

Golden Lotus Dam on the Pigeon River blocks the upstream migration of brown trout and steelhead from Mullet Lake. Its peaking flow regime results in numerous impacts to the river and its biota, as described previously. Dam removal would alleviate these problems. Alternate scenarios such as switching to run-of-river (ROR) flow regime and providing fish passage would also improve conditions. Bringing the Golden Lotus Dam under FERC regulation would address some of these concerns through license conditions and 401 water quality certification requirements (see **Special Jurisdictions**). As discussed earlier, on April 5, 2010, an interim order was entered with the 46th Circuit Court calling for removal of the Golden Lotus Dam after a plan for dam removal is developed and monitoring is conducted.

Maple River Dam fragments the Maple River system, blocking upstream migration of brown trout from Burt Lake, and increasing downstream water temperatures. It also provides a lentic environment for predators such as northern pike, which may in turn prey on trout. Although Maple River temperatures downstream of Lake Kathleen are relatively cool, temperatures may be further reduced by installing a bottom draw discharge on the dam. A fish ladder could be used to provide passage for migratory brown trout from Burt Lake, but probably would not be effective for non-salmonids. Dam removal would also accomplish these goals while restoring natural flows to the system. The Maple River Dam currently serves as a sea lamprey barrier, and this management concern must be considered in any structural change to the dam. Threatened and endangered species such as the Michigan monkey flower also are present in this area, so their protection must be considered as well (see **Biological Communities**).

Water Quality

General Water Quality, Point- and Non-point-source Issues

Water quality in the Cheboygan River watershed is affected by point- and non-point-source inflows and atmospheric deposition. Overall water quality within the basin is generally good, as determined by the criteria described below.

Point-source pollutants from sources such as factories and wastewater treatment plants reach the river from designated outfalls or discharge points. These point-source discharges are regulated by National Pollution Discharge Elimination System (NPDES) permits. The MDEQ, Water Bureau, has federally regulated authority to administer the NPDES permit program in Michigan. There are 30 NPDES permits in the Cheboygan River watershed, of which 7 are wastewater treatment permits, 7 are general permits, 15 are industrial storm water permits, and one is a construction site permit (Table 11). Wastewater permits cover discharges from treatment facilities and are based on the technology used in treatment, while general permits are standard permits for activities such as sand and gravel mining, hydrocarbon cleanups, and noncontact cooling water discharges. Storm water and construction site permits require that water pollution prevention plans be submitted by the facility and tend to focus more on site management and prevention than point-source treatment (R. Shoemaker, MDEQ-WB, personal communication).

Non-point-source pollutants—including nutrients, sediments, and pesticides—reach water bodies through erosion and runoff. Poorly designed road-stream crossings and eroding stream banks can be primary inputs of these pollutants. Inventories of road-stream crossing and eroding stream banks for many parts of the watershed have been conducted by various groups (see **Soils and Land Use**). Although correcting some of these road-stream crossings and eroding stream bank issues is straightforward, it is very costly when examined on a watershed-wide basis.

Air transport from distant sources also contributes pollutants to the watershed. The pollutants from local and distant sources may be deposited via precipitation in the Cheboygan River watershed and Lake Huron. Mercury is an example of a non-point-source type of pollutant that can affect distant areas through air transport and deposition.

Although water quality in the Cheboygan River watershed is generally good, some measures do indicate that certain water quality standards are not being met. Based on elevated PCB levels found in water chemistry samples near the river mouth, MDEQ reported that the Cheboygan River watershed did not attain Michigan water quality standards, as discussed below (Edly and Wuycheck 2006). Fish consumption advisories are one measure of water quality standard attainment or nonattainment. Lake Huron has fish consumption advisories for some fish species based on PCBs and dioxin. Additionally, several lakes within the Cheboygan River drainage do not meet water quality standards, as discussed below.

Measures of Water Quality

MDEQ Procedure 51 Monitoring

Michigan Department of Environmental Quality, Water Bureau surveyed the Cheboygan River watershed streams most recently in 2005, as detailed in a series of reports (Walker 2008a, 2008b, 2008c, 2008d). These stream surveys were conducted using the Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers (Procedure 51, MDEQ 1997). Macroinvertebrate communities, habitat quality, and water quality were evaluated. Assessment and sampling activities were conducted at a total of 66 stations in the Cheboygan watershed in 2005, while reconnaissance observations and notes were made at an additional 86 locations.

Walker (2008a, 2008b, 2008c, 2008d) reported that all assessed streams within the Cheboygan River watershed were supporting the “Other Indigenous Aquatic Life and Wildlife” designated use, and were generally high quality waters. Macroinvertebrate community composition was assessed at 38 sites, and the macroinvertebrate community at 31 sites rated “excellent,” while the other 7 sites rated “acceptable.” Each site had between 20 and 40 taxa, or groups of macroinvertebrates. Some macroinvertebrates (mayflies, stoneflies, and caddisflies) are important indicators of water quality because they have a long life history and are intolerant of stressors such as toxicants and/or low dissolved oxygen. These three orders of insects are often grouped together and termed EPT, an acronym for the names used as part of their scientific classification (mayflies-Ephemeroptera, stoneflies-Plecoptera, caddisflies-Trichoptera). At the surveyed locations, EPT taxa comprised 23-60% of the total number of taxa found at each site (Table 12; see **Biological Communities**).

Walker also noted that in several instances the instream habitat quality was lower than that of the overall habitat quality rating, because of less than optimal in-stream conditions. This was typically the result of excessive sediment (sand or silt) deposition, or limited hard substrate and cover due to a high degree of embeddedness (i.e., the extent to which gravel and cobble are buried by finer sediments).

Water Chemistry

Water chemistry samples were also collected at selected locations during the 2005 biosurvey. Water chemistry data were generally consistent with the macroinvertebrate community findings and indicated high-quality waters.

Milligan Creek had an elevated total copper concentration (150 ug/l) in one sample, but an excellent macroinvertebrate community was present at that location. Potential explanations for the elevated copper concentration include sample contamination or a brief spike in copper levels from an unknown source (Walker 2008a). Walker (2008a) also found elevated levels of sodium, chloride, and potassium in Bowen Creek, near the town of Onaway.

Increased nutrients, sodium, and chlorides were observed in Mullet Creek, suggesting potential anthropogenic sources such as livestock, residences, oil and gas operations, and/or road brining or salting (Walker 2008b).

Slightly elevated levels of chloride, hardness, nitrite/nitrate, iron, and conductivity were found in the upper-most part of the Pigeon River watershed (Walker 2008c). Concentrations of these parameters also increased in an upstream direction in the Sturgeon River watershed (Walker 2008d). Some of the increased levels in the headwaters region of the watershed are likely due to land use activities. These headwater regions contain the City of Gaylord and are the most heavily developed areas of the watershed.

Michigan Department of Environmental Quality, Water Bureau also administers a water chemistry program for trend monitoring purposes. A trend site is located near the mouth of the Cheboygan River watershed, at the Lincoln Avenue crossing of the Cheboygan River in the City of Cheboygan. Parameters measured include nutrients and conventionals; base/neutral organics; methyl tert-butyl ether (MTBE); benzene, toluene, ethylbenzene, and xylene (BTEX); mercury and trace metals; and polychlorinated biphenyls (PCBs) (Aiello 2006). Water samples from this site are analyzed at least 4 times annually. In 2004, the Cheboygan River ranked lowest for median concentration of total lead (Pb) and for median total suspended solids. All samples for total mercury (Hg) and trace metals met the applicable Rule 57 Water Quality values (Aiello 2006), and therefore met water quality standards.

Samples collected from the Cheboygan River at Lincoln Avenue as part of the trend monitoring program had elevated PCB concentrations. Although one sample met the Rule 57 water quality value, others samples did not meet that standard. MDEQ listing criteria for nonattainment of water quality standards indicate that a sample size of 1 is sufficient information to determine water quality standard nonattainment for PCBs (Edly and Wuycheck 2006). Elevated PCB levels were not unique to the Cheboygan River, as high PCB levels were ubiquitous in the trend monitoring program, with 99% of the samples collected statewide from 2002–2004 exceeding the PCB Rule 57 water quality value of 0.026 ng/L. “Because the industrial use of PCBs has been banned, the primary sources of PCBs to water likely are historical sediment contamination and on-going atmospheric deposition” (Edly and Wuycheck 2006).

Temperature and Dissolved Oxygen Issues

Temperature and dissolved oxygen concentrations in the Cheboygan River are influenced by the 48 dams in the system. Dams can increase water temperature and decrease dissolved oxygen concentrations (see **Dams and Barriers**). Because they impound coldwater reaches of the Black River, temperature and dissolved oxygen have been issues at the Tower and Kleber dams (Kyle Kruger, MDNR, personal communication).

Fish Contaminant Monitoring

Michigan Department of Environmental Quality also monitors chemical contaminants in fish from waters throughout the State of Michigan. These data are evaluated by MDEQ and the Michigan Department of Community Health (MDCH). MDCH then issues appropriate fish consumption advisories on a species and water body basis. From a human safety standpoint, mercury is the most important contaminant in the Cheboygan River watershed.

Zorn and Sendek (2001) summarized the effects that mercury can have on humans:

> Mercury is highly toxic to aquatic organisms and very persistent in the environment. The methyl form of mercury is most common in fish, and bioconcentration factors from water to fish range between 1,800 and 85,000 (O’Neal 1997). Long-term ingestion of mercury-contaminated fish can produce symptoms such as numbness of extremities, tremors, spasms, personality and behavior changes, difficulty in walking, deafness, blindness, and death. Mercury levels in Michigan fish tend to be higher in larger, fattier fishes of inland lakes than fishes in streams (Michigan Department of Community Health 1998).”

Mercury can enter water bodies from point-source discharges, non-point-source runoff, or atmospheric deposition. Annual mercury discharge to Michigan’s surface waters is approximately 490 pounds (MDEQ 2008). Atmospheric emissions of mercury in Michigan total approximately 7,000 pounds per year (MDEQ 2008). Most of these emissions are deposited within 622 miles of the sources. Most of the air emissions of mercury in Michigan in 2002 came from coal combustion (37%), volatilization during solid waste collection and processing (12%), cement manufacturing (10%), mercury-containing products (6%), blast/basic oxygen furnace steel manufacturing (5%), and natural gas combustion (5%). Michigan land (waste) releases total approximately 900 pounds per year. Mercury sources include dental amalgam, switches and relays (including thermostats), measurement and control devices (including thermometers), and fluorescent lights (MDEQ 2008).

A general fish consumption advisory exists for all Michigan inland lakes (Michigan Department of Community Health 2007) due to the likelihood that top predators have elevated levels of mercury (J. Bohr, MDEQ-Water Bureau, personal communication). A number of lakes within the Cheboygan River watershed were specifically identified as exceeding standards because mercury concentrations have been tested specifically for fish from those lakes. Burt, Crooked, Mullett, and Pickerel lakes were identified in a report to the EPA as not meeting water quality standards because of high mercury concentrations found in fish from those lakes. For these lakes, "at least one of the fish species [tested] exceeds the acceptable concentration of 0.35 ppm [of mercury], the concentration not expected to pose a health concern to people consuming 15 grams of fish per day" (Edly and Wuycheck 2006).

Stream Classification

In 1967, the MDNR Fisheries Division classified streams throughout the state based on temperature, habitat quality, size, and riparian development. River classification assists with establishing water quality standards for Michigan streams; assessing stream recreation values; designating "wild and scenic" rivers; administering stream frontage improvement and preservation; identifying dam and impoundment problems; administering fishing and boating access; targeting fishing regulations; determining designated trout streams; and guiding riparian land acquisition. Most of the Cheboygan River system is classified as top-quality cold water based on this classification scheme (Figure 33). Top-quality cold water (trout water) is defined as having good self-sustaining trout or salmon populations. Second-quality cold water is defined as having significant trout or salmon populations, which may be appreciably limited by such factors as inadequate natural reproduction, competition, siltation, or pollution (Anonymous 2000).

In 2008, Fisheries Division developed a new classification system for Michigan streams, based on average July water temperatures and fish community composition. Most of the streams in the Cheboygan River watershed are classified as "cold" (Figure 34). The new temperature classification is as follows (Zorn et al. 2008):

<u>Cold</u>: Mean July water temperature ≤ 63.5°F. Fish community is nearly all coldwater fishes; small changes in temperature do not affect species composition.

<u>Cold-transitional</u>: Mean July water temperature > 63.5°F and ≤ 67.1°F. Fish community is mostly coldwater fishes, but some warmwater fishes are present; small changes in temperature cause significant changes in species composition.

<u>Warm-transitional</u>: Mean July water temperature > 67.1°F and ≤ 69.8°F. Fish community is mostly warmwater fishes, but some coldwater fishes are present; small changes in temperature cause significant changes in species composition.

<u>Warm</u>: Mean July water temperature > 69.8°F. Fish community is nearly all warmwater fishes; small changes in temperature do not affect species composition.

Although Fisheries Division primarily uses the new (2008) classification, the 1967 classification is still used for water quality standards. The 1967 classification has legal standards associated with designated coldwater systems.

Special Jurisdictions

Federal and state statutes and local land use regulations provide protection to the Cheboygan River watershed. Management plans and special designations provide guidance for public lands management. Case law provides the framework for determining navigability of streams and lakes in the watershed.

State and Federally Designated River Segments

The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA) consolidated the majority of the State of Michigan's environmental and natural resource laws into one act. Part 305, Natural Rivers, NREPA, was established in 1971 and provides a means for the state to protect select river systems from unwise development patterns. A river system is designated a Natural River for the purpose of preserving and enhancing a range of values, including its free flowing condition, and its fisheries, wildlife, scenic, and recreational resources. Management guidelines are discussed in a Natural River Plan that is written by the MDNR with consultation from citizen advisory groups. Drawing from the management plan, zoning standards are then established for the regulation of private lands adjacent to the river. The standards include restrictions on lot size, minimum building set backs, riparian vegetation buffer zones, and limits on commercial use. The Natural Rivers district extends to 400 feet back from the ordinary high water mark. Currently, the Pigeon River is the only designated Natural River in the Cheboygan River watershed, and was so designated in 1982. The Pigeon River main stem as well as many of its tributaries are included in the designation. While the Black River is not a designated Natural River, it was included in a 1972 list of potential Natural Rivers.

If a local governmental unit adopts riverfront development standards that equate to or are more stringent than the state Natural River standards, Part 305 allows for that township or county to directly administer the program in lieu of the state. Cheboygan County has been approved by the MDNR to administer the program directly. At their own initiative, the county also applies similar development standards on the Black River. To date, Otsego County has not adopted Natural River zoning standards. As a result, the MDNR has been administering Natural River standards in Otsego County since the establishment of the Pigeon River Natural River Zoning Rules, which became effective in 1985. The rules require that all new structures are a minimum of 200 feet from the edge of the river on the main stem of the Pigeon River and 150 feet from the edge of a designated tributary. A vegetation buffer must be maintained at a width of 100 feet on the main stem and 75 feet on designated tributaries. An administrative process is available to land owners who want to request a variance to the development standards.

The Wild and Scenic Rivers Act of 1968, Public Law 90-542 (16 U.S.C. 1271 et seq.), was established at the federal level to preserve selected rivers that possess outstanding geologic, fish and wildlife, historic, cultural, or other values. Standards and guidelines that direct management activities within the designated area are intended to keep the river in a free-flowing condition for the benefit and enjoyment of present and future generations. There are currently no river segments in the Cheboygan River watershed that have been designated or are being studied for inclusion in the federal Wild and Scenic Rivers Act.

Inland Lake Levels and Dams Regulated Under State Dam Safety Standards

Part 307, Inland Lake Levels, NREPA, outlines the process involved in establishing a legal inland lake level. A county board, through its legal counsel, may petition the local circuit court to establish a legal lake level. The court will evaluate environmental and social factors in considering the request. Legal lake levels have been established at two lakes within the watershed: Alverno Dam Pond and Muskellunge Lake (J. Pawloski, MDEQ, personal communication).

Part 315, Dam Safety, NREPA, gives the MDEQ the authority to regulate the construction, enlargement, repair, reconstruction, alteration, removal, or abandonment of a dam. The authority is limited to dams impounding five or more acres and having a dam height greater than six feet. There are a total of forty-eight known dams in the Cheboygan River watershed and of this number, sixteen are regulated under Part 315 (J. Pawloski, MDEQ, personal communication). Dams that are regulated by the Federal Energy Regulatory Commission (FERC) under the Federal Powers Act, Chapter 41, are not regulated under Part 315, as the state's dam safety regulations are superseded by federal dam safety regulations. However, water quality associated with dams and dam operation, including dams regulated by the FERC, require a 401 water quality certification from the MDEQ (J. Suppnick, MDEQ, personal communication).

Federally Regulated Dams

Four hydroelectric dams in the Cheboygan River watershed are under license from FERC. Three of these are located on the main stem of the Black River. Cheboygan Dam operates under an exempt license (i.e., the license does not require periodic renewal). While the hydroelectric power production at Cheboygan Dam is owned and managed by the Great Lakes Tissue Company, regulation of the water flow is conducted by the MDNR. The license exemption and the operating agreement for the Cheboygan Dam are found in Appendix B. Alverno Dam is currently operating under a license that expires in 2040. The dam releases water in a modified run-of-the-river fashion that limits peaking activity. Tower and Kleber dams operate under one license that is due to expire in 2024. The Tower-Kleber dams have a negative effect on water quality, inhibit fish passage, and impound an area that would likely be suitable lake sturgeon spawning habitat. A settlement agreement is part of the current license and, as first drafted, incorporated a number of fish protection measures. The licensee appealed some of the requirements in the settlement agreement and FERC removed several of the fish protection measures required in the license (barrier nets or screening to prevent turbine entrainment and mortality). However, other measures such as those requiring the licensee to participate in lake sturgeon enhancement activities remain in the license (K. Kruger, MDNR, personal communication). The Alverno Dam and Tower-Kleber Dam licenses are found in Appendix B.

Dredge and Fill Activities

The federal government has the authority to regulate dredge and fill activities in the Cheboygan River proper with authority derived from the Rivers and Harbors Act of 1899 (33 U.S.C. 401, et seq.) and the 1972 amendments made to the Federal Water Pollution Control Act (33 U.S.C. 1344). This second act is commonly known as the Clean Water Act and the 1972 amendments are commonly known as Section 404. These guidelines are published in the Federal Register, Volume 45, Number 249, Part 230.

The State of Michigan has authority to regulate development activities affecting lakes, streams, or wetlands under Parts 301, Inland Lakes and Streams, and Part 303, Wetlands Protection, NREPA. Part 301 gives the state the authority to regulate dredging or filling of bottomlands; construction, enlargement or removal of structures on bottomlands; marina construction and operation; creation, enlargement or removal of an inland lake or stream; excavation or dredging within 500 feet of a lake or stream; and the connecting of any natural or artificial waterway with an existing body of water. Part 303 gives the state the authority to regulate certain activities within wetlands including: placement of fill material in a wetland; dredging or removal of soils from a wetland; construction within a wetland; and draining surface water from a wetland. Both parts are administered by the Land and Water Management Division of the MDEQ. Many of the activities regulated by Parts 301 and 303 are also subject to Natural River zoning ordinances and rules.

Water Quality and Floodplain Regulations

The State of Michigan implements the Federal Water Pollution Control Act (Clean Water Act, Section 404 authority) by means of Part 31, Water Resources, NREPA. Part 31 gives the state the authority to protect and conserve Michigan's water resources and to control pollution of surface or underground waters. It is administered by the Water Bureau of the MDEQ. The Water Bureau establishes water quality standards, provides regulatory oversight for public water supplies, issues permits to regulate the discharge of industrial and municipal wastewaters, and monitors state water resources for water quality, the quantity and quality of aquatic habitat, the health of aquatic communities, and compliance with state laws. The State of Michigan's Floodplain Regulatory Authority is also found in Part 31. The program requires that a permit be obtained prior to any alteration or occupation of the 100-year floodplain of a river, stream, or drain.

Contaminated Sites

Part 201, Environmental Response, NREPA, gives the state the authority to identify sites of environmental contamination, to request liable parties to take response action for site cleanup, and to prioritize contaminated sites for state-funded clean up. As of April 2007, 27 contaminated sites regulated under Part 201 have been identified in the Cheboygan River watershed (Table 13). Part 213, Leaking Underground Storage Tanks, NREPA, mandates that corrective action must be taken by owners/operators of leaking underground storage tanks. There are currently 45 sites regulated under Part 213 in the watershed (Table 14).

Sport Fishing Regulations and Designated Trout Streams

Part 487, Sport Fishing, NREPA, gives the State of Michigan the authority to regulate the take of fish, mollusks, amphibians, and reptiles. Harvest level, minimum size, seasons, and other parameters are determined, published, and enforced by the MDNR.

A significant amount of stream mileage in the Cheboygan River watershed is classified as designated trout stream by order of the Director of the MDNR (Table 15; Figure 35). Designated trout streams are streams that contain a significant population of trout or salmon and are managed for trout and salmon prevalence. Trout streams can be regulated as coldwater streams in accordance with Michigan surface water quality standards. Fishing regulations for trout streams and trout lakes along with regulations for other species are listed in the Michigan Fishing Guide.

Blue Ribbon Trout Stream Classification

A designated trout stream may also be classified as a Blue Ribbon Trout Stream. The Blue Ribbon Trout Stream Program recognizes some of the state's best trout streams. Like trout stream designation, the program is administered by the Fisheries Division of the MDNR. Certain standard criteria must be met to receive the classification. The stream must support excellent stocks of wild resident trout, be large enough to permit fly casting but shallow enough to wade, produce diverse insect life and good fly hatches, have earned a reputation for providing a quality trout fishing experience, and have excellent water quality (Anonymous 1988). Management of Blue Ribbon Trout Streams is directed toward providing for the needs of trout anglers through protection of wild trout stocks, protection and enhancement of trout habitat, maintenance of the natural stream environment, and acquisition and maintenance of public access.

The Cheboygan River watershed contains 134 stream miles classified as Blue Ribbon Trout stream. These include the Black River from McKinnon's Bend to the Cheboygan/Presque Isle County line, the East Branch of the Black River from Section 26 (T31N, R1E) to the junction with the Black River, Canada Creek from the junction with Montague Creek to the Cheboygan County line, the Maple River from the Maple River Dam to the Cheboygan County line, the Pigeon River from the Section 25-26 boundary (T32N, R2W) to M-68, the Sturgeon River from Sturgeon Valley Road to Burt Lake, and the West Branch of the Sturgeon River from Wilderness Road to the junction with the mainstream.

Special Local Watercraft Controls

Part 801, Marine Safety, NREPA, allows for the establishment of watercraft controls. Limitations can range from the prohibition of motorized watercraft, establishment of slow-no wake areas, and restrictions on hours of operation. A list of local watercraft controls, including those within the Cheboygan River watershed, can be found at: http://www.michigan.gov/dnr/0,4570,7-153-10366_37141_37701---,00.html (August 2007).

Permission to Use State Lands

Since 1973, a permit has been required from the MDNR for events or commercial use of state lands under the *Rules for the Regulation of Lands Administered by the Department of Natural Resources*. A change in the definition of commercial use in 2001, followed by the implementation of a new fee schedule and revised procedures on January 1, 2006, improved the MDNR's ability to effectively and uniformly apply the rules to all events and commercial users of state land. Requests to use state lands are reviewed for their intensity, potential facility impact and resource damage, and the potential for conflict with the use of state land by others.

2007 Inland Consent Decree

The 1836 Treaty of Washington, Article 13 preserved the right of Indian tribes "to hunt and the usual privileges of occupancy until the land is required for settlement." Litigation involving the scope of the treaty has been ongoing since 1973. In 1979 a federal court ruled that the 1836 tribes still had a viable treaty right to fish in the Great Lakes. As a result of this ruling, the State of Michigan, the United States, and the tribes entered into a Consent Decree in 1985 and again in 2000 to implement the court's 1979 ruling. However, Indian fishing and hunting rights on inland waters and lands remained unclear. In 2003 the State of Michigan filed a claim in federal court to resolve the issue of inland treaty rights. This action resulted in the 2007 Inland Consent Decree. Under this decree, tribal members may engage in hunting, fishing, and gathering activities on tribal lands and lands that are open to the public for those activities. The tribes regulate with methods, seasons, size limits, and bag limits that are generally more liberal than state regulations; however, the tribal harvest is for subsistence purposes only rather than commercial.

Local Government

Local units of government have authority to create master plans and implement zoning ordinances that can, by effect, play a large role in protecting watershed integrity. County road commissions can reduce the amount of sediment and other pollutants that reach watershed lakes and streams from roads and road ditches through careful design of road projects as well as the incorporation of best management practices in road maintenance activities.

The Michigan Drain Code (1956 PA 40, as amended) provides the legal framework for establishing and maintaining county and intercounty drains. A drain can vary in form, ranging from streams, open ditches, or underground pipes. To establish or improve a county drain, the county drain commissioner must receive a petition from landowners, a road commission, a county board of health, a municipality, or a developer. In addition, if the MDEQ determines that sewage or wastes carried by a drain are unlawful discharge, the MDEQ, in an effort to clean up the drain, may issue an order of determination that takes the place of a petition to construct a project. However, in general drain projects are intended to prevent flooding and provide adequate drainage for agriculture or development (F. Fuller, St. Clair County Drain Commissioner, personal communication).

There are no known designated drains in the Cheboygan River watershed. The potential for a previously recorded drainage easement to surface remains a possibility however, as organized records for established drainage easements have not been well-maintained by individual counties (B. Bury, MDNR, personal communication).

Major Public and Private Landowners

There are approximately 346,500 acres of state-owned land in the Cheboygan River watershed, an amount that accounts for 36 percent of the total land base in the watershed (M. Tonello, MDIT, personal communication). The majority of state owned lands in the watershed are managed as part of the MDNR, Forest, Mineral, and Fire Management Division (FMFMD) Eastern Lower Peninsula District. The district is subdivided into Forest Management Units. Of particular interest is the Pigeon River Country Unit (PRC), which is located entirely within the boundaries of the Cheboygan River watershed. At 105,049 acres the PRC is the smallest of the state's 14 forest management units; however, it is distinct in that it has the most contiguous state ownership of all the units.

State forest management practices, which include land use, timber production, and recreation are co-planned by the FMFMD and Wildlife Division. Input from other MDNR divisions, other agencies, and public stakeholders is considered in the planning process (J. Pilon, MDNR, personal communication). Resource management decisions in the PRC are further guided by the Pigeon River Concept of Management Plan. The Plan contains objectives intended to maintain and promote the remote and wild feel of the PRC, sustain healthy fish and other wildlife populations, including elk, and provide for timber management that is in concert with other management goals (Anonymous, 1973).

There are no federally owned lands of notable size in the Cheboygan River watershed. The largest private land owner is the Canada Creek Ranch Association (M. Tonello, MDIT, personal communication). The Ranch is a private outdoor recreation club that owns 13,897 acres of land (Canada Creek Ranch, personal communication). Also of size is the Black River Ranch, a private hunting and fishing club that totals 9,080 acres of land (Black River Ranch, personal communication).

The University of Michigan Biological Station (UMBS) consists of approximately 10,000 acres in the Cheboygan River watershed. UMBS was established in 1909 for education and research opportunities in field biology and related sciences. The station has property on Douglas and Burt lakes, as well as the East Branch Maple River.

Navigability

Issues associated with public rights on Michigan waters including navigability are discussed in detail in A Guide to Public Rights on Michigan Waters (Anonymous, 1997). Water law is complex and because it is established through both legislative and judicial action, it is continually evolving. The MDNR, Law Enforcement Division, generally considers all water bodies as navigable unless otherwise determined by a court. With limited exception, a navigable inland lake is any lake accessible to the public via publicly-owned lands, waters or highways contiguous, or via the bed of a navigable stream, and which is reasonably capable of supporting a beneficial public interest. A navigable inland stream is defined as 1) any stream declared navigable by the Michigan Supreme Court; 2) any stream included within the navigable waters of the United States by the U.S. Army Corps of Engineers for administration of the laws enacted by congress for the protection and preservation of the navigable waters of the United States; 3) any stream which floated logs during the lumbering days, or a stream of sufficient capacity for the floating of logs in the condition which it generally appears by nature; 4) any stream: having an average flow of approximately 41 CFS; an average width of some 30 feet; an average depth of about one foot; capacity for floating during spring seasonal periods; used for fishing by the public for an extended period of time; and stocked with fish by the state; 5) any stream which has been or is susceptible to navigation by boats for purposes of commerce or travel; or 6) all streams meandered by the General Land Office Survey in the mid 1800s.

The right to public use of navigable waters includes the right of trespass upon the submerged soil, but not the adjacent uplands. The public also has the common right of fishing in navigable streams, subject to state regulations.

The following reaches of the Cheboygan River system are being managed, have been adjudicated, or have been indicated as being navigable:

1. United States, navigable water jurisdiction exercised by the United States Army Engineering District, Detroit
    a. Cheboygan River, entire river

2. Michigan Supreme Court, determined to be navigable by judicial decision
    a. Cheboygan River, Cheboygan County, entire river
    b. Black River, from the mouth upstream to Black Lake
    c. Black Lake, Cheboygan and Presque Isle Counties
    d. Crooked Lake, Emmet County
    e. Mullet Lake, Cheboygan County
    f. Pickerel Lake, Emmett County

3. Michigan Supreme Court, indicated navigable by judicial notices or references (i.e., streams have a history of floating logs)
    a. Black River, Otsego County, downstream to Black Lake from lands owned by John Davis in 1885 in vicinity of “Chandler’s Dam”
    b. Black River, Otsego County, unspecified
    c. Maple River, Emmet and Cheboygan Counties, 30 miles upstream from mouth
    d. Pigeon River, Otsego County, 40 miles upstream from mouth
    e. Rainy River, Presque Isle County, 30 miles upstream from mouth

f. Sturgeon River, Cheboygan and Otsego Counties
g. Sturgeon River, West Branch, Cheboygan County

4. Cheboygan County Circuit Court, court approved Consent Judgment confirming navigability (*Hamp et al. v. Department of Natural Resources et al.*, Cheboygan County Circuit Court, 1993)

    a. Sturgeon River, Cheboygan County, T33N, R2W, Sections 27, 28, 29, and 34

The following reaches of the Cheboygan River system have been adjudicated as being non-navigable:

1. Otsego County Circuit Court, court decision determining reach non-navigable (*Sturgeon Valley Ranch v Department of Natural Resources et al.*, Otsego County Circuit Court, 1989)

    a. Sturgeon River, Otsego County, T31N, R3W, beginning just north of the north line of Sections 13 and 14 and running northerly to Whitmarsh Road

Inland Waterway

The Inland Waterway, also known as the Inland Route, is a series of interconnected lakes and streams contained within the Cheboygan River Watershed. The Inland Waterway is approximately 38 miles long and allows travel by boat from Crooked Lake to Lake Huron. Beginning in Crooked Lake, one can navigate through the Crooked River, Burt Lake, the Indian River, Mullett Lake, the Cheboygan River, and then enter Lake Huron. The route was originally developed and used primarily for transporting logs, freight, and passengers aboard commercial boats. Today it is largely a recreational boating destination. The route is maintained by the United States Army Corps of Engineers (COE). The COE routinely dredges various sections of the Inland Waterway with a design depth of five feet. Two lock systems on the route also facilitate boat passage. A lock system at the Cheboygan Lock and Dam (see *Federally Regulated Dams* in **Special Jurisdictions**, and *Migration/Movement* in **Dams & Barriers**) was built in 1869 by the Cheboygan Slack Water Navigation Company. However, the current lock system is now owned and operated by the MDNR's Parks and Recreation Division. The gate system at this lock can lower a boat by approximately 15 feet and can accommodate a boat up to 60 feet in length. A second lock system was built by the COE on the Crooked River. The Alanson Lock & Dam, also known as the Crooked River Lock and Weir, is also operated by the Parks and Recreation Division, although the site is still owned by the COE.

Biological Communities

Original Fish Communities

Presettlement fish community information of the Cheboygan River watershed is generally lacking. Madison and Lockwood (2004) provide an overview of the fish colonization of the Great Lakes region:

> The glacial activity that shaped Michigan and the [Cheboygan River] watershed also played an important role in repopulating the area with numerous fish species. The Great Lakes region has 153 species of native fish. Presence or absence of each species varied throughout glaciation. Connecting glacier-free refugia served as sources for re-population following glacial retreats. Three such areas of particular importance to the Great Lakes region were the Bering, Atlantic, and Mississippi refugia. The Great Lakes region was connected to the Bering drainage (refuge) by lake and river system created along the face of the retreating Laurentide glacier. Current day Great Slave Lake and Great Bear Lake are part of this system. Lake trout, grayling, and northern pike were

> some of the fish species that used the Bering refugia (Bailey and Smith 1981). The Atlantic refugia extended east from the northern Great Lakes region to the Atlantic Ocean. Fossil remains of walruses discovered near the Straits of Mackinac (Handley 1953) are linked to the North Bay outlet that drained Northern Michigan waters into the Atlantic Ocean. Fourteen species of fish populated the region solely from the Atlantic refugia. However, the primary source for re-population of fish species in the Great Lakes region came from the Mississippi refugia. This refugia alone supplied 122 species of fish to the region (Bailey and Smith 1981).

Evidence from the Juntunen site on Bois Blanc Island in northern Lake Huron provides some insight into fish assemblages in this region and their importance to early cultures. The site was occupied by natives in the Late Woodland period from 800 A.D. to 1300 A.D. (Cleland 1982) and is relatively close to the Cheboygan River mouth. Remains of eighteen fish species have been documented at the site, including lake sturgeon; longnose gar; lake trout; lake whitefish; various redhorse suckers; brown bullhead; channel catfish; northern pike; yellow perch; walleye; sauger; largemouth, smallmouth, and rock bass; and freshwater drum (McPherron 1967).

There remains some uncertainty whether brook trout were historically native to the Cheboygan River watershed. Vincent (1962) discusses in-depth the topic of whether brook trout were native to Michigan and the presence of Arctic grayling in Michigan. Vincent also reports that brook trout were very common in the lower reaches of the Cheboygan River. Whether they colonized this and other reaches of the watershed from northern populations (Upper Peninsula) or from stocking is unclear. Thorough searches for brook trout in the Sturgeon River found none of this species (Norman 1887). Brook trout were also not reported in the Pigeon and Black rivers until 1884 (Anonymous 1884). Only grayling were found in the Maple River in 1885 (Anonymous 1885), but both grayling and brook trout were found in this river by 1891 (Anonymous 1897). Arctic grayling were last documented in the Maple and Black rivers in 1899 and 1906, respectively (Hough 1899; Mershon 1916). It is likely that brook trout populations spread through natural colonization and stocking efforts on the heels of the Arctic grayling demise statewide.

According to MacCrimmon and Gots (1972), rainbow trout had been introduced into the Lake Huron watershed by 1876. Major spawning runs of rainbow trout (steelhead) had been established by the early 1900s in rivers to the south of the Cheboygan River watershed. Stocking efforts for this species became popular and continued throughout the Lake Huron watershed. Rainbow trout are sustained throughout the Lake Huron watershed today by both natural reproduction and supplemental stocking. This is a popular species in the Cheboygan River watershed. Strong, self-sustaining populations of rainbow trout live in both Burt and Mullett lakes and use the tributaries for spawning. These tributaries include the Pigeon, Sturgeon, and Maple rivers. The lower Cheboygan River also receives a run of rainbow trout (steelhead) that live in Lake Huron and provide both an offshore and river fishery. This reach of lower river below the Cheboygan River Dam is stocked annually with rainbow trout.

The lake sturgeon is a state threatened species in Michigan. According to Baker (1980), lake sturgeon were considered historically abundant throughout the Great Lakes region, particularly before the appearance of Europeans in the region. Lake sturgeon would have been common throughout the lower reaches of the watershed and probably common in Black, Burt, and Mullett lakes. The species still exists today in each lake, with the largest population found in Black Lake. Hay-Chmielewski and Whelan (1997) consider the Cheboygan River watershed as highly suitable for future lake sturgeon rehabilitation and enhancement.

Modifying Factors

The Cheboygan River watershed has been significantly altered by human activities since the arrival of European settlers. These changes have had profound effects on both the physical characteristics of the river system and the associated fish communities. Three specific activities have caused major changes, including intensive logging in the late 1800s and early 1900s, the construction of dams, and the stocking of nonnative fish species. These three activities have dramatically altered the ecology of the Cheboygan River watershed and most other watersheds in Michigan.

The impressive forests of this watershed were harvested and the river and lakes were used as means of transport. Log drives likely caused major streambank erosion and streambed scouring. Prior to log drives, it was common practice to send work crews down the river to clear the river of any existing jams. This often released large amounts of sand and sediment from the banks directly into the river. Meanwhile, clearing the river of natural woody debris reduced diversity of in-stream habitat.

Dams were first constructed in the Cheboygan River watershed in the late 1800s (**see Dams and Barriers**). Many of the prominent dams in this watershed are located in the lower reaches near Black Lake and the town of Cheboygan. These dams have restricted the movement of important native fishes such as walleye and lake sturgeon and have prevented passage of important naturalized species such as salmon and steelhead. It is likely that the removal of certain dams (Cheboygan, Alverno, Kleber, and Tower) would drastically change the dynamics of fish populations in this region. Zorn and Sendek (2001) summarize the effects of dams on resident fishes:

> Fishes require distinct spawning, growth, and refuge habitats in their life cycle (Schlosser 1991). Equally important, fishes must be able to freely migrate between these habitats. If any one habitat is lacking or if the ability to migrate from one to another is restricted, the population can become restricted or locally extinct. Migrations allow fish populations to fully use the best available feeding, growth, and refuge habitats within the aquatic system, and thus realize the potential of the river system. Migration corridors also provide a means for populations to recolonize disturbed areas. Dams in the [Cheboygan River] system prevent the river from realizing its potential to support thriving fish populations.

Beaver populations have fluctuated over time in this watershed and can have significant effects on the riparian area with successional setback and the associated impacts on channel evolution. High beaver populations in certain watersheds can block fish movement and change thermal regimes of streams. Many of the coldwater streams of this watershed are marginal for trout. Thus, a series of beaver dams will often pool large amounts of water and raise critical temperatures outside the tolerance range for certain species, particularly brook trout. Trapping was at one time an organized effort in the Black River watershed. Reductions in pelt prices and the increasing costs of the sport have reduced trapping in recent decades statewide, thus allowing furbearer numbers to surge.

Species introductions, both intentional and unintentional, have affected the biological communities in numerous ways. Some species introductions have created valuable sport fisheries and include steelhead, brown trout, Chinook salmon, coho salmon, and pink salmon. Other exotic species like zebra mussels, sea lamprey, and gobies continue to cause problems both to industry and to native ecosystems (see Aquatic Nuisance Species subsection).

Brown trout were imported to the United States from Germany in 1883. They were stocked in a variety of locations throughout Michigan in the late 1880s with mixed results. Stocking efforts for brown trout increased by the 1920s (MDNR 1974) in response to perceived declines in brook trout populations. Historical stocking records show that brown trout were stocked frequently throughout the streams of the Cheboygan River watershed, most certainly dating back to the early part of the twentieth century. Today this species is self-sustaining throughout parts of the Sturgeon, Maple, and

Pigeon river watersheds. The Black River remains relatively free of brown trout and is a haven for brook trout.

Salmon were introduced to the Great Lakes by the late 1960s. It is without doubt that they began to migrate into the Cheboygan River soon after these lake-wide stocking efforts began. Direct stocking efforts into the lower Cheboygan River did not begin until as recently as 2003. This species provides a popular off-shore fishery as well as a fishery for river anglers up to the Cheboygan River Dam. Salmon occasionally may swim through the Cheboygan lock system and migrate further upstream but do not provide a substantial fishery.

Other modifying factors for the Cheboygan River watershed include urbanization, road development, and oil and gas development. These activities have negative effects on waters in the basin through both point and non-point-source pollution (see **Water Quality**). Current industrial discharges to the river are subject to requirements of National Pollution Discharge Elimination System (NPDES) permits (see **Water Quality**). A fair amount of the aquatic shoreline in the Cheboygan River watershed is developed, particularly in the lower reaches and large lakes. Development along the water will shape the way water flows through and over the watershed. Such development will increase erosion and sedimentation to the watershed, alter hydrology by increasing impervious surfaces, and change the natural water-land interface. Oil and gas development is also quite prominent in this watershed, particularly in the headwaters of the Black, Pigeon, and Sturgeon rivers. Continued vigilance is needed to minimize the effects of current oil and gas development and protect the surface and groundwater resources within the watershed (see **Soils and Land Use Patterns**).

Current Fish Communities

Seventy-eight fish species are found in the Cheboygan River watershed (Table 16; Appendix C). Maps of their known distribution within the watershed were prepared using MDNR, Fisheries Division files, University of Michigan's Museum of Natural History records, the Michigan Fish Atlas (Bailey et al. 2004), and the best professional judgment of the authors. Many stream reaches inhabited by fish may be used only seasonally by some species. These reaches were still included in the distribution map as part of the species range.

Five species and two hybrids within the watershed were intentionally introduced and six species have colonized the watershed from Lake Huron. The Cheboygan River watershed is also home to four rare fish species. Historical records indicate the presence of pugnose shiners in the watershed. This species has special concern status in Michigan. The pugnose shiner requires streams with sand substrate or clear, weedy lakes, and is intolerant of turbidity. The lake sturgeon and lake herring are threatened species in Michigan. The lake sturgeon is relatively common in the Cheboygan River watershed and is found in Black Lake and the lower Black River, as well as the Cheboygan River. Lake sturgeon are also present, albeit in lower numbers, in Mullett and Burt lakes. It is unknown how many lake sturgeon migrate up the Cheboygan River from Lake Huron but cannot pass upstream beyond the dam. Lake herring often live in deep, oligotrophic lakes that possess good amounts of cold and highly oxygenated waters. This species has recently been found in Douglas, Burt, Mullett, and Black lakes, and is probably common in many other small inland lakes that possess these characteristics. One historical record of a channel darter exists for the Cheboygan River watershed. This species is currently considered endangered in Michigan.

Temperature plays a large role in the distribution and abundance of fishes. Fish can be placed into categories or guilds based on their temperature preference and temperatures at which they spawn. These guilds are composed of fish species that typically inhabit water bodies of cold, cool, or warm water (Diana 1995). Membership within one of these guilds is based on a number of factors, including the upper thermal tolerance limits for survival, the thermal preference for fishes in which they achieve optimum growth, and observations of presence-absence under certain conditions (Eaton et al. 1995). The effects of mean July temperatures on fish communities in Michigan rivers were examined by Wehrly et al. (2003). The study found relatively distinct community composition within three thermal categories based on July mean temperature values: cold (<66ºF), cool (66ºF to 72ºF), and warm (>72ºF). Although we use a more complex classification system for streams (see **Water Quality**), the simpler classification system of cold, cool, and warm is used here to be inclusive of lakes and to simplify the discussion.

Coldwater fish communities are composed of species with a relatively narrow tolerance range of temperatures, especially in the summer months. In rivers, coldwater fish communities typically have low species diversity. These communities include species such as rainbow, brown, and brook trout as well as sculpin species. Coldwater fish inhabit the headwater reaches of much of the Cheboygan River watershed and occupy other reaches seasonally (e.g., salmon migrations). Coolwater fish communities are composed of fishes that tolerate a broader range of temperatures, and generally have higher species diversity. Coolwater species of fish can live in cold water, but maximum growth and survival is typically limited. Coolwater fish species in the Cheboygan River watershed include walleye, yellow perch, darters; northern pike, muskellunge; suckers; and some minnow species, such as blacknose dace, longnose dace, and northern redbelly dace. Warmwater fish communities are composed of fishes that tolerate an even broader range of temperatures but do best in warmer waters. Warmwater streams typically have high species diversity. Warmwater fish species include bass, sunfish, minnow, and catfish species. Smallmouth bass, largemouth bass, rock bass, pumpkinseed sunfish, bullhead catfish, and bluegill are common throughout much of the watershed, except in the coldwater reaches of certain streams. Many of the lotic systems of this watershed have overlapping temperature regimes (coldwater, coolwater, warmwater) at various points as the rivers progress downstream. Consequently, fish communities typically transition from cold, to cool, to warm water communties.

Streams in the Cheboygan River watershed with coldwater fish communities are common in the southern portion of the watershed. These include the headwater reaches of the Sturgeon, Pigeon, and Black River. Some coldwater streams do exist in the northern portion of the watershed but are limited to smaller tributaries (e.g., Laperell Creek, Maple River, Mullett Creek). A coldwater reach is defined in this watershed by the geology and hydrology which result in large inflows of groundwater. Some coldwater streams receive more groundwater than other groundwater streams. For example, the Sturgeon, Pigeon, and Black rivers all start in areas of high groundwater discharge and have coldwater designation as earlier mentioned. However, the Sturgeon River maintains its coldwater status nearly the entire length. The Pigeon River has coldwater status for much of its length except the far river segment, where it changes to a coolwater designation based on empirical temperature assessments. The Black River makes a transition from coldwater to coolwater much higher in the watershed compared to the other mentioned rivers. Ironically, this latter stream has a brook trout population, which is a species that has the strictest temperature tolerances. Because of this, brook trout have evolved to adapt to variation in annual temperature changes in this river by often migrating from cool seasonal waters to areas with colder thermal refuge, such as springs or deeper pools. Coldwater species will often inhabit the lower, warmer reaches of these rivers during the cooler parts of the year. The lowest portion of the Cheboygan River downstream of Cheboygan Dam supports coldwater fish seasonally, as potamodromous fish such as steelhead and salmon migrate up the river. This reach normally has a mix of cool- and warmwater fish species.

Large lakes are a prominent feature in this watershed (see **Geography**). Rivers of the Cheboygan River watershed flow in and out of these lake systems which include: Crooked, Pickerel, Douglas, Burt, Mullett, and Black lakes. Species diversity and abundances are thus dictated by the temperature and morphology of the lakes. Diversity is typically much higher in the lake systems, particularly those lowest in the watershed drainage. Coolwater species are very common in the lakes (e.g., smallmouth bass, walleye, and northern pike). Yet warmwater species such as largemouth bass and coldwater species including trout can also be found within these lakes. Lakes also influence what is found in adjacent streams, as some fish may move from the lake into the stream.

Mussels and Aquatic Invertebrates

Mussel data are very limited in the Cheboygan River watershed. The University of Michigan, Museum of Zoology (http://www.lsa.umich.edu/ummz/ [February 2013]) lists historical records for various species of mussels in this watershed (Table 17). There is little doubt that the distribution of some species listed is more widespread. Nineteen species of mussels are listed under special status throughout Michigan (MNFI 2008).

The MDEQ-Water Bureau conducted macroinvertebrate community surveys within the Cheboygan River watershed in 1991, 1994, 2000, 2001, and 2005. This report will focus primarily on the most recent survey.

A total of 80 aquatic macroinvertebrate families have been identified over 38 sites in the 2005 Cheboygan River watershed surveys (Walker 2008a-d). In comparison, Cwalinski et al (2006) reported 76 aquatic macroinvertebrate families were surveyed in the nearby Thunder Bay River watershed at 15 sites in 2000 (Taft 2003). A variety of habitat types were surveyed in the Cheboygan River watershed, ranging from small coldwater streams to medium sized coolwater rivers. Macroinvertebrates are generally identified only to family so the number of genera and species found in the Cheboygan River watershed is much higher than 80. The mean richness across all sites was 32, while individual sampling locations ranged from 20 to 42 taxa (Table 18a-c). The lowest score (number) was for Minnehaha Creek at Pickerel Lake Road, while the highest score (number) was for the Black River at Black River Road.

Three species of aquatic invertebrates are listed as having special concern status in Michigan and have been found in the counties of the Cheboygan River watershed. These include the slippershell mussel (*Alasmidonta viridis*), Douglas Stenelmis riffle beetle (*Stenelmis douglasensis*), and splendid clubtail (*Gomphus lineatifrons*). Three species of aquatic invertebrates are considered endangered in the State of Michigan and have been found in the Cheboygan River watershed. These include the Hine's emerald dragonfly (*Somatochlora hineana*), aquatic freshwater snail (*Planorbella smithi*) and Hungerford's crawling water beetle (*Brychius hungerfordi*). The Hungerford's crawling water beetle has gained the most notoriety across the watershed and was even found in Canada Creek at Canada Creek Highway during the 2005 survey. The Hungerford's crawling water beetle has also been found in recent years in Van Hetton Creek, East Branch Black River, and the East Branch Maple River (USFWS 2006). The status of the aquatic snail *Planorbella smithi* was elevated to endangered by the State of Michigan in 2009, and is known to occur only in Douglas and Burt lakes (MNFI 2011).

Amphibians and Reptiles

Nine species of frogs and toads and seven species of salamanders live within the Cheboygan River watershed (Harding and Holman 1992). None of these species has a state or federal status of endangered, threatened, or special concern (Table 19).

Eleven species of snakes and one lizard (five-lined skink) reside within the Cheboygan River watershed (Holman et al. 1993, Harding and Holman 1990). The eastern massasauga rattlesnake has special concern status in Michigan (Table 19). The massssauga rattlesnake is unique because it is the only poisonous snake species found in Michigan. This species prefers marsh and swamp habitat but may be found in upland meadows and woodlands in summer (Holman et al. 1993). The massasauga rattlesnake is locally common in distinct parts of the Cheboygan River watershed.

The Cheboygan River watershed is home to five species of turtles. Two of these (wood and Blandings) are species of special concern in Michigan (Harding and Holman 1990) (Table 19). Populations of wood turtles have been reduced primarily through mortality from crossing roads and from pet collection. Habitat loss and road crossing mortality are the major causes of mortality for the Blandings turtle (Harding and Holman 1990). Egg predators also can have a large impact on nest success.

A fishing license is required to take frogs and turtles for personal use and as such may not be bought, sold, or offered for sale. The take of various reptiles and amphibians is regulated by the MDNR Fisheries Division and specific regulations by species are listed in the Michigan Fishing Guide.

Birds

Doepker et al. (2001) list 121 breeding birds associated with aquatic and wetland habitats in the Cheboygan River watershed (Table 20). The rivers, lakes, and wetland areas provide valuable habitat for a variety of game and nongame birds. Ducks, geese, and mergansers nest and forage along the rivers and lakes, while upland birds forage and travel within riparian corridors. Other species of birds not listed use the watershed seasonally on migration routes (e.g., northern pintail duck) or live in the uplands year-round (e.g., ruffed grouse). The state-threatened common loon breeds on the lakes while stream edges are popular habitat types for several species of shorebirds and wading birds, such as great blue herons. Seven species of birds are of special concern status in Michigan, while seven species are listed as threatened, and two species (piping plover and long-eared owl) are listed as endangered (Table 20).

Mammals

The abundant forests and wetlands (**see Soils and Land Use**) in the Cheboygan River watershed support a variety of mammalian species (Table 21). The river and riparian corridors provide food, cover, and travel or migration routes for such game species as black bear, white-tailed deer, coyote, and bobcat. Sport harvest is an important activity in this watershed, both in the form of hunting and trapping. Various mammal species are important to the trapping industry and include American beaver, muskrat, and mink (Table 21). Rare mammals in the watershed include the American marten (threatened) and woodland vole (special concern).

Much of the Cheboygan River watershed is home to one of the largest wild elk herds east of the Mississippi River. Prime elk range can be found throughout the upper and middle reaches of the Sturgeon, Pigeon, and Black river catchments. Herds are healthy enough to support an annual managed harvest. The current elk herd is managed for 800-900 animals and often fluctuates over this range prior to harvest. Eastern Elk were native to Michigan but were extirpated from the state by 1877 (Baker 1983). Seven Rocky Mountain elk were released near the town of Wolverine in 1918 in order to reestablish a local Michigan population.

Other Natural Features of Concern

Michigan Natural Features Inventory lists 22 vascular plants, 16 invertebrates, 4 fishes, 8 birds, 1 snake, 2 turtles, 1 mammal, 4 plant communities, and 2 other natural features as being of concern status within the Cheboygan River watershed (Table 22).

Plant community types listed as natural features include the dry-mesic northern forest, intermittent wetlands, pine barrens, and northern fens. Dry-mesic northern forests are pine or pine-hardwood dominated and often originate following catastrophic fire events and are maintained through low-intensity ground fires. Pine barrens are dominated by clumped or scattered coniferous trees in fire dependent savannas which occur on sandy outwash plains or glacial lake plains. Pine barrens often are composed of jack pine and pin oak. Intermittent wetlands are sedge and herb-dominated areas often found along lakeshores and are influenced by fluctuating water levels. Northern fens are sedge and rush dominated wetlands occurring on neutral or alkaline saturated peat or marl and fed by rich groundwater.

Great blue heron rookeries are also listed as a natural feature of concern in the Cheboygan River watershed (Table 22). These rookeries contain groups of nests and are located in wooded wetlands with large trees. These rookeries are often used annually by these birds.

Aquatic Nuisance Species

An aquatic nuisance species (ANS) is defined as an organism that is waterborne, nonnative, and has the potential to threaten the existence or diversity of native species or disrupt a natural community. ANS can also threaten commerce or recreational activity. Since the 1800s, at least 140 nonindigenous aquatic organisms have been introduced in the Great Lakes ecosystem (Coscarelli and Bankard 1999). Some of these organisms have already entered the inland waters of the Cheboygan River watershed.

Adult sea lamprey are parasitic on other fish species and can kill up to 40 pounds of fish per year (Coscarelli and Bankard 1999). This species lives most of its life in the larval stage within high quality rivers of Michigan. The United States Fish and Wildlife Service (USFWS) aims to control sea lamprey by treating these rivers with a chemical that selectively kills larval lamprey without harming resident fish populations. Many parts of the Cheboygan River watershed are treated for larval lamprey, especially the Sturgeon, Maple, and Pigeon rivers. Despite this control effort, many larval lamprey transform into adults and feed on fish in both Lake Huron and Lake Michigan. Some of the highest concentrations of adult sea lamprey in the Great Lakes are found in northern Lake Huron.

Eurasian ruffe and round goby are exotic fish species that can reduce native fish populations through predation on eggs and larvae or through direct competition for forage and habitat. Round gobies are common in the lower Cheboygan River. A recent netting of fish in a pool below the Cheboygan River Dam found this species to be prevalent. Round gobies were also observed in high numbers during a recent (fall 2007) walleye evaluation on Mullett Lake. The connectivity of the lower reaches of the watershed via the Inland Waterway suggests that gobies will become common throughout Burt, Crooked, and Pickerel lakes. The USFWS has surveyed various Great Lakes ports and river mouths for ruffe in recent years. This species has not been reported in the lower Cheboygan River, but has been found to the south in the Thunder Bay River mouth.

Zebra mussels are a small exotic mollusk that attach to hard surfaces underwater and filter microscopic algae and animals (zooplankton) from the water. Zooplankton are an important food source for young fish such as walleye, yellow perch, and bass. Though tiny, zebra mussels can become quite prolific and form dense colonies of over one-million per square meter (Coscarelli and Bankard 1999). These mussels can have detrimental effects upon Michigan's lakes by killing native clams and filtering out essential nutrients from the water column which fish rely upon for survival. They can also outcompete macroinvertebrates for food and habitat. It is not completely understood how zebra mussel colonization in inland waters affects populations of various fish species. Michigan Sea Grant (http://www.miseagrant.umich.edu/ais/lakes-m-r.html#o [February 2008]) lists eight lakes in the Cheboygan River watershed where zebra mussels have colonized. These lakes include Black, Long, Thumb, Mullett, Burt, Crooked, and Pickerel lakes. The first three lakes listed are not part of the Inland Waterway and zebra mussels were probably transferred to these waters through anglers or recreational boaters. The remaining listed lakes are part of the Inland Waterway and colonization could have been from those using the water route. Zebra mussels likely occur in additional waters not yet included on the official list kept by Sea Grant. Douglas Lake, for instance, has zebra mussels. The entire Cheboygan River is also home to zebra mussels. Earliest reports of zebra mussel colonization to the watershed date back to 1993.

Other invasive species and diseases that may currently inhabit the watershed or may do so in the future are the rusty crayfish, Eurasian water milfoil, purple loosestrife, viral hemorrhagic septicemia (VHS), and whirling disease. Whirling disease is caused by a parasite which infects trout and salmon. The parasite enters the head and spine of young fish, leading to erratic swimming behavior and potentially death. The spores of whirling disease have been found throughout Michigan streams, including the Sturgeon River. Spore densities in this system are quite low and fish species do not develop clinical signs of the disease. VHS is a newly introduced fish virus to Michigan. It does not affect humans, but has the potential to cause large-scale mortalities in fish populations. It was recently discovered in the Great Lakes but has not appeared within most inland water bodies in Michigan. The lakes and rivers of the Cheboygan River watershed are at high risk of being colonized by this virus due to the movement of boats between the Great Lakes and inland waters through the Inland Waterway.

Rusty crayfish are a nonnative invertebrate from the Ohio River valley. They can grow large and often out-compete native species of crayfish. Rusty crayfish are also known to remove or shred large amounts of aquatic vegetation that is essential for lake productivity and fish shelter. Reports of this species exist through parts of the Inland Waterway including Pickerel, Crooked, Burt, and Mullett lakes and outside the waterway in Long Lake. They may exist at other locations in the watershed and future aquatic community surveys will help document their spread as well as that of other invasive species.

Eurasian water milfoil and purple loosestrife are two invasive species of plants which can be found in parts of the Cheboygan River watershed. Purple loosestrife is a perennial wetland plant native to Europe and Asia. The plant can form dense monoculture stands and eventually displace native vegetation and reduce plant species richness. Many lake association members and volunteer groups seek to reduce this species through manual removal.

Eurasian water milfoil is a submergent plant that grows rapidly in lakes once established. This nuisance species out-competes native aquatic vegetation and often significantly disrupts the aquatic ecosystem for many years. It is hard to eliminate once large stands become established. This species does best in lake environments, and has been found in Burt, Thumb, and Long lakes but most likely exists in many lakes in the watershed. Treatment of Eurasian water milfoil is expensive and elimination is nearly impossible. Treatment can occur through chemicals, or biologically with weevils which reduce plant growth.

The preceding paragraphs provide a brief summary of the exotic species that affect the Cheboygan River watershed. All anglers and waterway users should educate themselves on these nuisance species and learn methods to prevent the spread of these and other nonnative organisms.

Fisheries Management

Historical and modern fisheries management in the Cheboygan River watershed has been shaped by the varying aquatic habitat types in its rivers and lakes. The watershed contains a diverse array of rivers and a multitude of lake types. The valley segments of small coldwater streams such as the West Branch Maple River (headwaters to Maple River Dam), Sturgeon River (headwaters to confluence with West

Branch Sturgeon River), West Branch Sturgeon River, Pigeon River (headwaters to Golden Lotus Dam), Black River (headwaters to Clark Bridge Road), East Branch Black River, and Canada Creek drain a region of high groundwater loading (see **Hydrology** and **Geology**) and maintain summer stream temperatures and top-quality habitat suitable for trout. These streams are managed primarily through habitat protection measures, such as permit reviews, and angling regulations that promote self-sustaining trout populations. The watershed also contains a number of medium-sized coldwater streams. These include valley segments in the Maple River (Maple River Dam to Burt Lake), Sturgeon River (confluence with West Branch Sturgeon River to Burt Lake), Pigeon River (Golden Lotus Dam to confluence with Little Pigeon River), and the Black River (Clark Bridge Road to Kleber Dam). Portions of these streams may be managed to take advantage of populations of migratory steelhead and brown trout from the large lakes discussed later in this section.

Although known primarily for its coldwater streams, the Cheboygan River watershed also contains a number of rivers with warmer water temperatures. These include the East Branch Maple River, the Pigeon River (confluence with Little Pigeon to Mullett Lake), the Black River (Kleber Dam to Black Lake), the Lower Black River, and the Cheboygan River. Most of these rivers are designated trout streams, but since all are thermally marginal for trout the designation is intended to protect migrating salmonids (adults and smolts). The Black River segments and the Cheboygan River also have special regulations to protect spawning lake sturgeon and muskellunge.

The Cheboygan River watershed includes three of the twenty largest inland lakes in the state (Burt, Mullett, and Black), as well as other large lakes over 1,000 acres in size including Pickerel-Crooked and Douglas lakes. These lakes are primarily managed through habitat protection and angling regulations that are protective of the fish populations within those lakes (See **Biological Communities**). On Black Lake, there is a regulated winter fishing season for lake sturgeon with limited harvest , where the primary method of take is by spear. Burt and Mullett lakes support good populations of rainbow trout (steelhead) and brown trout, which migrate into the Sturgeon River, Pigeon River, and other tributaries for spawning.

In addition to its large lakes, the Cheboygan River watershed contains numerous smaller lakes. Fish stocking, angling regulations, and habitat protection are again the primary methods of fishery management for these lakes. There are, however, a number of specially-managed lakes in the watershed which are discussed later in this section.

Fish stocking was historically a common fisheries management method throughout the watershed and remains an important tool today, although at a much smaller scale (Table 23). Most fish stocking has been done by the MDNR. Many warm and coolwater fish species, such as walleye, bluegill, and hybrid sunfish, were stocked in the watershed prior to the 1950s. These fish were typically large enough to be legally harvested in a short-lived put-and-take fishery. Fish stocking records from 1979 to present are available on the Fisheries Division website.

In the past, many streams in the watershed were stocked with trout, but this management practice was stopped because it was ineffective and costly. Today, trout streams within the watershed are managed through a combination of regulations that recognize the ecological importance and social values of salmonid species. Trout populations in nearly the entire Cheboygan River watershed were managed by uniform regulations prior to 2000, although statewide regulations on creel limits, seasons, and length limits varied substantially in the past (Borgeson 1974). The most recent changes for inland trout regulations were made in 2000 as a result of a statewide review of the existing regulations. Today, trout streams in the watershed are managed as Type 1, Type 2, Type 4, and Type 3 waters (Table 24, listed here in descending order of occurrence). Type 1 trout streams are the most common because they are the “standard” regulation for trout streams throughout the state. There are also a number of Type 2 trout streams in the watershed, including the Maple River from Maple River Dam downstream to mouth, the Pigeon River from Golden Lotus Dam downstream to M-68 bridge, and the Black River from Town Corner Lake stairs downstream to Tower Dam.

Type 4 trout streams in the Cheboygan River watershed include the Pigeon River from M-68 bridge downstream to its mouth and Sturgeon River from Afton Road downstream to its mouth. Type 4 regulations allow anglers to fish for migratory rainbow trout (steelhead) from Mullett and Burt lakes all year. One reach within the Cheboygan River watershed (the Cheboygan River from Cheboygan Dam downstream to Lake Huron) has Type 3 trout stream regulations, which are appropriate to allow fishing for potamodromous fish species, such as Chinook salmon.

In 2008, a reach within the Cheboygan River watershed was designated as a special regulation research area. For the Black River from Tin Shanty Bridge Road downstream to the Town Corner Lake stairs the season is open all year, but the possession season is from the last Saturday in April to September 30 (limit 2 trout). Only artificial lures may be used, and it is unlawful to use or possess live bait, dead or preserved bait, organic or processed food, or scented food on any of the waters or on shore. The minimum size limits (MSLs) are 10 inches for brook trout and 12 inches for brown trout. The objective of this special regulation is to determine if restricting anglers to the use of only artificial lures or flies on a reach of the Black River results in an increase in survival and abundance of larger and older brook trout as compared to a reach of the same river where bait angling is permitted.

Stocked and self-sustaining trout populations in the Cheboygan River watershed have been monitored by MDNR field staff and by staff from the Hunt Creek Fisheries Research Station and the Pigeon River Trout Research Station which have conducted over 50 years of trout stream research. The Pigeon River Trout Research Station operated from 1949–1965, and was located at the present site of the Pigeon River Country State Forest Headquarters. Staff from both research stations studied lakes and streams throughout the watershed, helping guide statewide trout management.

Data gathered from creel surveys of anglers and their catches provide another important fisheries management tool. These surveys allow managers to evaluate the effectiveness of management actions such as stocking or regulation changes. The oldest creel survey data for many lakes in the watershed were collected by conservation officers from 1928–64 (Appendix D). This effort was discontinued, in part, because the methods were rather informal and the data gathered did not allow for expanded estimates of total catch, harvest, or angling effort.

Fisheries Division has a number of long-term electrofishing sampling sites in the Cheboygan River watershed. These long-term sampling sites are fixed sites in the Stream Status and Trends Program (SSTP), which was recently developed by Fisheries Division to standardize data collection and allow for spatial and temporal comparisons among water bodies (Wills 2006). Fish populations within a 1,000-foot section of the river are estimated using standard mark-recapture fish sampling methods employed by the MDNR (Schneider 2000). The abundance (number and pounds per acre) of trout populations were estimated from samples collected in July or August of each year on a three-year rotation.

The following sections highlight fisheries management throughout the Cheboygan River watershed. The descriptions will follow the river valley segment approach defined earlier in this report (see **Geography**). The 2008 stream classification, based on temperatures and fish community, are used to classify streams (see **Water Quality**). Fisheries management for each reach is described for the main stem river reach, the tributaries to that reach, and the lakes within that catchment. Fish stocking events prior to 1978 are also listed for each waterbody.

West Branch Maple River—Headwaters to Maple River Dam

Main Stem

This reach has a number of habitat types. The West Branch Maple River originates in the Pleasantview Swamp and is classified as warm in its headwaters due to its surface drainage origins. However, the river quickly accrues groundwater along its length, cooling rapidly to warm-transitional by the time it crosses Ralmer Road and becomes even colder at the confluence of Cold Creek. Water temperatures (and classification) remain cold to Lake Kathleen. The majority of the West Branch Maple River supports a typical coldwater fish community and is managed with Type 1 trout stream regulations throughout.

The West Branch Maple River contains a mix of brown, brook, and rainbow trout. The stream is dominated by brook trout, which had the highest densities (number per acre) and standing crop (pounds per acre) of the three trout species each year it was sampled. In fact, the density of brook trout at the Robinson Road site is higher than any other Stream Status and Trends fixed site in the Northern Lake Huron Management Unit (NLHMU). Brook trout standing crop is second only to the North Branch of the Au Sable River, and is more than twice the statewide average of other high quality trout streams sampled during Stream Status and Trends fixed site surveys (Figure 36). This reach had an average of 1,415 trout per acre (5,156 trout per mile) from 2002-04. Standing crop of all trout during the same time period averaged nearly 51 pounds per acre (Fisheries Division, unpublished data).

Because the West Branch Maple River is relatively warm in its headwaters, the fish community is susceptible to small changes in water temperature, which can cause a significant change in species composition (P. Seelbach, MDNR, personal communication). Therefore, a partnership was formed in 2007 to begin managing multiple beaver dams which were thought to be warming the river. The group was organized by the Miller VanWinkle Chapter of Trout Unlimited and Conservation Resource Alliance (CRA). Volunteers floated the river in the fall of 2007 and documented a total of 36 beaver dams. Afterwards, staff of CRA and the MDNR worked with local trappers over the winter of 2007-08 to reduce the beaver population near the river. Once the population has been reduced, the partnership will remove a number of beaver dams to restore flows.

Other fisheries management activities for the West Branch Maple River include maintaining a sand trap near the airport; stocking brook trout in the 1950s and 1960s; and a number of trout population estimates.

Tributaries

The principal tributaries in this segment include Brush Creek and Cold Creek. Brush Creek, which originates as an outlet from Larks Lake (discussed below), is classified as a warm-transitional stream. There are no fisheries data on file for Brush Creek. Cold Creek is also classified as a warm-transitional stream and was last surveyed in 1972, when an excellent brook trout population was documented. Numerous gravel riffles which provide important spawning habitat were reported. Both streams are managed with Type 1 trout stream regulations.

Lakes

There are two lakes in this segment: Larks Lake and Lake Kathleen. Larks Lake, last surveyed in 2005, is very shallow (most of the lake is less than 5 feet deep) and unproductive. Nongame species, such as white sucker and bullheads, dominated the catch in terms of numbers and biomass. Sport fish species collected include yellow perch, pumpkinseed, rock bass, largemouth bass, and northern pike. The fish community is typical for a shallow lake with limited nutrient availability, low vegetation levels, and marl substrate. Largemouth bass, northern pike, and panfish populations are limited by the low productivity of the lake. The lake periodically winterkills due to its shallow nature.

Lake Kathleen is a 42-acre impoundment formed by the Maple River Dam. The entire shoreline of Lake Kathleen is privately owned, limiting public access. Average depth of the impoundment is 4.2 feet, with a maximum depth of 12.9 feet. The lake does stratify, and has cold temperatures (maximum of 64.1°F on August 22, 2007) and good oxygen levels (6.79 ppm at 11.1 ft. depth). A 1973 survey conducted by the University of Michigan Biological Station (Curless 1973) found a mix of coldwater and warmwater species, typical of an impoundment on a coldwater river. The species included brown trout, sculpin, northern pike, white suckers, Johnny darters, yellow perch, pumpkinseeds, bluegills, rock bass, largemouth bass, and several minnow species.

Because of their nature and limited access, no fisheries management activities beyond general statewide sport fishing regulations occur in Larks Lake or Lake Kathleen.

East Branch Maple River—Headwaters to Maple River Dam

Main Stem

The East Branch Maple River is a warm-transitional stream and originates as the outlet from Douglas Lake, and flows to its confluence with the West Branch Maple River at Lake Kathleen, forming the main stem Maple River downstream of the dam. Because it is a lake outlet, the fish community is composed primarily of warm and coolwater fish species, although it does have some coldwater habitat as it accrues groundwater in the lower portion of the river. The East Branch Maple River has Type 1 trout stream regulations.

The stream was sampled in 2002 at the Robinson Road crossing as a random survey site in the SSTP. The primary purpose of random survey data is to characterize different types of streams in the state, and to answer questions best answered by comparing different streams. The species encountered include bowfin, mudminnows, four cyprinid (minnow) species, grass pickerel, largemouth bass, mottled sculpin, pumpkinseed, white sucker, and yellow perch. This mix of coolwater species is typical of a marginal trout stream, with dace and sculpin alongside perch and centrarchids. No trout were found during the 2002 survey. The stream has good habitat for trout (gravel and woody debris), but temperatures get high enough during the summer to make it thermally marginal for these species. Therefore, trout only use the stream on a seasonal basis.

Tributaries

The tributaries in this segment include Beavertail Creek and Lancaster Creek (also known as Bessey Creek), which flow into Douglas Lake, and Van Creek, which flows directly to the East Branch Maple River. These three tributaries are all classified as warm-transitional streams. Lancaster Creek provides fish access to a large flooded marsh in the spring, which is important spawning habitat for esocid species such as grass pickerel and northern pike. This “pike marsh” has been operated by members of the Douglas Lake Preservation Society (DLPS) for a number of years in cooperation with the MDNR.

No fisheries data are available for Beavertail Creek or Van Creek. Management is limited to standard sport fishing regulations.

Lakes

Lancaster Lake is a 52-acre natural lake in northwestern Cheboygan County, in the Maple River watershed. Maximum depth is 57 feet. Lancaster Lake has two tributaries: Lancaster Creek flows into the northwest corner of the lake, and Munro Creek flows into the northeast portion of the lake. The lake outlet, Bessey Creek, flows into Douglas Lake to the south. Lancaster Lake was last surveyed in 2005. The survey showed a healthy fish community, with good numbers of both predators and prey. Predators such as largemouth bass and northern pike had good size distributions. Black crappie and bluegill also had good size distributions, but black crappie were much more abundant. Although slightly below state average, growth of black crappie and largemouth bass was satisfactory. Northern pike were especially slow growing, averaging 1.7 inches smaller than the state average length-at age. Bluegill were also growing below state average, with a growth index of -0.7.

Munro Lake is a 515-acre natural lake in northwest Cheboygan County. Although large in size, Munro Lake is relatively shallow, with a mean depth of about 5 feet, and a maximum depth of 15 feet. Because of its shallow depths, Munro Lake is prone to periodic winterkill and does not thermally stratify in the summer as the wind continually mixes the water column. Munro Lake has an unnamed tributary, and the lake's outlet, on the north end of the lake, flows into Lancaster Lake. Munro Lake was last surveyed in 2006, and although the catch was numerically dominated by yellow perch and rock bass, largemouth bass comprised the largest percentage of biomass in the catch. Growth of all species was above the state average, indicative of a productive lake. Bluegill and pumpkinseed had good size distributions up to 8 and 9 inches, respectively. The number of large rock bass (10 inches or greater) was impressive. The absence of larger predators in the catch may indicate that anglers are harvesting fish once they reach an acceptable size. Other fish have a good distribution of sizes, with many inch groups represented. This indicates a balanced fish community, good survival, and that the lake has not experienced a complete winterkill in a number of years.

Douglas Lake is a 3,350-acre natural lake with a maximum depth of 80 feet, although most of the lake is less than 30 feet deep. The lake was most recently surveyed in 2000. Cwalinski (2004) discusses this survey and the management direction for Douglas Lake:

> The overall fish community of Douglas Lake has not changed much through time, with a few exceptions. The current community can generally be characterized as having the following: 1) an average growing and diverse panfish community with some species more abundant than others, 2) an abundant rough fish community, 3) a remnant coldwater fish community, 4) and a predator game fish component consisting mainly of two abundant species (northern pike and smallmouth bass) and one uncommon species (largemouth bass). The large game fish tend to exhibit average to slightly below average growth.

Panfish species include yellow perch (most common), rock bass, bluegill, pumpkinseed sunfish, and black crappie. Ongoing fishery management within Douglas Lake includes cooperative operation of the pike rearing marsh between the DLPS and the MDNR. A better public access site for Douglas Lake should be pursued.

Maple River—Maple River Dam to Burt Lake

Main Stem

The main stem Maple River originates at the confluence of the East and West branches at Lake Kathleen, above Maple River Dam. Although originating as a tailwater below Maple River Dam, water temperatures are fairly cold because there is a considerable amount of groundwater input in the area. This cold-transitional reach is managed with Type 2 trout stream regulations.

The main stem was last surveyed in 2002 as a random site in the SSTP. Random sites involve a one-pass electrofishing effort to document species presence and relative abundance. Three species of trout (brook, brown, and rainbow) were collected at this station, in addition to 10 other species of fish representing both warm and coldwater preferences. This mix of fish types within the community reflects the origins of the main stem, which starts at the confluence of its two tributaries just upstream. The West Branch Maple River is a coldwater stream, with a good trout population. The East Branch Maple River is a marginal trout stream, due to its lentic origin (Douglas Lake) and the limited groundwater input provided by the surficial geology through which it flows. The upstream impoundment, Lake Kathleen, is also a likely source for warmwater species encountered below the dam. Brown trout were the most abundant game fish encountered, with lengths fairly well distributed but age-0 trout less abundant than one would expect. Five legal brown trout (12-14 inches) were observed during sampling. Brown trout growth was above the state average. Current regulations appear to be adequate; more restrictive size limits would not be appropriate.

Average width of this reach was 47.6 feet, with depths of 0.5–4.7 feet. Gravel was the predominant substrate throughout the reach, and there was a good variety of pool, riffle, and run habitat. In the past, two sand traps were maintained on the main stem near Brutus Road. Maintenance of these traps was discontinued because they were located relatively close to the mouth and the benefits of sand removal were only realized for a small part of the watershed. The heavy equipment pads at the sand traps became popular for illegal ORV use and trash dumping. To help address this issue, volunteers worked with the MDNR to place gates to limit motorized access to these areas. Initial results have been promising.

Other management activities in the main stem Maple River include streambank stabilization that was completed in 1989–1990 using stone rip rap. The river was also stocked with brown trout, brook trout, and rainbow trout in the 1960s, 1970s, and early 1980s. Stocking was discontinued after fisheries managers realized it was providing little benefit to the established fish community.

Tributaries

There are no major tributaries in this valley segment.

Lakes

There are no major lakes in this valley segment. Burt Lake will be discussed in another subsection of Fisheries Management.

Sturgeon River—Headwaters to confluence with West Branch Sturgeon River

Main Stem

The Sturgeon River begins as a series of springs that emerge from coarse-textured moraines near Gaylord. This reach receives a substantial amount of groundwater loading, and is appropriately classified as a coldwater stream above the confluence with Club Stream. Downstream of that confluence is classified as cold-transitional. The entire reach is regulated as a Type 1 trout stream.

The contributing watershed in this reach contains a number of large, privately-owned parcels. The river itself has been the subject of two court cases concerning its navigability (whether it is public water or private). A two-mile segment of this reach has been adjudicated as nonnavigable by the courts (see **Special Jurisdictions**) and is therefore considered private. Another segment in this reach was confirmed as navigable (public) by the courts (see **Special Jurisdictions**). The reach also includes a large parcel of state-owned land referred to as “Green Timbers.” Green Timbers is managed as a special use area within the Pigeon River Country State Forest by the Forest, Mineral, and Fire Management Division (FMFM) of the MDNR. Special management for this parcel includes prohibiting the use of motorized vehicles and an emphasis on wildlife management and a wilderness experience.

Fisheries Division has a fixed sampling site on the Sturgeon River at the river’s crossing of Trowbridge Road. Brown trout were the most abundant salmonid species captured at this station, followed by rainbow trout. No brook trout were present. Standing crop of brown trout (31 pounds per acre) was less than that of other fixed sites in the NLHMU (Figure 37). Standing crop of rainbow trout (17 pounds per acre) was the highest of any fixed site in NLHMU and above the average for other high quality trout streams sampled as fixed sites in the Stream Status and Trends Program (Figure 38).

There was a considerable amount of habitat work done in this reach during the 1980s in conjunction with the Michigan Youth Corps. Most of the work involved placing stone for bank stabilization and to prevent additional sediment from entering the river. Approximately 4,500 feet of stream bank was stabilized using clean fieldstone rip rap in the main stem Sturgeon River from 1983–89. A small portion of this work was done in the adjacent downstream reach below the confluence with the West Branch Sturgeon River.

A sand trap project was initiated in the mid-1980s in conjunction with the bank stabilization work and in cooperation with Trout Unlimited. Twelve sand traps, approximately one every mile, were dug in the upper Sturgeon River. This was done largely to address sediment from construction of a ski resort and golf course in the headwaters and other human development. Currently, only one of the traps (at Sturgeon Valley Road) is being maintained. Fisheries Division is also studying the effectiveness of the sand trap at Old Vanderbilt Road by monitoring bed elevations and channel cross sections at a number of locations in the reach. The other sand traps initiated in the mid-80s are no longer used due to either access issues or because they were deemed ineffective.

Tributaries

Mossback Creek, Pickerel Creek, Club Stream, Stewart Creek (including its tributary Blackjack Creek), are mostly small, groundwater-fed streams. All have Type 1 trout stream regulations, and are classified as coldwater streams.

Lakes

There are six lakes of note within this valley segment: Clifford, Lance, Murner, Olund, Pickerel, and Wildwood. Clifford and Lance lakes are small private lakes and are not actively managed by Fisheries Division. The MDNR attempted to acquire property on Lance Lake to provide a small carry-in access site for the public, but the property was sold before the purchase could be made. The state should pursue property acquisition on this lake to provide for public access if future opportunities become available. Pickerel Lake is a Designated Type A trout lake (Table 25), and is annually stocked with 2,500 rainbow trout. Pickerel Lake was last surveyed in 2007 and also supports populations of bluegill, yellow perch, pumpkinseed, and largemouth bass. The rainbow trout are surviving and providing a fishery, although growth rates are variable. Wildwood Lake is a 350-acre shallow lake with a lake-level control structure (dam) on it. Due to an abundance of small pike, there is a no minimum size limit, or “no MSL,” regulation for pike on this lake. Wildwood Lake was last surveyed in 2002, when game fish collected included yellow perch, bluegill, rock bass, and pumpkinseed, and a large number of northern pike. No fisheries data are available for Murner or Olund lakes.

West Branch Sturgeon River

Main Stem

The West Branch Sturgeon River is classified as a cold stream, and was stocked with rainbow trout and brook trout in the 1950s, but managers quickly realized that natural reproduction was more than adequate to maintain the fishery. Fisheries Division has a SSTP fixed sampling site on the West Branch Sturgeon River at the crossing of highway Old 27. Brown trout were the most abundant salmonid species captured at this station, followed by rainbow trout. Only a few brook trout were present. Standing crop of brown trout (66 pounds per acre) was slightly above that of other fixed sites in the NLHMU (Figure 37). Standing crop of rainbow trout (10 pounds per acre) was comparable to other high quality trout streams within NLHMU (Figure 38). Brook trout are also present in the upstream areas of the West Branch Sturgeon River.

Tributaries

Marl Creek is classified as a coldwater stream and has Type 1 trout stream regulations. No fisheries data are available for this stream.

Lakes

Four lakes within this segment that are actively managed by the MDNR include Hoffman, Thumb, Silver, and Weber lakes. General fisheries surveys of Hoffman Lake and Thumb Lake were conducted in spring 2008. Thumb Lake, also known as Lake Louise, is annually stocked with 20,000 splake (a cross between brook trout and lake trout) and has Type B trout lake regulations (Table 25). Thumb Lake has been stocked with trout on a fairly regular basis since 1942, with an initial rainbow trout plant as early as 1922. Splake have been stocked in the lake since 1976, except 1978–1980, when lake trout were stocked. Rainbow trout were also stocked in 2008. In the 1930s and 1940s, managers stocked warm and coolwater species such as largemouth and smallmouth bass, walleye, perch, and bluegill. In addition to splake and rainbow trout, game fish species encountered in the 2008 survey of Thumb Lake included panfish species (yellow perch, bluegill, and pumpkinseed), and northern pike. A creel survey was done on Thumb Lake in 2006, which indicated a fairly low catch of splake (MDNR, unpublished data). These results should be interpreted with caution however, as the creel survey was conducted only from April through September. Angler reports indicate that there is a substantial winter fishery for splake, but this information was not captured in the creel survey.

Hoffman Lake was stocked with rainbow trout in the 1920s and 1940s, and brook trout in the 1930s and 1940s. Bluegill were also stocked in Hoffman Lake in 1937. The 2008 survey of Hoffman Lake found largemouth bass, northern pike, bluegill, and yellow perch. There is no MSL for northern pike in Hoffman Lake, a regulation that was put in place to reduce the abundance of small fish and keep the population size in check. Based on the 2008 survey, which showed good northern pike size and age structure, the "no MSL" regulation will be removed for Hoffman Lake. The lake responded well to the no-MSL regulation, but we believe the size structure is currently such that the population will be self-regulating, and that standard, statewide regulations should be restored.

Silver Lake and Weber Lake have Type B trout lake regulations (Table 25), and are stocked annually with trout by the MDNR. Current management prescriptions call for Silver Lake and Weber Lake to receive an annual plant of 5,000 rainbow trout and 2,500 brown trout, respectively.

A general survey of Silver Lake was conducted in 1995. A good number of rainbow trout were captured in the nets, indicating that the stocked fish were surviving. Rainbow trout growth was acceptable at the time. Other species in the lake, including bluegills, pumpkinseeds, rock bass, and smallmouth bass, were not growing very well and did not have the size distributions that attract much angling attention. The lake primarily supports a trout fishery but perch fishing can be good there on occasion.

Weber Lake was last surveyed in 1992 to assess the trout population. Good survival of stocked brown trout was noted. Reports indicate that the yellow perch fishery was improving, with an average size of 8.4 inches in the catch.

Sturgeon River—Confluence with West Branch Sturgeon River to Burt Lake

Main Stem

The Sturgeon River becomes fast and deep with increased discharge from the added flow of the West Branch Sturgeon River, downstream of which it is classified as warm-transitional. The most recent fisheries survey for this reach was completed in 2007, at the township park in Wolverine, just downstream of the confluence with the West Branch Sturgeon River. This survey found a mix of brook, brown, and rainbow trout, with brown trout dominating the catch. Some warmwater species such as bluegill and pumpkinseed also were captured in 2007. This reach is similar to the adjacent reach upstream, and along with the West Branch Sturgeon River has a mix of resident and lake-run brown trout and rainbow trout (steelhead). The mostly coldwater fish community in this reach also has some cool and warmwater species present. In addition to the lake-run brown and rainbow trout, the river supports runs of other species from Burt Lake such as walleye and white suckers. Similar to the reach above the West Branch Sturgeon River, there was a considerable amount of habitat work done in this reach during the 1980s by the Michigan Youth Corps.

Tributaries

The only tributary to the Sturgeon River downstream of its confluence with West Branch Sturgeon River is Beebe Creek, which is classified as a coldwater stream and has Type 1 trout stream regulations. No fisheries data are available for Beebe Creek.

Lakes

Inland lakes are absent within this segment

Burt Lake

A netting survey of Burt Lake was done in 2001–2002 as part of Fisheries Division's Large Lakes Program, a statewide program designed to improve assessment and monitoring of fish communities and fisheries in Michigan's largest inland lakes.

Hanchin et al. (2005a) provide a description of the fish community based on that survey:

> We collected a total of 17,227 fish of 28 species…. Total sampling effort was 321 trapnet lifts, 31 fyke-net lifts and 6 electrofishing runs. We captured 2,899 walleyes and 203 northern pike. Other game species collected in order of abundance of total catch were: rock bass, smallmouth bass, yellow perch, rainbow trout, brown trout, largemouth bass, pumpkinseed, bluegill, black crappie, muskellunge, and brook trout.
>
> The trout populations in Burt Lake are a testimony to the quality of the rivers that feed the lake. The Sturgeon and Maple river systems harbor quality spawning runs of rainbow and brown trout. The young fish, particularly rainbow trout, often migrate downstream and live out their remaining life cycle in Burt Lake. Trout have access to more forage in the lake, and can grow to impressive sizes.

Hanchin et al. (2005a) also reported that an estimated 42,032 adult walleye (approximately 2.4 fish per acre) were in Burt Lake. An estimated 1,779 adult northern pike (approximately 0.1 fish per acre) were also in Burt Lake at the time of the survey. Burt Lake was again surveyed in the spring of 2011 as part of a walleye survey of the Inland Waterway, including Burt, Mullett, Pickerel, and Crooked lakes, as well as the Crooked, Indian, Cheboygan, and Black rivers. Results of this survey were not yet available at the time this report was completed.

Burt Lake has a long history of fisheries management. Since 1925 various fish species have been stocked in the lake, including rainbow trout, lake trout, walleye, lake sturgeon, rock bass, northern pike, and yellow perch. The most recent MDNR fish stockings in Burt Lake were a 1987 rainbow trout plant and lake sturgeon plants in 1990 and 2009. Burt Lake supports diverse and popular sport fisheries for everything from walleye and perch to rainbow trout and brown trout.

Tributaries

Tributaries to Burt Lake include the Sturgeon and Maple rivers, which were discussed previously. The Little Carp River, also a tributary to Burt Lake, is classified as a coldwater stream and has Type 1 trout stream regulations. Several unnamed tributaries to Burt Lake are also classified as coldwater streams: two at the northwest corner of the lake, and one in the northeast corner of the lake (tributary to White Goose Bay). None of the unnamed streams have trout stream regulations.

Other tributaries to Burt Lake are in the Crooked River drainage, which includes Pickerel and Crooked lakes. These tributaries include Minnehaha Creek, West Branch Minnehaha Creek, Silver Creek, Berry Creek, Cedar Creek, and McPhee Creek. All of these tributaries have Type 1 trout stream regulations and are classified as coldwater streams. The Crooked River does not have trout stream regulations and is classified as a warm-transitional river. A 2003 survey of West Branch Minnehaha Creek found brook trout and brown trout, with brook trout being much more abundant. Silver Creek, a tributary to Crooked Lake, was stocked with brook trout from 1959–1965, and with rainbow trout in 1988. No contemporary survey data exist for Silver Creek. Crooked River was surveyed in spring of 2011 as part of a walleye survey of the Inland Waterway, including Crooked, Indian, Cheboygan, and Black rivers, as well as Burt, Mullett, Pickerel, and Crooked lakes. Results of this survey were not yet available at the time this report was completed.

Other Lakes

Pickerel and Crooked lakes are managed primarily for coolwater fish species including walleye and northern pike. Walleye and pike populations were evaluated in 2001 as part of the large lakes program, with an estimated 12,346 adult walleye and 628 adult northern pike present at the time (Hanchin et al. 2005b). Both lakes were previously stocked with walleye in alternate years. However, fall walleye evaluations for Pickerel and Crooked lakes subsequent to the 2001 large lake survey have documented good natural reproduction of walleye so the stocking frequency has been reduced to every three years. Walleye stocking was not completely discontinued due to an agreement with the Pickerel-Crooked Lakes Association.

Round Lake is a 353-acre natural lake and has a maximum depth of 14 feet. The lake is at the head of the Cheboygan River watershed, with an unnamed outlet that flows to Crooked Lake. Round Lake was stocked with smallmouth and largemouth bass, perch, bluegill, and perch in the 1930s and 1940s. Walleye were stocked in 1957, 1991, 1995, 1996, and 1998. The lake was last surveyed in 1968, when northern pike, walleye, smallmouth and largemouth bass, and bluegill were the most abundant game fish species.

Pigeon River—Headwaters to Golden Lotus Dam

Main Stem

This reach and its tributaries are designated trout streams with Type 1 trout stream regulations, and are classified as coldwater streams. The primary game fish within this reach is brook trout. Golden Lotus Dam at the downstream end of this reach prevents access for migratory brown and rainbow trout.

Tributaries

The South Branch Pigeon River has Type 1 trout stream regulations, and is classified as a coldwater stream. The stream was last surveyed in 2007 and brook trout, brown trout, and tiger trout (a cross between brook and brown trout) were found.

Lakes

The most notable lake within this reach is Lansing Club Pond, an impoundment of the main stem formed by Golden Lotus Dam. Lansing Club Pond is not valuable from a fisheries management perspective; it is very shallow, with substrate that is thick organic silt accumulated along the bottom. This dark substrate absorbs sunlight and heats the water, warming the reach of the Pigeon River below the dam.

A more valuable lake from a fisheries management perspective is Big Lake. This lake is stocked with walleye by the MDNR and was most recently surveyed in 2005 to evaluate walleye recruitment. The survey found a good walleye population, with a substantial amount of natural reproduction. Based on an analysis of oxytetracycline (OTC) marks, 77% of the 22 age-0 walleye captured were of wild origin.

Other lakes within this segment include Denny Lake, Fifteen Lake, Ginsell Lake, Lewis Lake, and Oley Lake. No fisheries data are available for these water bodies, and fisheries management is limited to typical sport fishing regulations.

Pigeon River—Golden Lotus Dam to confluence with Little Pigeon River

Main Stem

Brook, brown, and rainbow trout are all present in this reach, which is greatly influenced by the presence and operation of Golden Lotus Dam. In addition to the warming effects of the impoundment reducing coldwater fisheries potential, the reach is affected by the peaking operation of the dam (see **Dams and Barriers**). This peaking and ponding operation results in the dewatering of steelhead redds, the stranding of fish and invertebrate species, and the downstream flushing of small fish, eggs, and invertebrates during high flows. This stretch of the Pigeon River is managed with Type 2 trout stream regulations.

In 1954 and 1984 sediment was released from the impoundment, resulting in fish kills downstream. Another sediment release and subsequent fish kill occurred in June 2008. Extensive sampling to determine the magnitude of the fish kill was conducted and is summarized in Nuhfer et al. (2009a). In addition, electronic temperature recording thermometers have been deployed above the dam and at various locations downstream of the dam over the past decade. Analyses of these temperature data show that summer water warming caused by the dam reduces thermal habitat suitability for trout downstream and that dam removal could expand optimal thermal habitat for trout by up to 16 miles (Nuhfer et al. 2009c). For the most recent case, an interim order was entered with the 46th Circuit Court on April 5, 2010, which called for removal of the Golden Lotus Dam after a plan for dam removal is developed and monitoring is done.

Fisheries Division has a SSTP fixed sampling site on the Pigeon River at Elk Hill Campground. Abundance, density, and standing crop of trout populations were estimated from samples collected in July or August of each year from 2002 to 2004. Fish populations within the 1,000-foot reach of river sampled were estimated using standard mark-recapture fish sampling methods employed by the MDNR (Schneider 2000). Brown trout, brook trout, and rainbow trout populations at this site were lower than the NLHMU and statewide averages (Figures 36-38).

Tributaries

Cornwall Creek, Grindstone Creek, and Nelson Creek are all designated trout streams and have Type 1 trout stream regulations. Although all of Cornwall Creek is classified as cold water, the Type 1 regulations apply only to the reach upstream of Cornwall Flooding. A 1984 survey of this stream found brook and brown trout.

Lakes

Cornwall Creek Flooding and Grass Lake support warmwater fish communities. Cornwall Creek Flooding is a good panfish lake, with notable catches of bluegills and perch. It was stocked with tiger muskellunge in alternate years from 1979 to 1991. Because of the muskellunge plants, spearing on the lake was banned. The spearing ban remained in place (except for carp) on the lake until 2010, when the spearing ban was removed. Cornwall Creek Flooding was last surveyed in 1995 and a good number of largemouth bass were found. Grass Lake is small and shallow and prone to periodic winterkill. The lake was stocked with bluegill and smallmouth bass in the 1930s. Grass Lake was last surveyed in 2003, when four species of fish were documented: bluegill, brown bullhead, green sunfish, and pumpkinseed.

A number of small, unique "sinkhole" lakes are located in this reach: North Twin, South Twin, Hemlock, Ford, West Lost, Lost, and Section 4 lakes. These lakes were formed when underground limestone caves collapsed to form sinkhole depressions at the surface. The seven sinkhole lakes, ranging in size from 3–10 acres, were closed to fishing in the 1960s to allow for research studies in their waters. While the lakes were used for a number of important studies, they had not been used for research since the 1990s. In an effort to increase fishing opportunity the fishing ban was removed for these lakes in 2008, and four of the lakes (Hemlock, Ford, West Lost, and Section 4 Lakes) are stocked with trout. Measures were taken to ensure that the fishing pressure on these lakes would not increase erosion and sedimentation. Watercraft restrictions were placed on the lakes so that vessels are prohibited where launching and recovery of such craft were expected to cause erosion. The exceptions are as follows: nonmotorized single-user float tubes are permitted on North and South Twin lakes, Section 4 Lake, and Lost Lake; while it is unlawful to operate a vessel powered by a motor except an electric motor on Hemlock, Ford, and West Lost lakes. The four stocked lakes are now classified under Type D trout lake regulations. Only artificial lures may be used on these lakes, and the minimum size limit for brown trout, brook trout and rainbow trout is 15 inches.

Pigeon River—Confluence with Little Pigeon River to Mullett Lake

Main Stem

The upper portions of this reach support high populations of subyearling rainbow trout along with fairly low-density populations of brook trout and brown trout. We believe that mortality of trout in this reach is high because during most years, summer water temperatures in this reach are higher than optimal for trout. Brown trout are the predominant salmonid species species based on biomass. Summer populations of brown trout are augmented by immigrants from Mullet Lake that ascend the river during the summer before spawning later in the fall. The warmer summer water temperatures in this reach support a more diverse and abundant community of non-trout fish species as compared to reaches farther upstream. Type 2 trout stream regulations are in place upstream of M-68, while Type 4 trout stream regulations occur downstream of M-68 to allow anglers to fish for steelhead that ascend the river from Mullett Lake.

A number of fish surveys have been done in this reach in the past, with the most recent survey completed in 2003 as a random site under the SSTP. A 1,200-foot reach was surveyed at the Andrea Agnes Nature Preserve downstream of M-68. Young rainbow trout and brook trout, which use this reach only seasonally, were captured along with a number of brown trout.

Tributaries

The Little Pigeon River is a designated trout stream with Type 1 trout stream regulations. It is a coldwater stream in its upper reaches and a cold-transitional stream in its lower half. The Little Pigeon River has not been stocked. A survey conducted in 2002 found brook and brown trout, with brook trout dominating. Forage fish such as shiners, dace, chubs, and suckers were common. Although there are no fisheries data for Kimberly Creek, a small tributary to the Little Pigeon River, angler reports indicate that it is an excellent brook trout stream.

Lakes

Lakes in this segment include Mud Lake, Echo Lake, Hackett Lake, and Sixteen Lake. Mud Lake is a small, shallow lake that is prone to winterkill. A 2003 survey of the lake found only two species of fish (yellow perch and golden shiners), both of which are relatively tolerant of low dissolved oxygen conditions. The limited fisheries data available for Echo Lake indicate the lake supports populations of bluegill and northern pike. No fisheries data are available for Hackett Lake or Sixteen Lake. Fisheries management is limited to general statewide sport fishing regulations.

Mullett Lake

Fisheries management in Mullett Lake has included fish surveys, creel surveys, and the stocking of numerous species such as lake trout, brown trout, brook trout, rainbow trout, splake, lake sturgeon, and walleye. The lake supports popular walleye and smallmouth bass fisheries, as well as fisheries for brown and rainbow trout. Although the lake has been stocked with a small number of walleye in recent years, the main source of walleye is from natural recruitment throughout the system. Mullett Lake, like the other large lakes in this watershed, has a population of lake sturgeon, although the size of that population is unknown. Mullett Lake supported a popular winter ice fishery (spearing) for lake sturgeon until 2000, when sturgeon spearing was closed statewide (with a few exceptions) due to population concerns. A research project that began in 2009 will attempt to quantify the size of the lake sturgeon population within this lake. Mullett Lake was surveyed in the spring of 2011 as part of a walleye survey of the Inland Waterway, including Burt, Mullett, Pickerel, and Crooked lakes, as well as the Crooked, Indian, Cheboygan, and Black rivers. Results of this survey were not yet available at the time this report was completed.

Tributaries

The Indian River is the principal tributary to Mullett Lake and is part of the Inland Waterway, connecting Burt Lake to Mullett Lake. The Indian River “spreads” provides good habitat for Great Lakes muskellunge and for a number of years was the collection site for the muskellunge egg take for Michigan’s hatchery system. From 1972 into the late 1980s and early 1990s muskellunge were trapped at the “spreads” for an egg take; the fertilized eggs were then flown to a hatchery in Wisconsin for incubation and hatching. Reports of lake sturgeon spawning in the Indian River have also been received. Indian River was surveyed in spring of 2011 as part of a walleye survey of the Inland Waterway, including Crooked, Indian, Cheboygan, and lower Black rivers, as well as Burt, Mullett, Pickerel, and Crooked lakes.

Tributaries to the Indian River include the Little Sturgeon River and Crumley Creek. The Little Sturgeon River is home to the Little Sturgeon Trout Club, which is a large property holder in this reach. The trout club stocks a substantial number of fish in this river, and has done a considerable amount of stream alteration on club property, including the addition of bulkheads, diverters, check dams, and fish cover. A 1958 survey of Crumley Creek found brook trout, sculpin, and yellow bullhead.

Mullett Creek is a small tributary to Mullett Lake. It is a coldwater stream in the upper reaches and a cold-transitional stream in its lower half. Mullett Creek has fairly high groundwater loading and supports a brook trout population, but the lower reaches are susceptible to elevated temperatures due to beaver dams and some agricultural land use practices. In 2007, a group was formed involving the U.S. Fish and Wildlife Service (USFWS), the Natural Resources Conservation Service, and the MDNR Fisheries Division out of concern about loss of in-stream habitat and increased sediment load. The last survey in 2007 revealed an excellent brook trout population along with other common coldwater species such as sculpins.

Other Lakes

Cochran Lake was stocked in 1940s to the early 1960s with a variety of species including smallmouth and largemouth bass, bluegill, redear sunfish, and rainbow trout. Numerous surveys show a fish community with yellow perch, largemouth bass, bluegill, bullhead, and a few northern pike. The lake was chemically reclaimed with rotenone in 1959, and restocked with bluegill and largemouth bass.

Roberts Lake is considered a twin lake to Cochran Lake. Roberts Lake was stocked with hybrid bluegill in the 1990s, and is known as a good panfish lake. MDNR Fisheries Division maintains a water level control structure on this lake.

Devereaux Lake is a private lake, but creel census records from the 1940s and 1950s indicate the presence of smallmouth bass, pumpkinseed sunfish, rock bass, and yellow perch.

Black River—Headwaters to Clark Bridge Road

Main Stem

The Black River watershed is known for its outstanding brook trout fishery which is managed through a variety of coldwater fisheries regulations (Table 24). The upper part of this reach is under Type 1 trout stream regulations while special regulations (see previous research area description) are in place from Tin Shanty Bridge to the Town Corner Lake stairs. Below the stairs, Type 1 trout streams regulations extend to Tower Pond.

The Upper Black River Council (UBRC), composed of many different partners including the MDNR (see **Citizen Involvement**), has been involved with fisheries management in this watershed. In this reach, the UBRC has placed large woody debris within the stream for fish habitat, and plans to continue this in-stream habitat work in the future. The UBRC works closely with trappers in the area to reduce the beaver population on the Black River and its tributaries. The group also employs a summer work crew to place large woody debris in the river and remove key beaver dams as directed.

The UBRC also spearheaded the completion of a number of watershed inventories, including those for road-stream crossings and eroding streambanks. These inventories have helped guide and prioritize restoration activities in the watershed. The group also collects hourly temperatures at various locations throughout the Black River watershed.

Past fisheries management activities within this reach of the Black River by the MDNR include maintenance of a sand trap at Tin Shanty Bridge. There are also two sand traps in this section that are maintained by a private association, the Black River Ranch. The reach was stocked with brook trout from 1959–1965 and numerous fisheries surveys have been conducted throughout the years. Brown trout were manually removed in 1981 and 1983 to reduce competition with brook trout.

Tributaries

Stewart Creek, Tubbs Creek, and Little McMasters Creek are all classified as cold-transitional streams. Stewart and Tubbs creeks have Type 1 trout stream regulations.

Lakes

Notable lakes in this segment include North and South Blue lakes, Town Corner Lake, and Hardwood Lake. North and South Blue lakes are managed under special “quality” regulations with an open season of last Saturday in April to September 30. Possession is not allowed (catch-and-release only), and only artificial lures may be used. North Blue Lake has a good yellow perch population, while South Blue Lake provides quality fishing for bluegill and largemouth bass. This was confirmed when the lakes were last surveyed in 2001.

The primary game fish in Town Corner Lake is largemouth bass. Green sunfish and brown trout were also encountered at lower numbers in the most recent (1983) survey. The lake was chemically reclaimed in 1962, and restocked with rainbow trout and largemouth bass. Subsequent stocking was done with brook trout (1964), brown trout (1965 and 1983), and rainbow trout (1973). Hardwood Lake was stocked in 1932 and 1933 with bluegill. There have been no other fisheries management actions in Hardwood Lake due to its low fisheries value.

East Branch Black River

Main Stem

The East Branch Black River is also known for its brook trout fishery and has seen a considerable amount of fisheries management over the years, with stream improvement plans dating back to 1932. These plans included placement of current deflectors and fish cover. Current fisheries management activities in this reach include Type 1 trout stream regulations, periodic maintenance of a sand trap, and numerous trout population estimates. There are plans to maintain the sand trap in this reach more frequently.

Tributaries

Rattlesnake Creek is a coldwater stream with Type 1 trout stream regulations. Rattlesnake Creek is a popular brook trout stream that was most recently surveyed in 2008 when population estimates were made at four stations. Management plans for this river include spawning riffle enhancements to increase the production of young-of-year brook trout.

Lakes

Foch Lake is an impoundment managed by Fisheries Division. The impoundment/flooding was originally proposed by Wildlife Division in 1949 or 1950, built by Fisheries Division in 1955 (52 acres), and raised in 1963 (85 acres). Foch Lake has largemouth bass and bluegill populations, and the impoundment here provides increased recreational fishing opportunity. The adjacent state-owned land is popular for dispersed camping.

Black River—Clark Bridge Road to Kleber Dam

Main Stem

Fisheries management in this segment of the Black River has been limited. Future activities in this reach may be conducted by the UBRWRC.

Tributaries

No fisheries management activities have occurred on the tributary streams, with the exception of Canada Creek (discussed below). McMasters Creek, Tomahawk Creek, Welch Creek, and Gregg Creek are warm-transitional streams. Bowen Creek is classified as a cold-transitional stream. All of these tributaries have Type 1 trout stream regulations, except for Bowen and Gregg creeks, which are not designated.

Lakes

Lakes in this segment include two floodings—one that is managed by Wildlife Division (Dog Lake), and one that is managed by Fisheries Division (Tomahawk Creek Flooding). Dog Lake flooding is prone to periodic winterkill, and the only fisheries management activity was a plant of bluegill and smallmouth bass in 1937. Tomahawk Creek Flooding was stocked in 1967 with golden shiners, largemouth bass, and tiger muskellunge. The most recent survey (2004) found good numbers of panfish (e.g., bluegills, pumpkinseed, and yellow perch), northern pike, and largemouth bass. Northern pike are a popular game fish on this flooding.

Kleber Pond is an impoundment of the Black River, and was last surveyed in 1969. Northern pike, bluegill, pumpkinseed, and rock bass were all common. Tower Pond impounds the Black River upstream of Kleber pond and has pike and panfish, as well as some brook trout that use the pond seasonally for refuge. Northern pike spearing is allowed in Tower Pond December 1 through March 15 through the ice. This regulation is designed to reduce predation on brook trout in the pond. Tower Pond was last surveyed in 1979.

Tomahawk Lake has good bass, pike, and bluegill populations based on the last survey (1979). The lake was stocked with smallmouth bass, perch, and bluegill from 1937-40. Little Tomahawk Lake was stocked with smallmouth and largemouth bass, perch, and bluegill in the 1930s and 40s. It was most recently stocked with splake in 1988.

Shoepac Lake was stocked with a variety of fish species over time. Smallmouth bass, largemouth bass, perch, and bluegill were stocked in the 1930s, rainbow trout in the 1960s, rainbow trout and steelhead in the 1970s, and brook trout, rainbow trout, and brown trout in the 1980s and early 1990s. The most recent survey of Shoepac Lake in 2007 documented a coolwater fish community with game fish species such as largemouth bass, northern pike, and various pan fish species.

Francis Lake was stocked with smallmouth bass, perch, and bluegill in the 1930s and early 1940s, and then with rainbow trout from 1966-72. There is no MSL for northern pike in Francis Lake.

Canada Creek

Main Stem

Canada Creek is well known for its brook trout fishery. The UBRWRC has added some large woody debris in this reach, and two sand traps are maintained by the MDNR. Four additional sand traps in Canada Creek are maintained by a private association, Canada Creek Ranch. Canada Creek is mostly a cold-transitional stream, except in the area downstream of Valentine Lake, where it is warm-transitional, and near the mouth, where it is classified as a coldwater stream.

The Hungerford’s crawling water beetle (HCWB, *Brychius hungerfordi*) was recently found in Canada Creek and has been known to inhabit one of its tributaries, Van Hetton Creek. The HCWB is an endangered species, and fisheries management plans that have the potential to disturb its habitat (such as stream habitat improvement) now must be reviewed by the USFWS.

Tributaries

Van Hetton, also known as Van Hellon, Creek was last surveyed in 2004. One brook trout, along with creek chubs, blacknose dace, and a blackside darter were found. Michigan Deparment of Environmental Quality, Water Bureau surveyed Oxbow Creek in 2005, and found mostly blacknose dace and creek chubs, along with a few mudminnows, fathead minnows, and northern redbelly dace. No fisheries data are available for the other streams. All tributaries in this reach have Type 1 trout stream regulations. Montague Creek is classified as a coldwater stream, Van Hetton Creek as a cold-transitional stream, and Oxbow Creek as a warm-transitional stream.

Lakes

Several small- to medium-sized lakes are present within this segment. Bear Den Lake was first stocked with warm and coolwater species from 1937–1942, and then stocked with brook trout, rainbow trout, and brown trout from 1942–1971. Since 2004, Bear Den Lake has been stocked with rainbow trout (Eagle Lake strain) and brook trout (Assinica strain). Bear Den Lake has Type B trout lake regulations.

Muskellunge Lake is a bass-bluegill lake, with a population of northern pike. The lake was last surveyed in 1952. Pug Lakes are a chain of lakes adjacent to Muskellunge Lake. The last official survey of Pug Lakes was in 1969, which documented largemouth bass, brook trout, pumpkinseed, northern pike, bluegill, and rock bass. Recent angler information indicates there is a high number of small northern pike. East Town Corner Lake is also a bass-bluegill-pike lake. East and West Town Corner lakes have no MSL for northern pike. Doty Lake is also a bass-bluegill lake but is prone to periodic winterkill. A 1975 survey of Jackson Lake revealed a strong panfish community (e.g., yellow perch, bluegill, and pumpkinseed sunfish), along with northern pike and largemouth bass.

Clear Lake receives a substantial amount of recreational fishing pressure, due in part to the presence of a state park on its shore. The lake has been stocked, primarily with trout, since the early 1960s. A number of chemical fish reclamations using rotenone have been done for trout management. Since 1990, splake have been stocked into Clear Lake annually (except in 1998, when no fish were stocked). A 2004 general survey found good populations of splake and smallmouth bass in this 2-story fishery (splake in the deeper water, and bass in the shallow areas). Angler reports of good splake fishing were also noted.

Valentine Lake is surrounded by private property, and reportedly has good populations of largemouth bass, smallmouth bass, and northern pike. Lake Geneva, Little Joe Lake, Virginia Lake, and Wildfowl Lake are all private lakes completely surrounded by Canada Creek Ranch Association property.

Black River—Kleber Pond Dam to Black Lake

Main Stem

This reach is managed primarily for lake sturgeon spawning habitat, and is a warm-transitional river. Black Lake supports a substantial lake sturgeon population, which spawns within this reach. Numerous research projects have been undertaken here by the MDNR, Michigan State University, Central Michigan University, and Sturgeon for Tomorrow. A lake sturgeon head-start program is also initiated here. Larval lake sturgeon are collected from the stream, brought to a hatchery to grow, and then released back into the Black River or other nearby streams. This program helps increase survival of this state-threatened fish species.

Tributaries

Two headwater tributaries, Gokee Creek and Adair Creek, are coldwater streams. Milligan Creek is a warm-transitional stream, with Type 1 trout stream regulations. Because Milligan Creek is a warm-transitional stream, it is susceptible to changes in fish community composition from small changes in temperature. For this reason, a beaver control and beaver dam removal program has been implemented in recent years on this stream to restore brook trout habitat. Much of the dam removal work has been done by the UBRWRC.

Lakes

Fisheries survey data are available for McLavey and Osmun lakes. McLavey Lake was netted in 1969 and 1974. A coolwater fish community dominated by northern pike, yellow perch, and pumpkinseed was documented. Osmun Lake is known for its healthy largemouth bass and bluegill populations. A survey of the lake was done in 2007, and the lake is being considered for classification as a "Quality Lake." Stony Creek Flooding is managed by Wildlife Division for waterfowl. No fisheries data are available for Duby Lake or Lost Lake.

Black Lake

Main Stem

Black Lake is managed primarily for lake sturgeon and coolwater fisheries (walleye, northern pike, and muskellunge). A survey was done on Black Lake in 2005, as part of the Large Lakes program. This survey estimated that 14,013 adult walleye and 8,826 adult northern pike were in Black Lake (Cwalinski and Hanchin, 2011).

Tributaries

Coldwater tributaries in this reach include Fisher, Stewart, Stony, and Mud creeks. Stony Creek is managed with Type 1 trout stream regulations. The Rainy River is classified as a warm-transitional stream, but also has Type 1 trout stream regulations upstream of M-68. Cold Creek is classified as cold-transitional stream.

Lakes

This reach contains a number of lakes within its drainage. Loon Lake was last surveyed in 1968 and pumpkinseed sunfish, yellow perch, and northern pike were documented. Excellent growth rates for northern pike were noted. Fisheries management in Big Mud Lake is limited to stocking a small number of smallmouth bass in 1939. Since Rainy Lake periodically drains (see **Geology**), little fisheries management activity has occurred there beyond commenting on lake augmentation strategies proposed by the lake association. Little Tomahawk Lake was stocked with bluegill, largemouth bass, and smallmouth bass in the 1930s, and was stocked with splake in 1988. The lake was surveyed in 1966, and good bass reproduction was noted. Big Tomahawk Lake was last surveyed in 1979 when a fish community of largemouth bass, rock bass, yellow perch, pumpkinseed sunfish, and northern pike were present. The lake was stocked with smallmouth bass, yellow perch, and bluegill in the 1930s and early 1940s.

Lower Black River

Main Stem

The lower Black River is a warm water stream, and is primarily managed through fisheries regulations. Lake sturgeon spawning has been reported in the area below Alverno Dam. Accordingly, the fishing season in the lower Black River is restricted from Alverno Dam down to Mograin Bridge. There is no fishing from April 1 to May 15 to protect spawning lake sturgeon as well as northern pike, muskellunge, and walleye. The lower Black River was surveyed in spring 2011 as part of a walleye survey of the Inland Waterway, including the lower Black, Crooked, Indian, and Cheboygan rivers. Results of this survey were not yet available at the time this report was completed.

Tributaries

All tributaries in this segment are classified as warm-transitional, except for Long Lake Outlet, which is cold-transitional. There are no designated trout streams in this portion of the watershed. Fisheries management on Myers Creek includes helping with designs for stream channel restoration to a coldwater tributary. In 2002, a private property owner placed a 225-ft culvert along the stream and placed fill over top of the culvert. In December 2005, a circuit court judge ruled that the culvert must be removed and the stream restored. Fisheries Division has been assisting in an advisory capacity for the stream restoration.

Lakes

Walleye and northern pike are the primary game fish in Long Lake. The lake was last surveyed in 2005, when some natural reproduction of walleye was documented. The level of reproduction is inadequate to maintain the fishery, so walleye are stocked on an alternate year basis.

Twin Lakes refers to five lakes in northeastern Cheboygan County. Twin Lake #1 is a designated trout lake with Type D regulations (Table 25). It has been stocked with trout since 1963. Brown trout have been stocked annually since 1990 and will be alternated with rainbow trout plants beginning in 2008. There is a local watercraft control for Twin Lakes which prohibits high speed boating, making the lakes ideal to fish from a float tube or canoe.

Twin Lakes #2-5 were stocked with tiger muskellunge in the 1970s, and then with splake in the 1980s and early 1990s. Based on a 2000 survey, major game species include bluegill, northern pike, and largemouth bass.

Cheboygan River

Main Stem

Steelhead and Chinook salmon are stocked annually in the Cheboygan River, which is classified as warm water. The Chinook salmon are kept in net pens near the mouth of the river for a number of days in the spring, allowing the fish to smolt in ambient river water. Holding the salmon in net pens prior to their release greatly improves the rate of return of adult salmon to their stocking location (J. Johnson, MDNR, personal communication).

Tributaries

Laperell Creek is a small brook trout stream with a few brown and rainbow trout. It is classified as a coldwater stream and is currently managed with Type 1 trout stream regulations. Laperell Creek was stocked with brook trout from 1959–1965, and was last surveyed in 1972.

Lakes

There are no lakes within this segment.

Recreational Use

Recreational opportunities are abundant in the Cheboygan River watershed due to the large amount of publicly-owned land (Figure 39) and the variety of lakes, streams, and rivers within its boundaries. Public access to these water bodies can be found throughout the watershed and includes state-owned canoe and boat launches (Figure 40), township and municipal ramps, and many informal, publicly-owned access points. Many water bodies may also be accessed through state forest lands (see **Special Jurisdictions**) and at road-stream crossings where allowed by law. There is a lack of public access sites (or access through forest land) in some regions of the watershed, particularly the Maple River, Rainy River, and the headwaters of the Sturgeon and Pigeon rivers. Access to some of the small tributaries within the watershed, such as Minnehaha Creek, Club Stream, and Mullett Creek, is also limited.

Although angling is one of the primary recreational activities within the watershed, very little angler pressure and use data exist. Historical catch rate data was gathered by Michigan Department of Conservation officers through angler interviews from the late 1920s through the 1960s (Appendix D; see **Fishery Management**). Much of these data were gathered during a period when small inland streams in Michigan were stocked with legal-size trout and should be interpreted with caution due to the lack of project design. For instance, effort and target species were not recorded in these historical interviews. Fishing pressure data has been gathered via creel surveys for many of the large lakes (see **Fishery Management**), but data on angler use, preferences, and demographics are lacking for most parts of the watershed and should be acquired. This is especially important for sections of the watershed where fish stocking is an ongoing management tool.

Boating opportunities exist in many of the rivers and lakes throughout the watershed. The Inland Waterway is Michigan's longest chain of rivers and lakes, with a navigable route of nearly 40 miles from the mouth of the Cheboygan River at Lake Huron to Crooked and Pickerel lakes in Emmet County. The waterway is used by both pleasure boaters and anglers seeking recreational opportunities throughout its course, which also includes Mullett Lake, the Indian River, Burt Lake, and the Crooked River. Passage through the waterway is aided by lock systems located on the Cheboygan River in Cheboygan and on the Crooked River in Alanson. Smaller rivers throughout the watershed are frequently used by canoeists and kayakers.

Other recreational activities in the Cheboygan River watershed include biking, bird watching, berry and mushroom picking, camping, cross-country skiing, horseback riding, hunting, off-road vehicle (ORV) riding, and trapping. Four state parks and eighteen state forest campgrounds exist within the watershed (Figure 41), most of which are located in close proximity to a river or lake. Biking, cross-country skiing, and hiking opportunities are available at state-owned pathways and trails throughout the watershed. Horseback riding is available at three locations (Elk Hill State Forest Campground and Trail Camp, Johnson's Crossing Trail Camp, and Stoney Creek Trail camp); all have connections to the north spur of the Shore-to-Shore Riding/Hiking Trail. Ample hunting opportunities for small and large game are available on publicly-owned land throughout the watershed.

The operation of off-road vehicles (ORVs) is allowed on six loop systems within state forest land including the 38-mile Black Lake trail (which contains one of five scramble areas in Michigan), the 28-mile Red Bridge motorcycle trail, the 21-mile Bummer's Roost motorcycle loop, and the Tomahawk A (17 mile-long), B (40 mile-long), and C (37 mile-long) motorcycle trails. It is unknown to what extent the operation of ORVs occurs on private land and illegally on public lands. Illegal operation of ORVs is of special concern since it can lead to increased erosion, particularly at stream crossings.

Citizen Involvement

Citizen involvement in management of the natural resources within the Cheboygan River watershed occurs primarily through interaction with government agencies that manage the resource. Government agencies involved are the MDNR; MDEQ; United States Fish and Wildlife Service; United States Forest Service; United States Department of Agriculture, Natural Resource Conservation Service; various county road commissions; township and county offices; NEMCOG; and the Charlevoix, Cheboygan, Emmet, Montmorency, Otsego, and Presque Isle Conservation Districts (see **Glossary** for acronym definitions).

In addition to interaction with governmental agencies, citizens may become involved with nongovernmental or non-profit organizations that work on various aspects of the Cheboygan River watershed. Such associations include the Conservation Resource Alliance; Headwaters Land Conservancy; Huron Pines Resource Conservation and Development Council; Little Traverse Land Conservancy; Michigan Chapter of the Nature Conservancy; Michigan Council of Trout Unlimited; Pigeon River Country Advisory Council; SEE-North; Sturgeon for Tomorrow; Tip of the Mitt Watershed Council; and the Upper Black River Council. The Cheboygan River Watershed Habitat Partnership, formed in 2001, combines the talents and experiences of many of these nongovernmental organizations with state and local government agencies to further protect the natural resources of the Cheboygan River watershed.

Lake associations and sportsmen's clubs also provide an opportunity for citizen involvement at the local level. Large lakes within the watershed are represented by the Black Lake Association, the Burt Lake Preservation Association, the Douglas Lake Improvement Association, the Mullett Lake Area

Preservation Society, and the Pickerel-Crooked Lakes Association. A number of other lake associations represent the smaller water bodies located throughout the watershed.

As the population within a watershed increases, the potential for conflict among natural resource stakeholders becomes greater. Therefore, public involvement in the management and stewardship of these resources is critical for the long-term protection and enhancement of the Cheboygan River watershed. The Northern Inland Lakes Citizens Fishery Advisory Committee, established in 2009, provides an excellent opportunity for citizens to become involved with natural resource management within the watershed through a multi-agency, multi-organization partnership. Public involvement through the advisory committee, one of its member organizations, or other citizen groups provides the opportunity to open a dialogue on natural resources issues and promotes the exchange of experiences, ideas, and proposals among individuals, communities, interest groups, and government agencies. Numerous opportunities exist for concerned citizens to become involved in issues affecting the watershed; citizens are encouraged to take advantage of these opportunities for participation.

MANAGEMENT OPTIONS

The Cheboygan River watershed is healthy relative to some other watersheds in Michigan, with a broad range of habitat and water types. The thermal regime of the rivers is determined by the glacial geology, soils and land use types through which the river flows, but may be altered somewhat by dams and barriers within the watershed. Habitat degradation of the watershed is being addressed in some areas of the watershed, but will continually need work throughout the basin. The management options identified in this assessment are intended to address some of the more important problems that are now understood.

Many of the management options are recommended based on the need to protect and preserve the health of a river's ecosystem (Dewberry 1992). The protection and restoration of headwater streams, riparian corridors, and floodplains are of great importance. We must view the river ecosystem as a whole, for many elements of fish habitat are driven by whole system processes.

The following options are consistent with the mission statement of the MDNR, Fisheries Division, which is to protect and enhance public trust in populations and habitat of fishes and other forms of aquatic life, and promote optimum use of these resources for the benefit of the people of Michigan. In particular, the division seeks to protect and maintain healthy aquatic environments and fish communities and rehabilitate those that are degraded; provide diverse angling opportunities and maximize the values of these fisheries; and to foster and contribute to public and scientific understandings of fish, fishing, and fishery management.

The options presented here are not intended for MDNR, Fisheries Division action only, but should also be initiated by citizen groups and other agencies as appropriate.

Hydrology and Geology

The surficial geology of the Cheboygan River watershed is diverse, ranging from coarse-textured glacial deposits to peat. The different geological types greatly affect how water moves through the basin. Streams that flow through permeable glacial deposits with high differences in elevation have higher groundwater inflows than streams that flow through less permeable deposits where elevation differences are small (see **Hydrology**). Therefore, groundwater inflows into particular segments of the watershed vary considerably due to variation in permeability and topographical relief. Dams contribute to flow variability at certain locations within the Cheboygan River watershed; peaking operations at Golden Lotus Dam on the Pigeon River continue to create extremely unstable flow conditions in this segment.

Option: Protect natural hydrologic regimes of streams by protecting existing wetlands, flood plains, and upland areas that provide recharge to the water table.

Option: Protect and restore groundwater recharge by requiring that all development-related runoff be captured by infiltration basins.

Option: Protect natural seasonal flow patterns of the river by incorporating best management practices and requiring that no additional runoff enter the river from land development.

Option: Protect existing hydrologic conditions of lakes and remaining natural lake outlets by prohibiting construction of new lake-level control structures. This would ensure natural water level fluctuations needed to maintain wetlands around a lake and at lake outlets as well as reducing drought flow conditions in outlet streams.

Option: Restore the natural hydrologic regime of streams by removing dams when possible and requiring existing dams to strictly adhere to run-of-river flow operations.

Option: Restore natural hydrologic regime of lakes and lake outlets by removing lake-level control structures when possible.

Option: Restore headwater, tributary, and main stem run-of-river flows by operating lake level control structures as fixed-crest structures with wide spillways rather than by opening and closing gates or adding or removing stop logs.

Option: Explore opportunities to recreate wetland habitats by plugging or otherwise disabling drain tile systems that are no longer needed for their original purpose (such as drainage fields on retired agricultural lands).

Option: Explore the possibilities of reestablishing USGS stream flow gauges.

Option: Protect all existing stable streams from the effects of land use changes, channelization, irrigation, and construction of dams and other activities that may disrupt the hydrologic cycle, by working with land managers, planners, and MDEQ personnel.

Option: Protect natural movement of water to the river by restricting addition of impervious surfaces in the watershed.

Option: Preserve the unique geological features of the watershed by protecting regional sinkholes from development, modification, and contamination.

Soils and Land Use Patterns

While still relatively undeveloped, the Cheboygan River watershed has a variety of land use issues that can affect its water bodies. Sandy soils are susceptible to erosion, particularly in road construction and maintenance, and riparian development. The loss of wetlands, combined with potential residential and commercial growth, existing oil and gas development, and some agricultural practices may increase sedimentation.

Option: Protect watershed soils from improper land use by encouraging the participation of watershed councils in land use planning, development, and other river protection issues.

Option: Protect undeveloped private riparian lands by bringing lands under public ownership or through economic incentives such as tax credits, deed restrictions, conservation easements, or other means.

Option: Protect lands through land-use planning and zoning guidelines that emphasize protection of critical areas and discourage alteration of natural drainage patterns. Support development of zoning standards for townships presently not zoned.

Option: Protect the river from excessive sedimentation by encouraging education of workers involved with road siting, construction, and maintenance in the use of best management practices (BMPs).

Option: Protect the river from excessive sedimentation by increasing spacing between oil and gas well pads and supporting increased use of angular or directional drilling techniques.

Option: Restore retired well sites and access roads through best management practices to minimize potential impacts of continued erosion and sedimentation.

Option: Protect the river from excessive sedimentation associated with oil and gas development by requiring quicker revegetation of soils in affected areas. Access roads for wells should also be closed when wells are retired.

Option: Protect the watershed by continuing to work with MDEQ staff in the classification of state land for oil and gas leases, considering the new resource demands of horizontal drilling and hydraulic fracturing in the Utica/Collingwood formation.

Option: Protect stream channels from excessive sediment delivery by using BMPs at road-stream crossings. Support cooperative funding in situations when local road commission budgets are inadequate for use of BMPs.

Option: Protect and maintain forested buffers along lake shores and river corridors to retain critical habitats and to allow for natural wood inputs to rivers.

Option: Rehabilitate or improve instream culverts or road crossings that are under-sized, perched, misaligned, or placed incorrectly.

Option: Encourage the use of bridges to improve road-stream crossings and discourage the use of culverts.

Channel Morphology

Stream channels within the Cheboygan River watershed support substantial amounts of important high- to very high-gradient habitat with good to excellent hydraulic diversity. Impoundments mask some of the higher gradient reaches in the watershed, particularly in the Maple, Pigeon, and Black rivers. The majority of stream channels in the watershed appear stable, which is not surprising given the abundance of coldwater streams and their steady flows.

Option: Protect diverse stream channel habitats by preventing removal of large woody structure from the channel.

Option: Protect channel morphology by using bridges or properly sized culverts at road-stream crossings.

Option: Protect and restore riparian function by educating riparian residents on how riparian areas influence water quality, stream temperatures, trophic conditions, channel morphology, bank erosion and stability, and aquatic, terrestrial, and avian communities.

Option: Protect riparian greenbelts through adoption and enforcement of zoning standards.

Option: Prioritize stream sections and erosion locations with restoration groups to maximize biological benefit to the aquatic community.

Option: Survey coldwater streams to identify where high beaver activity (or beaver dam density) adversely affects riparian habitats and stream channel morphology.

Option: Rehabilitate channel diversity by removing excess streambed sediment load and controlling sediment contributions.

Option: Rehabilitate channel configuration in reaches where dam peaking operations have altered river appearance and function.

Option: Increase channel diversity by improving habitat in reaches where channel diversity is low, sedimentation is high, or where natural contributions of large woody debris have been reduced.

Option: Protect natural channel movement by encouraging and requiring the use of soft armor/engineering methods of bank stabilization (e.g., vegetative plantings or whole tree revetments rather than rock riprap) through permitting processes and cooperative planning.

Dams and Barriers

Forty-eight dams are known to exist in the Cheboygan River watershed. Some impound considerable high-gradient habitat, block migrations of potamodromous and resident fishes, alter flow regimes, and may create flow fluctuations in streams. Other dams increase stream temperatures, degrade water quality, trap sediments and woody structure, and eliminate natural lake-level fluctuations.

Option: Protect the public trust by requiring dam owners to make appropriate financial provisions for future dam removal or perpetual maintenance and proper operation.

Option: Pursue removal of Golden Lotus Dam.

Option: Survey dams throughout the watershed to examine conditions and identify areas where environmental damage and the need for mitigation are greatest.

Option: Survey state-owned dams, especially floodings, and examine ways of creating better fish habitat in these impoundments. Also assess their need and potential for removal.

Option: Survey beaver dams and use throughout coldwater tributaries.

Option: Work with anglers and citizen groups to promote beaver trapping and beaver dam removal on coldwater tributaries that may be affected by excessive beaver populations and damming.

Option: Restore free flowing river conditions by removing dams no longer used for their original purpose.

Option: Rehabilitate the former productivity of the Cheboygan River for Lake Huron fishes by removing the Cheboygan Dam.

Option: Partially rehabilitate the former productivity of the Cheboygan River for Lake Huron fishes by installing fish passage at the Cheboygan Dam.

Option: Identify and rehabilitate poorly designed road-stream crossings including undersized bridges and culverts, perched culverts, and poor approaches.

Option: Work with MDEQ to prevent the construction of new dams and lake level control structures within the watershed.

Option: Educate public on the effects of dams.

Water Quality

Water quality is generally good throughout the Cheboygan River watershed. Threats to water quality in the basin include non-point-source pollution such as agricultural and construction site runoff and poor road-stream crossings; atmospheric deposition; mercury deposition in inland water bodies and accumulation in fish, and toxics found in Great Lakes fishes migrating into the river.

Option: Promote public stewardship of the watershed and support educational programs teaching best management practices that prevent further degradation of aquatic resources.

Option: Protect water quality by protecting existing wetlands, rehabilitating former wetlands, and maximizing use of wetlands and floodplains as natural filters.

Option: Protect the river by implementing best management practices for storm water and non-point-source pollution.

Option: Evaluate water quality characteristics (especially nutrient levels) at sites where historic data exist to better determine the extent of temporal changes in water quality.

Option: Survey effects of non-point-source pollutants on river water quality characteristics.

Option: Survey thermal effects of dams and develop a list of dams having the greatest thermal effect on downstream reaches.

Option: Survey dissolved oxygen levels below dams to determine where effects are the greatest.

Option: Restore water quality by supporting Act 307 cleanups.

Special Jurisdictions

Four hydroelectric facilities in the watershed are licensed by the Federal Energy Regulatory Commission. The MDEQ and MDNR are responsible for the administration of many environmental regulations as well as the management of a large percentage of the land base in the watershed. Local units of government are responsible for planning, zoning, and road management.

Option: Implement additional fish protection measures, such as entrainment protection, at Tower Dam and Kleber Dam.

Option: Protect additional stream mileage from unwise development practices by designating the Black River and/or Sturgeon River systems as Natural Rivers.

Option: Protect existing aquatic and riparian habitat by establishing protected conservation areas where appropriate.

Option: Protect watershed integrity by ensuring all state environmental regulatory programs with jurisdiction in the watershed are adequately funded, staffed, and enforced.

Option: Protect stream habitat and water quality by discouraging the designation of county drains.

Biological Communities

Biological communities in the Cheboygan River watershed have been affected by fragmentation by dams, habitat loss from sedimentation, and exotic species introductions. Dams in key locations prevent upstream migration of important game fish such as lake sturgeon and walleye; sediment from non-point-source pollution can cover important spawning substrate; and exotic species such as zebra mussels and gobies and burgeoning numbers of double-crested cormorants can have large affects on aquatic ecosystems.

Option: Better define and understand the effects of varying habitat components and actions on Hungerford’s crawling water beetle so potential fisheries management actions can be evaluated from a more informed perspective.

Option: Protect gravel habitats from sedimentation due to land development by enforcing local soil and sedimentation codes. Implement non-point-source best management practices at all construction sites.

Option: Protect stream margin habitats, including floodplains and wetlands.

Option: Evaluate the status of fish communities on river segments and lakes without recent survey data. Surveys should encompass the fish community and should follow MDNR Fisheries Division sampling procedures.

Option: Protect resident, naturally-reproducing fish populations by screening all private and public fish stocking efforts to ensure they are free of diseases and undesirable species.

Option: Prevent the spread of more invasive species to the Inland Waterway and entire watershed through education practices and best management practices.

Option: Survey present distribution and status of fishes, aquatic invertebrates, mussels, amphibians, reptiles, aquatic plants, and pest species throughout the watershed.

Option: Enhance understanding of fish communities in rivers and lakes through surveys conducted under the Status and Trends program.

Option: Restore potential for fishes to migrate throughout the river system by removing appropriate dams (e.g., Alverno Dam and Golden Lotus Dam) or by restoring appropriate flow regimes (e.g., Golden Lotus Dam).

Option: Restore free flowing cold/cool-water reaches of the watershed where beaver populations degrade the coldwater fishery (e.g., Milligan Creek).

Option: Restore lake sturgeon populations throughout the appropriate sections of the watershed by stocking. Create a management plan for this species for the Cheboygan River watershed which defines appropriate adult sturgeon populations and stocking levels, as well as habitat restoration plans to achieve a self-sustaining population.

Fishery Management

Many of the tributaries in the watershed support self-sustaining populations of brook, brown, and rainbow trout. Dams on some of the rivers prevent access to spawning ground for migrating salmonids, or may adversely affect downstream populations because of their unstable flow regimes and temperature effects. Inland lakes and trout streams provide a wealth of fishing opportunities in this watershed.

Option: Protect self-sustaining trout stocks by discouraging stocking on top of these populations.

Option: Require disease-free certification for any fish to be stocked.

Option: Protect the brown trout population in the Sturgeon River through appropriate seasons, harvest limits, protection of spawning habitat, and prohibiting brown trout stocking in that river. This should be done for protection of the Sturgeon River strain of brown trout, recently brought into our hatcheries for brood stock.

Option: Protect fisheries habitats by protecting and appropriately managing existing riparian forests by working with foresters, loggers, ORV users, farmers, and oil and gas developers.

Option: Protect fish communities by working with private citizens, communities, and the permitting agency (MDEQ) to restrict construction of new dams.

Option: Survey fish communities and habitats to assess their condition and identify threats to guide management.

Option: Determine the relative contribution of stocked walleye in lakes where we currently have stocking prescriptions through oxytetracycline marking and analysis.

Option: Gather fish and temperature data on streams and change designated trout stream status and regulation classification where appropriate.

Option: Survey anglers in the watershed to gain insight into effort, preferences, and harvest rates.

Option: Evaluate lakes with walleye or trout stocking prescriptions to evaluate survival and growth of stocked fish and to determine whether stocking is meeting management objectives.

Option: Identify streams or stream segments, in cooperation and coordination with the MDNR-Wildlife Division, where more aggressive control of beaver and beaver dams would restore trout habitat.

Option: Restore connectivity between habitats by removing dams no longer used for their original purpose, dams that are a safety hazard, and dams serving little purpose.

Option: Work with partners to restore sites of severe erosion and poor road-stream crossings.

Option: Continue stocking cool- and cold-water fish species where it is ecologically appropriate to maintain diverse fishing opportunities in the watershed.

Recreational Use

The Cheboygan River watershed is highly valued for its ample recreation opportunities. Although angling is one of the primary recreational activities within the watershed, very little angler pressure and use data exist. Public access to its lakes and rivers is good in most locations, but can be improved in some regions such as the Maple River, Rainy River, and the headwaters of the Sturgeon and Pigeon rivers.

Option: Survey the level of angling pressure and use throughout the watershed's lakes, rivers, and streams.

Option: Improve public access opportunities where lacking (especially those already identified) through MDNR, county, township, and other municipal recreation departments.

Option: Increase recreational access by developing additional launch sites and purchasing additional potential sites.

Option: Improve canoe portages and boat launches at all dams along the main stem and branches. These sites can be maintained by hydropower facilities under FERC relicensing agreements where applicable.

Option: Improve recreational fishing potential by removing dams or providing fish passage when possible and providing upstream passage of Lake Huron fishes into existing riverine reaches with appropriate sea lamprey barriers.

Option: Protect river by encouraging the use of dedicated ORV, bicycle, and equestrian trail systems within the watershed to decrease illegal road-stream crossings and reduce erosion.

Option: Limit recreational access for trailered boats to designated launch sites to prevent erosion and sedimentation.

Option: Work with user groups and outfitters to set appropriate guidelines for river use and to ease user conflicts.

Option: Increase number of handicapped-accessible fishing opportunities (e.g., fishing piers on lakes).

Citizen Involvement

Citizen involvement is crucial to resource management in the Cheboygan River watershed. Future management of the watershed should incorporate participation from the public.

Option: Educate citizens and other governmental agencies and resource managers about important management issues by providing information through various media outlets, sports groups, civic leaders, and other management agencies.

Option: Protect the watershed by building public support through a network of citizen involvement groups.

Option: Support and improve communication between interest groups and governmental agencies.

Option: Support citizen group efforts to seek funding for the protection and restoration of the river system.

Option: Provide additional opportunities for public input into fisheries management decisions and into fisheries management plans.

PUBLIC COMMENT AND RESPONSE

A draft of this river assessment was distributed for public review on February 10, 2011. A statewide press release was issued by the MDNR Communications Division in conjunction with the release of the draft. The draft was posted online, on the Fisheries Division website; since it is a large document, however, electronic copies on compact disc were available upon request. Copies of the press release were also sent to a variety of individuals and organizations, including the Northern Inland Lakes Citizen Fisheries Advisory Committee, which has representatives of many lake associations and citizen groups within the watershed.

A public meeting to receive comments concerning the draft river assessment was held on February 23, 2011, at the Tuscarora Township Hall in Indian River. The meeting was announced in local papers via the press release mentioned above. Thirteen people attended the public meeting.

The comment period for verbal or written comments ended on March 11, 2011. All comments received were considered. Similar comments were combined to avoid unnecessary duplication. Suggested changes to the document were either incorporated in the final document or are listed with the reason why they were not included.

Entire Draft

Comment: A number of comments were received indicating that the Cheboygan River Assessment is a excellent compilation of information that can be used for future reference, research, or background for project proposals.

> Response: Thank you.

Comment: The need for consultation between Fisheries Division and DEQ for permits should be emphasized.

> Response: We agree that it is important for Fisheries Division to work cooperatively with MDEQ on the review of permit applications. In fact, many of the management options listed in this document require coordination with MDEQ personnel.

Hydrology

Comment: Is groundwater output and streamflow examined and recorded on a yearly basis or more frequently?

> Response: Streamflow is monitored continuously at several gauging stations throughout the watershed by the United States Geological Survey. This information can be accessed at: http://waterdata.usgs.gov/mi/nwis/current/?type=flow (March 2011). Measures of groundwater input to the streams are discussed in **Hydrology**.

Comment: A number of comments were received about the use of the water withdrawal assessment tool.

Response: Information on Michigan's Water Withdrawal Assessment Tool can be found at the website: http://www.miwwat.org/ (March 2011).

Comment: There is an important management option to protect natural hydrologic regimes of streams by protecting existing wetlands, flood plains, and upland areas that provide recharge to the water table. This is excellent. In regards to the importance of groundwater recharge, there is a zone of recharge that is the highest recharge area in the state and explains the extremely high baseflows in the rivers that derive from it, including the Cheboygan. It is worth mentioning this region in the Hydrology section.

Response: The Hydrology section has been updated to include mention of this area of groundwater recharge.

Soils and Land Use

Comment: A number of comments were received indicating that the process of hydraulic fracturing for natural gas drilling should be discussed.

Response: Information on the use of hydraulic fracturing and the development of the Utica/Collingwood formation has been added to the document under the Oil and Gas Development section in **Soils and Land Use**.

Comment: How many stream/road crossings are there? Who determines which are worst? How is priority of re-construction determined? Can a citizen make a case for re-construction based on observations of sediment washing into the stream and a potential road washout?

Response: Road-stream crossings are discussed in the Soils and Sedimentation section of **Soils and Land Use**. The number of road-stream crossings (779) and how they are ranked is discussed there. Priority of reconstruction depends on the ranking done as part of the inventory, as well as available funding. Citizens can, and should, report potential road washouts and problem crossings to the appropriate road commission.

Dams and Barriers

Comment: While dams should be avoided and removed when feasible, there are a few impoundments within the watershed that provide wildlife values without damaging stream quality to a significant degree (e.g., Stoney Creek Flooding and Dog Lake). Careful evaluation and adequate public consultation should occur where dam removals are being considered.

Response: We agree that some dams provide value and should be retained in some instances if they do not pose a significant risk. This is addressed in **Dams and Barriers**, where some situations are discussed where dams should be retained.

Water Quality

Comment: Water quality in the watershed is inconsistently described as good, generally good, and high quality.

Response: These descriptors were used in the source documents referenced in the text, and were used as they were in the cited documents.

Comment: In areas of the watershed it is apparently still common to use large amounts of herbicides/molluscicides for control of nuisance species. Can you comment further on the environmental impact of this practice?

Response: Use of herbicides/molluscicides in aquatic environments typically requires a permit from MDEQ. Permit applications are reviewed to determine the environmental impact to the waterbody, and any human health and safety issues. A subset of permit applications are also requested to be reviewed by Fisheries Division staff for possible impacts to fish management activities. For additional information regarding permitted herbicide/molluscicide use, please contact the Aquatic Nuisance Control Program by telephone at 517-241-1554, by email at deq-lwm-anc@michigan.gov, or you may visit their webpage at www.michigan.gov/deqinlandlakes.

Special Jurisdictions

Comment: A number of drains in Cheboygan County were not listed in the report.

Response: Drain commissioners throughout the watershed were contacted during the writing of this report. The authors did not receive a list of drains for Cheboygan County when requested.

Comment: On page 165, Item 11, Northwood Oil is listed as a contaminated Part 201 site. This is inaccurate, because DEQ cleaned up the site.

Response: Staff from MDEQ Remediation Division indicate that while some cleanup activity has been done at this site, it is still classified as a contaminated site.

Biological Communities

Comment: In 2009 Michigan declared the freshwater snail *Planorbella smithi* endangered. It has been found only in Douglas and Burt lakes so far.

Response: This information was confirmed with MDEQ staff, and was added to the **Biological Communities** section of the report.

Fisheries Management

Comment: With respect to fishery management of the Cheboygan River watershed, I would suggest some protection of the lake sturgeon and Great Lakes muskellunge. These are two native long-lived species with low reproductive potential. They are both catchable species by hook and line, a method that makes catch and release an option by which several sportsmen may share the resource. These two species would benefit from being protected from spearing at all times.

Response: Lake sturgeon populations are protected, and limited harvest is allowed only in Black Lake and Otsego Lake within the watershed. Management of the species is guided by the Lake Sturgeon Rehabilitation Strategy (Hay-Chmielewski and Whelan 1997) and

Fisheries Order (FO) 240. Statewide muskellunge regulation review is in progress; Fisheries Division staff is working with representatives of the angling community to develop a regulation package.

Recreational Use

Comment: For boat access, there is now a large ramp at Marina Park in Indian River.

Response: The township-owned ramp at Marina Park is a great facility for accessing the waterway. The figure showing boating access sites depicts state-owned access sites. We have updated the text to clarify this.

GLOSSARY

alluvium – sediment deposited by flowing water, such as glacial meltwaters

base flow – the portion of stream discharge that is derived from natural storage (i.e., groundwater inflow, lakes, or swamps), or sources other than rainfall that create surface runoff

basin – an area of the earth's surface that drain toward a receiving body of water (such as a lake or stream) at a lower elevation; a complete drainage area including both land and water from which water flows to a central point; synonymous with watershed

BCE – before the common era

benthic – associated with the bottom of a stream or lake; plants and animals living on, or associated with, the bottom of a water body

biomass – the total mass of living material in an area (e.g., the total weight of brook trout in a stream reach)

biodiversity – the number and type of biological organisms in a system

biological integrity – the ability of biotic communities to withstand and survive natural and human perturbations

biota – animal and plant life

BMPs – best management practices used to protect water quality, generally from erosion; examples are buffer strips, location and design of roads, and proper design of road crossings of streams

boom shocker – an electrofishing boat used to sample fishes in waters that are generally too deep to wade; electrodes mounted on booms extend from the bow of the boat and are used to transfer electricity into the water to temporarily stun fish so they can be captured with dip nets

broodstock – adult fish used for obtaining gametes for hatchery-reared fish

buffer strip – an area adjacent to a waterbody in which harvest of trees is limited or precluded; designed to protect water quality

bulkhead – a retaining wall along a waterbody; a low-head dam

catchment – the area of the earth's surface that drains to a particular location on a stream

CE – common era

centrarchidae – sunfishes; species such as bluegill, crappies, and largemouth and smallmouth bass

cfs – cubic feet per second; ft^3/s; a unit commonly used to express stream discharge, the volume of water flowing past a point each second; one cubic foot of water equals 7.48 gallons

channelization – the conversion of a stream to a ditch; channelized streams are narrower, deeper, and straighter than natural channels; channelization may be done for navigation, flood control at that site, or to improve drainage for agricultural or other purposes

channel morphology – the structure and form of stream and river channels including width, depth, and bottom type (substrate)

coldwater fish species – a term commonly applied to trout species, although nongame species such as slimy and mottled sculpin also need and prefer colder waters

confluence – the joining or convergence of two streams

coniferous – cone-bearing, typically evergreen, trees

coolwater fish species – a term usually referring to game fish in the perch or pike families; examples are walleye, yellow perch, northern pike, and muskellunge

creel survey – a statistically designed survey of angler trips on a water body to provide information regarding effort, catch, and harvest

deciduous – vegetation that sheds its foliage annually

discharge – a common term that refers to the volume of water flowing in, or discharged by, a stream into another stream or water body; also referred to as streamflow discharge or stream discharge

drought flow – the water flow during a prolonged period of dry weather

ecosystem – stands for ecological system; a biological community functioning with its environment

electrofishing – the process of putting an electric current, either AC or DC, through water for the purpose of stunning and capturing fish

embeddedness – the extent to which gravel and cobble are buried by finer sediments such as sand

entrain – to pass through the turbines of a hydroelectric dam; varying percentages of fish entrained at hydroelectric dams are killed

EPT – refers to three orders of insects (Ephemeroptera-Mayflies, Plecoptera-Stoneflies, and Trichoptera-Caddisflies); often used as an indicator of water quality

Esocid – species of fish that are in the Esocidae family. In the Cheboygan River watershed this is generally northern pike or muskellunge

exceedence flow – a discharge amount that is exceeded by the stream for a given percentage of time; for example, for 90% of the year the stream's discharge is greater than its 90% exceedence flow value; consequently, the 90% exceedence flow represents a stream's summer low (drought) flow

exotic species – successfully-reproducing organisms transported by human actions into regions where they did not previously exist

extirpation – to make extinct; eliminate completely

fauna – the animals of a specific region or time

FERC – Federal Energy Regulatory Commission

fixed-crest – a dam that is fixed at an elevation and whose elevation can not be changed

flashy – streams and rivers characterized by rapid and substantial fluctuations in streamflow

flow regime – a term used to describe the constancy or stability of stream discharge over periods ranging from days to years; discharge of streams with stable flow regimes does not fluctuate quickly or substantially through time whereas streams with unstable flow regimes are referred to as "flashy" (see above definition)

flushing rate – the amount of time it takes for the total volume of water in an impoundment to be replaced by incoming streamflow; also referred to as retention time

forage fish – the term applied to small-bodied fishes that can be eaten by piscivorous fish species such as walleye, pike, or bass

game fish – the term applied to fishes that sport fishing anglers are most likely to pursue; most of these species are in the trout, sunfish, and perch families

glacial-fluvial valley – a river valley formed by glacial melt waters cutting through deposits left by a glacier

glacial outwash – gravel and sand carried by running water from the melting ice of a glacier and laid down in stratified deposits

GLEAS – Great Lakes and Environmental Assessment Section

gradient – rate of decent of a stream, usually expressed in feet per mile

groundwater – water that is beneath the surface of the ground and is the source of a spring or well water; groundwater may also flow laterally to discharge into streams or lakes at lower elevations

hydraulic diversity – the variability of water depths and velocities in a stream or river channel

hydraulic fracturing "fracking" – a process used to extract natural gas by pressurizing underground wells with water and sand and chemicals to break up formations and maximize well production

hydrology – the study of water

impoundment – water of a river system that has been held up by a dam creating an artificial lake

indigenous – a species that is native to a particular area

invertebrates – animals without a backbone

karst – an area of limestone formation, characterized by sinks, caves, ravines, and underground streams

lake plain – land once covered by a lake that is now elevated above the water table

lake-level control structure – a dam placed at the outlet of a lake to control the water-level

large woody material – larger trees, logs, and logjams at or beneath the surface of stream or lake waters

lentic – nonflowing water typically associated with lakes; for example, lentic fishes typically inhabit nonflowing waters

loam – a soil consisting of an easily crumbled mixture containing from 7 to 27% clay, 28 to 50% silt, and less than 52% sand

lotic – flowing water; for example, lotic habitats are habitats present in flowing waters

low-flow yield – defined in this document as the 90% exceedence flow divided by catchment area and expressed as $ft^3/s/mi^2$; streams with high low-flow yields in Michigan generally are colder, have higher drought flows, and are more suitable for habitation by coldwater fish species

LWD – Large woody debris; a term used to refer to larger woody material in a stream or lake that may provide instream fish cover or be colonized by fish-food organisms; see large woody material

macroinvertebrate – animals without a backbone that are visible to the naked eye

main stem – primary branch of a river or stream

MDEQ – Michigan Department of Environmental Quality

MDIT – Michigan Department of Information Technology

MDNR – Michigan Department of Natural Resources

MDOC – Michigan Department of Conservation; this organization was reorganized and renamed as the Michigan Department of Natural Resources circa 1968

mesotrophic – a term applied to clear water lakes and ponds with beds of submerged aquatic plants and medium levels of nutrients; these lakes are also of intermediate clarity, depth, and temperature

mitigation – action required to be taken to compensate for adverse effects of an activity

MNFI – Michigan Natural Features Inventory

moraine – a mass of rocks, gravel, sand, clay, and other material carried and deposited directly by a glacier

morphology – pertaining to form or structure of a river or organism

MSL – minimum size limit

naturalized – animals or plants previously introduced into a region that have become permanently established as if native

NEMCOG – Northeast Michigan Council of Governments

NLHMU – Northern Lake Huron Management Unit

nongame fish – term applied to fishes that sport fishing anglers generally do not attempt to catch; this term is also applied to certain species sought by a minority of anglers; for example, carp, suckers, and bullhead catfishes

NPDES – National Pollution Discharge Elimination System

NREPA – Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA); consolidated the majority of the State of Michigan's environmental and natural resource laws into one act

oligotrophic lakes – lakes where nutrient levels and biological productivity are low; these lakes typically contain high levels of dissolved oxygen in their waters at all depths

organic – of, relating to, or derived from living organisms; often used to describe fine substrate of decaying vegetation (muck)

oxytetracycline (OTC) – an antibiotic which produces a mark on a fish once it is submersed in and fed the chemical, thus allowing for differentiation between stocked and wild fish

panfish – used to refer collectively to the following: bluegill, pumpkinseed, green sunfish, rock bass, black and white crappies, hybrid sunfish, and yellow perch

peaking – operational mode for a hydroelectric project that maximizes economic return by operating at maximum possible capacity during peak demand periods (generally 8 a.m. to 8 p.m.) and reducing or ceasing operations and discharge during nonpeak periods; streamflows in rivers with peaking operations may alternate between flood and drought on a daily basis

permeability – the ability of a substance to allow passage of fluids; sands and gravels have high permeability for water because it readily moves through them

perched culvert – a culvert that blocks upstream movement of aquatic organisms by creating a significant drop between the culvert outlet and the downstream stream surface

permeable – soils with coarse particles that allow passage of water

piscicide – a chemical applied to water which selectively kills fish

point source – a discharge from a designated outfall or other specific source

potamodromous – fish that migrate from fresh water lakes up fresh water streams to spawn; in the context of this report, it refers to fish that could migrate into the Cheboygan River watershed from Lake Huron

PRC – Pigeon River Country State Forest

private stocking – fish stocking by private individuals; a permit from the Michigan Department of Natural Resources, Fisheries Division is required to legally stock fish in public waters of the state

Quality Lake – A lake with the potential for growing larger fish under special fishing regulations.

recruitment – usually refers to number of fish reaching sexual maturity, harvestable size, or some size that is vulnerable to a particular sampling gear; refers to natural reproduction of fishes in the context of this report

riparian – adjacent to or living on the bank of a river or other body of water; also refers to the owner of stream or lakefront property

riprap – rock or other solid material used to armor shorelines, bridges, streambeds, etc.

riverine – a reach or portion of a river that is free-flowing and not impounded by dams; of or pertaining to a river

ROR – see run-of-river

rotenone – a white, crystalline poisonous compound obtained from derris root; fisheries managers use it as a toxicant to kill undesired fish species; it is not toxic to other non-gill-breathing aquatic organisms

rotenone survey – a method sometimes used to sample fish in a water body; in the context of the Cheboygan River watershed, fishes in some stream sections were killed with rotenone and collected with dip nets or blocking nets; the rotenone compound was detoxified at the downstream end of the sampled section with potassium permanganate

run habitat – fast, nonturbulent water

run-of-river – refers to impounded systems where the instantaneous inflow of water approximately equals the instantaneous outflow of water at the dam; this flow regime mimics the natural flow regime of a river

salmonid – fishes in the family Salmonidae; includes trouts, salmon, whitefish, and herring species

savanna – a treeless plain or grassland with scattered trees

sedimentation – the deposition or accumulation of sediment

self-sustaining population – a fish population that remains at an acceptable level of abundance by naturally reproducing young

Serns index – a method for determining levels of walleye natural reproduction, or the survival of stocked walleye from boom shocker catch-per-unit-effort

smolt – the physiological change in a young salmon or steelhead that usually corresponds with a migration from a river setting to a lake (Cheboygan River watershed to Lake Huron)

species richness – the number of different species collected at a site

sport fish – fish sought by anglers for sport and food

SSTP – Stream Status and Trends Program

substrate – a term used to refer to materials lying beneath the waters of a lake or stream; examples are clay, silt, sand, gravel, and cobble

surficial – referring to something on or at the surface

temperature regime – a phrase commonly used by fisheries biologists to describe the seasonal or daily pattern of temperature fluctuations (maximums, minimums, and averages); for example, streams with cold temperature regimes are those where summer daily mean water temperatures generally are colder than 68^{o}F and maximum daily temperatures do not reach levels lethal or unduly stressful to coldwater fish species

till – unstratified, unsorted glacial deposits of clay, sand, boulders, and gravel

turbidity – suspended particles in water that cause it to be less transparent

two-story lake – lakes that thermally stratify during warm weather periods and contain sufficient dissolved oxygen to support life in the deep, lower strata; warmwater fishes inhabit the shallow, upper strata and coldwater fishes (such as trout) inhabit the deep, lower strata

topography – the configuration of the earth's surface including its relief and the position of its natural features

Type 1-4 trout stream regulation – trout streams in the State of Michigan are typically managed with one of four regulation types or as "Gear Restricted"; see Table 24

UBRWRC – Upper Black River Watershed Restoration Committee

USDA – Unites States Department of Agriculture

USFS – United States Forest Service

USFWS – United States Fish and Wildlife Service

USGS – United States Geological Survey

valley segment – a river segment with homogenous features, such as hydrology, channel shape, temperature, fish community, etc.

wadeable – a stream that is shallow enough to be traversed by someone wearing chest waders

warmwater fish species – species that grow and thrive in waters that are seasonally warm; most game fish species in this classification are members of the sunfish family

watershed – an area of the earth's surface that drains toward a receiving body of water (such as a stream or lake) at a lower elevation

wetland – areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support types of vegetation typically adapted to life in saturated soil; includes swamps, marshes, fens, and bogs

wigglers – mayfly larva

winterkill – to die from exposure to winter cold; in the context of this text, heavy ice/snow cover and oxygen depletion in the water may kill fish living in shallow lakes

young-of-year (YOY) – fish that is in its first year of life, which is defined to end on December 31

FIGURES

Figure 1 Legend:

Watershed and Major Tributaries

1. West Branch Maple River
2. Brush Creek
3. Cold Creek
4. Lancaster Creek
5. Douglas Lake
6. East Branch Maple River
7. Van Creek
8. Maple River
9. West Branch Minnehaha Creek
10. Minnehaha Creek
11. Silver Creek
12. Crooked Lake
13. Pickerel Lake
14. Berry Creek
15. McPhee Creek
16. Crooked River
17. Burt Lake
18. Little Carp River
19. Sturgeon River
20. Mossback Creek
21. Pickerel Creek
22. Club Stream
23. Stewart Creek
24. Blackjack Creek
25. West Branch Sturgeon River
26. Marl Creek
27. Little Sturgeon River
28. Crumley Creek
29. Indian River
30. Pigeon River
31. South Branch Pigeon River
32. Cornwall Creek
33. Little Pigeon River
34. Wilkes Creek
35. Little Pigeon River
36. Mullett Lake
37. Mullett Creek
38. Ballard Creek
39. Black River
40. Saunders Creek
41. Tubbs Creek
42. Hardwood Creek
43. Stewart Creek
44. East Branch Black River
45. Rattlesnake Creek
46. Foch Creek
47. Little McMasters Creek
48. McMasters Creek
49. Canada Creek
50. Packer Creek
51. Van Hetton Creek
52. Oxbow Creek
53. Tomahawk Creek
54. Bowen Creek
55. Milligan Creek
56. Gokee Creek
57. Stony Creek
58. West Branch Upper Rainy River
59. Healy Creek
60. Rainy River
61. East Branch Rainy River
62. Little Rainy River
63. Cold Creek
64. Stony Creek
65. Stewart Creek
66. Black Lake
67. Mud Creek
68. Long Lake Outlet
69. Owens Creek
70. Myers Creek
71. Laperell Creek
72. Cheboygan River

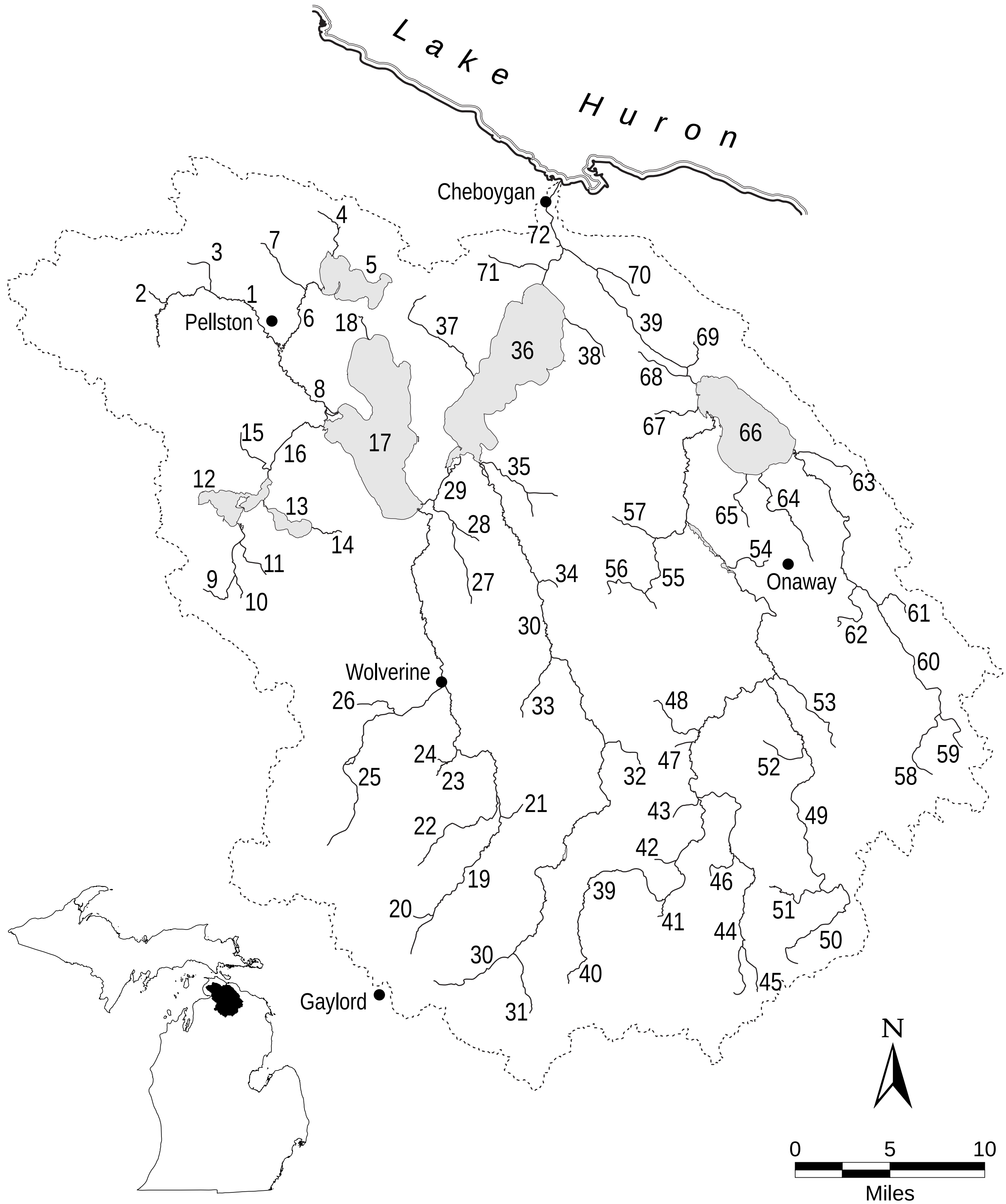
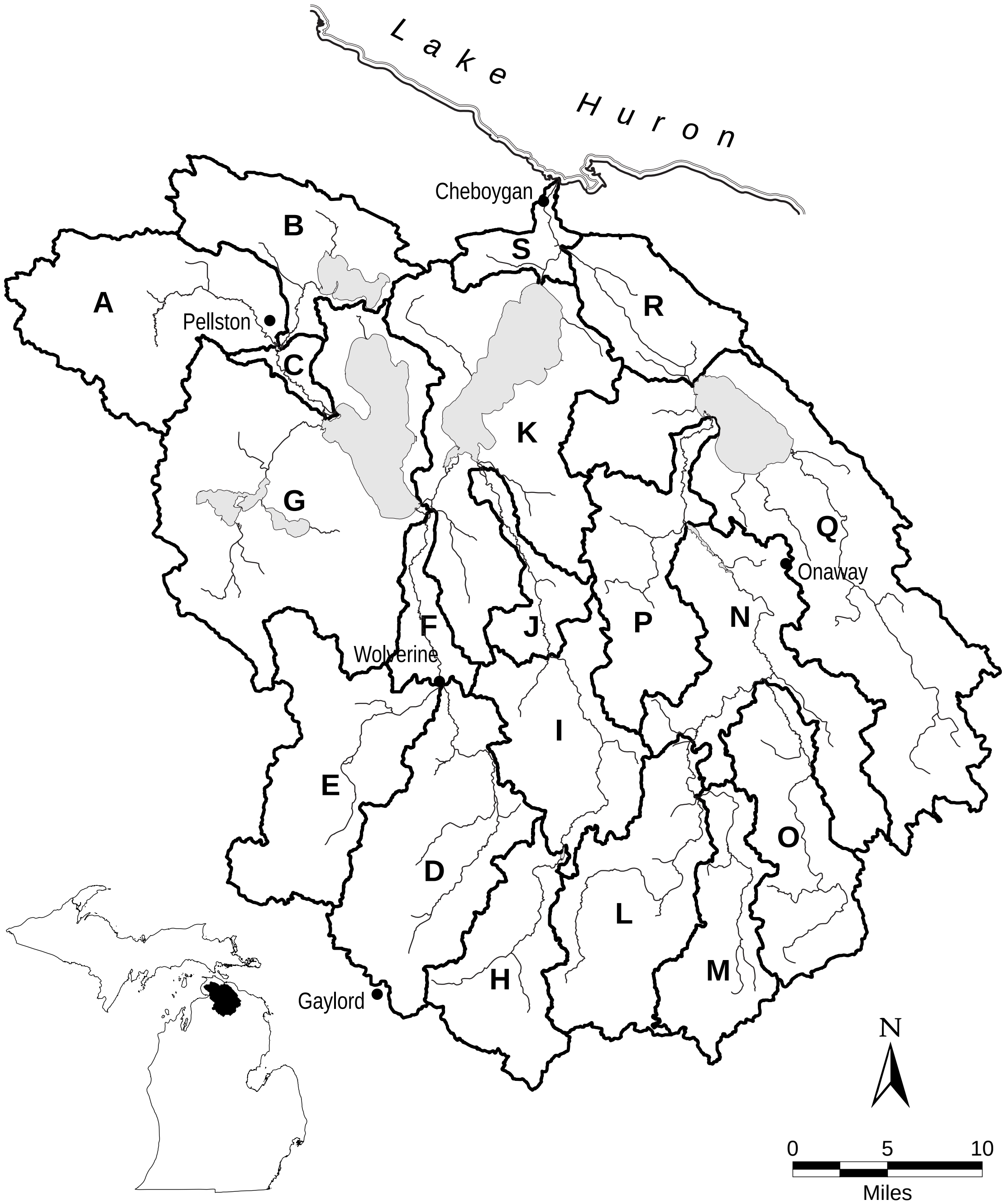


Figure 1.–Map of Cheboygan River watershed and major tributaries.



A. West Branch Maple River - Headwaters to Maple River Dam
B. East Branch Maple River - Douglas Lake to Maple River Dam
C. Maple River – Maple River Dam to Burt Lake
D. Sturgeon River – Headwaters to confluence with West Branch Sturgeon River
E. West Branch Sturgeon River
F. Sturgeon River – Confluence with West Branch Sturgeon River to Burt Lake
G. Burt Lake
H. Pigeon River – Headwaters to Golden Lotus Dam
I. Pigeon River – Golden Lotus Dam to confluence with Little Pigeon River
J. Pigeon River – Confluence with Little Pigeon River to Mullett Lake
K. Mullett Lake
L. Black River – Headwaters to Clark Bridge Road
M. East Branch Black River
N. Black River – Clark Bridge Road to Kleber Dam
O. Canada Creek
P. Black River – Kleber Dam to Black Lake
Q. Black Lake
R. Lower Black River
S. Cheboygan River

Figure 2.–River valley segments within the Cheboygan River watershed.

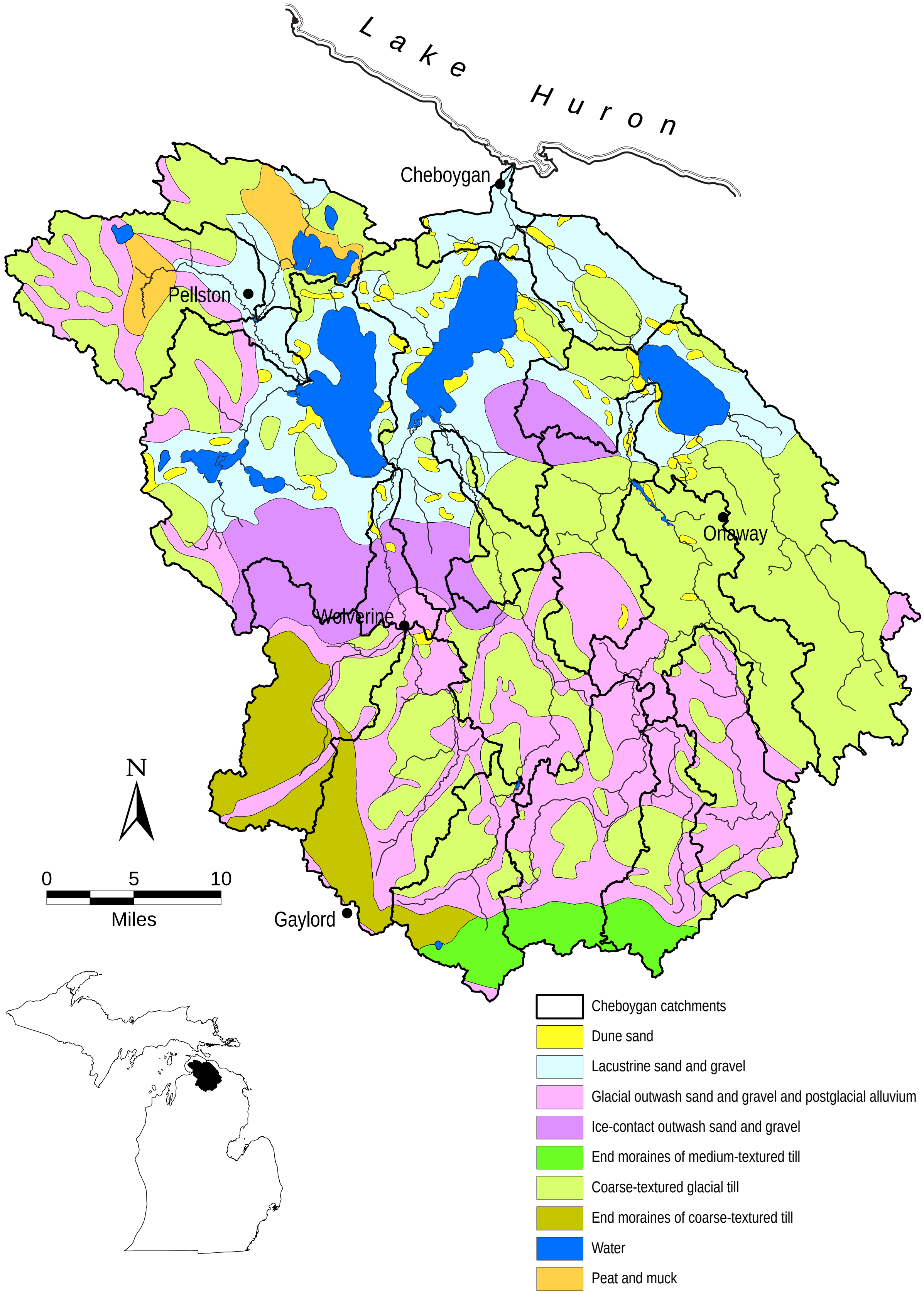


Figure 3.–Surficial geology of the Cheboygan River watershed (Fisheries Division, unpublished data).

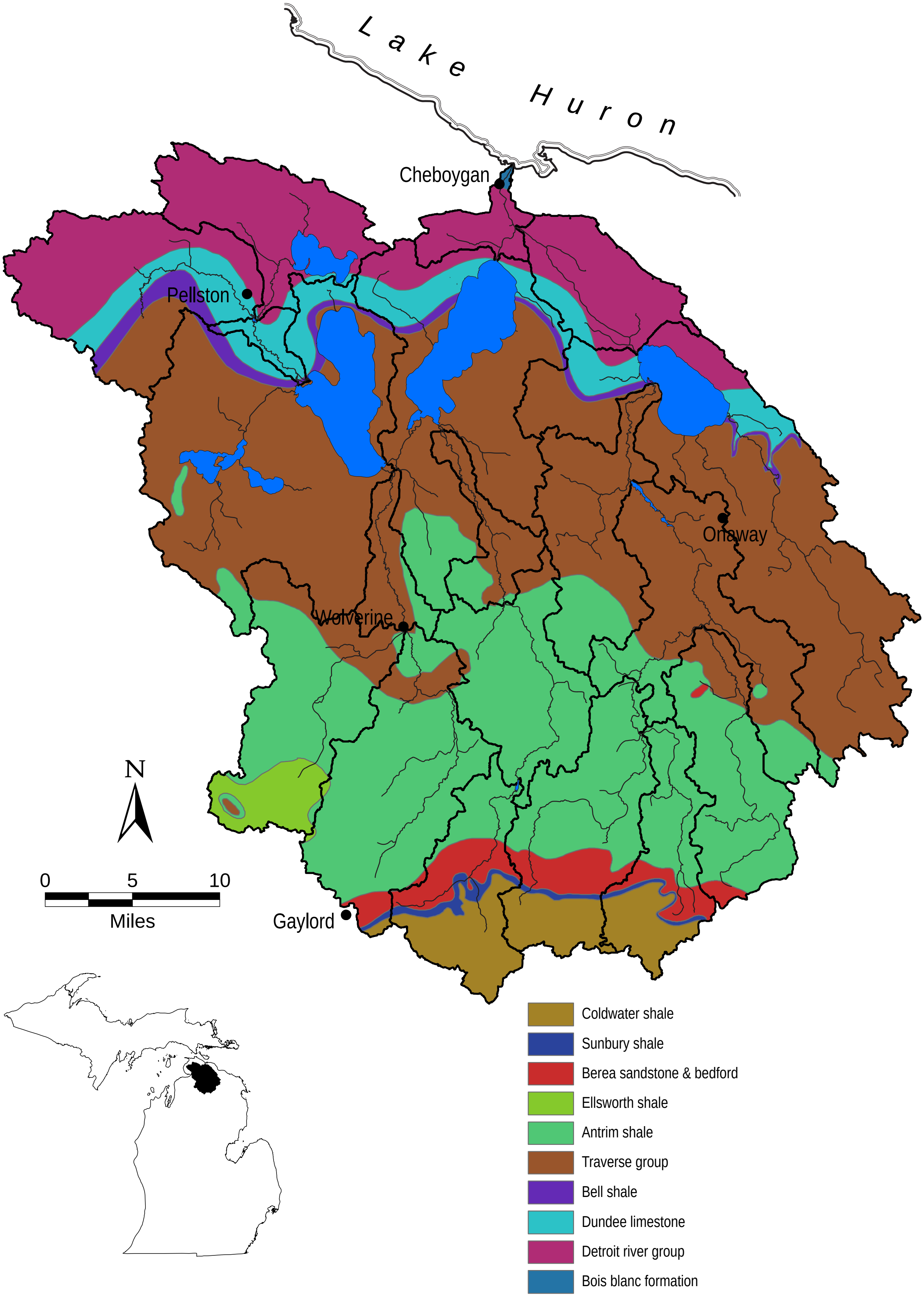


Figure 4.–Bedrock geology of Cheboygan River watershed.

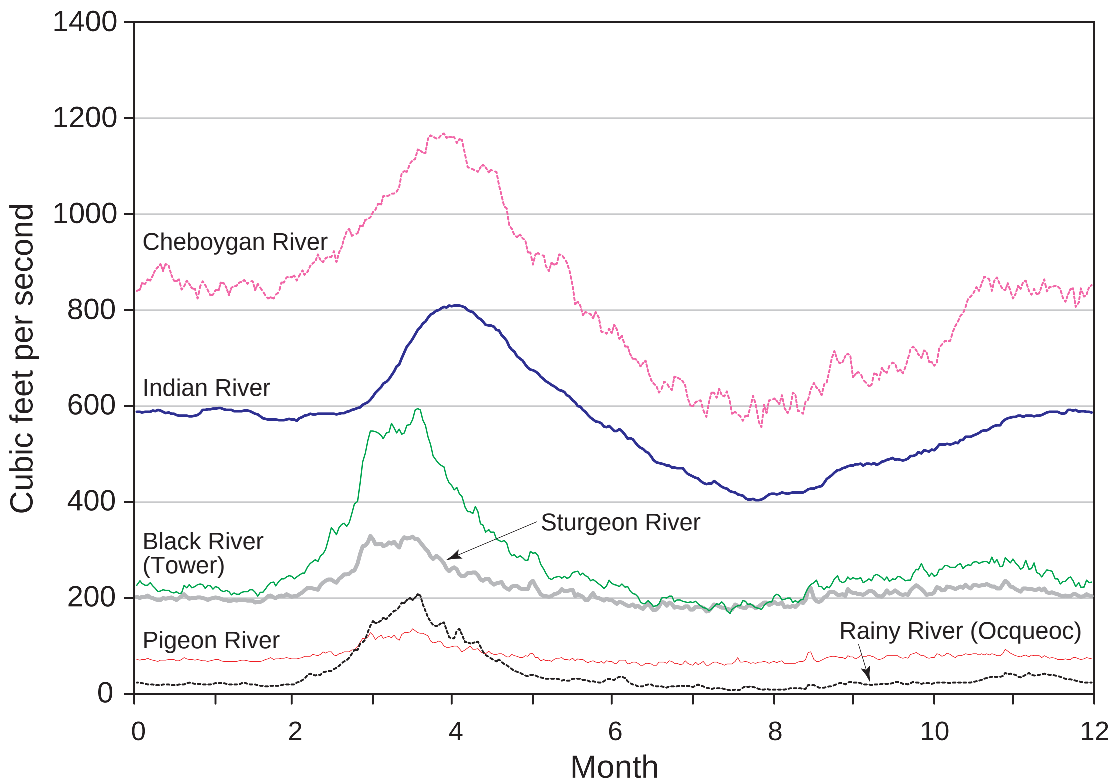


Figure 5.–Annual hydrograph for entire period of record at six United States Geological Survey gage sites in the Cheboygan River watershed.

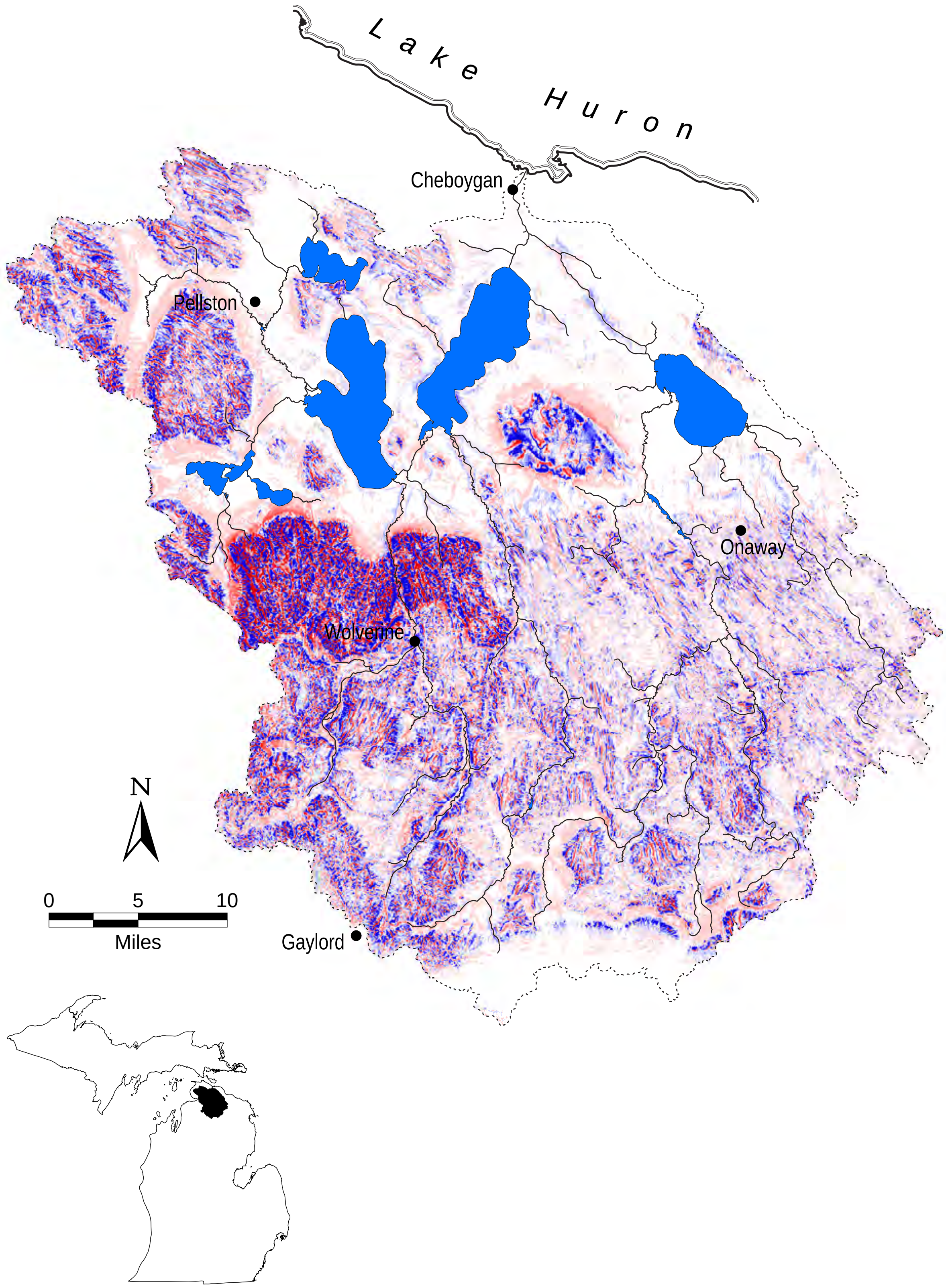


Figure 6.–Darcy groundwater movement predictions for the Cheboygan River watershed (Baker et al. 2003a). Areas of groundwater potential are highlighted in blue (recharge) and red (discharge).

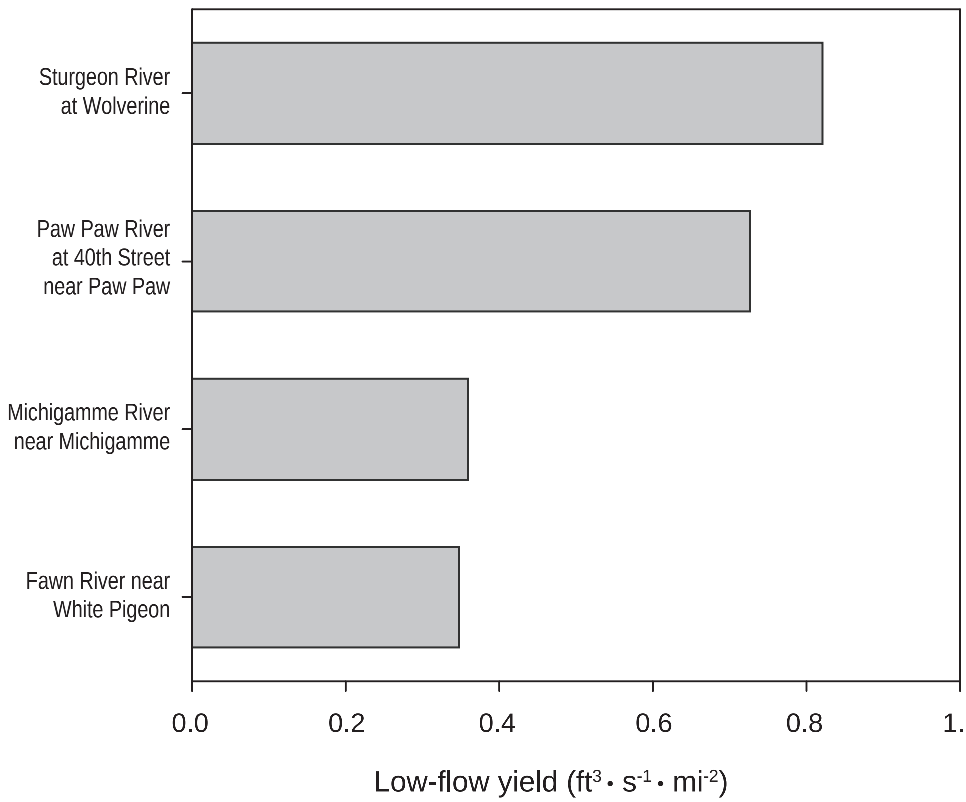


Figure 7.–Low-flow yield (90% exceedence flow divided by catchment area) expressed as ft3/s/mi2 for the Sturgeon River at Wolverine, compared to low-flow yields for other Michigan streams with similar-sized catchments. Note that some flow regulation occurs upstream of gages on the Paw Paw and Fawn rivers. Data are from the United States Geological Survey.

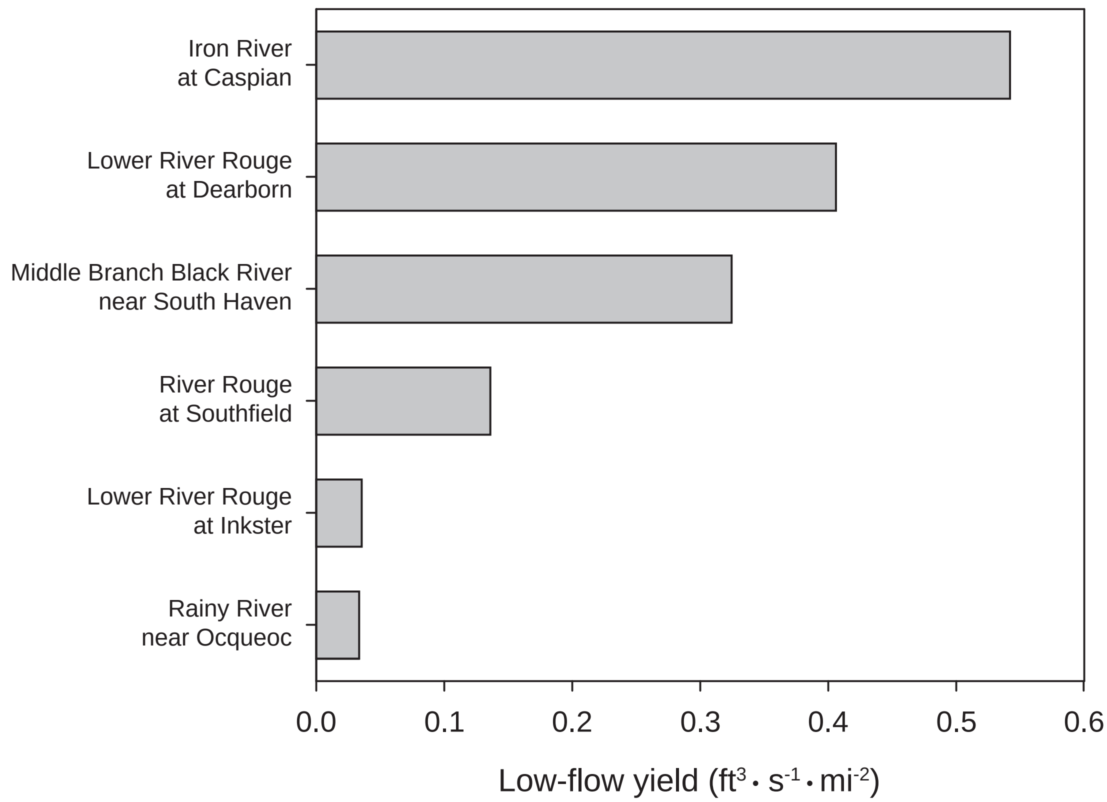


Figure 8.–Low-flow yield (90% exceedence flow divided by catchment area) expressed as ft3/s/mi2 for the Rainy River near Ocqueoc, compared to low-flow yields for other Michigan streams with similar-sized catchments. Data are from the United States Geological Survey.

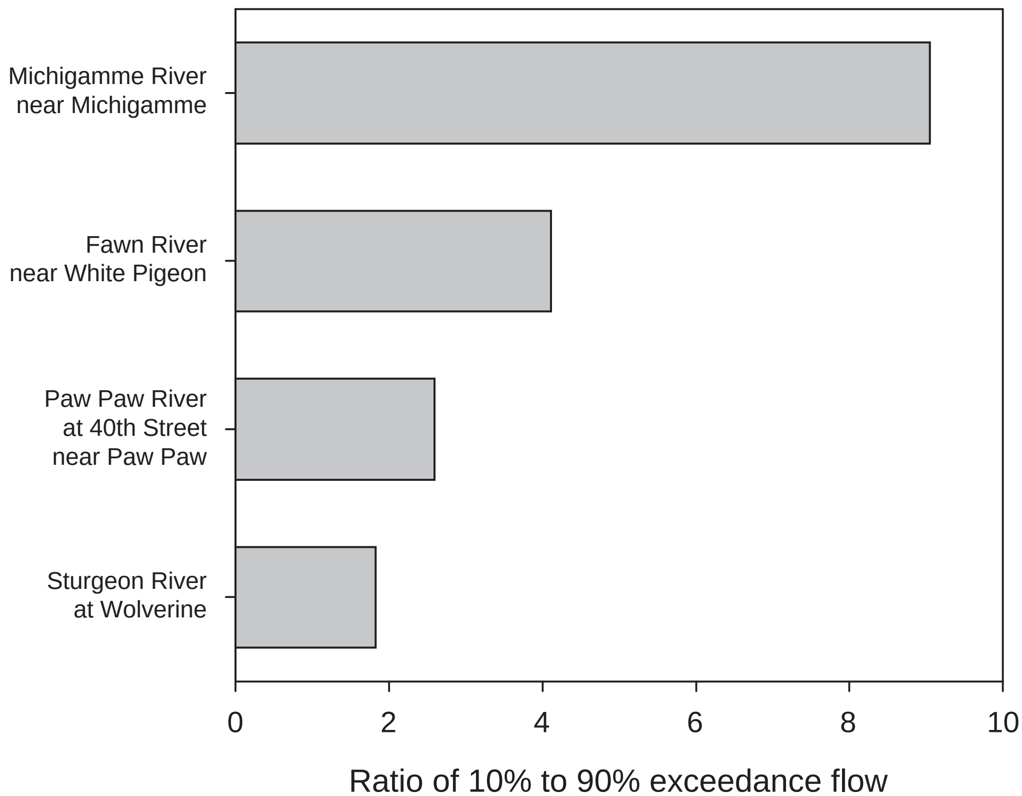


Figure 9.–Flow stability (expressed as the ratio of 10% and 90% exceedence flows) of Michigan streams having catchments comparable in size to the Sturgeon River at Wolverine. Note that some flow regulation occurs upstream of the gages on the Fawn and Paw Paw rivers. Data are from the United States Geological Survey.

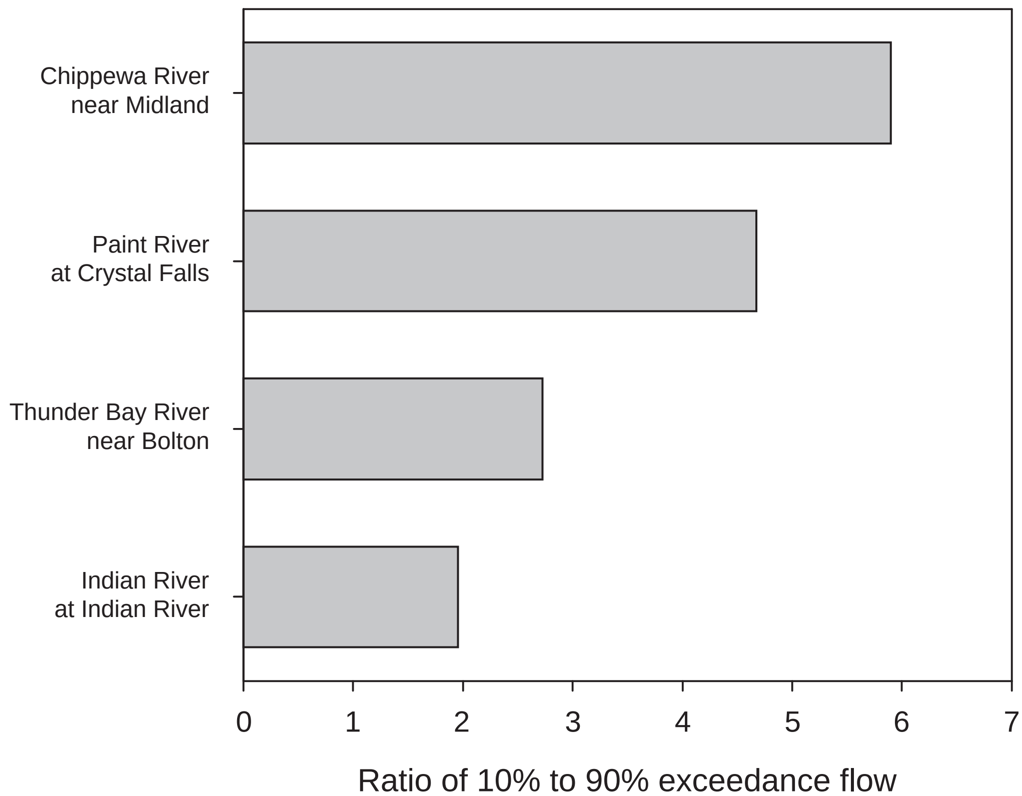


Figure 10.–Flow stability (expressed as the ratio of 10% and 90% exceedence flows) of Michigan streams having catchments comparable in size to the Indian River at Indian River. Note that some flow regulation occurs upstream of gages on the Chippewa, Paint, and Thunder Bay rivers; some flow regulation occurs downstream of the gage on the Indian River. Data are from the United States Geological Survey.

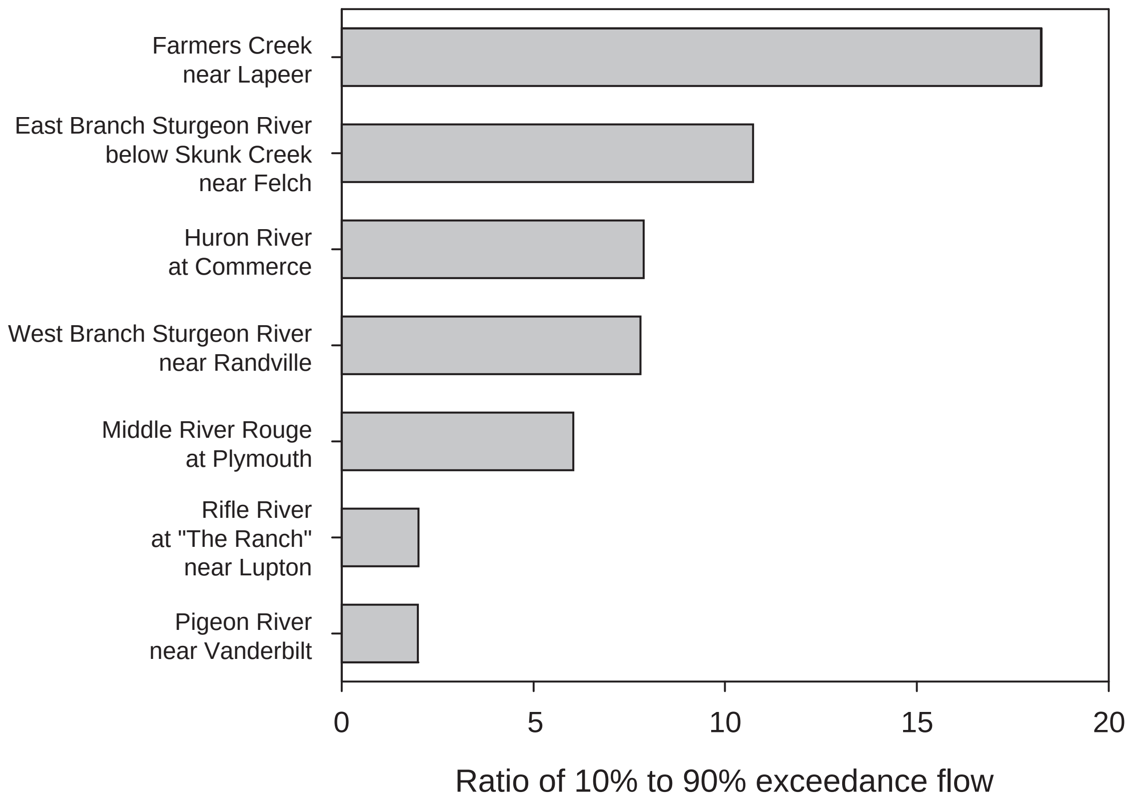


Figure 11.–Flow stability (expressed as the ratio of 10% and 90% exceedence flows) of Michigan streams having catchments comparable in size to the Pigeon River near Vanderbilt. Note that some flow regulation occurs upstream of all gages. Data are from the United States Geological Survey.

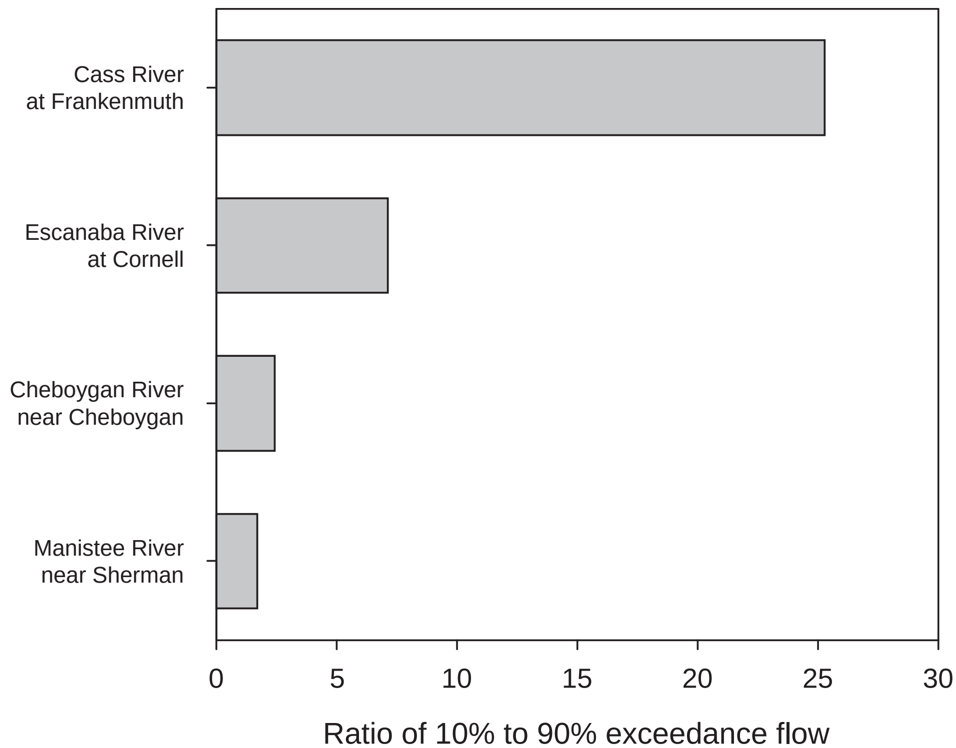


Figure 12.–Flow stability (expressed as the ratio of 10% and 90% exceedence flows) of Michigan streams having catchments comparable in size to the Cheboygan River near Cheboygan. Note that some flow regulation occurs upstream of gages on the Cass and Escanaba rivers; some flow regulation occurs downstream of the gage on the Cheboygan River. Data are from the United States Geological Survey.

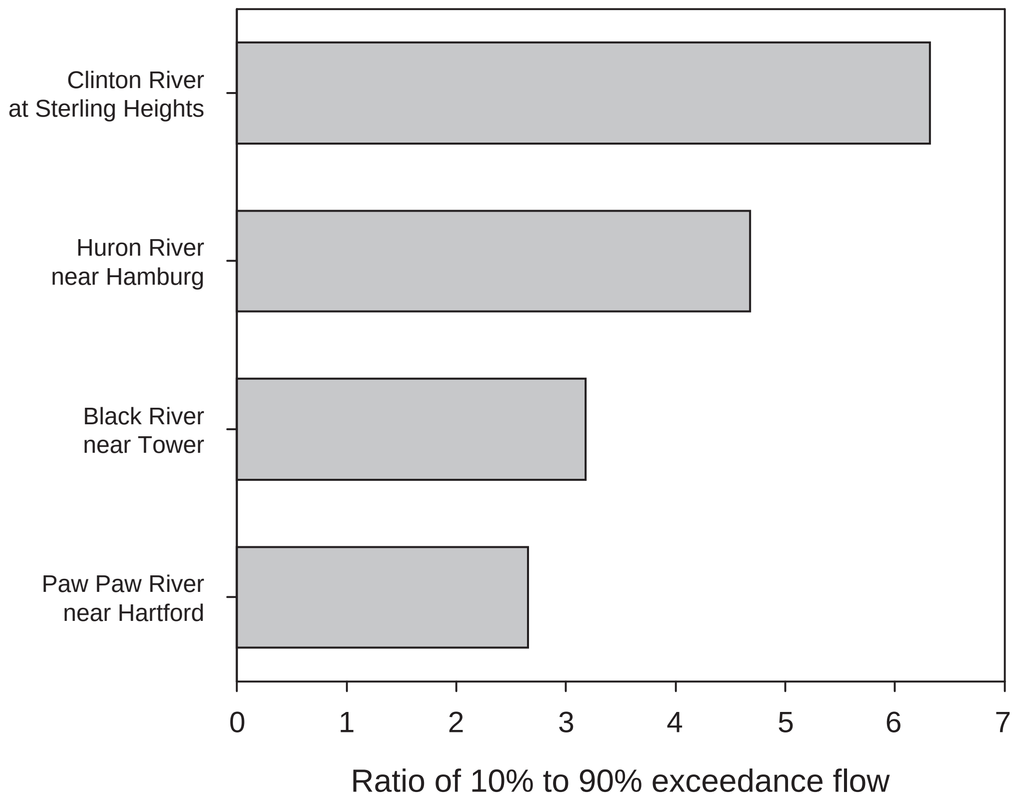


Figure 13.–Flow stability (expressed as the ratio of 10% and 90% exceedence flows) of Michigan streams having catchments comparable in size to the Black River near Tower. Note that some flow regulation occurs upstream of gages on the Huron, Black, and Paw Paw rivers. Data are from the United States Geological Survey.

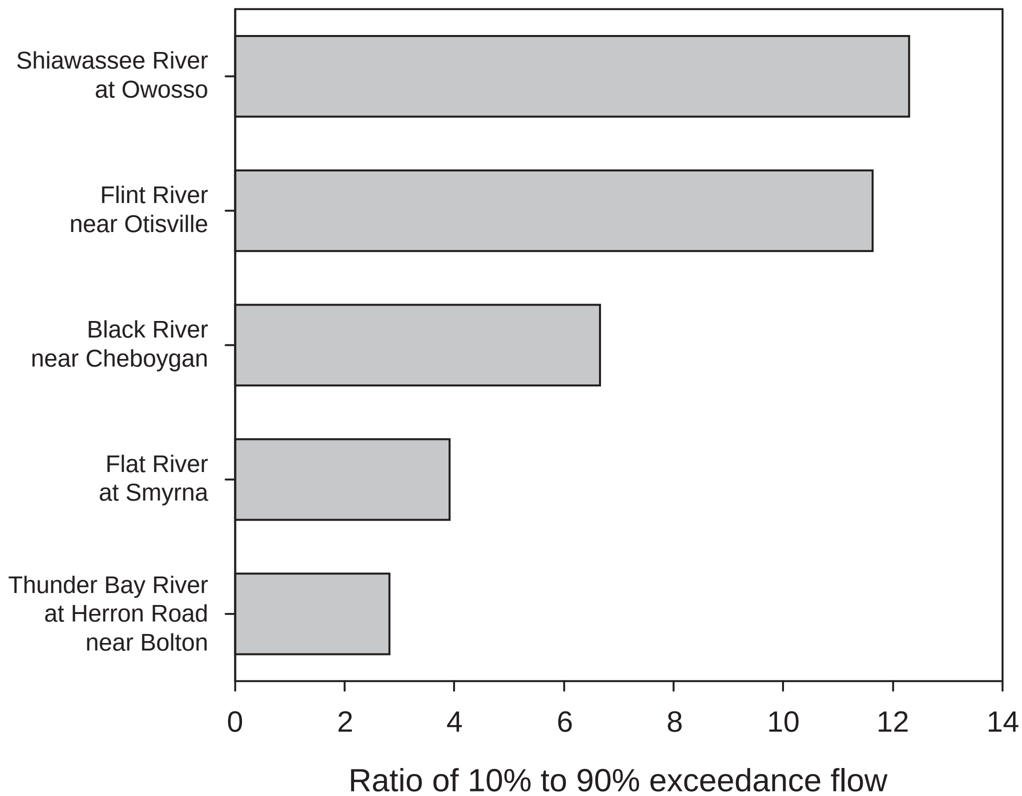


Figure 14.–Flow stability (expressed as the ratio of 10% and 90% exceedence flows) of Michigan streams having catchments comparable in size to the Black River near Cheboygan. Note that some flow regulation occurs upstream of all gages except the Black River, where some regulation occurs downstream of the gage. Data are from the United States Geological Survey.

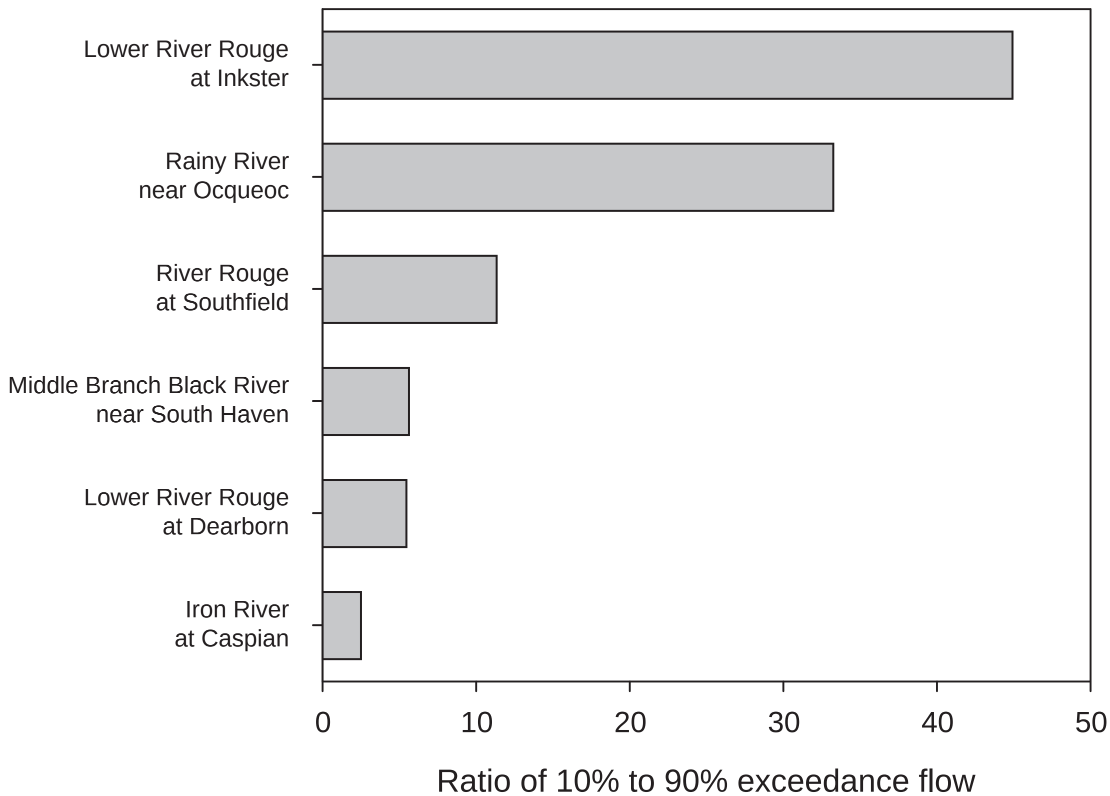


Figure 15.–Flow stability (expressed as the ratio of 10% and 90% exceedence flows) of Michigan streams having catchments comparable in size to the Rainy River near Ocqueoc. Data are from the United States Geological Survey.

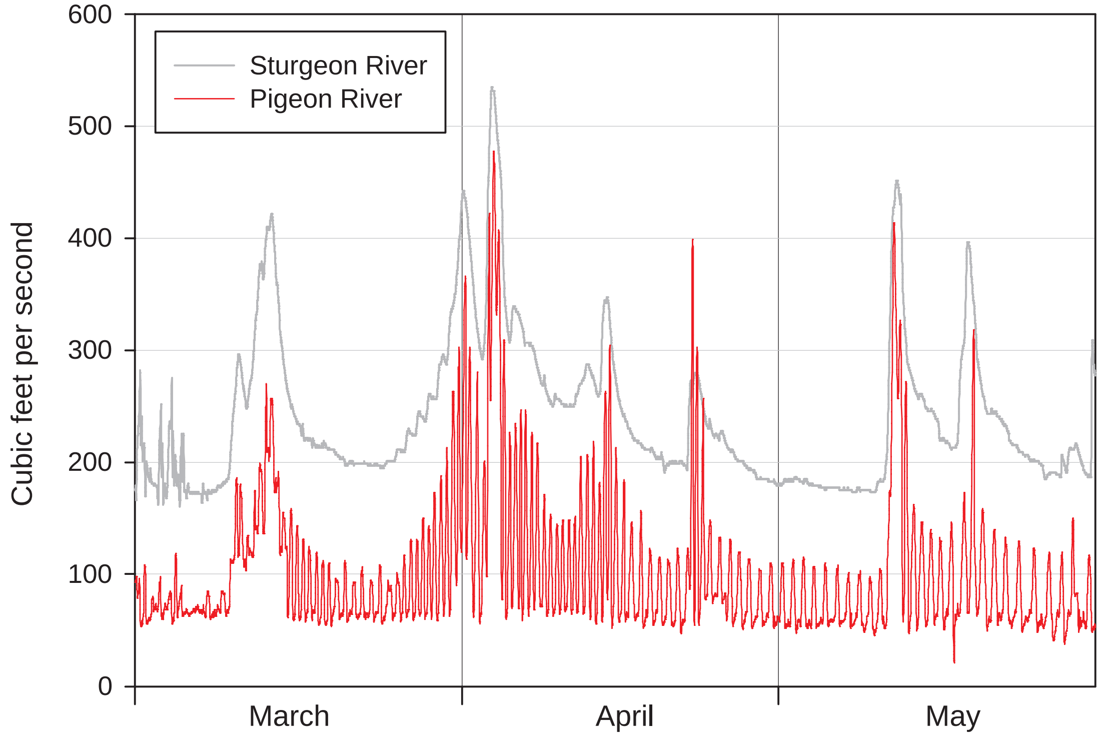


Figure 16.–Daily variation in stream flow (cubic feet per second) of the Pigeon River (red line) and Sturgeon River (gray line), March 01–May 31, 2006. Data are from the United States Geological Survey (2007).

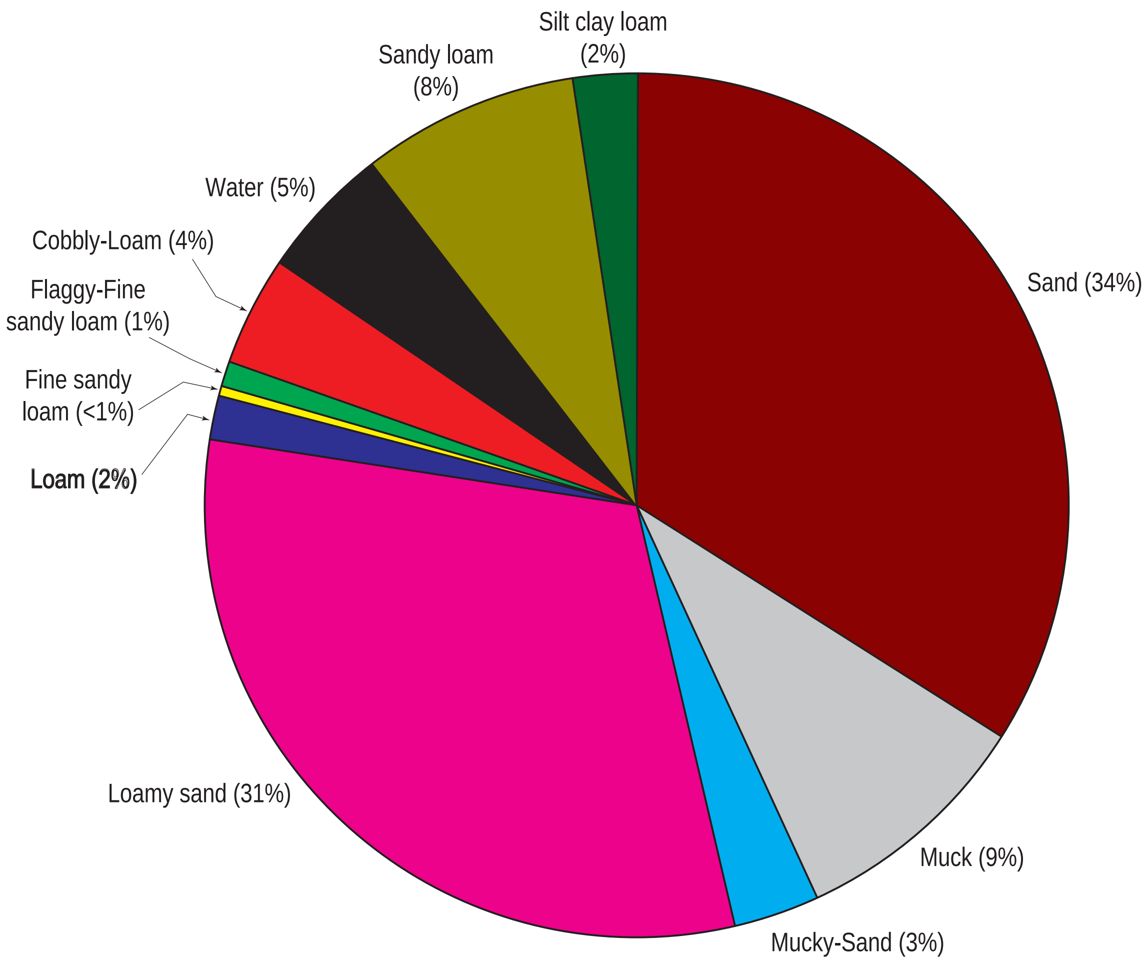


Figure 17.–Percentage of soil types within the Cheboygan River watershed (NRCS 1994).

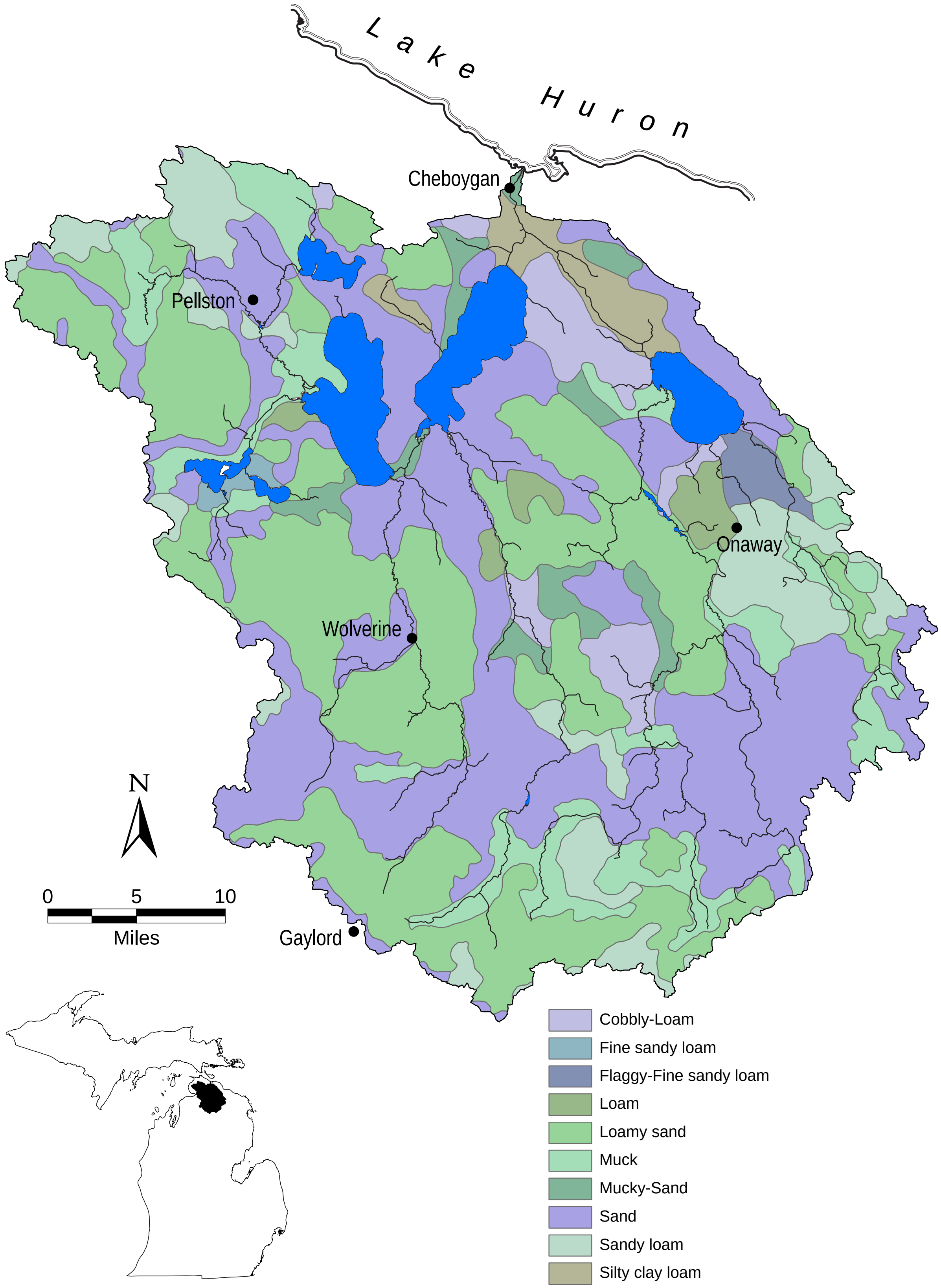


Figure 18.–Soils in the Cheboygan River watershed (NRCS 1994).

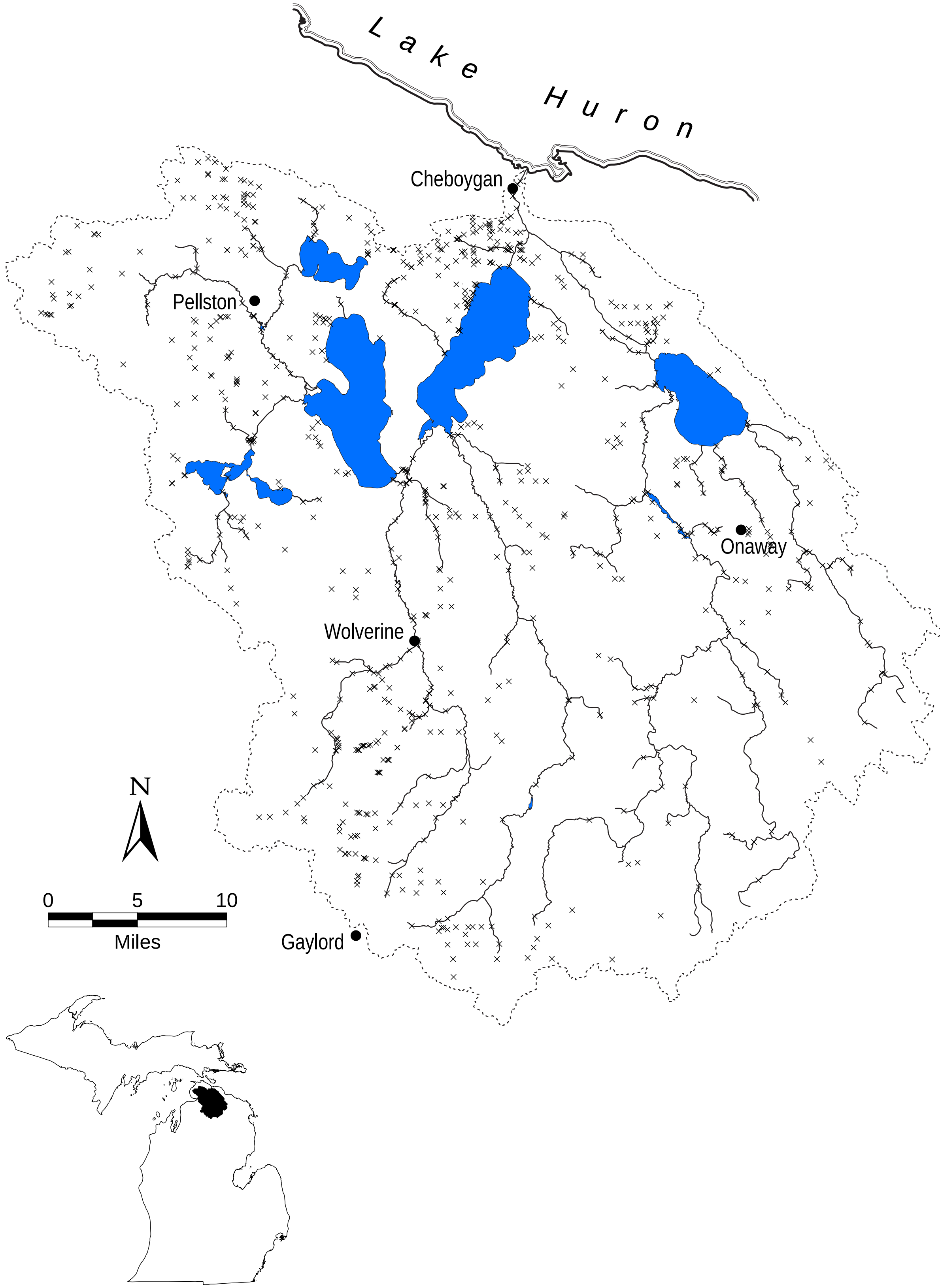


Figure 19.–Road-stream crossings in the Cheboygan River watershed. Data are from a MIRIS-based 1:24,000 scale map clipped to the Cheboygan River watershed (Michigan Geographic Data Library 2007).

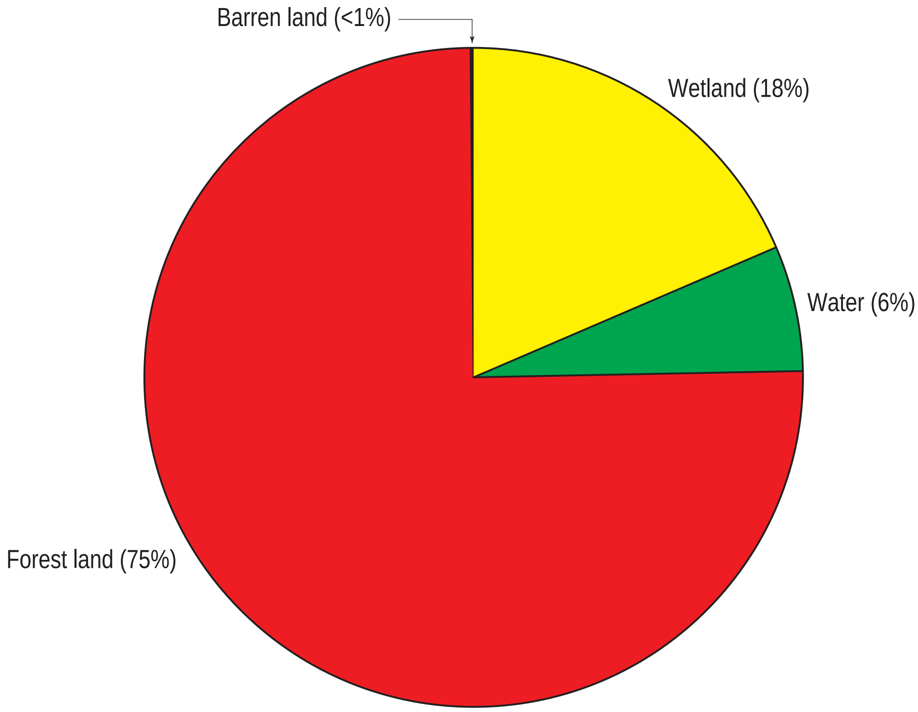


Figure 20a.–Percent land cover in the Cheboygan River watershed circa 1800 (MIRIS 1978).

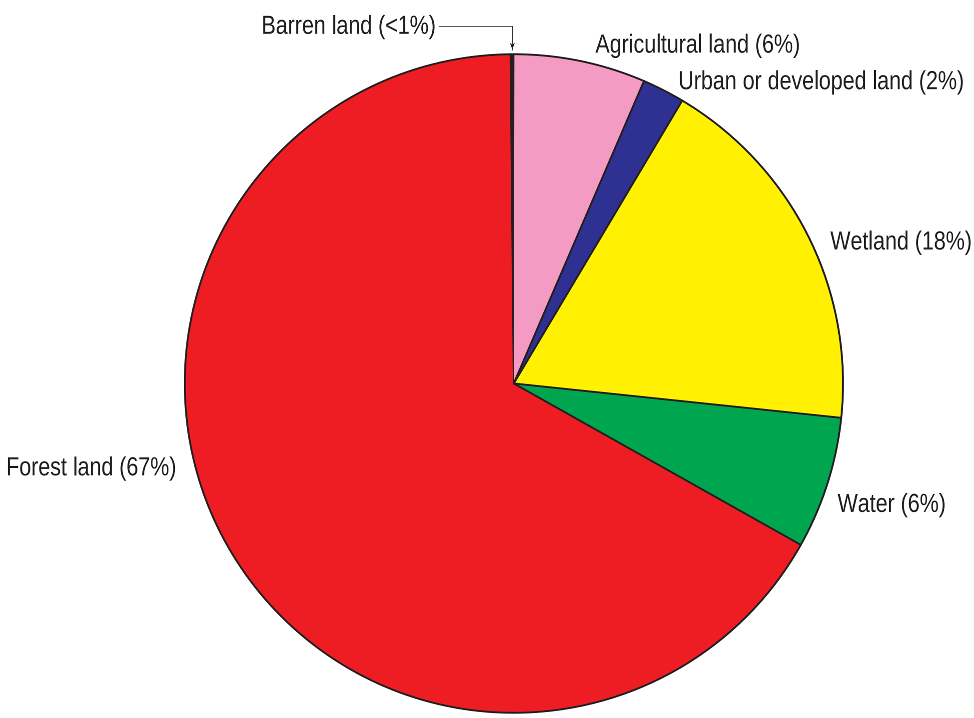


Figure 20b.–Percent land use and land cover in the Cheboygan River watershed in 2000 (NOAA 2001).

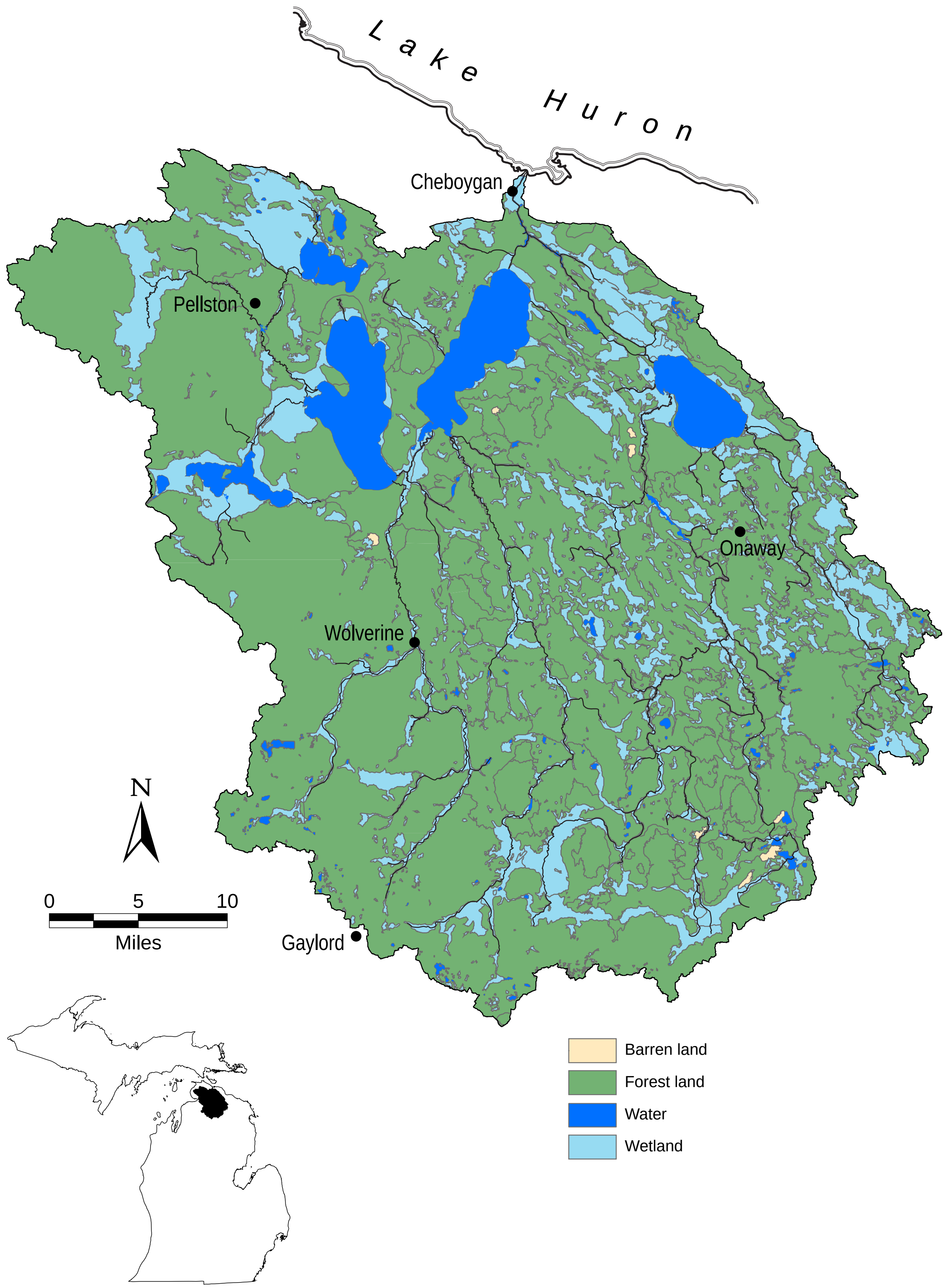


Figure 21.–Land cover in the Cheboygan River watershed circa 1800 (Michigan Geographic Data Library 2007).

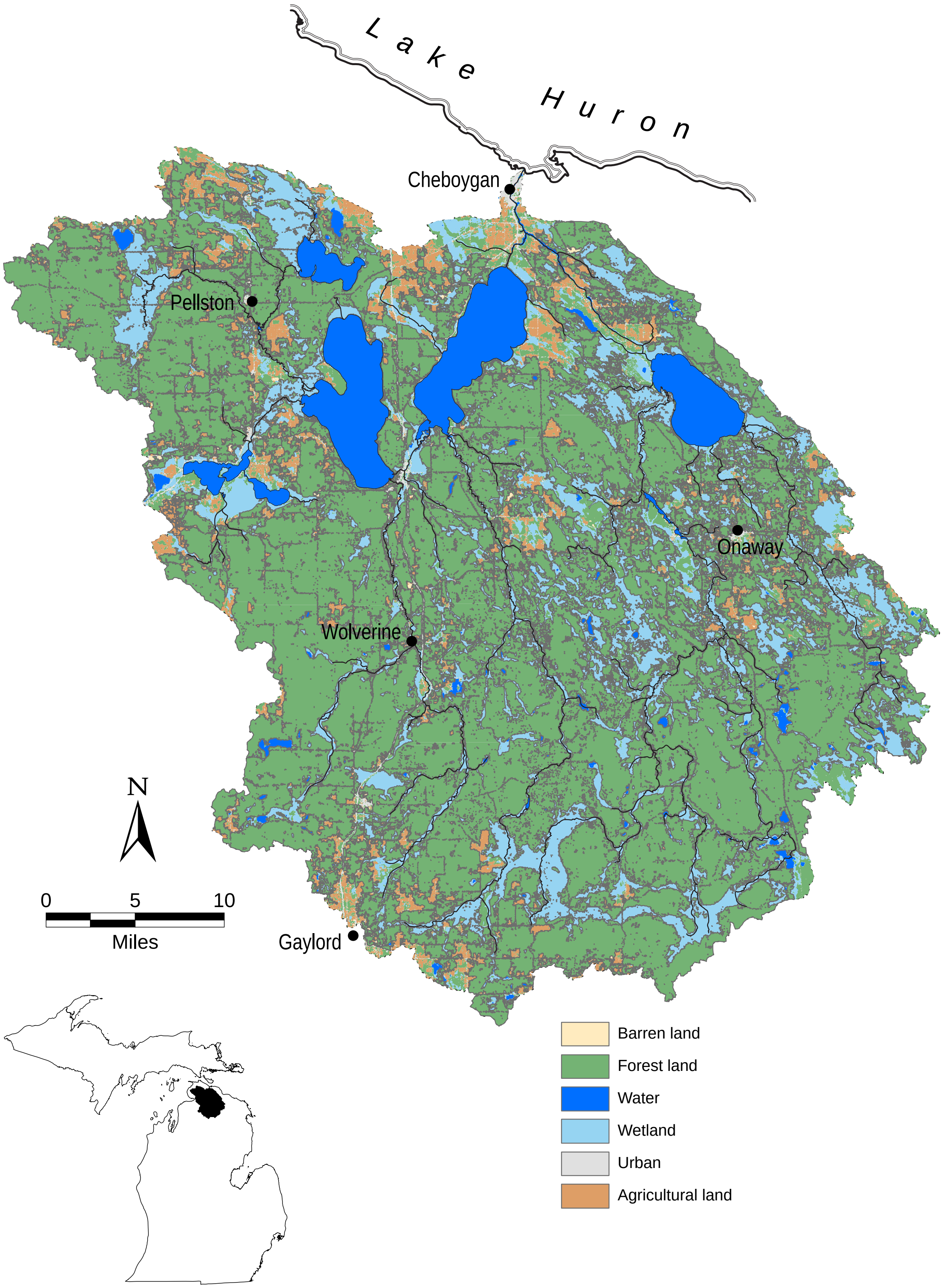


Figure 22.–Land use and land cover in the Cheboygan River Watershed in 2000 (NOAA 2001).

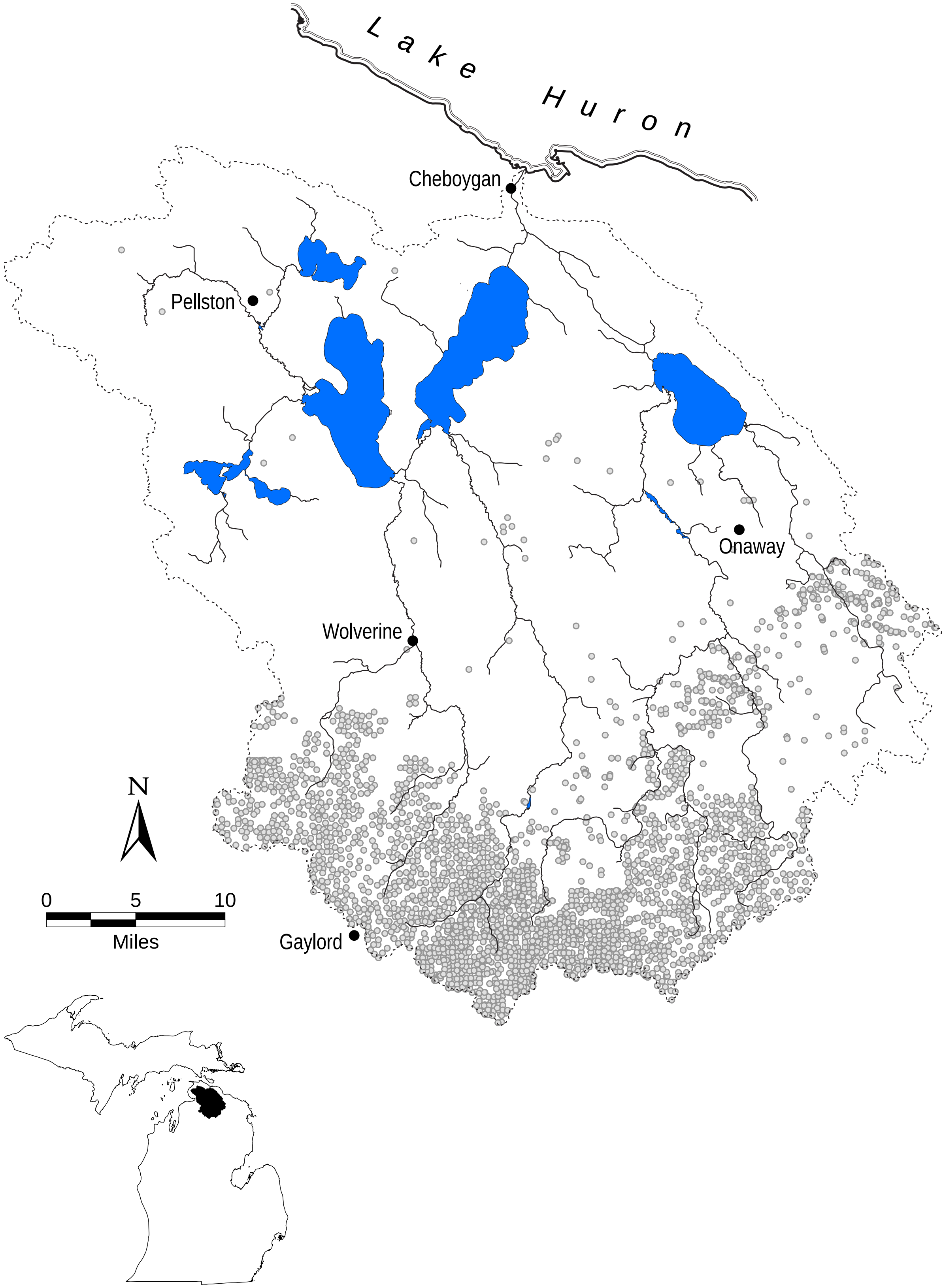


Figure 23.–Oil and gas wells in the Cheboygan River watershed (MDNR Spatial Data Library 2007).

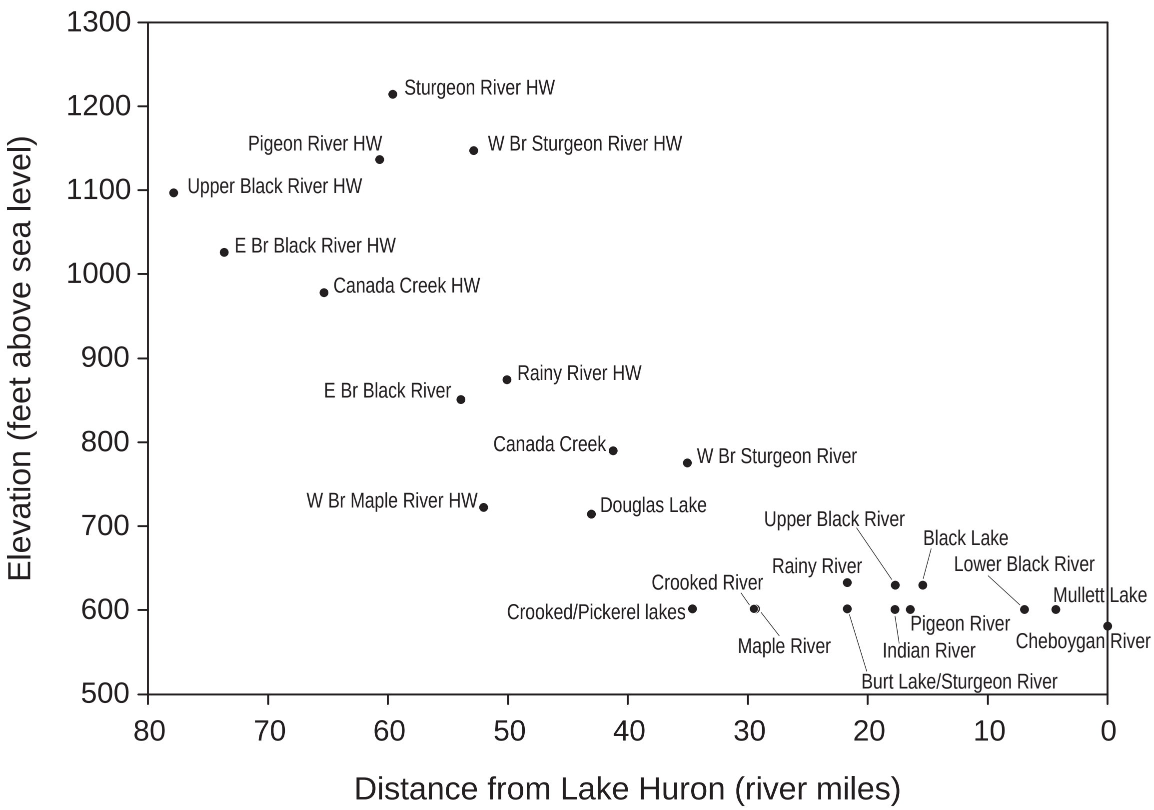


Figure 24.–Approximate elevation (feet above sea level) and distance from Lake Huron (river miles) of select water bodies in the Cheboygan River watershed. HW = headwaters; elevations of all other points are at the confluence of the next downstream river or lake.

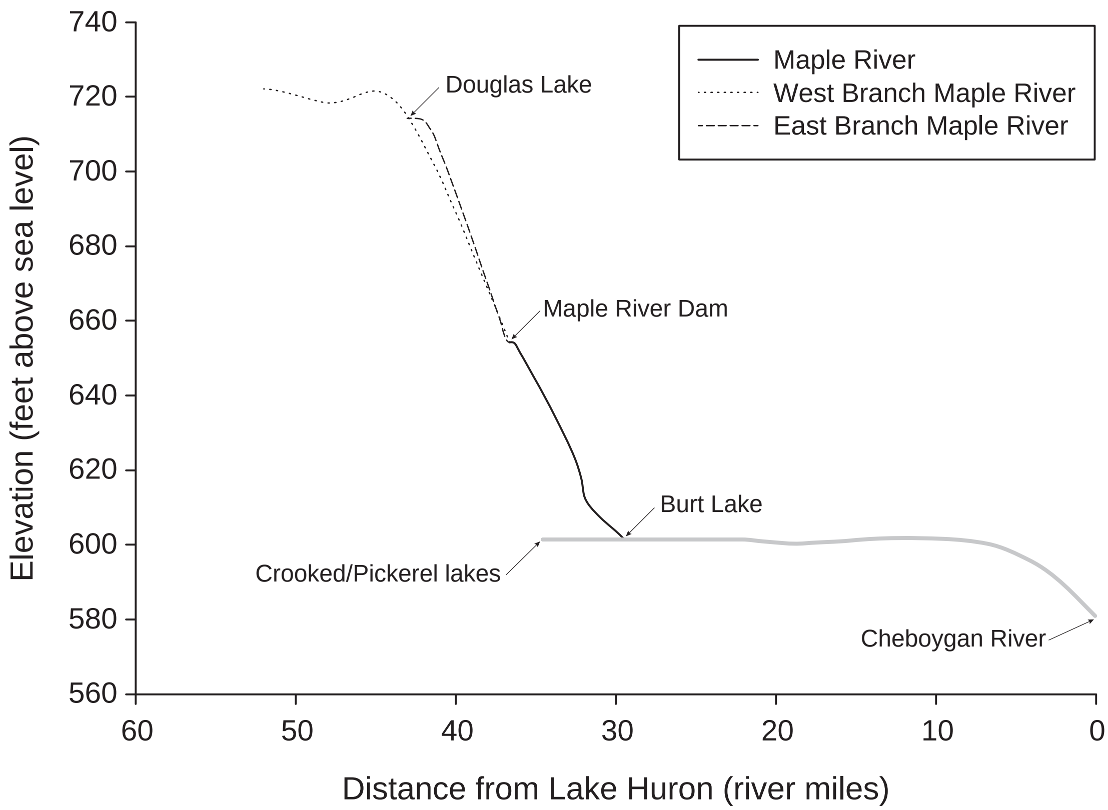


Figure 25.–Approximate elevation (feet above sea level) and distance from Lake Huron (river miles) of the Maple River and other water bodies in the Cheboygan River watershed.

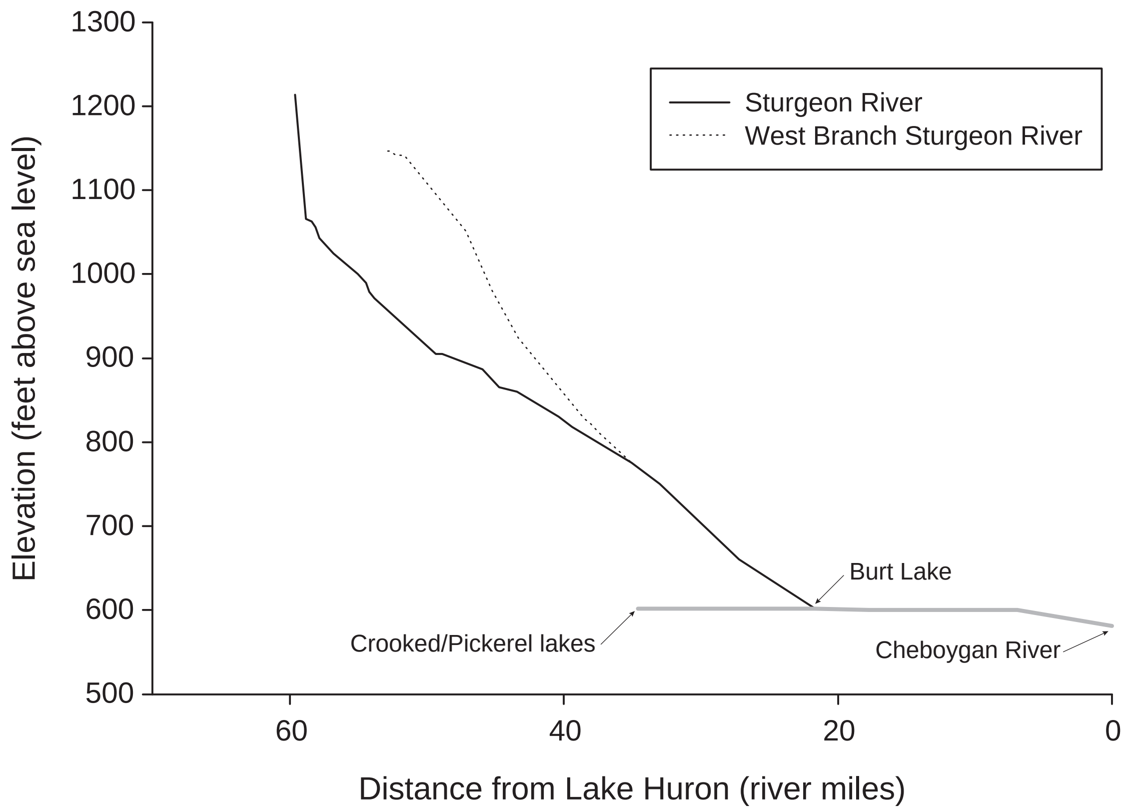


Figure 26.–Approximate elevation (feet above sea level) and distance from Lake Huron (river miles) of the Sturgeon River and other water bodies in the Cheboygan River watershed.

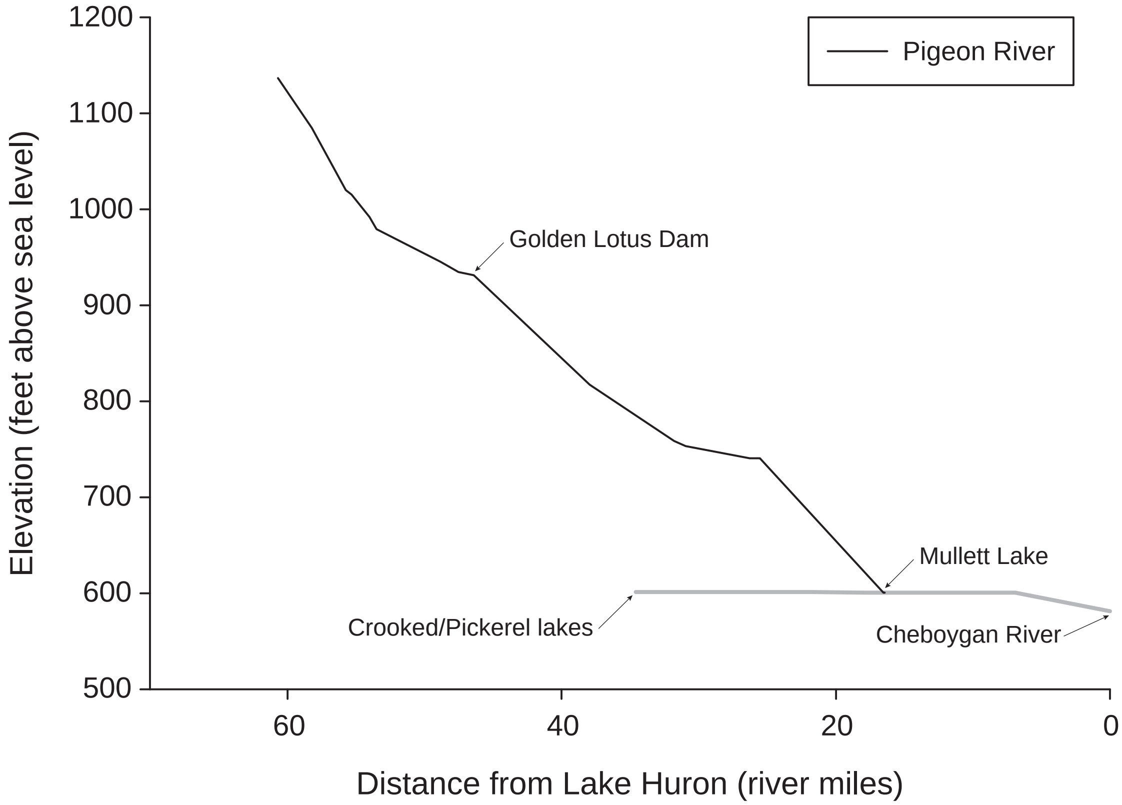


Figure 27.–Approximate elevation (feet above sea level) and distance from Lake Huron (river miles) of the Pigeon River and other water bodies in the Cheboygan River watershed.

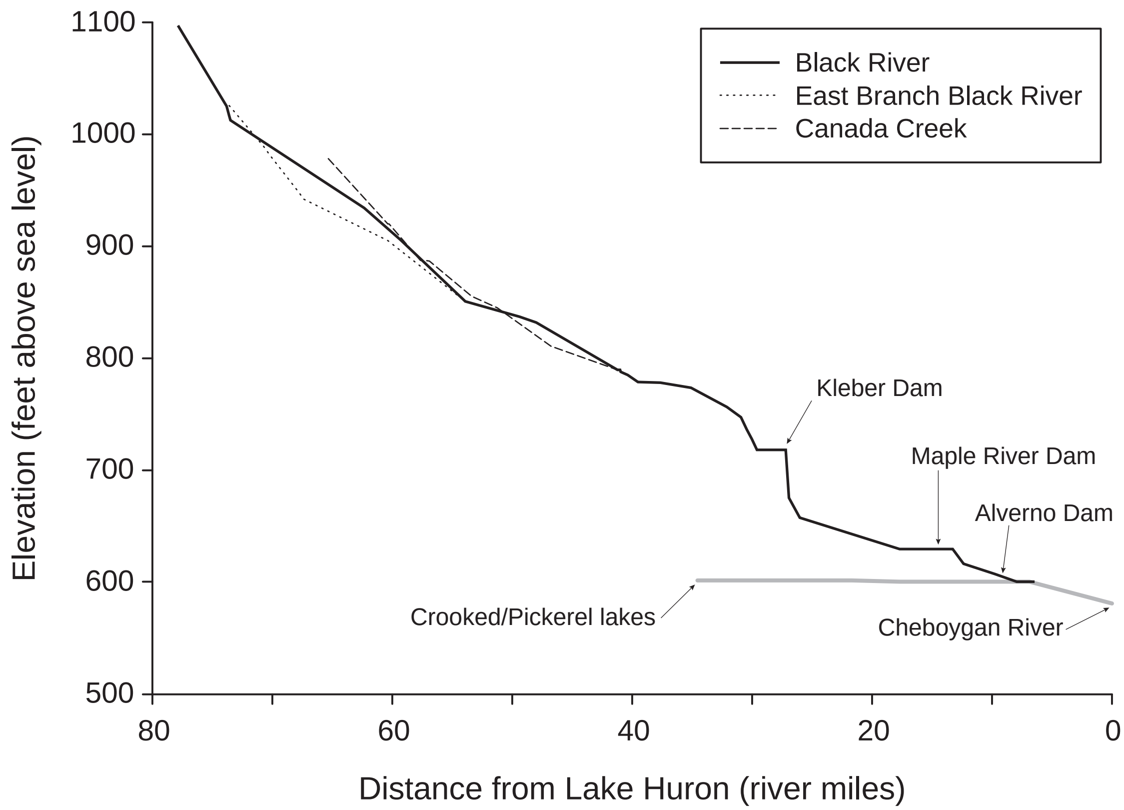


Figure 28.–Approximate elevation (feet above sea level) and distance from Lake Huron (river miles) of the Black River and other water bodies in the Cheboygan River watershed.

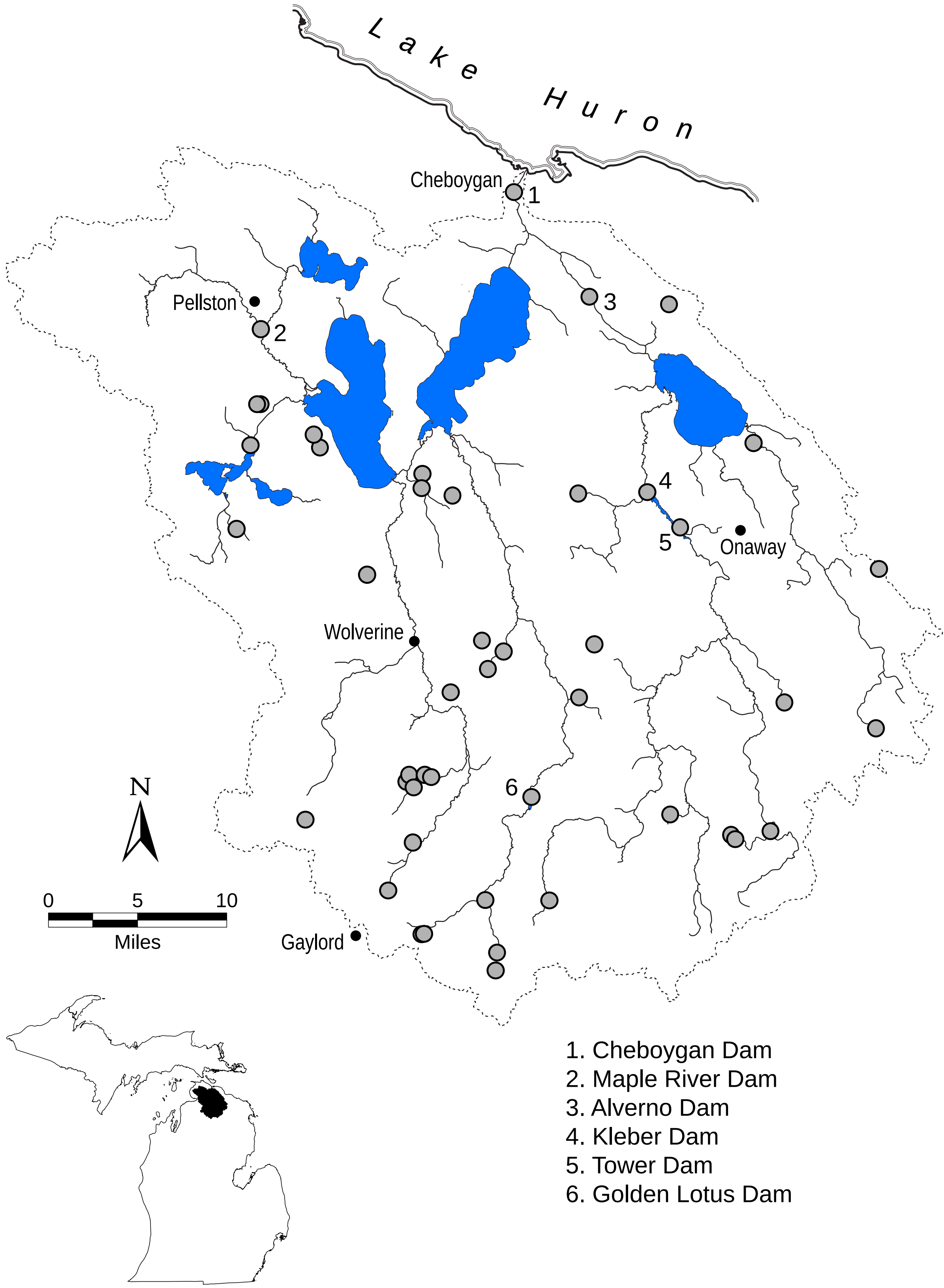


Figure 29.–Locations of dams in the Cheboygan River watershed. Principal dams are labeled numerically (Michigan Department of Environmental Quality, Land and Water Management Division, unpublished data).

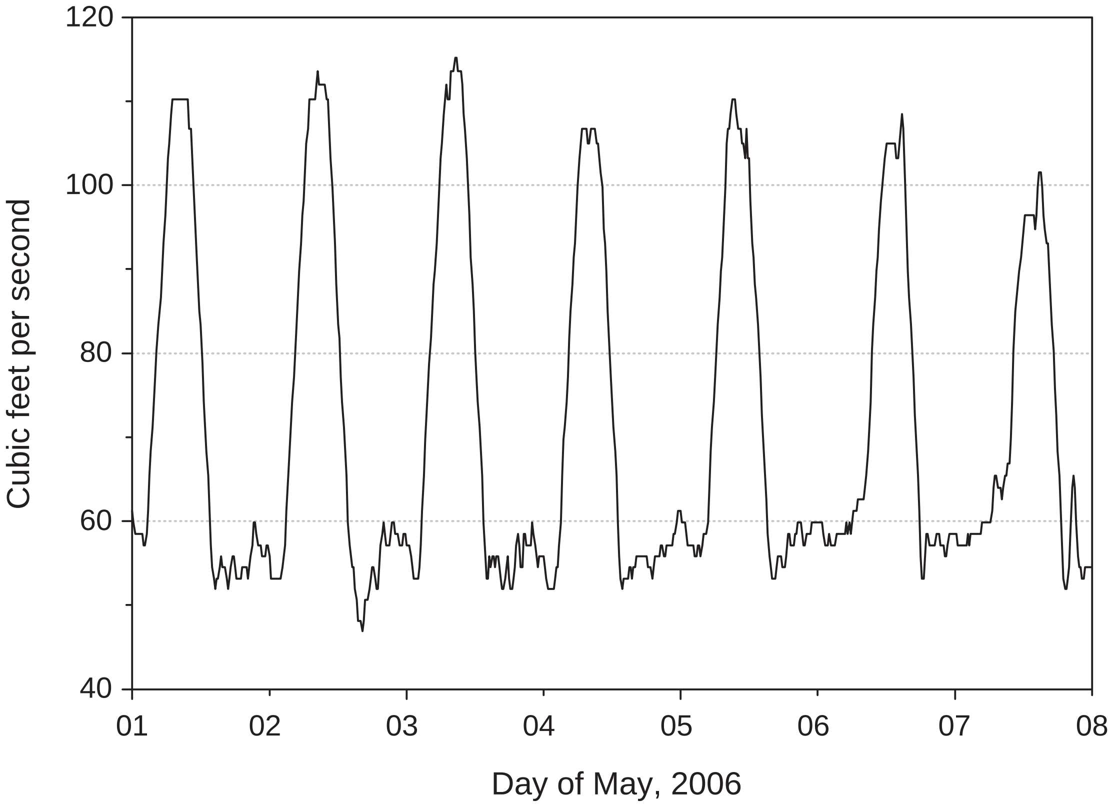


Figure 30.–Pigeon River flows at Sturgeon Valley Road, May 1–7, 2006 (USGS unpublished data).

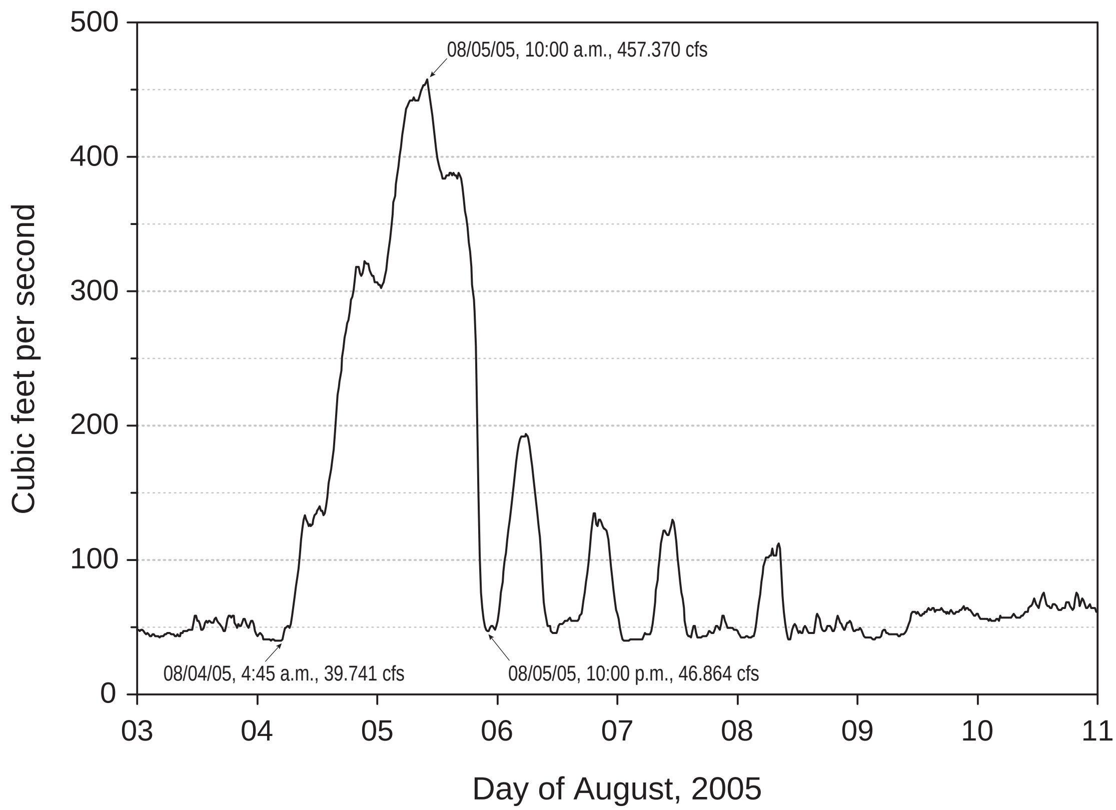


Figure 31.–Pigeon River flows at Sturgeon Valley Road, August 3-10, 2005 (USGS unpublished data).

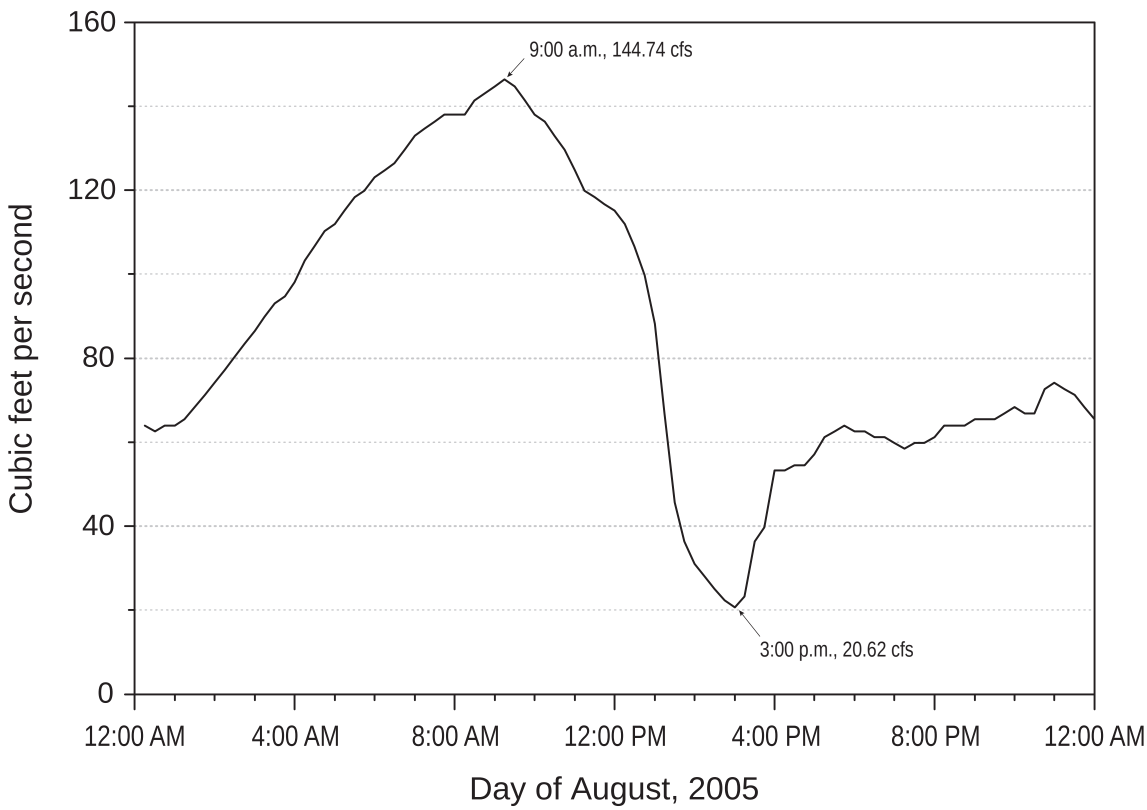


Figure 32.–Pigeon River flows at Sturgeon Valley Road on May 17, 2006 (USGS unpublished data).

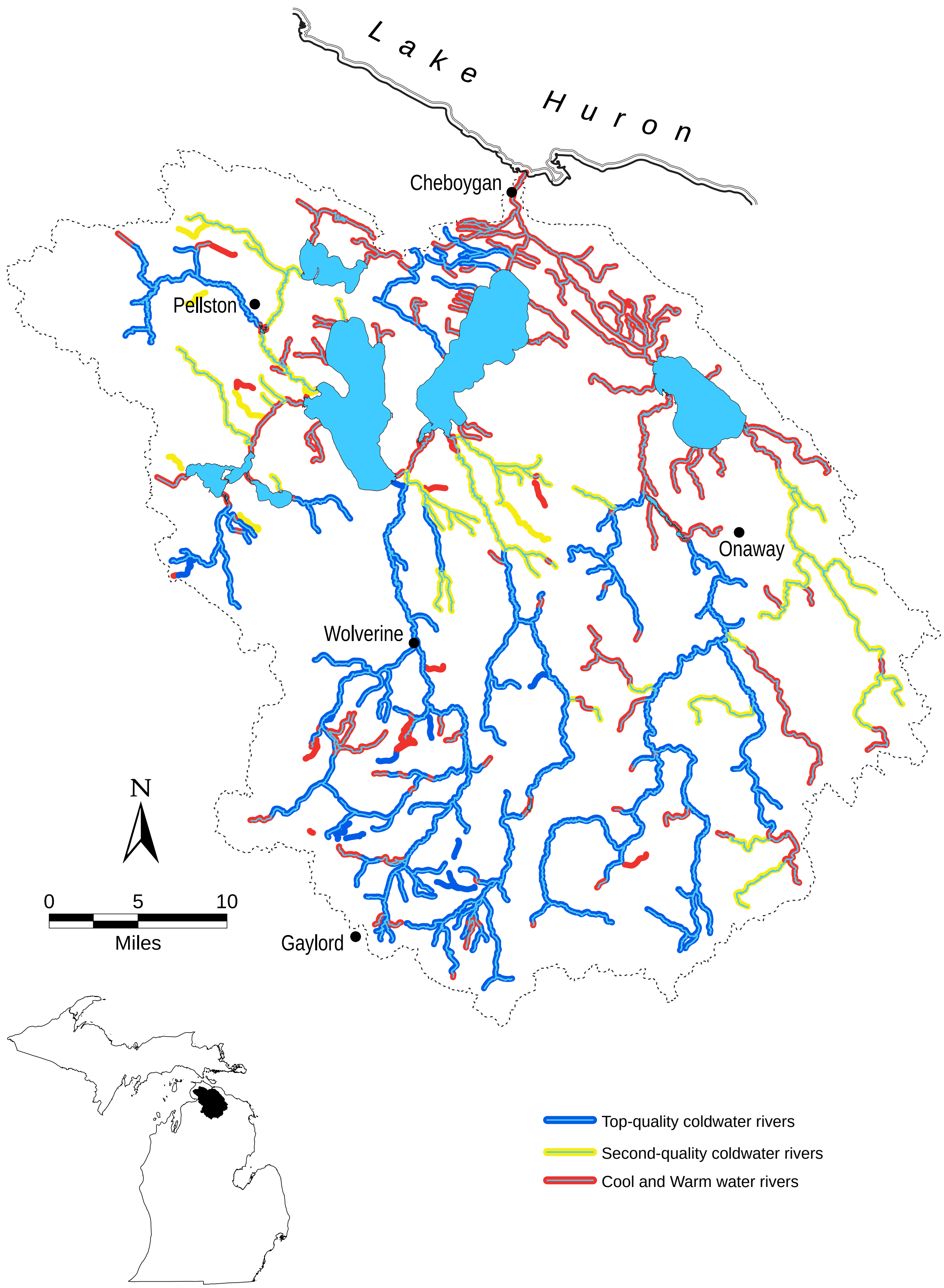


Figure 33.–MDNR 1967 stream classification.

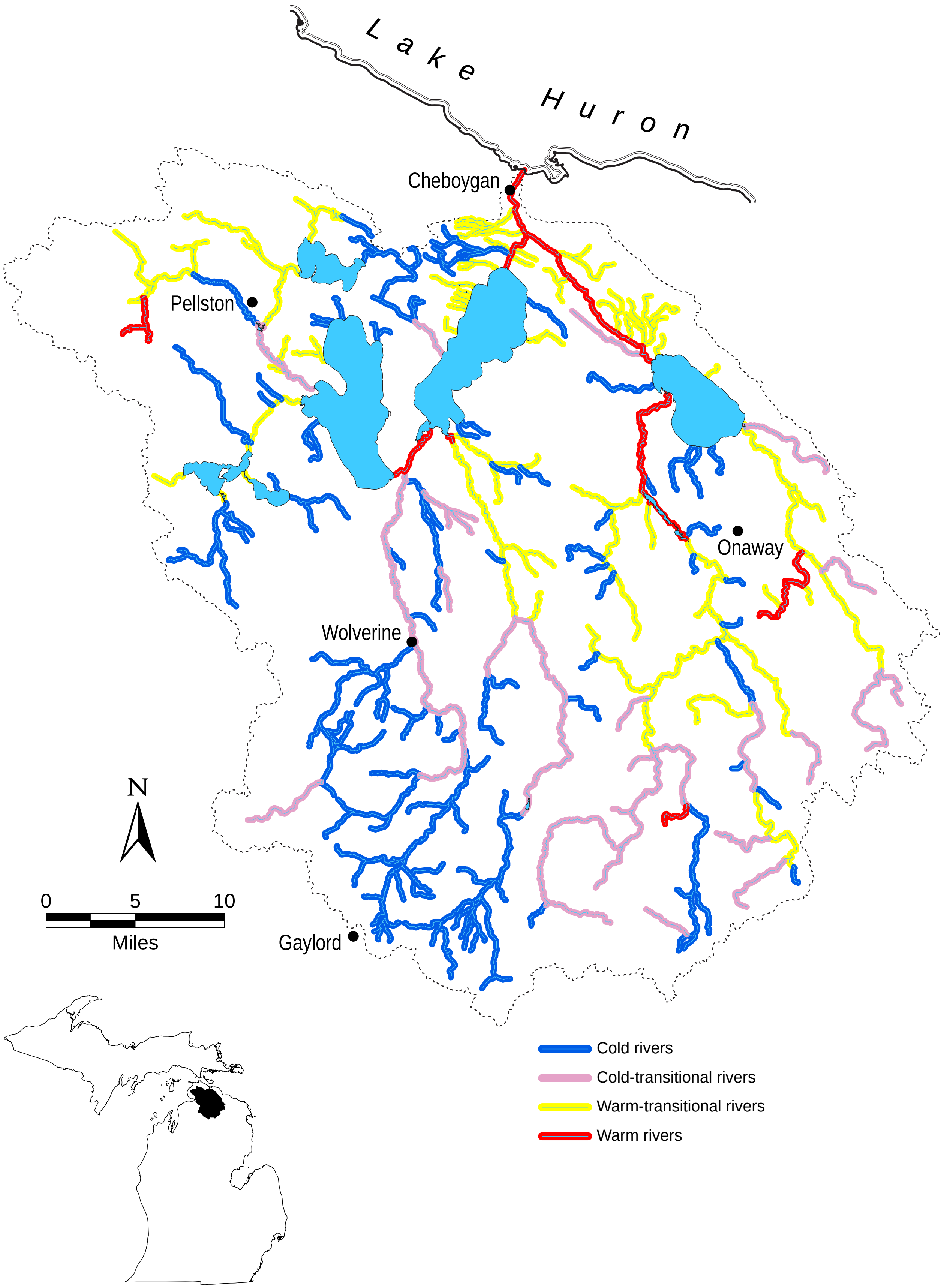


Figure 34.–MDNR 2008 stream classification.

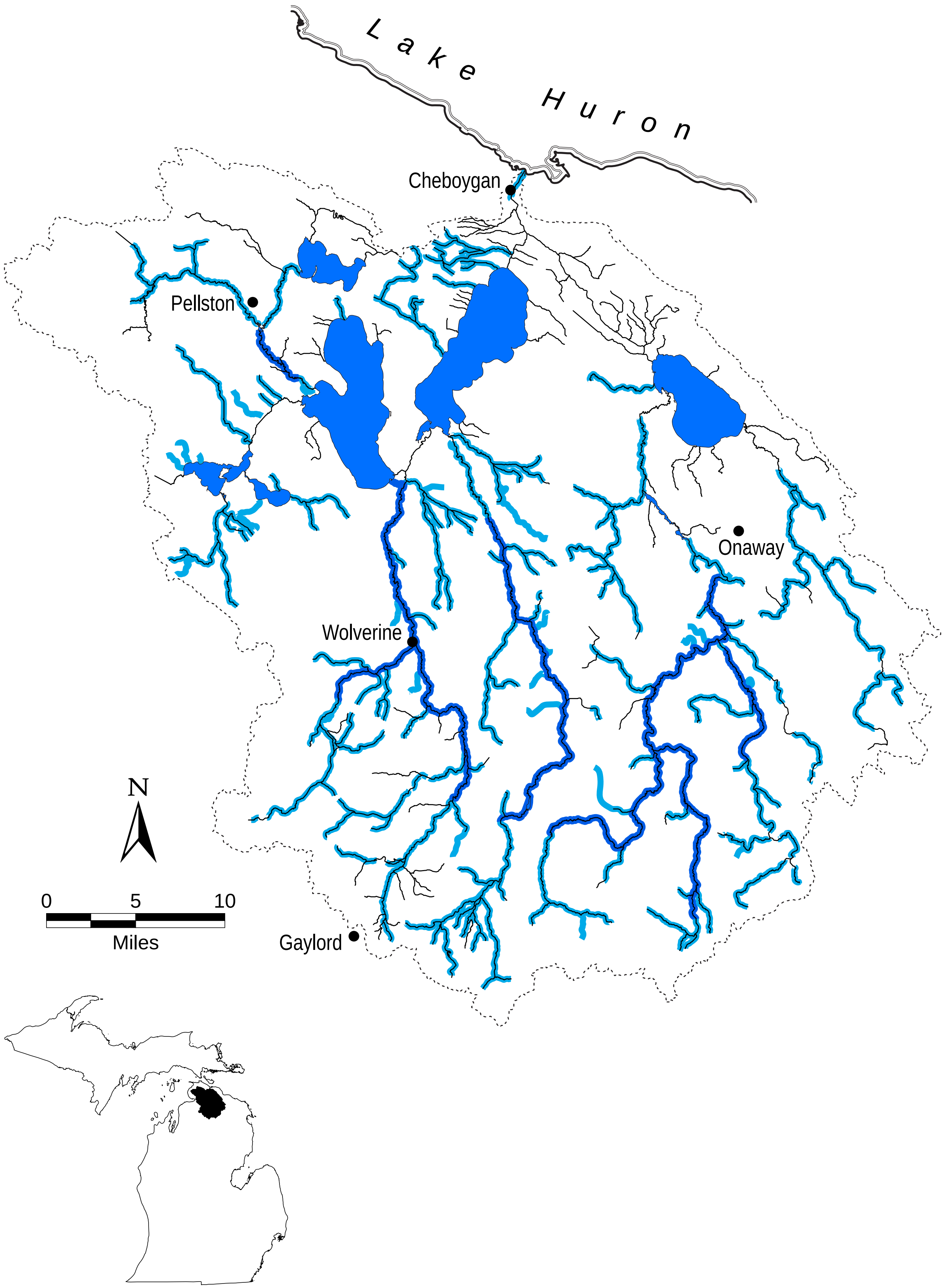


Figure 35.–Designated trout streams (bold in the above figure) of the Cheboygan River watershed.

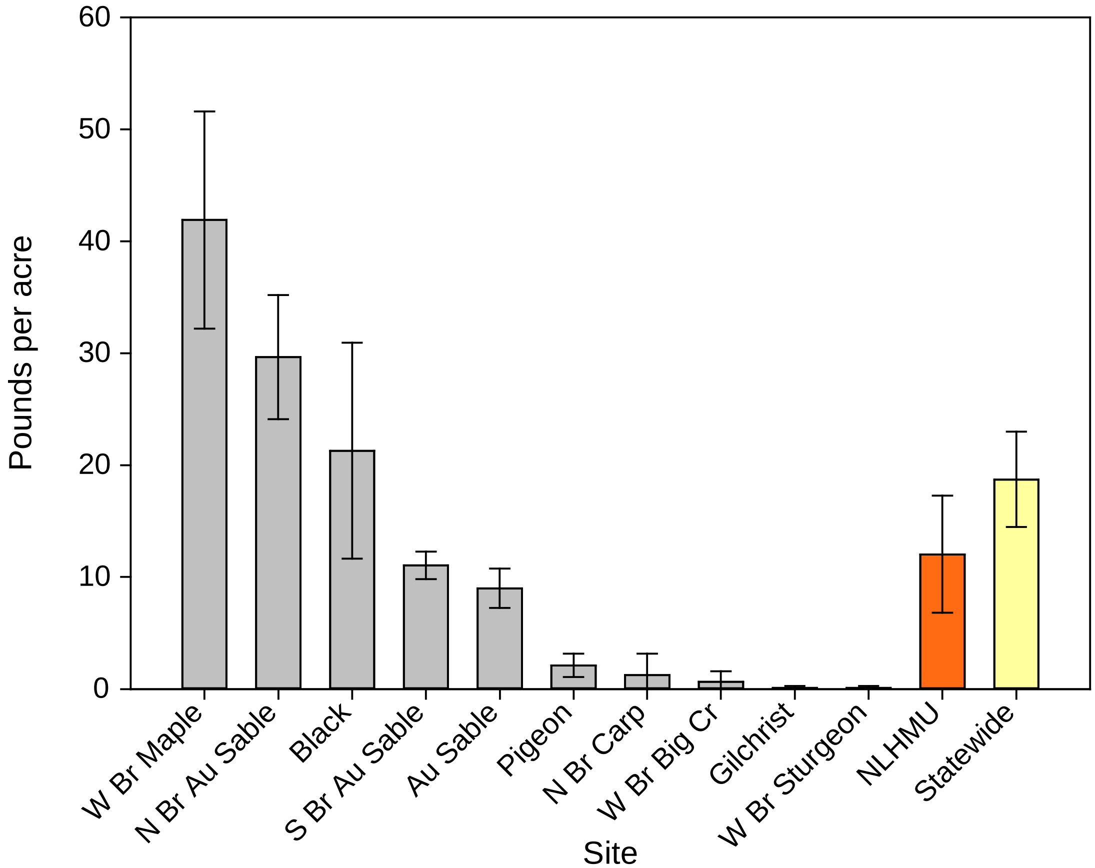


Figure 36.–Average brook trout biomass at fixed sites within Northern Lake Huron Management Unit.

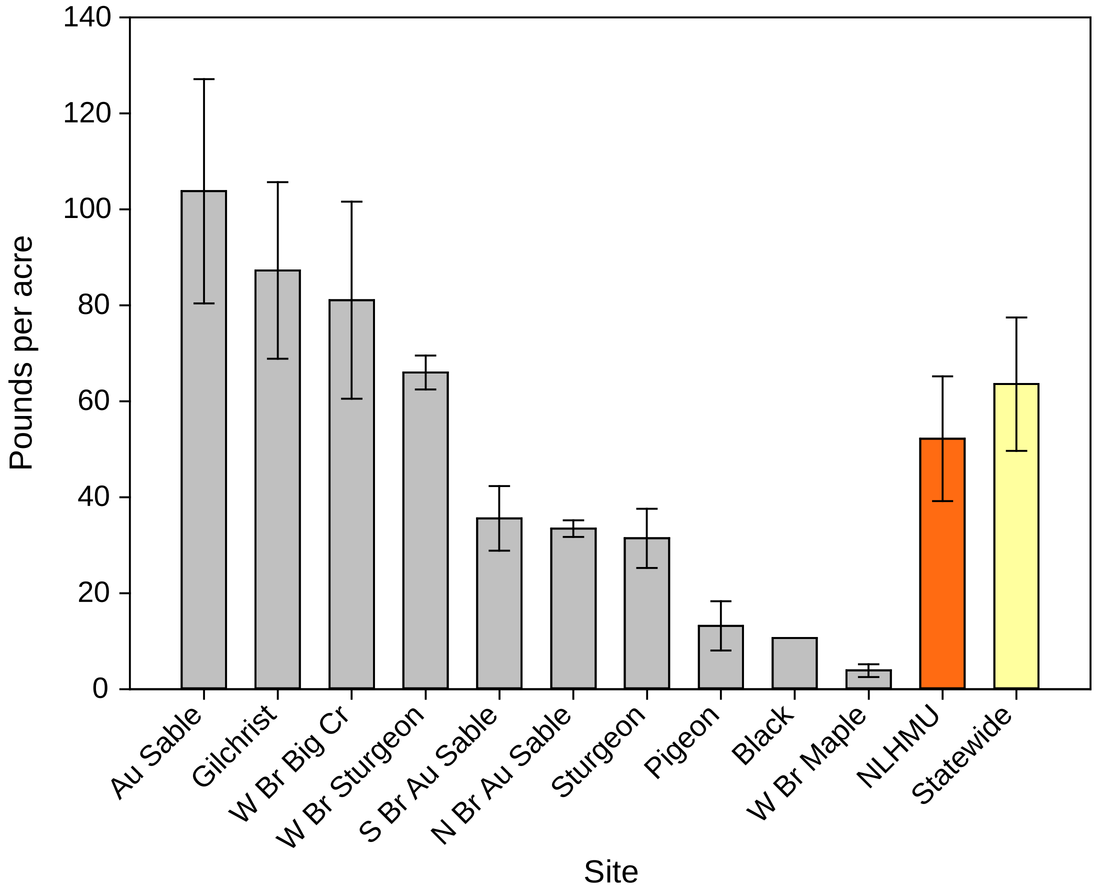


Figure 37.–Average brown trout biomass at fixed sites within Northern Lake Huron Management Unit.

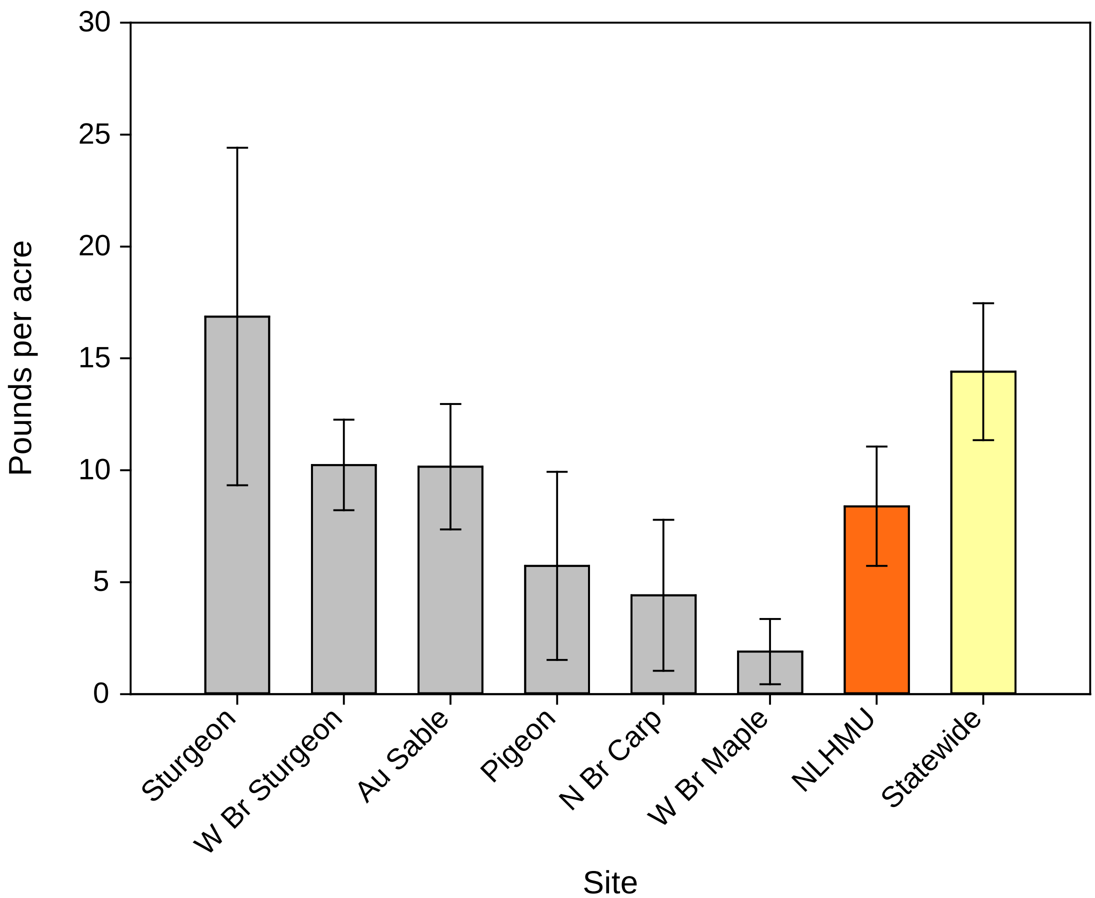


Figure 38.–Average rainbow trout biomass at fixed sites within the Northern Lake Huron Management Unit.

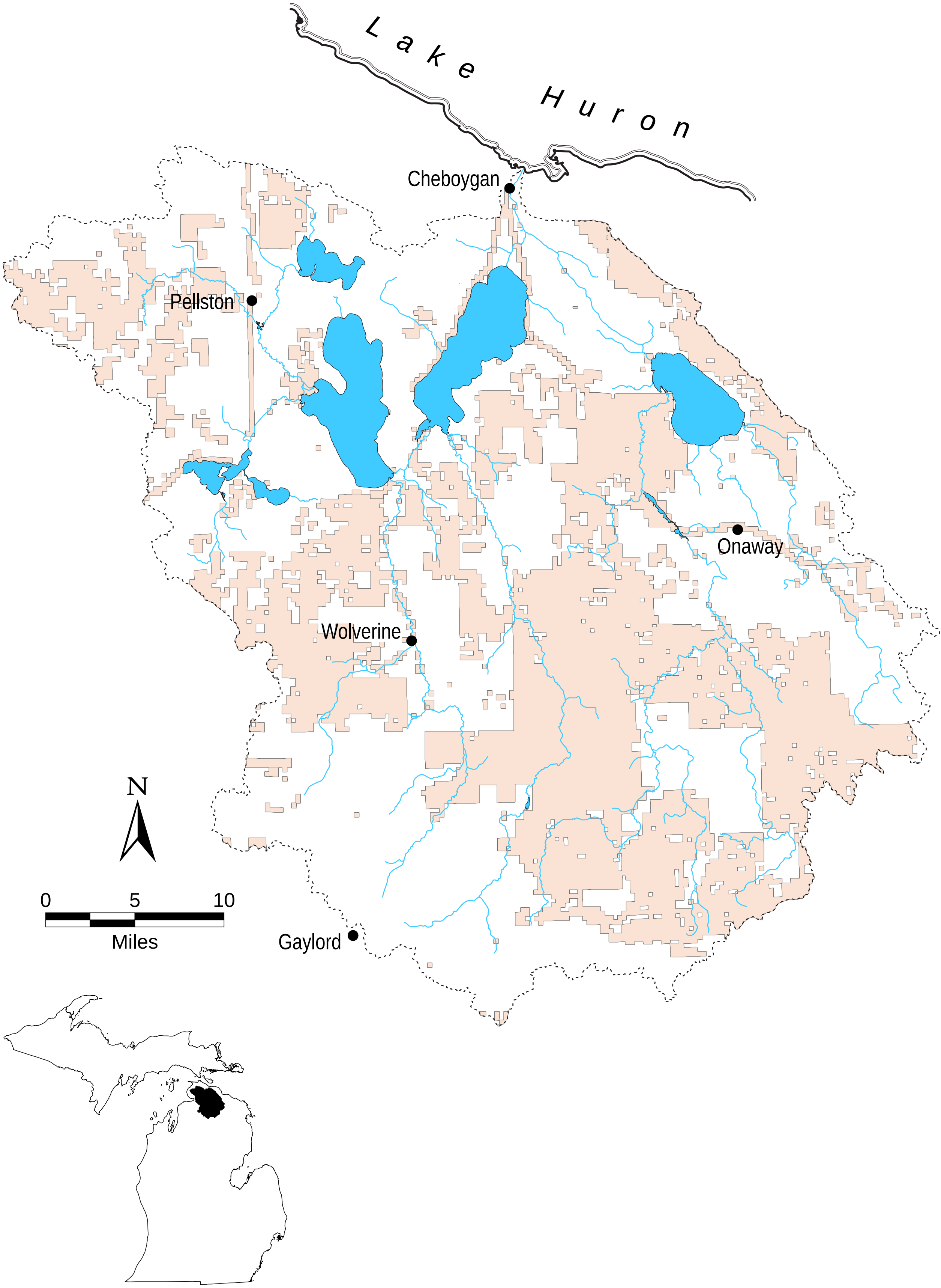
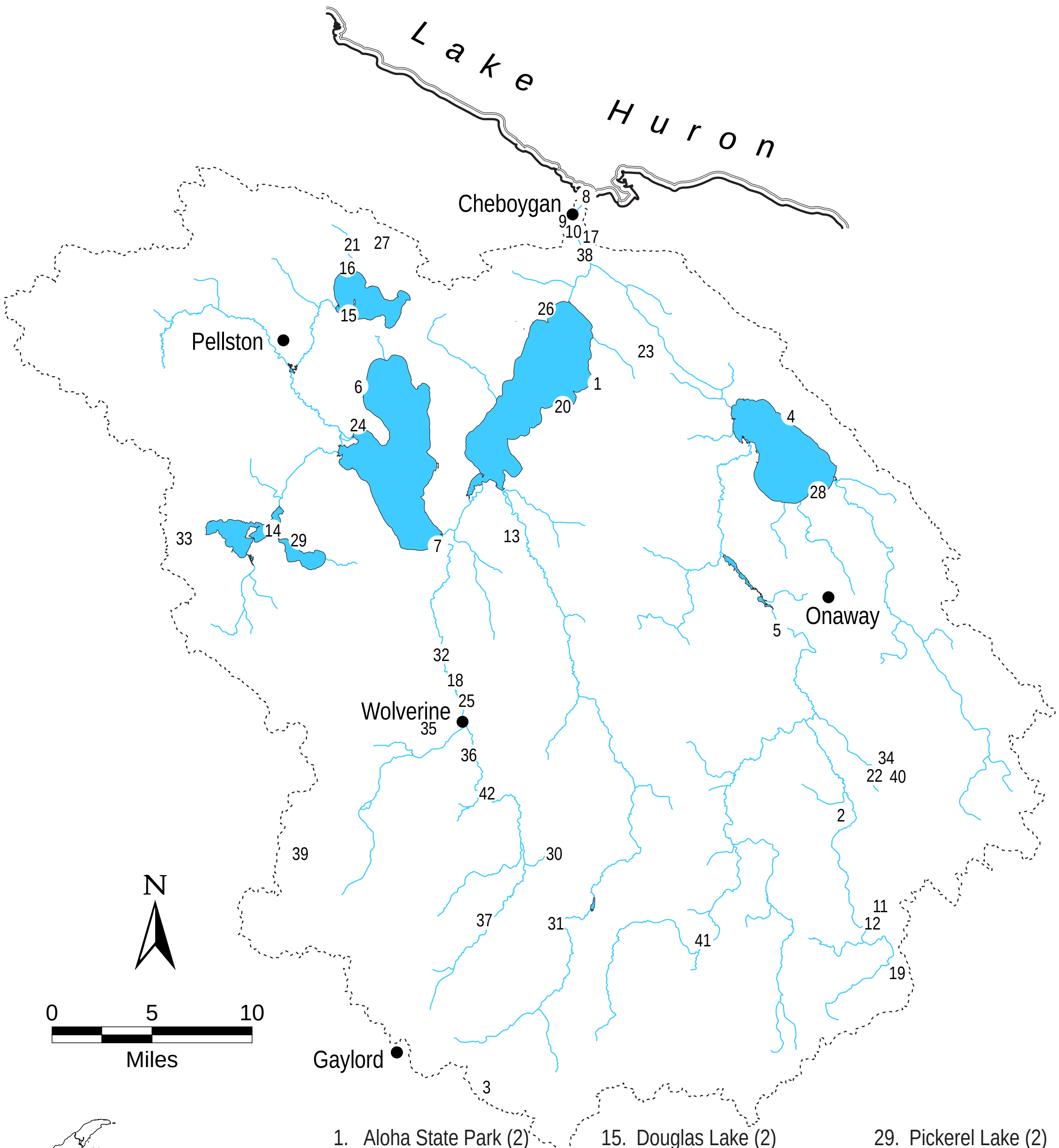


Figure 39.–Public land in the Cheboygan River watershed.



1. Aloha State Park (2)
2. Bear Den Lake (3)
3. Big Lake (2)
4. Black Lake SFCG (2)
5. Black River (6)
6. Burt Lake (6)
7. Burt Lake State Park (1)
8. Cheboygan Co. Launch (1)
9. Cheboygan Dam (1)
10. Cheboygan River (5)
11. Clear Lake State Park (2)
12. Clear Lake State Park (2)
13. Cochran Lake (3)
14. Crooked Lake (2)
15. Douglas Lake (2)
16. Douglas Lake (6)
17. Garfield Road (3)
18. Haakwood SFCG (4)
19. Jackson Lake SFCG (4)
20. Jewel Road (1)
21. Lancaster Lake (3)
22. Little Tomahawk Lake (4)
23. Long Lake (2)
24. Maple Bay SFCG (2)
25. Meadows (4)
26. Mullett Lake Village (1)
27. Munro Lake (2)
28. Onaway State Park (1)
29. Pickerel Lake (2)
30. Pickerel Lake SFCG (2)
31. Pigeon River (6)
32. Rondo (4)
33. Round Lake (2)
34. Shoepac Lake SFCG (2)
35. Silver Lake (2)
36. Sturgeon River (6)
37. Sturgeon River (6)
38. The Forks (6)
39. Thumb Lake (2)
40. Tomahawk Lake SFCG (2)
41. Town Corner Lake SFCG (4)
42. Trowbridge Road (4)

Figure 40.–Designated public access sites in the Cheboygan River watershed. Ramp description codes (in parentheses) include signed, hard-surface ramps, which accommodate all trailerable watercraft (1); hard-surfaced ramps where launching large watercraft may be difficult (2); gravel ramps for medium to small-sized watercraft (3); carry-down launching areas (4);signed, shore-fishing access (5); and unsigned, undeveloped sites (6). SFCG = State Forest Campground.

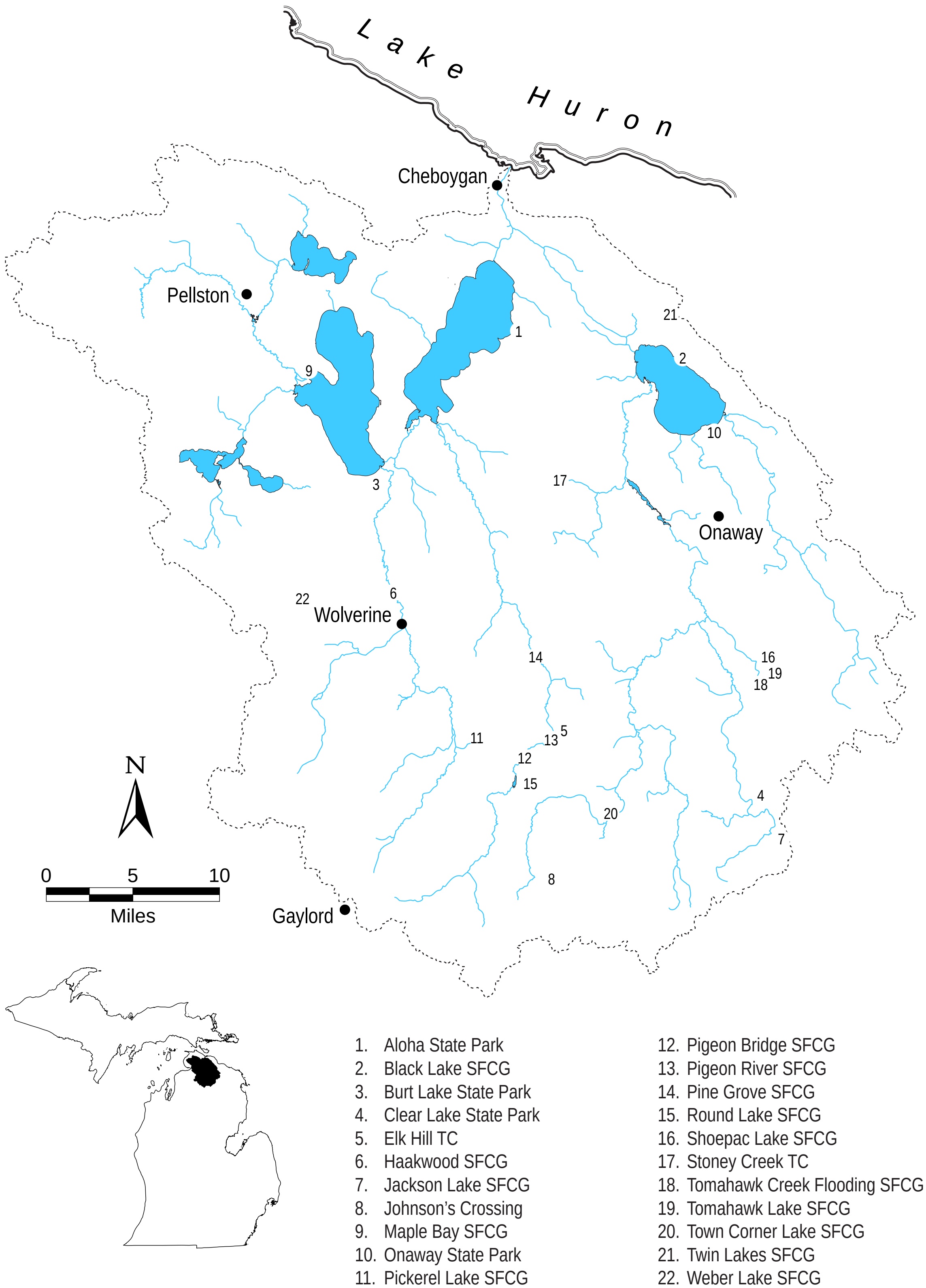


Figure 41.–State parks and state forest campgrounds in the Cheboygan River watershed. SFCG = State Forest Campground; TC = Trail Camp.

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TABLES

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Table 1.–Inventory of major tributaries and lakes associated with the various Cheboygan River watershed segments. Tributaries are indented to show the stream they flow into.

Segment	Stream–tributary
West Branch Maple River – Headwaters to Maple River Dam	Brush Creek
	Cold Creek
East Branch Maple River – Headwaters to Maple River Dam	Douglas Lake
	Beavertail Creek
	Lancaster Creek
	Van Creek
Maple River – Maple River Dam to Burt Lake	
Sturgeon River – Headwaters to confluence with West Branch Sturgeon River	Mossback Creek
	Pickerel Creek
	Club Stream
	Stewart Creek
	Blackjack Creek
West Brach Sturgeon River	Marl Creek
Sturgeon River – Confluence with West Branch Sturgeon River to Burt Lake	Beebe Creek
Burt Lake	Crooked River
	Crooked Lake
	Minnehaha Creek
	West Branch Minnehaha Creek
	Silver Creek
	Pickerel Lake
	Berry Creek
	Cedar Creek
	McPhee Creek
	Little Carp River
Pigeon River – Headwaters to Lansing Club Pond Dam	South Branch Pigeon River
Pigeon River – Lansing Club Pond Dam to confluence with Little Pigeon River	Cornwall Creek
	Grindstone Creek
	Nelson Creek
Pigeon River – Confluence with Little Pigeon River to Mullett Lake	Little Pigeon River
	Wilkes Creek
Mullett Lake	Indian River
	Little Sturgeon River
	Crumley Creek
	Little Pigeon River
	Kimberly Creek
	Middle Branch Little Pigeon River
	North Branch Little Pigeon River
	Mullett Creek
	Ballard Creek

Table 1.–Continued.

Segment	Stream–tributary
Black River – Headwaters to Clark Bridge Road	Saunders Creek Tubbs Creek Hardwood Creek Stewart Creek Little McMasters Creek East Branch Black River
East Branch Black River	Rattlesnake Creek
Black River – Clark Bridge Road to Kleber Dam	McMasters Creek Canada Creek Tomahawk Creek Gregg Creek Bowen Creek Welch Creek
Canada Creek	Packer Creek Van Hetton Creek Montague Creek Oxbow Creek

Black River – Kleber Pond Dam to Black Lake	Milligan Creek
	  Adair Creek
	  Gokee Creek

Black Lake	Stewart Creek
	Stony Creek
	Rainy River
	  West Branch Rainy River
	    Healy Creek
	  Little Rainy River
	  East Branch Rainy River
	  Cold Creek
	Mud Creek

Lower Black River	Long Lake Outlet Owens Creek Myers Creek
Cheboygan River	Laperell Creek Terry Creek Lower Black River

Table 2.–Inventory of lakes 10 acres or larger in the Cheboygan River watershed. Lakes are organized by river valley segment.

Lake	County	Latitude	Longitude	Acreage
West Branch Maple River – Headwaters to Maple River Dam				
Kathleen Lake	Emmet	45.5300	-84.7752	45
Larks Lake	Emmet	45.6047	-84.9298	592
East Branch Maple River – Headwaters to Maple River Dam				
Arnott Lake	Emmet	45.6261	-84.7751	23
Douglas Lake	Cheboygan	45.5811	-84.6970	3,727
Galloway Lake	Emmet	45.6526	-84.7779	20
Lancaster Lake	Cheboygan	45.6219	-84.7079	51
Munro Lake	Cheboygan	45.6147	-84.6829	515
Sherett Lake	Emmet	45.6367	-84.7695	14
Vincent Lake	Cheboygan	45.6030	-84.6945	30
Sturgeon River – Headwaters to confluence with West Branch Sturgeon River				
Clifford Lake	Otsego	45.0283	-84.6359	11
Lance Lake	Cheboygan	45.2294	-84.5687	25
Murner Lake	Otsego	45.0732	-84.7175	14
Olund Lake	Otsego	45.0844	-84.7182	24
Pickerel Lake	Otsego	45.1767	-84.5223	43
Wildwood Lake	Cheboygan	45.2320	-84.5571	227
unnamed lake	Cheboygan	45.2528	-84.5679	10
unnamed lake	Otsego	45.1644	-84.6140	44
West Branch Sturgeon River				
Barhite Lake	Cheboygan	45.2644	-84.6598	11
Berry Lake	Otsego	45.1236	-84.7323	19
Booth Lake	Charlevoix	45.1991	-84.7354	17
Bows Lake	Charlevoix	45.1503	-84.7790	48
Eighteen Lake	Otsego	45.1633	-84.7262	21
Fleming Lake	Otsego	45.1780	-84.6837	11
Heart Lake	Charlevoix	45.1364	-84.8176	10
Hoffman Lake	Charlevoix	45.1319	-84.7804	119
Kidney Lake	Charlevoix	45.1314	-84.7957	11
Silver Lake	Cheboygan	45.2694	-84.6329	68
Standard Lake	Charlevoix	45.1991	-84.7354	15
Thumb Lake	Charlevoix	45.1917	-84.7626	511
Weber Lake	Cheboygan	45.2980	-84.7243	28
Woodin Lake	Otsego	45.1325	-84.7284	29
Burt Lake				
Burt Lake	Cheboygan	45.4667	-84.6668	17,395
Crooked Lake	Emmet	45.4108	-84.8259	2,352
Pickerel Lake	Emmet	45.3967	-84.7684	1,082
Round Lake	Emmet	45.4069	-84.8893	353

Table 2.–Continued.

Lake	County	Latitude	Longitude	Acreage
Pigeon River – Headwaters to Lansing Club Pond Dam				
Big Lake	Otsego	45.0083	-84.5848	124
Denny Lake	Otsego	44.9939	-84.4823	19
Fifteen Lake	Otsego	45.0789	-84.5384	15
Ginsell Lake	Otsego	44.9919	-84.4973	11
Lansing Club Pond	Otsego	45.1455	-84.4732	51
Lewis Lake	Otsego	44.9836	-84.4976	74
Oley Lake	Otsego	44.9989	-84.5740	23
Pigeon River – Lansing Club Pond Dam to confluence with Little Pigeon River				
Cornwall Creek Flooding	Cheboygan	45.2273	-84.4140	161
Grass Lake	Otsego	45.1936	-84.4576	29
Pigeon River – Confluence with Little Pigeon River to Mullett Lake				
Echo Lake	Cheboygan	45.2501	-84.5197	27
Hackett Lake	Cheboygan	45.2475	-84.4998	32
Mud Lake	Otsego	45.1925	-84.4965	12
Unnamed lake	Cheboygan	45.2641	-84.5018	17
Sixteen Lake	Cheboygan	45.5936	-84.3254	10
Mullett Lake				
Cochran Lake	Cheboygan	45.4067	-84.5512	29
Devereaux Lake	Cheboygan	45.4853	-84.4573	36
Marina Lake	Cheboygan	45.4333	-84.6015	23
Mullett Lake	Cheboygan	45.4361	-84.5168	16,704
Roberts Lake	Cheboygan	45.4014	-84.5565	68
Silver Lake	Cheboygan	45.4330	-84.4859	77
Black River – Headwaters to Clark Bridge Road				
Blue Lake North	Montmorency	45.1517	-84.3607	18
Blue Lake South	Montmorency	45.1480	-84.3611	18
Hardwood Lake	Otsego	45.1703	-84.4012	47
Nineteen Lake	Otsego	45.0664	-84.4809	25
Town Corner Lake	Montmorency	45.1142	-84.3657	15
Walled Lake	Montmorency	45.1222	-84.3626	42
East Branch Black River				
Foch Lakes	Montmorency	45.1300	-84.3176	59
Black River – Clark Bridge Road to Kleber Pond Dam				
Dog Lake	Cheboygan	45.2839	-84.3987	192
Dollar Lake	Montmorency	45.1928	-84.3176	10
Francis Lake	Presque Isle	45.2405	-84.1834	40
Kleber Pond	Cheboygan	45.3905	-84.3320	257
Little Tomahawk Lake	Presque Isle	45.2319	-84.1807	23
Long Lake	Presque Isle	45.2330	-84.2032	14

Table 2.–Continued.

Lake	County	Latitude	Longitude	Acreage
Shoepac Lake	Presque Isle	45.2444	-84.1745	53
Silver Lake	Cheboygan	45.2047	-84.3173	146
Tomahawk Creek Flooding	Presque Isle	45.2168	-84.1790	574
Tomahawk Lake	Presque Isle	45.2292	-84.1673	42
Tower Pond	Cheboygan	45.3620	-84.2957	65
Twin Tomahawk Lakes	Montmorency	45.1693	-84.1425	42
unnamed lake	Montmorency	45.1827	-84.1267	15
unnamed lake	Montmorency	45.1795	-84.1223	19
		Canada Creek		
Bear Lake	Montmorency	45.0711	-84.1909	12
Bear Den Lake	Presque Isle	45.2036	-84.2212	30
Clear Lake	Montmorency	45.1219	-84.1793	138
Doty Lake	Montmorency	45.1086	-84.2419	24
East Town Corner Lake	Montmorency	45.1133	-84.2493	17
Geneva Lake	Montmorency	45.1800	-84.2154	92
Jackson Lake	Montmorency	45.0867	-84.1607	30
Little Joe Lake	Montmorency	45.1936	-84.2237	12
Muskellunge Lake	Montmorency	45.1058	-84.1923	126
Pug Lakes	Montmorency	45.1033	-84.2065	21
unnamed lake	Montmorency	45.0914	-84.1916	17
Valentine Lake	Montmorency	45.0917	-84.1782	310
Virginia Lake	Montmorency	45.1680	-84.2107	16
West Town Corner Lake	Montmorency	45.1142	-84.2568	10
Wildfowl Lake	Montmorency	45.1853	-84.2065	35
		Black River – Kleber Pond Dam to Black Lake		
Duby Lake	Cheboygan	45.2755	-84.3470	68
Lost Lake	Cheboygan	45.3100	-84.4082	16
McLavey Lake	Cheboygan	45.2861	-84.3554	24
Osmun Lake	Cheboygan	45.3247	-84.3890	48
Stony Creek Flooding	Cheboygan	45.3913	-84.4121	41
		Black Lake		
Black Lake	Cheboygan/Presque Isle	45.4667	-84.2668	10,114
Burgess Lake	Presque Isle	45.2495	-84.0880	15
Gorman Lakes	Presque Isle	45.2867	-84.0223	38
Hackett Lake	Presque Isle	45.2860	-84.1730	15
Healy Lake	Presque Isle	45.2286	-84.0387	25
Little Tomahawk Lake	Montmorency	45.1844	-84.0615	104
Loon Lake	Presque Isle	45.2583	-84.1690	55
McAvoy Lake	Presque Isle	45.2483	-84.0951	11
Mud Lake	Cheboygan	45.4914	-84.3307	39
Mud Lake	Cheboygan	45.4483	-84.3051	12
Rainy Lake	Presque Isle	45.2494	-84.0684	202
Upper Tomahawk Lake	Montmorency	45.1800	-84.0815	39

Table 2.–Continued.

Lake	County	Latitude	Longitude	Acreage
		Lower Black River		
Long Lake	Cheboygan	45.5347	-84.3987	379
Twin Lakes North	Cheboygan	45.5375	-84.2873	181
Twin Lake South	Cheboygan	45.5322	-84.2813	10

Table 3.–Surficial geology composition of valley segment catchments in the Cheboygan River watershed.

Segment	Surficial geology type	Area (mi^2) in each catchment	% type by catchment
W. Branch Maple R. – Headwaters to Maple R. Dam	Coarse-textured glacial till	43.4	45.1
	Glacial outwash sand & gravel; postglacial alluvium	30.5	31.6
	Lacustrine sand & gravel	10.7	11.1
	Peat & muck	10.7	11.1
	Water	1.0	1.0
E. Branch Maple R. – Douglas Lake to Maple R. Dam	Coarse-textured glacial till	28.5	45.5
	Glacial outwash sand & gravel; postglacial alluvium	2.1	3.4
	Lacustrine sand & gravel	11.6	18.5
	Peat & muck	14.9	23.7
	Water	5.6	9.0
Maple R. – Maple R. Dam to Burt Lake	Coarse-textured glacial till	0.8	8.5
	Dune sand	0.2	2.7
	Glacial outwash sand & gravel; postglacial alluvium	0.6	6.7
	Lacustrine sand & gravel	7.5	82.1
	Water	0.0	0.0
Sturgeon R. – Headwaters to confluence with W. Branch Sturgeon R.	Coarse-textured glacial till	37.3	37.3
	Dune sand	0.5	0.5
	End moraines of coarse-textured till	24.2	24.2
	Glacial outwash sand & gravel; postglacial alluvium	37.9	38.0
W. Branch Sturgeon R.	Coarse-textured glacial till	12.1	13.7
	End moraines of coarse-textured till	44.9	50.6
	Glacial outwash sand & gravel; postglacial alluvium	16.9	19.0
	Ice-contact outwash sand & gravel	14.8	16.7
Sturgeon R. – Headwaters to confluence with W. Branch Sturgeon R. to Burt Lake	Coarse-textured glacial till	0.0	0.2
	Dune sand	1.1	5.1
	Glacial outwash sand & gravel; postglacial alluvium	5.3	25.1
	Ice-contact outwash sand & gravel	11.1	52.7
	Lacustrine sand & gravel	3.6	17.0
Burt Lake	Coarse-textured glacial till	40.4	20.0
	Dune sand	7.6	3.8
	Glacial outwash sand & gravel; postglacial alluvium	19.0	9.4
	Ice-contact outwash sand & gravel	36.2	17.9
	Lacustrine sand & gravel	69.7	34.5
	Peat & muck	0.0	0.0
	Water	29.3	14.5
Pigeon R. – Headwaters to Golden Lotus Dam	Coarse-textured glacial till	18.5	33.1
	End moraines of coarse-textured till	7.2	12.9
	End moraines of medium-textured till	13.6	24.3
	Glacial outwash sand & gravel; postglacial alluvium	16.5	29.5
	Water	0.2	0.3
Pigeon R. – Golden Lotus Dam to confluence with Little Pigeon R.	Coarse-textured glacial till	34.1	49.9
	Glacial outwash sand & gravel; postglacial alluvium	30.4	44.6
	Ice-contact outwash sand & gravel	3.7	5.5
Pigeon R. – confluence with Little Pigeon R. to Mullett Lake	Coarse-textured glacial till	15.4	62.8
	Dune sand	0.0	0.0
	Glacial outwash sand & gravel; postglacial alluvium	0.0	0.0
	Ice-contact outwash sand & gravel	4.4	17.8
	Lacustrine sand & gravel	4.8	19.4

Table 3.–Continued.

Segment	Surficial geology type	Area (mi^2) in each catchment	% type by catchment
Mullett Lake	Coarse-textured glacial till	27.4	18.9
	Dune sand	10.1	6.9
	Glacial outwash sand & gravel; postglacial alluvium	1.1	0.8
	Ice-contact outwash sand & gravel	21.3	14.6
	Lacustrine sand & gravel	62.5	42.9
	Peat & muck	0.0	0.0
	Water	23.1	15.9
Black R. – Headwaters to Clark Bridge Rd.	Coarse-textured glacial till	22.0	26.3
	End moraines of medium-textured till	13.7	16.4
	Glacial outwash sand & gravel; postglacial alluvium	48.1	57.4
E. Branch Black R.	Coarse-textured glacial till	14.7	29.0
	End moraines of medium-textured till	12.3	24.4
	Glacial outwash sand & gravel; postglacial alluvium	23.5	46.6
Black R. – Clark Bridge Rd. to Kleber Dam	Coarse-textured glacial till	72.5	79.2
	Dune sand	1.2	1.3
	Glacial outwash sand & gravel; postglacial alluvium	17.9	19.5
Canada Creek	Coarse-textured glacial till	25.1	37.5
	Glacial outwash sand & gravel; postglacial alluvium	42.0	62.5
Black R. – Kleber Dam to Black Lake	Coarse-textured glacial till	35.5	53.3
	Dune sand	1.5	2.2
	Glacial outwash sand & gravel; postglacial alluvium	19.1	28.6
	Ice-contact outwash sand & gravel	5.7	8.6
	Lacustrine sand & gravel	4.8	7.2
	Water	0.0	0.1
Black Lake	Coarse-textured glacial till	127.6	65.3
	Dune sand	5.1	2.6
	Glacial outwash sand & gravel; postglacial alluvium	3.1	1.6
	Ice-contact outwash sand & gravel	10.4	5.3
	Lacustrine sand & gravel	34.7	17.8
	Water	14.3	7.3
Lower Black R.	Coarse-textured glacial till	12.5	27.3
	Dune sand	2.7	5.8
	Lacustrine sand & gravel	30.6	66.8
	Water	0.0	0.0
Cheboygan R.	Coarse-textured glacial till	2.1	12.0
	Dune sand	1.2	6.8
	Lacustrine sand & gravel	14.4	81.1

Table 4.–Monthly mean, maximum, and minimum flows in cubic feet per second (ft^3/s) from United States Geological Survey gages in the Cheboygan River watershed (United State Geological Survey 2007).

Station number (drainage area, mi^2) and location (years of data)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
04127997 (192)												
Sturgeon River at Wolverine 1942–2006												
Mean	211	223	211	200	198	243	305	237	207	184	171	198
Maximum	326	301	306	295	275	354	431	353	272	255	301	290
Minimum	153	164	157	133	130	172	179	154	149	130	134	141
04128500 (598)												
Indian River at Indian River 1942–82												
Mean	489	540	584	586	582	586	730	757	615	502	424	435
Maximum	686	777	793	755	749	803	1,088	1,181	863	796	678	600
Minimum	318	408	422	451	382	453	379	501	360	260	277	262
04128990 (57.7)												
Pigeon River near Vanderbilt 1950–2006												
Mean	77.4	82.1	75.8	70.6	70.3	88.2	117	86.3	70.4	64.3	64.5	71.5
Maximum	112	112	105	94.9	90.1	136	164	142	94.5	106	116	120
Minimum	56.6	63.1	60.1	50.8	50.1	62.8	69.8	54.4	50.7	46.7	42.6	50
04129500 (139)												
Pigeon River at Afton (1942–81)												
Mean	123	137	126	117	114	174	260	172	131	108	95.5	114
Maximum	198	228	200	204	172	302	420	283	205	200	169	208
Minimum	81.9	85.3	90	77.5	80.2	96.5	144	93.2	80.4	59.2	64.5	76.4
04130000 (889)												
Cheboygan River near Cheboygan (1942–82)												
Mean	680	805	840	858	847	922	1,097	1,054	846	677	600	640
Maximum	1,019	1,228	1,157	1,177	1,173	1,317	1,537	1,733	1,367	1,137	977	1,009
Minimum	260	425	458	517	610	603	533	561	451	363	404	384

Table 4.–Continued.

Station number (drainage area, mi^2) and location (years of data)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
04130500 (311)												
Black River near Tower (1942–2000)												
Mean	244	269	248	221	220	338	535	343	248	202	184	217
Maximum	459	489	409	433	398	594	882	638	405	408	351	367
Minimum	138	130	163	150	138	188	220	177	140	112	86.1	116
04131000 (79)												
Rainy River near Onaway (1942–52)												
Mean	10.2	18.2	11.5	11.4	9.2	52.2	126	41.7	17.5	8.7	1.9	3.3
Maximum	59.2	75.5	37.5	39.7	33.1	128	272	104	41.5	24.4	9	11.1
Minimum	0.5	1	2	2.7	2.3	9.3	38.2	23.2	2.7	0.8	0.2	0.2
04131500 (87.9)												
Rainy River near Ocqueoc (1952–79)												
Mean	21.3	28.6	35.2	20.2	19.2	60.5	167	80.0	30.2	20.0	11.8	14.5
Maximum	92.2	72.6	92.8	80.5	54.7	179	334	178	77.6	118	76.4	57.0
Minimum	2.0	4.1	3.0	2.5	3.6	8.8	70.7	16.9	4.3	1.5	0.7	1.1
04132000 (558)												
Black River near Cheboygan (1942–74)												
Mean	358	447	455	408	404	499	1,001	677	370	295	258	287
Maximum	898	916	791	636	671	904	1,708	1,564	722	718	734	749
Minimum	95.1	143	239	248	204	324	380	258	133	77.0	80.3	124

Table 5.–Mean annual discharge, drainage area in square miles, and exceedence flows at nine United States Geological Survey gage sites in the Cheboygan River watershed. All discharge data are presented as cubic feet per second. Sites are arranged in ascending order by gage number (United States Geological Survey 2007).

Gage site (station number)	Period of record	Drainage area	Mean annual discharge	Exceedence flows			Ratio of 10% and 90% exceedence flow
				10%	50%	90%	
Sturgeon River at Wolverine (04127997)	1942–2006	192	216	289	200	158	1.8
Indian River at Indian River (04128500)	1942–82	598	569	760	555	387	2.0
Pigeon River near Vanderbilt (04128990)	1950–2006	57.7	78.2	109	70	54	2.0
Pigeon River at Afton (04129500)	1942–81	139	139	215	118	82	2.6
Cheboygan River near Cheboygan (04130000)	1942–82	889	822	1,170	802	477	2.5
Black River near Tower (04130500)	1942–2000	311	272	463	228	145	3.2
Rainy River near Onaway (04131000)	1942–52	79	26	64	7	1	64.0
Rainy River near Ocqueoc (04131500)	1952–79	87.9	42	100	20	3	33.3
Black River near Cheboygan (04132000)	1942–74	558	455	853	380	128	6.7

Table 6.–July and August water temperature (°F) of the Cheboygan River watershed (MDNR, Fisheries Division, unpublished data). Data within segments are sorted in an upstream to downstream direction.

Segment number	Subwatershed	Water body	Location	Date	Maximum	Minimum	Mean	Maximum weekly mean
1	W. Br. Maple River	W. Br. Maple River	Ralmer or Robinson Rd. West	Jul-05	84.2	64.0	74.2	79.7
				Aug-05	81.2	60.8	69.8	75.0
		Brush Creek	Van Rd.	Jul-05	77.0	54.8	68.0	71.8
				Aug-05	75.1	57.0	65.9	68.4
		W. Br. Maple River	Ely Br. Rd.	Jul-05	79.1	57.3	69.4	73.9
				Aug-05	78.4	58.7	66.6	70.6
		Cold Creek	Ely Rd.	Jul-05	80.2	60.2	70.2	74.8
				Aug-05	78.0	58.3	67.5	71.1
		W. Br. Maple River	Robinson Rd.	Jul-04	68.2	53.8	60.4	62.5
				Aug-04	68.4	51.2	58.8	61.3
2	E. Br. Maple River	E. Br. Maple River	Douglas Lake Rd.	Jul-05	84.3	61.7	73.3	78.6
				Aug-05	83.6	59.4	68.4	72.2
			C64	Jul-05	63.5	55.9	60.1	61.7
				Aug-05	63.5	57.0	60.8	61.8
3	Maple River	Maple River	Below Lake Kathleen Dam	Jul-05	72.3	61.2	65.7	68.4
				Aug-05	69.9	58.7	63.5	66.4
			Brutus Rd.	Jul-05	69.9	56.1	62.3	64.8
				Aug-05	68.7	55.3	60.2	62.6
4	Sturgeon River	Sturgeon River	Poquette Rd.	Jul-05	62.0	49.4	55.9	57.0
				Aug-05	65.2	49.1	55.6	57.9
		Mossback Creek	Nowak Rd.	Jul-05	60.9	47.5	53.7	54.9
				Aug-05	66.7	48.9	54.4	56.6
		Sturgeon River	Whitmarsh Rd.	Jul-05	68.5	51.4	60.8	62.6
				Aug-05	68.5	54.8	59.5	62.8
			Sturgeon Valley Rd.	Jul-05	65.5	53.0	60.4	62.2
				Aug-05	66.1	53.0	59.1	62.4
		Pickerel Creek	Near mouth	Jul-05	68.6	50.4	60.3	62.0
				Aug-05	68.9	52.7	60.2	62.4

Table 6.–Continued.

Segment number	Subwatershed	Water body	Location	Date	Maximum	Minimum	Mean	Maximum weekly mean
4	Sturgeon River–						53.5	54.3
	continued	Club Creek	Sturgeon Valley Rd.	Jul-05	57.8	47.7	55.0	57.5
				Aug-05	63.2	49.7		
			Fontinalis Rd.	Jul-05	74.6	57.4	67.0	69.7
				Aug-05	74.9	56.9	64.8	68.9
		Sturgeon River	Trowbridge Rd.	Jul-05	73.1	54.6	64.1	66.7
				Aug-05	73.5	54.0	62.0	65.8
		Blackjack Creek	Shire Rd.	Jul-05	54.4	48.2	50.8	51.7
				Aug-05	62.5	51.0	52.7	53.1
		Stewart Creek	Near mouth	Jul-05	77.1	51.4	64.7	67.2
				Aug-05	77.5	51.7	62.3	66.6
5	W. Br. Sturgeon River	W. Br. Sturgeon River	McGregor Rd.	Jul-05	77.1	56.0	67.6	71.1
				Aug-05	76.5	55.5	65.1	69.4
			Shingle Mill Br.	Jul-05	66.7	51.7	59.8	61.9
				Aug-05	66.7	51.7	58.6	61.9
			Old 27 Br.	Jul-06	68.9	53.3	60.9	62.8
				Aug-06	69.1	50.9	58.4	63.1
6	Sturgeon River	Sturgeon River	Wolverine Rd.	Jul-05	73.1	54.3	64.3	67.0
				Aug-05	73.1	54.1	62.2	66.0
			Rondo Rd.	Jul-05	72.3	55.0	64.5	67.4
				Aug-05	72.3	54.4	62.1	66.1
			Cutover or Hutch Rd.	Jul-05	70.0	56.0	64.4	67.3
				Aug-05	70.6	55.2	62.3	66.1
7	Burt Lake	Minnehaha Creek	Newson Rd.	Jul-06	75.3	63.1	68.9	70.7
				Aug-06	75.0	61.6	68.3	71.8
		W. Br. Minnehaha Creek	South of Mitchell Rd.	Jul-03	64.0	51.8	57.9	59.4
				Aug-03	64.3	50.3	58.6	60.4
		Minnehaha Creek	Pickerel Lake Rd.	Jul-05	62.8	48.4	55.4	57.0
				Aug-05	61.9	48.7	55.0	56.6

Table 6.–Continued.

Segment number	Subwatershed	Water body	Location	Date	Maximum	Minimum	Mean	Maximum weekly mean
7	Burt Lake–continued	Berry Creek	Reams Rd.	Jul-05	62.3	48.6	55.6	57.1
				Aug-05	62.1	50.3	55.9	56.9
		Cedar Creek	Pickerel Lake Rd.	Jul-05	52.8	45.6	48.8	49.5
				Aug-05	52.0	46.4	48.5	49.2
8	Pigeon River	Pigeon River	Whitehouse Trail	Jul-05	66.0	50.2	58.0	59.5
				Aug-05	66.0	51.2	57.3	59.8
		S. Br. Pigeon River	Sparr Rd.	Jul-05	68.6	52.8	61.3	63.2
				Aug-05	67.3	53.3	60.3	63.2
		Pigeon River	Old Vanderbilt Rd.	Jul-06	71.5	54.2	63.5	66.1
				Aug-06	75.1	52.0	60.7	65.6
9	Pigeon River	Pigeon River	Below Lansing Club Pond	Jul-98	78.5	58.1	67.5	71.7
				Aug-98	72.3	59.8	66.2	67.0
			Sturgeon Valley Rd.	Jul-06	80.0	52.7	66.5	68.6
				Aug-06	78.3	44.7	62.3	68.5
			Tin Br./Cornwall Rd.	Jul-05	77.8	55.2	66.8	70.2
				Aug-05	75.9	56.1	63.7	68.0
		Cornwall Creek	Cornwall Rd.	Jul-05	71.9	52.4	62.4	65.5
				Aug-05	71.9	57.2	64.9	67.3
		Pigeon River	Webb Rd.	Jul-05	77.8	56.1	68.0	71.9
				Aug-05	76.6	51.1	64.3	69.0
		McIntosh Creek	Montgomery Rd.	Jul-05	79.6	61.7	71.1	74.7
				Aug-05	77.1	58.9	67.9	72.0
10	Pigeon River	Little Pigeon River	Webb Rd.	Jul-05	71.7	55.2	64.7	67.9
				Aug-05	70.2	55.5	62.5	66.0
		Wilkes Creek	Montgomery Rd.	Jul-05	79.1	51.8	65.9	70.8
				Aug-05	74.5	57.9	64.6	68.1
		Wilkes Creek Tributary	Montgomery Rd. bend	Jul-05	84.9	58.0	71.0	75.4
				Aug-05	80.0	60.3	68.7	72.3

Table 6.–Continued.

Segment number	Subwatershed	Water body	Location	Date	Maximum	Minimum	Mean	Maximum weekly mean
10	Pigeon River–continued	Pigeon River	M-68	Jul-05	79.2	59.0	70.1	74.6
				Aug-05	77.0	57.9	66.0	70.4
			Agnes Andrea Nature Preserve	Jul-03	78.0	58.2	67.6	71.0
				Aug-03	77.3	58.7	68.5	71.2
11	Mullett Lake	Little Sturgeon River	Afton Rd.	Jul-05	79.6	58.0	68.8	72.8
				Aug-05	78.0	57.4	65.9	70.2
		Johnson Creek	Dunham Rd. ford	Jul-05	71.6	52.1	63.0	66.4
				Aug-05	70.7	54.4	61.8	64.9
		Little Sturgeon River	M-68	Jul-05	72.0	53.0	61.7	64.8
				Aug-05	68.1	53.9	60.6	63.6
		Kimberly Creek	M-68	Aug-05	80.1	57.6	66.5	70.7
		Little Pigeon River	Ormsbee Rd.	Jul-05	82.5	56.6	69.0	73.8
				Aug-05	82.1	57.1	65.8	70.7
		N. Br. Little Pigeon River	Silver Lake Rd.	Jul-05	81.9	62.2	72.2	76.6
				Aug-05	76.8	58.8	66.9	71.3
		Little Pigeon River	near mouth at Silery Rd	Jul-05	78.5	60.7	70.0	74.7
				Aug-05	76.6	59.5	66.7	71.1
		Mullett Creek	South Extension Rd.	Jul-04	63.4	49.9	55.9	57.5
				Aug-04	61.7	46.8	54.8	56.2
			Mullett-Burt Rd.	Jul-04	78.3	55.7	67.8	69.9
				Aug-04	75.5	54.4	64.2	67.9
		Ballard Creek	M-33	Jul-04	71.4	54.7	62.3	64.3
				Aug-04	67.0	50.8	59.3	61.8
12	Black River	Black River	Johnson's Crossing	Jul-04	68.7	50.7	59.3	61.2
				Aug-04	66.3	48.8	57.5	59.7
		Saunders Creek	Gingell Rd.	Jul-04	63.1	49.4	55.0	56.2
				Aug-04	61.4	47.4	53.8	55.0
		Black River	Tyrolean Hills	Jul-04	72.6	52.3	62.0	64.1
				Aug-04	70.8	49.2	59.4	62.2

Table 6.–Continued.

Segment number	Subwatershed	Water body	Location	Date	Maximum	Minimum	Mean	Maximum weekly mean
12	Black River–continued	Black River–continued	McKinnon's Bend	Jul-06	75.6	55.0	65.3	68.3
				Aug-06	79.0	53.3	62.4	67.5
			Tin Shanty Br.	Jul-06	76.2	56.1	66.7	70.0
				Aug-06	79.8	54.3	63.5	69.0
		Tubbs Creek	High Country Pathway	Jul-04	79.1	71.4	75.3	76.7
				Aug-04	78.8	67.6	72.1	74.8
		Black River	Blue Lakes Rd.	Jul-06	77.0	55.7	66.3	69.1
				Aug-06	80.5	53.2	63.1	68.7
		Stewart Creek	Blue Lake Rd.	Jul-04	76.4	59.6	66.9	68.9
				Aug-04	73.1	54.9	63.6	66.8
		Little McMasters Creek	Clark Rd.	Jul-04	79.7	53.8	65.5	68.4
				Aug-04	76.6	49.1	61.7	64.4
		Black River	Clark Br. Rd.	Jul-06	75.9	59.2	68.2	71.2
				Aug-06	79.7	55.8	64.6	70.5
13	E. Br. Black River	E. Br. Black River	Huff Rd.	Jul-04	67.4	49.3	57.7	59.4
				Aug-04	66.0	47.1	56.0	57.9
		Rattlesnake Creek	Rattlesnake Creek Rd.	Jul-04	66.0	49.6	57.6	59.3
				Aug-04	64.0	46.6	55.7	57.8
		E. Br. Black River	Co. Rd. 622	Jul-06	71.2	55.0	63.6	66.1
				Aug-06	73.1	52.6	60.8	65.7
		Foch Creek	Below Foch Lake	Jul-04	79.9	65.4	73.2	76.0
				Aug-04	77.1	63.7	69.8	73.8
			Townline Lake Rd.	Jul-04	74.5	56.8	65.0	67.0
				Aug-04	71.8	51.8	62.5	64.5
		E. Br. Black River	Barber Br.	Jul-06	74.8	56.5	66.0	68.8
				Aug-06	78.2	53.7	62.7	68.1
14	Black River	McMasters Creek	Clute Rd.	Jul-05	81.2	58.2	70.3	74.4
				Aug-05	79.8	58.4	66.5	71.2

Table 6.–Continued.

Segment number	Subwatershed	Water body	Location	Date	Maximum	Minimum	Mean	Maximum weekly mean
14	Black River–continued	Black River	Shangrila Rd.	Jul-04	73.0	57.6	65.3	67.4
				Aug-04	72.4	53.9	62.2	65.8
			Crockett Rapids Br.	Jul-06	77.7	60.9	69.5	72.6
				Aug-06	80.8	57.9	65.7	71.8
		Tomahawk Creek	Elk Hill Rd.	Jul-04	76.6	57.3	66.8	69.5
				Aug-04	73.8	50.9	62.1	65.3
			Co. Rd. 634	Jul-04	83.4	61.6	72.4	75.4
				Aug-04	82.4	55.4	68.2	72.4
			M-33	Jul-04	75.2	58.8	67.4	70.6
				Aug-04	73.1	54.4	63.4	67.3
		Gregg Creek	Black River Rd.	Jul-04	69.6	52.2	61.4	63.3
				Aug-04	68.2	48.0	59.0	61.9
		Black River	Black River Rd.	Jul-04	75.0	58.6	66.9	69.2
				Aug-04	74.1	55.8	63.8	67.8
15	Canada Creek	Packer Creek	Rouse Rd.	Jul-04	77.9	52.6	64.9	67.4
				Aug-04	76.4	48.7	61.6	64.7
		Van Hetton Creek	Roth Rd.	Jul-04	82.2	52.3	66.5	69.3
				Aug-04	79.6	49.3	63.5	67.2
		Canada Creek	Co. Rd. 622	Jul-04	81.8	62.2	70.5	73.2
				Aug-04	80.2	57.6	67.5	70.8
			South wire	Jul-06	80.4	62.3	71.7	74.4
			(Canada Creek Ranch)	Aug-06	82.3	59.7	68.5	74.3
			High banks	Jul-06	76.5	59.7	67.8	70.1
			(Canada Creek Ranch)	Aug-06	78.3	55.5	64.7	70.2
		Canada Creek	Gravel bottom	Jul-05	77.7	56.8	68.5	72.2
			(Canada Creek Ranch)	Aug-05	75.5	59.1	66.7	69.9
			Above Montague Creek	Jul-06	74.9	58.5	66.2	68.6
			(Canada Creek Ranch)	Aug-06	76.8	47.7	63.3	68.5
			Below Montague Creek	Jul-06	75.0	58.3	66.3	68.6
			(Canada Creek Ranch)	Aug-06	76.5	54.1	63.3	68.6

Table 6.–Continued.

Segment number	Subwatershed	Water body	Location	Date	Maximum	Minimum	Mean	Maximum weekly mean
15	Canada Creek–continued	Canada Creek–continued	Wilson Br.	Jul-05	74.7	54.7	64.8	67.8
			(Canada Creek Ranch)	Aug-05	72.6	57.5	63.6	66.2
			Wadsworth Br.	Jul-05	75.3	55.2	65.1	68.1
			(Canada Creek Ranch)	Aug-05	73.8	57.4	63.7	66.5
			North wire	Jul-06	76.8	57.4	66.9	69.5
			(Canada Creek Ranch)	Aug-06	80.6	54.6	63.7	69.0
			Canada Creek Highway	Jul-04	71.1	53.3	61.9	63.8
				Aug-04	69.9	50.0	59.0	61.0
		Oxbow Creek	Oxbow Creek Rd.	Jul-06	86.9	55.5	70.8	74.0
				Aug-06	91.5	48.9	66.1	72.5
			Near county line	Jul-06	80.8	58.2	70.1	73.2
				Aug-06	85.2	53.9	65.8	72.2
			Canada Creek Highway	Jul-04	73.8	56.1	64.7	67.1
				Aug-04	72.6	51.4	61.7	64.7
16	Black River	Black River	Below Kleber Dam	Jul-04	74.8	63.4	70.3	72.4
				Aug-04	92.3	55.2	72.0	75.5
		Milligan Creek	Near headwaters	Jul-04	77.5	55.8	66.6	68.8
				Aug-04	75.7	54.2	63.0	67.3
		Gokee Creek	Osmun Rd.	Jul-04	71.1	49.7	62.4	65.3
		Milligan Creek	Gokee Hill area	Jul-03	78.7	57.1	66.9	70.0
				Aug-03	77.4	54.6	67.8	70.6
		Milligan Creek	Upstream of M-68	Jul-06	85.6	47.6	67.2	70.9
				Aug-06	81.4	46.7	62.4	67.5
			Near M-68	Jul-06	81.1	59.5	70.6	73.6
				Aug-06	79.8	53.5	66.3	72.0
		Black River	One mile below Kleber Dam	Jul-05	83.7	67.5	74.0	76.1
				Aug-05	79.0	62.6	69.8	74.5
			Near mouth of Black Lake	Jul-05	82.6	67.0	75.5	79.6
				Aug-05	79.3	61.9	70.3	75.5

Table 6.–Continued.

Segment number	Subwatershed	Water body	Location	Date	Maximum	Minimum	Mean	Maximum weekly mean
17	Black Lake	Stewart Creek	Steel Rd.	Aug-04	76.9	47.1	60.7	63.9
		Stony Creek	Vermilya Highway	Jul-04	73.2	47.8	62.8	65.8
				Aug-04	73.2	41.9	59.7	62.6
			North Allis Highway	Jul-04	76.2	50.8	62.1	65.0
		W. Br. Upper Rainy River	Near mouth	Jul-04	71.7	56.0	64.2	67.2
				Aug-04	71.7	52.8	60.8	64.1
		Healy Creek	Near mouth	Jul-04	78.4	52.5	64.9	68.9
				Aug-04	71.1	46.7	58.3	61.1
		Rainy River	Below Rainy Lake	Jul-04	77.8	60.9	68.7	71.4
				Aug-04	81.0	46.9	61.9	66.3
		Stony Creek	End of Brady Rd.	Jul-04	77.1	58.8	67.5	70.0
		E. Br. Rainy River	Schnep Rd.	Jul-04	74.4	56.9	63.6	67.5
				Aug-04	67.3	50.3	55.8	62.9
		Rainy River	South Porter Rd.	Jul-04	79.5	59.3	68.1	69.1
				Aug-04	77.7	54.0	64.8	69.8
		Little Rainy River	South Porter Rd.	Jul-04	83.5	58.8	70.1	72.5
				Aug-04	81.9	52.1	66.7	70.6
		Rainy River	North Allis Highway	Jul-04	76.8	59.1	67.9	70.1
				Aug-04	75.9	54.9	64.4	68.2
17	Black Lake	Cold Creek	Roost Rd.	Jul-04	73.2	57.8	65.0	67.9
				Aug-04	69.3	53.3	61.2	63.8
18	Lower Black River	Long Lake Creek	Gaynor Rd.	Jul-04	73.1	54.4	64.0	66.5
				Aug-04	71.9	44.1	60.6	63.5
		Owens Creek	Ross Rd.	Jul-04	78.2	58.7	67.6	70.1
				Aug-04	74.5	55.4	64.8	67.5
	Black River	Stony Creek	End of Brady Rd.	Aug-04	74.3	53.8	63.2	66.4
19	Cheboygan River	Laperell Creek	Inverness Trail	Jul-04	60.8	52.4	55.9	56.9
				Aug-04	60.3	49.9	54.9	56.2
			Near Old 27	Jul-04	65.5	52.5	58.5	60.4
				Aug-04	63.5	48.6	56.8	58.5
		Cheboygan River	Bayview Drive	Jul-05	85.8	70.1	77.1	81.2
				Aug-05	82.2	60.2	73.2	77.3

Table 7.–Gradient of the entire Cheboygan River watershed.

Gradient class	Description	Miles	% of watershed
0–2.9 ft/mile	low	147.4	17.5
3.0–4.9 ft/mile	medium	39.1	4.6
5.0–9.9 ft/mile	high	132.2	15.7
10.0–69.9 ft/mile	very high	442.5	52.6
70–149.9 ft/mile	chutes and pools	65.6	7.8
>150 ft/mile	falls and rapids	14.7	1.8
Total:		841.6	

Table 8.–Gradient of the Cheboygan River and its tributaries by river segment.

Reach	Segment or major tributary	Gradient class (ft/mile)	Miles	% of reach
W. Br. Maple River	Headwaters to Maple River Dam	0–2.9	9.5	59.5
		5.0–9.9	6.5	40.5
			Total: 16.0	
E. Br. Maple River		0–2.9	1.6	26.3
		10.0–69.9	4.6	73.7
			Total: 6.2	
Maple River	Maple River Dam to Burt Lake	3.0–4.9	2.4	35.3
		5.0–9.9	3.7	54.3
		10.0–69.9	0.7	10.4
			Total: 6.8	
Sturgeon River	Headwaters to confluence with W. Br. Sturgeon River	0–2.9	0.4	1.8
		3.0–4.9	1.3	5.4
		5.0–9.9	10.3	42.0
		10.0-69.9	11.2	45.7
		>150	1.3	5.1
			Total: 24.6	
	Confluence with W. Br. Sturgeon River to Burt Lake	0–2.9	0.7	4.7
		10.0-69.9	13.4	95.3
			Total: 14.1	
W. Br. Sturgeon River		0–2.9	0.8	4.4
		10.0–69.9	17.0	95.6
			Total: 17.8	
Burt Lake	Crooked River	0–2.9	5.2	100.0
			Total: 5.2	
Pigeon River	Headwaters to Golden Lotus Dam	0–2.9	1.1	7.7
		5.0–9.9	6.0	42.0
		10.0–69.9	7.2	50.4
			Total: 14.3	
	Golden Lotus Dam to confluence with Little Pigeon River	5.0–9.9	7.0	45.1
		10.0–69.9	8.5	54.9
			Total: 15.4	
	Confluence with Little Pigeon River to Mullett Lake	0–2.9	5.5	37.9
		10.0–69.9	9.0	62.1
			Total: 14.5	
Mullett Lake	Indian River	0–2.9	4.0	100.0
			Total: 4.0	

Table 8.–Continued.

Reach	Segment or major tributary	Gradient class (ft/mile)	Miles	% of reach
Black River	Headwaters to Clark Bridge Road	0–2.9	4.5	15.9
		5.0–9.9	14.3	50.5
		10.0–69.9	9.5	33.5
			Total: 28.4	
	Clark Bridge Road to Kleber Dam	0–2.9	5.5	28.5
		3.0–4.9	0.2	0.8
		5.0–9.9	12.3	63.8
		10.0–69.9	1.3	6.9
			Total: 19.2	
	Kleber Dam to Black Lake	3.0–4.9	8.3	87.8
		10.0–69.9	0.9	9.4
		>150	0.3	2.8
			Total: 9.5	
	Lower Black River	0–2.9	5.8	52.4
		3.0–4.9	4.4	39.6
		10.0–69.9	0.9	8.0
			Total: 11.1	
	E. Br. Black River	5.0–9.9	13.5	68.4
		10.0–69.9	6.2	31.6
			Total: 19.7	
	Canada Creek	0–2.9	0.9	4.2
		3.0–4.9	7.7	38.0
		5.0–9.9	8.0	39.1
		10.0–69.9	3.8	18.7
			Total: 20.4	
Black Lake	Rainy River	0–2.9	1.8	7.6
		3.0–4.9	2.4	10.2
		5.0–9.9	7.1	29.9
		10.0–69.9	12.4	52.3
			Total: 23.8	
	Cheboygan River	0–2.9	4.2	60.3
		5.0–9.9	2.7	39.7
			Total: 6.9	

Table 9.–Analysis of channel morphology data for select tributaries of the Cheboygan River. Stream width was calculated from measurements made by the United States Geological Survey and Michigan Department of Natural Resources, Fisheries Division. Status indicates whether site is outside of expected range; "W" is too wide and "N" is too narrow. Expected range (mean, upper 95%, and lower 95% widths) were calculated using equations developed by Leopold and Maddock (1953) and Leopold and Wolman (1957).

					Expected width (ft)			
Water body	Location	Date	Actual width (ft)	Discharge (ft^3/s)	Lower 95%[a]	Mean[b]	Upper 95%[c]	Status
W. Br. Maple River	Robinson Rd.	08/07/2002	26.0	35.4	24.7	32.6	43.0	
E. Br. Maple River	C64 (Mills Rd.)	07/31/2002	23.9	21.3	19.5	25.3	33.0	
Maple River	below Maple River Dam	07/29/2002	40.0	115.2	43.1	58.7	80.0	N
Sturgeon River	Trowbridge Rd.	07/18/2005	30.0	75.0	35.2	47.4	63.9	N
	Wolverine	07/02/2007	54.0	145.0	48.1	65.9	90.3	
W. Br. Sturgeon River	Old 27 Highway	07/25/2005	30.0	51.7	29.6	39.4	52.5	
W. Br. Minnehaha Creek	Berger Rd.	07/25/2003	8.0	2.2	6.7	8.2	10.1	
Pigeon River	near Vanderbilt	08/03/2007	46.0	43.1	27.1	36.0	47.7	
	Elk Hill Campground	08/06/2002	38.0	105.1	41.3	56.1	76.2	N
	Afton	08/07/2007	57.0	67.1	33.4	44.9	60.2	
	Agnes Andreae Nature Preserve	07/24/2003	34.0	92.3	38.9	52.6	71.2	N
Little Pigeon River	Burls Rd.	07/25/2002	23.0	13.3	15.6	20.0	25.8	
Black River	Springs area (Black River Rd.)	08/17/2006	38.0	29.1	22.5	29.6	38.8	
	Sids Drive	08/16/2006	36.0	34.8	24.5	32.4	42.7	
	Blue Lakes Rd.	08/08/2005	38.0	62.1	32.2	43.2	57.8	
	near Tower	07/23/2001	51.0	174.0	52.4	72.2	99.4	N
E. Br. Black River	Old Railroad Grade (Huff Rd.)	08/23/2007	37.8	29.3	22.6	29.7	39.0	
Canada Creek	Geodetic Rd.	08/25/2005	21.0	22.2	19.8	25.8	33.6	
	Doty Trail	08/20/2004	25.0	29.4	22.7	29.8	39.1	
	Wilson Bridge	08/25/2005	31.5	31.0	23.2	30.6	40.2	

[a] Lower 95% = $10^{(0.662895+(0.471522*\log_{10}(Q)))}$.
[b] Mean = $10^{(0.741436+(0.498473*\log_{10}(Q)))}$.
[c] Upper 95% = $10^{(0.819976+(0.525423*\log_{10}(Q)))}$.

Table 10.–Dams in the Cheboygan River watershed, sorted by county. Date is the date of construction; location is provided by township (T.), range (R.), and section (Sec.); "Owner" indicates ownership as private, state, or local government; blanks indicate data are missing; an asterisk (*) indicates the dam is classified a high or significant hazard (J. Pawloski, MDEQ LWMD).

County Dam name	River reach	Date	T.	R.	Sec.	Owner	Head (ft)	Pond area (acres)	Storage (acre-ft)
Cheboygan									
Alverno Dam*	Black River	1904	37N	1W	35	private	16	1,025	1,260
Berry Creek Ranch Dam	Berry Creek	1942	34N	3W	22	private	6	4	0
Cheboygan Dam*	Cheboygan River	1922	38N	1W	31	private/state	21	18,150	82,947
Cornwall Creek Dam*	Cornwall Creek	1966	33N	1W	27	state	27	161	2,570
Crooked Lake Walleye Pond	Trib-Hassler Creek	1970	35N	3W	17	state	8	4	19
Dog Lake Dam	McMasters Creek	1957	33N	1W	11	state	4	520	1,870
Echo Lake Dam	Trib-Little Pigeon River	1971	33N	2W	14	state	4.5	25	150
Ginop Dam	Hasler Creek	1987	34N	3W	7	private	0	1	0
Jury Dam	Trib-Little Pigeon River	1958	33N	2W	12	private	0	20	0
Kleber Dam	Upper Black River	1949	35N	1E	29	private	42	270	7,320
Little Sturgeon Club Dam	Little Sturgeon River		35M	2W	30	private	1	1	
Maxson Dam	Morrow Creek		35N	2W	20	private	6	4	
Roberts Lake Dam	Twin Lakes Creek	1948	35N	2W	28	state	4.3	54	210
Stony Creek Dam	Stony Creek	1952	35N	1W	27	state	5	190	1,330
Tower Dam	Black River	1918	34N	1E	3	private	20	102	1,900
Towner Dam	Trib-Little Pigeon River		33N	2W	2	private		7	
Wildwood Lake Dam*	Bradley Creek	1962	33N	2W	21	private	20	222	2,800
Twin Lakes Dam	Twin Lakes Outlet		37N	1E	34	private	3	234	
Emmet									
Crooked Lake Dam	Crooked River	1967	35N	4W	10	state	1	2,300	
Maple River Dam	Maple river	1966	36N	4W	10	private	16	43	808
Ottawa Trout Pond #1 Dam	Trib-Crooked River	1920	36N	4W	34	private	4	0	1
Ottawa Trout Pond #3 Dam	Trib-Crooked River	1920	36N	4W	34	private	12	3	16
Spring Lake Dam	Trib-Crooked Lake		34N	5W	27	local		5	
Starks Mill Dam	Silver Creek	1951	34N	4W	4	private	20	4	60

Table 10.–Continued.

County Dam name	River reach	Date	T.	R.	Sec.	Owner	Head (ft)	Pond area (acres)	Storage (acre-ft)
Montmorency									
Doty Dam	Van Hetton Creek		31N	2E	6		3	24	
Foch Lakes Dam	Trib-East Branch Black	1948	32N	1E	28	state	9	60	440
Muskellunge Lake Level Control	Canada Creek	1957	32N	2E	33	private	4	126	1,000
Rainy River Dam	West Branch Upper	1960	32N	3E	4	state	7.5	270	1,755
Otsego									
Bailey Fund East Dam	Trib-Pigeon River		31N	2W	31	private	0	2	
Bailey Fund West Dam	Trib-Pigeon River		31N	2W	31	private	0	3	
Fontinalis Club Home Dam	Club Stream	1960	32N	2W	17	private	9.1	5	50
Fontinalis Club Middle Dam	Club Steam	1960	32N	2W	18	private	8.2	10	70
Fontinalis Club Upper Dam	Club Stream	1870	32N	2W	19	private	5.2	15	75
Golden Lotus Dam	Pigeon River	1955	32N	1W	19	private	13	45	565
Light Dam	Trib-Sturgeon River		31N	2W	6	private	0	2	
Platte Dam (Downstream)	Duck Creek		30N	2W	2	private	0	2	
Platte Dam (Upstream)	Duck Creek		30N	2W	2	private	0	1	
Quigley Dam	Trib-Club Stream	1965	32N	3W	13	private	15	50	120
Rogell Dam	Trib-Club Stream	1958	32N	3W	13	private	6	2	
Saunders Dam	Black River	1920	31N	1W	20	private	4	12	
Schrader Dam	Duck Creek		31N	2W	23	private	0	1	
Turner Dam	Sturgeon River		31N	3W	14	private		4	
Woodin Lake Dam	West Branch Sturgeon	1940	32N	3W	30	private	7	28	100
Presque Isle									
Feel Dam #2	Healy Creek	1974	33N	3E	22	private	8	6	26
Feel Dam #1	Healy Creek	1960	33N	3E	22	private	4	14	
Moreau Dam	Trib-Stony Creek	2000	34N	2E	16	private		5	
Ramsey Dam	Healy Creek	1963	35N	2E	8	private	0	2	16
Tomahawk Creek Flooding	Tomahawk Creek	1965	33N	2E	27	state	12	575	8,060

Table 11.–Active National Pollution Discharge Elimination System (NPDES) permits in the Cheboygan River watershed, as of May 9, 2007 (Kenneth Hozak, MDEQ Water Bureau, personnel communication). An * indicates that data were not available.

County and permittee	Permit type	Receiving water
Cheboygan County		
Great Lakes Tissue	Wastewater	Unnamed
Cheboygan Wastewater Treatment Plant	Wastewater	Cheboygan River
Blarney Castle Oil	General	Cheboygan River
Inverness Dairy Inc	General	*
Wolverine Power Supply – Tower	General	*
Rieth-Riley-Afton Site	General	Little Pigeon River
BP Products NA Inc-Cheboygan	General	Cheboygan River
Anchor In Marina	Storm water	Lake Huron via Cheboygan R
Burt Lake Marina	Storm water	Sturgeon River
Cheboygan Cement-Cheboygan	Storm water	Cheboygan River
Howe Marine-Indian River	Storm water	Indian River
Moran Iron Works-Bowen Road	Storm water	Bowen Creek
Link Industries	Storm water	Ditches to Indian River
WSM Ent-Indian River Marina	Storm water	Indian River
Baumgarten Forest Products	Storm water	Welch Creek
Circle M Ranch	Storm water	Sturgeon River
Walstrom Marine-Cheboygan	Storm water	Cheboygan River
R E Glancy-Crusher 3	Storm water	
BP Amoco – Cheboygan	Storm water	Cheboygan River
Emmet County		
MDNR-Oden Fish Hatchery	Wastewater	Unnamed tributary to Crooked Lake
UM Biological Station	Wastewater	Maple River
Harbor Springs Area Sewage	Wastewater	*
Karriger Eng & Mfg Inc	Construction	*
Up North Industries-Petoskey	Storm water	Round Lake
Ryde Marine Inc-Alanson	Storm water	Crooked Lake
Otsego County		
MACTEC Eng and Con Inc	Wastewater	Unnamed
Treetops Resort-Gaylord	General	Pigeon River
Treetops Resort-Gaylord	General	Pigeon River
Presque Isle County		
Onaway Wastewater Treatment Plant	Wastewater	Bowen Creek
Elk Run Landfill-Republic	Storm water	Little Rainy River

Table 12.–MDEQ Procedure 51 macroinvertebrate community information for the Cheboygan River watershed (from Walker 2008a, 2008b, 2008c, 2008d).

Water body	Location	Number of taxa	Taxa (number) mayfly	Taxa (number) caddisfly	Taxa (number) stonefly	EPT %	Rating
Black River	Ninnever Cabin	33	7	7	2	48.5	Excellent
Black River	Blue Lakes Road	37	6	9	1	43.2	Excellent
E Br Black River	Blue Lakes Road	36	7	8	1	44.4	Excellent
Black River	Crocket Rapids	31	5	7	3	48.4	Excellent
McMasters Cr	N of Clark Bridge Rd	30	2	5	0	23.3	Acceptable
Black River	Black River Road	42	7	8	2	40.5	Excellent
Milligan Cr	Brady Rd	31	4	9	2	48.4	Excellent
Canada Cr	Canada Creek Hwy	38	6	10	2	47.4	Excellent
Oxbow Cr	S off Canada Cr Hwy	27	4	8	1	48.1	Excellent
Tomahawk Cr	M-33	29	3	6	1	34.5	Excellent
Bowen Cr	Bowen Rd	27	2	7	0	33.3	Acceptable
Rainy River	Allis Hwy	34	6	5	3	41.2	Excellent
Little Rainy River	1 Mile Hwy	25	3	5	0	32.0	Acceptable
Owens Cr	Ross Rd	22	2	3	0	22.7	Acceptable
Laperell Cr	Laperell Rd	29	5	6	1	41.4	Excellent
Mullett Cr	d/s Crump Rd	20	2	7	3	60.0	Excellent
E Br Maple R	Douglas Lake Rd	38	5	7	1	34.2	Acceptable
Maple River	Maple River Rd	37	7	10	3	54.1	Excellent
Maple River	Robinson Rd	37	5	10	3	48.6	Excellent
McPhee Cr	Valley Rd	25	2	8	1	44.0	Excellent
Minnehaha Cr	Pickerel Lake Rd	21	4	3	2	42.9	Acceptable
Little Pigeon River	Silery Road	29	3	7	1	37.9	Excellent
Pigeon River	M-68	38	4	7	2	34.2	Excellent

Table 12.–Continued.

Water body	Location	Number of taxa	Taxa (number) mayfly	caddisfly	stonefly	EPT %	Rating
Pigeon River	Webb Rd	35	5	9	1	42.9	Excellent
Little Pigeon River	Webb Rd	34	6	7	3	47.1	Excellent
Pigeon River	Elk Hill Campground	39	7	8	1	41.0	Excellent
Pigeon River	Sturgeon Valley Rd	40	6	6	2	35.0	Excellent
Pigeon River	Old Vanderbilt Rd	36	7	8	4	52.8	Excellent
Pigeon River	Whitehouse Trail	31	6	6	2	45.2	Excellent
Sturgeon River	Fisher Woods Rd	35	5	9	2	45.7	Excellent
Sturgeon River	Rondo Rd	31	4	9	2	48.4	Excellent
Sturgeon River	Cornwall Grade Canoe Launch	35	5	10	2	48.6	Excellent
Sturgeon River	Sturgeon Valley Rd	25	5	5	2	48.0	Excellent
Sturgeon River	Poquette Rd	28	6	7	3	57.1	Excellent
Club Stream	Fontinalis Club	30	6	8	1	50.0	Excellent
Little Sturgeon River	Crumley Creek Rd	29	6	6	4	55.2	Excellent
W Br Sturgeon River	Shire Rd	35	4	8	3	42.9	Excellent
W Br Sturgeon River	McGregor Rd.	32	8	9	1	56.3	Excellent

Table 13.–Cheboygan River watershed sites regulated under Part 201 as of April 2007, data provided by Michigan Department of Environmental Quality, Remediation and Redevelopment Division. Acronyms: BTEX = benzene, toluene, ethylbenzene, xylene; PCE = perchloroethylene; PNAs = polynuclear aromatic hydrocarbons; TCA = trichloroethane; TCE = trichloroethylene; TMB = trimethylbenzene; MTBE = methyl tertiary butyl ether. (There are no listed Charlevoix County, Presque Isle County, or Montmorency County Part 201 sites in the Cheboygan River watershed.)

County Common site name	Pollutant
Cheboygan County:	
1. Cheboygan DPW	Benzene, Xylenes
2. Amoco Oil Company	Benzene, PNAs
3. Cheboygan City Park	Lead, Zinc
4. 992 South Main St.	PCE, TCE
5. Inverness Twp. Dump	Diethyl ether, Lead
6. Center Tool	Arsenic, Lead, Cyanide, PNAs, BTEX
7. Lownsberry Salvage	Benzene, Cadmium, Lead, Zinc
8. Cheboygan County Rd Commission	Chloride
9. Rivertown Tannery	Arsenic, Lead, Bis(2-Ethylhexyl)phthalate
10. Arsenic Disposal Area	Arsenic, Lead
11. Northwood Oil	BTEX, Arsenic, 1,2,4-TMB, 1,3,5 TMB, MTBE, PNAs
12. State St. Bulk	BTEX, Lead
13. Wolverine Elementary School	TCE
14. Club Road Property	Benzene, PNAs
15. Former Rittenhouse Furniture	Arsenic, Barium, Lead
Emmet County:	
1. Martins Fruit Market	Selenium
2. One Way Auto Parts	1,2,4-TMB, 1,3,5- TMB, Benzene, Ethylbenzene, Napthalene, Toluene, Xylenes, n-Butylbenzene, n-Propylbenzene, sec-Butylbenzene
3. Pellston Dump Village	Solid waste
4. Littlefield Twp. Dump	Solid waste
5. McKinley Twp. Dump	Solid waste
6. Windjammer Marine	1,2,4-TMB, 1,3,5-TMB, 2-Methylnaphthalene, Arsenic, Benzene, Ethylbenzene, Naphthalene, Xylenes, n-Propylbenzene, Mercury, Indeno (1,2,3-cd) pyrene
7. Former Howes Leather Tannery	TCE, PCE
Otsego County:	
1. Shell Oil Company	Chlorides
2. Sparr Rd Spill	Benzene, Toluene
3. Wilkinson Rd	1,1,2 TCA
4. Res Wells East of Gaylord	Brine
5. Higgins Industries	TCE, PCE

Table 14.–Cheboygan River watershed sites regulated under Part 213 as of April 2007. Data provided by Michigan Department of Environmental Quality, Remediation and Redevelopment Division.

County Common site name	Pollutant
Cheboygan County:	
1. Corner Store	Gasoline
2. Stan Stelden (Old Orchard Trailer Park)	Gasoline
3. White's Sales Service	Gasoline
4. 9636 M-33 S (Crowley Store)	BTEX, PNAs, Metals
5. Zyco Distributing	Gasoline
6. Former Cook Corp.	Gasoline
7. Former Texaco Indian River	Gasoline
8. Cheboygan-Otsego-Presque Isle ISD	Closed
9. Bundy's Party Store (Tower Mini Mart)	Gasoline
10. Cheboygan Ct Rd Garage Tower	Diesel
11. Tri-River Party Store	Gasoline
12. Forward Indian River (Robert Mitchell Property)	Gasoline/Diesel
13. Jack Auto Repair	BTEX & PNAs
14. Vincent's Service	Gasoline
15. Alpena Oil Co. (Indian River Trading Post)	Gasoline
16. Paula's Café	Gasoline
17. Cheboygan Imperial #18	Gasoline
18. Schultz's Interstate	Gasoline
19. Hostettlers Office Supply	Used oil/Gasoline
20. Cheboygan Convenience Store (Convenient Food Mart)	BTEX/PNAs
21. Main St. (M-72 Hwy) Right Of	Gasoline
22. Blarney Castle France Super	Gasoline
23. Great Lakes Tissue	Gasoline
24. Cheboygan Clark (Clark #1011)	BTEX
25. Proctor & Gamble Paper	BTEX & PNAs
26. Holiday Station Store #173	Gasoline
27. Cheboygan EZ Mart (Cheboygan Bay Mart)	BTEX
28. Ormsbee Motors	Gasoline
29. Rex Oil & Gas Company	Gasoline
Emmet County:	
1. County General Store	Gasoline
2. Windjammer Marina	Gasoline
3. Williams Marathon	Gasoline
4. Emmet County Rd Commission	Gasoline
5. UPS Petoskey	Gasoline

Table 14.–Continued.

County Common site name	Pollutant
Otsego County:	
1. Sparr Mall	Gasoline
Presque Isle:	
1. Onaway Food Mart	Gasoline
2. Village Corner Party Store	Gasoline
3. Winter Hawks/General Store	Gasoline
4. 211 Outpost	Gasoline
5. Presque Isle Electric Coop Inc.	Gasoline
6. Presque Isle Co Rd Commission	Gasoline
7. Croad Salvage	Gasoline
8. Onaway Tax Service	Gasoline
9. Painter Petroleum	Gasoline
10. Vance’s Service Center	Gasoline

Table 15.–Designated trout streams in the Cheboygan River watershed. The entire stream, from its source to the downstream limit, including tributaries, is designated trout water, unless excepted.

Designated trout streams	County
Cheboygan River (T38N, R1W, S29) up to dam in S31	Cheboygan
EXCEPT: During the months of June, July, and August	
Laperell Creek (T37N, R1W, S19)	Cheboygan
Tributaries of Crooked River:	
Whites Creek (T36N, R4W, S35)	Emmet
Unnamed Creek (T35N, R4W, S3)	Emmet
Unnamed Creek (T36N, R4W, S35)	Emmet
McPhee Creek (T35N, R4W, S10)	Emmet
Tributaries of Crooked Lake:	
Hatchery Outlet (T35N, R4W, S18)	Emmet
Unnamed Creek (T35N, R5W, S13)	Emmet
Unnamed Creek (T35N, R5W, S24)	Emmet
Minnehaha (T35N, R4W, S29) *EXCEPT:*	Emmet
Silver Creek Pond (T34N, R4W, S4)	*Emmet*
Tributaries of Pickerel Lake:	
Mud Creek (T35N, R4W, S27)	Emmet
Cedar River (Berry Creek, T35N, R4W, S25)	Emmet, Cheboygan
Unnamed Creek (T35N, R4W, S26)	Emmet
Tributaries of Burt Lake:	
Little Carp River (T36N, R3W, S4)	Cheboygan
Maple River (T36N, R3W, S29, 31) and following tributaries:	Cheboygan, Emmet
West Branch Maple River (T36N, R4W, S10)	Emmet
East Branch Maple River (T36N, R4W, S10)	Emmet
Cold Creek (T37N, R4W, S30)	Emmet
Brush Creek (T37N, R5W, S27)	Emmet
Sturgeon River (T35N, R3W, S24) and following tributaries:	Cheboygan, Otsego
Beebee Creek (T34N, R2W, S31)	Cheboygan, Otsego
West Branch Sturgeon River (T33N, R2W, S7)	Cheboygan, Otsego, Charlevoix
Marl Creek (T33N, R3W, S15)	Cheboygan
Allen Creek (T33N, R3W, S14)	Cheboygan
Bairds Creek (T34N, R3W, S12)	Cheboygan
No Name Creek (T34N, R3W, S25)	Cheboygan
Mud Creek (T33N, R3W, S18)	Cheboygan
Bradley Creek (T33N, R2W, S20)	Cheboygan
Stewart Creek (T33N, R2W, S31) and all other tributaries	Cheboygan
Pickerel Creek (T32N, R2W, S10)	Otsego
Unnamed Creek (T32N, R2W, S21)	Otsego
Club Stream (T32N, R2W, S10)	Otsego
Mossback Creek (T31N, R3W, S12)	Otsego
Indian River tributaries:	
Little Sturgeon River (T35N, R2W, S19)	Cheboygan
Mullett Lake tributaries:	
No Name Creek (T37N, R2W, S25)	Cheboygan
No Name Creek (T37N, R2W, S26)	Cheboygan

Table 15.–Continued.

Designated trout streams	County
Mullett Lake tributaries–continued:	
Mullet Creek (T36N, R2W, S16)	Cheboygan
Little Pigeon River (T35N, R2W, S9)	Cheboygan
North Branch Little Pigeon River (T35N, R2W, S14)	Cheboygan
Middle Branch Little Pigeon River (T35N, R2W, S23)	Cheboygan
South Branch Little Pigeon River (T35N, R2W, S23)	Cheboygan
Pigeon River (T35N, R2W, S9) and the following tributaries:	Cheboygan, Otsego
Wilkes Creek (T34N, R2W, S12)	Cheboygan
Nelson Creek (T34N, R1W, S32)	Cheboygan
Little Pigeon River (T34N, R1W, S31)	Cheboygan
McIntosh Creek (T33N, R1W, S5)	Cheboygan
McPhee Creek (T33N, R1W, S8)	Cheboygan
Grindstone Creek (T33N, R1W, S17)	Cheboygan
Cornwall Creek (Cornwall Impoundment Dam)	Cheboygan
Unnamed Creek (T34N, R2W, S24)	Cheboygan
Unnamed Creek (T33N, R1W, S28)	Cheboygan
Unnamed Creek (T32N, R2W, S25)	Otsego
And all unnamed above T31N, R2W, S13	Otsego
Black River Basin	
Black River from Red Bridge (T35N, R1E, S5) upstream to Kleber Dam (T35N, R1E, S29)	Cheboygan
Black River from Tower Dam Pond upstream and following tributaries:	Cheboygan, Presque Isle
Milligan Creek (T35N, R1E, S29)	Cheboygan
Sturgis Creek (T34N, R1E, S14)	Cheboygan
Two Unnamed Creeks (T34N, R2E, S19)	Presque Isle
Gregg Creek (T34N, R1E, S25)	Cheboygan
Unnamed Creek (T34N, R2E, S31)	Presque Isle
Canada Creek (T33N, R1E, S12)	Cheboygan
Unnamed Creek (T33N, R1E, S12)	Cheboygan
Unnamed Creek (T33N, R1E, S11)	Cheboygan
McMasters Creek (T33N, R1E, S21)	Cheboygan
East Branch Black River (T32N, R1E, S8)	Montmorency
Stewart Creek (T32N, R1E, S8)	Montmorency
Hardwood Creek (T32N, R1E, S30)	Montmorency
Tubbs Creek (T31N, R1W, S1)	Otsego
Unnamed Creek (T31N, R1W, S20)	Otsego
Unnamed Creek (T31N, R1W, S27)	Otsego
Little Mud Creek (T36N, R1E, S28)	Cheboygan
Stony Creek (T35N, R1E, S12)	Cheboygan, Presque Isle
Rainy River (T35N, R2E, S22)	Presque Isle
Unnamed Creek (T35N, R2E, S26)	Presque Isle
Little Rainy River (T34N, R2E, S11)	Presque Isle
East Branch Rainy River (T34N, R3E, S18)	Presque Isle
Unnamed Creek (T33N, R3E, S21)	Presque Isle

Table 16.–Fish species documented in the Cheboygan River watershed. Species origin: N = native; C = colonized; and I = introduced. Cheboygan River watershed status: P = recent observation; O = extirpated; U = historic record, or current status unknown. Threatened (T) and Special Concern (SC) species are noted.

Common name	Scientific name	Species origin	Cheboygan watershed status
Lampreys	Petromyzontidae		
northern brook lamprey	*Ichthyomyzon fossor*	N	P
American brook lamprey	*Lampetra appendix*	N	P
sea lamprey	*Petromyzon marinus*	C	P
silver lamprey	*Ichthyomyzon unicuspis*	N	P
Sturgeons	Acipenseridae		
lake sturgeon (T)	*Acipenser fulvescens*	N	P
Gars	*Lepisosteidae*		
longnose gar	*Lepisosteus osseus*	N	P
Bowfins	Amiidae		
bowfin	*Amia calva*	N	P
Herrings	Clupeidae		
alewife	*Alosa pseudoharengus*	C	P
Carps and minnows	Cyprinidae		
spotfin shiner	*Cyprinella spiloptera*	N	P
common carp	*Cyprinus carpio*	C	P
brassy minnow	*Hybognathus hankinsoni*	N	U
common shiner	*Luxilus cornutus*	N	P
northern pearl dace	*Margariscus nachtriebi*	N	P
hornyhead chub	*Nocomis biguttatus*	N	P
river chub	*Nocomis micropogon*	N	P
golden shiner	*Notemigonus crysoleucas*	N	P
pugnose shiner (SC)	*Notropis anogenus*	N	U
emerald shiner	*Notropis atherinoides*	N	P
blackchin shiner	*Notropis heterodon*	N	U
blacknose shiner	*Notropis heterolepis*	N	U
spottail shiner	*Notropis hudsonius*	N	P
rosyface shiner	*Notropis rubellus*	N	U
sand shiner	*Notropis stramineus*	N	P
mimic shiner	*Notropis volucellus*	N	P
northern redbelly dace	*Phoxinus eos*	N	P
finescale dace	*Phoxinus neogaeus*	N	U
bluntnose minnow	*Pimephales notatus*	N	P
fathead minnow	*Pimephales promelas*	N	P
longnose dace	*Rhinichthys cataractae*	N	P
western blacknose dace	*Rhinichthys obtusus*	N	P
creek chub	*Semotilus atromaculatus*	N	P
Suckers	Catostomidae		
white sucker	*Catostomus commersonii*	N	P
silver redhorse	*Moxostoma anisurum*	N	P
greater redhorse	*Moxostoma valenciennesi*	N	P

Table 16.–Continued.

Common name	Scientific name	Species origin	Cheboygan watershed status
Bullhead catfishes	Ictaluridae		
black bullhead	*Ameiurus melas*	N	P
yellow bullhead	*Ameiurus natalis*	N	P
brown bullhead	*Ameiurus nebulosus*	N	P
channel catfish	*Ictalurus punctatus*	N	P
Pikes	Esocidae		
northern pike	*Esox lucius*	N	P
tiger muskellunge [a]	*E. lucius x E. masquinongy*	I	O
muskellunge	*Esox masquinongy*	N	P
Mudminnows	Umbridae		
central mudminnow	*Umbra limi*	N	P
Smelts	Osmeridae		
rainbow smelt	*Osmerus mordax*	I	U
Trouts	Salmonidae		
lake herring	*Coregonus artedi*	N	U
lake whitefish	*Coregonus clupeaformis*	N	P
pink salmon	*Oncorhynchus gorbuscha*	C	P
coho salmon	*Oncorhynchus kisutch*	I	P
rainbow trout	*Oncorhynchus mykiss*	I	P
Chinook salmon	*Oncorhynchus tshawytscha*	I	P
brown trout	*Salmo trutta*	I	P
brook trout	*Salvelinus fontinalis*	N	P
splake	*Salvelinus fontinalis x S. namaycush*	I	P
lake trout	*Salvelinus namaycush*	N	P
Arctic grayling (extirpated)	*Thymallus arcticus*	N	O
Trout-Perch	Percopsidae		
trout-perch	*Percopsis omiscomaycus*	N	U
Cods	Lotidae		
burbot	*Lota lota*	N	P
Killifishes	Cyprinodontidae		
western banded killifish	*Fundulus diaphanus*	N	U
Sticklebacks	Gasterosteidae		
brook stickleback	*Culaea inconstans*	N	P
ninespine stickleback	*Pungitius pungitius*	N	P
Sculpins	Cottidae		
mottled sculpin	*Cottus bairdii*	N	P
slimy sculpin	*Cottus cognatus*	N	P

Table 16.–Continued.

Common name	Scientific name	Species origin	Cheboygan watershed status
Sunfishes	Centrarchidae		
rock bass	*Ambloplites rupestris*	N	P
green sunfish	*Lepomis cyanellus*	N	P
pumpkinseed	*Lepomis gibbosus*	N	P
bluegill	*Lepomis macrochirus*	N	P
northern longear sunfish	*Lepomis peltastes*	N	U
smallmouth bass	*Micropterus dolomieu*	N	P
largemouth bass	*Micropterus salmoides*	N	P
black crappie	*Pomoxis nigromaculatus*	N	P
Perches	Percidae		
rainbow darter	*Etheostoma caeruleum*	N	P
Iowa darter	*Etheostoma exile*	N	P
least darter	*Etheostoma microperca*	N	U
johnny darter	*Etheostoma nigrum*	N	P
yellow perch	*Perca flavescens*	N	P
northern logperch	*Percina caprodes*	N	P
channel darter	*Percina copelandi*	N	U
blackside darter	*Percina maculata*	N	P
walleye	*Sander vitreus*	N	P
Gobies	Gobiidae		
round goby	*Neogobius melanostomus*	C	P
Drum	Sciaenidae		
freshwater drum	*Aplodinotus grunniens*	C	P

[a] last stocked in Cornwall Impoundment in 1991

Table 17.–Mussel species documented in the Cheboygan River watershed (University of Michigan Museum of Zoology 2013).

Common name	Scientific name	Year documented	Location
eastern pond mussel	*Ligumia nasuta*	1817	Indian River; Douglas and Valentine lakes
eastern floater	*Pyganodon cataracta*	1817	Cochran Lake
kidneyshell	*Ptychobranchus fasciolaris*	1820	Black River
limpet	*Ferrissia parallelus*	1841	Douglas Lake
giant floater	*Pyganodon grandis*	1829	Pickerel Lake (Otsego Co); Ford, Crooked, Jackson, Valentine, Town Corner lakes
fatmucket	*Lampsilis siliquoidea*	1823	Ford and Valentine lakes
creeper	*Strophitus undulates*	1817	Crooked Lake
cylindrical papershell	*Anodontoides ferussacianus*	1834	Valentine Lake

Table 18a.–Aquatic invertebrates in the Black River subwatershed of the Cheboygan River watershed (modified from Walker 2008). X = present, dash (–) indicates not collected.

Taxa	Black R.–Tubbs Ck confluence	Black R.–Blue Lakes Rd	E B Black R.–Blue Lakes Rd	Black R.–Crockett Rapids Br	McMasters Ck–near Clark Bridge Rd	Black R.–Black R. Rd	Milligan Ck–Brady Rd	Canada Ck–Canada Ck Highway	Oxbow Ck–mid station	Tomahawk Ck–M33 Highway	Bowen Ck–Bowen Rd	Rainry R.–Allis Highway	Little Rainy R.–One Mile Highway	Owens Ck–Ross Rd
PORIFERA (sponges)	–	–	–	–	X	–	–	–	X	–	–	–	X	–
PLATYHELMINTHES (flatworms)														
Turbellaria	–	–	–	–	–	–	–	–	–	–	–	–	–	–
BRYOZOA (moss animals)	–	–	–	–	–	X	–	–	–	–	–	–	–	–
ANNELIDA (segmented worms)														
Hirudinea (leeches)	X	–	–	–	X	–	X	–	–	–	X	–	X	X
Oligochaeta (worms)	X	X	X	X	X	X	X	X	–	X	X	X	–	X
ARTHROPODA														
Arachnoidea														
Hydracarina	X	–	X	X	X	X	X	X	–	–	–	X	X	–
Crustacea														
Amphipoda (scuds)	–	–	X	–	X	X	–	X	X	X	–	X	X	X
Decapoda (crayfish)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Isopoda (sowbugs)	X	X	–	X	X	X	–	–	–	–	X	–	X	X
Insecta														
Ephemeroptera (mayflies)														
Baetiscidae	X	X	X	–	–	X	–	X	–	–	–	X	–	–
Baetidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Caenidae	X	–	X	–	–	X	–	X	–	–	–	X	X	X
Ephemerellidae	X	X	X	X	–	X	–	X	X	–	–	–	–	–
Ephemeridae	X	X	X	X	–	X	–	X	–	–	–	–	–	–
Heptageniidae	X	X	X	X	X	X	X	X	X	X	X	X	X	
Isonychiidae	X	X	X	X	–	X	X	–	–	–	–	X	–	–

Table 18a.–Continued.

Taxa	Black R.–Tubbs Ck confluence	Black R.–Blue Lakes Rd	E B Black R.–Blue Lakes Rd	Black R.–Crockett Rapids Br	McMasters Ck–near Clark Bridge Rd	Black R.–Black R. Rd	Milligan Ck–Brady Rd	Canada Ck–Canada Ck Highway	Oxbow Ck–mid station	Tomahawk Ck–M33 Highway	Bowen Ck–Bowen Rd	Rainy R.–Allis Highway	Little Rainy R.–One Mile Highway	Owens Ck–Ross Rd
Leptophlebiidae	–	–	–	–	–	–	X	–	X	X	–	X	–	–
Tricorythidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Odonata														
Anisoptera (dragonflies)														
Aeshnidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cordulegastridae	–	X	–	–	–	X	–	X	X	X	X	–	–	–
Gomphidae	X	X	X	X	X	X	X	X	X	X	–	X	X	–
Zygoptera (damselflies)														
Calopterygidae	–	X	X	X	X	X	X	X	X	X	X	X	X	X
Coenagrionidae	–	–	–	–	–	–	–	–	–	–	–	–	X	–
Lestidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Plecoptera (stoneflies)														
Nemouridae	–	–	–	–	–	–	–	–	–	X	–	X	–	–
Perlidae	X	–	–	X	–	X	X	X	X	–	–	X	–	–
Perlodida	X	X	–	X	–	X	X	X	–	–	–	X	–	–
Pteronarcyidae	–	–	X	X	–	–	–	–	–	–	–	–	–	–
Hemiptera (true bugs)														
Belostomatidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Corixidae	X	X	X	X	X	X	–	–	–	–	–	–	–	–
Gerridae	X	–	–	X	X	X	–	X	X	X	X	X	–	X
Mesoveliidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nepidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Veliidae	–	X	X	X	–	X	X	–	X	X	–	X	–	X
Megaloptera														
Corydalidae (dobson flies)	X	X	X	X	–	X	X	X	–	X	X	X	–	X
Sialidae (alder flies)	–	X	–	–	–	–	–	–	–	–	X	–	–	–

Table 18a.–Continued.

Taxa	Black R.–Tubbs Ck confluence	Black R.–Blue Lakes Rd	E B Black R.–Blue Lakes Rd	Black R.–Crockett Rapids Br	McMasters Ck–near Clark Bridge Rd	Black R.–Black R. Rd	Milligan Ck–Brady Rd	Canada Ck–Canada Ck Highway	Oxbow Ck–mid station	Tomahawk Ck–M33 Highway	Bowen Ck–Bowen Rd	Rainry R.–Allis Highway	Little Rainy R.–One Mile Highway	Owens Ck–Ross Rd
Trichoptera (caddisflies)														
Brachycentridae	X	X	X	X	–	X	–	X	X	–	–	–	–	–
Glossosomatidae	–	X	X	–	–	–	X	–	–	–	–	X	–	–
Helicopsychidae	X	X	X	X	X	X	X	X	X	X	X	X	X	–
Hydropsychidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hydroptilidae	–	–	–	–	–	–	X	–	–	–	–	–	–	–
Lepidostomatidae	–	–	X	–	–	–	–	X	X	–	X	–	–	–
Leptoceridae	–	X	–	X	–	X	X	X	–	–	–	–	–	–
Limnephilidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Molannidae	X	–	–	–	X	–	–	X	–	X	X	–	X	–
Philopotamidae	–	X	–	X	–	X	X	X	X	X	–	–	–	–
Phryganeidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Polycentropodidae	X	X	X	X	X	X	X	X	X	–	X	–	–	X
Psychomyiidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Uenoidae	X	X	X	–	–	X	X	X	X	X	X	X	X	–
Coleoptera (beetles)														
Dryopidae	–	–	–	–	–	–	–	–	–	–	X	X	–	–
Dytiscidae (total)	–	–	–	–	–	X	–	–	–	X	–	–	–	X
Elmidae	–	X	X	X	X	X	X	X	X	X	X	X	X	X
Gyrinidae (larvae)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Gyrinidae (adults)	–	X	–	–	X	–	–	–	–	–	–	–	–	–
Haliplidae (larvae)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Haliplidae (adults)	–	–	–	–	–	–	–	X	–	–	–	–	–	–
Hydrophilidae (total)	X	–	X	–	–	X	–	X	–	–	–	X	–	–
Psephenidae (larvae)	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Psephenidae (adults)	–	–	–	–	–	X	–	–	–	–	–	X	–	–

Table 18a.–Continued.

Taxa	Black R.–Tubbs Ck confluence	Black R.–Blue Lakes Rd	E B Black R.–Blue Lakes Rd	Black R.–Crockett Rapids Br	McMasters Ck–near Clark Bridge Rd	Black R.–Black R. Rd	Milligan Ck–Brady Rd	Canada Ck–Canada Ck Highway	Oxbow Ck–mid station	Tomahawk Ck–M33 Highway	Bowen Ck–Bowen Rd	Rainry R.–Allis Highway	Little Rainy R.–One Mile Highway	Owens Ck–Ross Rd
Diptera (flies)														
Athericidae	X	X	–	–	–	–	–	–	–	–	–	X	–	–
Ceratopogonidae	–	–	–	X	X	X	X	–	–	X	–	X	X	X
Chironomidea	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Culicidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Simuliidae	X	X	X	X	–	X	X	X	X	X	X	–	X	X
Stratiomyidae	–	–	–	–	X	–	–	–	–	X	–	–	–	–
Tabanidae	X	–	–	–	X	X	–	–	–	X	–	X	X	–
Tipulidae	X	X	X	–	–	–	X	X	–	X	X	X	–	–
MOLLUSCA														
Gastropoda (snails)														
Ancylidae (limpets)	–	–	X	–	–	–	–	–	–	–	–	–	–	–
Lymnaeidae	–	X	X	–	–	–	–	–	–	–	–	–	–	–
Physidae	X	X	X	–	X	X	–	X	X	X	X	–	X	–
Planorbidae	–	–	X	–	X	–	–	–	–	–	X	–	–	–
Plauronceridae	–	–	–	–	–	X	–	–	–	–	–	–	–	–
Viviparidae	–	–	–	–	X	–	–	X	–	–	–	–	–	X
Pelecypoda (bivalves)														
Pisidiidae	–	X	X	–	–	X	–	X	–	–	–	–	–	X
Sphaeriidae (clams)	–	X	–	X	X	–	X	X	X	–	X	X	X	–
Unionidae (mussels)	–	–	–	–	X	–	X	–	–	–	–	–	–	–
Total Number of Taxa	33	37	36	31	30	42	31	38	27	29	27	34	25	22
Macroinvertebrate Community Rating[a]	EXC	EXC	EXC	EXC	ACC	EXC	EXC	EXC	EXC	EXC	ACC	EXC	ACC	ACC

[a] ACC = acceptable; EXC = excellent

Table 18b.–Aquatic invertebrates in the Maple and Pigeon river subwatersheds of the Cheboygan River watershed (modified from Walker 2008). X = present, dash (–) indicates not collected.

Taxa	Laperell Ck–Laperell Rd	Mullett Ck–near Crump Rd	E B Maple R.–Douglas Lk Rd	Maple R.–Maple R. Rd	Maple R.–Robinson Rd	McPhee Ck–Valley Rd	Minnehaha Ck–Pickerel Lk Rd	Little Pigeon R.–Silery Rd	Pigeon R.–M68 Highway	Pigeon R.–Webb Rd	Little Pigeon R.–Webb Rd	Pigeon R.–Elk Hill Campground	Pigeon R.–Sturgeon Valley Rd	Pigeon R.–Old Vanderbilt Rd	Pigeon R.–Whitehouse Trail
PORIFERA (sponges)	–	–	X	–	X	–	–	X	–	X	–	X	X	–	–
NEMATOMORPHA (roundworms)	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–
PLATYHELMINTHES (flatworms)															
Turbellaria	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–
BRYOZOA (moss animals)	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–
ANNELIDA (segmented worms)															
Hirudinea (leeches)	–	–	X	X	X	–	–	X	X	–	–	X	X	–	–
Oligochaeta (worms)	X	X	X	X	X	X	X	–	X	X	X	X	X	X	X
ARTHROPODA															
Arachnoidea															
Hydracarina	X	–	–	X	X	–	X	X	–	X	–	X	X	X	X
Crustacea															
Amphipoda (scuds)	X	–	X	X	X	–	X	X	–	–	X	X	–	–	X
Decapoda (crayfish)	X	–	X	–	–	–	–	X	X	X	X	X	X	–	–
Isopoda (sowbugs)	–	–	X	X	X	–	X	–	–	–	–	–	X	–	–
Insecta															
Ephemeroptera (mayflies)															
Baetiscidae	–	–	X	X	X	–	–	–	–	–	X	–	X	X	–
Baetidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Caenidae	–	–	X	–	–	–	–	–	–	X	X	–	–	X	X
Ephemerellidae	X	–	X	X	X	–	X	–	X	X	X	X	X	X	X
Ephemeridae	X	–	–	X	X	–	X	–	–	–	–	X	–	X	X
Heptageniidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 18b.–Continued.

Taxa	Laperell Ck–Laperell Rd	Mullett Ck–near Crump Rd	E B Maple R.–Douglas Lk Rd	Maple R.–Maple R. Rd	Maple R.–Robinson Rd	McPhee Ck–Valley Rd	Minnehaha Ck–Pickerel Lk Rd	Little Pigeon R.–Silery Rd	Pigeon R.–M68 Highway	Pigeon R.–Webb Rd	Little Pigeon R.–Webb Rd	Pigeon R.–Elk Hill Campground	Pigeon R.–Sturgeon Valley Rd	Pigeon R.–Old Vanderbilt Rd	Pigeon R.–Whitehouse Trail
Isonychiidae	–	–	–	X	–	–	–	X	X	X	–	X	X	–	–
Leptophlebiidae	X	–	–	X	–	–	–	–	–	–	–	X	–	–	X
Tricorythidae	–	–	–	–	–	–	–	–	–	–	X	X	X	X	–
Odonata															
Anisoptera (dragonflies)															
Aeshnidae	X	–	X	X	X	X	–	X	X	X	X	X	X	X	–
Cordulegastridae	X	–	X	–	–	X	–	X	–	–	X	–	–	–	–
Gomphidae	–	–	–	–	X	–	–	X	X	X	X	–	X	X	X
Zygoptera (damselflies)															
Calopterygidae	–	–	X	X	–	–	–	X	X	X	X	X	X	–	–
Coenagrionidae	–	–	X	–	–	–	–	–	X	–	–	–	–	–	–
Lestidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Plecoptera (stoneflies)															
Leuctridae	–	X	–	–	–	–	–	–	–	–	X	–	–	X	–
Numouridae	X	X	–	–	–	X	X	–	–	–	–	–	–	X	X
Perlidae	–	–	X	X	X	–	–	X	X	X	X	X	X	X	–
Perlodida	–	X	–	X	X	–	X	–	–	–	–	–	–	–	–
Pteronarcyidae	–	–	–	X	X	–	–	–	X	–	X	–	X	X	X
Hemiptera (true bugs)															
Belostomatidae	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–
Corixidae	–	–	X	–	X	–	–	–	X	X	–	X	X	X	X
Gerridae	X	X	X	X	X	X	X	X	–	X	X	X	X	X	X
Mesoveliidae	–	–	–	–	–	–	–	–	–	X	X	X	–	X	X
Nepidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Veliidae	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–

Table 18b.–Continued.

Taxa	Laperell Ck–Laperell Rd	Mullett Ck–near Crump Rd	E B Maple R.–Douglas Lk Rd	Maple R.–Maple R. Rd	Maple R.–Robinson Rd	McPhee Ck–Valley Rd	Minnehaha Ck–Pickerel Lk Rd	Little Pigeon R.–Silery Rd	Pigeon R.–M68 Highway	Pigeon R.–Webb Rd	Little Pigeon R.–Webb Rd	Pigeon R.–Elk Hill Campground	Pigeon R.–Sturgeon Valley Rd	Pigeon R.–Old Vanderbilt Rd	Pigeon R.–Whitehouse Trail
Megaloptera															
Corydalidae (dobson flies)	X	–	X	X	X	–	–	–	X	X	X	X	X	X	–
Sialidae (alder flies)	X	X	–	–	–	X	X	–	–	X	–	X	X	X	–
Neuroptera (spongilla flies)															
Sisyridae	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–
Trichoptera (caddisflies)															
Brachycentridae	X	–	–	X	X	–	–	X	X	X	X	X	X	X	X
Glossosomatidae	X	X	X	X	X	X	–	–	X	X	–	X	–	X	–
Helicopsychidae	–	–	X	–	–	–	–	–	–	X	–	X	X	X	–
Hydropsychidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hydroptilidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lepidostomatidae	X	X	–	X	X	X	–	–	–	–	X	–	–	–	X
Leptoceridae	–	–	X	X	X	X	–	X	X	X	X	X	X	X	X
Limnephilidae	X	X	X	X	X	X	–	X	X	X	X	X	X	X	X
Molannidae	–	–	X	X	X	–	–	–	–	–	–	–	–	–	–
Philopotamidae	X	X	–	X	X	X	X	X	X	–	–	–	–	X	X
Phryganeidae	–	–	–	–	–	–	–	–	–	X	X	–	–	–	–
Polycentropodidae	–	–	–	X	X	–	–	X	–	X	X	X	–	–	–
Psychomyiidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rhyacophilidae	–	X	–	–	–	X	X	–	–	–	–	–	–	–	–
Uenoidae	–	X	X	X	X	X	–	X	X	X	–	X	X	X	–
Coleoptera (beetles)															
Dryopidae	–	–	–	–	–	–	–	X	X	–	–	–	–	X	–
Dytiscidae (total)	–	X	X	X	X	X	–	–	X	–	–	–	X	–	–

Table 18b.–Continued.

Taxa	Laperell Ck–Laperell Rd	Mullett Ck–near Crump Rd	E B Maple R.–Douglas Lk Rd	Maple R.–Maple R. Rd	Maple R.–Robinson Rd	McPhee Ck–Valley Rd	Minnehaha Ck–Pickerel Lk Rd	Little Pigeon R.–Silery Rd	Pigeon R.–M68 Highway	Pigeon R.–Webb Rd	Little Pigeon R.–Webb Rd	Pigeon R.–Elk Hill Campground	Pigeon R.–Sturgeon Valley Rd	Pigeon R.–Old Vanderbilt Rd	Pigeon R.–Whitehouse Trail
Elmidae	X	X	X	X	X	X	–	X	X	X	X	X	X	X	X
Gyrinidae (larvae)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Gyrinidae (adults)	X	–	–	–	–	–	–	–	–	–	–	–	–	–	X
Haliplidae (larvae)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Haliplidae (adults)	–	–	X	–	–	–	–	–	–	–	X	–	–	–	–
Hydrophilidae (total)	X	–	–	–	–	–	–	–	X	X	–	X	X	–	X
Psephenidae (larvae)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diptera (flies)															
Athericidae	–	–	–	–	–	X	–	–	X	X	X	X	–	–	X
Ceratopogonidae	–	–	–	X	X	–	X	X	–	–	X	–	X	–	–
Chironomidea	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Culicidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dixidae	–	–	–	–	–	–	–	–	X	–	–	–	–	X	X
Simuliidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Stratiomyidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tabanidae	–	–	–	–	–	–	–	–	–	–	–	X	X	X	–
Tipulidae	X	X	X	–	X	X	X	X	–	–	–	–	–	–	X
MOLLUSCA															
Gastropoda (snails)															
Ancylidae (limpets)	–	–	X	X	–	–	–	–	–	–	–	–	–	–	–
Lymnaeidae	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
Physidae	X	–	X	X	X	X	–	X	X	–	X	X	X	X	X
Planorbidae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Plauronceridae	–	–	–	–	–	–	–	–	X	X	–	X	X	–	–

Table 18b.–Continued.

Taxa	Laperell Ck–Laperell Rd	Mullett Ck–near Crump Rd	E B Maple R.–Douglas Lk Rd	Maple R.–Maple R. Rd	Maple R.–Robinson Rd	McPhee Ck–Valley Rd	Minnehaha Ck–Pickerel Lk Rd	Little Pigeon R.–Silery Rd	Pigeon R.–M68 Highway	Pigeon R.–Webb Rd	Little Pigeon R.–Webb Rd	Pigeon R.–Elk Hill Campground	Pigeon R.–Sturgeon Valley Rd	Pigeon R.–Old Vanderbilt Rd	Pigeon R.–Whitehouse Trail
Pomaiopsidae	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–
Viviparidae	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
Pelecypoda (bivalves)															
Pisidiidae	X	–	X	–	–	–	X	X	X	X	–	X	X	–	X
Sphaeriidae (clams)	–	–	X	X	X	X	X	–	X	X	X	X	X	X	–
Unionidae (mussels)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Number of Taxa	29	20	38	37	37	25	21	29	38	35	34	39	40	36	31
Macroinvertebrate Community Rating[a]	EXC	EXC	ACC	EXC	EXC	EXC	ACC	EXC	EXC	EXC	EXC	EXC	EXC	EXC	EXC

[a] ACC = acceptable; EXC = excellent

Table 18c.–Aquatic invertebrates in the Sturgeon River subwatershed of the Cheboygan River watershed (modified from Walker 2008). X = present, dash (–) indicates not collected.

Taxa	Sturgeon R.–Fisher Woods Rd	Sturgeon R.–Rondo Rd	Sturgeon R.–Cornwall Grade Canoe Access	Sturgeon R.–Sturgeon Valley Rd	Sturgeon R.–Poquette Rd	Club Stream–Fontinalis Rd	Little Sturgeon R.–Crumley Ck Rd	W Br Sturgeon R.–Shire Rd	W Br Sturgeon R.–MacGregor Rd
PORIFERA (sponges)	–	–	–	–	–	–	–	–	–
PLATYHELMINTHES (flatworms)									
Turbellaria	–	–	–	–	–	–	–	–	
BRYOZOA (moss animals)	–	–	–	–	–	–	–	–	–
ANNELIDA (segmented worms)									
Hirudinea (leeches)	–	–	–	–	–	–	–	–	–
Oligochaeta (worms)	X	X	X	–	X	–	X	X	–
ARTHROPODA									
Arachnoidea									
Hydracarina	X	X	X	X	X	X	–	X	X
Crustacea									
Amphipoda (scuds)	X	X	X	X	–	X	X	X	X
Decapoda (crayfish)	X	X	X	–	–	X	–	–	X
Isopoda (sowbugs)	X	X	X	–	X	X	–	X	–
Insecta									
Ephemeroptera (mayflies)									
Baetiscidae	–	–	–	X	X	–	–	X	–
Baetidae	X	X	X	X	X	X	X	X	X
Caenidae	–	–	X	–	–	–	X	–	X
Ephemerellidae	X	X	X	X	X	X	X	X	X
Ephemeridae	–	–	X	X	X	X	X	X	X
Heptageniidae	X	X	X	X	X	X	X	–	X
Isonychiidae	X	X	–	–	–	X	–	–	X
Leptophlebiidae	–	–	–	–	X	–	X	–	X
Tricorythidae	X	–	–	–	–	X	–	–	X
Odonata									
Anisoptera (dragonflies)									
Aeshnidae	X	X	X	–	–	X	X	X	X
Cordulegastridae	X	X	–	–	–	–	X	X	X
Gomphidae	–	–	–	–	–	–	–	–	X
Zygoptera (damselflies)									
Calopterygidae	X	–	X	X	–	X	X	X	X
Coenagrionidae	–	–	–	–	–	–	–	–	–
Lestidae	–	–	–	–	–	–	–	–	–
Plecoptera (stoneflies)									
Leuctridae	–	–	–	–	–	–	X	X	–
Nemouridae	–	–	–	X	X	–	X	X	–
Perlidae	X	X	X	–	–	X	X	–	–

Table 18c.–Continued.

Taxa	Sturgeon R.–Fisher Woods Rd	Sturgeon R.–Rondo Rd	Sturgeon R.–Cornwall Grade Canoe Access	Sturgeon R.–Sturgeon Valley Rd	Sturgeon R.–Poquette Rd	Club Stream–Fontinalis Rd	Little Sturgeon R.–Crumley Ck Rd	W Br Sturgeon R.–Shire Rd	W Br Sturgeon R.–MacGregor Rd
Perlodida	X	X	X	X	X	–	–	–	X
Pteronarcyidae	–	–	–	–	X	–	X	X	–
Hemiptera (true bugs)									
Belostomatidae	–	–	–	–	–	–	–	–	–
Corixidae	–	–	X	–	–	–	–	X	–
Gerridae	X	X	X	X	X	X	X	X	X
Mesoveliidae	–	–	–	–	–	–	–	–	–
Nepidae	–	–	–	–	–	–	–	–	–
Pleidae	X	–	–	–	–	–	–	–	–
Veliidae	–	–	–	–	X	X	–	–	–
Megaloptera									
Corydalidae (dobson flies)	X	X	X	X	–	X	X	X	X
Sialidae (alder flies)	X	–	X	–	–	–	–	–	–
Trichoptera (caddisflies)									
Brachycentridae	X	X	X	X	X	X	X	X	X
Glossosomatidae	X	X	X	–	–	X	–	X	X
Helicopsychidae	X	X	X	–	–	–	–	–	X
Hydropsychidae	X	X	X	X	X	X	X	X	X
Hydroptilidae	–	–	–	–	–	–	–	–	–
Lepidostomatidae	X	X	X	X	X	X	–	X	X
Leptoceridae	X	–	X	–	–	X	–	–	X
Limnephilidae	X	X	X	X	X	X	X	X	X
Molannidae	–	–	–	–	–	–	–	–	–
Philopotamidae	–	X	X	–	X	X	X	X	X
Phryganeidae	–	–	–	–	X	–	–	X	–
Polycentropodidae	X	X	X	X	X	–	X	–	X
Psychomyiidae	–	–	–	–	–	–	–	–	–
Uenoidae	X	X	X	–	–	X	X	X	–
Coleoptera (beetles)									
Dryopidae	–	X	–	X	–	–	–	–	–
Dytiscidae (total)	–	–	–	–	–	–	–	–	–
Elmidae	X	X	X	–	–	X	–	X	X
Gyrinidae (larvae)	–	–	–	X	–	–	–	–	–
Gyrinidae (adults)	–	–	–	–	–	–	–	–	–
Haliplidae (larvae)	–	–	–	–	–	–	–	–	–
Haliplidae (adults)	X	–	–	–	–	–	–	–	–
Hydrophilidae (total)	–	–	X	X	X	X	X	X	X
Psephenidae (larvae)	–	–	–	–	–	–	–	–	–
Diptera (flies)									
Athericidae	X	X	–	X	X	X	–	X	X

Table 18c.–Continued.

Taxa	Sturgeon R.–Fisher Woods Rd	Sturgeon R.–Rondo Rd	Sturgeon R.–Cornwall Grade Canoe Access	Sturgeon R.–Sturgeon Valley Rd	Sturgeon R.–Poquette Rd	Club Stream–Fontinalis Rd	Little Sturgeon R.–Crumley Ck Rd	W Br Sturgeon R.–Shire Rd	W Br Sturgeon R.–MacGregor Rd
Ceratopogonidae	–	–	–	X	X	–	X	X	–
Chironomidea	X	X	X	X	X	X	X	X	X
Culicidae	–	–	–	–	–	–	–	–	–
Simuliidae	X	X	X	X	X	X	X	X	–
Stratiomyidae	–	–	–	–	–	–	–	–	–
Tabanidae	–	–	X	–	X	–	X	X	–
Tipulidae	–	–	–	–	–	X	–	–	–
MOLLUSCA									
Gastropoda (snails)									
Ancylidae (limpets)	–	–	–	–	–	–	–	–	–
Lymnaeidae	–	–	–	–	–	–	–	–	–
Physidae	X	X	X	X	–	–	–	X	X
Planorbidae	–	–	–	–	–	–	X	–	–
Plauronceridae	–	–	–	–	–	–	–	–	–
Viviparidae	–	–	–	–	–	–	–	–	–
Pelecypoda (bivalves)									
Pisidiidae	–	X	X	–	X	–	–	X	–
Sphaeriidae (clams)	X	–	–	X	–	–	–	X	–
Unionidae (mussels)	–	–	–	–	–	–	–	–	–
Total Number of Taxa	35	31	35	26	28	30	29	35	32
Macroinvertebrate Community Rating[a]	EXC	EXC	EXC	EXC	EXC	EXC	EXC	EXC	ACC

[a] ACC = acceptable; EXC = excellent

Table 19.–Amphibian and reptile species found in counties of the Cheboygan River watershed (Holman et al. 1993, Harding and Holman 1992, and Harding and Holman 1990). Threatened (T) and Special Concern (SC) species are noted. O = Otsego, M = Montmorency, V = Charlevoix, C = Cheboygan, and P = Presque Isle.

Common name	Scientific name	O	M	V	C	P
Frogs and Toads						
eastern American toad	*Bufo americanus americanus*	X	X	X	X	X
eastern gray tree frog	*Hyla versicolor*	X	X	X	X	X
northern spring peeper	*Pseudacris crucifer crucifer*	X	X	X	X	X
western chorus frog	*Pseudacris triseriata triseriata*	X	X	X	X	X
bull frog	*Rana catesbeiana*	X	X	X	X	X
green frog	*Rana clamitans melanota*	X	X	X	X	X
pickerel frog	*Rana palustris*	X	X	X	X	X
northern leopard frog	*Rana pipiens*	X	X	X	X	X
wood frog	*Rana sylvatica*	X	X	X	X	X
Salamanders						
blue-spotted salamander	*Ambystoma laterale*	X	X	X	X	X
spotted salamander	*Ambystoma maculatum*	X	X	X	X	X
eastern tiger salamander	*Ambystoma tigrinum tigrinum*	X	X			
four-toed salamander	*Hemidactylium scutatum*	X	X	X	X	X
mudpuppy	*Necturus maculosus maculosus*	X	X	X	X	X
eastern newt-central subspecies	*Notophthalmus viridescens louisianensis*	X	X	X	X	X
red-backed salamander	*Plethodon cinereus*	X	X	X	X	X
Snakes and lizards						
northern ringneck snake	*Diadophis punctatus edwardsi*	X	X	X	X	X
five-lined skink	*Eumeces fasciatus*	X	X	X	X	X
eastern hognose snake	*Heterodon platirhinos*	X	X	X	X	X
blue racer	*Coluber constrictor*	X				
eastern milk snake	*Lampropeltis tringulum triangulum*	X	X	X	X	X
northern water snake	*Nerodia sipedon sipedon*	X	X	X	X	X
eastern smooth green snake	*Opheodrys vernalis vernalis*	X	X	X	X	X
eastern massasauga rattlesnake (SC)	*Sistrurus catenatus catenatus*	X	X	X	X	X
brown snake	*Storeria dekayi*	X	X	X	X	X
northern red-bellied snake	*Storeria occipitomaculate occipitomaculate*	X	X	X	X	X
northern ribbon snake	*Thamnophis sauritus septentrionalis*	X	X	X	X	X
eastern garter snake	*Thamnophis sirtalis sirtalis*	X	X	X	X	X
Turtles						
snapping turtle	*Chelydra serpentine*	X	X	X	X	X
painted turtle	*Chrysemys picta*	X	X	X	X	X
wood turtle (SC)	*Clemmys insculpta*	X	X	X	X	X
Blanding’s turtle (SC)	*Emydoidea blandingii*	X	X	X	X	X
common musk turtle	*Sternotherus odoratus*	X	X	X	X	X

Table 20.–Breeding bird species associated with wetland habitats—Otsego, Montmorency, Emmet, Cheboygan, and Presque Isle counties, MI (Doepker et al. 2001). SC = special concern, T = threatened, E = endangered.

Common name	Scientific name
Gaviidae (loons)	
Common loon (T)	*Gavia immer*
Colymbidae (grebes)	
Pied-billed grebe	*Podilymbus podiceps*
Phalacrocoracidae (cormorants)	
Double-crested cormorant	*Phalacrocorax auritus*
Ardeidae (herons)	
Great blue heron	*Ardea herodias*
Green-backed heron	*Butorides striatus*
American bittern	*Botaurus lentiginosus*
Least bittern (SC)	*Ixobrychus exilis*
Black-crowned night heron (SC)	*Nycticorax nycticorax*
Greater egret	*Casmerodius albus*
Anatidae (swans, geese and ducks)	
Canada goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
American black duck	*Anas rubripes*
Blue winged teal	*Anas discors*
Green winged teal	*Anas crecca*
Gadwall	*Anas streperas*
Wood duck	*Aix sponsa*
Ring-necked duck	*Aythya collaris*
Common goldeneye	*Bucephala clangula*
Hooded merganser	*Lophodytes cucullatus*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Charadriidae (plovers)	
Piping plover (E)	*Charadrius melodus*
Laridae (gulls and terns)	
Herring gull	*Larus argentatus*
Ring-billed gull	*Larus dealawarensis*
Black tern (SC)	*Chlidonias niger*
Caspian tern (T)	*Sterna caspia*
Common tern (T)	*Sterna hirundo*
Accipitridae (hawks and eagles)	
Cooper’s hawk	*Accipiter cooperii*
Red-tailed hawk	*Buteo jamaicensis*
Red-shouldered hawk (T)	*Buteo lineatus*
Bald eagle (T)	*Haliaeetus Ieucicephalus*
Northern harrier (SC)	*Circus cyaneus*
Pandionidae (ospreys)	
Osprey (T)	Pandion haliaetus

Table 20.–Continued.

Common name	Scientific name
Falconidae (falcons)	
Merlin (T)	*Falco columbarius*
Tetraonidae (grouse)	
Ruffed grouse	*Bonasa umbellus*
Gruidae (cranes)	
Sandhill crane	*Grus canadensis*
Rallidae (rails)	
Virginia rail	*Rallus limicola*
Sora	*Porzana carolina*
American coot	*Fulica americana*
Common moorhen (SC)	*Gallinula chloropus*
Charadriidae (plovers)	
Killdeer	*Charadrius vociferus*
Scolopacidae (sandpipers)	
American woodcock	*Scolopax minor*
Common snipe	*Gallinago gallinago*
Spotted sandpiper	*Actitis macularia*
Upland sandpiper	*Bartramia longicauda*
Cuculidae (cuckoos)	
Yellow-billed cuckoo	*Coccyzus americanus*
Black-billed cuckoo	*Coccyzus erythropthalmus*
Tytonidae (barn owls)	
Great horned owl	*Bubo virginianus*
Barred owl	*Strix varia*
Long-eared owl (E)	*Asio otus*
Northern saw-shet owl	*Aegolius acadicus*
Eastern screech-owl	*Otus asio*
Common nighthawk	*Chordeiles minor*
Trochilidae (hummingbirds)	
Ruby-throated hummingbird	*Archilochus colubris*
Alcedinidae (kingfishers)	
Belted kingfisher	*Ceryle alcyon*
Picidae (woodpeckers)	
Red-bellied woodpecker	*Melanerpes carolinus*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Black-backed woodpecker	*Picoides arcticus*
Pileated woodpecker	*Dryocopus pileatus*
Tyrannidae (flycatchers)	
Olive-sided flycatcher	*Contopus cooperi*
Alder flycatcher	*Empidonax alnorum*
Willow flycatcher	*Empidonax traillii*
Great crested flycatcher	*Myiarchus crinitus*
Eastern kingbird	*Tyrannus tyrannus*

Table 20.–Continued.

Common name	Scientific name
Alaudidae (larks)	
Tree swallow	*Tachycineta bicolor*
Bank swallow	*Riparia riparia*
Barn swallow	*Hirundo rustica*
Cliff swallow	*Petrochelidon pyrrhonota*
Purple martin	*Progne subis*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Paridae (titmice)	
Black-capped chickadee	*Poecile atricapillus*
Tufted titmouse	*Baeolophus bicolor*
Sittidae (nuthatches)	
Red-breasted nuthatch	*Sitta canadensis*
Certhiidae (creepers)	
Brown creeper	*Certhia americana*
Troglodytidae (wrens)	
House wren	*Troglodytes aedon*
Winter wren	*Troglodytes troglodytes*
Carolina wren	*Thryothorus ludovicianus*
Sedge wren	*Cistothorus platensis*
Marsh wren (SC)	*Cistothorus palustris*
Mimidae (mockingbirds/thrashers)	
Gray catbird	*Dumetella carolinensis*
Turdidae (thrushes)	
American robin	*Turdus migratorius*
Wood thrush	*Hylocichla mustelina*
Swainson’s thrush	*Catharus ustulatus*
Veery	*Catharus fuscescens*
Sylviidae (gnatcatchers/kinglets)	
Blue-gray gnatcatcher	*Polioptila caerulea*
Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet	*Regulus calendulas*
Bombycillidae (waxwings)	
Cedar waxwing	*Bombycilla cedrorum*
Vireonidae (vireos)	
Yellow-throated vireo	*Vireo flavifrons*
Philadelphia vireo	*Vireo philadelphicus*
Red-eyed vireo	*Vireo olivaceus*
Parulidae (warblers)	
Northern parula	*Parula americana*
Nashville warbler	*Vermivora ruficapilla*
Yellow warbler	*Dendroica petechia*
Yellow-rumped warbler	*Dendroica coronata*
Cape May warbler	*Dendroica tigrina*
Black-and-white warbler	*Mniotilta varia*
American redstart	*Setophaga ruticilla*

Table 20.–Continued.

Common name	Scientific name
Northern waterthrush	*Seiurus noveboracensis*
Mourning warbler	*Oporornis philadelphia*
Connecticut warbler	*Oporornis agilis*
Common yellowthroat	*Geothlypis trichas*
Fringillidae (Finches, sparrows, buntings)	
Northern cardinal	*Cardinalis cardinalis*
Red crossbill	*Loxia curvirostra*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Savannah sparrow	*Passerculus sandwichensis*
Henslow's sparrow (SC)	*Ammodramus henslowii*
Song sparrow	*Melospiza melodia*
Lincoln's sparrow	*Melospiza lincolnii*
Swamp sparrow	*Melospiza georgiana*
White-throated sparrow	*Zonotrichia albicollis*
Icteridae (blackbirds and orioles)	
Red-winged blackbird	*Agelaius phoeniceus*
Brewer's blackbird	*Euphagus cyanocephalus*
Common grackle	*Quiscalus quiscula*
Northern oriole	*Icterus galbula*
Ploceidae (finches)	
Purple finch	*Carpodacus purpureus*
Pine siskin	*Carduelis pinus*

Table 21.–Mammals in the Cheboygan River watershed (Baker 1983). Threatened (T) and special concern (SC) species are noted.

Common name	Scientific name
Marsupiala (pouched mammals)	
opossum	*Didelphis virginiana*
Insectivora (shrews,moles, and allies)	
eastern mole	*Scalopus aquaticus*
starnose mole	*Condylura cristata*
masked shrew	*Sorex cinereus*
pygmy shrew	*Sorex hoyi*
water shrew	*Sorex palustris*
shorttail shrew	*Blarina brevicauda*
Chiroptera (bats and flying mammals)	
little brown myotis	*Myotis lucifugus*
silver-haired bat	*Lasionycteris noctivagans*
big brown bat	*Eptesicus fuscus*
red bat	*Lasiurus borealis*
hoary bat	*Lasiurus cinereus*
Lagamorpha (rabbits, hares and picas)	
snowshoe hare	*Lepus americanus*
eastern cottontail	*Sylvilagus floridanus*
Rodentia (rodents)	
eastern chipmunk	*Tamias striatus*
woodchuck	*Marmota monax*
thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
eastern gray squirrel	*Sciurus carolinensis*
eastern fox squirrel	*Sciurus niger*
red squirrel	*Tamiasciurus hudsonicus*
northern flying squirrel	*Glaucomys sabrinus*
American beaver	*Castor canadensis*
white-footed mouse	*Peromyscus leucopus*
deer mouse	*Peromyscus maniculatus*
meadow vole	*Microtus pennsylvanicus*
southern red-backed vole	*Clethrionomys gapperi*
woodland vole (SC)	*Microtus pinetorum*
muskrat	*Ondatra zibethicus*
southern bog lemming	*Synaptomys cooperi*
Norway rat	*Rattus norvegicus*
house mouse	*Mus musculus*
meadow jumping mouse	*Zapus hudsonius*
woodland jumping mouse	*Napaeozapus insignis*
porcupine	*Erethizon dorsatum*
Carnivora (flesh eaters)	
coyote	*Canis latrans*
red fox	*Vulpes vulpes*
gray fox	*Urocyon cinereoargenteus*
black bear	*Ursus americanus*
raccoon	*Procyon lotor*

Table 21.–Continued.

Common name	Scientific name
American marten (T)	*Martes americana*
ermine	*Mustela erminea*
long-tailed weasel	*Mustela frenata*
least weasel	*Mustela nivalis*
mink	*Mustela vison*
American badger	*Taxidea taxus*
striped skunk	*Mephitis mephitis*
river otter	*Lutra canadensis*
bobcat	*Lynx rufus*
Artiodactyla (even-toed ungulates)	
eastern elk	*Cervus elaphus*
whitetail deer	*Odocoileus virginianus*

Table 22.–Natural features in the Cheboygan River watershed. Status codes: E = endangered; T = threatened; SC = Special Concern. Blanks occur when none of the status categories apply. Michigan Department of Natural Resources, Natural Features Inventory, unpublished data.

Common name	Scientific name	State status
Vertebrate		
lake sturgeon	*Acipenser fulvescens*	T
Northern goshawk	*Accipiter gentiles*	SC
Grasshopper sparrow	*Ammodramus savannarum*	SC
Red-shouldered hawk	*Buteo lineatus*	T
Black tern	*Chlidonias niger*	SC
lake herring	*Coregonus artedi*	T
Blanding’s turtle	*Emydoidea blandingii*	SC
Common loon	*Gavia immer*	T
wood turtle	*Glyptemys insculpta*	SC
Bald eagle	*Haliaeetus leucocephalus*	T
woodland vole	*Microtus pinetorum*	SC
pugnose shiner	*Notropis anogenus*	SC
Osprey	*Pandion haliaetus*	T
channel darter	*Percina copelandi*	E
King rail	*Rallus elegans*	E
eastern massasauga	*Sistrurus catenatus catenatus*	SC
Invertebrate		
secretive locust	*Appalachia arcana*	SC
spike-lip crater	*Appalachina sayanus*	SC
dusted skipper	*Atrytonopsis hianna*	T
slough grass	*Beckmannia syzigachne*	T
Hungerford’s crawling water beetle	*Brychius hungerfordi*	E
watercress snail	*Fontigens nickliniana*	SC
splendid clubtail	*Gomphus lineatifrons*	SC
Henry’s elfin	*Incisalia henrici*	SC
three-striped oncocnemis	*Oncocnemis piffardi*	SC
three-horned moth	*Pachypolia atricornis*	SC
eastern flat-whorl	*Planogyra asteriscus*	SC
aquatic snail	*Planorbella smithi*	SC
red-legged spittlebug	*Prosapia ignipectus*	SC
grizzled skipper	*Pyrgus Wyandot*	SC
Douglas stenelmis riffle beetle	*Stenelmis douglasensis*	SC
Lake Huron locust	*Trimerotropis huroniana*	T
Vascular Plant		
pale agoseris	*Agoseris glauca*	T
round-leaved orchis	*Amerorchis rotundifolia*	E
lake cress	*Armoracia lacustris*	T
goblin moonwort	*Botrychium mormo*	T
Pumpelly’s brome grass	*Bromus pumpellianus*	T
large water-starwort	*Callitriche heterophylla*	T
fairy-slipper	*Calypso bulbosa*	T

Table 22.–Continued.

Common name	Scientific name	State status
Hill’s thistle	*Cirsium hillii*	SC
Pitcher’s thistle	*Cirsium pitcheri*	T
ram’s head lady’s slipper	*Cypripedium arietinum*	SC
false violet	*Dalibarda repens*	T
English sundew	*Drosera anglica*	SC
early hairstreak	*Erora laeta*	SC
rough fescue	*Festuca scabrella*	T
limestone oak fern	*Gytmnocarpium robertianum*	T
whiskered sunflower	*Helianthus hirsutus*	SC
bayonet rush	*Juncus militaris*	T
Michigan monkey flower	*Mimulus michiganensis*	E
bog bluegrass	*Poa paludigena*	T
Hill’s pondweed	*Potamogeton hillii*	T
sloe plum	*Prunus alleghaniensis*	SC
blunt-lobed woodsia	*Woodsia obtuse*	T
Plant community		
dry-mesic northern forest		
intermittent wetland		
northern fen		
pine barrens		
Other features		
Great blue heron rookery		
lichen	*Menegazzia terebrata*	

Table 23.–Fish stocking, by county, in the Cheboygan River watershed, 1979–2007. Data from Michigan Department of Natural Resources, Fisheries Division records. Includes known private fish stockings and rearing marsh plants.

County Location	Species	Years	Number stocked in period
Charlevoix			
Hoffman Lake	walleye	93–94	2,800
Thumb (Louise) Lake	lake trout	79–80	20,000
	rainbow trout	89, 07	44,068
	splake	81–06	512,870
Cheboygan			
Black Lake	lake sturgeon	82–84, 88	11,512
	walleye	89–93	50,650
Black River	lake sturgeon	01–03, 05–07	16,668
Burt Lake	atlantic salmon	86	38
	lake sturgeon	83–84, 90	13,543
	rainbow trout	87	194,963
	walleye	89–93	88,976
Cheboygan River	brown trout	88	10,000
	chinook salmon	03–07	410,766
	lake trout	01	115,425
	rainbow trout	80–07	488,600
Cornwall Impoundment	tiger musky	79–91 (alt yrs)	4,850
Douglas Lake	northern pike	79–80, 82–86, 88–89, 93–97, 99–04	425,682
Hemlock Lake	brook trout	07	295
	brown trout	82	148
	rainbow trout	92	600
Indian River	muskellunge	89–93, 96–97	69,320
Little Sturgeon River	brook trout	79–81, 83, 85, 88–99, 03–07	26,135
	brown trout	92–99, 03–07	6,363
	rainbow trout	79–83, 85, 89–99, 03–07	41,953
Long Lake	walleye	79–86, 89–93, 97, 98, 00–01, 03, 05	869,655
Mullett Lake	brown trout	89, 91	60,000
	lake sturgeon	83–84, 90, 03, 05–07	18,007
	lake trout	79–87, 96–98	663,900
	rainbow trout	87, 89, 92, 07	76,258
	splake	87–88, 90–95	424,075
	walleye	99–03	413,870
Roberts Lake	hybrid sunfish	86	14,000
Silver Lake	rainbow trout	79–07	158,709
Sturgeon River	lake sturgeon	03, 05–07	4,338
	rainbow trout	79–93	213,757
Twin Lakes 2, 3, 4, 5	splake	82–88, 90–93	69,490
Weber Lake	brook trout	79–81, 83–87	18,140
	brown trout	88–07	50,990

Table 23.–Continued.

County Location	Species	Years	Number stocked in period
Emmet			
Crooked Lake	brown trout	88	127,410
	walleye	79–81, 84–86, 88–91, 94, 96, 98–00, 03–06	603,025
East Branch Maple River	brook trout	83–84	890
Four Lakes	brook trout	94-95	2,250
	rainbow trout	95	250
Maple River	brook trout	79, 86, 07	937
	brown trout	81-83	21,000
Pickerel Lake	walleye	81-85, 89, 94, 96, 98, 00, 04, 06	188,425
Round Lake	walleye	91, 95-96, 98	75,800
Silver Creek Pond	brook trout	81-85	2,250
	rainbow trout	79-85, 88, 90-94	17,300
Montmorency			
Clear Lake	rainbow trout	79-86, 89	59,300
	splake	88, 90-97, 99-07	139,540
Foch Lakes	largemouth bass	79	920
Lake Geneva	bluegill	05, 07	750
	hybrid sunfish	05	325
Town Corner Lake	brown trout	83	102
Wildfowl Lake	bluegill	05, 07	750
	hybrid sunfish	05	325
Otsego			
Big Lake	walleye	88, 91-05 (alt yrs)	98,000
Club Creek	brook trout	91, 98-99, 03-07	3,900
	rainbow trout	90-07	14,545
Ford Lake	brown trout	82, 92	1,275
	rainbow trout	07	590
Lost Lake	brook trout	82, 85	770
North Twin Lake	brown trout	82, 92	600
Pickerel Lake	rainbow trout	79-07	82,022
Pigeon River	brook trout	84	23,300
Section Four Lake	brook trout	82, 85, 07	660
	brown trout	92	300
South Twin lake	brown trout	82, 92	518
Storey Lake	rainbow trout	03, 04	290
West Lost Lake	brook trout	82, 85	750
	rainbow trout	92, 07	570
Presque Isle			
Bear Den Lake	brook trout	05-07	4,590
	rainbow trout	04-07	8,514
Little Tomahawk Lake	brook trout	88	3,500

Table 23.–Continued.

County Location	Species	Years	Number stocked in period
Presque Isle–continued			
Rainy Lake	bluegill	79	700
	fathead minnow	79	17,250
	rainbow trout	80	1,200
	walleye	99	1,400
	yellow perch	79	700
Shoepac Lake	brook trout	81, 84-88	13,694
	brown trout	88-93	20,774
	rainbow trout	79, 81-86	14,150

Table 24.–Trout stream fishing regulations by type (Anonymous 2010). LP = Lower Peninsula; UP = Upper Peninsula.

					Minimum size limit (in)						
Type	Open season	Possession season	Tackle	Daily possession limit	Brook trout	Brown trout	Rainbow trout (steelhead)	Splake	Lake trout	Coho, Chinook, & pink salmon	Atlantic salmon
1	Last Sat in April – Sept 30	Last Sat in April– Sept 30	All	5/3 [a]	8 LP 7 UP	8 LP 7 UP	10	8	24	10	15
2	Last Sat in April – Sept 30	Last Sat in April– Sept 30	All	5/3 [a]	10	12	12	10	24	10	15
3	All year	All year	All	5/3 [a]	15	15	15	15	24	10	15
4	All year	brown trout, brook trout, & Atlantic salmon: Last Sat in April– Sept 30 Other trout species all year	All	5/3 [a]	8	10	10	10	24	10	15

[a] Five fish, with no more than three fish 15 inches or larger, and no more than one Atlantic salmon.
NOTE: It is unlawful to fish for any species or possess fishing devices along a stream closed to fishing.

Table 25.–Trout lake regulations by type.

					Minimum size limit (in)				
Type	Open season	Possession season	Tackle	Daily possession limit	Brook trout	Brown trout, rainbow trout, & splake	Lake trout	Coho, Chinook, & pink salmon	Atlantic salmon
A	Last Sat. in April – Sept. 30	Last Sat. in April – Sept. 30	All except minnows	5/3[a]	10	12	15	10	15
B	All year	All year	All	5/3[a]	10	12	15	10	15
C	All year	All year	All	5/3[a]	8	8	8	10	15
D	Last Sat. in April – Sept. 30	Last Sat. in April – Sept. 30	Artificial lures only[b]	1	15	15	15	10	15
E	All year	All year	All	3[c]	15	15	15	10	15
F	All year	Lake trout May 1 – Labor Day Other trout species all year	All	5/3/2[d]	10	10	10	10	10

[a] Five fish, with no more than three fish 15 inches or larger, and no more than one Atlantic salmon.
[b] On Type D lakes only artificial lures may be used. It is unlawful to use or possess live bait, dead or preserved bait, organic or processed food, or scented material on any of the waters or on shore.
[c] No more than one Atlantic salmon.
[d] Daily harvest limits: five in any combination, no more than three fish of any one species, except Lake trout and Splake. For Lake trout and Splake – two fish.
NOTE: It is unlawful to fish for any species or possess fishing devices along a stream closed to fishing.

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Kevin E. Wehrly, Editor
Alan D. Sutton, Graphics
Ellen S. Grove, Desktop Publishing

Approved by David F. Clapp

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Appendix A

Correspondence related to a jurisdictional review of Golden Lotus Dam by the Federal Energy Regulatory Commission, 2005–06. (Documents were reduced to fit these pages.)

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STATE OF MICHIGAN

JENNIFER M. GRANHOLM
GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LANSING

REBECCA A. HUMPHRIES
DIRECTOR

April 15, 2005

Ms. Magalie Roman Salas, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

RE: GOLDEN LOTUS DAM JURISTICTIONAL REVIEW (FERC Docket # UL05-1)

Dear Ms. Salas:

The Michigan Department of Natural Resources (MDNR) would like a jurisdictional review conducted on Golden Lotus Dam and hydroelectric project, located on the Pigeon River in Cheboygan County, Michigan. MDNR has concerns that the dam owner is generating hydroelectric power at the expense of public trust resources. Specifically, we are concerned that the project is negatively impacting the fish populations and other aquatic resources of the Pigeon River by increasing stream temperatures below the dam and the peaking operational mode of the hydropower unit. A jurisdictional review is necessary to ensure that fish and wildlife resources are not impacted by unauthorized activities.

The following is specific information related to the dam (per Michigan Department of Environmental Quality Dam Safety Database):

Name - Golden Lotus Dam (aka. Lansing Club Dam)
Owner - Golden Lotus, Inc.
9607 Sturgeon Valley Road
Vanderbilt, MI 49795-9742
(989) 983-4107
Dam Position- 1
Hazard - Low
Material - Earthen
Purpose - Electrical Generation
Generation Capacity - 100kw

Height - 13 feet
Impoundment - 45 acres
Storage – 365 acre feet
Fish Passage - No
Latitude – 45.145° N
Longitude – 84.473° W
Town - 32N
Range - 1W
Section – 19 SE 1/4

We appreciate your assistance in this matter. If you have any questions, please contact me at: Michigan Department of Natural Resources, Mio Field Office, 191 S. Mt. Tom Rd., Mio, MI 48647.

Sincerely,

Kyle Kruger
Senior Fisheries Biologist
Habitat Management Unit
FISHERIES DIVISION
989-826-3211 Ext. 7073
krugerk@michigan.gov

cc: Mr. Henry Ecton, FERC Washington
Mr. Chris Freiburger, Fisheries, Lansing
Mr. David Borgeson, Fisheries, Gaylord

STEVENS T. MASON BUILDING • P.O. BOX 30028 • LANSING, MICHIGAN 48909-7528
www.michigan.gov/dnr • (517) 373-2329

STATE OF MICHIGAN
JENNIFER M. GRANHOLM GOVERNOR
DEPARTMENT OF NATURAL RESOURCES
LANSING
REBECCA A. HUMPHRIES DIRECTOR

April 29, 2005

Ms. Magalie R. Salas, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

RE: CORRECTION TO GOLDEN LOTUS DAM JURISTICTION REVIEW REQEUST DATED APRIL 15, 2005 (Docket Number UL05-1), LOCATION INFORMATION REVISION

Dear Ms. Salas,

In my filing regarding the above mentioned request, I indicated the project location was in Cheboygan County, Michigan. The correct county location is Otsego County, Michigan. Please update your files regarding this facility. Thank you. If you have any questions or comments, please feel free to contact me at: Michigan Department of Natural Resources, Mio Field Office, 191 S. Mt. Tom Rd., Mio, MI 48647.

Sincerely,

Kyle Kruger
Senior Fisheries Biologist
Habitat Management Unit
FISHERIES DIVISION
(989) 826-3211 Ext. 7073

cc Henry Ecton, FERC, Washington

STEVENS T. MASON BUILDING ● P.O. BOX 30028 ● LANSING, MICHIGAN 48909-7528
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FEDERAL ENERGY REGULATORY COMMISSION
Washington, D. C. 20426

OFFICE OF ENERGY PROJECTS

Docket No. UL05-1-000
Lansing Club Hydroelectric Project - MI
Golden Lotus, Inc.

Judy Tracy, Chair
Board of Directors
Golden Lotus/ Song of the Morning
9607 Sturgeon Valley Road E.
Vanderbilt, MI 49795

JUN 07 2005

Dear Ms Tracy:

On April 21, 2005, the Federal Energy Regulatory Commission (Commission) received an environmental complaint from the Michigan Department of Natural Resources concerning the operation of the Lansing Club Hydroelectric Project (project). As a result, we are beginning a review of the project to determine whether the project is subject to the Commission's licensing jurisdiction under Part I of the Federal Power Act.

Section 23(b) of the Federal Power Act established the jurisdiction of the Commission over the construction, operation, or maintenance of hydropower projects which:

1. are located on navigable waters of the United States; or

2. occupy public lands or reservations of the United States; or

3. utilize the surplus water or water power from a federal dam; [1] or

4. are located on waters which are non-navigable but over which congress has jurisdiction under its authority to regulate interstate and foreign commerce, and the project would affect interstate or foreign commerce (such as transmission of its power in interstate commerce), and there has been project construction or modifications other than routine maintenance after 1935.

---

[1] Commission jurisdiction under 1, 2, and 3 does not attach if the project is constructed, operated, and maintained in accordance with the terms of a valid federal permit issued prior to June 10, 1920.

A river is navigable under section 3(8) of the Federal Power Act if (1) it is currently being used or is suitable for use, or (2) it has been used or was suitable for use in the past, or (3) it could be made suitable for use in the future by reasonable improvement, to transport persons or property in interstate or foreign commerce. Note that navigability is not destroyed by obstructions or disuse of many years; personal or private use may be sufficient to demonstrate the availability of the river for commercial navigation; and the seasonal floatation of logs is sufficient to determine that a river is navigable.

The Lansing Club Project may fall under one or more of the bases of Commission jurisdiction. Please provide for the record the following information:

- The power generated by the project is used for what purpose?
- Is any excess power sold to the local power company?
- Do you purchase any power from the local power company to supplement the power generated by the project?
- If all of the power generated by the project is used on site, how is this power distributed?
- What do you use instead of the power generated by your project do in the event of a shut-down caused by low water, a frozen reservoir, equipment failure, etc.?

We request that Golden Lotus, Inc. file a response to this letter with the Commission's Secretary within 45 days of the date of this letter. In your response please refer to Docket No. UL05-1-000. The Secretary's address is:

Secretary
Federal Energy Regulatory Commission
Mail Code PJ-12
888 1st Street NE
Washington, D.C. 20426

If we do not receive a timely response from you, the matter will be referred to the Commission's enforcement group in the General Counsel's Office. Please be aware that any party may file a license application for an unlicensed project and, if the license is issued, obtain authority, through the use of eminent domain, to own and operate the project.

We, therefore, urge your cooperation. If you have any questions, please do not hesitate to contact me at (202) 502-8768.

Sincerely,

Henry G. Ecton
Division of Hydropower Administration
and Compliance

Golden Lotus, Inc.

August 17, 2005

FILED
OFFICE OF THE
SECRETARY
2005 AUG 26 A 10:21
FEDERAL ENERGY
REGULATORY COMMISSION

Ms. Magalie Roman Salas, Secretary
Federal Energy Regulatory Commission
Mail Code PJ-12
888 First Street, NE
Washington, DC 20426

Re: *Docket # UL05-1-000*
Golden Lotus, Inc. Hydroelectric Project

Dear Ms. Salas:

We are in receipt of your letter of June 7, 2005 which was addressed to our Board Chair, Judy Tracey. In my capacity as General Manager of Golden Lotus, Inc., she has asked me to respond on her behalf. We understand that you are beginning a jurisdictional review of our hydroelectric project at the request of the Michigan Department of Natural Resources. In that letter you ask us a series of questions which I will respond to shortly.

I would like to preface our answers by describing who we are and what we are doing with a hydroelectric project in the first place. Golden Lotus, Inc. is a Michigan-based, non-profit religious organization that operates a retreat center called *Song of the Morning*. The hydroelectric project was installed in the 1950's to provide renewable energy for the buildings and it would certainly constitute an economic hardship for us to remove it. The impoundment, known as the Lansing Club Pond, was already there and creates a lake that is the jewel at the center of the retreat.

One issue raised by your questions concerns connection of the hydroelectric project with the local power company and hence the electricity grid. In light of this fact and the concern it creates, we wish to advise you that we intend to disconnect our hydroelectric project from the electrical grid. This act will ensure that the buildings serviced by our hydropower will not be able to get power from the grid, and the buildings that will be serviced by the grid (should we choose to have any do that) will not be able to get power from the project; in other words, a closed circuit. The connection with the grid was fairly recent and is only used as a backup. We do also have a diesel generator for emergency backup.

Now to answer the questions:

The power generated by the project is used for what purpose?

We use the power to run our buildings, that is, for lights, office computers, maintenance, kitchen, well, and laundry.

9607 East Sturgeon Valley Road • Vanderbilt, Michigan 49795 • Phone (517) 983-4107

Is any excess power sold to the local power company?

No. We are not set up that way, nor have we ever been.

Do you purchase any power from the local power company to supplement the power generated by the project?

We have occasionally; as stated above, we will be disconnecting the power grid line from our project so that this will not be the case in the future.

If all of the power generated by the project is used on site, how is this power distributed?

The power is distributed from the control room beside the turbine room through 4 switches. One goes to the turbine and generator room, another to the Main House, another to the Domes and Wheelhouse, and the last to the Lodge, Boathouse, trailers and maintenance shed.

What do you use instead of the power generated by your project in the event of a shut-down caused by low water, a frozen reservoir, equipment failure, etc.?

We switch to either the backup diesel generator or to the local power company. As we will be removing the power company option from the generator control room and either not accessing the interstate grid or using it alone for some of the buildings, the backup diesel generator will provide all emergency power.

A couple of further points should be made. I notice that the MDNR complaint says that the project has a 100 kw capacity. This is incorrect. In fact, it is a 50 kilowatt project with actual output below 40 kw. As specified in the complaint it is a low hazard earthen dam that is regularly inspected for the Michigan Dept. of Environmental Quality, Dam Safety.

Should any further clarification be needed, please do not hesitate to contact me.

Sincerely yours,

Ian Wylie

Ian Wylie
General Manager
Golden Lotus Inc.
(989) 983-4107

UNITED STATES OF AMERICA 114 FERC ¶62,083
FEDERAL ENERGY REGULATORY COMMISSION

Golden Lotus, Inc. Docket No. UL05-1-000

ORDER FINDING LICENSING OF HYDROELECTRIC PROJECT
NOT REQUIRED

(Issued January 31, 2006)

1. On April 21, 2005, the Federal Energy Regulatory Commission (Commission) received an environmental complaint from the Michigan Department of Natural Resources concerning the operation of the Lansing Club Hydroelectric Project (project), located on the Pigeon River near the town of Vanderbilt in Otsego County, Michigan. A review of the project was undertaken to determine whether the project is subject to the Commission's licensing jurisdiction under Part 1 of the Federal Power Act. We have determined that the Lansing Club Hydroelectric Project is not subject to the Commission's licensing jurisdiction.

2. Pursuant to Section 23(b)(1) of the Federal Power Act (FPA), §817(1), a non-federal hydroelectric project must (unless it has a still-valid pre-1920 federal permit) be licensed if it:

* is located on a navigable water of the United States;
* Occupies lands of the United States;
* utilizes surplus water or waterpower from a government dam; or
* is located on a body of water over which Congress has Commerce Clause jurisdiction, project construction has occurred on or after August 26, 1935, and the project affects the interests of interstate or foreign commerce.

3. The Lansing Club Hydroelectric Project, a run-of-river project owned and operated by Golden Lotus, Inc., consists of: (1) a 45-acre reservoir; (2) a 13-foot-high, 255-foot-long earthen dam; (3) a powerhouse containing one generating unit with an installed capacity of 74 kW; and (4) appurtenant facilities. The project is not connected to an interstate grid, and will not occupy any tribal or federal lands.

4. No evidence has been found to document past or present usage of the Pigeon River for navigation in interstate commerce from above and past the project site. The project does not occupy any public lands or reservations of the United States and does not use surplus water or waterpower from a federal government dam. Although the project was constructed after 1935 and is located on a Commerce

Clause water, the project is not connected to an interstate grid. Consequently, Section 23(b)(1) does not require licensing of the Lansing Club Hydroelectric Project.

The Director orders:

(A) Section 23(b)(1) of the Federal Power Act does not require licensing of the Lansing Club Hydroelectric Project. This order is issued without prejudice to any future determination, upon new or additional evidence, that licensing is required.

(B) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. § 385.713.

William Y. Guey-Lee
Chief, Engineering and Jurisdiction Branch
Division of Hydropower
Administration and Compliance

UNITED STATES OF AMERICA 114 FERC ¶62,083
FEDERAL ENERGY REGULATORY COMMISSION

Golden Lotus, Inc. Docket No. UL05-1-000

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4. No evidence has been found to document past or present usage of the Pigeon River for navigation in interstate commerce from above and past the project site. The project does not occupy any public lands or reservations of the United States and does not use surplus water or waterpower from a federal government dam. Although the project was constructed after 1935 and is located on a Commerce

Appendix. These changes in flow are responsible for reducing the abundance and diversity of aquatic organisms downstream of the project. The adverse effects of peaking operations are well documented in the literature. Data from nearby streams of similar physical characteristics (temperature, flow, etc.) and upstream of the impoundment not affected by the peaking flows verify the degradation of the Pigeon River and its aquatic resources downstream of the Lansing Club Project.

In Section 4 of the Order, the commission indicated:

> No evidence has been found to document past or present usage of the Pigeon River for navigation in interstate commerce from above and past the project site.

The Department provided the Commission staff with reference to a Michigan Supreme Court case determining that the Pigeon River was deemed navigable based on floating logs to a distance of 40 miles upstream of Mullet Lake which is above the location of the Lansing Club Project (Nelson v Cheboygan Slack-Water Nav. Co., 44 Mich 7; 5 NW 998 [1880]). This determination was based on evidence presented in the case or known to the court when the case was heard. The Department has included a summary of that case (Appendix 2). The Department has also included an excerpt from a historical work on log marks in northeastern Michigan that covers the region including the Pigeon River and indicating that logs were floated on the Pigeon River and that these forest products from the Cheboygan River system were exported to locations outside of the state of Michigan (Appendix 3). The Department also provided Commission staff copies of deeds (circa 1910) for the location of the Lansing Club Project which includes specific reference to use of the property for a dam to float timber (Appendix 4). To provide additional support to the Department's position that the Pigeon River is a navigable stream from a point upstream of the Lansing Club Project, we have attached portions of the US Army Corps of Engineers (ACE), Detroit District publication *A Report of the Findings of Navigability, Cheboygan River and Inland Waterway Basin, Michigan* that includes the following information:

> The Pigeon River, as with most tributaries to this system, flows through lands once covered with marketable pine and cedar. An 1871 Army Corps of Engineers report stated that, "logs are now run for an extent of 45 miles in the Pigeon River"

And

> The Pigeon River is cited as having logs run in it for 45 miles. While the method of measure is uncertain, it can be assumed that this extends log driving to the source.

It is clear from this document that the ACE holds the opinion that logs were floated throughout the Pigeon River, from the headwaters to Mullet Lake. The source and the mouth are points both above and below the location of the Lansing Club Project. The pertinent sections of the above mentioned ACE report are included in Appendix 5. In addition to the court case and historical documents, saw logs persist in the stream bed upstream and downstream of the project. And, finally, on this point, the FPA gives the following definition:

> (8) "navigable waters" means those parts of streams or other bodies of water over which Congress has jurisdiction under its authority to regulate commerce with foreign nations and among the several States, and which either in their natural or improved condition notwithstanding interruptions between the navigable parts of such streams or waters by falls, shallows, or rapids compelling land carriage, are used or **suitable for use** [emphasis added] for the transportation of persons or property in interstate or foreign commerce, including therein all such interrupting falls, shallows, or rapids, together with such other parts of streams as shall have been authorized by Congress for improvement by the United States or shall have been recommended to Congress for such improvement after investigation under its authority;

Clearly, the burden of proof suggested by the Order is not reflected in FPA. The definition only requires that a waterbody be “suitable for use”, not “proven to have been used” for interstate commerce. The Department believes it has provided ample evidence of use, notwithstanding the characteristics of the Pigeon River are clearly “suitable for use” in interstate commerce given the history of lumbering in the state of Michigan. If the Commission requires proof that a river was (is being) used for interstate commerce in order to enforce regulations under the FPA, then the Commission should lobby Congress to amend the FPA to reflect that requirement.

The Order also indicates that the Lansing Club Project is not connected to the interstate grid. While at the time the order was issued that may be true, when the Department requested jurisdictional review, the Lansing Club Project was in fact connected to the interstate grid (through Great Lakes Energy, a Michigan based utility) and Commission staff at the Chicago Regional Office were provided that evidence in late May 2005, which was confirmed back to the Department on May 24, 2005. This information regarding hooking up to and unhooking from the interstate grid provided to the Commission is additional proof that the Lansing Club Project has affected interstate commerce.

The Department is very concerned that the Commission allowed the owners of the Lansing Club Project time to disconnect from the grid with the sole purpose to avoid jurisdiction after operating illegally for some unknown period of time prior to the Department’s request. Therefore, the Department requests that the Commission utilize the information regarding the Lansing Club Project at the time the Department requested jurisdictional review, and not after the Commission allowed the Lansing Club Project to unhook from the interstate grid. At the time of the Department’s request, the Lansing Club Project did in fact meet all of the requirements of the FPA to find that the project requires licensing by the Commission.

Given the information presented above, the Department respectfully requests upon rehearing that the Commission:

1. Rescind the delegated Order finding licensing of hydroelectric project not required issued January 31, 2006, and

2. Find the Lansing Club Project does require a license through the Commission to operate the project on the Pigeon River in northern Michigan and direct the owners of the Lansing Club Project to begin the licensing process.

Sincerely yours,

/S/

Pamela J. Stevenson
Assistant Attorney General
Environment, Natural Resources
and Agriculture Division
517-373-7540

PJS/jls
S:CASES/FERC/Lansing Club (Golden Lotus)/01 Ltr-Rqst for Rehrg

CERTIFICATE OF SERVICE

I hereby certify that on February 28, 2006, I served the foregoing document and attachments upon the parties identified on the official service list in this matter.

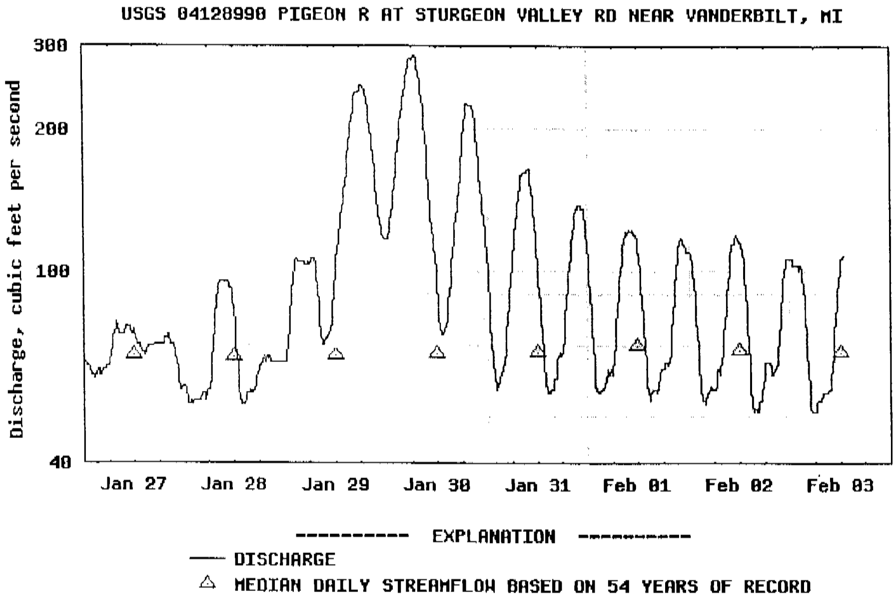
/s/
JoLynn Satterelli

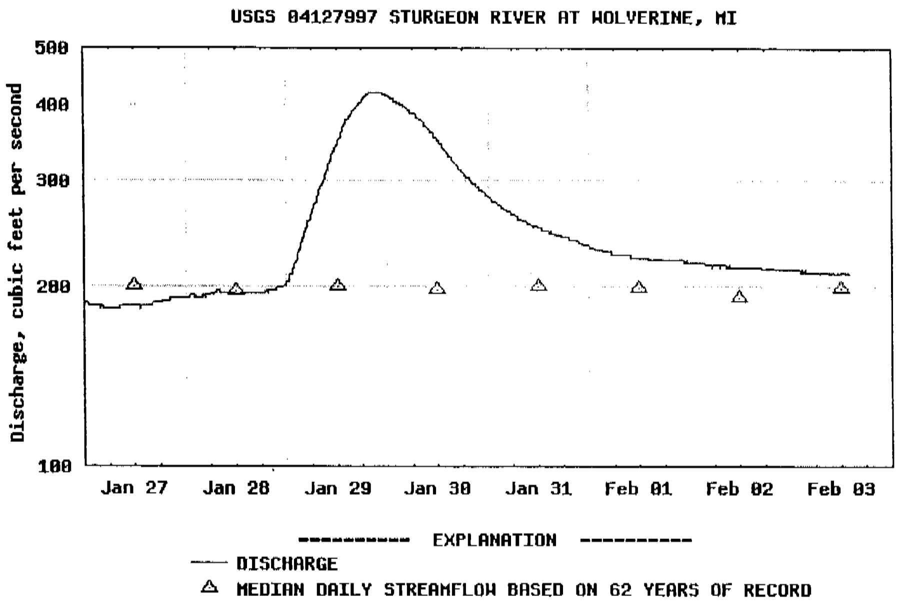
Appendix 1

ESTIMATED INCREASES AND DECREASE S IN PAIRED FLOWS FOR SELECTED PERIODS FOR THE PIGEON AND STURGEON RIVERS VIA USGS DATA

WEEK	DATE	COMMENTS
1/27-2/3/06	1/29-31	Sturgeon: about 2X Qr increase in ≤ 24 hrs. Pigeon: about 4X Qr increase in ≤ 24 hr; 75% decreases in Qr in ≤ 6hs. Peaking.
11/14-21/05	All week	Sturgeon: Weeks biggest Qr change is about 1.3X. 2 small Qr increases during week. Pigeon: Qr changes ≤ 4.8X in ≤ 6 hrs; 13 large Qr increases. Peaking .
11/3-10/05	11/5-7	Sturgeon: A big flow surge, about 2.2X increase Pigeon: 11/6-about 5.3X increase in Qr in < 24 hrs; 11/8-Qr cut ≥ 75% in 6 hrs; Peaking
10/21-10/29/05	10/25	Sturgeon: Stable Qr, only 5% changes in Qr Pigeon: 3.3X Qr increase in 6 hrs; Peaking
9/30-10/7/05	9/30, 10/3	Sturgeon: 9/30- Qr drop of 4% in 6 hr; 10/3- 1.6X increase in Qr in 12 hrs Pigeon: 9/30- Qr drop of 75% in 6 hr; 10/3- 3.8X increase in Qr in 12 hrs. Peaking
9/26-10/3/05	9/26, 9/28-29	Sturgeon: 9/26- 9% Qr drop in 6 hrs; 9/28- 1.4X increase in Qr in 24 hrs. Pigeon: 9/26-75% Qr drop in 6 hrs; 9/28- 4.2X increase in Qr in 24 hrs. Peaking
8/19-26/05	8/21-22	Sturgeon: 32% Qr drop in < 18 hrs Pigeon: 91% Qr drop in < 18 hrs. Peaking
8/3-8/10/05	8/4-5	Sturgeon: A big Qr increase, 2.9X in just over a day; 3% Qr drop in 12 hrs. Pigeon: 11X Qr increase in just over a day; 90% Qr drop in 12 hrs. Peaking
7/26-8/2/05	7/26	Sturgeon: 1.7X Qr increase in a day; 17% Qr drop in 9 hrs. Pigeon: 5.6X Qr increase in just 18 hrs; 83% Qr drop in 9 hrs. Peaking
6/15-22/05	6/15-16	Sturgeon: A big Qr increase, 2.9X in 12 hrs. 20% Qr drop in 7 hrs Pigeon: 6.7X increase in Qr in 18 hrs; 77% Qr drop in 7 hrs. Peaking
5/24-5/31/05	5/24	Sturgeon: 4% Qr drop in 6 hrs. One peak in week Pigeon: 72% Qr drop in 6 hrs. 10 peaks in week. Peaking.
5/19-26/05	5/23	Sturgeon: 1.4X increase on 5/23; one peak. Dry weeks before rain event. Pigeon: 5.4X increase on 5/23; 5 peaks. Peaking
4/14-21/05	4/20-21	Sturgeon: 1.7X increase over the day; 24% Qr drop in 12 hrs. Stable until 1peak. Pigeon: 5.8X increase over the day; 80% Qr drop in 12 hrs. 8 peaks. Peaking.
4/6-13/05	All week	Sturgeon: No peaks, steady decline over the week. Pigeon: 2X-3.5X variation (up & down) all week over 6 hr periods. 11 peaks. Peaking.
3/30-4/6/05	All week	Sturgeon: 1.7X Qr increase over 3/30-31. 2 peaks. Steady decline in Qr. Pigeon: 3.6x Qr increase over 3/30-31. 4/1-4.6X increase < 12 hrs. 4/2- 78% decrease in < 12 hrs. 10 peaks. Peaking.

Sturgeon River USGS gage – 04127997
Pigeon River USGS gage- 04128990


USGS 04128990 PIGEON R AT STURGEON VALLEY RD NEAR VANDERBILT, MI
Discharge, cubic feet per second
300
200
100
40
Jan 27
Jan 28
Jan 29
Jan 30
Jan 31
Feb 01
Feb 02
Feb 03
---------- EXPLANATION ----------
DISCHARGE
MEDIAN DAILY STREAMFLOW BASED ON 54 YEARS OF RECORD


USGS 04127997 STURGEON RIVER AT WOLVERINE, MI
Discharge, cubic feet per second
500
400
300
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Jan 27
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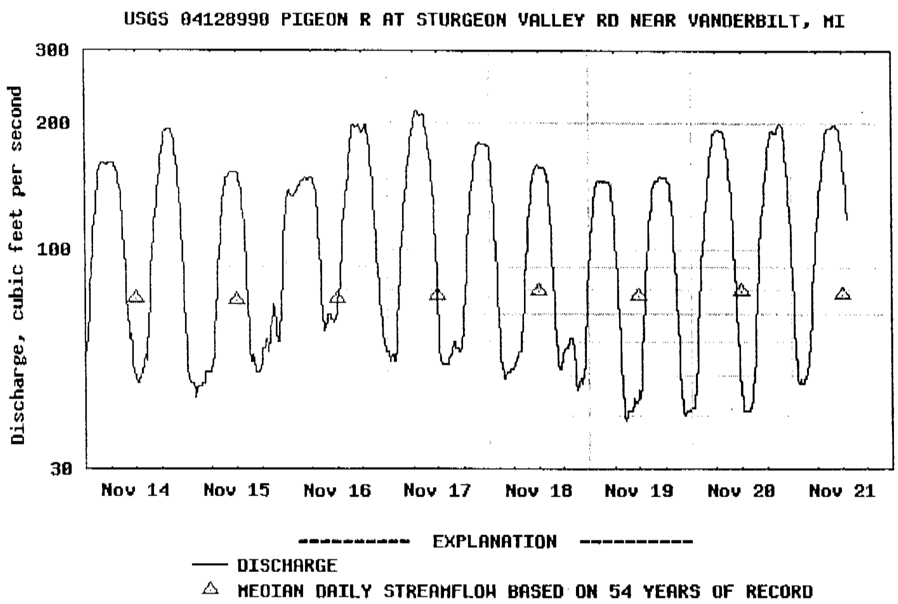
---------- EXPLANATION ----------
DISCHARGE
MEDIAN DAILY STREAMFLOW BASED ON 62 YEARS OF RECORD


USGS 04128990 PIGEON R AT STURGEON VALLEY RD NEAR VANDERBILT, MI
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DISCHARGE
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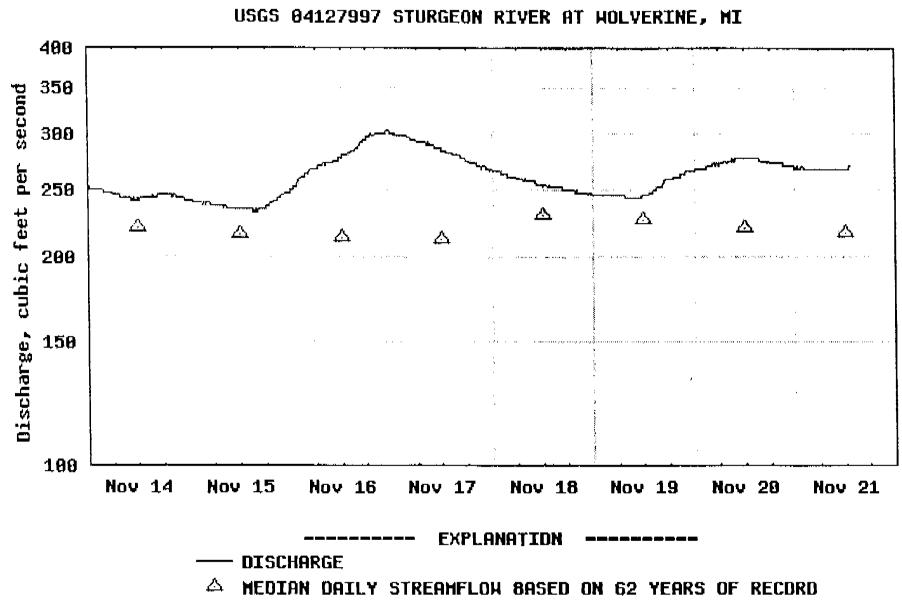
USGS 04127997 STURGEON RIVER AT WOLVERINE, MI
400
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Discharge, cubic feet per second
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USGS

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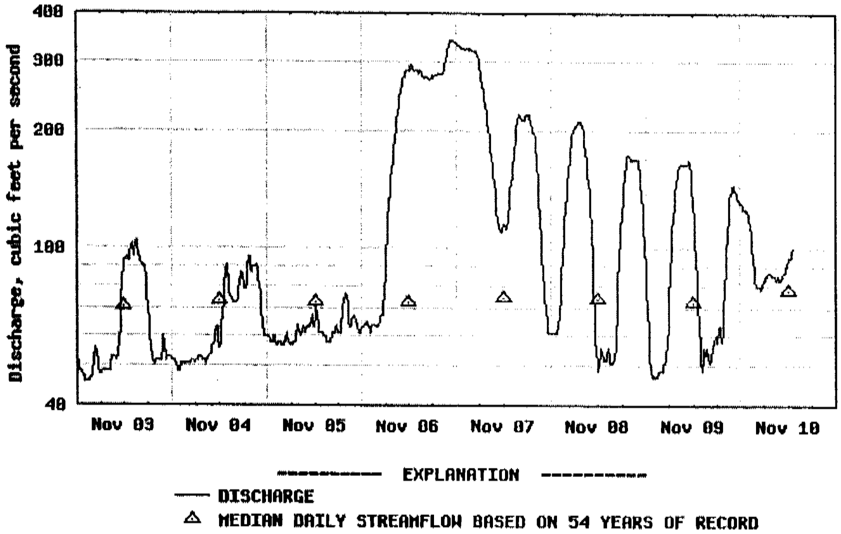
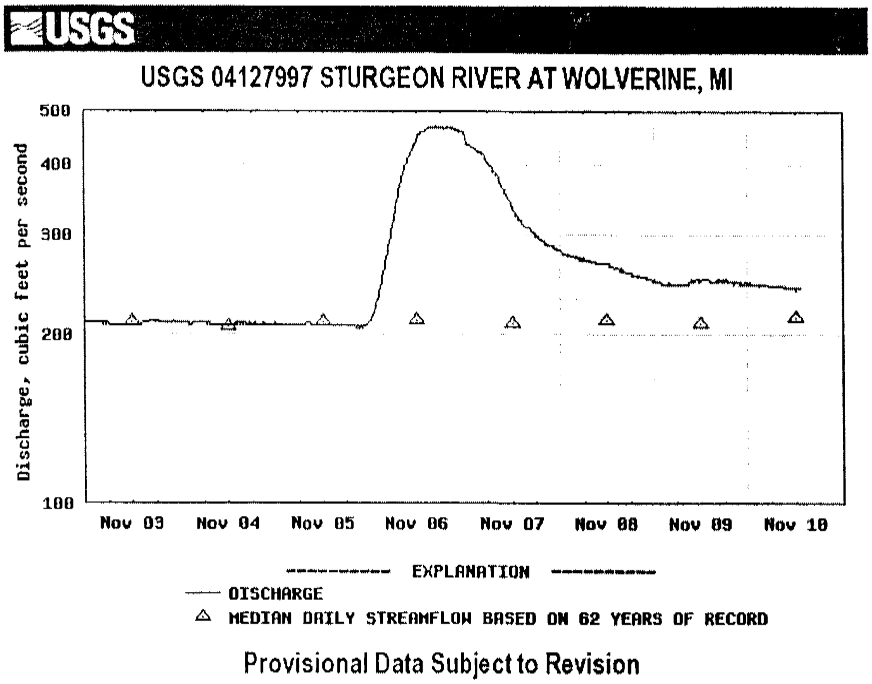


Provisional Data Subject to Revision



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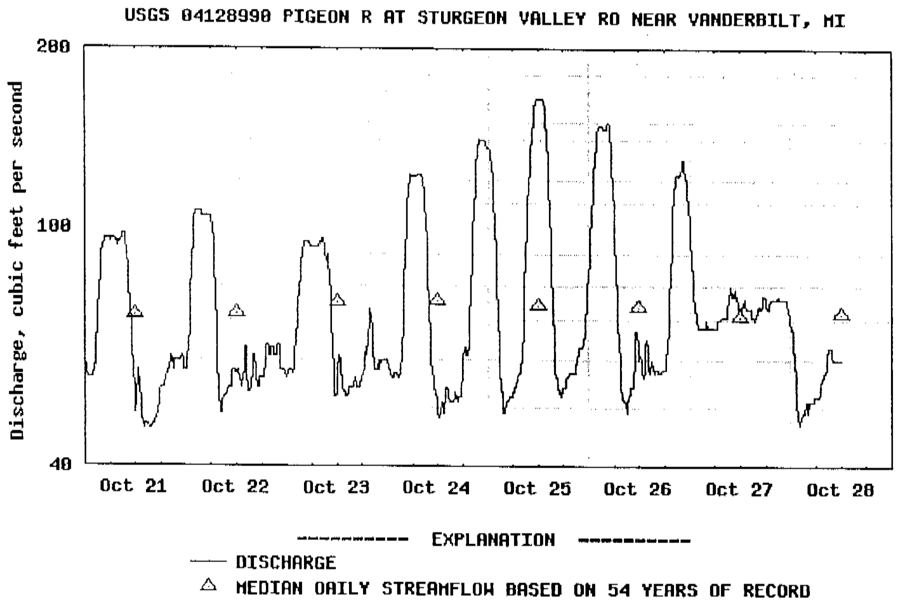
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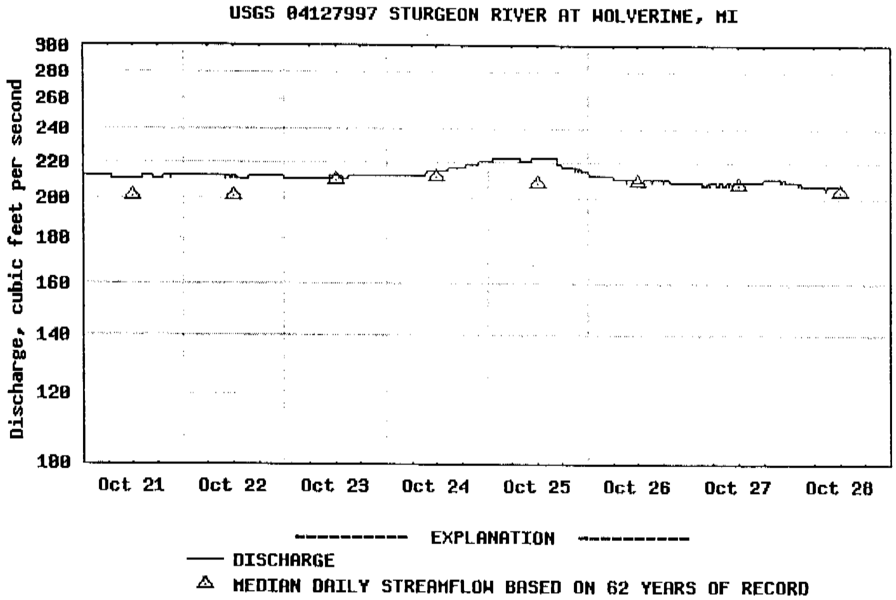
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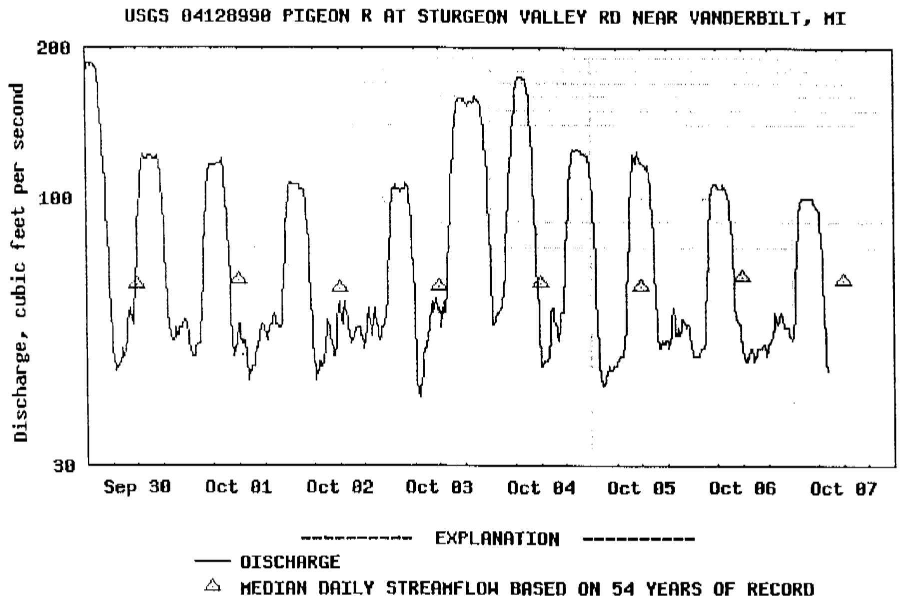
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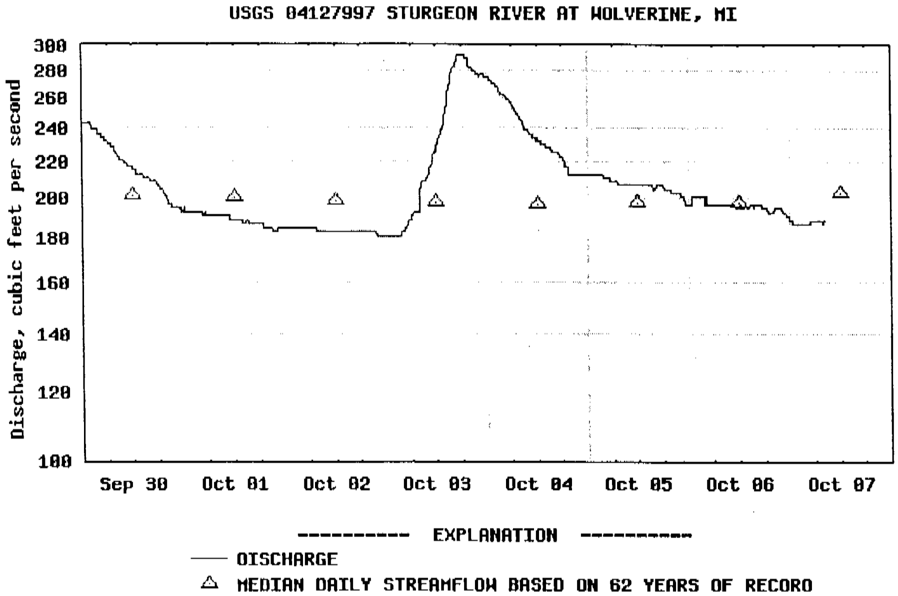
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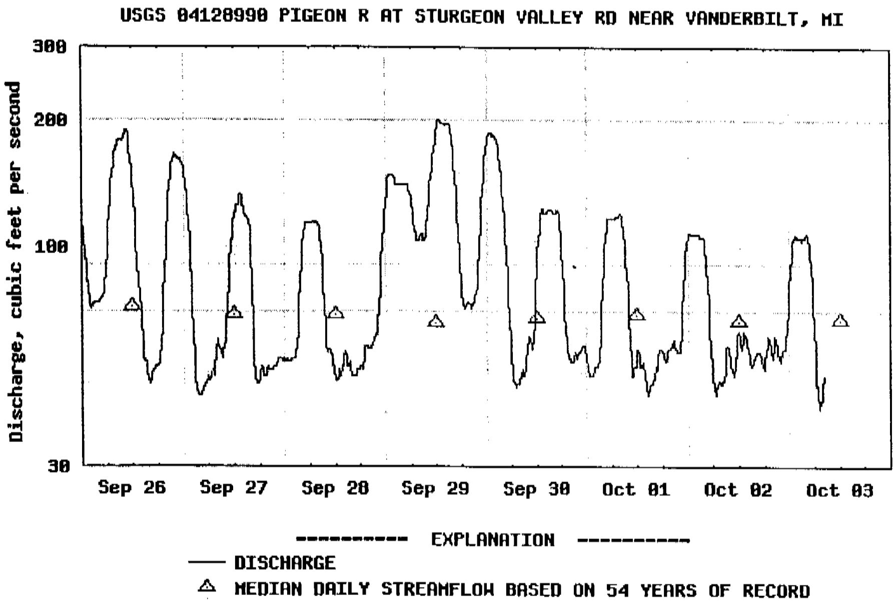
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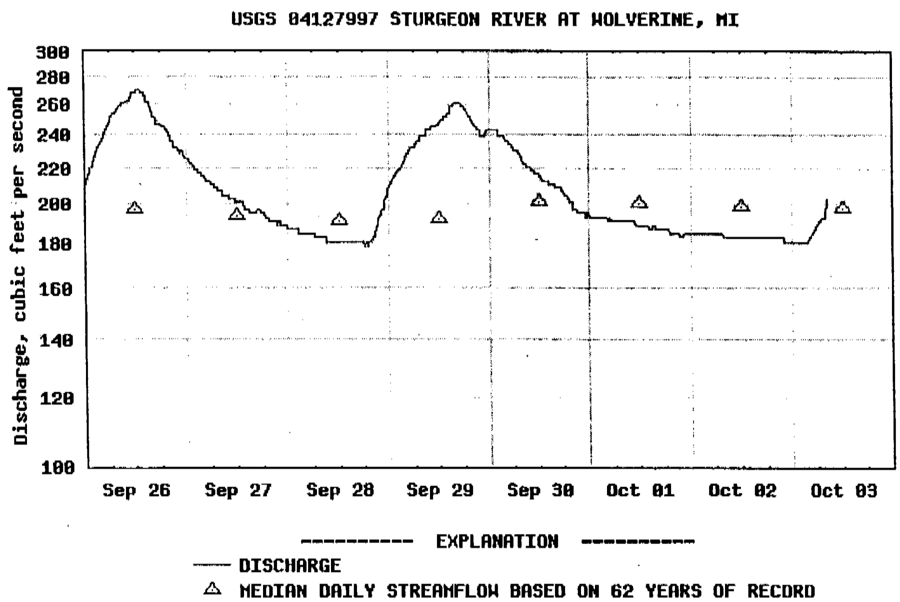
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DISCHARGE
MEDIAN DAILY STREAMFLOW BASED ON 62 YEARS OF RECORD

Appendix 2

LEXSEE

Ephraim Nelson et al. v. The Cheboygan Slack-water Navigation Company.

[NO NUMBER IN ORIGINAL]

SUPREME COURT OF MICHIGAN

44 Mich. 7; 5 N.W. 998; 1880 Mich. LEXIS 463

April 28, 1880, Submitted
June 11, 1880, Decided

PRIOR HISTORY: [***1] Error to Cheboygan. Submitted April 28. Decided June 11.

HEADNOTES: *Improvement of navigable streams — Tolls.*

It is not competent for the State to give the control of one of its navigable streams to private parties for improvement, with power to charge toll at discretion. *Semble.*

But it is competent to authorize such parties to charge toll, at rates fixed by the legislature, for the use of improvements made by them. And the provision in the Ordinance of 1787 that the navigable waters of the Northwest Territory shall be "forever free" does not interfere with this, as the meaning of that provision is that the use of the waters in their natural condition shall be free. *Benjamin v. Manistee etc. Co. 42 Mich. 628.*

Tolls for the use of the improvement of a navigable stream may be charged, notwithstanding the stream was capable of such use in its natural condition, provided the improvement facilitated it.

The question whether a navigable stream has been dammed without permission of the board of supervisors will not be considered on error, when the record does not show it was raised in the court below.

SYLLABUS: Trespass on the case. Plaintiffs [***2] bring error. Affirmed.

COUNSEL: Watts S. Humphrey and Atkinson & Atkinson, for plaintiffs in error.

G. W. Bell and C. I. Walker for defendants in error.

JUDGES: Cooley, J. The other Justices concurred.

DISPOSITION: Judgment affirmed with costs.

OPINIONBY: Cooley

OPINION:

[*8] [998]** This is a suit to recover of the defendant a considerable sum of money which the plaintiffs have paid under protest, as tolls for passing through a canal around a **[**999]** dam constructed by defendant across the Cheboygan river about a mile above its mouth where, before the construction of any dam, there were rapids. To an understanding of the legal questions it is necessary to have some knowledge of the water courses which find an outlet by way of this river.

The stream named the Cheboygan is eight miles long, passing from Mullett lake to Mackinaw straits. Mullett lake is twelve miles long by three or four wide, and is connected with Burt lake of like size by Indian river, a stream five miles long. Crooked river, five miles long, connects Crooked lake, six miles long and a mile wide, with Burt lake. Round lake, about a mile in diameter, is near Crooked lake and connected with it. About five miles above the mouth of the Cheboygan river, Black river comes into it. This **[***3]** is a stream sixty miles long, and passes through Black lake, which is ten miles long and three wide. Rainy river, thirty miles long, empties into Black lake. Pigeon river, forty miles long, empties into Mullett lake. Sturgeon river, seventy miles long, empties into Indian river. Maple river, thirty miles long, empties into Burt lake. Two small steamers, capable of carrying a hundred passengers each, navigate the waters from the head of Crooked lake to the straits of Mackinaw. All the waters mentioned are made use of for floating logs and lumber on their way to the place of manufacture or to market, and vessels drawing five feet of water run up to the head of Mullett lake, and those drawing two and a half feet to the head of Crooked lake. Freight boats and lighters are also used on Black river.

In the year 1847 a dam was built by one McLeod across the Cheboygan river where that of the defendant now stands. It was not so high as defendant's dam now is, but high enough to raise the water so that such craft as the plaintiffs now make use of on the river could navigate it to Mullett's lake. [*9] The case does not show how or why McLeod came to build this dam, nor how the defendant [***4] comes to be now in possession of its site with a higher dam. In 1867 an act of the Legislature was passed to provide for the incorporation of slackwater navigation companies for the improvement of rivers in the counties of St. Joseph, Cass, Berrien and Cheboygan, and in the following year defendant was organized and constructed the dam complained of. By the act of incorporation any company that should be formed was authorized to take possession of any navigable river proposed to be improved, and to improve the same by the erection of dams [**1000] and the construction of locks, and it was provided that "said river, when so improved, and the lock constructed by such company, shall be deemed and taken to be public highways, and free to all persons whatever, to pass and repass with their boats and other water craft, and with their produce, goods and chattels, wares and merchandise, such persons conforming to such rules and regulations as may be established by the company for the navigation of such river, and paying such tolls as may be established and required for the same by such company:" 2 Laws of 1867, p. 840. As the act did not in any way limit the tolls that might be charged by the companies [***5] formed under it, or confer upon any public officer or authority the right to limit them, or to supervise the action of the companies in any manner, it was in effect an act to transfer to voluntary organizations the control of navigable streams, with power to levy burdens upon commerce at discretion, and was probably inoperative under the principles laid down in *Ames v. Port Huron etc. Co. 11 Mich. 139.* But in 1871 this power was restricted, and a schedule of tolls which might be charged was fixed by legislation: General Laws 1871, p. 176. The constitutional validity of these acts was contested, but the lawful existence of defendant as a corporation was affirmed in *Nelson v. Cheboygan etc. Co. 38 Mich. 204.*

To prove a personal grievance the plaintiffs gave evidence tending to show that they owned a mill above the dam, and used in their business a tug and several lighters; that in 1876 the tug made a hundred and sixteen trips each way, and the [*10] lighters two hundred and six trips up and two hundred and four trips down; that in 1877 the lighters made forty-eight trips up and forty-nine trips down; that in going up they were light and drew ten to twelve inches of water; [***6] that in going down they were loaded and drew from three to three and a half feet of water; that plaintiffs sent over the waters of the Cheboygan in 1876, 7,596,000 feet of lumber and a considerable quantity of wood, bark and shingles, 1,151,000 feet of the lumber being shipped on the lighters and the remainder on rafts to the mouth of the river; that the dam, so far as vessel navigation and rafts were concerned, completely obstructed the stream, and to get around it with their tugs, lighters and merchandise, plaintiffs were compelled to use defendant's canal, for which defendant compelled them to pay tolls, amounting in all to $ 2767.70; that in the natural stage of water in the Cheboygan river without any dam the lighters used by the plaintiffs could have passed in the [**1001] condition they were in on their up trips--that is, unloaded--and that rafts of lumber could have been run down. This constituted the case for the plaintiffs.

It was decided in *Benjamin v. Manistee River etc. Co. 42 Mich. 628,* that the State might lawfully authorize corporations to make improvements of navigable rivers and to charge tolls for the use of the same, notwithstanding the compact in the Ordinance of 1787 [***7] that the navigable waters of the Northwest Territory should be forever free. The tolls, it was said in that case, are not charged for the use of the navigable river thus made free, but are imposed in respect of the improvements, and to obtain the benefit thereof, and the compact itself might have been a curse to the Territory instead of the blessing it was meant for, had it required the water highways of the Territory to remain unimproved in order that they might be used in their natural condition without toll or impost. That case governs this, to the extent at least of determining the general question of the right to take tolls.

But it is insisted on the part of the plaintiffs that the right to the free navigation of public streams must still exist, notwithstanding the improvements, as to whatever property or [*11] vehicle of commerce might previously have navigated them. Also that defendant can have no right to stop at its dam and require tolls for the passage through its canal of that which before the dam was built would have floated in the river at that point, thereby making the improvement a burden on such navigation as did not need it. The true construction of the act under [***8] which defendant is organized is claimed to be, to give the company a right to charge tolls to those who need and use its improvements, and it is only permitted to obstruct such navigation as the stream in its natural condition is capable of, on condition that it provides locks for getting around its obstructions, and makes them free.

We do not think the broad question which the plaintiffs attempt to raise is in the case. There was no attempt in the court below to show that the commerce carried on by the plaintiffs was not facilitated by the improvement, or that any portion of it was burdened with tolls for the use of that which did not benefit it. It was shown, negatively at least, that the tug and lighters required the facilities of the canal in passing down, and though it was proved the lighters could have passed up unloaded before the dam was constructed, it did not appear that their going up, when they could not also go down, would be of advantage [**1002] to the interest of any one. The rafts, it was shown, could have passed down before, but whether as conveniently and safely did not appear. It is consistent with everything appearing in the record that every use made by the plaintiffs [***9] of the river was facilitated by the construction of the dam and canal. If they were so, the exaction of tolls for the use of the canal was as proper and just as it would have been if the dam had first made the use of the waters practicable. The tolls are charged in respect to the enjoyment of benefits conferred by the expenditures of defendant; and whether these benefits originate with the improvement the defendant has made, or are only enhanced by it, is immaterial to the justice or legality of the impost.

It is further contended that defendant is the successor and assign of McLeod in respect to this dam, and is charged with all his duties; and that there was legislation under which [*12] McLeod built which required him to construct a lock for the passage without charge of whatever navigated the river. The deduction is that defendant must maintain such a free passage now. But in the first place no such legislation appears to have been brought to notice in the court below, and in the second place it is not shown that defendant is the assign of McLeod. The supposition that McLeod may have abandoned his dam as useless, is consistent with anything that appears in the evidence; and [***10] in that case the appropriation of it by any one else who should find it a convenience in improving the river would have been perfectly proper, provided the authority of the appropriator from the State was such as would justify the erection as a new one. Certainly so long as defendant does not claim under McLeod, or need any grant McLeod may have had to justify damming the river, his obligations cannot be said presumptively to have been assumed by it.

But it is said that defendant must claim under McLeod, who built his dam before the present Constitution was adopted, because since that time no dam can be constructed across a navigable stream except with the consent of the board of supervisors of the county, which defendant has never obtained. The conclusive reply to this suggestion is that no question of the consent of the board of supervisors appears to have been made in the court below, and we neither know what the fact was, nor could we act upon it if we did. We sit here to review only the rulings of the circuit judge. [**1003] The circuit judge gave instructions to the jury corresponding to the views above expressed, and verdict and judgment were rendered for defendant.

This judgment [***11] must be affirmed with costs.

The other Justices concurred.

Appendix 3

Michigan Log Marks: their function and use during the great Michigan pine harvest / compiled by the Works Project Administration

Michigan State College. 1941. Michigan Log Marks bulletin 4, East Lansing, Michigan

log mark, recognized by law and respected by fight-loving men, was the symbol that created order in the rampaging, Herculean task that was river driving.

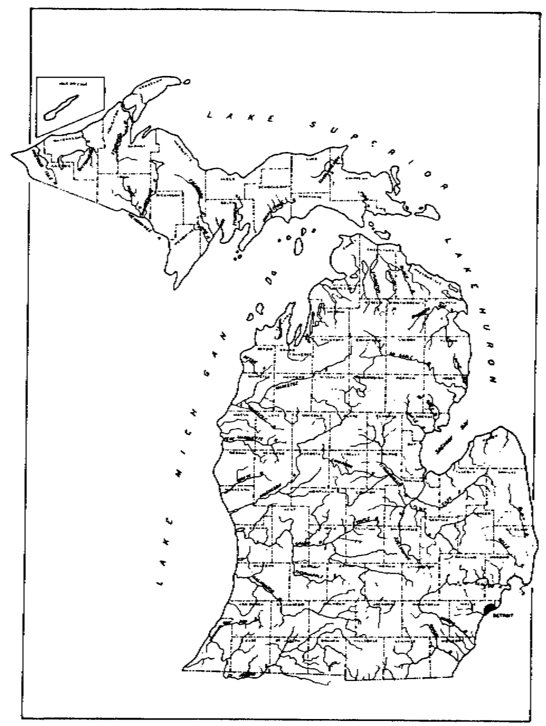
The tradition behind log marks is old. In early Colonial times, Queen Anne's Surveyor General marked with a "Broad Arrow" and attempted to reserve for the Royal Navy the finest pines of New England. Lumbermen, aggressive and acquisitive then as ever since, disregarded royal attempts to appropriate American property. Efforts to enforce the Broad Arrow policy, though unsuccessful, aroused such resentment that the incidents formed part of the background for the American Revolution. Lumbermen, however, continued the policy of identifying ownership of logs by hacking or stamping symbols upon them, and much later, when Michigan's waterways began to writhe with their burdens of logs, the English tradition was still strong. Michigan's first log mark law was patterned closely after that of the English, and log marks numbering thousands, widely varied as to design, were colorfully interwoven in the patterns of the pine harvest.

For many years, including the earliest logging era in Michigan, log marks were cut into the bark by ax, and, of necessity, such hacks, or bark marks, were limited in design to patterns of straight lines, simple initials, triangles, squares, and combinations of these.

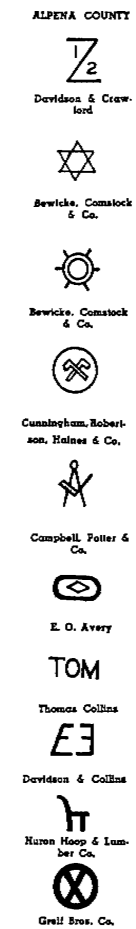
Logging on a rapidly increasing scale began about 1840 to create in the state complex problems of operation that demanded solution. On the Muskegon River, although only the lower reaches were at first used to float logs, many operators made common use of the stream to get their logs to mill. Serious questions often arose concerning the similarity of bark marks. By 1842, the Michigan Legislature answered the need and enacted a law requiring log marks to be registered in the county where the logs were to be manufactured into lumber. The statute followed the plan of an English law of 1692 intended for the protection of New England lumbermen.

Before 1850, lumbermen of the Muskegon Valley found a solution for another angle of the problem, which eliminated

much of the confusion and high cost of duplicated efforts in river driving. An arrangement was effected whereby a mutual drive was made, the force of rivermen being assembled from the crews of all participating operators. However, the task of sorting logs for the growing number of mills, once the river's end was reached, was still unorganized and continued



Location of rivers and counties mentioned in this bulletin.



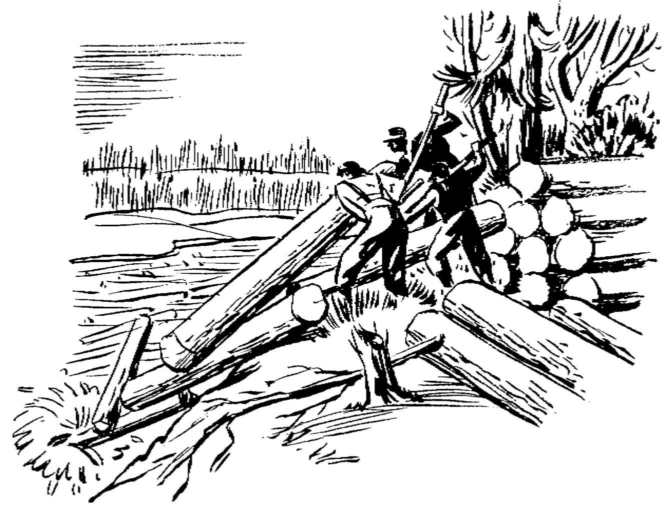
business, necessitating transfer of rights in log marks from original owners to salvagers.

When the flow of logs had subsided, owners of agricultural lands along Saginaw region waterways found accumulations of logs on their property. If log owners were unknown or refused to remove the logs, land owners were authorized to appeal to the county for a sheriff's sale. After a statement of fact, showing that the logs had been abandoned for two years, the sheriff at a prescribed time offered the logs to the highest bidder, and in all cases of record the land owner was the successful bidder. After deducting fees, the remainder of the proceeds of sale, which was usually $25 to $35, was returned to the buyer. A necessary legal procedure, since the logs carried log marks, this routine method gave to the land owner sawlogs for the mere cost of keeping the record straight.

LUMBER CUT IN THE SAGINAW VALLEY AREA DURING THE EXISTENCE OF THE CHARLES MERRILL & COMPANY BOOM AND THE TITTABAWASSEE BOOM COMPANY, 1856-94, INCLUSIVE

1856	110,000,000	1860	125,000,000	Tittabawassee Boom Co.
1857	113,700,000	1861	120,000,000	
1858	106,500,000	1862	128,000,000	
1859	122,750,000	1863	133,580,000	

1864	215,000,000	1880	873,047,731	Charles Merrill & Co.
1865	250,639,340	1881	976,320,317	
1866	349,767,344	1882	1,011,274,605	
1867	423,963,190	1883	938,675,078	
1868	451,395,225	1884	978,497,853	
1869	523,500,830	1885	728,498,221	
1870	576,726,606	1886	798,826,224	
1871	529,682,878	1887	783,661,265	
1872	602,118,980	1888	880,669,440	
1873	619,877,021	1889	851,823,133	
1874	573,632,771	1890	815,054,465	
1875	581,558,273	1891	758,610,548	
1876	583,950,771	1892	708,465,027	
1877	640,166,231	1893	585,839,426	
1878	574,162,757	1894	481,244,039	
1879	736,106,000			

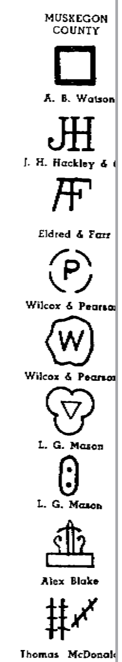


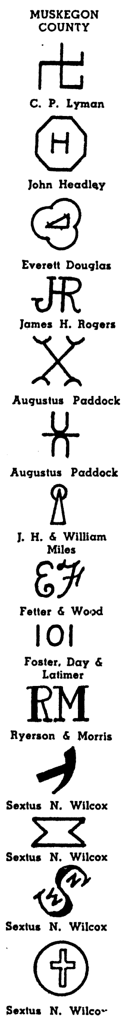
IV

THE NORTHEAST REGION

The pine country north of Saginaw Bay to the Straits of Mackinac, between Lake Huron and the divide, forms sharp contrast to the Saginaw Valley. While Saginaw tributaries flow gently from widespread sources to converge into one outlet, streams from the great central highlands are tortuous and swift, diverging to course south to Saginaw Bay, east into Lake Huron, and north toward the Straits. The land is broken and irregular; the waters cut steep banks through rugged terrain and tumble over rapids.

The Rifle, Au Gres, Au Sable, and Thunder Bay rivers, the Cheboygan and its sources, the Black, Pigeon, and Stur-





geon, all presented special difficulties, and logs that floated upon them carried their marks hell-bent for quick descent, breaking dams and men placed to control them. Operators, lumberjacks, and rivermen surmounted challenging obstacles to get their logs out. The Lumberman's Memorial, raised on the Au Sable, is a monument to their daring exploits.

The name of David Ward recurs in the history of this area as that of the great timber cruiser opening the region to seekers of pine and, later, as an operator. Others had made extensive buys also. Big names showing early on the records are Loud, Alger, Packs of Pack, Woods & Company, Smith, Brackenridge, Potter, Luce, Noxon, Fletcher, Richardson, Avery & Company, George Prentiss, and many others whose marks here appear. In the Cheboygan region, the name of Merritt Chandler was one to reckon with, for he had secured, through the Saint Mary's Falls Ship Canal Company, large holdings on Cheboygan River tributaries.

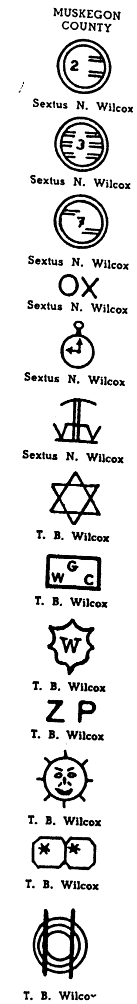
Organization of booming companies for northeastern rivers followed closely upon that of the Tittabawassee. The Au Gres Boom, that of C. D. Hale of Tawas City, and several in connection with the Cheboygan Slack Water Navigation Company were built in 1867. The Thunder Bay River Boom began business in 1868, and one on the Rifle in 1870. The great Oscoda Boom of the Au Sable was not formed until 1877, but logs had been streaming down for years then. The bays formed by rivers emptying into Lake Huron made excellent booming grounds, allowing the sorting pockets to be built around river mouths, freeing the river channels for passage of logs into the booms, and giving plenty of space for the many tugs to operate. The Hale boom at Tawas City, a six-acre enclosure of piling, received many rafts from the Au Gres and Rifle rivers, and the place became the chief manufacturing center for lumber of the immediate region.

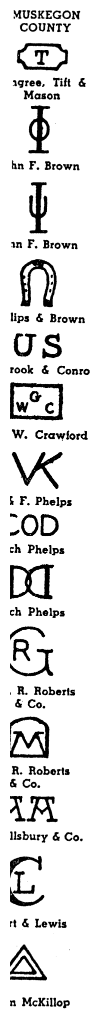
At Black River village, headquarters for R. A. Alger interests, a spar and mast industry began in 1868 and grew to be the world's largest, supplying New York, Boston, and many other seaports, besides sending great rafts of lumber

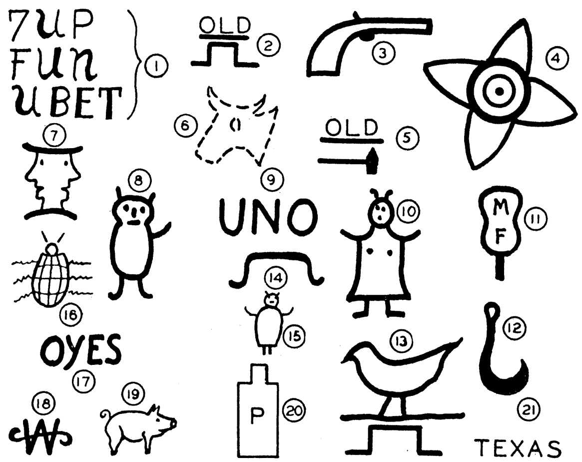
to Great Lakes ports as far as Buffalo. At Alpena, where the storage boom was located on the south side of Thunder Bay River, one of the many mills was situated on an island in the middle of that stream. On the Cheboygan system of waters, dominated by the Navigation Company, many mills and booms were built on Burt, Mullet, and Black lakes. A problem arose because of the great rapids over which that river dropped after leaving Mullet Lake. This was solved by building a lock and canal, 18 feet wide, 85 feet long, with a lift of nine feet, through which the company annually passed millions of feet of logs and lumber, besides the operating tug boats. A large sluice dam at the outlet of Black Lake took care of a like problem there, controlling the level of the lake for booming logs at the Black Lake mouth of the Upper Black.

The Oscoda Boom Company was typical of those of the whole region. Capitalized at $25,000, later increased to $100,000, it included among its stockholders David Ward, William T. Smith, Edward A. Brackenridge, Woods & Pack, Oscoda Salt & Lumber Company, and Smith, Kelley & Company. Its directors were E. and W. T. Smith, H. N. Loud, Ward, and Brackenridge. The company built and controlled many dams on the Au Sable and had miles of booms at Oscoda and along the lower river. The Dwight interests, organizing the Au Sable River Boom Company, had already improved the upper river. The Van Etten Boom Company, headed by H. N. Loud and with E. F. Holmes as secretary, operated on Pine River and Van Etten Lake, north of Oscoda, employing a tug on the lake and having a force of 40 or 50 men. First officers of the Thunder Bay River Boom Company were Benjamin F. Luce, president, and S. M. Noxon, secretary. There, also, the great difficulty was one of the swiftness of the stream, and many dams were maintained.

As in other sections, many log marks of great interest were lost by fires here, which destroyed records, and, in some cases, where work was confined to one county on short streams, marks were not necessarily recorded. In Alpena County, however, the record is fairly complete, beginning







A group of rather unusal log marks.

1. Monroe, Boyce & Co., Ottawa, 1875. 2. "Old Hat"—Farr Lumber Co., Osceola, 1883. 3. "Pistol"—John F. Brown, Newaygo, 1881. 4. "Daisy"—Newaygo Co., Osceola, 1874. 5. "Old Hammer"—Farr Lumber Co., Osceola, 1883. 6. "Ox Head"—Muskegon Shingle & Lumber Co., Newaygo, 1883. 7. "Two Face"—D. C. Bowen, Muskegon Region, 1871. 8. "Elf"—H. G. Billings, Newaygo, 1881. 9. W. Holland, Saginaw, 1890. 10. "Snow Man"—Farr Lumber Co., Osceola, 1883. 11. "Mandolin"—Levi Truesdale, Osceola, 1881. 12. "Chain Hook"—John Torrent, Osceola, 1885. 13. "Chicken on a Fence"—Farr Lumber Co., Osceola, 1883. 14. "Trunkhandle"—Thomas Richardson, Cheboygan, 1886. 15. "Lady Bug"—Muskegon Shingle & Lumber Co., 1883. 16. "Bed Bug"—Storrs & McDougall, Muskegon, 1872. 17. Gow & Campbell, Clare, 1902. 18. Huron Log Booming Company, Huron, 1869. 19. "Pig"—W. S. Prettyman, Cheboygan, 1889. 20. "Bottle P"—Joseph T. Palmer, 1869. 21. A. J. McIntyre, Saginaw, 1892.

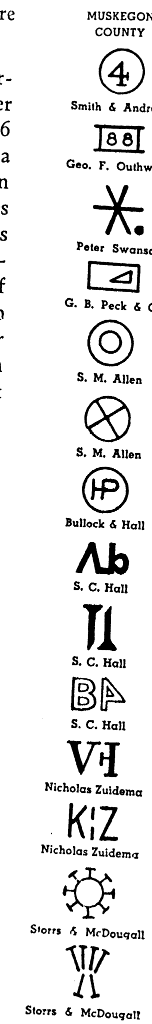
with 1870, when Folkerts & Butterfield recorded yellow, red, and green paint marks. F. W. Gilchrist was identified by white paint daubed on the log, and A. N. Spratt used blue. This was not general practice, however, for a great variety of bark marks and end marks were also registered, including

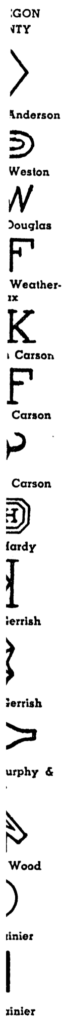
triangle and octagon marks (Gilchrist) and Spratt's "Square Snake."

Nelson LeBlanc, of Alpena, was a lumberjack and riverman for more than 20 years, working mainly on Thunder Bay River waters. His wages as a loader were usually $26 per month and board, and as a riverman he was paid $2 a day. He drove logs on Gilchrist, Hunt, Beaver, and McGinn creeks and on the Little Wolf and Big Wolf, all tributaries to Thunder Bay River, and on the main river and its branches, besides working other streams of the region. Logging camps in which he worked were usually crude, built of logs or rough lumber covered with tar-paper, furnished with double-decker bunks of springy poles covered with cedar boughs. His pillow was his "turkey"—the grain sack in which spare clothing was carried—and many nights he slept with his shoes on and with soaking wet feet, for fear he could not get his shoes on again in the morning. Mr. LeBlanc remembers a tough job of picking a channel through rapids of the "Cheboygan Black" River, and many other difficult tasks of the big times.

While driving the rivers, the men made no camp. They slept in the open air in the blankets they carried. Drivers worked from early morning until after dark, and on these swift streams constant vigilance was necessary. The rocky, winding beds of the streams were certain to hang up the drives in jams, if they were not constantly freed of stopped logs. The general practice here was to install dams every few miles, taking the drive through sluice gates in sections, to keep close control over water and logs. With a sluice dam below a rapids, the shallow could be flooded so that logs were floated over, and, by placing the sluice gate above the rapids, logs and water could be accumulated and sent down in great rushes.

Steam railroads were generally used in this region, spreading out from lumber centers. Because logs sent to mill by rail did not pass through the usual sorting arrangements, the log marks were not needed in many places on each log, and it became usual for marks to be stamped in only one place





on each end of each log. The Potts mark was plain "JEP", and Loud's was "Circle L". Pack, Woods & Company used a "PW" and other marks, including a "K" either boxed or in a diamond. It is claimed that most of the marks used in Iosco and Arenac counties were never registered, but Charles W. Kotcher registered a pink-paint daub mark used on Au Sable and Pine rivers. T. T. Allen & Company, for use on the same rivers, registered a yellow paint mark and various box marks, besides its "TTA". The Maltby Lumber Company had its initials in varying combinations, with a white mark to use on the Au Gres and Rifle rivers. Another white paint mark was that of Penoyer Lumber Company, and this was known as the "Snowball Mark".

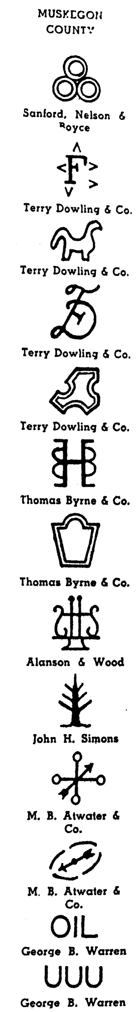
The log mark record of Alpena County, comprising 252 pages when transcribed, includes many of the best-known marks of the lumber business. A. N. Spratt's list, besides the "Square Snake", "Dumbell", crossed keys and commoner symbols, presents a group, from 1878 and 1879, designed to read the same right side up or upside down. These are "HOH", "808", "906", "SXS", "AXA" (the last letters inverse), "X, lying S, X", "T" (last letter inverse), "E, reverse E", and "010". Some log marks of this kind are found in every region. Frank D. Spratt used only hack marks, "Square Cross", "Long Thirty", "Long Forty", Long Box, Five Hacks, etc. Richardson, Avery & Company's "Circle R" was varied by replacing the initial with numbers for grade reference; Porter and Parmeater's triangle mark enclosed the company initials with reference numbers, and Cunningham, Robertson, Haines & Company's long-familiar log mark was "Circle crossed axes".

A. R. Richardson's property was easily identified by an ox-yoke mark, and George Prentiss & Company's by a hand with forefinger and thumb extended. That firm's series mark was the outline of a heart enclosing numerals. The famed "Pitcher" belonged to Warner & Davis, and the "Single Handcuff" to Thomas B. Johnson. R. D. Taylor, in 1878, used a "Crawfoot", and Smith Brown marked logs with a fish outline. The "Square & Compass" emblem was Camp-

ball Potter & Company's mark until 1883, when it represented W. H. & E. K. Potter. Another well-known emblem was the "Snuff Box" of E. O. Avery, and Thomas Collins was known by his plain "TOM". John Donovan chose a "Buzz Saw" outline, with or without initial, to mark his logs. Sentimentality was reflected in the three entwined hearts of James Woods; Alonzo Davis stamped a neat jew's-harp on his logs; F. C. Falkert, a snowshoe; George Masters, either a house outline or anchor; and Falkert & McRae, a congress boot.

A chair, or "Circle Chair", marked Alpena Hoop & Lumber Company logs; two fishhooks, those of Besser Churchill Company; while a picture of the end of a veneer bolt identified those of Michigan Veneer Company. Two distinctive cross marks were those of W. H. Campbell and of Platt & Miller, the former's a circled Botones cross and the latter's resembling the German Iron Cross. Bolton & McRae recorded a clay pipe in 1882, and W. L. & H. D. Churchill a slightly different one in 1886. Arthur Pack & Company used two variations of picture frame marks, while Salling, Hanson & Company used the letters "RH" with a pine tree. Morris & McKay had three unusual log marks: the Odd Fellows emblem (three links), a bird's head, and an anvil. "A Fork for a Barn" was one of the George Holmes marks, and another tool, the brace, was one of Menroe Kluek's. A pair of horseshoes marked James O. Cann logs.

Movements of individuals and companies in changing operations may be seen in mark recordings. Salling, Hanson & Company used the same mark noted above when they logged on Cheboygan River tributaries, and they registered it in Cheboygan County. "JOE", of Turner and Tousey, Cheboygan County in 1885, is found in 1891 in Presque Isle County to be owned by Wilson & Platz, and in 1895 Morris R. Tousey recorded a plain "Circle T" in that county. The snowshoe mark, when recorded in Presque Isle County in 1888, became Whitney & Stinchfield's. Many others who logged further south in the region registered log



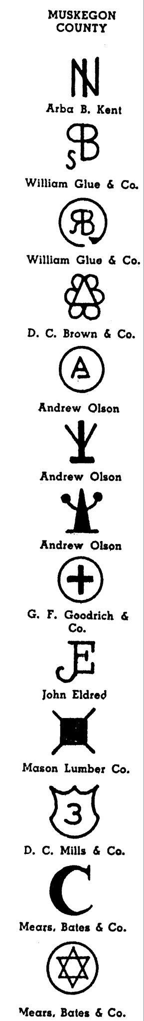
marks, usually in later years, in Presque Isle and Cheboygan counties.

Merritt Chandler's was the "C X C-in-C" mark. The Cheboygan River Boom Company had a "JPP" mark, and the Cheboygan Towing Company was known by its "Q", sometimes combined with other letters. Michigan Veneer Company, in Cheboygan County, marked logs "MVCo", while Turner and Tousey's "Trunk Handle" resembled the one called "Hat" elsewhere. For unique design, W. S. Prettyman would be awarded first prize anywhere for his outline of a pig.

These are only a few of the log marks that mingled on the turbulent currents of northeast rivers, and the narrative tells only a little of the story. In general, the picture was the same as elsewhere—confusion first, with simple marks predominating, then the necessity for orderly organization, registration of marks in greater numbers, together with increased control by boom companies, and finally the decline with disappearance of pine. Here, however, the boom period was later, ending in the first decade of the present century, and here steam entered largely into the work. Lumberjacks and riverhogs did the bulk of the work, as ever, and these rivers were paradise to the drivers. One old riverman claims that often, while working in this part of the state, he "had to turn his head to catch his breath, the logs he rode travelled so fast." At any rate, it was a continual fight for them in making the waters carry stupendous burdens to mill.

As samples of work done, these figures are enlightening: In one year, 1893, sixteen mills of the Cheboygan district cut 200 million feet of lumber. In 1871, the Black River alone carried 100 million feet in logs. In 1872, 80 million feet of timber passed through the Rifle River boom, and the next year the Au Gres Boom Company handled 63 million feet. That year, the Au Sable River Boom Company, in which Alfred A. Dwight was the dominating figure, rafted out 86 million, and the total estimated output of that boom for all time was 500 million. All told, the total production

of the Lake Huron shore from Saginaw Bay to Alpena was estimated at 12 billion board feet. One little detail of that immense business was the hauling of one load of logs scaling 31 thousand feet, weighing probably 100 tons, by a team belonging to Pack, Woods & Company. Brute force did the work, while order was maintained by use of the controlling symbols—log marks.



Appendix 4

ESTATE OF LEWIS CORNWELL
TO
RICHARDSON LUMBER CO.

This instrument was presented and received for record this 10th day of Nov. A.D. 1910, at 2 o'clock P. M. (as a proper certificate was furnished in compliance with Section 3957, Compiled Laws of 1897.

John J. Hugen, Register of Deeds.

This Indenture,

Made this 22nd day of October in the year of our Lord one thousand nine hundred and 1910,

BETWEEN Edgar L. Cornwell, William C. Cornwell and Elmer J. Cornwell, trustees of the Estate of Lewis Cornwell, deceased; Edgar L. Cornwell, a single man of Flushing, Mich. William C. Cornwell, and his wife Maude G. Cornwell, Elmer J. Cornwell and his wife Olga S. Cornwell, of Saginaw, County of Saginaw, and State of Michigan, of the first part, and Richardson Lumber Co., of Alpena, County of Alpena, and State of Michigan, of the second part,

Witnesseth, That the said parties of the first part, for and in consideration of the sum of One dollar and other valuable considerations Dollars to them in hand paid by the said party of the second part, the receipt whereof is hereby confessed and acknowledged, do by these presents grant, bargain, sell, remise, release, alien and confirm unto the said party of the second part, and successors and assigns, FOREVER, ALL that certain piece or parcel of land situate and being in the County of Otsego, and State of Michigan, and described as follows, to-wit: All of said first parties right, title and interest in and to a certain Dam located on Section 13, Town 32 North, Range One West, provided that the right and privilege is reserved to said first parties or any one of them to operate said Dam in connection with said second party, if said first parties or any one of them so desire for the purpose of driving or floating timber of any kind, which they own or control or may hereafter acquire where the use of the Dam may be necessary; and it is agreed that said first parties or any of them shall not sell, assign or transfer the reserved, right and privilege herein mentioned to any other person or persons.

This deed is made in accordance with the terms, conditions, and covenants of a certain land contract made and executed between the parties hereto, and dated the 16th day of October, 1907.

Together with all and singular the hereditaments and appurtenances thereunto belonging or in anywise appertaining: To HAVE AND TO HOLD the said premises as herein described, with the appurtenances, unto the said party of the second part, and to its successors and assigns, FOREVER. And the said Edgar L. Cornwell, William C. Cornwell and Elmer J. Cornwell, trustees of said estate parties of the first part, for and behalf of said Estate its heirs, executors and administrators, do covenant, grant, bargain and agree to and with the said party of the second part, its successors and assigns, that at the time of the ensealing and delivery of these presents, said Estate is well seized of the above granted premises in FEE SIMPLE; that they are free from all incumbrances whatever;

and that said Estate will, and its heirs, executors, and administrators shall WARRANT AND DEFEND the same against all lawful claims whatsoever.

In Witness Whereof, The said parties of the first part, have hereunto set their hands and seals the day and year first above written.

Signed, Sealed and Delivered in Presence of

F. E. SAYRE Witnesses to Edgar L. Cornwell
JAMES B. GREENFIELD Signature
C. C. WAALER as to signature
ELMER HANSON of W.C., Maude G., Elmer J. and Olga S. Cornwell

EDGAR L. CORNWELL [SEAL]
WM. C. CORNWELL [SEAL]
MAUDE G. CORNWELL [SEAL]
ELMER J. CORNWELL [SEAL]
OLGA S. CORNWELL [SEAL]
[SEAL]

STATE OF MICHIGAN, COUNTY OF SAGINAW. } ss. On this 22nd day of October in the year one thousand nine hundred and ten, before me, a Notary Public in and for said county, personally appeared William C. Cornwell, Maude G. Cornwell, Elmer J. Cornwell and Olga S. Cornwell to me known to be the same persons described in and who executed the within instrument, who severally acknowledged the same to be their free act and deed for the intents and purpose therein stated individually, and as trustees of the Estate of Lewis Cornwell, deceased.

My commission expires Jan. 2, 1912

ALFRED DAVIES, Notary Public

(NOTARIAL SEAL)

STATE OF MICHIGAN,) ss.
COUNTY OF GENESEE.)

On this 25th day of October in the year one thousand nine hundred and ten before me, a Notary Public in and for said county, personally appeared Edgar L. Cornwell to me known to be the same person described in and who executed the within instrument, who acknowledged the same to be his free act and deed, for the intent and purpose therein stated individually, and as one of the trustees of the Estate of Lewis Cornwell, deceased.

My Commission Expires March 14, 1911.

FRED L. SAYRE, Notary Public.

WARRANTY DEED—Short Form.

LIBER 88

X 42

GEORGE BOLINGER & WIFE
TO
JOHN & THOMAS YUILL

This instrument was presented and received for record this 22nd day of Nov. A. D. 1912, at 8 o'clock A. M. (as a proper certificate was furnished in compliance with Section 3957, Compiled Laws of 1897.

John F. Munger, Register of Deeds.

This Indenture,

Made this 20th day of Sept. in the year of our Lord one thousand nine hundred and twelve, Between GEORGE BOLINGER and ALICE BOLINGER (his wife), of Corwith township, Otsego County, Mich. parties of the first part, and JOHN YUILL and THOMAS YUILL, of Vanderbilt, Mich. parties of the second part,

WITNESSETH, That the said parties of the first part, for and in consideration of the sum of One dollar and other valuable considerations Dollars, to them in hand paid by the said parties of the second part, the receipt whereof is hereby confessed and acknowledged, do by these presents grant, bargain, sell, remise, release, alien and confirm unto the said parties of the second part, and their heirs and assigns, FOREVER, ALL that certain piece or parcel of land situate and being in the township of Corwith, County of Otsego, and State of Michigan, and described as follows, to-wit: The North half of the Southeast quarter and the South half (S.1/2) of the Northeast quarter (NE.1/4) of Section Nineteen (19) town Thirty-two (32) North Range One (1) West, according to government survey thereof, excepting and reserving therefrom, all rights, privileges and franchises in and to the Dam, across Pigeon river, located on said Section (19) the same having been heretofore deeded to Richardson Lumber Co., and said second parties shall not have any claim for losses or damage caused by the use or operation of said Dam by overflow or otherwise to the lands described herein.

Together with all and singular the hereditaments and appurtenances thereunto belonging or in anywise appertaining: To HAVE AND TO HOLD the said premises, as herein described, with the appurtenances, unto the said parties of the second part, and to their heirs and assigns, FOREVER. And the said George Bolinger and Alice Bolinger, parties of the first part, for themselves, their heirs, executors and administrators, do covenant, grant, bargain, and agree to and with the said parties of the second part, their heirs and assigns, that at the time of the ensealing and delivery of these presents, they are well seized of the above granted premises in FEE SIMPLE: that they are free from all incumbrances whatever; and that they will, and their heirs, executors, administrators shall WARRANT AND DEFEND the same against all lawful claims whatsoever.

In Witness Whereof, The said parties of the first part have hereunto set their hands and seals the day and year first above written.

Signed, Sealed and Delivered in presence of

GEO. C. HOOPER
SAMUEL YUILL

GEORGE BOLINGER [SEAL.]
ALICE BOLINGER [SEAL.]
[SEAL.]
[SEAL.]
[SEAL.]
[SEAL.]

STATE OF MICHIGAN
COUNTY OF OTSEGO. } ss.

On this 30th day of Sept., in the year one thousand nine hundred and twelve before me, a notary public in and for said county personally appeared George Bolinger and Alice Bolinger, to me known to be the same persons described in and who executed the within instrument, who each acknowledged the same to be their free act and deed.

My commission expires Oct. 8 - 1912.

GEO. C. HOOPER
Notary Public, Otsego County, Michig.

4122 ✗
WARRANTY DEED

LIBER 26

CHARLES E. CORNWELL & WIFE
TO.
GEORGE BOLTNGER

This instrument was presented and received for record this 22nd day of Nov. A. D. 1912, at 8 o'clock A.M. (as a proper certificate was furnished in compliance with Section 3957, Compiled Laws of 1897.

John J. Munger, Register of Deeds.

This Indenture,

Made this thirteenth day of September in the year of our Lord one thousand nine hundred and twelve, Between CHARLES E. CORNWELL and IDA L. CORNWELL, his wife, of the City of Saginaw, County of Saginaw and State of Michigan, of the first part, and GEORGE BOLTNGER, of Vanderbilt, Otsego County and State of Michigan, of the second part,

WITNESSETH, That the said parties of the first part, for and in consideration of the sum of Six hundred and forty dollars ($640.00) to them in hand paid by the said party of the second part, the receipt whereof is hereby confessed and acknowledged, do by these presents grant, bargain, sell, remise, release, alien and confirm unto the said party of the second part, and his heirs and assigns, FOREVER, All that certain piece or parcel of land situate and being in the County of Otsego, and State of Michigan, and described as follows, to-wit: The North half (N.1/2) of the Southeast quarter (SE.1/4) and the South half (S.1/2) of the Northeast quarter (NE.1/4) of Section Nineteen (19), Town Thirty-two (32) North, Range One (1) West, according to the government survey thereof. Excepting and reserving therefrom all rights, privileges and franchises in and to the Dam across the Pigeon River located on said Section Nineteen (19), the same having been heretofore deeded to Richardson Lumber Company. And said second party shall not have any claim for losses or damage caused by the use or operation of said Dam by over-flow or otherwise to the lands described herein.

Together with all and singular the hereditaments and appurtenances thereunto belonging or in anywise appertaining: To HAVE AND TO HOLD the said premises, as herein described, with the appurtenances, unto the said party of the second part, and to his heirs and assigns, FOREVER. And the said Charles E. Cornwell and Ida L. Cornwell, parties of the first part, for themselves, their heirs, executors and administrators, do covenant, grant, bargain, and agree to and with the said party of the second part, his heirs and assigns, that at the time of the ensealing and delivery of these presents, they are well seized of the above granted premises in FEE SIMPLE; that they are free from all incumbrances whatever; and that they will, and their heirs, executors, and administrators shall WARRANT AND DEFEND the same against all lawful claims whatsoever.

In Witness Whereof, The said parties of the first part have hereunto set their hands and seals the day and year first above written.

Signed, Sealed and Delivered in presence of

ALFRED DAVIES
EDNA SHEEHAN

CHARLES E. CORNWELL [SEAL]
IDA L. CORNWELL [SEAL]
[SEAL]
[SEAL]
[SEAL]
[SEAL]

STATE OF MICHIGAN, ss.
COUNTY OF SAGINAW.

On this thirteenth day of September in the year one thousand nine hundred and twelve before me, a Notary Public in and for said county, personally appeared Charles E. Cornwell and Ida L. Cornwell, to me known to be the same persons described in and who executed the within instrument, who severally acknowledged the same to be their free act and deed.

My commission expires December 28, 1915.

ALFRED DAVIES,
Notary Public.

(NOTARIAL SEAL)

QUIT-CLAIM DEED—Short

Received for record the 26th day of July A. D. 19 20
at 2:30 o'clock P. M., and recorded in Liber 30 of Deeds, on page 258
James Allen Register of Deeds.

THE RICHARDSON LUMBER COMPANY

JOHN YUILL et al

This Indenture, Made the Nineteenth day of July in the year of our Lord one thousand nine hundred Twenty.

BETWEEN The Richardson Lumber Company of Alpena, Michigan parties

of the first part,

John Yuill and Thomas Yuill of Vanderbilt, Michigan, parties

of the second part.

Witnesseth, That the said party of the first part, for and in consideration of the sum of One Dollar and other valuable consideration to it in hand paid by the said parties of the second part, the receipt whereof is hereby confessed and acknowledged, do by these presents, grant, bargain, remise, release and forever QUIT-CLAIM unto the said parties of the second part, and to their heirs and assigns, **Forever,** a certain Dam XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX Otsego County, State of Michigan, known and described as follows:

All of said first parties rights, title and interest in and to a certain Dam located on Section Nineteen (19) Township Thirty-two (32) North, Range One (1) West. as conveyed to the parties of the first part by Edgar L. Cornwell, Etal. by Deed dated October 22nd 1920 and recorded in Liber 24 of Deeds on page 242 in the office of the Register of Deeds of Otsego County Mich.

Together with all and singular the hereditaments and appurtenances thereunto belonging or in anywise appertaining: **To Have and to Hold** the said Described premises to the said parties, their heirs and assigns, to the sole and only proper use, benefit and behoof of the said parties of the second part, their heirs and assigns, Forever.

In Witness Whereof, the said party of the first part has hereunto set its hand and seal the day and year first above written.

THE RICHARDSON LUMBER CO. [L. S.]

Signed, Sealed and Delivered in Presence of

By Roy S. Richardson [L. S.]
President

Guy Eaton

(CORPORATE SEAL) [L. S.]

By Lee Richardson [L. S.]
Secretary

Mildred E. Berger

STATE OF MICHIGAN, County of Alpena } ss. On this Nineteenth day of July in the year one thousand nine hundred Twenty before me, the subscriber, a Notary Public in and for said County, personally appeared Roy Richardson, (President) and Lee Richardson (Secretary) to me known to be the same persons described in and who executed the within instrument, and have acknowledged the same to be their free act and deed.

GUY EATON Notary Public,
Alpena County, Michigan

My Commission expires March 1st, 1921.

Received for record the 14th day of Oct. A. D. 1911
at 8 o'clock A. M., and recorded in Liber of Deeds, on page
EST. OF LEWIS CORNWELL to John J. Morrison Register of Deeds.

CHARLES E. CORNWELL

This Indenture, Made the 20th day of January in the year of our Lord one thousand nine hundred eleven,

BETWEEN EDGAR L. CORNWELL, WILLIAM C. CORNWELL and ELMER J. CORNWELL trustees of the Estate of Lewis Cornwell(deceased)Edgar L.Cornwell(a single man)of Flushing,Genesee County,Mich.,William C. Cornwell and his wife,Maude G.Cornwell;Elmer J.Cornwell and his wife,Olga S.Cornwell Saginaw, Mich. of the first part, and C H A R L E S E. C O R N W E L L of Saginaw, Michigan, of the second part,

Witnesseth, That the said parties of the first part, for and in consideration of the sum of One dollar and other valuable consideration to them in hand paid by the said party of the second part, the receipt whereof is hereby confessed and acknowledged, do by these presents, grant, bargain, sell, remise, release and forever QUIT-CLAIM unto the said party of the second part, and to his heirs and assigns, Forever, All that certain piece or parcel of land, situated in Otsego County, and State of Michigan, known and described as follows:

The North half (N.1/2) of the Southeast quarter (SE.1/4) and the South half (S.1/2) of the Northeast quarter (NE.1/4) of Section 19, town 32 north, range 1 west., according to the Government survey thereof.

Excepting and reserving therefrom all rights, privileges and franchises in and to the Dam across the Pigeon River, located on said Section 19, the same having been heretofore deeded to Richardson Lumber Co. And said second party shall not have any claim for losses or damage caused by the use or operation of said Dam by overflow or otherwise of the lands described herein.

Together with all and singular the hereditaments and appurtenances thereunto belonging or in anywise appertaining; To Have and to Hold the said described premises to the said party of the second part, and to his heirs and assigns, to the sole and only proper fit and behoof of the said party of the second part, his heirs and assigns, Forever.

In Witness Whereof, the said parties of the first part have hereunto set their hands and seals the day and year first above written.

Signed, Sealed and Delivered in Presence of

F.D.SAYRE)Witnesses to Edgar L.
GLENN C.SAYRE)Cornwell signature

EDNA SHEEHAN)As to signatures of W.C.,
F.R.CAMPBELL)Elmer J.Maude G and Olga S.Cornwell

E D G A R L. C O R N W E L L (L. S)
W M. C. C O R N W E L L (L. S.)
M A U D E G. C O R N W E L L (L. S.)
E L M E R J. C O R N W E L L (L. S.)
O L G A S. C O R N W E L L (L. S.)

STATE OF MICHIGAN, COUNTY OF S A G I N A W. } ss. On this 20th day of January in the year one thousand nine hundred eleven before me, the subscriber, a Notary Public in and for said county, personally appeared William C. Cornwell, Maude G. Cornwell, Elmer J. Cornwell and Olga S. Cornwell to me known to be the same persons described in and who executed the within instrument, and severally acknowledged the same to be their free act and deed for the intent and purposes therein stated individually and as trustees of the Estate of Lewis Cornwell (deceased).

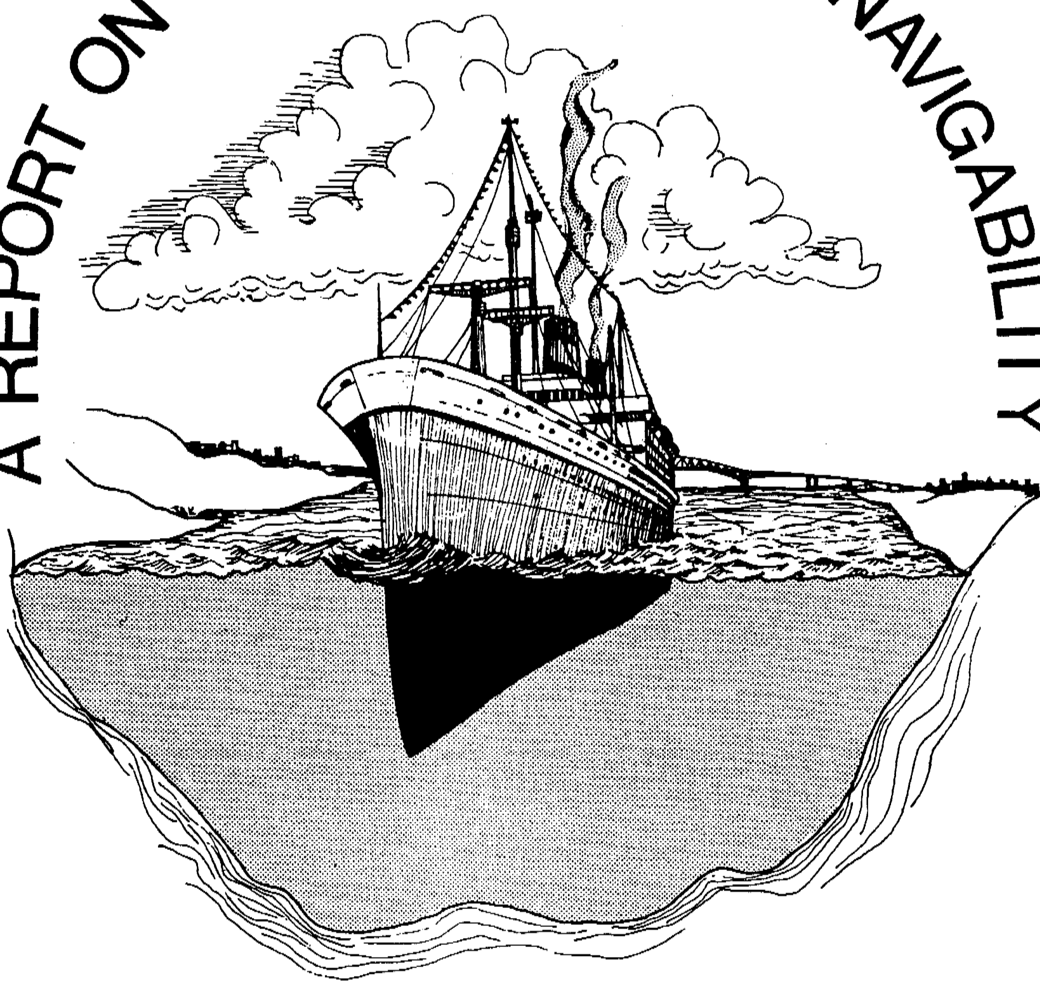
(NOTARIAL SEAL) A L F R E D D A V I E S,
Notary Public, Saginaw County, Michigan.
My commission expires Jan. 2, 1912.

STATE OF MICHIGAN,)
County of GENESEE.) ss. On this 23rd day of January in the year One thousand nine hundred and eleven, before me the subscriber, a Notary Public in and for said County, personally appeared Edgar L. Cornwell, to me known to be the same person described in and who executed the within instrument and acknowledged the same to be his free act and deed, for the intent and purposes therein stated, individually and as one of the trustees of the Estate of Lewis Cornwell, (deceased)

F R E D D. S A Y R E,
My commission expires March 14, 1911. Notary Public.

Appendix 5

A REPORT ON THE FINDINGS OF NAVIGABILITY



CHEBOYGAN RIVER AND INLAND WATERWAY BASIN, MICHIGAN

WATERWAY NUMBERS 29 - 34

U.S. ARMY CORPS OF ENGINEERS • DETROIT DISTRICT

U. S. ARMY CORPS OF ENGINEERS
DETROIT DISTRICT

NAVIGABLE STATUS OF CHEBOYGAN RIVER/INLAND WATERWAY BASIN MICHIGAN

NAVIGABILITY REPORT: 29 THRU 34

DECEMBER 1979

River and Harbors Act	Project Authorized	Document and/or Report
1954 River and Harbor Act	Channel of 5-Foot depth and 30-Foot width	H. Doc. 142, 82d Cong., 1st sess.
1964 River and Harbor Act	Lock and Dam	Chief of Engineers Report

6. Past and Present Interstate Commerce -

a. Past Usage - Use of the Cheboygan River and the Inland Waterway for commercial purposes is well documented. Primarily, this use consisted of transportation of wood from the lumbering regions in the upstream reaches. Several tributaries to this system were also used for this purpose.

Sources indicate that the Black River and Black Lake were used for gathering logs and floating them to mills in and around Cheboygan. An Army Corps of Engineers publication (1871, p. 183) reported that, "all the way up into...Black Lake, the navigation is excellent". Hudgins (1961, p. 62) included Black Lake in the list of lakes which were used as gathering points for logs prior to sending them downriver. Lieutenant Colonel C. Townsend (House Document 303/61/2, 1910, p. 4) reported on investigations into deepening of Black River. He wrote, "As Black Lake is centered in a farming area," deepening the channel would, "facilitate the movement of the crops to Cheboygan."

The Pigeon River, as with most tributaries to this system, flows through lands once covered with marketable pine and cedar. An 1871 Army Corps of Engineers report stated that, "logs are now run for an extent of 45 miles in Pigeon River" (p. 183).

The Maple River flows from Douglas Lake to Burt Lake. Douglas Lake is cited as one of several lakes used for gathering logs prior to sending the timber down river (Hudgins, 1961, p. 62). Fuller (no date, p. 87) quotes a source which reports that mills flourished on the Maple River and these mills exhausted the merchantable pine in Emmett County forests.

The main course of the Inland Waterway was extensively used for transporting logs to Cheboygan. A U. S. House of Representatives Document (303/61/2, 1910, p. 3) reported that considerable pulp wood was floated to Cheboygan and that several mills in Alanson received their logs from Crooked River. This document further states that:

> The inland route has been extensively employed in removing the timber products from the surrounding country, and while there has been a dimunition in the supply as the forests are cleared off there is still a considerable commerce in these articles.

An earlier House Document (537/59/1, 1906, pp. 2-3) mentions Burt Lake and its connecting streams as "Fine navigable bodies of water." Hudgins (1961, p. 62) includes Burt and Mullett Lakes in the group used to gather logs prior to floating them to mills. Larson (1977, p. 1-54) indicates that the Inland Waterway, in 1906, was still used for, "considerable commerce in logs, timber, bark, and farm products. The route was also being used by summer residents and tourists. More board feet of lumber was boomed from the Cheboygan basin in 1893, it is probable that these improvements were made.

Each stream must be considered individually as to the extent of the usage of the waterway for log driving. Black Lake was used to gather logs prior to floating them downstream to the Cheboygan River. It is reasonable to assume that these logs were cut upstream and floated into Black Lake via the Black River however, specific documentation was not found. Certainly, the valuable timber was there, and the marshes associated with the upstream reaches of the river may be the result of removal of trees and other vegetation from soils which are poorly drained.

The Pigeon River is cited as having logs run in it for 45 miles. While the method of measuring this mileage is uncertain, it can be assumed that this extends log driving to the source. Currently, the river is mapped as being 36 miles long, measured from Sparr, Michigan, to its mouth.

The Sturgeon River roughly parallels the Pigeon. No specific references to milepoints or log drives were found; however, legal references indicate that boom companies operated at the mouth. Nevertheless, lacking substantive evidence to the actual use of the Sturgeon River for driving logs, no recommendation of navigability can be offered.

Douglas Lake was used as a gathering point for logs. The only outlet of this lake, Maple River, was the avenue by which these logs were moved to the Inland

Appendix IV

BIBLIOGRAPHY

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3. Larson, J. W., A History of Detroit District, United States Army Corps of Engineers, Unpublished Manuscript, Part 2, Michigan, 1977.

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6. Rector, W. G., Log Transportation in the Lake States Lumber Industry, Glendale, California, 1953.

7. United States Congress, 59th Congress, 1st session, House of Representatives Document No. 537, 1906.

8. United States Congress, 61st Congress, 2d session, House of Representatives Document No. 303, 1910.

9. United States Congress, 82d Congress, 1st session, House of Representatives Document No. 142, 1952.

10. United States Congress, 84th Congress, 1st session, Senate Document No. 71, 1955.

11. United States Department of Defense, Army Corps of Engineers, Annual Report of the Chief of Engineers, 1871.

12. United States Department of Defense, Army Corps of Engineers, Waterborne Commerce of the United States, Part 3, 1974.

13. United States Department of Defense, Army Corps of Engineers, Water Resources Development: Michigan, 1977.

14. United States Department of Interior, Geological Survey, Water Resources Data For Michigan, Water Year 1977, U.S.G.S., Lansing, Michigan, 1978.

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Appendix B

Federal Energy Regulatory Commission license agreements for the licensed dams in the Cheboygan River watershed. Also included are operating agreements and documents regarding the Cheboygan Dam. (Documents were reduced to fit these pages.)[1]

[1]Figures missing on pages 360–362 of this document were missing and unavailable from the source document, pages 36–38 of FERC's Environmental Assessment for Hydropower License, Tower and Kleber Hydroelectric Project, FERC Project 10615-001, Michigan, 1993.

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THE PROCTER & GAMBLE PAPER PRODUCTS COMPANY

SOUTH MAIN STREET
CHEBOYGAN, MICHIGAN 49721
616-627-5664

May 18, 1982

Michigan Department of Natural Resources,
Waterways Division
P. O. Box 30028
Lansing, Michigan 48909

Attention: Keith E. Wilson
Chief, Waterways Division

Gentlemen:

Re: Cheboygan Hydropower and River Flow Regulation Agreement

The Procter & Gamble Paper Products Company (Procter & Gamble) has initiated a Cheboygan Dam Powerhouse Redevelopment Project, pursuant to which the Company intends to rehabilitate and operate the hydroelectric power generating facilities located on the Cheboygan River, City of Cheboygan, Cheboygan County, Michigan, at the existing powerhouse adjacent to our Cheboygan plant. The proposed project generally consists of refurbishing the powerhouse with two turbine-generator units with a combined rated capacity of 1,400 kw. The project will be run-of-the-river, utilizing the water power potential of the existing dam. There will be no increase in the normal surface elevation of the impoundment, nor will the project entail any change from the prevailing regime of the storage and release of water from the impoundment, for which the Waterways Division, Michigan Department of Natural Resources (Waterways Division) has had, and will continue to have, the responsibility of regulating.

Because Procter & Gamble's project to rehabilitate and operate the powerhouse and the Waterways Division's continuing responsibility to regulate river flow are both interrelated, the parties wish to establish and confirm by this agreement a mutually acceptable and beneficial manner of pursuing their respective interests and discharging their respective responsibilities.

The premises underlying this agreement are as follows:

A. The Cheboygan dam consists of the following structures and facilities:

-- A powerhouse with four turbine bays and associated equipment.

-- A navigation lock.

-- A natural earth embankment forming part of the dam.

-- A six bay spillway.

-- A fishladder located at the spillway.

-- Associated riverside property on the east and west side of the dam.

-- A process water pump house intake.

B. Procter & Gamble owns the powerhouse and associated equipment (from which generators and related items were removed in 1965 when the turbines were last used to generate power), the pump house, and certain riverside property on the west side of the dam.

C. The Waterways Division owns all other impounding structures and facilities at the dam, including the navigation lock, the earth embankment, the gated spillway, the fishladder and certain riverside property east of the dam.

D. The Waterways Division has operated and will continue to operate the dam to regulate the flow of the Cheboygan River. Flow regulation is accomplished primarily by operating the turbine ring gates at the powerhouse, and secondarily by operating the gates at the spillway.

E. To enable the Waterways Division to 1) regulate the river flow at the dam, and 2) lock recreational watercraft through the dam, Procter & Gamble granted to the Waterways Division in 1967 an easement for roadway purposes as a means of ingress and egress to and from the powerhouse and lock facilities, and an easement to enter upon its property for the purpose of operating and maintaining "water elevation control devices" and other specified structures and equipment (hereinafter collectively referred to as "flow control equipment").

F. The Waterways Division has established a flow regime of storage and release of water from the impoundment, with the following objectives and procedures, hereinafter referred to as the "established flow regime":

<u>Objective 1</u>. Enable migratory fish passage at the dam pursuant to the policy of the Michigan Department of Natural Resources, Inland Fisheries (Lakes and Streams) Division.

The fishladder head gate is left fully open at all times, and water spills continuously down the ladder. Pursuant to the current policy of the Inland Fisheries Division, the fishladder is currently in a deactivated mode to block passage of sea lamprey from the Great Lakes to the Inland lakes and streams. The fishladder may be reactivated in the future by the Inland Fisheries Division should the sea lamprey situation change. In that event, the reactivation and operation of the powerhouse would not affect operation of the fishladder.

<u>Objective 2</u>. Provide flowing water to the fishery at the catch basin located below the spillway bays, and to enhance seasonal attraction of the fishery.

One bay at the spillway is opened seasonally to increase flow through the spillway catch basin and draw spawning fish from the Great Lakes into the catch basin

<u>Objective 3</u>. Reduce the river current that strikes recreational water craft at right angles as they pass below the powerhouse.

One bay at the spillway is opened as necessary to develop a current along the east bank below the powerhouse, thereby facilitating the passage of recreational water craft.

Objective 4. Lock recreational water craft through the dam.

The services of a lockmaster are provided by the Waterways Division to boaters.

Objective 5. Regulate water levels of the Inland Route (Cheboygan River and upstream impoundments).

The powerhouse and spillway gates are manipulated to regulate Mullett Lake levels according to the following schedule:

a) 1 January to 31 March - draw down gradually to 592.65 feet (USC&GS)

b) 1 April to 14 April - bring up to 593.6 feet (USC&GS)

c) 15 April to 14 October - hold at 593.6 feet (USC&GS)

d) 15 October to 14 November - draw down to 593.1 feet (USC&GS)

e) 15 November to 31 December - hold at 593.1 feet(USC&GS)

This schedule allows Mullett Lake draw-down to minimize shoreline ice damage. Operation of the powerhouse turbine ring gates is the primary means of flow regulation, with the operation of the spillway gates being a secondary or supplemental means of regulation when flow capacity of the powerhouse is exceeded.

Based upon the foregoing, Procter & Gamble and the Waterways Division hereby agree as follows:

1. The Waterways Division shall use its best efforts to follow substantially the "established flow regime".

2. Upon installation of the refurbished hydroelectric generating units and related equipment, the Waterways Division shall be entitled to use and operate such related equipment as is necessary or convenient in discharging its responsibilities to regulate the river flowage.

3. The Waterways Division shall, consistent with adherence to the "established flow regime", direct the river flow through a specific turbine bay or bays in the powerhouse as requested by Procter & Gamble for the purpose of maximizing the water power potential for the generation of electrical power.

4. Procter & Gamble shall have the right and privilege, but not any obligation, to inspect, maintain, repair, replace, reconstruct, and install the "flow control equipment" which may be necessary or convenient for its use of the hydroelectric plant. This right shall be concurrent with the similar right of the Waterways Division, but Procter & Gamble's right shall expire when it, and its successors and assigns abandon the use of the plant to generate electricity.

If you are in agreement with the above terms and conditions, please arrange to have an authorized representative of the Waterways Division execute two copies of this agreement and return one to my attention.

Very truly yours,

THE PROCTER & GAMBLE PAPER PRODUCTS COMPANY

H A Bullard

Homer A. Bullard
Plant Manager
Cheboygan Plant

ACCEPTED:

Michigan Department of Natural Resources, Waterways Division

By Keith Wilson

Title Chief, Waterways Div.

Date June 7, 1982

HAB/ac

23 FERC ¶62,009

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

The Proctor and Gamble Paper Products Company) Project No. 7142-000

NOTICE OF EXEMPTION FROM LICENSING

(Issued April 4, 1983)

A notice of exemption from licensing of a small hydroelectric project known as Cheboygan Dam, Project No. 7142, was filed on March 14, 1983, by The Proctor and Gamble Paper Products Company. The proposed hydroelectric project would have an installed capacity of 1500 kW and would be located on the Cheboygan River in Cheboygan County, Michigan.

Pursuant to Sections 4.109(c) and 375.308(ss) of the Commission's regulations, and subject to the terms and conditions set forth in Section 4.111 of the Commission's regulations, the Director, Office of Electric Power Regulation, issues this notification that the above project is exempted from licensing as of April 14, 1983.

Lawrence R. Anderson

Lawrence R. Anderson
Director, Office of Electric Power Regulation

DC-A-13

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

OFFICE OF ...
1983 MAR 14 AM 11: 26
FEDERAL ... REGULATORY COMMISSION

Cheboygan Dam Powerhouse)
Redevelopment Project)

NOTICE OF EXEMPTION OF
SMALL HYDROELECTRIC POWER PROJECT
FROM LICENSING

(1) THE PROCTER & GAMBLE PAPER PRODUCTS COMPANY notifies the Federal Energy Regulatory Commission that the CHEBOYGAN DAM POWERHOUSE REDEVELOPMENT PROJECT, a small hydroelectric power project as defined in 18 C.F.R. Section 4.102 is exempt from licensing under the terms of 18 C.F.R. Section 4.109 through Section 4.111. The project is not currently licensed.

(2) The location of the project is:

(State or territory)	Michigan
(County)	Cheboygan
(Township or nearby town)	Cheboygan
(River or stream)	Cheboygan River
(River basin)	Cheboygan River

(3) The exact name, business address, and telephone number of the filing party is:

Business Office at Project Site

The Procter & Gamble Paper Products Company
307-549 South Main Street
Cheboygan, Michigan 49721
616-627-5664

Principal Business Office

The Procter & Gamble Paper Products Company
301 East 6th Street
Cincinnati, Ohio 45202
513-562-1100

(4) The project is located entirely on non-Federal lands, and includes the following features:

(i) Dams: The project powerhouse is located at the Cheboygan Dam that was first constructed in 1845. A navigation lock and spillway was built in 1869, and an electric light plant was added in 1887. The existing powerhouse was constructed in 1922 with four bays and four vertical Francis type 400 kw turbine-generators. In 1945, two bays were reconstructed for installation of one vertical manually adjustable blade runner, modified Kaplan type turbine-generator with a capacity of 1000 kw.

The length across the powerhouse, lock, and spillway face at the dam total 252 feet. A natural earth embankment with sheet pile face adds another 375 feet to the width of the dam.

The height above streambed, as defined in 18 C.F.R. 12.30, is 19.5 feet.

The gross storage capacity of the related impoundment is 191 acre feet.

(ii) Powerplants: One powerplant exists at the Cheboygan Dam; it has existed since 1922. No changes to the civil works at the powerhouse are planned. The average hydraulic gross head is 14.1 feet. The hydraulic head varies due to uncontrolled water level variations at the tailrace caused by the level of Lake Huron located only 1.6 miles downstream, and due to controlled head pond variations caused by the established flow regime and water flow management practices at the dam under the continuing operating control of the Waterways Division of the Michigan Department of Natural Resources. Prior to temporary retirement of the powerhouse in 1965, the installed electric power generating capacity at the powerhouse was 1800 kw. This capacity was removed leaving behind only the gates and actuators, and the partly dismantled runners. It is proposed to refurbish the largest of the three existing gate/draft tube sites with a vertical Kaplan type turbine-generator with a total installed capcity of 1500 kilowatts, and an estimated average annual generation of 9,370,000 kilowatt-hours.

(iii) Average stream flow: The average annual stream flow is 1,037 cubic feet per second as determined from 35-year stream flow records of the U.S. Department of the Interior.

(5) It is certified that the small hydroelectric power project conforms to the specifications set forth in section 4.109(a) of the Commission's regulations and that The Procter & Gamble Paper Products Company has complied with section 4.112(b) of the Commission's regulations, including the following:

(i) The Michigan Department of Natural Resources, Water Quality Division, has certified that the construction, operation, and maintenance of the project will not cause a violation of any applicable water quality standards.

(ii) The U.S. Fish and Wildlife Service, East Lansing Field Office, and the Michigan Department of Natural Resources, Fisheries Division, have certified that there is not a significant existing population of migratory fish at the project dam.

(iii) The Michigan State Historic Preservation Office has certified that the proposed small hydroelectric power project does not entail any construction that would adversely affect any site included in or eligible for inclusion in the National Register of Historic Places.

(iv) The U.S. Fish and Wildlife Service, East Lansing Field Office, has certified that the proposed small hydroelectric power project does not entail construction or operations that would adversely affect any threatened or endangered species or critical habitat listed or designated in the regulations of the U.S. Fish and Wildlife Service of the Department of the Interior or the National Marine Fisheries Service of the Department of Commerce.

(v) The U.S. Fish and Wildlife Service, East Lansing Field Office, and the Michigan Department of Natural Resources, Fisheries Division, have not prescribed migratory fish restoration measures as a condition of the exemption.

(6) Executed this 9 day of March, 1983, by an authorized representative of The Procter & Gamble Paper Products Company.

Ashley L. Ford
Ashley L. Ford
Secretary, The Procter & Gamble
Paper Products Company

VERIFICATION

The facts alleged in the foregoing Notice of Exemption are true and accurate to the best of my knowledge, information and belief.

Ashley L. Ford
Ashley L. Ford
Secretary, The Procter & Gamble
Paper Products Company

Sworn to and subscribed in my presence this 9th day of March, 1983.

Carol Jackson
CAROL JACKSON
Notary Public, State of Ohio
My Commission Expires June 2, 1985

9411B

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the attached Notice of Exemption of Small Hydroelectric Power Project from Licensing upon the following agencies, by depositing a copy thereof in the U.S. mails, properly addressed with postage prepaid:

United States Department of the Interior
Fish and Wildlife Service, East Lansing Field Office
Room 301, Manly Miles Building
1405 S. Harrison Road
East Lansing, Michigan 48823

Michigan Department of Natural Resources
Water Quality Division
Stevens T. Mason Building
Box 30028
Lansing, Michigan 48909

Michigan Department of Natural Resources
Fisheries Division
Stevens T. Mason Building
Box 30028
Lansing, Michigan 48909

Michigan Department of State
Michigan History Division
208 N. Capitol Avenue
Lansing, Michigan 48918

Dated at Cincinnati, Ohio this 10th day of March, 1983.

David E. Ross
Senior Counsel, The Procter & Gamble Paper Products Company

9411B

FEDERAL ENERGY REGULATORY COMMISSION

Wolverine Power Supply Cooperative, Inc. — Project No. 10615-001, Michigan

ORDER ISSUING LICENSE
(Major Constructed Project)
(Issued May 12, 1994)

The Wolverine Power Supply Cooperative, Inc. (Wolverine), filed a license application under Part I of the Federal Power Act (FPA) to continue to operate and maintain the existing but unlicensed 1,760-kilowatt (kW) Tower and Kleber Hydro Project located on the Black River, a navigable waterway of the United States, in Cheboygan County, Michigan.

BACKGROUND

Wolverine is not proposing to add any new capacity, or make any major modifications to the project. The project was found jurisdictional under Docket No. UL 86-1.1/

Notice of the application has been published. No agency or other entity objected to or opposed the issuance of this license. The comments received from interested agencies and individuals have been fully considered in determining whether to issue this license. Michigan Department of Natural Resources (Michigan DNR) and the Michigan Water Resources Commission jointly filed a motion to intervene in order to be a party to the proceedings. The Anglers of the AuSable, Inc., the Great Lakes Council, Inc. of the Federation of Fly Fishers, Inc., the Michigan United Conservation Clubs, and the Michigan Council of Trout Unlimited filed a collective motion to intervene in order to protect their interests with respect to the nondevelopmental values of the Black River.

The Commission's staff issued an Environmental Assessment (EA) for this project on April 7, 1993, which is attached to and made part of this license. The staff also prepared a Safety and Design Assessment (SDA) which is available in the Commission's public file for this project.

PROJECT DESCRIPTION

The Tower and Kleber Hydro Project consists of two

1/ The Black River was found navigable based on a navigation status report prepared by the Commission's Chicago Regional Office in May of 1939.

developments: (A) the Tower Hydroelectric Development which includes a 29.3-foot-high concrete gravity dam, a 102-acre reservoir, a spillway section, a powerhouse containing two 280-kW generating units, a 2.4-kV transmission line, and appurtenant equipment and facilities; and (B) the Kleber Hydroelectric Development which includes a 40-foot-high earth dam, a 295-acre reservoir, a spillway controlled by a Taintor gate, an intake structure equipped with two vertical lift gates, a reinforced concrete powerhouse containing two 600-kW generating units, a 12.5-kV transmission line, and appurtenant equipment and facilities. A more detailed description is contained in paragraph (B)(2) of this license.

WATER QUALITY CERTIFICATION

The Michigan DNR, by letter dated July 21, 1988, granted Section 401 water quality certification for the Tower and Kleber Project, pursuant to the Clean Water Act. The water quality certificate for the project contains the following conditions:

1(a) The project shall be operated in a run-of-river mode, except for events completely beyond the control of the Licensee.

(b) In the event of a violation in run-of-river operation, the Licensee shall make every effort to ensure a release from the impoundment, immediately contact the Michigan DNR FERC Coordinator, and notify the Michigan DNR - Fisheries Division within 24 hours.

2) Should the Licensee become aware of a water quality emergency in the project impoundment or downstream, the Licensee shall immediately contact the Michigan DNR through the Pollution Emergency Alerting System, and shall modify project operation or discharge as needed to alleviate the emergency.

3) To assure run-of-river operation, the Licensee shall monitor and record inflow to the project impoundment and outflow from the project, and provide this information to the Michigan DNR and/or the FWS upon request.

These conditions require measures that would help to maintain water quality in the Black River, but do not

specifically require maintenance with State standards. Articles 401, 402, and 404 encompass these conditions, and require the Licensee to: develop and implement a water quality monitoring plan, including implementing reasonable measures to alleviate water quality problems, operate the Tower and Kleber Project in a run-of-river mode, and develop and implement a plan to monitor run-of-river operation.

SECTION 18 FISHWAY PRESCRIPTION

The U.S. Department of the Interior (Interior), by letter dated December 7, 1992, requests that its authority to prescribe the construction, operation, and maintenance of fishways pursuant to Section 18 of the FPA be reserved for any project licensed at Tower dam and Kleber dam. Although fish passage facilities may not be prescribed by Interior at the time of project licensing, the Commission's practice has been to include a license article which reserves Interior's authority to prescribe facilities for fish passage. Therefore, Article 408 of this license reserves authority to the Commission to require the Licensee to construct, operate, and maintain such fishways as may be prescribed by Interior pursuant to Section 18 of the FPA.

RECOMMENDATIONS OF FEDERAL AND STATE FISH AND WILDLIFE AGENCIES

Section 10(j) of the FPA requires the Commission to include license conditions, based on recommendations of Federal and state fish and wildlife agencies, for the protection of, mitigation of adverse impacts to, and enhancement of fish and wildlife. Section 10(j) of the FPA also states that whenever the Commission believes any fish and wildlife agency recommendations are inconsistent with the purposes and requirements of the FPA or other applicable law, the Commission and the agencies shall attempt to resolve any such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agencies.

Staff made a preliminary determination that certain Michigan DNR and Interior recommendations were inconsistent with the purpose and requirements of Part I of the FPA and other applicable law, and conflicted with the comprehensive planning and public interest standards of Section 10(a) of the FPA.

In response to the determinations, staff received comment letters from Interior, the Michigan DNR, and Wolverine Power Supply Cooperative (Wolverine). The following discussion is to address comments in letters from the Michigan DNR (letter dated June 1, 1993, from James G. Truchan, Michigan DNR - FERC Program Manager, Lansing, MI), the U.S. Fish and Wildlife Service (letter dated June 22, 1993, from Charles M. Wooley, USFWS -- Field Supervisor, East Lansing, MI), and Wolverine (letter dated May 6, 1993, from James R. Nickel, Wolverine Power Supply Cooperative -- Power Production Manager, Cadillac, MI) to the Commission regarding the EA for the Tower and Kleber Hydro Project issued April 7, 1993.

The Michigan DNR and the U.S. Fish and Wildlife Service (FWS) requested, and subsequently attended, a consultation meeting on June 28, 1993, at the Commission's Washington, D.C. office to resolve issues arising under 10(j) of the FPA

[10(j) meeting]. Other participants represented Wolverine and Commission staff. All fish and wildlife concerns and other concerns presented in the letters were addressed at the 10(j) meeting, as summarized below. Unless otherwise cited, the statements attributed to the Michigan DNR and the FWS are from these letters.

FISHERIES

Fish Entrainment and Protection

As noted on the bottom of page 17 of the EA for the Tower and Kleber Project, Wolverine and the Michigan DNR have reached agreement on a four-stage fish protection plan that is designed to minimize fish entrainment at the project. The agreement between Wolverine and the Michigan DNR states "The intent will be to determine the optimum method(s) for reducing fish entrainment at our project sites, given realistic operating and maintenance constraints. Appropriate new developments and alternative methods will be considered along with or instead of currently proposed measures, as the process continues."

In its letter dated May 6, 1993, and at the 10(j) meeting, Wolverine requested that the Commission, for any license issued for the Tower and Kleber Project, specifically allow Wolverine, in consultation with the Michigan DNR, to include new developments and alternative methods in its evaluation process, and if deemed appropriate, to install fish protection measures other than those specifically mentioned in the EA.

At the 10(j) meeting, Commission staff, Wolverine, and Michigan DNR agreed that a certain degree of flexibility in the 4-year phased approach to providing fish protection at the Tower and Kleber Project is warranted, and that such language should be incorporated into any license issued for the project. This flexibility would permit substitution of technology or the re-ordering of fish protection measures upon agreement between Wolverine and the Michigan DNR.

With regards to fish valuation, the Michigan DNR, in its letter of June 1, 1993, recommends that Wolverine conduct a fishery damage assessment, in consultation with the Michigan DNR, or pay the Michigan DNR restitution value for the lost fishery resources in the amount equal to that determined by application of Public Act 165 of 1929 as amended (Michigan Compiled Laws 305.13). Commission staff disagree with both aspects of this recommendation.

The fish damage assessment recommended by Michigan DNR is based on a CERCLA (Comprehensive Environment Response and Cleanup Liability Act of 1980, P.L. 96-510) methodology. The staff argued that such methodology is not appropriate in this case.

CERCLA, while dealing with liability, is based on intent or negligence. While Wolverine may be killing a portion of the fish that pass through the turbines at the Tower and Kleber Project, Wolverine is not intentionally taking fish. Further, the fish that are lost from operation of the Tower and Kleber Hydroelectric facility should not be considered similar to fish kills resulting from contaminant spills, because they will be a direct consequence of lawful operation of the project under a federal license.

The Michigan State Legislature has codified a valuation method providing for restitution, which the Michigan DNR, in the absence of a site-specific fish damage assessment, seeks to apply to the Tower and Kleber Project. The Michigan DNR states that the fish are the State's property and their loss to entrainment mortality is an "illegal taking." The Michigan DNR's restitution value is said to include both the replacement and social (i.e., option and existence) value of the entrained fish.

As support for using option and existence values, the Michigan DNR erroneously cites Utah v. Kennecott Corp. (Civ. No. 86-C-0902G, September 3, 1992). This case is not applicable here, as it is a case involving contaminated groundwater and associated human health impacts. Although Commission staff agrees with the Michigan DNR that the analysis upheld in Utah, may be appropriately used for fisheries resources in certain circumstances, this does not include cases, like the Tower and Kleber Project, where future uses of a fishery would not be compromised by turbine entrainment mortality.

The Michigan DNR views fish loss due to turbine entrainment mortality as an "illegal taking." Staff disagrees. The staff considers turbine mortality to be incidental to operating a licensed project, and considers such losses along with other factors in issuing a license.

Staff believes the value that Michigan DNR seeks to place on entrained fish is excessive. Staff does not understand what method is used by Michigan DNR to account for option and existence values, in light of the values assigned to different fishes killed at the project. For example, the Michigan DNR values a small juvenile black crappie the same as a one-pound brown trout; the value is $10.00, each. Staff cannot agree that the appropriate value for a juvenile crappie, which would cost less than $0.50 to replace, is $10.00.

In its written comments and at the § 10(j) meeting, Michigan DNR consistently held that the Commission has no right to value the property of the State of Michigan. Staff disagrees. The Commission is mandated to make licensing decisions that represent the best comprehensive use of the waterway. Certainly, staff considers the values that the state places on its resources, but when it cannot support the appropriateness of these values, staff must develop other values based upon accepted methodologies. In its analysis, staff used replacement values accepted by the American Fisheries Society. The Michigan DNR and Commission staff did not agree at the § 10(j) meeting on the valuation of fishes killed.

Commission staff concludes that replacement values are appropriate for the fish losses at the Tower and Kleber Project, and that requiring the Licensee to conduct Michigan DNR's fish damage assessment, or assume compensation based on restitution value, would not, under current conditions, promote the best comprehensive use of this waterway. In an effort to reach a compromise on the fish valuation issue, the Michigan DNR, at the § 10(j) meeting, suggested that a settlement could be reached, which would provide a value for the fishery affected. Wolverine and Commission staff accepted this approach.

The March 1, 1994 settlement agreement between Wolverine and the Michigan DNR includes the following:

(1) For the first four years after the issuance of the license, during the time that Wolverine is installing and testing various fish loss mitigation measures at the Tower and Kleber dams, no fish loss damages will be paid by Wolverine. Thereafter, losses based upon regular electronic and/or manual fish counts will be paid by Wolverine with a cap not to exceed $35,000 (in 1993 dollars) per year adjusted by the Consumers Price Index (CPI). Reductions in fish losses resulting from successful mitigation efforts of Wolverine would reduce the $35,000 proportionately.

(2) Beginning four years after the effective date of the license for the Tower and Kleber Project, Wolverine will annually contribute up to $35,000 to the State of Michigan Habitat Improvement Account (Account), which will be used for fish habitat restoration or enhancement, preparing comprehensive river management plans, aquatic studies, fisheries recreation, water quality improvement, and soil erosion control activities on the Black River. Contributions made to the Account will be by check made payable to the State of Michigan by October 1 of each year for the previous 12-month period, or any portion thereof, and forwarded to the Assistant Attorney General in charge of the Natural Resources Division for deposit to the Account. For any period of time in which this settlement is in place and one or more of the units associated with the Tower and Kleber Project are not operating due to maintenance, or other scheduled or unscheduled outages, the payments will be adjusted downward accordingly.

(3) Each year, Michigan DNR will consult in advance with

Wolverine regarding the expenditure of contributions made to the Account prior to Michigan DNR authorizing an activity. The Michigan DNR will not obtain Commission approval of any activity, except where it would require modification of the project license. The Michigan DNR will provide an annual report to the Commission and Wolverine detailing the expenditures made from the Account by December 1 of each year.

Staff agrees with the provisions of this agreement, and I am requiring these provisions be included as license conditions for the Tower and Kleber Project.

With regard to the compensation mechanism for residual fish losses, the Michigan DNR, at the § 10(j) meeting, requested clarification regarding the mechanism by which payments for residual fish losses would be accomplished. In its June 1, 1993, letter, the Michigan DNR stated that it cannot agree with Wolverine undertaking fish management activities, an activity which Wolverine is not authorized to conduct in the state of Michigan. The Michigan DNR also stated that compensation should be provided to the State of Michigan, as stated in their recommended license condition.

At the § 10(j) meeting, staff indicated that payments for residual fish losses would be accomplished in two different ways. First, Wolverine, in consultation with the resource agencies, would be required to develop fisheries management plans. A second approach would require Wolverine to file with the Commission an agreement between Wolverine and the resource agencies for Michigan DNR to allocate funds at its discretion for specific fisheries management plans. The Michigan DNR concluded that these two options satisfied their concerns about compensating for residual fish losses, and agreed with the approach.

Article 407 of this license requires the Licensee to implement a fish protection plan (including providing monetary compensation for residual fish losses) in accordance with the settlement agreement.

Upstream Fish Passage

Staff estimates the cost of Denil fish ladders, similar to one used at projects in Canada (Katopodis, 1991 2/), for the Tower and Kleber Project at $1,814,000 in 1994 dollars --

2/ Katopodis, C., A.J. Derksen, and B.L. Christensen (1991). Assessment of two Denil fishways for passage of freshwater species. Fisheries Bioengineering Symposium. American Fisheries Society Symposium (10:306-324).

extrapolated on a per-foot-of-head basis from the Fairford wooden fishway in Manitoba, Canada -- and that such a fish ladder would cost Wolverine about $178,000 annually when levelized over a 30-year licensing period, or about 55.2 mills per kilowatt-hour (kWh), assuming an annual generation of 7.5 gigawatt-hours (GWh).3/

The limited number of studies on the effectiveness of Denil fish ladders passing resident fishes indicate that some resident species may utilize Denil fishways, although generally low percentages of sport fish tagged in the tailwaters have been observed to ascend the fishways. In order to evaluate the appropriateness of providing Denil or any other type of fishways at the Tower and Kleber Project, I would require evidence to support the need for fish passage by the resident species at the project, the expected use of the fishway by these fishes, and the expected benefits of such a passage program, in terms of fish production, recreational enhancement, and any other benefits.

The Michigan DNR is currently evaluating the need for fish passage in the Cheboygan River Basin, including the Black River. The Michigan DNR intends to develop a river management plan that would address resident fish passage at the Tower and Kleber Project. If the above data become available and Michigan DNR concludes that fish passage is warranted at the Tower and Kleber Project, the Michigan DNR's request for fish passage, including supporting documentation, should be submitted to the Commission for consideration under the standard re-opener clause.4/

Should the Michigan DNR submit evidence under the re-opener, and if it is determine that it is appropriate to install and operate upstream fish passage facilities at the Tower and Kleber Project, the Commission would consider the installation and operation of such facilities. Based upon this understanding of the application of the standard re-opener clause, the Michigan DNR agreed at the 10(j) meeting that a special re-opener for

3/ Staff's estimate does not include costs associated with replacing the facility in less than 30 years (if it is constructed of treated lumber) and reduced generating flows. Staff's estimate does include costs associated with operation and maintenance ($10,000/year in 1994 dollars), contingencies (15 percent of fishway costs) and engineering (10 percent of fishway costs).

4/ The Michigan DNR may also seek fish passage through Interior via the Section 18 fishway prescription. Article 408 of this license reserves authority to the Commission to require the licensee to construct, operate, and maintain such fishways as may be prescribed by Interior pursuant to Section 18 of the FPA.

fish passage is unnecessary for the Tower and Kleber Project.

Lake Sturgeon Management Plan

The Michigan DNR disagrees with the staff's finding that Wolverine's responsibility for impacts on the lake sturgeon be limited to operational considerations. At the § 10 (j) meeting, Michigan DNR stated that the intent of Michigan DNR's original recommendation was for Wolverine's cooperation in the development of the lake sturgeon management plan. The Michigan DNR and FWS clarified that Michigan DNR would develop the lake sturgeon management plan for the Black River, and implement the plan with Wolverine's cooperation. I agree with this approach.

In their written correspondence, the Michigan DNR stated that they are seeking full participation by Wolverine in the plan for such items as bank stabilization, propagation, and habitat improvement (i.e., the addition of spawning substrate) for lake sturgeon. While staff agrees with Wolverine's involvement in implementing a lake sturgeon management plan, staff also recommends that such involvement be limited to any reasonable activities, including operational considerations for the Tower and Kleber Project, certain habitat improvement measures within areas influenced by project operation, and fish inventories.

Regarding habitat improvement, the Michigan DNR is recommending that Wolverine be responsible for reclaiming specific erosion areas in the Black River downstream of the Kleber development (6 to 7 miles downstream to Black Lake). Commission staff disagrees. Wolverine should not be responsible for reclaiming and monitoring erosion sites in the 6 to 7 mile stretch of the Black River downstream from Kleber dam to Black Lake, as this area was likely not influenced by the historical operation of the Tower and Kleber Project, nor would it likely be influenced by the future operation of the project. However, Wolverine should be responsible for erosion areas in, and around, the project site.

At the § 10(j) meeting, Commission staff and Michigan DNR agreed that Wolverine would play a somewhat broader role in the implementation of a lake sturgeon management plan for the Black River. However, management activities that Wolverine would be engaged in would be limited in scope, and the formalized plan required by this license would need to define the type of reasonable activities Wolverine would cooperate with the Michigan DNR to implement. The Michigan DNR, at the § 10(j) meeting, suggested that a settlement could be reached, which would identify such measures for Wolverine's involvement. Wolverine and Commission staff accepted this approach.

On March 1, 1994, the Michigan DNR filed with the Commission, the settlement agreement for lake sturgeon management on the Black River. The provisions of this plan are as follows:

> It has been agreed between Wolverine and the MDNR that Wolverine will assist the MDNR in its involvement as to the enhancement of sturgeon propagation; however, it is agreed that for the time being no significant facilities such as a pond or shed (rearing facility) will need to be constructed by Wolverine for such purposes at this time. In the future, should a rearing facility be necessary for the sturgeon propagation activities of the MDNR, Wolverine will work with the MDNR in constructing the rearing facility. The plan for the rearing facility will be developed by MDNR, in consultation with Wolverine and filed with the Commission by Wolverine. The plan will describe the type of facility, construction schedule, and Wolverine's obligation with respect to the rearing facility. Upon Commission approval, Wolverine will implement the plan. Further, Wolverine will continue to work with the MDNR in operating the Kleber dam so as to allow the MDNR to continue its present lake sturgeon habitat protection and propagation activities below the project.

Staff agrees with the provisions of this agreement, and I am requiring these provisions be included as license conditions for the Tower and Kleber Project.

Article 406 of this license requires the Licensee to cooperate with the Michigan DNR in managing the Lake sturgeon in the Black River per the March 1, 1994 settlement agreement.

PROJECT OPERATION

Streamflow Gaging

In the EA for the Tower and Kleber Project, Commission staff determined that streamflow gaging was outside the scope of § 10(j). At the § 10(j) meeting, the Michigan DNR questioned the staff's determination that streamflow gaging was not a § 10(j) recommendation. The Michigan DNR supported their position by stating that without streamflow gaging, there is no way to detect compliance with run-of-river operation. Commission staff agrees that streamflow gaging should be a § 10(j) recommendation.

In written comments and at the § 10(j) meeting, the Michigan DNR maintained that a contingency plan is needed to ensure that the Tower and Kleber project is operated in a run-of-river mode. On page 14 of the EA, staff concluded that the installation of a new upstream U.S. Geological Survey (USGS) gaging station was not necessary to monitor compliance with run-of-river operation. At the § 10(j) meeting, Commission staff stated that the objection was not with the need for a contingency plan, but that maintaining the Michigan DNR's recommended ñ5 percent flow differential between the upstream and downstream gaging stations could be a potential problem.

To reach a compromise, the Michigan DNR and Commission staff, at the § 10(j) meeting, agreed to a phased approach to monitoring compliance with run-of-river operation at the Tower and Kleber Project. Wolverine would be required to implement a 3-year test period to determine the adequacy of the proposed headpond elevation and streamflow monitoring measures to maintain run-of-river operation. At the end of 3 years, compliance with run-of-river, based on the proposed monitoring system, would be evaluated. If compliance with run-of-river can not be adequately proven by Wolverine's proposed streamflow monitoring system, Wolverine would be required to install, operate, and maintain an upstream USGS gaging station.

Article 404 of this license requires the Licensee to develop and implement a monitoring plan that includes a provision for installing an upstream USGS gaging station at the end of 3 years, if needed.

TERRESTRIAL

Threatened and Endangered Species

The Michigan DNR stated that while it supported the Commission's efforts to enhance and protect the bald eagles' habitat and forage base, Michigan DNR objected to "the specific license article language which may preclude Wolverine from participating in State mandated fisheries management activities and to the 1,320-foot buffer zone for bald eagle feeding areas." The Michigan DNR further stated that its recommended threatened and endangered species plan would afford the site specific protection needed to meet the needs of the bald eagles, and the needs of the recreationists which use the project area.

The two measures to which the Michigan DNR referred are:

> "c. To restrict human activity, such as bird watching and hiking, in consistently used bald eagle feeding area(s) by posting the area(s). A distance of 1,320 feet is recommended as a minimum buffer zone for human presence"; and
>
> "e. To protect the forage base of the bald eagle, the Licensee shall not participate in, encourage, or support the removal of rough fish, such as carp, sucker, or bullhead, in the stream sections within the project boundary."

During the meeting, the Commission staff, Michigan DNR, and FWS agreed that the addition of language to the recommendations which reflects a process for identification of foraging areas and establishment of exclusionary zones around those areas, as well as conditions under which Wolverine could participate in State mandated fisheries activities, would settle the disagreement. The Michigan DNR further agreed that a threatened and endangered species plan would not be needed if the above conditions are included in an article in the license. The bald eagle article reflecting the decision reached during the meeting, Article 410, addresses Michigan DNR and FWS's concerns.

I agree to the addition of further language regarding exclusionary zones around the foraging areas (i.e., who has the responsibility to identify foraging areas, and once identified, the distances of exclusionary zones); and to the inclusion of language requiring the Licensee to file with the Commission for approval, upon completion of consultation with the FWS and Michigan DNR, any plan which would require the participation of the Licensee in rough fish removal from the project reservoirs or stream sections within the project.

OTHER ISSUES

Soil Erosion Control Plan

During the meeting, Wolverine and Michigan DNR agreed to attempt to settle disagreement over the need for an erosion plan for the project. There was no evidence to warrant requiring the plan and it may not be possible to determine, in some cases, a direct link between the project operations and soil erosion. However, Wolverine agreed to do a joint survey with Michigan DNR of the projects' reservoirs, evaluate the causes of any erosion found, and cooperate with the Michigan DNR in the maintenance and reclamation of areas that are directly affected by project operations. Michigan DNR suggested that a settlement could be reached, which would outline the areas that need to be reclaimed and the role of Wolverine in the reclamation and monitoring of those sites. Wolverine agreed.

As a result of the meeting, the settlement agreement filed by the Michigan DNR on March 1, 1994, also contains the following provisions regarding soil erosion at the project:

> As to possible erosion sites above and below both dams, the parties agree that a joint survey would be made and that repair and restoration of identified sites would be undertaken. [Wolverine] and the MDNR have jointly surveyed the area and initially inventoried a total of two sites, both on private property, as needing restoration activity. Bank stabilization, restoration, and seeding of these sites has been initiated by [Wolverine]; hereafter, [Wolverine] will take reasonable action to maintain the seeding to ensure appropriate vegetative growth. Erosion sites caused by project operation that are identified in the future will

be repaired by [Wolverine]. Future identified erosion on state land caused by activity other than project operation shall be the responsibility of the MDNR.

Staff agrees with these provisions of the settlement agreement, and I am requiring these provisions be included as a license condition for the Tower and Kleber Project.

Article 413 of this license requires the Licensee to cooperate with the Michigan DNR in identifying and repairing erosion sites caused by project operation per the March 1, 1994, settlement agreement.

Recreation

At the Section 10(j) meeting, the Michigan DNR withdrew its original opposition to the Licensee's charging user fees at recreation sites where more than a minimum level of access is provided. The Licensee would address this issue in detail in its recreation report to be filed with the as-built drawings in accordance with Article 411 of the license.

COMPREHENSIVE PLANS

Section 10(a)(2) of the FPA requires the Commission to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. Under Section 10(a)(2), Federal and state agencies filed a total of 47 plans for Michigan and 7 for the United States. Staff has determined that 2 of these plans are relevant to this project.5/ No conflicts were found. Although Michigan's recreation plan (1985) shows no need for improving resource-based recreational opportunities in Cheboygan County, the DNR has identified a need for improved public access at the project, especially facilities for the disabled. I conclude that the phased approach to recreation development proposed by Wolverine would be consistent with Michigan's recreation plan.

COMPREHENSIVE DEVELOPMENT

Sections 4(e) and 10(a)(1) of the FPA, require the Commission to give equal consideration to all uses of the waterway on which a project is located. When the Commission reviews a project, the recreation, fish and wildlife, and other

5/ Michigan Department of Natural Resources, Building Michigan's recreation future: the 1985-90 Michigan recreation plan, 1985; and Fish and Wildlife Service and Canadian Wildlife Service, North American Waterfowl Management Plan, May 1986.

nondevelopmental values are considered equally with power and other developmental values. In determining whether, and under what conditions, a hydropower license should be issued, the Commission must weigh the various economic and environmental tradeoffs involved in the decision.

Recommended Alternative

Based on staff's independent review and evaluation of the project, the project with additional environmental measures, and the no-action alternative, I have selected the project, with additonal enhancement measures, as the preferred option. I selected this option because overall these measures along with the standard articles would protect or enhance fish resources, water quality, recreational resources, cultural resources, and protect existing and undiscovered archeological sites. Also, the electricity generated from the project would continue to off-set the use of fossil-fueled, electrical generating plants, conserve non-renewable energy resources, and reduce atmospheric pollution.

The measures included in this license require the Licensee to:

(a) operate the project in run-of-river mode;

(b) provide passage of streamflow equal to inflow into the project during emergency shutdowns;

(c) implement a water quality monitoring plan;

(d) limit winter draw down to no more that 1 foot;

(e) cooperate with DNR to develop a formal Lake sturgeon management plan, however participation will be limited to operational considerations only;

(f) implement a turbine and entrainment protection and mitigation plan;

(g) implement a monitoring plan for compliance with dissolved oxygen and temperature limits;

(h) implement a plan to control/eliminate noxious water plants when deemed appropriate;

(i) cooperate with the Michigan DNR in identifying and repairing soil erosion caused by project operation;

(j) implement a bald eagle protection measures; and

(k) protect any previously undiscovered properties that may be eligible for listing on the National Register of Historic Places;

The above measures would adequately protect or enhance aquatic resources as well as recreational fishing, and their costs are included in the economic evaluation of the project.

Developmental and Nondevelopmental Uses of the Waterway

A project would be economically beneficial, so long as its projected levelized cost is less than the levelized cost of alternative energy and capacity.

Staff has prepared an economic analysis for the project with enhancement measures. The project with the above-mentioned enhancement measures would provide a number of benefits. An estimated 7,498.5 MWh of relatively low-cost electricity would continue to be generated annually from a clean, domestic, reliable, and renewable energy resource for use by seven of Wolverine's nearby wholesale cooperative customers. 6/

The 30-year levelized value of alternative power would be about $242,510 annually or 32.33 mills/kWh, and the project's levelized cost would be about $173,600 annually or 23.09 mills/kWh. The project would have levelized net annual benefits of $69,350 or 9.24 mills/kWh. There would be beneficial effects to the environment associated with the licensing of the Tower and Kleber Hydro Project and the above-mentioned enhancement measures required for the protection of natural resources. The project is economically beneficial with the enhancement measures.

PROJECT RETIREMENT

Both the Michigan DNR and the Michigan Hydro Licensing Coalition disagreed with the Commission's recommendation not to require Wolverine, 10 years after license issuance, to begin consulting with Michigan DNR on a plan for studying the costs of (1) permanent non-power operation, (2) partial project removal, and (3) complete project removal, without implying any obligation on Wolverine's part to retire the project or not seek additional new licenses for it. The details of this recommendation and staff's opposition to it are explained in the EA.

The Commission has issued a Notice of Inquiry (NOI), dated September 15, 1993, requesting comments that address the potential decommissioning of licensed hydropower projects at some

6/ The electricity potentially generated by the proposed project is equivalent to the energy that would be produced by burning 3,147 tons of coal annually in a steam-electric power plant.

future time, based on project-specific circumstances. 7/ The NOI states that the Commission is not proposing new regulations at this time, but is inviting comments on whether new regulations may be appropriate. Alternatively, the Commission may consider issuing a statement of policy addressing the decommissioning of licensed hydropower projects, or take other measures. The Tower and Kleber Project may be affected by future actions that the Commission takes with respect to issues raised in the NOI. Therefore, the license includes Article 204, which reserves authority to the Commission to require the licensee to conduct studies, make financial provisions, or otherwise make reasonable provisions for decommissioning of the project in appropriate circumstances. The terms of Article 204 are effective unless the Commission, in Docket No. RM 93-23, finds that it lacks statutory authority to require such actions.

By including Article 204, the Commission does not intend to prejudge the outcome of the NOI. We are simply including the article so that we will be in a position to make any lawful and appropriate changes in the terms and conditions of this license, which is being issued during the pendency of the NOI, based on the final outcome of that proceeding.

LICENSE TERM AND BACK ANNUAL CHARGES

The Tower and Kleber Hydro Project began electric operation in 1918. This license authorizes no new construction. Accordingly, pursuant to the license term policy articulated in City of Danville 8/, I will give the license a prospective term of thirty years.

The project affects the Black River that was found navigable based on a navigation status report prepared by the Commission's Chicago Regional Office in May of 1939. As articulated in City of Danville, it is Commission policy to require, in a license for a previously unauthorized existing pre-1935 project located on a navigable waterway, payment of an amount equivalent to the annual charges that would have been collected from April 1, 1962, unless there was an earlier specific navigability finding, or January 1, 1938, whichever is later. Consequently, I will condition the license issued herein upon payment of an amount equivalent to annual charges that would have been paid, had the license been obtained on May 1, 1939.

7/ Notice of Inquiry, Project Decommissioning at Relicensing, Docket No. RM93-23-000, September 15, 1993.

8/ City of Danville, Virginia, Project No. 10896, 58 FERC 61,318 (1992).

SUMMARY OF FINDINGS

An EA was issued for this project. Background information, analysis of impacts, support for related license articles, and the basis for a finding of no significant impact on the environment are contained in the EA attached to this order. Issuance of this license is not a major federal action significantly affecting the quality of the human environment.

The design of this project is consistent with the engineering standards governing dam safety. The project will be safe if operated and maintained in accordance with the requirements of this license. Analysis of related issues is provided in the SDA.

I conclude that the project would not conflict with any planned or authorized development, and would be best adapted to comprehensive development of the waterway for beneficial public uses.

The Director orders:

(A) This license is issued to Wolverine Power Supply Cooperative, Inc. (Licensee), for a term of thirty years, effective the first day of the month in which this order is issued to operate and maintain the Tower and Kleber Hydro Project. This license is subject to the terms and conditions of the FPA, which are incorporated by reference as part of this license, and subject to the regulations the Commission issues under the provisions of the FPA.

(B) The project consists of:

(1) All lands, to the extent of the Licensee's interests in those lands, enclosed by the project boundary shown by exhibit G:

Exhibit G-	FERC No. 10615-	Showing
G-1	17	Project Location
G-2	18	Project Location
G-3	19	Project Location

(2) Project works consisting of the following two developments.

A. The Tower Hydroelectric Development which consists of: (1) a 727-foot-long and 29.3-foot-high concrete gravity dam consisting, from right to left looking downstream, (a) a short embankment section, (b) a powerhouse section, (c) a 110-foot-long gated spillway section, (d) a 194-foot-long concrete non-overflow section, and (e) a 350-foot-long concrete core wall section; (2) an intake structure integral with the powerhouse equipped with 4 vertical timber slide headgates; (3) a brick/reinforced concrete powerhouse 35 feet long by 32 feet wide and 50 feet high, integral with the dam, housing two 280-kW generating units with a total installed capacity of 560-kW; (4) a non-operational sluiceway; (5) a 102-acre reservoir having a maximum storage capacity of 620 acre-feet at 722.1 feet m.s.l.; (6) a 150-foot-long, 2.4-kV transmission line connecting the Tower generator plant bus to the Tower switchyard bus; and (7) appurtenant facilities.

B. The Kleber Hydroelectric Development which consists of; (1) a 535-foot-long and 40-foot-high earth dam; (2) a 12-foot-long ogee type spillway controlled by a Taintor gate and a 200-foot-long uncontrolled emergency spillway; (3) an intake structure equipped with two vertical lift gates; (4) a reinforced concrete powerhouse 42 feet long by 40 feet wide and 54 feet high, housing two 600-kW generating units with a total installed capacity of 1,200-kW; (5) two 84-inch diameter, 139-foot-long steel penstocks; (6) a 295-acre reservoir having a maximum storage capacity of 3,000 acre-feet at 701.1 feet m.s.l.; (7) a 4-mile-long, 12.5-kV transmission line connecting the Kleber generator plant bus to the Presque Island distribution load top; and (8) appurtenant facilities.

The project works generally described above are more specifically shown and described by those portions of exhibits A and F shown below:

Exhibit A: The following sections of exhibit A filed February 21, 1989:

Pages 1 through 13 and Figure A-1, describing the existing mechanical, electrical and transmission equipment, filed February 21, 1989.

Exhibit F drawings	FERC NO.	Showing
Sheet F-1	10615-1	Kleber Dam Component Project Features
Sheet F-2	10615-2	Kleber Dam Component Dam and Powerhouse Arrangement
Sheet F-3	10615-3	Kleber Dam Component Dam Profile
Sheet F-4	10615-4	Kleber Dam Component Dam Sections

Sheet F-5	10615-5	Kleber Dam Component Spillway and Intake Plan and Sections
Sheet F-6	10615-6	Kleber Dam Component Spillway and Intake Elevation and Section
Sheet F-7	10615-7	Kleber Dam Component Powerhouse Plans and Section
Sheet F-8	10615-8	Kleber Dam Component Powerhouse Elevations
Sheet F-9	10615-9	Kleber Dam Component Emergency Spillway Plan and Sections
Sheet F-10	10615-10	Tower Dam Component Project Features
Sheet F-11	10615-11	Tower Dam Component Spillway Plan and Elevation
Sheet F-12	10615-12	Tower Dam Component Gated Spillway Sections
Sheet F-13	10615-13	Tower Dam Component Overflow Spillway Sections
Sheet F-14	10615-14	Tower Dam Component Dam Sections
Sheet F-15	10615-15	Tower Dam Component Powerhouse Plans and Sections
Sheet F-16	10615-16	Tower Dam Component Powerhouse Elevations

(3) All of the structures, fixtures, equipment or facilities used to operate or maintain the project and located within the project boundary, all portable property that may be employed in connection with the project and all riparian or other rights that are necessary or appropriate in the operation or maintenance of the project.

(C) The exhibits A, F, and G described above are approved and made part of the license.

(D) This license is subject to the articles set forth in Form L-3, (October 1975), entitled "Terms and Conditions of License for Constructed Major Project Affecting Navigable Waters of the United States," and the following additional articles:

Article 201. The Licensee shall pay the United States an annual charge, effective the first day of the month in which this license is issued.

(a) For the purposes of reimbursing the United States for the cost of administration of Part I of the FPA as determined by the Commission. The authorized installed capacity for that purpose is 2,400 horsepower.

Article 202. The Licensee shall pay the United States an amount equal to the annual charges for administrative costs that would have been assessed for the period from May 1, 1939 to the effective date of this license, if the project had been licensed during that period. The authorized installed capacity for that purpose is 2,400 horsepower.

Article 203. Within 90 days from the date of issuance of this license, the Licensee shall file with the Commission: (a) a statement which includes the dates and amounts of each change in installed capacity of the project since May 1, 1939; (b) a statement showing the gross amount of power generation for the project in kilowatt-hours for each calendar year commencing May 1, 1939, in accordance with the provisions of 18 C.F.R. Part 11 of the Commission's regulations.

Article 204. The Commission reserves authority, in the context of a rulemaking proceeding or a proceeding specific to this license, to require the Licensee at any time to conduct studies, make financial provisions, or otherwise make reasonable provisions for decommissioning of the project. The terms of this article shall be effective unless the Commission, in Docket No. RM93-23, finds that the Commission lacks statutory authority to require such actions or otherwise determines that the article should be rescinded.

Article 401. Within 180 days from the date of issuance of this license, the Licensee shall file with the Commission, for approval, a plan to monitor dissolved oxygen (DO) and temperature of the Black River upstream of the Tower reservoir (in the project headrace), directly downstream of Tower dam (tailrace area) and downstream of the Kleber powerhouse (tailrace area), and to maintain state water quality standards.

The purpose of this monitoring plan is to provide data adequate to determine if streamflows below the project, as measured immediately downstream of the Tower dam and Kleber dam, maintain the following standards, which the Licensee is required to implement reasonable measures to maintain, for DO concentration and temperature when river discharges are greater than or equal to the 95% exceedence flow:

(a) DO concentrations in the project tailwaters not less than 7 milligrams per liter (mg/l) at any time unless Wolverine demonstrates to the Michigan Department of Natural Resources (Michigan DNR) that these DO limits are not attainable through further feasible and prudent measures or the variation between the daily average and daily minimum DO concentrations in the river exceeds 1 mg/l as measured upstream from the project. If the Michigan DNR agrees with Wolverine's demonstration, DO concentrations in project tailwaters shall not be less than 6 mg/l at any time during the warm weather season (June through September) until such time as the Michigan DNR prepares and implements a comprehensive plan as described in the State of Michigan water quality standards to upgrade these waters to 7 mg/l at any time;

(b) temperature in the project tailwaters no greater than a monthly average of 2 degrees Fahrenheit (èF) higher than the temperature as measured upstream of the project; and

(c) monthly average temperatures downstream of the project no greater than:

January, February -- 38èF
March -------------- 43èF
April -------------- 54èF
May ---------------- 65èF
June - August ------ 68èF
September ---------- 63èF
October ------------ 56èF
November ----------- 48èF
December ----------- 40èF

These monthly average temperatures may be exceeded for short periods with approval from the Michigan DNR when natural water temperatures measured upstream of the project exceed the ninetieth percentile occurrence of water temperatures (i.e., the monthly average temperatures cited in item c, minus the allowable 2èF deviation allowed in item b). In all cases, temperature increases shall not be greater than the natural water temperature as measured upstream of the project plus the increase allowed in item b.

The monitoring plan shall include provisions for (1) continuous monitoring of dissolved oxygen and temperature above the Tower reservoir, below Tower dam, and downstream of the Kleber powerhouse with the sensor locations determined in consultation with the Michigan DNR and FWS; and (2) the preparation of operating procedures developed in consultation with the Michigan DNR and the FWS to address water quality conditions which deviate from the above limits.

The Licensee shall prepare the plan after consultation with the U.S. Fish and Wildlife Service (FWS) and the Michigan DNR. The water quality monitoring plan shall include a schedule for:

(a) implementation of the program (must be implemented within 24 months from the date of issuance of this license);

(b) consultation with the Michigan DNR and the FWS concerning the results of the monitoring; and

(c) filing the results, agency comments, and Licensee's response to agency comments with the Commission.

The Licensee shall include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the plan. The Licensee shall allow a minimum of 30 days for the agencies to comment and make recommendations before filing the plan with the Commission. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the Licensee shall implement the DO and temperature monitoring plan, including any changes to the plan required by the Commission.

Article 402. The Licensee shall operate the project in a run-of-river mode for the protection of water quality and aquatic resources in the Black River. The Licensee shall at all times act to minimize the fluctuation of the reservoir surface elevations by maintaining a discharge from the project so that, at any point in time, flows, as measured immediately downstream from the project tailrace, approximate the sum of inflows to the project reservoirs. Under normal operating conditions, the Licensee shall maintain the Tower reservoir at a target elevation of 722.1 feet National Geodetic Vertical Datum (NGVD), and the Kleber reservoir at a target elevation of 701.1 feet NGVD.

Prior to project automation, as required by article 404 to monitor compliance with run-of-river operation, fluctuations shall be limited to ñ0.5 foot around the target elevations. Thereafter, fluctuations shall be limited to ñ0.25 foot around the target elevations. The Licensee shall notify the Commission within 30 days of implementing the automation system in order to identify the date that project automation is to begin and when the required fluctuation limit shall be reduced to ñ0.25 foot.

Run-of-river operation may be temporarily modified if required by operating emergencies beyond the control of the Licensee, during periods where inflows exceed project's hydraulic capacity, or for short periods upon mutual agreement between the Licensee and the Michigan Department of Natural Resources (Michigan DNR). If the flow is so modified, the Licensee shall notify the Commission as soon as possible, but no later than 10 days after each such incident.

Article 403. To protect aquatic habitat downstream of Tower dam and Kleber dam, the Licensee shall pass inflow through the project during emergency periods when the project is shut down (i.e., during power outages or maintenance activities).

Article 404. Within 180 days from the issuance date of this license, the Licensee shall file with the Commission, for approval, a plan to monitor compliance with the run-of-river mode of operation, and to provide for flow continuation during project shutdown, as stipulated by articles 402 and 403, respectively.

The monitoring plan shall include provisions for: (a) providing funds to operate and maintain the existing downstream U.S. Geological Survey (USGS) gaging station (USGS Gage No. 04130500); (b) installing continuous level recording devices (or the project automation system) on both the Tower and Kleber reservoirs and tailwaters to ensure flow continuation during power outages and determine instantaneous headwater and tailwater elevations; (c) implementing a 3-year test period to determine the adequacy of the existing downstream USGS gaging station and proposed project automation system to maintain run-of-river operation, as stipulated by Article 402; and (d) installing, operating, and maintaining an upstream USGS gaging station, if needed, to determine instantaneous project inflow and outflow.

The plan shall include, but not be limited to, the proposed location, design, and calibration of the monitoring equipment, the method of flow data collection, and a provision for providing flow data to the U.S. Fish and Wildlife Service (FWS), the USGS, and the Michigan Department of Natural Resources (Michigan DNR) within 30 days from the date of the agency's request for the data.

The monitoring plan shall also include a schedule for:

(1) implementation of the program;

(2) consultation with the appropriate federal and state agencies concerning the data from the monitoring; and

(3) filing the data, agency comments, and Licensee's response to agency comments with the Commission.

The Licensee shall prepare the plan after consultation with the FWS, the USGS, and the Michigan DNR. The Licensee shall include with the plan documentation of consultation and copies of comments or recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agency comments are accommodated by the plan. The Licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations prior to filing the plan with the Commission. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on project specific information.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the Licensee shall implement the plan, including any changes required by the Commission.

Article 405. To protect fishery resources in the project reservoirs, and in consultation with the Michigan Department of Natural Resources (Michigan DNR), the Licensee shall limit the winter reservoir drawdown in the Tower and Kleber reservoirs to no more than 1 foot from November 1 through March 31.

Article 406. To protect and enhance lake sturgeon and lake sturgeon habitat in the Black River Basin, the Licensee shall, in accordance with the terms and provisions of section 4.0 of the "Settlement Agreement between Wolverine Power Supply Cooperative (Licensee) and the Michigan Department of Natural Resources (MDNR)," cooperate with the MDNR in implementing the MDNR's lake sturgeon management plan for the Black River Basin.

The Licensee, in consultation with the MDNR shall file annual status reports with the Commission, beginning 1 year after any license is issued for the Tower and Kleber Project, outlining the progress and activities engaged in by the Licensee as part of the MDNR's lake sturgeon management plan. The annual status reports shall be filed with the Commission by October 1 of each year, and shall include a description of the progress and activities engaged in during the previous year and the expected progress and activities to be engaged in during the upcoming year.

Article 407. Within 180 days from the date of issuance of this license, the Licensee shall file with the Commission, for approval, a turbine mortality and entrainment protection and mitigation plan. The fish protection and mitigation plan shall include provisions for □ contacting a qualified consultant in designing fish protection devices; □ designing and conducting an evaluation of all potential fish protection devices to prevent fish losses at the Tower and Kleber Project; and □ to develop the 4 year phased approach to prevent turbine mortality at the Tower and Kleber Project outlined in the December 4, 1992, letter from the Michigan Department of Natural Resources (MDNR).

Per agreement between the Licensee and the MDNR, the stages of the 4-year program, in order, shall include: (1) the installation of a new bar rack; (2) addition of an electrical field to the bar rack; (3) the installation of a barrier net; and (4) the installation of a Louver system. The Licensee shall also evaluate the effectiveness of each device using a study plan similar to that used for the entrainment study, which is to be developed in consultation with the MDNR. In accordance with this agreement, should new developments and alternative methods to providing fish protection be identified during the 4-year program, the Licensee, in consultation with the MDNR, shall include such new developments and alternative methods in the evaluation process.

In the event that no device provides 100 percent fish protection, the plan shall include provisions for the Licensee to provide payment, in accordance with the terms and provisions of section 5.0 of the "Settlement Agreement between Wolverine Power Supply Cooperative (Licensee) and the MDNR," for any residual fish killed by operation of the Tower and Kleber Project.

The fish protection and mitigation plan shall also include a schedule for:

(1) implementation of the plan;

(2) consultation with the appropriate federal and state agencies concerning the data from each phase of the plan; and

(3) filing the data, agency comments, and Licensee's response to agency comments for each phase of the plan with the Commission.

The Licensee shall prepare the plan after consultation with the MDNR and the FWS. The Licensee shall include with the plan documentation of consultation and copies of comments or recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agency comments are accommodated by the plan. The Licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations prior to filing the plan with the Commission. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on project specific information.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the Licensee shall implement the plan, including any changes required by the Commission.

Article 408. Authority is reserved to the Commission to require the Licensee to construct, operate, and maintain, or to provide for the construction, operation, and maintenance of such fishways as may be prescribed by the Secretary of the Interior.

Article 409. The Licensee shall, in consultation with the Michigan Department of Natural Resources (Michigan DNR), develop a plan to monitor purple loosestrife (Lythrum salicaria) and European milfoil (Myriphlylum spictum) in project waters annually. The plan shall include, but is not limited to: (a) the method of monitoring, (b) the frequency of monitoring, and (c) documentation of transmission of monitoring data to the Michigan DNR. The plan shall be submitted to the Commission for approval within 6 months of the date of issuance of this license. If at any time during the period of the license, the Michigan DNR deems it necessary to control/eliminate purple loosestrife and/or European milfoil, the Licensee shall cooperate in this measure. The Commission reserves the right to require changes in the plan.

The Licensee shall include documentation of consultation with the Michigan DNR before preparing the plan, copies of the Michigan DNR comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the Michigan DNR comments were accommodated by the plan. The Licensee shall allow a minimum of 30 days for the Michigan DNR to comment and to make recommendations prior to filing the plan with the Commission. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on project-specific information.

Article 410. The Licensee shall implement the measures listed below to protect the federally-listed threatened bald eagles' (Haliaeetus leucocephalus) potential nesting trees and roosting and feeding areas from human disturbance, as well as protecting the eagles' forage base.

a. To maintain and protect bald eagle perch trees, prohibit clearcutting of trees (diameter breast height of 12 inches or greater) within 200 feet of the reservoirs' shorelines, except to clear felled or damaged trees, which may affect public safety or project-related operations. In the event project operation and/or maintenance would involve any tree removal along the reservoirs' shorelines or stream sections within the project boundary, the Licensee shall contact the U. S. Fish and Wildlife Service (FWS) and the Michigan Department of Natural Resources (Michigan DNR) for approval, before removing any identified tree(s);

b. Upon determination by the FWS and Michigan DNR of consistently used bald eagle feeding area(s), the Licensee shall establish, in consultation with the FWS and Michigan DNR, human activity restriction zones around the identified area;

c. Meet annually with the FWS and Michigan DNR to identify any new nest, or previously unknown and potential nesting, roosting, or feeding sites in the project area, which would be subject to protection; and

d. Should the Michigan DNR recommend a rough fish removal program which requires the Licensee's cooperation, the Licensee shall file, upon completion of consultation with the FWS and Michigan DNR, for Commission approval any plans to remove rough fish on reservoirs or stream sections within the project including any proposed changes in project operation. The Commission reserves the right to change the plan.

Article 411. Within 6 months from the date of issuance of this license, the Licensee shall file as-built drawings showing the seven phase 1 recreation facilities, as described in the revised recreation plan filed on December 11, 1992.

The Licensee shall file a report with the as-built drawings, which shall describe: (a) how the design of the facilities accommodates use by the disabled, (b) the scope of the sign program implemented for the public access areas, including signage from major roads, (c) a general plan for operation and maintenance of all the developed public use facilities, and (d) consultation with the Michigan Department of Natural Resources and the National Park Service on the phase 1 recreation facilities, copies of comments and recommendations on the report after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated in the report. The Licensee shall allow a minimum of 30 days for the agencies to comment before filing the report with the Commission. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on project-specific information.

Within 18 months from the date of issuance of this license, the Licensee shall file as-built drawings showing the three phase 2 recreation facilities, as described in the revised recreation plan filed on December 11, 1992, together with a phase 2 report that includes the same type of descriptive information outlined above, (a) through (d), for the phase 1 report.

Article 412. The Licensee, before starting any land-clearing or land-disturbing actives within the project boundaries, other than those specifically authorized in this license, including recreation developments at the project, shall consult with the State Historic Preservation Officer (SHPO).

If the Licensee discovers previously unidentified archeological or historic properties during the course of constructing or developing project works or other facilities at the project, the Licensee shall stop all land-clearing and land-disturbing activities in the vicinity of the properties and consult with the SHPO.

In either instance, the Licensee shall file for Commission approval a cultural resource management plan (plan) prepared by a qualified cultural resource specialist after having consulted with the SHPO. The plan shall include the following items: (1) a description of each discovered property indicating whether it is listed on or eligible to be listed on the National Register of Historic Places; (2) a description of the potential effect on each discovered property; (3) proposed measures for avoiding or mitigating effects; (4) documentation of the nature and extent of consultation; and (5) a schedule for mitigating effects and conducting additional studies. The Commission may require changes to the plan.

The Licensee shall not begin land-clearing or land-disturbing activities, other than those specifically authorized in this license, or resume such activities in the vicinity of a property, discovered during construction, until informed that the requirements of this article have been fulfilled.

Article 413. The Licensee shall, in accordance with the terms and provisions of section 6.0 of the "Settlement Agreement between Wolverine Power Supply Cooperative (Licensee) and the Michigan Department of Natural Resources (MDNR)," cooperate with the MDNR in identifying and repairing erosion sites caused by project operation.

The Licensee, in consultation with the MDNR, shall file annual status reports with the Commission, beginning 1 year after any license is issued for the Tower and Kleber Project, outlining the progress and activities engaged in by the Licensee in cooperating with the MDNR in identifying and repairing erosion sites caused by project operation. The annual status reports shall be filed with the Commission by October 1 of each year, and shall include a description of the progress and activities engaged in during the previous year and the expected progress and activities to be engaged in during the upcoming year.

Article 414. (a) In accordance with the provisions of this article, the Licensee shall have the authority to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior Commission approval. The Licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the project. For those purposes, the Licensee shall also have continuing responsibility to supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the Licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the Licensee shall take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, cancelling the permission to use and occupy the project lands and waters and requiring the removal of any non-complying structures and facilities.

(b) The type of use and occupancy of project lands and water for which the Licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) non-commercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 watercraft at a time and where said facility is intended to serve single-family type dwellings; (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline; and (4) food plots and other wildlife enhancement. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the Licensee shall require multiple use and occupancy of facilities for access to project lands or waters. The Licensee shall also ensure, to the satisfaction of the Commission's authorized representative, that the use and occupancies for which it grants permission are maintained in good repair and comply with applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the Licensee shall: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the reservoir shoreline. To implement this paragraph (b), the Licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the Licensee's costs of administering the permit program. The Commission reserves the right to require the Licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The Licensee may convey easements or rights-of-way across, or leases of, project lands for: (1) replacement, expansion, realignment, or maintenance of bridges or roads where all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) non-project overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69-kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project reservoir. No later than January 31 of each year, the Licensee shall file three copies of a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed. If no conveyance was made during the prior calendar year, the Licensee shall so inform the Commission and the Regional Director in writing no later than January 31 of each year.

(d) The Licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certification or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) non-project overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or public marinas that can accommodate no more than 10 watercraft at a time and are located at least one-half mile (measured over project waters) from any other private or public marina; (6) recreational development consistent with an approved Exhibit R or approved report on recreational resources of an Exhibit E; and (7) other uses, if: (i) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from project waters at normal surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 60 days before conveying any interest in project lands under this paragraph (d), the Licensee must submit a letter to the Director, Office of Hydropower Licensing, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked exhibit G or K map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Director, within 45 days from the filing date, requires the Licensee to file an application for prior approval, the Licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the Licensee shall consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the Licensee shall determine that the proposed use of the lands to be conveyed is not inconsistent with any approved exhibit R or approved report on recreational resources of an exhibit E; or, if the project does not have an approved exhibit R or approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include the following covenants running with the land: (i) the use of the lands conveyed shall not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; (ii) the grantee shall take all reasonable precautions to insure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project; and (iii) the grantee shall not unduly restrict public access to project waters.

(4) The Commission reserves the right to require the Licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude land conveyed under this article only upon approval of revised exhibit G or K drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project shall be consolidated for consideration when revised exhibit G or K drawings would be filed for approval for other purposes.

(g) The authority granted to the Licensee under this article shall not apply to any part of the public lands and reservations of the United States included within the project boundary.

(E) The Licensee shall serve copies of any Commission filing required by this order on any entity specified in this order to be consulted on matters related to that filing. Proof of service on these entities must accompany the filing with the Commission.

(F) This order is issued under authority delegated to the Director and constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. §385.713. Filing a request for rehearing does not operate as a stay of the license unless specifically ordered by the Commission. The Licensee's failure to file a request for rehearing shall constitute acceptance of the order.

Fred E. Springer
Director, Office of
Hydropower Licensing

Form L-3
(October, 1975)

FEDERAL ENERGY REGULATORY COMMISSION

TERMS AND CONDITIONS OF LICENSE FOR CONSTRUCTED
MAJOR PROJECT AFFECTING NAVIGABLE
WATERS OF THE UNITED STATES

Article 1. The entire project, as described in this order of the Commission, shall be subject to all of the provisions, terms, and conditions of the license.

Article 2. No substantial change shall be made in the maps, plans, specifications, and statements described and designated as exhibits and approved by the Commission in its order as a part of the license until such change shall have been approved by the Commission: Provided, however, That if the Licensee or the Commission deems it necessary or desirable that said approved exhibits, or any of them, be changed, there shall be submitted to the Commission for approval a revised, or additional exhibit or exhibits covering the proposed changes which, upon approval by the Commission, shall become a part of the license and shall supersede, in whole or in part, such exhibit or exhibits theretofore made a part of the license as may be specified by the Commission.

Article 3. The project area and project works shall be in substantial conformity with the approved exhibits referred to in Article 2 herein or as changed in accordance with the provisions of said article. Except when emergency shall require for the protection of navigation, life, health, or property, there shall not be made without prior approval of the Commission any substantial alteration or addition not in conformity with the approved plans to any dam or other project works under the license or any substantial use of project lands and waters not authorized herein; and any emergency alteration, addition, or use so made shall thereafter be subject to such modification and change as the Commission may direct. Minor changes in project works, or in uses of project lands and waters, or divergence from such approved exhibits may be made if such changes will not result in a decrease in efficiency, in a material increase in cost, in an adverse environmental impact, or in impairment of the general scheme of development; but any of such minor changes made without the prior approval of the Commission, which in its judgment have produced or will produce any of such results, shall be subject to such alteration as the Commission may direct.

Article 4. The project, including its operation and maintenance and any work incidental to additions or alterations authorized by the Commission, whether or not conducted upon lands of the United States, shall be subject to the inspection and supervision of the Regional Engineer, Federal Energy Regulatory Commission, in the region wherein the project is located, or of such other officer or agent as the Commission may designate, who shall be the authorized representative of the Commission for such purposes. The Licensee shall cooperate fully with said representative and shall furnish him such information as he may require concerning the operation and maintenance of the project, and any such alterations thereto, and shall notify him of the date upon which work with respect to any alteration will begin, as far in advance thereof as said representative may reasonably specify, and shall notify him promptly in writing of any suspension of work for a period of more than one week, and of its resumption and completion. The Licensee shall submit to said representative a detailed program of inspection by the Licensee that will provide for an adequate and qualified inspection force for construction of any such alterations to the project. Construction of said alterations or any feature thereof shall not be initiated until the program of inspection for the alterations or any feature thereof has been approved by said representative. The Licensee shall allow said representative and other officers or employees of the United States, showing proper credentials, free and unrestricted access to, through, and across the project lands and project works in the performance of their official duties. The Licensee shall comply with such rules and regulations of general or special applicability as the Commission may prescribe from time to time for the protection of life, health, or property.

Article 5. The Licensee, within five years from the date of issuance of the license, shall acquire title in fee or the right to use in perpetuity all lands, other than lands of the United States, necessary or appropriate for the construction maintenance, and operation of the project. The Licensee or its successors and assigns shall, during the period of the license, retain the possession of all project property covered by the license as issued or as later amended, including the project area, the project works, and all franchises, easements, water rights, and rights or occupancy and use; and none of such properties shall be voluntarily sold, leased, transferred, abandoned, or otherwise disposed of without the prior written approval of the Commission, except that the Licensee may lease or otherwise dispose of interests in project lands or property without specific written approval of the Commission pursuant to the then current regulations of the Commission. The provisions of this article are not intended to prevent the abandonment or the retirement from service of structures, equipment, or other project works in connection with replacements thereof when they become obsolete, inadequate, or inefficient for further service due to wear and tear; and mortgage or trust deeds or judicial sales made thereunder, or tax sales, shall not be deemed voluntary transfers within the meaning of this article.

Article 6. In the event the project is taken over by the

United States upon the termination of the license as provided in Section 14 of the Federal Power Act, or is transferred to a new licensee or to a non-power licensee under the provisions of Section 15 of said Act, the Licensee, its successors and assigns shall be responsible for, and shall make good any defect of title to, or of right of occupancy and use in, any of such project property that is necessary or appropriate or valuable and serviceable in the maintenance and operation of the project, and shall pay and discharge, or shall assume responsibility for payment and discharge of, all liens or encumbrances upon the project or project property created by the Licensee or created or incurred after the issuance of the license: Provided, That the provisions of this article are not intended to require the Licensee, for the purpose of transferring the project to the United States or to a new licensee, to acquire any different title to, or right of occupancy and use in, any of such project property than was necessary to acquire for its own purposes as the Licensee.

Article 7. The actual legitimate original cost of the project, and of any addition thereto or betterment thereof, shall be determined by the Commission in accordance with the Federal Power Act and the Commission's Rules and Regulations thereunder.

Article 8. The Licensee shall install and thereafter maintain gages and stream-gaging stations for the purpose of determining the stage and flow of the stream or streams on which the project is located, the amount of water held in and withdrawn from storage, and the effective head on the turbines; shall provide for the required reading of such gages and for the adequate rating of such stations; and shall install and maintain standard meters adequate for the determination of the amount of electric energy generated by the project works. The number, character, and location of gages, meters, or other measuring devices, and the method of operation thereof, shall at all times be satisfactory to the Commission or its authorized representative. The Commission reserves the right, after notice and opportunity for hearing, to require such alterations in the number, character, and location of gages, meters, or other measuring devices, and the method of operation thereof, as are necessary to secure adequate determinations. The installation of gages, the rating of said stream or streams, and the determination of the flow thereof, shall be under the supervision of, or in cooperation with, the District Engineer of the United States Geological Survey having charge of stream-gaging operations in the region of the project, and the Licensee shall advance to the United States Geological Survey the amount of funds estimated to be necessary for such supervision, or cooperation for such periods as may mutually agreed upon. The Licensee shall keep accurate and sufficient records of the foregoing determinations to the satisfaction of the Commission, and shall make return of such records annually at such time and in such form as the Commission may prescribe.

Article 9. The Licensee shall, after notice and opportunity for hearing, install additional capacity or make other changes in the project as directed by the Commission, to the extent that it is economically sound and in the public interest to do so.

Article 10. The Licensee shall, after notice and opportunity for hearing, coordinate the operation of the project, electrically and hydraulically, with such other projects or power systems and in such manner as the Commission any direct in the interest of power and other beneficial public uses of water resources, and on such conditions concerning the equitable sharing of benefits by the Licensee as the Commission may order.

Article 11. Whenever the Licensee is directly benefited by the construction work of another licensee, a permittee, or the United States on a storage reservoir or other headwater improvement, the Licensee shall reimburse the owner of the headwater improvement for such part of the annual charges for interest, maintenance, and depreciation thereof as the Commission shall determine to be equitable, and shall pay to the United States the cost of making such determination as fixed by the Commission. For benefits provided by a storage reservoir or other headwater improvement of the United States, the Licensee shall pay to the Commission the amounts for which it is billed from time to time for such headwater benefits and for the cost of making the determinations pursuant to the then current regulations of the Commission under the Federal Power Act.

Article 12. The United States specifically retains and safeguards the right to use water in such amount, to be determined by the Secretary of the Army, as may be necessary for the purposes of navigation on the navigable waterway affected; and the operations of the Licensee, so far as they affect the use, storage and discharge from storage of waters affected by the license, shall at all times be controlled by such reasonable rules and regulations as the Secretary of the Army may prescribe in the interest of navigation, and as the Commission may prescribe for the protection of life, health, and property, and in the interest of the fullest practicable conservation and utilization of such waters for power purposes and for other beneficial public uses, including recreational purposes, and the Licensee shall release water from the project reservoir at such rate in cubic feet per second, or such volume in acre-feet per specified period of time, as the Secretary of the Army may prescribe in the interest of navigation, or as the Commission may prescribe for the other purposes hereinbefore mentioned.

Article 13. On the application of any person, association, corporation, Federal agency, State or municipality, the Licensee shall permit such reasonable use of its reservoir or other project properties, including works, lands and water rights, or parts thereof, as may be ordered by the Commission, after notice and opportunity for hearing, in the interests of comprehensive development of the waterway or waterways involved and the conservation and utilization of the water resources of the region for water supply or for the purposes of steam-electric, irrigation, industrial, municipal or similar uses. The Licensee shall receive reasonable compensation for use of its reservoir or other project properties or parts thereof for such purposes, to include at least full reimbursement for any damages or expenses which the joint use causes the Licensee to incur. Any such compensation shall be fixed by the Commission either by approval of an agreement between the Licensee and the party or parties benefiting or after notice and opportunity for hearing. Applications shall contain information in sufficient detail to afford a full understanding of the proposed use, including satisfactory evidence that the applicant possesses necessary water rights pursuant to applicable State law, or a showing of cause why such evidence cannot concurrently be submitted, and a statement as to the relationship of the proposed use to any State or municipal plans or orders which may have been adopted with respect to the use of such waters.

Article 14. In the construction or maintenance of the project works, the Licensee shall place and maintain suitable structures and devices to reduce to a reasonable degree the liability of contact between its transmission lines and telegraph, telephone and other signal wires or power transmission lines constructed prior to its transmission lines and not owned by the Licensee, and shall also place and maintain suitable structures and devices to reduce to a reasonable degree the liability of any structures or wires falling or obstructing traffic or endangering life. None of the provisions of this article are intended to relieve the Licensee from any responsibility or requirement which may be imposed by any other lawful authority for avoiding or eliminating inductive interference.

Article 15. The Licensee shall, for the conservation and development of fish and wildlife resources, construct, maintain, and operate, or arrange for the construction, maintenance, and operation of such reasonable facilities, and comply with such reasonable modifications of the project structures and operation, as may be ordered by the Commission upon its own motion or upon the recommendation of the Secretary of the Interior or the fish and wildlife agency or agencies of any State in which the project or a part thereof is located, after notice and opportunity for hearing.

Article 16. Whenever the United States shall desire, in connection with the project, to construct fish and wildlife facilities or to improve the existing fish and wildlife facilities at its own expense, the Licensee shall permit the United States or its designated agency to use, free of cost, such of the Licensee's lands and interests in lands, reservoirs, waterways and project works as may be reasonably required to complete such facilities or such improvements thereof. In addition, after notice and opportunity for hearing, the Licensee shall modify the project operation as may be reasonably prescribed by the Commission in order to permit the maintenance and operation of the fish and wildlife facilities constructed or improved by the United States under the provisions of this article. This article shall not be interpreted to place any obligation on the United States to construct or improve fish and wildlife facilities or to relieve the Licensee of any obligation under this license.

Article 17. The Licensee shall construct, maintain, and operate, or shall arrange for the construction, maintenance, and operation of such reasonable recreational facilities, including modifications thereto, such as access roads, wharves, launching ramps, beaches, picnic and camping areas, sanitary facilities, and utilities, giving consideration to the needs of the physically handicapped, and shall comply with such reasonable modifications of the project, as may be prescribed hereafter by the Commission during the term of this license upon its own motion or upon the recommendation of the Secretary of the Interior or other interested Federal or State agencies, after notice and opportunity for hearing.

Article 18. So far as is consistent with proper operation of the project, the Licensee shall allow the public free access, to a reasonable extent, to project waters and adjacent project lands owned by the Licensee for the purpose of full public utilization of such lands and waters for navigation and for outdoor recreational purposes, including fishing and hunting: Provided, That the Licensee may reserve from public access such portions of the project waters, adjacent lands, and project facilities as may be necessary for the protection of life, health, and property.

Article 19. In the construction, maintenance, or operation of the project, the Licensee shall be responsible for, and shall take reasonable measures to prevent, soil erosion on lands adjacent to streams or other waters, stream sedimentation, and any form of water or air pollution. The Commission, upon request or upon its own motion, may order the Licensee to take such measures as the Commission finds to be necessary for these purposes, after notice and opportunity for hearing.

Article 20. The Licensee shall clear and keep clear to an adequate width lands along open conduits and shall dispose of all temporary structures, unused timber, brush, refuse, or other material unnecessary for the purposes of the project which results from the clearing of lands or from the maintenance or alteration of the project works. In addition, all trees along the periphery of project reservoirs which may die during operations of the project shall be removed. All clearing of the lands and disposal of the unnecessary material shall be done with due diligence and to the satisfaction of the authorized representative of the Commission and in accordance with appropriate Federal, State, and local statutes and regulations.

Article 21. Material may be dredged or excavated from, or placed as fill in, project lands and/or waters only in the prosecution of work specifically authorized under the license; in the maintenance of the project; or after obtaining Commission approval, as appropriate. Any such material shall be removed and/or deposited in such manner as to reasonably preserve the environmental values of the project and so as not to interfere with traffic on land or water. Dredging and filling in a navigable water of the United States shall also be done to the satisfaction of the District Engineer, Department of the Army, in charge of the locality.

Article 22. Whenever the United States shall desire to construct, complete, or improve navigation facilities in connection with the project, the Licensee shall convey to the United States, free of cost, such of its lands and rights-of-way and such rights of passage through its dams or other structures, and shall permit such control of its pools, as may be required to complete and maintain such navigation facilities.

Article 23. The operation of any navigation facilities which may be constructed as a part of, or in connection with, any dam or diversion structure constituting a part of the project works shall at all times be controlled by such reasonable rules and regulations in the interest of navigation, including control of the level of the pool caused by such dam or diversion structure, as may be made from time to time by the Secretary of the Army.

Article 24. The Licensee shall furnish power free of cost to the United States for the operation and maintenance of navigation facilities in the vicinity of the project at the voltage and frequency required by such facilities and at a point adjacent thereto, whether said facilities are constructed by the Licensee or by the United States.

Article 25. The Licensee shall construct, maintain, and operate at its own expense such lights and other signals for the protection of navigation as may be directed by the Secretary of the Department in which the Coast Guard is operating.

Article 26. If the Licensee shall cause or suffer essential project property to be removed or destroyed or to become unfit for use, without adequate replacement, or shall abandon or discontinue good faith operation of the project or refuse or neglect to comply with the terms of the license and the lawful orders of the Commission mailed to the record address of the Licensee or its agent, the Commission will deem it to be the intent of the Licensee to surrender the license. The Commission, after notice and opportunity for hearing, may require the Licensee to remove any or all structures, equipment and power lines within the project boundary and to take any such other action necessary to restore the project waters, lands, and facilities remaining within the project boundary to a condition satisfactory to the United States agency having jurisdiction over its lands or the

Commission's authorized representative, as appropriate, or to provide for the continued operation and maintenance of nonpower facilities and fulfill such other obligations under the license as the Commission may prescribe. In addition, the Commission in its discretion, after notice and opportunity for hearing, may also agree to the surrender of the license when the Commission, for the reasons recited herein, deems it to be the intent of the Licensee to surrender the license.

Article 27. The right of the Licensee and of its successors and assigns to use or occupy waters over which the United States has jurisdiction, or lands of the United States under the license, for the purpose of maintaining the project works or otherwise, shall absolutely cease at the end of the license period, unless the Licensee has obtained a new license pursuant to the then existing laws and regulations, or an annual license under the terms and conditions of this license.

Article 28. The terms and conditions expressly set forth in the license shall not be construed as impairing any terms and conditions of the Federal Power Act which are not expressly set forth herein.

ENVIRONMENTAL ASSESSMENT
FOR HYDROPOWER LICENSE

Tower and Kleber Hydroelectric Project

FERC Project No. 10615-001

Michigan

Federal Energy Regulatory Commission
Office of Hydropower Licensing
Division of Project Review
825 N. Capitol Street, NE
Washington, D.C. 20426

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SUMMARY

On February 21, 1989, The Wolverine Power Supply Cooperative, Inc., (Wolverine) filed an application for a license for the existing unlicensed Tower and Kleber Hydroelectric Project, located on the Black River in Forest and Waverly Townships, Michigan. The project would continue to generate about 1.7 megawatts (MW) per year, which would continue to be sold to seven of Wolverine's nearby wholesale cooperative customers.

The environmental assessment (EA) prepared for the Tower and Kleber Project analyzes the effects associated with the issuance of a license for the developments, and recommends terms and conditions to become a part of any license issued. For any license issued, the Federal Energy Regulatory Commission (Commission) must determine that the project adopted will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and development purposes for which licenses are issued, the Commission must give equal consideration to the purpose of energy conservation, the protection, mitigation of damages to, and enhancement of fish and wildlife, protection of recreational opportunities, and the preservation of other aspects of environmental quality. The EA for the Tower and Kleber Project reflects the Commission's consideration of these factors.

After carefully considering all these resources, and benefits, we recommend that 9 measures be included in any license issued for the Tower and Kleber Project. These measures are: (1) operate project in a run-of-river mode; (2) pass a streamflow equal to inflow into the project during emergency shutdowns; (3) implement a water quality monitoring plan; (4) limit winter (November 1 to March 31) drawdown to no more than 1 foot; (5) cooperate with the Michigan Department of Natural Resources (DNR) to develop a formal lake sturgeon management plan; (6) implement a turbine and entrainment protection and mitigation plan; (7) implement a plan to control/eliminate nuisance flora when deemed appropriate; (8) implement bald eagle protection measures; and (9) protect any previously undiscovered properties that may be eligible for listing on the National Register of Historic Places.

Overall, these mitigation measures would protect or enhance fish and wildlife resources, water quality, and recreational resources in both the Tower and Kleber Project ponds and the Black River, protect the federally-listed bald eagle (Haliaeetus leucocephalus) and protect any previously undiscovered properties that may be eligible for listing on the National Register of Historic Places. In addition, the electricity generated from the project would be beneficial because it would continue to reduce the use of fossil-fueled, electric generating plants, conserve nonrenewable energy resources, and reduce atmospheric pollution.

No reasonable action alternatives to the project have been identified for assessment. The no action alternative, denial of a license, has been considered and is addressed in the EA and the Comprehensive Development sections of the EA. Denial of the license would mean that all of the power that would have been generated by the Tower and Kleber Project would be generated by alternative resources (probably fossil-fueled generating plants), which would release various amounts of pollutants into the atmosphere. Furthermore, no measures would be implemented to protect, mitigate adverse impacts to, or enhance existing environmental resources.

On November 11, 1987, pursuant to Section 401 of the Clean Water Act, Wolverine requested that the DNR issue a water quality certificate for the Tower and Kleber Project. By letter dated July 21, 1988, Wolverine received the water quality certification (Thomas R. Doyle, FERC Coordinator, Fisheries Division, Michigan Department of Natural Resources, Lansing, Michigan).

Pursuant to Section 10(j) of the Act, we make a determination that all of the U. S. Department of Interior's (Interior) recommendations are consistent with the purposes and requirements of Part I of the Act and applicable law. Section 10(j) of the Act requires the Commission to include license conditions, based on recommendations of Federal and state fish and wildlife agencies, for the protection of, mitigation of adverse impacts to, and enhancement of fish and wildlife resources. We have addressed the concerns of the Interior and have made recommendations consistent with Interior.

Pursuant to Section 10(j) of the Act, we are making a preliminary determination that certain recommendations of the Michigan state fish and wildlife agency are inconsistent with the purpose and requirements of Sections 4(e) and 10(a) of the Act. Michigan Department of Natural Resources' (DNR) recommendations conflict with the comprehensive planning and public interest standards of the Act. These are DNR's recommendations: (1) requiring Wolverine to develop and implement an upstream fish passage plan, (2) requiring Wolverine to develop and implement a turbine mortality and entrainment plan, and (3) requiring Wolverine to develop and implement a management plan for lake sturgeon as well as other threatened, endangered, and sensitive species.

On the basis of staff's independent environmental analysis, issuance of a license for the project would not constitute a major federal action significantly affecting the quality of the human environment.

ENVIRONMENTAL ASSESSMENT

FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF HYDROPOWER LICENSING, DIVISION OF PROJECT REVIEW

Tower and Kleber Hydroelectric Project
FERC Project No. 10615-001
March 31, 1993

I. APPLICATION

On February 21, 1989, the Wolverine Power Supply Cooperative, Inc. (Wolverine), filed an application for a license for the existing unlicensed Tower and Kleber Hydroelectric Project, a major project of 1,760-kilowatts (kW). On June 22, 1989, November 20, 1989, and December 11, 1992, Wolverine supplemented its application.

The project sites are located on the Black River in Cheboygan County, Michigan. Tower Dam is in the town of Tower. Both dams are located in Cheboygan County, Michigan. As of January 6, 1993, the only other hydropower development on the Black River is the Alverno Dam. Alverno is a retired project located downstream of Black Lake. The project would not occupy any United States lands.

II. PURPOSE AND NEED FOR ACTION

A. Purpose

The Tower and Kleber project generates an estimated 7,498,500 kilowatthours (kWh) of electric energy per year which is sold to seven of Wolverine's nearby wholesale cooperative customers.

B. Need for Power

Wolverine is a Michigan non-profit cooperative corporation. The existing project complex consists of two dams and two hydroelectric power plants - the Tower Dam and power plant and the Kleber Dam and power plant. The Tower Hydroelectric Plant was constructed in 1917 and its operation records are available for 1918 and subsequent years. The Kleber Hydroelectric Plant was built during years 1948 to 1949 and operating records are available for 1949 and subsequent years.

Two facts establish the need for electric power equivalent to the net output of the Tower and Kleber facilities and also establish the need for the project complex. First, the output of the two facilities--operating without a Federal license--has been used by service-area end-use customers for more than forty years. Second, the applicant purchases about seventy percent of the electric energy it sells to its nearby wholesale cooperative customers. This supplementary energy is supplied principally by the Detroit Edison Company and by Consumers Power Company.

Denial of license would force the applicant to increase its purchases from Detroit Edison or Consumers Power.

Furthermore, continued operation of the Tower and Kleber hydropower facilities is in the best interest of the public. Hydropower generation produces no atmospheric pollutants and consumes no non-renewable primary energy resources--such as fossil fuels.

The Tower and Kleber hydropower facilities have a combined energy net output of about 7.5 gigawatt-hours per year. The energy which the applicant purchases from Detroit Edison Company and Consumers Power Company is generated principally by coal-fired steam-electric plants.

Using a heat rate of 10,659 Btu per kilowatt-hour and assuming that the heat content of the pulverized bituminous coal is 25.4 million Btu per short ton, the generation of one net gigawatt-hour of electric energy requires the combustion of 419.65 tons of coal.

Thus one year of operation of the Tower and Kleber hydropower facilities would make the consumption of approximately 3,147 tons of coal unnecessary.

In view of public concerns about acid rain, global warming, and the uncertain costs to electric utilities of complying with the new Clear Air Act, we believe that in all instances where economic, financial, and environmental considerations permit, it is in the public's best interest to develop hydroelectric power whenever possible.

III. PROPOSED PROJECT AND ALTERNATIVES

A. Proposed Project

1. Project description: Tower Hydroelectric Plant was initially owned and operated by Onaway Light and Power Company of Onaway, Michigan. The entire facility was acquired in 1941 by Presque Isle Electric Cooperative, Inc. and operated until it was acquired by Northern Michigan Electric Cooperative, Inc. (Northern) on December 5, 1950. All assets of Northern were transferred to Wolverine Power Supply Cooperative, Inc. when Northern and Wolverine Electric Cooperative merged to form Wolverine Power Supply Cooperative, Inc.

The existing constructed project consists of two hydroelectric developments (Figure 2 and 3):

A. The constructed Tower Hydroelectric Project which consists of: (1) the 727-foot-long and 22-foot-high Tower Dam; (2) a 110-foot-long gated spillway; (3) an intake structure integral with the powerhouse equipped with 4 vertical slide headgates; (4) a brick reinforced concrete powerhouse integral with the dam and housing 2 280-kW generating units with a total installed capacity of 560 kW; (5) a non-operational sluiceway; (6) a 102-acre reservoir having a maximum storage capacity of 620 acre-feet at 722.1 feet m.s.l.; (7) a 150-foot-long, 69-kV transmission line; and (8) appurtenant facilities;

B. The constructed Kleber Hydropower Project which consists of: (1) the 535-foot-long and 40-foot-high Kleber Dam; (2) a 12-foot-long ogee-type spillway controlled by a Taintor gate and a 200-foot-long uncontrolled emergency spillway; (3) an intake structure equipped with 2 vertical lift gates; (4) a reinforced concrete powerhouse 42-foot-long by 40-foot wide by 54-foot-high and housing 2 600-kW generating units with a total installed capacity of 1,200 kW; (5) two 84-inch-diameter and 139-foot-long steel penstocks; (6) a 295-acre reservoir having a maximum storage capacity of 3,000 acre-feet at 701.1 feet m.s.l.; (7) a 4-mile long, 12.5 kV transmission line connecting the Kleber generator plant bus to the Presque Isle distribution load tap; and (8) appurtenant facilities.

2. Proposed Environmental Measures

a. Construction. In order to enhance public recreational use at the project, Wolverine formulated a phased plan in consultation with the Michigan Department of Natural Resources (DNR) to improve public access, including improved boat launching ramps, access roads, parking areas, footpaths, toilet facilities, and signs. The initial phase of development (phase 1), requiring improvements at seven locations, has been completed. Additional improvements (phase 2) would be completed at three more locations before January 1995.

b. Operation. Wolverine proposes: (1) to continue operating the project in a run-of-river mode, and to provide for the maintenance and operation of headwater and tailwater gages to verify run-of-river operation; (2) to maintain pond levels at 722.1 feet (Tower pond) and 701.1 feet (Kleber pond); (3) a winter (November 1 to March 31) drawdown of 1 foot; (4) to automate the project within 3 years of license issuance to help ensure maintenance of pond levels; (5) to monitor dissolved oxygen (DO) and water temperature at the project site and to develop a water quality protection plan to maintain water quality in the Black River; (6) to develop and implement a downstream fish protection and mitigation plan; and (7) to install downstream fish passage facilities at such time as they are deemed necessary.

Wolverine proposes to (1) record any observations of eagles made incidental to normal work activities, and (2) consult with the U.S. Fish and Wildlife Service (FWS) in the event that one or more mature trees, > 12-inch-dbh9/, must be removed along the ponds or stream sections during normal facility maintenance. Wolverine further proposes to provide nesting boxes for ducks and other waterfowl; maintain a sandy area for turtles; and provide an osprey platform.

Wolverine proposes to maintain all the recreational access facilities developed in accordance with its recreation plan. Winter maintenance would include reasonable snow removal at the boat launches to maintain accessibility.

B. Alternatives to the Proposed Project Including the No Action Alternative

1. Alternative Project Operations: Alternative modes of operation of the project considered include the proposed mode and the current mode of operation. Currently, Wolverine operates the project run-of-river. Proposed project operation is discussed in section V.B.2, V.B.3, V.B.4, and V.B.5 of this report.

2. Alternative of No Action: The no-action alternative is continued operation of the Tower and Kleber Project and maintenance of the environmental status quo. There would be no changes to the existing environmental setting or to the current mode of project operation.

IV. CONSULTATION AND COMPLIANCE

A. Agency Consultation

The Commission's regulations require prospective applicants to consult with the appropriate resource agencies before filing a license application. This prefiling consultation initiates compliance with the National Environmental Policy Act, Fish and Wildlife Coordination Act, Endangered Species Act, National Historic Preservation Act, and other federal statutes. Prefiling consultation must be complete and documented for the application to be accepted. After acceptance, the Commission notifies the agencies that the application is ready for environmental analysis and seeks formal comments in accordance with these statutes. All comments become part of the record and are considered during the staff's analysis of the proposed project.

9/ dbh = diameter breast height - measured about 4.5 feet above the ground.

The following entities commented on the application by the December 12, 1992 deadline specified in our notice that the application is ready for environmental analysis.

Commenting agencies and other entities	Date of letter
U.S. Department of Interior	12/07/92
Michigan Department of Natural Resources	12/04/92
Michigan Hydro Relicensing Coalition	12/04/92

The applicant responded to the agency comments by letter dated January 19, 1993.

In addition to providing comments, organizations and individuals may petition to intervene and become a party to any subsequent proceedings. The following entities filed a motion to intervene in the proceedings, but were not in opposition to the licensing of the project.

Interveners	Date of motion
State of Michigan	07/08/92
Michigan Hydro Relicensing Coalition	07/08/92

The applicant did respond to the intervention by the Michigan Hydro Relicensing Coalition by letter dated January 19, 1993.

B. Water Quality Certification

On November 11, 1987, Wolverine requested that the Michigan Department of Natural Resources (DNR) issue a Section 401 water quality certificate (WQC) for the Tower and Kleber Project. Wolverine received Section 401 water quality certification, as required by the Clean Water Act, from the DNR on July 21, 1988 (Thomas R. Doyle, FERC Coordinator, Fisheries Division, Michigan Department of Natural Resources, Lansing, Michigan, July 21, 1988). In the certification, the DNR required the following:

(1) The licensee operate the Tower and Kleber Project in an instantaneous run-of-river mode at all times, except for events completely beyond the control of the licensee. Should an event, as indicated above, occur that would not provide run-of-river, the licensee shall make all practical efforts to assure a release from the pond, immediately contact the DNR FERC Coordinator, and within 24 hours initiate notification by mail providing all pertinent information to the DNR-Fisheries Division;

(2) Upon the occurrence of a water quality emergency in the reservoir or downstream being made known to the licensee, the licensee shall immediately contact the DNR through the Pollution Emergency Alerting System (PEAS), and with all practicable speed, arrange for any modifications of pond operation or discharge as will relieve the emergency; and

(3) In order that the licensee can assure run-of-river releases, it is necessary that inflow and outflow to the pond be gauged and recorded. Such records shall be made available to DNR and/or FWS as needed.

V. ENVIRONMENTAL ANALYSIS

A. General Description of the Locale

1. Black River Basin. The Black River watershed includes parts of Presque Isle and Cheboygan Counties. The Black River enters Lake Huron's South Channel near the Town of Cheboygan. Black Lake occupies a depression scoured out by glacial erosion. The drainage area for Tower and Kleber Dams are essentially the same, slightly over 300 square miles (Figure 1).

Lands around Tower and Kleber ponds are used for hydroelectric generation facilities as well as facilities associated with diesel generators. There are many long time residential properties in the vicinity of both plants.

2. Proposed and Existing Hydropower Development.

The only other hydropower development along the Black River is the retired 1,300 kW Alverno hydropower plant downstream from the Kleber hydropower plant.

3. Cumulative Impacts On Target Resources. We have identified fisheries and water quality as target resources. A target resource is an important resource that may be cumulatively affected by multiple development within the river basin. We based our selection of target resources on the regional significance and geographical distribution of the resource within the river basin. Cumulative beneficial impacts to target resources from our recommended mitigation measures at the Tower and Kleber Project are discussed in section V.B.

The DNR, Fisheries Division, has been working with a population of lake sturgeon, in Black Lake and Upper Black River since the early 1920's to maintain this run of fish. In 1973, DNR constructed four spawning reefs in the upper Black River between Kleber Dam and Black Lake. Historically, Wolverine has maintained a minimum at all times of 80 cfs downstream of its Kleber Dam during the May and June sturgeon spawning season to assure a steady flow of water over these reefs as well as over existing natural spawning habitat. Studies preformed by DNR indicate that maintenance of minimum spawning flows has been successful in maintaining this population of fish.

Brook trout, northern pike, smallmouth bass, and a variety of sunfishes are recreationally-important species that reside in the Tower and Kleber ponds.

We identified fisheries because of its importance for recreational fishing (coldwater salmonid fishery) and because Black Lake and the upper Black River support a significant population of lake sturgeon, which has been the target of management by the DNR.

The Tower and Kleber Project has operated for many years without causing significant water quality impacts.

Water quality is identified as a target resource because of potential adverse effects that may be caused by alteration of DO concentrations and temperature in the river. Potential effects concerning water quality are discussed in section V.B.2.a.

B. Proposed Project We have reviewed the proposed project in relation to the environmental resources in the project impact area and have concluded that there would be no relevant or material unavoidable adverse impacts to any of the resource areas. Furthermore, there would be neither a beneficial nor adverse impact on visual resources and socioeconomics.

The proposed project would have no effect on visual resources because there would be no construction or major change in operations. The only change in operations would be limiting the winter (November 31 to March 1) pond drawdown to no more than 1 foot. This would not have any effect on the aesthetic experience because during the winter months, the pond is shrouded in ice, and the drawdown is not visible to the naked eye. Therefore, no change in the visual aspects of the projects would occur.

The socioeconomics of the area will not be effected either adversely or beneficially because with no new construction and the automation of the Tower and Kleber Projects, there will be no influx of new workers.

1. Geological Resources

Affected Environment: The project is located in the northern portion of the Michigan High Plains. The predominant deposits in the area are glacial moraines, outwash sands and gravel, and till. Bedrock at the project is limestone. There are no reported shoreline erosion problems at the project.

Environmental impacts and recommendations: There is no new proposed project construction. There would be no adverse impacts to geological and soils resources. Instead, the proposed run-of-river operation would minimize pond fluctuations, and thus have a beneficial effect by further reducing the potential for future shoreline erosion.

The DNR says past and present project operation have caused some additional erosion in the project area that needs to be addressed. The DNR is concerned about possible resultant negative effects on fish productivity from additional sand bedload in the river and from sedimentation in the ponds. Consequently, the DNR recommends that Wolverine develop a plan to inventory, control, and repair present and future erosion sites on project lands and below the project in the project influence zone.

The Michigan Hydro Coalition (the Coalition) is concerned dam construction activities and peaking operations of any hydroelectric plant could cause riverbed scouring and shoreline erosion. Therefore, to guard against habitat degradation, the Coalition recommends that Wolverine develop provisions for simulating natural conditions and restoring degraded habitat caused by the project.

Wolverine doesn't agree with DNR's recommendation to develop and implement a plan to inventory, control, and repair present and future erosion sites or the Coalition's recommendation. Wolverine reports it met with the DNR on January 15, 1993, to discuss the DNR's recommendations. Wolverine further states the DNR has said it has no knowledge of any shoreline erosion problems in the ponds or in the area of the dams.

There is no new project-related construction and, as noted above, there are no reported shoreline erosion problems at the project. Operating the Tower and Kleber Project in a run-of-river mode would minimize fluctuations of the ponds' surface elevations and reduce the potential for erosion of the ponds' shorelines. As a result, the proposed run-of-river operation would have a beneficial effect by further reducing the potential for future shoreline erosion.

Therefore, we conclude that neither the DNR's recommendation nor the Coalition's concerns are warranted because (1) there is no evidence of shoreline erosion, (2) run-of-river operation would help to limit any future erosion problems, and (3) there would be no project related construction. For further discussion, refer to the water resource and terrestrial resource sections herein.

2. Water Resources

Affected Environment:

a. Streamflow:

	cfs 10/	Flow parameter
low flow:	162 cfs	exceeded 90 percent of the time
high flow:	423 cfs	exceeded 10 percent of the time
average flow:	274 cfs	average annual

Flow parameters for the Tower and Kleber Project are from U.S. Geological Survey (USGS) records for stream gauging station No. 04130500 located on the Black River, approximately 400 feet downstream of the Kleber Dam and about 2.7 miles downstream from Tower Dam. Data were obtained from this station for a 44-year period of record, from 1943 to 1986. The drainage area at the USGS gauging station is 313 square miles, while the drainage area at Tower Dam is 302 square miles. The minimum and maximum historical discharges are 4 cfs and 2,340 cfs, respectively. The minimum and maximum annual average discharges are 189 cfs and 350 cfs, respectively.

b. Water quality: The Black River, in the vicinity of the Tower and Kleber Project, supports a quality coolwater/coldwater fishery. Water quality standards are designated by the DNR according to the following numerical criteria: (1) total dissolved solids [500 milligrams per liter (mg/l) monthly average, 750 mg/l maximum]; (2) chlorides (50 mg/l monthly average); (3) pH (6.5 to 9.0 standard units); (4) phosphorus (1.0 mg/l monthly average); (5) fecal coliform (200 organisms per 100 milliliters); (6) dissolved oxygen (7.0 mg/l minimum); (7) temperature [heat load causing rise in temperature no more than 2 degrees Fahrenheit (èF) for receiving waters at the edge of the mixing zone and monthly maximum temperatures]; and (8) a variety of toxicants (generally following Environmental Protection Agency guidelines).

Data collected by Wolverine in July 1987 indicated that the Tower Pond did not stratify near the dam, but that the Kleber Pond did stratify in the deeper portion of the pond close to the dam. Temperature throughout Tower Pond varied little, from 24 to 26 degrees celsius (èC), while dissolved oxygen (DO) exceeded 6.2 mg/l at the dam. Temperature in the upper portion (about 10 to 13 feet) of Kleber Pond was relatively constant, from 25 to 27èC, but decreased significantly as depth increased beyond 13 feet. Oxygen levels showed similar stratification, with levels of at

10/ cubic feet per second

least 5 mg/l in the top 15 feet, and declining to minimal levels beyond 21 feet. However, little of Kleber Pond is deeper than 15 feet.

Data from the stream survey also indicated that the Tower and Kleber ponds have a minor effect on downstream temperatures and DO levels. During July, DO was found to decline in Tower Pond, but increase again downstream from Kleber Pond. In August, water temperature downstream of the Kleber Dam was 1èC higher than the temperature of water flowing into Tower Pond.

Currently, Tower Pond receives cooling water discharge from the Tower Diesel Plant. Although the baseline water quality study did not specifically address impacts of this discharge, data do indicate that the effect of cooling water discharges is negligible. In a "worst-case scenario" of a 41.7èC discharge when water temperature in Tower Pond was 30èC, temperature increase downstream of Tower Dam would be less than 0.2èC.

Environmental impacts and recommendations:

a. Dissolved oxygen and temperature: The DNR recommends Wolverine maintain the following state standards for DO concentration and temperature when river discharges are greater than or equal to the 95% exceedence flow:

(1) DO concentrations in the project tailwaters not less than 7 mg/l at any time unless Wolverine demonstrates to the Michigan Water Resources Commission (WRC) that these DO limits are not attainable through further feasible and prudent measures or the variation between the daily average and daily minimum DO concentrations in the river exceeds 1 mg/l. Further, if the WRC agrees with Wolverine's demonstration, DO concentrations in project tailwaters shall not be less than 6 mg/l at any time during the warm weather season (June through September) until such time as the WRC causes the preparation and implementation of a comprehensive plan as described in the State of Michigan water quality standards to upgrade these waters to 7 mg/l at any time;

(2) temperature in the project tailwaters no greater than a monthly average of 2èF higher than the temperature as measured upstream of the project; and

(3) monthly average temperatures in waters downstream of the project no greater than:

January, February -- 38èF
March -------------- 43èF
April -------------- 54èF
May ---------------- 65èF
June - August ------ 68èF
September ---------- 63èF
October ------------ 56èF

November ----------- 48èF
December ----------- 40èF

The DNR recommends that these monthly average temperatures may be exceeded for short periods with approval from the WRC when natural water temperatures measured upstream of the project exceed the ninetieth percentile occurrence of water temperatures (i.e., the monthly average temperatures cited in item 3, minus the allowable 2èF deviation allowed in item 2). DNR recommends that, in all cases, temperature increases shall not be greater than the natural water temperature as measured upstream of the project plus the increase allowed in item 2.

The DNR states that Wolverine or the DNR may petition the WRC during every fifth year after the issuance of the license, to modify the above DO or temperature limits to ensure the protection of the public health, welfare, safety, and the natural resources of the state of Michigan, including the fishery resources. The DNR recommends that, upon approval of the WRC of all such petitions, the petition shall be submitted to the Commission to amend the license.

In addition, the DNR recommends that Wolverine, within 24 months of licensing, develop and implement a water quality monitoring program, in consultation with the DNR, that includes: (1) continuous monitoring of DO and temperature above the Tower pond, below Tower Dam, and below Kleber Dam with the sensor locations to be determined in consultation with the DNR; (2) a temperature mitigation plan; and (3) the preparation of operating procedures for DNR review and concurrence to address water quality conditions which deviate from the above limits.

Wolverine recorded DO concentrations and water temperatures in the headwaters and tailwaters of both the Tower and Kleber developments. Morning and afternoon measurements were taken for 3 days at the end of July, 1987. All but one DO measurement in either tailwater met or exceeded the state DO standard of 7.0 mg/l. Temperatures recorded downstream of the project dams approximated temperatures in each of the respective headraces. Further, the state standard that "temperature in the project tailwaters shall be no greater than a monthly average of 2èF higher than the temperature as measured upstream of the project dam" was not violated at either development for the 3-day sampling period.

To detect any thermal stratification, Wolverine recorded temperature profiles (0.75-foot vertical increments) in the Tower and Kleber ponds on July 27, 1987. Temperatures at the surface were slightly higher than the rest of the water column, likely due to solar radiation and surface mixing by wind. Little temperature stratification existed in Tower Pond [typically all measurements were within 1èC (1.8èF), with a maximum difference of only 1.6èC (2.8èF)]. Kleber Pond did exhibit thermal stratification, as temperatures dropped from about 27èC [80.6èF] at the surface to around 11èC [52èF] near the bottom (about 31 feet). However, because water passing through the turbine at the Kleber powerhouse is withdrawn from the top 15 feet of the pond, the thermal stratification that does occur in Kleber Pond did not cause discharge water to be substantially different in temperature from inflow waters.

Based on the existing data, violations to state water quality standards do occasionally occur. Further, no definitive insights as to what level of impact would be solely attributable to the presence and operation of the Tower and Kleber Project can be drawn from the 3 day study conducted by Wolverine. To ensure that state standards of DO concentration and temperature are maintained, and to ensure compliance with the WQC, Wolverine must develop a plan and implementation schedule to monitor DO concentration and temperature upstream of the Tower pond, downstream of the Tower Dam, and downstream of the Kleber Dam.

The plan and implementation schedule should be developed after consultation with the FWS and the DNR and submitted for Commission approval, along with comments from these agencies and an explanation of how Wolverine's proposal incorporates DNR and FWS's recommendations or site-specific reasons for not including such recommendations. It should include measures for altering project operation to ensure maintenance of state standards for DO concentration and temperature in the Black River. Upon Commission approval, Wolverine should implement the water quality monitoring plan.

b. Project operation: Wolverine proposes to continue operating the Tower and Kleber Project in a run-of-river mode, such that outflow from the project downstream into the Black River equals inflow to the project's upper pond (Tower Pond). The headpond elevation for Tower Pond would be maintained at 722.1 feet National Geodetic Vertical Datum (NGVD), and the headpond elevation for Kleber Pond would be maintained at 701.1 feet NGVD. Wolverine also proposes to automate the Tower and Kleber Project. Prior to project automation, fluctuation around the headpond elevations will be ñ 0.5 foot. Wolverine proposes to reduce the fluctuation limit to ñ 0.25 foot once automation is complete. In order to minimize water level fluctuations in the impoundment and flows downstream of the project, operation of the project in a run-of-river mode is recommended by the Department of Interior (Interior) and DNR.

Operating the project in a run-of-river mode would minimize fluctuations of pond surface levels and would maintain the natural volume and periodicity of streamflow downstream from the project. Because the project would not alter streamflow in the Black River upstream or downstream, fish and wildlife habitats, including wetland areas, would not be affected by project operation. In addition, reproductive potential and trophic relations would not be affected.

Therefore, we recommend that any license for the project include a requirement for (1) operating in a run-of-river mode; (2) maintaining pond levels to the extent that operating conditions and equipment calibration permits; and (3) setting a target elevation for Tower Pond at 722.1 feet NGVD and for Kleber Pond at 701.1 feet NGVD, while allowing for a fluctuation of ñ0.25 foot around the target elevation for the Tower and Kleber ponds once project automation is complete. Prior to automation, fluctuations should be no greater than ñ0.5 foot. We also recommend that normal elevation limits for the ponds be lifted under extreme conditions, such as wind and wave action on the pond level, instrumentation drift and uncertainty, and seasonal changes in flowage level from ice formation and subsequent breakup.

c. Gaging: To monitor compliance with run-of-river operation at the Tower and Kleber Project, Wolverine proposes to install continuous level recording devices in the pond and tailwater areas of both the Tower and Kleber developments. These water level sensors will be connected, through an existing computerized Supervisory Control and Data Acquisition (SCADA) system, to Taintor gates at each dam, thus, providing remote operation capabilities to the Taintor gates. Further, Wolverine proposes to provide funds to operate and maintain the existing downstream USGS gaging station (USGS Gage No. 04130500 located in Tower, Wisconsin), which will be equipped with telemetry equipment and sufficient memory for instantaneous and short-term retrieval of data over a phone line.

Interior and DNR recommend Wolverine develop and implement, in consultation with the FWS, USGS, and DNR, a streamflow gaging plan within 12 months of license issuance in order to verify run-of-river operation. This plan includes, in addition to what has been proposed by Wolverine, a contingency plan for a second USGS gaging station located upstream of Tower Pond. The DNR recommends that a three year test period be established to determine if the recommended gaging plan described above will be adequate to demonstrate compliance with run-of-river operation. If operational compliance with run-of-river operations can not be maintained with the downstream gaging station and the pond and tailwater sensors, the DNR recommends that Wolverine provide funds to establish, operate, and maintain an upstream USGS gaging station as well as operating and maintaining the existing downstream USGS gaging station. The DNR further states that the Tower and Kleber Project would be deemed in compliance if the outflow, as measured at the downstream gaging station, is within ñ5 percent of the inflow, as measured at the recommended upstream station.

Wolverine objects to providing funds to establish, operate, and maintain a USGS gaging upstream of Tower Pond, stating that the proposed limit of upstream and downstream discharge to ñ5 percent would be difficult to achieve at all times. We concur with Wolverine, and believe that Wolverine's proposed streamflow monitoring system is adequate to verify compliance with run-of-river operation and pond level requirements. The proposed system would provide sufficient means to maintain and monitor run-of-river operation.

We conclude headwater and tailwater elevation monitoring is necessary to verify run-of-river operation, including pond and tailwater elevation requirements. However, we believe that installation of a new upstream gaging station (for coordinated use with the existing downstream USGS gaging station) is not necessary.

Therefore, if a license is issued for this project, we recommend Wolverine, after consultation with the FWS, USGS, and the DNR develop a plan to monitor run-of-river operation of the project (including pond and tailwater requirements for both developments) and the flows at the Tower Gage. The plan should include methods of pond and tailwater elevation and flow data collection and should describe the proposed location, design, and calibration of all monitoring devices. The plan should also include an implementation schedule and a provision for providing elevation and flow data to the consulted agencies within 30 days from the date of an agency's request for the data.

d. Flow continuation during power outages: Project shut down could lead to an interruption in river flow below the project's two dams. An interruption in flow could create a stranding problem, which could kill small fish and other aquatic life. Interior recommends that Wolverine be required to pass river inflow through the project in the event of a project shut down. Interior indicates that its recommendation is intended to prevent the dewatering of downstream aquatic habitat.

To ensure that downstream habitat would not be dewatered in the event of a project shutdown, Wolverine plans to upgrade project operations from manual to automatic within three years of license issuance. Project automation will include remote operation of Taintor gates at the Tower and Kleber dams via a SCADA system. During a shutdown, the Tower and the Kleber ponds and their representative tailrace elevations would be maintained at the target elevations by the remote and automated controls for the automated Taintor gates.

We conclude that, in the event of a project shutdown, Wolverine's planned automation upgrade, as describe above, would be adequate to maintain river flow to prevent dewatering of aquatic habitat downstream of the Tower and Kleber Project.

Therefore, we recommend that any license for the project include a requirement that Wolverine install, operate, and maintain the proposed streamflow automation system. This automation system should include provisions for operating the Taintor gates via an alternative power source should the SCADA system fail.

3. Fishery Resources

Affected Environment:

The resident fish community in the Black River and the Tower and Kleber reservoirs include brook trout, northern pike, smallmouth bass, largemouth bass, pumpkinseed, bluegill, rock bass, yellow perch, bullhead, burbot, and common suckers. A wide variety of forage fishes and other non-game species also inhabit these areas. Lake sturgeon from Black Lake ascend the Black River to spawn downstream of Kleber Dam.

The DNR manages this area for the state-listed threatened lake sturgeon. The Fisheries Division of the DNR has been working with a unique population of lake sturgeon since the 1920's to maintain this run of fish. In 1973, the DNR constructed four sturgeon spawning reefs in the upper Black River between Kleber Dam and Black Lake. Historically, when the project operated in a peaking mode, Wolverine maintained a minimum flow of 80 cfs downstream of Kleber Dam during the May and June sturgeon spawning season. The proposed and current mode of operation (run-of-river) precludes the need for this provision. In 1982, the DNR began a recruitment program for Black Lake and adjacent Burt and Mullet Lakes. This program involves capturing and removing spawn from Black Lake sturgeon population. The fertilized eggs are hatched and reared at a state hatchery for subsequent planting in other locations as fingerlings.

The DNR also actively manages for black crappie, and stocks these fish in Kleber Pond upstream of Kleber Dam.

Environmental Impacts and Recommendations:

a. Pond drawdown: Wolverine proposes a 1-foot annual winter drawdown (pond fluctuation) in both the Tower and Kleber ponds in order to protect against ice damage. This drawdown occurs from November 1 to March 31 each winter. Fluctuating water surface levels can reduce fish spawning success and strand fish and invertebrates, subjecting them to desiccation and predation from terrestrial predators (Cushman, 1985). Large fluctuations in water level can also be detrimental to wetland plant species that depend on saturated soil (Rochester et al., 1984).

Brook trout, northern pike, smallmouth bass, and a variety of sunfishes are recreationally-important species that reside in the Tower and Kleber ponds. Except for the brook trout, these fishes are most vulnerable to adverse effects from water surface elevation fluctuations during their spring spawning period when these fluctuations can lead to nest desiccation or nest abandonment (which may ultimately lead to predation of the young). The brook trout would be most vulnerable during its early fall spawning season. Further, the potential for adverse impacts is largely dependant upon the loss of aquatic habitat when the pond is drawn down.

Wolverine proposes to continue the one foot winter drawdown, which occurs at a time of year that would have little, if any, adverse impacts to aquatic habitat, (i.e., spawning and nursery habitat of fishes inhabiting the project's two ponds). Adverse impacts to juvenile and adult habitat would also be minimized. The FWS and the DNR concur with this proposal.

Operating the project with a one foot winter drawdown would prevent excessive dewatering of fisheries habitat and wetlands resulting from lowered water levels and would prevent any significant adverse impacts to spawning, nursery, juvenile, and adult fish habitat during the critical spring, summer, and fall periods. Impacts during the winter months would be minimal because fishes tend to concentrate in deeper portions of the ponds where aquatic habitat is more favorable. Therefore, if a license is issued for the Tower and Kleber Project, we recommend that Wolverine be required to limit drawdown of the project's ponds to one foot during the winter months in order to protect fish habitat in the two ponds.

b. Turbine entrainment and impingement: Project operation may affect the fishery resources by entraining fish into project turbines that may cause fish injury and mortality. Mortality or injury could occur as a result of fish being struck by turbine blades, pressure changes, sheer forces in turbulent flows, and water velocity accelerations (Knapp et al., 1982; Cada, 1990).

Wolverine presented entrainment and mortality estimates for fishes at the project in a filing to the Commission dated December 30, 1991. Entrainment rates and mortality estimates were based upon site-specific studies. Entrainment rates at the Tower development were generally low, averaging 83 fish per day (or 30,295 fish per year). Wolverine estimated immediate and delayed mortality to be 28 percent and 9 percent, respectively. Estimated annual entrainment mortality at the Tower development is 11,209 fish. Entrainment at the Kleber development was considerably higher, averaging 173 fish per day, with annual entrainment of 63,145 fish. Wolverine estimated immediate and delayed mortality to be 41 percent and 2 percent, respectively. Using these mortality estimates, annual entrainment mortality at the Kleber development is estimated at 27,152 fish.

The DNR estimates an entrainment mortality rate at the Tower development of 9,787 fish per year, with an annual restitution value under Michigan's Public Act 43 (1986) of $44,858. Entrainment mortality at the Kleber development was estimated at 23,638 fish per year, with an annual restitution value under Michigan's Public Act 43 (1986) of $210,083. These restitution values include a replacement social value for the killed fishes. The DNR estimates the annual replacement value of fishes to be $11,200 (Tower Dam) and $18,404 (Kleber Dam) (1992 dollars). These estimates were also based on the 1982 American Fisheries Society fish replacement values (American Fisheries Society, 1982), with a multiplier of 1.38 (based upon the Consumers Price Index (CPI)) to adjust to 1992 values.

Based on the study results, the DNR considers this level of mortality significant. Accordingly, the DNR recommends Wolverine, after consultation with, and with approval of the resource agencies, develop a turbine mortality and entrainment protection and mitigation plan, including contracting a qualified consultant to evaluate all potential protection devices to prevent fish losses at the project and developing and implementing a 4-year phased approach to prevent turbine mortality at the Tower and Kleber Project. If no protection device is determined to be feasible at the project, the DNR recommends Wolverine pay the annual restitution value, adjusted for 1982 dollars by the CPI, to the State of Michigan Game and Fish Habitat Improvement Fund by October 1 of each year. The DNR states all such funds would be earmarked for use on fisheries enhancement projects in the Black River system in the vicinity of the project and that DNR would provide Wolverine and the Commission an accounting for all funds by December 1 of each year. The DNR states that construction costs for fish passage installation may be used as a credit against fish damages from turbine mortality with the concurrence of the DNR and the FWS and with the approval of the Commission. The DNR also recommends that all installed devices have an effectiveness study, designed and conducted by the licensee with agency consultation and approval, and that all modifications to the protective devices to meet both engineering and biological design specifications be done by the licensee.

Wolverine and the DNR have agreed to a fish protection plan that includes:

(1) A four phase process to prevent fish losses at both the Tower and Kleber Dams. The four stages, in order, are: (a) the installation of a new bar rack to physically exclude fish; (b) addition of an electrical field to the bar rack; (c) the installation of a barrier net; and (d) the installation of a Louver system;

(2) A four year period to complete this phased approach during which fish damage values are waived;

(3) An evaluation process to verify effectiveness of each device installed using a similar study plan to that used in the entrainment study, which is to be developed in consultation with the DNR; and

(4) Payment of residual fish damages after the phased approach is completed and the effectiveness of the devices are determined. The value of these losses will be negotiated between the DNR and Wolverine.

Although Wolverine agrees to pay for the design and evaluation of the potential protective devices and for implementation of one of the devices (or more, if this proves necessary), they do not believe that "complete" fish protection is possible. Wolverine states that the Commission should make some allowances for fish losses which would not be compensated for. Further, Wolverine disagrees with DNR's use of restitution value for mitigating fish losses.

Although we find the prevention of fish mortality due to entrainment at a project ultimately more desirable than monetary compensation for lost fishes, we recognize, in some instances, the costs associated with prevention of fish entrainment mortality may be excessive given the benefits derived. Under these circumstances, compensation for fish losses may be appropriate.

We do not agree with the DNR's recommendation for Wolverine to reimburse the state or provide enhancement at the cost of the state's restitution value of the killed fishes. The fishes killed may be replaced by stocking without notable losses to the recreational value of these fishes. The fishery in the Black River, and in the project area itself, has been supplemented by stocking. The DNR has previously stocked black crappie in the Kleber pond. We do not perceive stocking would contaminate pure stocks of fish in the system.

We concur with the fish protection and mitigation plan developed between the DNR and Wolverine. Further, we believe that Wolverine should not be required to pay restitution value for fishes killed at the project. Therefore, we recommend that for any license issued for the Tower and Kleber Project, Wolverine be required to develop and implement the plan as described in the DNR letter dated December 4, 1992, which is discussed above. The plan should be modified such that Wolverine, in addition to the fish protection device(s) used, be required to reimburse the state for fishes killed at the project based on fish replacement costs and not restitution value of the killed fishes.

Implementation of the above measures would adequately compensate the public for losses to its fishery resources caused by operating the project and promote the development and application of appropriate resource protection measures. It would also minimize any cumulative adverse impacts to the fisheries on the Black River.

c. Fish passage: Presently, the DNR is evaluating the need for fish passage in the Cheboygan River system, including the Black River. Fish passage is the emphasis of a river management plan which will be developed in the near future. Currently, there are no anadromous fishes in the project area needing to pass the Tower and Kleber dams. However, the DNR believes that this contingency should be planned for in any license issued for the project.

The DNR recommends that Wolverine complete an upstream fish passage plan, including retaining a qualified consultant to design and evaluate fish passage devices for the Tower and Kleber Project, and to construct, operate, and maintain appropriate fish passage facilities and provide necessary operating flows at the project if effective fish passage provisions are determined to be economical at either site. The DNR recommends the design criteria be determined after consultation with the DNR and FWS, and be with the approval of the Commission. If no device is determined to be economical at either site, the DNR recommends that Wolverine conduct an evaluation of fish passage provisions every five years until fish passage is installed. The DNR also recommends that all fish passage facilities have an effectiveness study designed and conducted after consultation with the DNR and the FWS, and with Commission approval, and that any modifications to the fish passage facilities to meet engineering and biological design specifications be performed by Wolverine.

The DNR justifies its recommendations on the premise that the yet-to-be developed river management plan may call for the restoration of anadromous runs of fish to riverine areas above the Tower and Kleber Project. Further, the DNR states that many "resident" fish species utilize large amounts of riverine habitat and that these fishes may undertake long distance migrations to gain access to needed areas. The DNR believes fish passage at the project may be necessary for access of resident fishes to upstream portions of the Black River.

The DNR may request fish passage in the future under the provisions of the standard articles included in the license or through Interior, which may request fish passage in the future under Section 18 of the Federal Power Act (Act).11/

d. Lake sturgeon management plan: Black Lake and the upper Black River support a significant population of lake sturgeon, which has been the target of management by the DNR. Wolverine has worked with the DNR informally in recent years to manage this important fishery resource. The DNR recommends Wolverine develop and implement a plan to protect and enhance lake sturgeon habitat in the upper Black River downstream of Kleber Dam. We concur with the DNR, and conclude that the development of a lake sturgeon management plan would provide a valuable, formalized setting for lake sturgeon management in the Black River Basin. However, we disagree with the DNR's recommendation that Wolverine should develop and implement the plan. The DNR has the responsibility to act as steward for a publicly utilized resource within Michigan. Given this role of public steward, the DNR has the responsibility to manage Michigan's resources, including state-listed species such as lake sturgeon.

Accordingly, we recommend that, if a license is issued for the project, Wolverine should be required to enter into a formal agreement with the DNR to manage lake sturgeon in the Black River. Wolverine should cooperate with the DNR in developing and implementing the management plan. Wolverine's involvement would begin when development of such a plan is deemed appropriate by the DNR, and should be limited to operational considerations of the Tower and Kleber Project. Once developed, the lake sturgeon management plan should be filed with the Commission.

e. Section 18 reservation of authority: Interior requested reservation of authority to prescribe the construction, operation, and maintenance of fishways for the Tower and Kleber Project pursuant to Section 18 of the Act (Jonathan P. Deason, Director, Office of Environmental Affairs, Department of the Interior, Washington, D.C., December 7, 1992). Wolverine Power concurs with Interior's request for the reservation of authority.

Section 18 of the Act provides the Secretary of the Interior the authority to prescribe fishways. Although fish passage facilities may not be recommended by Interior at the time of project licensing, such as for the Tower and Kleber Project, the Commission should include a license article which reserves

11/ Section 18 of the Federal Power Act provides: "The Commission shall require construction, maintenance, and operation by a licensee at its own expense ... such fishways as may be prescribed by the Secretary of Commerce or the Secretary of Interior as appropriate."

Interior's prescription authority.12/ We recognize that future fishway needs and management objectives cannot always be predicted at the time of license issuance. Under these circumstances, and upon receiving a specific request from Interior, the Commission should reserve Interior's authority to prescribe fishways.

4 Terrestrial Resources

Affected Environment: Vegetation in the project area includes: paper birch, maple, popular, American hophornbeam, red pine, white pine, white cedar, balsam fir, spruce, elm, and basswood. Shrubs in the area include: grey, red ozier, and alternate-leaved dogwoods as well as alders. There are approximately 8.7 acres of wetlands at Tower Pond and at Kleber Pond there are about 27.3 acres of wetlands. Pondweed, waterweed, wild celery, water lily, cattails, bullrushes, sedges, and reeds are the dominant wetland vegetation. These wetlands afford nesting and resting opportunities to migrating waterfowl.

Common animal species in the project area include: cotton-tail rabbit, gray and fox squirrel, ruffed grouse, and white-tailed deer. Furbearers resident to the area include: mink, river otter, muskrat, and beaver.

There are two primary transmission lines within the project's boundary. A 150-foot-buried transmission line runs from the Tower Project to the Wolverine substation, and the other is a 4-mile-long line which starts at the Kleber Project generator plant bus and ends at the Presque Isle distribution load tap.

Environmental impacts and recommendations:

a. Monitor and control/eliminate nuisance plants: Purple loosestrife (Lythrum salicaria) and European milfoil (Myriophyllum spictum) are plants introduced from Europe. Often they grow profusely, at the expense of the native wetland vegetation, reducing the wildlife habitat value of wetlands. Both plants have little food value for wildlife.

The DNR recommended the applicant in consultation with the DNR develop and implement a plan to monitor and control/eliminate, when deemed appropriate by the DNR, purple loosestrife and European milfoil in project waters.

Wolverine doesn't agree with DNR's recommendation to develop and implement a plan to monitor and control/eliminate purple loosestrife and European milfoil. Wolverine states that there is

12/ Lynchburg Hydro Associates, 39 FERC ¶ 61,079 (1987).

no documentation of the plants being present, and therefore objects to the inclusion of this recommendation.

There is no evidence that either plant exists in the project area. Furthermore, measures available to control these species are limited. However, should it be deemed necessary to control Purple loosestrife and European milfoil in the project and surrounding areas, and safe control measures become available, the applicant should cooperate with the DNR to implement control measures. Therefore, we recommend that these measures be included in any license issued for the Tower and Kleber Project.

b. Wildlife habitat resources: The DNR recommends that Wolverine develop and implement, in coordination with the DNR, a wildlife management and land use plan that (a) enhances and protects wildlife habitat, and (b) provides for the protection of environmentally sensitive areas, and a plan to protect and enhance any federal or state listed threatened, endangered, or sensitive species on project lands to include specific protective measures.

The DNR also recommends that Wolverine, for the conservation and development of fish and wildlife resources, construct, maintain, and operate, or arrange for the construction, maintenance, and operation of such reasonable facilities, and comply with such reasonable modifications of the project structures and operation, as may be ordered by the Commission upon its own motion or upon the recommendation of the Secretary of the Interior or the fish and wildlife agency or agencies of any state in which the project or a part thereof is located, after notice and opportunity for hearing.

The Coalition believes that the licensee should develop provisions that simulate natural conditions to the greatest extent possible and guard against habitat degradation and for the restoration of degraded habitat caused by the project.

We agree with the DNR and the Coalition. Wolverine agrees to provide nesting boxes for ducks and other waterfowl; maintain a sandy area for turtles; and provide an osprey platform as requested by DNR during the January 15, 1993 meeting between DNR and Wolverine. Maintaining run-of-river will not affect existing wetlands or other wildlife habitat, as well as other measures summarized on page 30.

We agree with the plan for wildlife habitat enhancement measures proposed by Wolverine. Further, implementing the measures for protection of the bald eagle, as described in section V.B.4, would provide adequate wildlife habitat enhancement at the project.

We recognize that future fisheries and wildlife needs and management objectives cannot always be predicted at the time of license issuance. Therefore, the Commission has provided for its option to require changes to projects upon its own motion and opportunity for hearing. Such provisions are included in the standard articles of currently licensed projects.

5 Threatened and Endangered Species

Affected Environment: The FWS states that the federally-listed bald eagle (Haliaeetus leucocephalus) forages along the Black River and the project ponds. No bald eagle nests have been found within the project boundary.

Environmental Impacts and Recommendations: We completed a biological assessment of the effect of continued project operations on the bald eagle on October 16, 1992 (Dean Shumway, Director, Division of Project Review, Federal Energy Regulatory Commission, Washington, D.C., October 16, 1992). We concluded that no adverse effects are likely with our enhancement recommendations. The FWS agreed by letter dated November 13, 1992 (John Hamilton, Acting Supervisor, U.S. Fish and Wildlife Service, East Lansing, Michigan, November 13, 1992).

Accordingly, we are recommending that the measures outlined below become a part of any license issued for the Tower and Kleber Project in order to protect future bald eagle habitat and nests.

a. Operate the project in a run-of-river mode to minimize headpond and downstream water level fluctuations, and therefore, help prevent loss of shoreline perch or roost trees from shoreline erosion;

b. Maintain and protect bald eagle perch trees by prohibiting clear-cutting of trees (Diameter breast height of 12 inches or greater) within 200 feet of the ponds' shorelines, except to clear felled or disease-damaged trees, which may affect public safety or project-related operation. In the event project operation and/or maintenance would involve any tree removal along the ponds' shorelines or stream sections within the project boundary, the licensee must contact the FWS and DNR for approval, before removing any identified tree(s);

c. Restrict human activity, such as birdwatching and hiking, in consistently used bald eagle feeding area(s) by posting the areas(s). A distance of 1,320 feet is recommended as a minimum buffer zone for human presence;

d. Conduct annual meetings with the FWS and DNR to identify any new nest, or previously unknown and potential nesting, roosting, or feeding sites in the project area, which would be subject to protection; and

e. To protect the forage base of the bald eagle, the licensee shall not participate in, encourage, or support the removal of rough fish, such as carp, sucker, or bullhead, in the pond or stream sections within the project boundary.

6. Cultural Resources

Affected environment: The Tower Dam and powerhouse were constructed in 1917 and 1918 and began operation in 1918. Kleber Dam and powerhouse were built in 1948 and 1949 and began operation in 1949. The project is neither listed nor eligible for listing on the National Register of Historic Places.

Environmental impacts and recommendations: Every reasonable effort has been made to search for listed and eligible National Register properties in the project area, without any such properties being discovered. Moreover, upon review, the State Historic Preservation Officer (SHPO) judged the project as not eligible for listing in the National Register, and cleared all work proposed for the project with a determination of "No Historic Properties Found" (letter to Richard Love from Martha Bigelow, Michigan State Historic Preservation Officer, Michigan Bureau of History, Lansing, Michigan, February 25, 1987).

In view of the results of discovery efforts and the SHPO's determination, and because no land-disturbing activities are proposed, we find that the project would have no effect on any structure, site, building, district, or object listed on or eligible for listing on the National Register.

Despite this however, there remains the possibility for affecting National Register and eligible properties.

First, our no effect determination is based on Wolverine's proposal involving no ground-disturbing activities. Before engaging in any ground disturbance not covered by the proposed licensing action, Wolverine should take the following actions: (a) consult with the SHPO; (b) based on consultations with the SHPO, prepare a plan describing the appropriate course of action and a schedule for carrying it out; (c) file the plan for Commission approval; and (d) do nothing to affect National Register or eligible properties until notified by the Commission that all these requirements have been satisfied.

Second, there is still the possibility that there could be significant undiscovered properties in the project area that could be adversely affected by project operation. If such properties are found during project operation, Wolverine should take the following actions: (a) consult with the SHPO; (b) based on consultations with the SHPO, prepare a plan describing the appropriate course of action and a schedule for carrying it out; (c) file the plan for Commission's approval; and (d) take the necessary steps to protect the discovered properties from further impact until notified by the Commission that all of these requirements have been satisfied.

7. Recreation and Other Land and Water Uses

Affected Environment: Public recreational use at the two ponds and tailrace has historically been small due to limited formal public access facilities around the 372 acres of combined water surface at the Tower and Kleber ponds. However, limited fishing, swimming, boating, and canoeing occur.

Wolverine consulted extensively with the DNR, and filed a revised recreation enhancement plan as part of its application for license (Table 1). The plan outlines a 3-phase schedule of public access improvements at the project. Phase 1 has been completed, phase 2 is scheduled to be completed before January 1995, and phase 3 would be implemented as future needs require. The tabulation below outlines Wolverine's recreation plan.

Table 1. Revised recreation plan for Tower and Kleber Project (Source: Wolverine Power Supply Corporation, Inc., December 11, 1992)

Phase/Facility	Description
Phase 1:	
Tower Pond	ù Improve boat access ramp and parking area; install vault toilet and signs. ù Improve canoe take-out and install signs.
Tower Dam	ù Improve canoe launch area, construct trail and signs.
Kleber Pond	ù Improve canoe take-out, construct trail and signs.
Kleber Dam	ù Construct tail race fishing access on powerhouse side, including parking area. ù Improve access road for tailrace fishing access on side opposite powerhouse, construct parking area, vault toilet, and signs. ù Improve canoe launch area, construct trail and signs.
Phase 2:	
Tower Pond	ù Construct access road and parking area to potential DNR-owned fishing area on old railroad bridge; install vault toilet and signs; facilities would be accessible to the disabled.
Tower Dam	ù Construct foot path from potential DNR fishing area to canoe portage.
Kleber Pond	ù Improve existing boat access ramp and access road; construct parking area, vault toilet, and signs.
Phase 3:	
Kleber Pond	ù Improve foot path for shoreline fishing area.

Wolverine reports that it has spent $127,230 on the completed phase 1 recreational improvements, and plans to spend an additional $87,500 on phase 2 recreational improvements. As a result of the recently completed phase 1 recreational improvements, Wolverine reports that public use is increasing at the project, with the most concentrated use reported at the Kleber dam tailrace fishing area (350-400 visitors in 1992).

Environmental Impacts and Recommendations: The DNR recommends implementation of phased recreation improvements at the project that are generally consistent with the plan proposed, and partly implemented, by Wolverine. However, some of the detailed recommendations of the DNR extend beyond the measures specifically included in Wolverine's proposed plan, including the following: (a) no user fees at the boat launching areas; (b) functional and final design drawings for all proposed facilities subject to DNR approval: (c) all facilities designed barrier free to accommodate the disabled; (d) directional signs constructed along major highways to all the project recreation areas; and (e) DNR review all of proposed leases of project land and development and implementation of a lease compliance program.

Wolverine does no object to the DNR's recommended measures, except for the construction of directional signs along major highways. Wolverine believes this responsibility lies with public authorities.

We concur with the revised recreation enhancement plan proposed by Wolverine, and the additional recommendations of the DNR except for: (1) DNR's recommended prohibition of any recreational use fees at project facilities, and (2) DNR's recommended approval authority in reviewing the recreation facility designs. We often allow licensees to charge reasonable recreation user fees to help offset the costs of the facilities and improvements, and we will afford Wolverine this same opportunity. We recommend that Wolverine continue to consult with the DNR on recreational issues, but note that approval authority for the final phase 2 recreation plans rests exclusively with the Commission under the terms of any license.

In regard to DNR recommendation (e) above, the Commission's standard land use article requires that, for most project conveyances, the Licensee must consult with the state and Federal resource agencies, and subsequently supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with, the covenants of any instrument of conveyance. We conclude that our standard land use license article would satisfy the objectives of the DNR. Wolverine notes that it has not leased any of its lands in the project area.

We recommend approval of the revised recreation plan filed by Wolverine in any license issued for the project, and will also recommend that the Licensee file as-built drawings for the phase 1 and phase 2 facilities, as well as accompanying reports that describe: (a) how the facilities would accommodate the disabled, (b) scope of its sign program, including signage from major roads, (c) plans for operation and maintenance of the facilities, and (d) evidence of consultation with the DNR and the National Park Service (NPS) on the plans.

8. Project retirement: The DNR recommends, pursuant to Section 10(j) of the Act, that Wolverine shall, 10 years after license issuance, begin consulting with the DNR on a plan for studying the costs of: (a) permanent non-power operation; (b) partial project removal; or (c) complete project removal at the Tower and Kleber Project.

Within 6 months thereafter, Wolverine would submit the study plans to the FERC for approval. Within 24 months after approval of the plans by the FERC, Wolverine would complete the studies called for by the plans, unless the FERC established a different period for study completion. On completion of the studies, Wolverine would submit study reports to the FERC and DNR.

In the first retail and wholesale general change of rate fillings following the completion of the studies, Wolverine would include costs related to the establishment of trust funds to collect from the ratepayers the costs of permanent non-power operation, partial project removal, or complete project removal. If the Michigan Public Service Commission (MPSC) or the FERC did not approve Wolverine rates insofar as they reflect costs related to the trust funds, it would include such costs in successive retail and wholesale general change of rate filings unless the DNR believed that making such a proposal would be unproductive.

The State of Michigan on behalf of Wolverine's ratepayers would be the beneficiary of the trust funds unless otherwise directed by the MPSC or FERC. The proposed license condition would state that nothing therein could be constructed to create an obligation on Wolverine's part to retire the project or not seek additional new licenses for the project.

Wolverine stated by letter dated January 19, 1993, that it has no present or contemplated plans to remove the dams at any time in the future. Wolverine has always maintained the dams so as to provide safe and reliable water power, in addition to providing recreation and wildlife habitat for the area. To remove the dams may result in legal exposure for violating established riparian rights of adjoining owners.

Wolverine disagrees with the need for a "retirement" fund and questions whether such a fund would be allowed by the MPSC in establishing's Wolverine's rates. Wolverine, will, however, maintain a ten-year advance plan at all times for the operation and maintenance of the hydroelectric projects, including the dams, the recreational facilities, and promoting the environmental habitat and will agree to give the DNR and the

Commission a ten-year notice before it commences discontinuance of either of the facilities.

We conclude preliminarily that DNR's recommendation is not a recommendation pursuant to Section 10(j) of the Act, in that it does not provide measures for the protection, mitigation of damages to, and enhancement of fish and wildlife resources. We will, however, consider it pursuant to Section 10(a) of the Act.

DNR has provided no persuasive evidence, indeed no evidence at all, to support its recommendation and we conclude that it is inappropriate. The ten-year date for comprehensively reexamining our 10(a) determination is completely arbitrary. The Commission has no way of knowing at this juncture how long the Tower and Kleber Project will continue to be economically justified. Its remaining economic life depends on factors such as future costs of alternative energy, system generation and load analyses, and continuing maintenance and repair expenses that cannot even be guessed at this time. Many projects under license exceed seventy years in age with no end to their economic life in sight. Nor can we determine now that it will be appropriate to revisit environmental concerns in ten years. An appropriate time might be two years or five years or twenty-five years, depending on future conditions. To require the Licensee to undertake expensive decommissioning studies at a specific future time in the complete absence of any evidence they will then be appropriate seems to us unwise. Similarly, it would not be appropriate to establish now what issues will be considered in Wolverine's MPSC and FERC rate cases ten or more years hence without a demonstration that the issue will then be ripe for consideration, or give DNR sole authority to determine whether or not this will be an issue.

The appropriate way to approach future dam decommissioning studies is for DNR to avail itself of Standard Article 17, under which it may at any time during the license term request the Commission to require Wolverine to undertake such studies based on a showing that they are warranted under the conditions then extant. Such a request may be based on economic or environmental consideration, or both. We think it is reasonable to assume that if the Commission does determine it is appropriate to establish a decommissioning fund, Wolverine will seek to recover its costs in its rates.

C Impacts of the No-Action Alternative

Under the no-action alternative, the project would continue to operate as it has in the past and without any changes to the existing physical, biological, or cultural components of the area.

VI. COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a)(1) of the Federal Power Act, require the Commission to give equal consideration to all uses of the waterway on which a project is located. When the Commission reviews a proposed project, the recreation, fish and wildlife, and other nondevelopmental values are considered equally with power and other developmental values. In determining whether, and under what conditions, a hydropower license should be issued, the Commission must weigh the various economic and environmental tradeoffs involved in the decision.

A. Recommended Alternative

No reasonable action alternatives to the proposed project have been identified for assessment (see section III.B). Based on our independent review and evaluation of the proposed project, the proposed project with our enhancement measures, and the no-action alternatives, we have selected the proposed project, with our recommended enhancement measures, as the preferred option. We recommend this option because the net benefits of the project outweigh the consequences associated with taking no action.

B. Developmental and non developmental uses of the waterway

The proposed project with our recommended enhancement measures would provide a number of benefits. An estimated 7,498.5 MWh of relatively low-cost electricity, currently worth about $297,165 13/ would continue to be generated annually from a clean, domestic, reliable, and renewable energy resource for use by seven of Wolverine's nearby wholesale cooperative customers14/.

The project's costs would be to operate and maintain the entire hydropower complex which are negligible when compared to the value of the power. The beneficial effects on the environment associated with the licensing of the Tower and Kleber Hydro Project would result from the enhancement measures required for the protection of natural resources in the project area. Enhancement measures include:

(a) operation of project in run-of-river mode;

13/ 7,498,500 kWh at 39.63 mills/kWh.

14/ The electricity potentially generated by the proposed project is equivalent to the energy that would be produced by burning 3,147 tons of coal annually in a steam-electric power plant.

(b) passage of streamflow equal to inflow into the project during emergency shutdowns;

(c) implement water quality monitoring plan;

(d) limit winter draw down to no more that 1 foot;

(e) cooperate with DNR to develop a formal Lake sturgeon management plan, however participation will be limited to operational considerations only;

(f) implement a turbine and entrainment protection and mitigation plan;

(g) implement monitoring plan for compliance with dissolved oxygen and temperature limits;

(h) implement plan to control/eliminate noxious water plants when deemed appropriate;

(i) implement bald eagle protection measures; and

(j) protect any previously undiscovered properties that may be eligible for listing on the National Register of Historic Places;

We have analyzed the economic impacts of providing the enhancement measures. The economics of the project were based on the following assumptions:

(a) the project would generate an average of about 7,498,500 kWh of energy annually;

(b) the levelized unit energy value of the project's power is 39.63 mills/kWh;

(c) the annual hydroelectric operation and maintenance cost is insignificant; and

(d) enhancement measures would result in no lost generation annually.

Since it is not possible at this time to foresee future changes to project operations or other mitigative or enhancement measures that may become necessary to protect the fishery and wildlife resources at the project, it is also not possible to estimate the costs of these measures. Prior to the Commission ordering specific changes to project operations or other mitigative or enhancement measures, as may be recommended by resource agencies in the future, Wolverine would be provided the opportunity for a hearing. At such a hearing, any costs associated with the change affecting the economic viability of the project could be presented and considered.

Section 10(a)(2) of the Act also requires the Commission to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. Under Section 10(a)(2), Federal and state agencies have filed a total of 47 plans for Michigan and seven for the United States. We have determined that two of these plans are relevant to this project.15/ No conflicts were found. Although Michigan's recreation plan (1985) shows no need for improving resource-based recreational opportunities in Cheboygan County, the DNR has identified a need for improved public access at the project, especially facilities for the disabled. We conclude that the phased approach to recreation development proposed by Wolverine would be consistent with Michigan's recreation plan.

VII. PRELIMINARY DETERMINATION OF CONSISTENCY WITH FISH AND WILDLIFE RECOMMENDATIONS

Pursuant to Section 10(j) of the Act, we determine that all of the U. S. Department of Interior's (Interior) recommendations are consistent with the purpose and requirements of Part I of the Act and applicable law. Section 10(j) of the Act requires the Commission to include license conditions, based on recommendations of Federal and state fish and wildlife agencies, for the protection of, mitigation of adverse impacts to, and enhancement of fish and wildlife resources. We have addressed the concerns of the Interior and made recommendations consistent with them.

Pursuant to Section 10(j) of the Act, we are making a preliminary determination that certain recommendations of the Michigan Department of Natural Resource are inconsistent with the purpose and requirements of the comprehensive planning and public interest standards of Sections 4(e) and 10(a) of the Federal Power Act. These are DNR's following recommendations: (1) requiring Wolverine to develop and implement an upstream fish passage plan, (2) requiring Wolverine to develop and implement a turbine mortality and entrainment plan, and (3) requiring Wolverine to develop and implement a management plan for lake sturgeon as well as other state threatened, endangered, and sensitive species.

15/ Michigan Department of Natural Resources, Building Michigan's recreation future: the 1985-90 Michigan recreation plan, 1985; and Fish and Wildlife Service and Canadian Wildlife Service, North American Waterfowl Management Plan, May 1986.

Moreover, the DNR's recommendations (1) a gaging plan; (2) a recreation plan; (3) a water quality monitoring plan, and (4) a plan for studying the costs of permanent non-power operation, partial project removal, or complete project removal at the Tower and Kleber Project are inappropriate fish and wildlife recommendations, under Section 10(j) of the Act, in that they do not provide measures for the protection, enhancement, mitigation of damages to, and enhancement of fish and wildlife resources.

Upstream Fish Passage Plan. The DNR has provided no persuasive evidence to support its recommendation to develop and implement an upstream fish passage plan. Although fish passage may be necessary for the enhancement of a future anadromous

fishery, there is no evidence to warrant fish passage for the resident fishes in the vicinity of the Tower and Kleber Project at this time. In place of the DNR's recommendation, we recommend that any license issued for the Tower and Kleber Project include standard articles wherein the DNR may request fish passage in the future, or through Interior, which may request fish passage in the future under Section 18 of the Act. We have recommended that any license issued include an article reserving Interior's authority to prescribe fishways.

Turbine Mortality and Entrainment Plan. The DNR and Wolverine have agreed to a fish protection plan, which requires, in part, that Wolverine pay for the design and evaluation of four separate fish protection measures. The plan also requires Wolverine to compensate for any residual fish losses once fish protection measures are in place. The DNR requires compensation in the form of restitution value.

We concur with the fish protection and mitigation plan agreed to by the DNR and Wolverine as discussed in section V.B.3.b. However, we believe that Wolverine should not be required to pay restitution value for fishes killed at the project. The fishes killed may be replaced by stocking without notable losses to the recreational value of these fishes. Therefore, we recommend that for any license issued for the Tower and Kleber Project, Wolverine be required to develop and implement the plan. The plan should be modified such that Wolverine, in addition to the fish protection device(s) used, be required to reimburse the state for fishes killed at the project based on fish replacement costs and not restitution value of the killed fishes.

Lake Sturgeon Management Plan: The DNR recommends Wolverine develop and implement a plan to protect and enhance lake sturgeon habitat in the Black River downstream of Kleber Dam. We concur with the DNR, and conclude that the development of a lake sturgeon management plan would provide a valuable, formalized setting for lake sturgeon management in the Black River Basin. However, we disagree with the DNR's recommendation that Wolverine should develop and implement the plan. The DNR has the responsibility to act as steward for a publicly utilized resource within Michigan. Given their role, the DNR has the responsibility to manage Michigan's fishery resources, including the state-listed lake sturgeon.

VIII. FINDING OF NO SIGNIFICANT IMPACT

Implementing the mitigative measures described in this environmental assessment would ensure that the environmental effects of project construction and operation would be insignificant.

On the basis of this independent environmental analysis, issuance of a license for the project would not constitute a major federal action significantly affecting the quality of the human environment.

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X. LIST OF PREPARERS

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Figure 1. The location of the proposed Tower and Kleber Hydroelectric Project.

Figure 2. Location of project features of the Tower Pond Development for the Tower and Kleber Hydroelectric Project, FERC No. 10615, Michigan, (Adapted from the Wolverine Power Supply Cooperative, Inc., 1989, application, exhibit G).

Figure 3. Location of project features of the Kleber Pond Development for the Tower and Kleber Hydroelectric Project, FERC No. 10615, Michigan.

FEDERAL ENERGY REGULATORY COMMISSION

Wolverine Power Supply Cooperative, Inc. — Project No. 10615-001, Michigan

ORDER ISSUING LICENSE
(Major Constructed Project)
(Issued May 12, 1994)

The Wolverine Power Supply Cooperative, Inc. (Wolverine), filed a license application under Part I of the Federal Power Act (FPA) to continue to operate and maintain the existing but unlicensed 1,760-kilowatt (kW) Tower and Kleber Hydro Project located on the Black River, a navigable waterway of the United States, in Cheboygan County, Michigan.

BACKGROUND

Wolverine is not proposing to add any new capacity, or make any major modifications to the project. The project was found jurisdictional under Docket No. UL 86-1.1/

Notice of the application has been published. No agency or other entity objected to or opposed the issuance of this license. The comments received from interested agencies and individuals have been fully considered in determining whether to issue this license. Michigan Department of Natural Resources (Michigan DNR) and the Michigan Water Resources Commission jointly filed a motion to intervene in order to be a party to the proceedings. The Anglers of the AuSable, Inc., the Great Lakes Council, Inc. of the Federation of Fly Fishers, Inc., the Michigan United Conservation Clubs, and the Michigan Council of Trout Unlimited filed a collective motion to intervene in order to protect their interests with respect to the nondevelopmental values of the Black River.

The Commission's staff issued an Environmental Assessment (EA) for this project on April 7, 1993, which is attached to and made part of this license. The staff also prepared a Safety and Design Assessment (SDA) which is available in the Commission's public file for this project.

PROJECT DESCRIPTION

The Tower and Kleber Hydro Project consists of two

1/ The Black River was found navigable based on a navigation status report prepared by the Commission's Chicago Regional Office in May of 1939.

97 FERC ¶ 62, 194
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Black River Limited Partnership — Project No. 11730-000

ORDER ISSUING ORIGINAL LICENSE
(Minor Project)
December 4, 2001

INTRODUCTION

Franklin Hydro Inc. on behalf of the Black River Limited Partnership (BRLP) filed on April 21, 1999, pursuant to Part 1 of the Federal Power Act (FPA),[1] an application for a minor license for the unlicensed 1.1 megawatt (MW) Alverno Hydroelectric Project No.11730. The project is located on the Black River in Cheboygan County, Michigan.[2]

BACKGROUND

The Commission issued a public notice soliciting motions to intervene for the project on August 19, 1999. The Michigan Department of Natural Resources (MDNR), Michigan Department of Environmental Quality (MDEQ), and the Michigan Hydro Relicensing Coalition (MHRC) filed timely interventions, but did not oppose the project. The Commission then issued a public notice on January 28, 2000, indicating the project was ready for environmental analysis and soliciting comments, recommendations, and terms and conditions. In response, the Commission received comments from the MDNR, the U.S. Department of the Interior (Interior), and the Black Lake Association.

On October 19, 2000, the Commission staff made available for public comment a draft environmental assessment (DEA). The DEA recommended that the project be licensed with certain additional mitigation measures, and found that licensing the project would not constitute a major federal action significantly affecting the quality of the human environment. Comments on the DEA were filled by the MDNR, MDEQ, and BRLP. The Commission issued the final environmental assessment on August 14, 2001,

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[1] 16 U.S.C. § § 791a - 825r.

[2] The Black River is a navigable waterway of the United States, see 67 FERC 62,057 (1994). Therefore, Section 23 (b) (1) of the 16 U.S.C. § 817 (1), requires the project to be licensed.

which is attached to this license and incorporated by reference. The motions to intervene and comments filed by the agencies and interested parties have been considered and addressed in this order in determining whether, and under what conditions to issue this license.

PROJECT DESCRIPTION

The constructed project consists of a powerhouse located on the eastern riverbank that is integral with a 360-foot-long earth-filled dam. The dam includes a concrete spillway towards the western river bank that is controlled by a 16-foot high radial gate. A three-foot wide abandoned log chute and fish ladder is located adjacent to the spillway. The impoundment formed by the dam extends approximately 2.5 miles upstream and has a normal surface area of 80 acres and a gross storage capacity of 480 acre-feet. The 76-foot concrete powerhouse contains two horizontal, 6-foot diameter propeller turbines and accompanying 2,400-volt generators that generate 3.8 gigawatt-hours (GWh) annually. The two turbine intakes have trashracks that are 17-feet deep by 21-feet long and constructed of 0.25-inch vertical steel bars, having a clear bar spacing of 1.25 inches.

At some flow levels, operation of the project has a direct influence on the water surface elevation of Black Lake, a 10,130-acre natural lake located 4.3 miles upstream of Alverno dam. Black Lake is not part of the Alverno Project. A 1965 court order directed that Black Lake be maintained at an elevation of 612.2 feet from May 15 through October 31, and 610.2 from December 1 through April 15 with the periods of November 1 to 30 to transition from the summer to winter level and April 15 to May 15 to transition from the winter to summer level. Because the project serves as the hydraulic control for Black Lake at some flow levels, depending on the season, the Alverno Project should be operated to pass more or less than inflow to maintain the water surface elevation of Black Lake at those levels. Within seasonally-occurring operational constraints, the BRLP proposes to operate the project in a non-peaking, modified run-of-river mode.

The BRLP proposes to install a third generating unit that would provide finer-scale control over flows through the project. The third unit would have a hydraulic capacity of 20 to 75 cubic feet per second (cfs), which would enable the BRLP to provide flows downstream of the project on a more continuous basis than what is currently possible with the existing turbines.

WATER QUALITY CERTIFICATION

Under Section 401(a)(1) of the Clean Water Act (CWA),[3] the Commission may not issue a license for a hydroelectric project unless the state water quality certifying agency has issued a water quality certification (WQC) for the project or has waived certification. Section 401(d) of the CWA provides that state certification shall become a condition on any federal license or permit that is issued.[4] Only a reviewing court can revise or delete these conditions.[5]

On April 16, 1999, the BRLP requested a WQC for the Alverno Project from the MDEQ, as required by Section 401 of the CWA. On March 21, 2000, the MDEQ issued the WQC for the project, subject to 23 conditions pertaining to project operations, measures to maintain water quality, erosion control, debris removal, and monitoring. The WQC is attached to this order as Appendix A, and is made part of this license (see ordering paragraph F).

THREATENED AND ENDANGERED SPECIES

Section 7(a) of the Endangered Species Act of 1973 (ESA)[6] requires federal agencies to ensure that their actions are not likely to jeopardize the existence of federally listed threatened and endangered species, or result in the destruction or adverse modification of designated critical habitat. No federally listed threatened, endangered, or proposed species occur within the Alverno Project area, and therefore, further consultation per the Endangered Species of Act of 1993, as amended, is not needed.[7]

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[3] 33 U.S.C. § 1341(a)(1).

[4] 33 U.S.C. § 13419d).

[5] See American Rivers v. FERC, 129 F.3d 99 (D.C. Cir. 1997).

[6] 16 U.S.C. § 1536(a).

[7] See letter from Michael T. Chezik, Regional Environmental Officer, U.S. Department of the Interior, Office of the Secretary, Philadelphia, March 27, 2000.

FISHWAY PRESCRIPTIONS

Section 18 of the FPA[8] provides that the Commission shall require construction, maintenance, and operation by the licensee of such fishways as the Secretaries of the U.S. Department of Commerce and of the Interior may prescribe. By letter filed March 28, 2000, Interior requested a reservation of authority to prescribe fish passage for the project. Article 401 of this license reserves the Commission's authority to require fishways that may be prescribed by Interior for the Alverno Project.

RECOMMENDATIONS OF FEDERAL AND STATE FISH AND WILDLIFE AGENCIES

Section 10(j)(1) of the FPA[9] requires the Commission, when issuing a license to include conditions based upon recommendations of federal and state fish and wildlife agencies submitted pursuant to the Fish and Wildlife Coordination Act,[10] to "adequately and equitably protect, mitigate damages to, and enhance, fish and wildlife (including related spawning grounds and habitat)" affected by the project. If the Commission believes that any such recommendations may be inconsistent with the purpose and requirements of Part 1 of the FPA, or other law, Section 10(j)(2) of the FPA requires the Commission and the agencies to attempt to resolve such inconsistencies, giving due weight to the recommendations, expertise, and statutory responsibilities of such agencies. If the Commission still does not adopt a recommendation, it must explain how the recommendation is inconsistent with Part 1 of the FPA or other applicable law and how the conditions imposed by the Commission adequately and equitably protect, mitigate damages to, and enhance fish and wildlife resources.

Interior and MDNR filed recommendations for license conditions that were considered in the Section 10(j) process in this proceeding.[11] I am including in this license conditions based on the agencies' recommendations, including requirements

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[8] 16 U.S.C. § 803(j)(1).

[9] 16 U.S.C. § 803(j)(1).

[10] 16 U.S.C. § 661 et seq.

[11] See letter dated March 27, 2000, for Interior's recommendations submitted under Section 10(j) of the FPA. See letter dated March 24, 2000, for MDNR's recommendations submitted under Section 10(j) of the FPA.

relating to: maintaining state water quality standards for dissolved oxygen concentrations and water temperatures at the project (Article 402); a water quality monitoring plan (Article 403); water surface elevations for Black Lake (Article 404); limiting Black Lake water surface elevation fluctuations (Article 404); modified run-of-river operation (Article 404); gaging and flow compliance plan (Article 405); recording headwater elevations of Alverno impoundment and Black Lake (Article 405); installing a staff gage on the upstream wall of the dam (Article 405); recording project operations, including turbine operations (Article 405); documenting three years of compliance with operating standards (Article 405), a maintenance drawdown plan (Article 407); passing river inflow immediately through the project in the event of a shutdown (Article 408); a woody debris passage protocols (Article 412), a nuisance plant monitoring plan (Article 415), a and wildlife management plan (Article 413).

In the DEA, the Commission staff made a determination that the recommendations made by Interior and MDNR to operate the project in an instantaneous run-of-river mode at all times, install flow gages upstream and downstream of Alverno dam, and monitor compliance with run-of-river operations by having no more than a 10 percent difference in discharge upstream and downstream of the project, and to maintain a minimum flow downstream of the project of 75 cfs between inflows of 75 and 245 cfs were potentially inconsistent with the requirements of the FPA.

In letters dated November 8, 2000, the Commission staff sought to resolve the apparent inconsistencies regarding Interior's and MDNR's four recommendations. In a letter dated November 16, 2000, commenting on the DEA, MDNR disagreed with the Commission staff recommendations.

On January 31, 2001, the Commission staff convened a Section 10(j) teleconference with representatives from the U.S. Fish and Wildlife Service (FWS) and the MDNR in an attempt to resolve the apparent inconsistencies of their recommendations with the FPA.

Commission staff and the MDNR resolved issues related to project operations, recommended minimum flows, and Black Lake water surface elevations. The MDNR acknowledged that the highest priority with regard to project operations is to maintain water surface levels in Black Lake at an elevation of 612.2 feet from May 15 through October 31, and 610.2 from December 1 through April 15 with the periods of November 1 to 30 to transition from the summer to winter level and April 15 to May 15 to transition from the winter to summer level. The release of 75 cfs minimum flows, when inflows are between 75 and 245 cfs, along with the potential to operate the project in a run-of-river mode as often as possible, are both contingent on first ensuring Black Lake is within seasonal limits. The MDNR clarified that at inflows of less than 75 cfs, the applicant could use the low flow turbine to maintain minimum flows downstream of the project. Based on the MDNR's clarification, staff concludes that the operational scenario recommended for the Alervno Project is not inconsistent with the FPA.

Commission staff and Interior were unable to resolve the Section 10(j) inconsistencies as follows:

1. Operate project in an instantaneous run-of-river mode

Interior's recommendation to operate the project in an instantaneous run-of-river mode at all times (with no hydro peaking) would cause Black Lake water surface elevations to range outside the seasonal limits and have negative effects on habitat for fish and aquatic resources. I have included in this license a condition that requires the licensee to operate the project in a run-of-river mode except as necessary to maintain Black Lake at an elevation of 612.2 feet from May 15 through October 31, and 610.2 from December 1 through April 15 with the periods of November 1 to 30 to transition from the summer to winter level and April 15 to May 15 to transition from the winter to summer level (Article 404).

2. Install flow gaging stations upstream and downstream of the dam.

Interior's recommendation to construct, maintain, and fund USGS flow gaging stations upstream and downstream of Alverno dam to measure inflow and discharge is not necessary, because compliance with the recommended operating regime will be determined using water surface elevation data from Black Lake and Alverno impoundment and project operations data. Therefore, I have included in this license a condition that requires the licensee to develop, in consultation the MDEQ, MDNR, and FWS, a gaging and flow compliance plan (Article 405).

3. Comply with run-of-river operations by maintaining no more than 10 percent difference in discharge upstream and downstream of the project.

Interior's recommendation to maintain compliance with run-of-river operation by having no more than a 10 percent difference in discharge upstream and downstream of the project is unnecessary, because we do not recommend a strict run-of-river operation for the project because it would have significant adverse effects on fish and aquatic resources in Black Lake. I have included in this license a condition that requires the licensee to operate the project in a run-of-river mode except as necessary to maintain Black Lake at an elevation of 612.2 feet from May 15 through October 31, and 610.2

from December 1 through April 15 with the periods of November 1 to 30 to transition from the summer to winter level and April 15 to May 15 to transition from the winter to summer level (Article 404) and a condition that requires the licensee to develop, in consultation the MDEQ, MDNR, and FWS, a gaging and flow compliance plan (Article 405).

OTHER ISSUES

A. Administrative Conditions

Section 10(e) of the FPA[12] provides that the Commission shall assess licensees annual charges to reimburse the United States' costs of administrating Part 1 of the FPA. When the Commission issues a license for a pre-1935 project that has been operating without FPA authorization despite its location on a navigable water of the United States,[13] it also assesses the licensee an amount equal to the annual charges that would have been assessed from the earlier of April 1, 1962,[14] or the date of finding that the river on which the project is located is navigable at the project site. The project was determined to be jurisdictional based upon the navigability of the Black River on April 20, 1994. The Commission has not assessed annual charges for projects less than 1,500kW authorized installed capacity since October 1, 1994. The authorized installed capacity for this project is 1,000 kW , therefore, under current regulations no annual administrative charge will be assessed.

B. Cultural Resources

[12] 16 U.S.C. § 803(e).

[13] Section 23(b)(1) of the FPA, 16 U.S.C. § 817(1), requires the licensing of any hydroelectric project that is, inter alia, located on navigable waters of the United States, as that term is defined in FPA Section 3(8), 16 U.S.C. § 796(8).

[14] This is the date of the Federal Power Commission's order in Public Service Company of New Hampshire, 27 FPC 830 (1962), which established a new policy governing license terms and back charges for existing, unlicensed projects on navigable waterways. The Commission considered the law on navigability to have become well settled two decades earlier, such that project operators should have known by then whether their projects were located on navigable waters and therefore required licenses. For a fuller explanation, see City of Danville, 58 FERC ¶ at p. 62,017 (1992).

The Michigan State Historic Preservation Officer concludes that no cultural resources listed or eligible for inclusion in the Nation Register of Historic Places are known in the project area and that the project would have no effect on such resources. However, Article 415 of this license order provides guidance and protection if archeological or historic sites are discovered during: (1) upgrading recreation facilities; and (2) the future operation and maintenance of the project.

C. Project Boundary Map

Minor license applicants are not required to file a project boundary map delineating the project works such as the dam, powerhouse, and reservoir. Included in the application for license is an Exhibit G, showing a proposed project boundary. The applicant, by letter dated July 31, 2000, stated that the Exhibit G included with the license application is in error and submitted a revised Exhibit G with no project boundary. However, in this case recreation facilities are located within the project reservoir, and erosion control measures and wildlife habitat enhancement measures are required by this license to protect and enhance resources located within the project reservoir. Since the project reservoir is needed to accomplish project purposes, including recreation and environmental resources resource protection, it should be enclosed within a project boundary. A project boundary line would assist in establishing the project lands, and help to identify the lands necessary to enhance resources in the project area as required by Articles 411, 413, 414, 415, and 416 . Therefore, in order to simplify the identification and administration of project lands for project purposes, I am approving the Exhibit G, which includes a project boundary, filed with the license application.[15]

CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2)(A) of the FPA[16] require the Commission to consider the extent to which a hydroelectric project is consistent with federal and state comprehensive plans for improving, developing, or conserving waterways affected by the project.[17] Under Section 10(a)(2)(A), federal and state agencies filed 55 comprehensive plans that address various

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[15]See Northern States Power Company, 75 FERC ¶ 61,136 (1996), where the Commission required a project boundary, enclosing project lands needed for a specified project purpose at a minor project.

[16]16 U.S.C. § 803(a)(2)(A).

[17]Comprehensive plans for this purpose are defined at C.F.R. § 2.19 (1997).

resources in Michigan. Of these, the Commission staff identified and reviewed one plan relevant to this project.[18]

COMPREHENSIVE DEVELOPMENT

In determining whether a proposed hydroelectric power project will be best adapted to a comprehensive plan for developing a waterway for beneficial public uses, pursuant to section 10(a)(1), the Commission considers a number of public interest factors, including the projected economic benefits of project power.

Under the Commission's approach to evaluating the economics of hydroelectric projects, as articulated in Mead Corp.,[19] the Commission employs an analysis that uses current costs to compare the costs of the project and likely alternative power, with no forecasts concerning potential future inflation, escalation, or deflation beyond the license issuance date. The basic purpose of the Commission's economic analysis is to provide a general estimate of the potential power benefits and the costs of a project, and of reasonable alternatives to the power. The estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. In making the decision, the Commission considers the project power benefits both with the applicant's proposed measures and with the Commission's modifications and additions to the applicant's proposal.

As proposed by BRLP, the project would produce an average of 4,000 megawatt hours (MWh) of energy annually at an annual cost of about $85,000 or about 21.32 mills per kilowatt-hour (mills/kWh). The annual value of the power would be about $34,000 or about 8.45 mills/kWh.[20]

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[18]Michigan Department of Natural Resources. Recreation Division. 1991. 1991-1996 Michigan recreation plan. Lansing, Michigan 28pp. and appendices.

[19]72 FERC ¶ 61,027 (1995).

[20]Our estimate of the cost of alternative power is based on the current cost of energy generation in natural gas-fueled combined cycle combustion turbine (CCCT) generating plants in the East Central Area Reliability Coordination Agreement region, plus a value of $109 per kilowatt year for the project's average annual capacity of 1,000 kW. We compute the regional energy value to be 17.34 mills/kWh and the capacity value to be 12.43 mills/kWh, for a total power value of 29.77 mills/kWh. Our estimate of the energy value is based on the cost of fuel that would be displaced by the

(continued...)

As licensed with staff recommended measures, the project would produce an average of 4,000 MWh of energy annually at an annual cost of about $87,000 or about 21.80 mills/kWh. The annual power would be about $32,000 or about 7.96 mills/kWh. To determine if the project would be economically beneficial, we subtract the project's cost from the value of the project's power. Thus, the project's power would cost about $32,000 less than currently available alternative power.

In analyzing public interest factors, the Commission takes into account that hydroelectric projects offer unique operational benefits to the electric utility system (ancillary benefits). These include their value as almost instantaneous load-following response to dampen voltage and frequency instability on the transmission system, system-power-factor-correction through condensing operations, and a source of power available to help in quickly putting fossil-fuel based generating stations back on line following a major utility system or regional blackout.

Ancillary benefits are now mostly priced at rates that recover only the cost of providing the electric service at issue, which do not resemble the prices that would occur in competitive markets. As competitive markets for ancillary benefits begin to develop, the ability of hydro projects to provide ancillary services to the system will increase the benefits of the projects.

Based on our independent review and evaluation of the Alverno Project, recommendations from the resource agencies and other stakeholders, and no-action as documented in the FEA, I have selected the Alverno Project, with the staff-recommended measures, as the preferred alternative.

I selected this alternative because: (1) issuance of an original license would provide a beneficial, dependable, and an inexpensive source of electric energy; (2) the required mitigation measures would protect and enhance fish and wildlife resources, water quality, recreation and cultural resources; and (3) the 1,000-kW electric energy generated from renewable resources would continue to offset the use of fossil-fueled,

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[20](...continued)
hydroelectric generation in a natural gas-fueled CCCT generating plant, operating at a heat rate of 6,200 Btu/kWh. We estimate the cost of fuel based on the Energy Information Administration's reference-case estimate of average real fossil fuel costs for electric utilities, as published by the Energy Information Administration (EIA) in their Annual Energy Outlook for 1998 and its supplemental data on the EIA Internet Homepage.

steam-electric generating plants, thereby conserving nonrenewable resources and reducing atmospheric pollution.

The preferred alternative includes the following measures:

(1) reserve authority for the Secretary of the Interior to prescribe the construction, operation, and maintenance of fishways (Article 401).

(2) operate the Alverno Project in a manner consistent with the State of Michigan's water quality standards set forth in the Water Quality Certificate (Article 402);

(3) in consultation with the resource agencies, develop and implement a water quality monitoring program the fifth year after license issuance and every five years thereafter (Article 403);

(4) operate the project in a modified run-of-river mode to maintain the water surface elevation of Black Lake within an elevation of 612.2 feet from May 15 through October 31, and 610.2 from December 1 through April 15 with the periods of November 1 to 30 to transition from the summer to winter level and April 15 to May 15 to transition from the winter to summer level (Article 404);

(5) develop and implement a gaging and flow compliance monitoring plan, in consultation with the resource agencies, including monitoring Black Lake water surface elevation, Alverno impoundment water surface elevation, and project operations (Article 405);

(6) develop and implement a plan to monitor flow of the Black River downstream of the dam (Article 406);

(7) develop and implement a reservoir drawdown management plan, in consultation with the resources agencies, to prevent adverse effects on aquatic resources from planned reservoir drawdowns for project maintenance (Article 407);

(8) develop and implement provisions to immediately provide flow to downstream reaches in the event of a project shutdown (Article 408);

(9) cooperate with the resource agencies and nongovernmental organizations in the management of lake sturgeon in the Black River (Article 409);

(10) consult with resource agencies before undertaking any activities which may cause a significant mobilization of sediments (Article 410);

(11) develop and implement a shoreline erosion control plan, in consultation with the resource agencies, for the Alverno impoundment (Article 411);

(12) develop and implement a natural organic debris management plan, in consultation with the resource agencies, focusing on passing debris downstream of the project, to enhance habitat resources in the Black River (Article 412);

(13) develop and implement a wildlife management plan, in consultation with the resource agencies, focusing on nesting structures, habitat enhancement, and vegetation management (Article 413);

(14) development and implement a recreation management plan, in consultation with the MDNR, focusing on enhancing existing facilities (Article 414);

(15) develop and implement a plan to monitor purple loosestrife *(Lythrum salicaria)* and Eurasian water-milfoil *(Myriophyllum spication)* in consultation with the resource agencies (Article 415); and

(16) consult with the SHPO in case archeological or historic sites are discovered (Article 416);

LICENSE TERM

Section 6 of the FPA[21] provides that original licenses for hydropower projects shall be issued for a term not exceeding 50 years. The Commission's license term policy when issuing original licenses for existing projects that should have been licensed earlier is set forth in *City of Danville*.[22] We issue a 30-year license for projects with little or no redevelopment, new construction, or new environmental mitigation and enhancement measures; a 40-year license for projects with a moderate amount of such activities; and a 50-year license for projects with extensive measures.

This license authorizes a moderate amount of new environmental mitigation measures and new construction relative to the size of the project. Accordingly, I issue

[21] 16 U.S.C. § 799.

[22] 58 FERC ¶ 61,318 at pp. 62,020-21 (1992).

this license for a term of 40 years, effective the first day of the month the license is issued.

SUMMARY OF FINDINGS

Background information, analysis of impacts, support for related license articles, and the basis for a finding of no significant impact on the environment are contained in the final EA, which is attached to and made part of this license order. Issuance of this license is not a major federal action significantly affecting the quality of the human environment.

The design of this project is consistent with the engineering standards governing dam safety. The project will be safe if constructed, operated and maintained in accordance with the requirements of this license.

The Director orders:

(A) This license is issued to Black River Limited Partnership (licensee) for a period of 40 years, effective the first day of the month in which this license is issued, to construct, operate, and maintain the Alverno Hydroelectric Project. This license is subject to the terms and conditions of the Federal Power Act (FPA), which is incorporated by reference as part of this license, and subject to the regulations the Commission issues under the provisions of the FPA.

(B) The project consists of:

(1) All lands, to the extent of the licensee's interest in those lands, shown by Exhibit A and Exhibit G filed April 21, 1999.

(2) Project works consisting of: (1) a powerhouse located on the eastern riverbank that is integral with a 360-foot-long earth-filled dam; (2) a dam that includes a concrete spillway with a 16-foot high radial gate; (3) a reservoir with a normal surface area of 80 acres and a gross storage capacity of 480 acre-feet; (4) a 76-foot by 46-foot concrete powerhouse containing two horizontal, 6-foot diameter propeller turbines and accompanying 2,400-volt generators; and (4) two turbine intakes with trashracks that are 17-feet deep by 21-feet long and constructed of 0.25-inch vertical steel bars, having a clear bar spacing of 1.25 inches. A three-foot wide abandoned log chute and fish ladder is located adjacent to the spillway.

The project works generally described above are more specifically described in Exhibit A of the application (Figures F-1, F-2, F-3, and F-4).

Exhibit F Drawing	FERC No.	Description
Sheet F-1	11730-1	Site Plan
Sheet F-2	11730-2	Powerhouse Plan
Sheet F-3	11730-3	Powerhouse Section
Sheet F-4	11730-4	Dam Elevation & Spillway Section

(3) Exhibit G: The following exhibit G filed April 21, 1999:

Exhibit G Drawing	FERC No.	Showing
Sheet G-1	11730-5	Project Map and Boundary

(4) All of the structures, fixtures, equipment, or facilities used to operate or maintain the project and located within the project boundary; all portable property that may be employed in connection with the project and located within or outside the project boundary; and all riparian or other rights that are necessary or appropriate in the operation or maintenance of the project.

(C) The exhibits A, F, and G as designated above are approved and made part of this license.

(D) The following sections of the FPA are waived and excluded from the license for this minor project:

> 4(b), except the second sentence; 4(e), insofar as it relates to approval of plans by the Chief of Engineers and the Secretary of the Army; 6, insofar as it relates to public notice and to the acceptance and expression in the license of the terms and conditions of the FPA that are waived here; 10(c), insofar as it relates to depreciation reserves; 10(d); 10(f); 14, except insofar as the power of condemnation is reserved; 15; 16; 19; 20; and 22.

(E) This license is subject to the articles set forth in Form L-9 (October 1975), entitled "Terms and Conditions of License for Constructed Minor Project Affecting Navigable Water of the United States," and the following additional articles:

(F) This license is subject to the water quality certification conditions submitted by the Michigan Department of Environmental Quality pursuant to Section 401(a) of the Clean Water Act, as those are set forth in Appendix A to this order.

Article 201. The licensee shall pay the United States an annual charge, effective as of the date of commencement of project construction, for the purpose of reimbursing the United States for the cost of administering Part I of the FPA, as determined by the Commission. The authorized installed capacity for that purpose is 1,100 kilowatts (kW). Under regulations currently in effect, projects with authorized capacity of less than or equal to 1,500-kW are not assessed an annual charge.

Article 202. Within 90 days of the issuance date of this order, the licensee shall file three sets of aperture cards of the approved drawings. The aperture cards should be reproduced on silver microfilm. All microfilm should be mounted on a Type D (3 1/4" x 7 3/8") aperture card.

Prior to microfilming, the FERC Drawing Number (11730-1 through -4) shall be shown in the margin below the title block of the approved drawings. After mounting, the FERC Drawing Number should be typed in the upper right corner of each aperture card. Additionally, the Project Number, FERC Exhibit (e.g. F-1, G-1, etc.), drawing title, and date of this order should be typed on the upper left corner of each aperture card. See Figure 1.

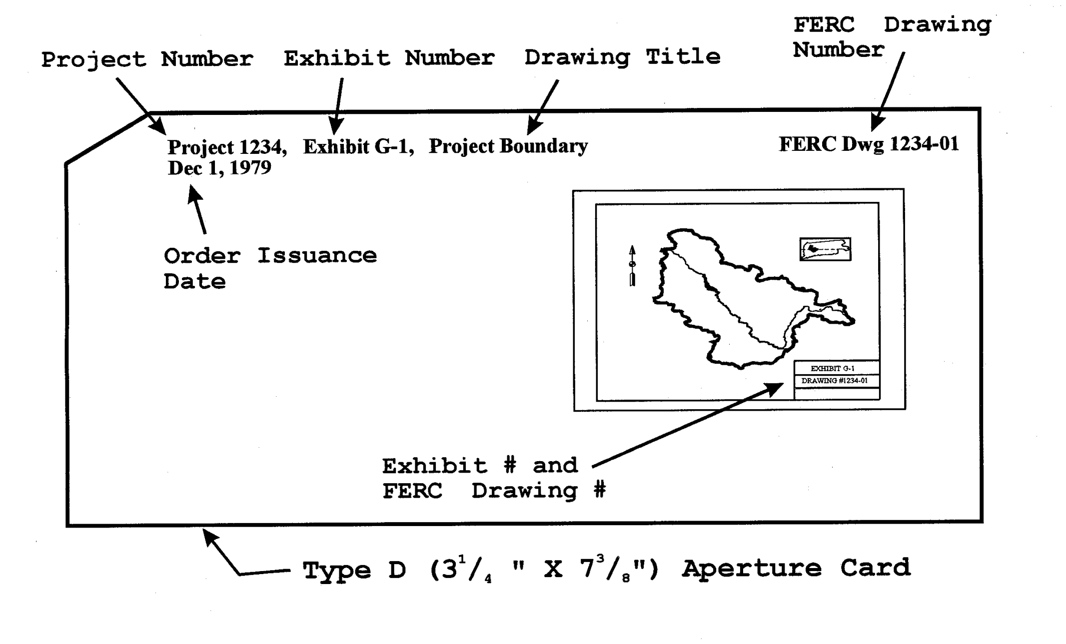

Figure 1. Sample Aperture Card Format

Two sets of aperture cards should be filed with the Secretary of the Commission. The remaining set of aperture cards should be filed with the Commission's Chicago Regional Office.

<u>Article 203</u>. If the licensee's project is directly benefitted by the construction work of another licensee, a permittee or the United States of a storage reservoir or other headwater improvement, the licensee shall reimburse the owner of the headwater improvement for those benefits, at such time as they are assessed. The benefits will be assessed in accordance with Subpart B of the Commission's regulations.

<u>Article 301</u>. Before starting construction, the licensee shall review and approve the design of contractor-designed cofferdams and deep excavations, and shall make sure construction of cofferdams and deep excavations is consistent with the approved design. At least 30 days before starting construction of the cofferdam, the licensee shall submit one copy to the Commission's Regional Director and two copies to the Commission (one of these copies shall be a courtesy copy to the Commission's Director, Division of Dam Safety and Inspections), of the approved cofferdam construction drawings and specifications and the letters of approval.

Article 302. The licensee shall, at least 60 days prior to the start of construction, submit one copy to the Commission's Regional Director and two copies to the Commission (one of these shall be a courtesy copy to the Director, Division of Dam Safety and Inspections), of the final contract drawings and specifications for pertinent features of the project, such as water retention structures, powerhouse, and water conveyance structures. Included in the plans and specifications submittal will be a soil erosion control plan. The Commission may require changes in the plans and specifications to assure a safe and adequate project.

If the licensee plans substantial changes to location, size, type, or purpose of the water retention structures, powerhouse, or water conveyance structures, the plans and specifications must be accompanied by revised Exhibit F and G drawings.

Article 303. The licensee shall complete an Independent Consultant's Inspection of the project facilities in accordance with Part 12, Subpart D of the Commission's Regulations within one year after receiving a license. The 2-year filing time requirement under §12.38(b) of the Commission's Regulations is hereby changed to one year for the Alverno Project.

Article 304. The licensee shall commence construction of the project works within two years from the issuance date of the license and shall complete construction of the project within 4 years from the issuance date of the license.

Article 305. Within 180 days of the completion of construction of the project works authorized by this license, the licensee shall file for Commission approval revised Exhibits A, F, and G which describe and show the project facilities "as-built".

Article 401. Authority is reserved to the Commission to require the licensee to construct, operate, and maintain, or to provide for the construction, operation, and maintenance of, such fishways as may be prescribed by the Secretary of the Interior under Section 18 of the Federal Power Act.

Article 402. The licensee shall maintain the following state water quality standards for water temperature and dissolved oxygen (DO) at the Alverno Project as follows:

(a) the licensee shall not warm the Black River downstream of the Alverno Project, by operation of the project, to temperatures in degrees Fahrenheit higher than the following monthly average temperatures:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
38	38	41	56	70	80	83	81	74	64	49	39

These monthly average water temperature standards shall not apply when the natural water temperature of the Black River as measured upstream of the Alverno impoundment exceed the above monthly average water temperature values.

(b) the licensee shall not cause the dissolved oxygen (DO) concentration measured in the Black River downstream of the Alverno Project to be less than 5.0 milligrams per liter (mg/l) at any time. This DO concentration standard shall not apply when the DO of the Black River as measured upstream of the Alverno impoundment is less than 5.0 mg/l; and

(c) in the event that any of the water quality limitations are not met, or if conditions change to indicate that they may not be met, the licensee shall immediately notify the Cadillac District Supervisor of the Michigan Department of Environmental Quality, and take all practical steps, including appropriate monitoring, to achieve compliance and minimize impacts on downstream waters.

Article 403. The licensee shall monitor water quality and related chemical parameters at the Alverno Project as follows:

(a) monitor water temperature and dissolved oxygen (DO) of the Black River from June 1 through September 30 at representative locations upstream of the impoundment and immediately downstream of the Alverno Project, beginning five years after license issuance and every five years thereafter, with the monitoring frequency determined in consultation with the Michigan Department of Environmental Quality (MDEQ);

(b) during the years when water temperature and DO are monitored, the licensee shall also measure the water temperature and DO profile in the deepest part of the impoundment every two weeks from June through September. Measurements shall be made at 0.5 meter increments or less. Secchi disk depth measurements shall be made at the same time as the profiling;

(c) ten years after license issuance and every ten years thereafter, the licensee shall analyze the sediments in the Alverno impoundment for the following parameters: oil and grease; total cadmium; total copper; total mercury; total organic carbon; total selenium; total zinc; total polychlorinated biphenyls; total arsenic; total chromium; total lead; total mercury; total nickel; total phosphorus; total silver; and acid volatile sulfides; and

(d) all measurements of water quality shall use methods approved by the U.S. Environmental Protection Agency Pursuant to 40 C.F.R. § 136 or methods approved by the MDEQ. All sampling locations, sampling methods, and analytical methods shall be determined in consultation with the MDEQ.

The licensee shall prepare an annual report of the data generated in items (a) - (d) (as applicable) to be submitted to the MDEQ and the Michigan Department of Natural Resources within three months of completing sampling. The report shall include a summary of quality insurance data.

Within 60 days of filing the annual report to the aforementioned resource agencies, the licensee shall file a copy of the annual report with the Commission, to include comments of the resource agencies on water quality monitoring activities, results of activities, and any agency-recommended changes to water quality sampling. The agencies should be provided 30 days to provide comments on the annual report, before submission of the report to the Commission. The Commission reserves the right to amend the water quality sampling program pending the submission of annual reports from the licensee.

The licensee shall file, within one year of license issuance, for Commission approval, a water quality monitoring plan, to include a description of methods for water quality monitoring and a description of provisions for chemical analysis, itemized above.

The licensee shall prepare the plan after consultation with the U.S. Fish and Wildlife Service, the Michigan Department of Natural Resources, and the Michigan Department of Environmental Quality. The licensee shall include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing should include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 404. The licensee shall operate the project in a run-of-river (R-O-R) mode for the protection of water quality, aquatic and recreational resources of the Alervno

Project and the Black River, except as necessary to maintain Black Lake at an elevation of 612.2 feet from May 15 through October 31, and 610.2 from December 1 through April 15 with the periods of November 1 to 30 to transition from the summer to winter level and April 15 to May 15 to transition from the winter to summer level, and except as provided for in item (a) below. Run-of-river means the instantaneous flow through the dam shall approximately equal the instantaneous impoundment inflow as monitored by impoundment elevations and streamflow downstream of the project.

(a) when there are more than 75 cubic feet per second (cfs) but less than 245 cfs available to operate the turbines, the Alverno Project may be operated in a limited store and release mode. During the limited store and release mode of operation, the licensee shall: (1) maintain Black Lake at an elevation of 612.2 feet from May 15 through October 31, and 610.2 from December 1 through April 15 with the periods of November 1 to 30 to transition from the summer to winter level and April 15 to May 15 to transition from the winter to summer level; (2) minimize the frequency and magnitude of turbine flow release changes; and (3) provide a minimum flow release from the turbines of at least 75 cfs.

Article 405. The licensee shall file, within 180 days of license issuance, for Commission approval, a gaging and flow compliance plan to monitor the modified run-of-river (R-O-R) operating mode required by Article 404. The plan shall include, at a minimum, measures to implement the following:

(a) install a calibrated staff gage in the Alverno impoundment at a location clearly visible to the public that shows the impoundment level referenced to the National Geodetic Vertical Datum;

(b) record the water surface elevation of the Alverno impoundment on an hourly basis using the staff gage or automated water surface elevation sensor (item d);

(c) record the water surface elevation of Black Lake on an hourly basis using an existing or installed automated water surface elevation sensor;

(d) install an automated water surface elevation sensor on the Alverno impoundment and record water surface elevation of the impoundment on an hourly basis; and

(e) record project operations data, including turbine start-up and shutdown times, and flows associated with project features.

The flow and operations monitoring plan shall also include: (1) a timetable for consulting with resource agencies regarding the installation of the recommended monitoring equipment; (2) protocols for recording monitoring data, such as pond elevations and turbine flows; (3) provisions for maintaining and filing a log of naturally-occurring high flow and ice jams that may hinder compliance with project operations; and (4) a timetable for telemetering monitoring equipment or making gage data accessible in electronic form.

The licensee shall prepare the plan after consultation with the Michigan Department of Environmental Quality (MDEQ), Michigan Department of Natural Resources (MDNR), and the U.S. Fish and Wildlife Service. The licensee shall include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing should include the licensee's reasons, based on project-specific information. The Commission reserves the right to require changes to the plan. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

On a semi-annual basis following approval of the plan, the licensee shall file with the Commission, and consulted resource agencies, a summary of all monitoring data, including staff gage readings, water surface elevation of the Alverno impoundment and Black Lake, and project operations data as specified above. The licensee shall also file an annual report of all monitoring data and submit the report to the MDNR. The licensee shall allow the MDNR a minimum of 30 days to comment on the report before filing the report with the Commission.

The licensee shall be given a three-year test period beginning after the gaging and flow monitoring plan is implemented, to determine the licensee's ability to comply with the operations requirements outlined in this Article. Within 90 days after the end of the three-year test period, the licensee shall prepare a report, in cooperation with the MDNR and MDEQ, and submitted to the MDEQ, which documents the licensee's ability to comply with the project operations requirements identified in this Article. If the report indicates that the licensee is not able to comply with all of the project operations requirements outlined in this Article, the licensee shall, in cooperation with the MDNR and MDEQ, develop a plan of action and implementation schedule to meet those requirements.

During adverse conditions when the project operations requirements outlined in this article cannot be met, the licensee shall, within one business day, consult with the MDNR and the Cadillac District Supervisor for the MDEQ, Surface Water Quality Division, regarding emergency actions taken or planned. Consultation during the adverse conditions shall continue following a mutually agreed upon schedule. Upon cessation of the adverse condition, the licensee shall resume the normal operations.

Article 406. The licensee shall, within one year of license issuance, provide a plan for approval by the Michigan Department of Environmental Quality, in consultation with the Michigan Department of Natural Resources (MDNR), to monitor flow of the Black River downstream of Alverno dam. This plan shall contain a timetable for implementation of monitoring within one full construction season after plan approval, annual submission of summary results to the MDNR, and a provision for submission of all data upon request.

Article 407. At least 90 days before undertaking any planned drawdowns of the Alverno Project impoundment for construction or operations and maintenance purposes, the licensee shall file notification of the planned drawdown with the Commission.

The licensee shall consult with the U.S. Fish and Wildlife Service (FWS) and the Michigan Department of Natural Resources (MDNR). The licensee shall provide a minimum of 30 days for the FWS and MDNR to comment on any planned reservoir drawdown. The licensee shall file with the notification, a summary of resource agency comments, including how comments were addressed. If the licensee does not adopt a recommendation, the filing should include the licensee's reasons, based on project-specific information. The Commission reserves the right to modify procedures for planned reservoir drawdowns.

Article 408. The licensee shall provide downstream flow immediately in the event of a project shutdown.

Article 409. To protect and enhance lake sturgeon and lake sturgeon habitat in the Black River basin the licensee shall cooperate with the Michigan Department of Natural Resources (MDNR), the U.S. Fish and Wildlife Service (FWS), and non-governmental organizations on lake sturgeon management in the Black River basin. The licensee shall engage in reasonable measures to minimize any potential adverse effects of operating the Alverno Project on lake sturgeon or lake sturgeon habitat. If at any time the licensee, the MDNR and FWS, are unable to agree upon reasonable measures necessary to minimize adverse effects to lake sturgeon or lake sturgeon habitat, the licensee shall immediately notify the Commission of the disagreement, the reason(s) given for needing licensee action to minimize adverse effects, the measures proposed for minimizing adverse effects and the licensee's reasons why these measures are not needed and/or the licensee's proposed measures for minimizing adverse effects to lake sturgeon and/or lake sturgeon habitat. The Commission will then determine whether reasonable measures to minimize adverse effects are needed and/or what measures the licensee shall take to support lake sturgeon management.

The licensee, in consultation with the MDNR and FWS, shall file annual status reports with the Commission, beginning one year after license issuance, outlining any reasonable measures undertaken by the licensee to minimize any adverse effects to lake sturgeon or lake sturgeon habitat and/or to support lake sturgeon management in the Black River basin. The annual status reports shall be filed with the Commission by October 1 of each year, and shall include a description of the activities engaged in the previous year and any expected activities to be engaged in during the upcoming year.

Article 410 Before conducting any construction activities that may mobilize significant sediment loads, the licensee shall consult with the Michigan Department of Natural Resources (MDNR) and the U.S. Fish and Wildlife Service (FWS) on best management practices to minimize the disturbance and suspension of sediments.

The licensee shall allow a minimum of 30 days for the MDNR and FWS to comment and to make recommendations on best management practices before filing the summary of consultation with the Commission. If the licensee does not adopt a recommendation, the filing should include the licensee's reasons, based on project-specific information. The Commission reserves the right to modify plans for minimizing sediment loading.

Article 411. The licensee shall, within three years of license issuance, develop and implement a plan to remediate stream and reservoir bank erosion sites that are caused by the Alverno Project. Prior to implementation, the plan shall be approved by the Michigan Department of Environmental Quality (MDEQ), in consultation with the Michigan Department of Natural Resources (MDNR). The plan shall include a determination of the area of influence by the Alverno Project, an erosion site inventory, an assessment of reasonable erosion control alternatives available for each site, and implementation dates for the erosion control option(s) selected for each site. The plan shall include a mechanism for the licensee to identify and control future erosion problems caused by the Alverno Project.

Article 412. The licensee shall, within one year of license issuance, develop and with the approval of the Michigan Department of Environmental Quality and the

Michigan Department of Natural Resources, implement a program to pass natural vegetative debris (logs, stumps, sticks, limbs, leaves and aquatic vegetation) collected on the trash racks and log booms over the Alverno Dam in a manner which will not create a navigation hazard. The licensee shall remove and properly dispose of all other materials collected in the trash racks and spill gates.

Article 413. The licensee shall file, within 180 days of license issuance, for Commission approval, a wildlife management plan. The plan shall include, but not be limited to the following:

(a) Install and maintain nesting boxes or platforms for wood duck, mallard, purple martin, bat, bluebird, owl and kestrel, osprey, as determined during consultation;

(b) monitor wildlife populations using nesting structures and maintain structures annually;

(c) promote the use of native grasses when opportunities for re-vegetation occur;

(d) maintain licensee's existing ownership of lands within the project; and

(e) an implementation schedule and map showing the location for the installation of the various artificial nesting structures.

The licensee shall prepare the plan after consultation with the U.S. Fish and Wildlife Service (FWS) and the Michigan Department of Natural Resources (MDNR). The licensee shall include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing should include the licensee's reasons, based on project-specific information.

If any of the measures prove unsuccessful, the plan shall provide for the inclusion of alternative measures or modifications to measures that are developed in consultation with the FWS and MDNR. Additional measures may be necessary, if bald eagles become established at the project in the future.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 414.. The licensee shall file, within 180 days of license issuance, for Commission approval, a recreation plan for providing enhanced recreational opportunities in and around the project site. The plan shall include:

(a) specifics on maintaining the existing recreation facilities;

(b) a signage plan detailing directions for users to access the project facilities;

(c) identification of any construction activities that may mobilize sediment loads, and erosion and sediment control measures to be used during construction of the facilities;

(d) plans to provide additional parking and fishing areas, and a restroom that are accessible for persons with disabilities, and additional downstream shoreline areas for fishing sites, and a canoe portage; and

(e) a schedule for implementing the recreation enhancements.

The licensee shall prepare the plan after consultation with the U.S. Fish and Wildlife Service and the Michigan Department of Natural Resources. The licensee shall include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing should include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 415. The licensee shall file, within 12 months of license issuance, for Commission approval, a plan to monitor purple loosestrife *(Lythrum salicaria)* and Eurasian water-milfoil *(Myriophyllum spication)* in project waters. The plan shall include, but not be limited to the following:

(a) a description of the monitoring method;

(b) a monitoring schedule;

(c) a schedule for providing the monitoring results to the U.S. Fish and Wildlife Service (USFWS) and the Michigan Department of Natural Resources (MDNR); and

(d) documentation of agency construction, including copies of comments and recommendations on the completed plan.

The licensee shall prepare the plan after consultation with the USFWS and the MDNR. The licensee shall include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing should include the licensee's reasons, based on project-specific information.

If at any time during the term of the license, the USFWS or the MDNR demonstrate that purple loosestrife or Eurasian water-milfoil is significantly affecting fish and wildlife populations at the project and that control measures are needed, and that the Commission agrees with those determinations, the Commission may require the licensee to cooperate with the MDNR and the USFWS to undertake reasonable measures to control or eliminate these weeds.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 416. If archeological or historic sites are discovered during any future project modification or construction that require land-disturbing activities, or during project operation or maintenance, or if the licensee plans any future modifications, other than routine maintenance, the Licensee shall: (1) consult with Michigan State Historic Preservation Officer (SHPO) about any discovered sites; (2) prepare a cultural resource management plan and a schedule to evaluate the significance of the sites and to avoid or mitigate any impacts to sites found eligible for inclusion in the National Register of Historic Places; (3) base the plan on recommendations of the SHPO and on the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation; (4) file the plan for Commission approval, together with the written comments of the SHPO documenting consultation and the adequacy of the plan; and (5) take the necessary steps to protect the discovered archeological or historic sites from further impact until notified by the Commission that all of these requirements have been satisfied.

The Commission may require a cultural resources survey and changes to the cultural resources management plan based on the filings. The Licensee shall not implement a cultural resource management plan or begin any land-cleaning or land-disturbing activities in the vicinity of any discovered sites until informed by the Commission that the requirements of this article have been fulfilled.

Article 417. Land Use. (a) In accordance with the provisions of this article, the licensee shall have the authority to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior Commission approval. The licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the project. For those purposes, the licensee shall also have continuing responsibility to supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the licensee shall take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, canceling the permission to use and occupy the project lands and waters and requiring the removal of any non-complying structures and facilities.

(b) The type of use and occupancy of project lands and water for which the licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) non-commercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 watercraft at a time and where said facility is intended to serve single-family type dwellings; (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline; and (4) food plots and other wildlife enhancement. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the licensee shall require multiple use and occupancy of facilities for access to project lands or waters. The licensee shall also ensure, to the satisfaction of the Commission's authorized representative, that the use and occupancies for which it grants permission are maintained in good repair and comply with applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the licensee shall: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the reservoir shoreline. To implement this paragraph (b), the licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the licensee's costs of administering the permit program. The Commission reserves the right to require the licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The licensee may convey easements or rights-of-way across, or leases of project lands for: (1) replacement, expansion, realignment, or maintenance of bridges or roads where all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) non-project overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69-kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project reservoir. No later than January 31 of each year, the licensee shall file three copies of a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed. If no conveyance was made during the prior calendar year, the licensee shall so inform the Commission and the Regional Director in writing no later than January 31 of each year.

(d) The licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certification or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) non-project overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or public marinas that can accommodate no more than 10 watercraft at a time and are located at least one-half mile (measured over project waters) from any other private or public marina; (6) recreational development consistent with an approved Exhibit R or approved report on recreational resources of an Exhibit E; and (7) other uses, if: (I) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from project waters at normal surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 60 days before conveying any interest in project lands under this paragraph (d), the licensee must submit a letter to the Director, Office of Hydropower Licensing, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked exhibit G or K map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Director, within 45 days from the filing date, requires the licensee to file an application for prior approval, the licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the licensee shall consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the licensee shall determine that the proposed use of the lands to be conveyed is not inconsistent with any approved Exhibit R or approved report on recreational resources of an Exhibit E; or, if the project does not have an approved Exhibit R or approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include the following covenants running with the land: (i) the use of the lands conveyed shall not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; (ii) the grantee shall take all reasonable precautions to ensure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project; and (iii) the grantee shall not unduly restrict public access to project waters.

(4) The Commission reserves the right to require the licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude land conveyed under this article only upon approval of revised Exhibit G or K drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project shall be consolidated for consideration when revised Exhibit G or K drawings would be filed for approval for other purposes.

(g) The authority granted to the licensee under this article shall not apply to any part of the public lands and reservations of the United States included within the project boundary.

(G) The licensee shall serve copies of any Commission filings required by this order on any entity specified in this order to be consulted on matters related to that filing. Proof of serve on these entities must accompany the filing with the Commission.

(H) This prder is issued under authority delegated to the Director and is final unless a request for a rehearing is filed within in 30 days from the date of issuance, as provided in Section 313 of the FPA. The filing of a request for a rehearing does not operate as a stay of the effective date of this license or any other date specified in this order, except as specifically ordered by the Commission. The licensee's failure to file a request for rehearing of this order shall constitute acceptance of this license.

J. Mark Robinson
Director
Office of Energy Projects

A-1

APPENDIX A

Michigan Department of Environmental Quality'
Certification Under Section 401 of the Federal Clean Water Act
Alverno Hydroelectric Project, P-11730-000

Certification Conditions:

1.0. Alverno Project - Operational Requirements:

1.1. The Black River Limited Partnership (BRLP) shall, within six months of the FERC license issuance, install a calibrated staff gauge in the Alverno Impoundment at a location clearly visible to the public that shows the impoundment level referenced to the National Geodetic Vertical Datum. The impoundment level and the level of Black Lake shall be recorded hourly. An annual report of all recorded impoundment and Black Lake levels shall be submitted to the Michigan Department of Natural Resources (MDNR).

1.2. Upon FERC license issuance, the BRLP shall operate the Alverno Project in a run-of-river mode except as necessary to maintain Black Lake at court-ordered levels and except as provided for under Section 1.3 of this Certification. Run-of-river means the instantaneous flow through the dam shall approximately equal instantaneous impoundment inflow as monitored by impoundment level elevations and stream flow downstream of the Alverno Project.

1.3. When there are more than 75 cfs but less than 245 cfs available to operate the turbines, the Alverno Project may be operated in a limited store and release mode. During the limited store and release mode of operation, the BRLP shall 1) maintain Black Lake at the court-ordered level, 2) minimize the frequency and magnitude of turbine flow release changes, and 3) provide a minimum flow release from the turbines of at least 75 cfs.

1.4. The BRLP shall, within one year of FERC license issuance, provide a plan for approval by the Michigan Department of Environmental Quality (MDEQ), in consultation with the MDNR, to monitor flow of the Black River downstream of the Alvemo Dam. This plan shall contain a timetable for implementation of the monitoring within one full construction season after plan approval, annual submission of summary results to the MDNR, and a provision for submission of all data upon request.

1.5. A three-year test period beginning after the flow monitoring plan in Section 1.4 is implemented shall be used to determine the BRLP's ability to comply with the requirements listed in Sections 1.2 and 1.3 of this Certification.

Within 90 days after the end of the three-year test period, a report shall be prepared by the BRLP, in cooperation with the MDNR and the MDEQ, and submitted to the MDEQ, which documents their ability to comply with requirements in Sections 1.2 and 1.3.

If the report indicates that the BRLP is not able to comply with all of the requirements in Sections 1.2 and 1.3, there the BRLP shall, in cooperation with the MDNR and the MDEQ, develop a plan of action and implementation schedule to meet those requirements.

1.6. During adverse conditions when the requirements in Sections 1.2 or 1.3 cannot be met, the BRLP, shall, within one business day, consult with the MDNR and the Cadillac District Supervisor for the MDEQ, Surface Water Quality Division (SWQD), regarding emergency actions taken or planned. Consultation during the adverse conditions shall continue following a mutually agreed upon schedule. Upon cessation of the adverse conditions, the BRLP shall resume the normal operations.

2.0. Alverno Project - Water Quality Limitations:

2.1. The BRLP shall not warm the Black River downstream from the Alverno Project, by operation of the project, to temperatures in degrees Fahrenheit higher than the following monthly average temperatures:

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
38	38	41	56	70	80	83	81	74	64	49	39

This Section (2.1) shall not apply when the natural temperatures of the Black River measured upstream of the Alverno Impoundment exceed the above monthly average temperature values.

2.2. The BRLP shall not cause the dissolved oxygen (DO) concentration measured in the Black River downstream of the Alverno Project to be less than 5.0 mg/I at any time. This Section (2.2) shall not apply when the DO of the Black River measured upstream of the Alverno Impoundment is less than 5.0 mg/I.

2.3. In the event that any of the water quality limitations listed in Sections 2.1 or 2.2 of this Certification are not met, or if conditions change to indicate that they may not be met, the BRLP shall immediately notify the Cadillac District Supervisor of the MDEQ, SWQD, and take all practical steps, including appropriate monitoring, to achieve compliance and minimize impacts on downstream waters.

3.0. Alverno Project - Water Quality Monitoring and Reporting:

3.1. All measurements of water quality shall use methods approved by the U.S. Environmental Protection Agency pursuant to 40 C.F.R. §136 or methods approved by the MDEQ.

3.2. The BRLP shall monitor the temperature and DO of the Black River from June 1 through September 30 at representative locations upstream of the impoundment and immediately downstream of the Alvemo Project beginning five years after the issuance of the FERC license and every five years thereafter. The monitoring frequency shall be determined in consultation with the MDEQ.

3.3. During the years when DO and temperature are monitored pursuant to Section 3.2 of this Certification, the BRLP shall also measure the temperature and DO profile in the deepest part of the impoundment every two weeks from June through September. Measurements shall be made at 0.5 meter increments or less. Secchi disc depth measurements shall be made at the same time as the profiling.

3.4. Ten years after the issuance of the FERC license, and every ten years thereafter, the BRLP shall analyze the sediments in the Alvemo impoundment for the following parameters:

Oil and Grease	Total Arsenic
Total Cadmium	Total Chromium
Total Copper	Total Lead

Total Mercury	Total Nickel
Total Organic Carbon	Total Phosphorus
Total Selenium	Total Silver
Total Zinc Acid	Volatile Sulfides
Total PCB	

3.5. All sampling locations, sampling methods, and analytical methods shall be determined in consultation with the MDEQ. An annual report of the data generated to comply with Sections 3.1 - 3.4 shall be submitted to the MDEQ and the MDNR within three months of completing the sampling. The report shall include a summary of quality assurance data.

4.0. Alvemo Project - Bank Erosion Control:

4.1. The BRLP shall, within three years of the issuance of the FERC license, develop and implement a plan to remediate stream and reservoir bank erosion sites that are caused by the Alvemo Project. Prior to implementation, the plan shall be approved by the MDEQ, in consultation with the MDNR. This plan shall include a determination of the area of influence by the Alvemo Project, an erosion site inventory, an assessment of reasonable erosion control alternatives available for each site, and implementation dates for the erosion control option(s) selected for each site. The plan shall include a mechanism for the BRLP to identify and control future erosion problems caused by the Alvemo Project.

5.0. Alvemo Project - Natural Organic Debris Maintenance:

5.1. The BRLP shall, within one year of the issuance of the FERC license, develop and, with the approval of the MDEQ and the MDNR, implement a program to pass natural vegetative debris (logs, stumps, sticks, limbs, leaves, and aquatic vegetation) collected on the trash racks and log booms over the Alvemo Dam in a manner which will not create a navigation hazard. The BRLP shall remove and properly dispose of all other materials collected in the trash racks and spill gates.

6.0. Schedule Modification:

6.1. The MDEQ may extend or modify the specified implementation schedules within this Certification upon written request from the BRLP, in the event the BRLP, despite their good faith efforts, is unable to meet the schedules specified within this Certification because of events beyond their control.

7.0. Temporary Modification of Operational Requirements:

7.1. Operational requirements of this Certification may be temporarily suspended for completion of necessary inspections, maintenance activities, dam safety activities, and other activities as may be required by the FERC provided that prior-notice is given to the MDNR. _

8.0. Alvemo Project - Natural Resources Damages and Penalties:

8.1. The state reserves the right to seek civil or criminal penalties and liabilities under applicable law for natural resource damages which may occur.

9.0. Alvemo Project - Permits and Approvals:

9.1. Nothing herein shall relieve the BRLP from the requirement to obtain any other necessary permits, licenses, or approvals from other federal or state departments or agencies.

10.0. Alvemo Project- Right of Entry:

10.1. The BRLP shall allow the MDEQ, or any agent appointed by the MDEQ, upon the presentation of credentials, to enter upon the BRLP premises at reasonable times, to have access to and copy any records required to be kept under the conditions of this Certification, and to inspect the facilities or to sample any discharge of water from the Alvemo Project

11.0. Alvemo Project- Changes:

11.1. The BRLP shall notify the MDEQ and the MDNR within ten days of any change that has or may occur in the structures or operation of the Alvemo Project, which may affect compliance with the MWQS.

12.0. Alverno Project-Revocation:

12.1. If the MDEQ determines that the Alvemo Project can no longer comply with Section 401 (a) of the federal Clean Water Act and the

MWQS, then this Certification may be revoked or modified after appropriate public notice and opportunity for hearing.

ENVIRONMENTAL ASSESSMENT
FOR HYDROPOWER LICENSING

ALVERNO HYDROELECTRIC PROJECT
FERC Project No. 11730-000

MICHIGAN

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Environmental and Engineering Review
888 First Street, N.E.
Washington, D.C. 20426

August 2001

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SUMMARY

On April 21, 1999, Franklin Hydro Inc. (Franklin or Applicant) on behalf of the Black River Limited Partnership (BRLP) filed an application with the Federal Energy Regulatory Commission (Commission) for an original license for the existing and operating Alverno Hydroelectric Project (FERC Project No. 11730-000). The Alverno Project had not been previously licensed by the Commission. The Alverno Project is located on the Black River about 5.3 miles upstream of its confluence with the Cheboygan River, in Aloha, Benton, and Grant townships, Cheboygan County, Michigan (Figure 1) and does not occupy any United States federal lands. The proposed project would have an installed generating capacity of 1.1 megawatts (MW) and would generate about 4.0 gigawatt-hours (GWh) of energy annually.

This environmental assessment (EA) analyzes the effects of the proposed action, the proposed action with additional staff-recommended measures, and no action. Our analysis shows that the best alternative for the Alverno Project to reduce or avoid adverse effects on environmental resources is to issue an original license for the project with the following applicant proposed and staff-recommended measures: (1) operate the project in a manner consistent with the State of Michigan's water quality standards set forth in the Section 401 Water Quality Certificate (WQC); (2) develop and implement a water quality monitoring program; (3) consult with resource agencies before performing any activities which may cause a significant mobilization of sediments; (4) operate the project in a modified run-of-river mode to maintain the water surface elevation of Black Lake within court-ordered levels; (5) develop and implement a gaging and flow compliance monitoring plan, including monitoring Black Lake water surface elevation, Alverno impoundment water surface elevation, and project operations; (6) cooperate with the resource agencies and non-government organizations in the management of lake sturgeon in the Black River; (7) develop and implement provisions to immediately provide flow to downstream reaches in the event of a project shutdown; (8) develop and implement a reservoir drawdown management plan to prevent adverse effects on aquatic resources from planned reservoir drawdowns for project maintenance; (9) develop and implement a natural organic debris management plan focusing on passing debris downstream of the project, to enhance habitat resources in the Black River; (10) develop and implement a wildlife management plan focusing on nesting structures, habitat enhancement, and vegetation management; (11) develop and implement a shoreline erosion control plan, for the Alverno impoundment; (12) development and implement a recreation management plan focusing on enhancing existing facilities; and (13) reserve authority for the Secretary of the Interior to prescribe the construction, operation, and maintenance of fishways. We discuss these measures in Section V and summarize them in Section VI of this EA.

Overall, these measures, along with standard articles provided in any license issued for the project, would protect, mitigate adverse effects to, and enhance fisheries and aquatic resources. In addition, the electricity generated from the project would be beneficial because it would reduce the use of fossil-fueled electric generating plants, conserve non-renewable energy resources, and reduce atmospheric pollution.

Under the provisions of Section 10(j) of the Federal Power Act (FPA), each hydroelectric license issued by the Commission shall include conditions based on recommendations of federal and state fish and wildlife agencies, to adequately and equitably protect, mitigate damages to, and enhance fish and wildlife (including spawning grounds and habitat) affected by the project, unless such recommendations are inconsistent with the FPA or other applicable law. On March 27, 2000 and March 24, 2000, the U.S. Department of the Interior (Interior) and the Michigan Department of Natural Resources (MDNR) (respectively) filed recommendations for the protection, mitigation, and enhancement of such resources affected by the proposed project in response to the Notice of Application Ready for Environmental Assessment issued on January 27, 2000.

Commission staff and the MDNR and Interior held a Section 10(j) teleconference on January 23, 2001, to attempt to resolve agency recommendations that staff preliminarily determined to be inconsistent with the FPA Unresolved inconsistencies include three of Interior's recommendations to: (1) operate the project in a instantaneous run-of-river mode; (2) install flow gaging stations to track compliance with run-of-river operations; and (3) maintain a flow-based run-of-river compliance standard. Staff determined that an instantaneous run-of-river mode at the Alverno Project would cause a significant loss of fish and aquatic resources habitat in Black Lake. Operation of the Alverno Project in an instantaneous run-of-river mode is also inconsistent with the 401 WQC issued by the Michigan Department of Environmental Quality (MDEQ).

On April 16, 1999, BRLP applied to the MDEQ for a WQC for the Alverno Project, as required by Section 401 of the Clean Water Act. On March 21, 2000, the MDEQ issued a 401 WQC for the project, focusing on water quality, project operations, including bank erosion, but not other potentially controversial resource areas, such as fish passage.

Based on our independent review and evaluation of the proposed project, agency recommendations, and the no-action alternative, we recommend issuing an original license for the Alverno Project with our additional staff-recommended enhancement measures. We recommend this option because: (1) the project's continued operation would have minor environmental effects; (2) our recommended measures would protect and enhance fishery and aquatic resources; and (3) about 4.0 gigawatthours (GWh) of energy that would be generated annually from a renewable resource would continue to reduce the use of fossil-fueled, steam-electric generating plants, conserve nonrenewable energy sources, and reduce atmospheric pollution.

On the basis of our independent environmental analysis, we conclude that issuing licenses for the Alverno Project as proposed by the applicant's, with additional staff-recommended measures, would not be a major federal action significantly affecting the quality of the human environment.

ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Environmental and Engineering Review
Washington, D.C.

Alverno Hydroelectric Project
FERC Project No. 11730-000

I. INTRODUCTION

On April 21, 1999, Franklin Hydro Inc. (BRLP or Applicant), on behalf of the Black River Limited Partnership (BRLP), filed an application for an original license for the Alverno Hydroelectric Project (FERC Project No. 11730-000). The existing and operating Alverno Project has not previously been licensed by the Commission. The Alverno Project is located on the Black River in Aloha, Grant, and Benton townships, Cheboygan County, Michigan (Figure 1). The proposed project would have a generating capacity of 1.1 megawatts (MW) and would annually generate about 4.0 gigawatt-hours (kWh) of energy. The project does not occupy any United States lands.

II. PURPOSE AND NEED FOR ACTION

A. Purpose of Action

The Commission must decide whether to issue an original license for the Alverno Project and what, if any, conditions should be placed in any license issued. In this environmental assessment (EA), we assess the environmental and economic effects of operating the project as proposed by the applicant, operating the project as proposed by the applicant with additional staff-recommended measures, and no-action.

In deciding whether to issue any license, the Commission must determine that the project adopted will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and development purposes for which licenses are issued, the Commission must give equal consideration to the purposes of energy conservation, the protection, mitigation of damage to, and enhancement of fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality.

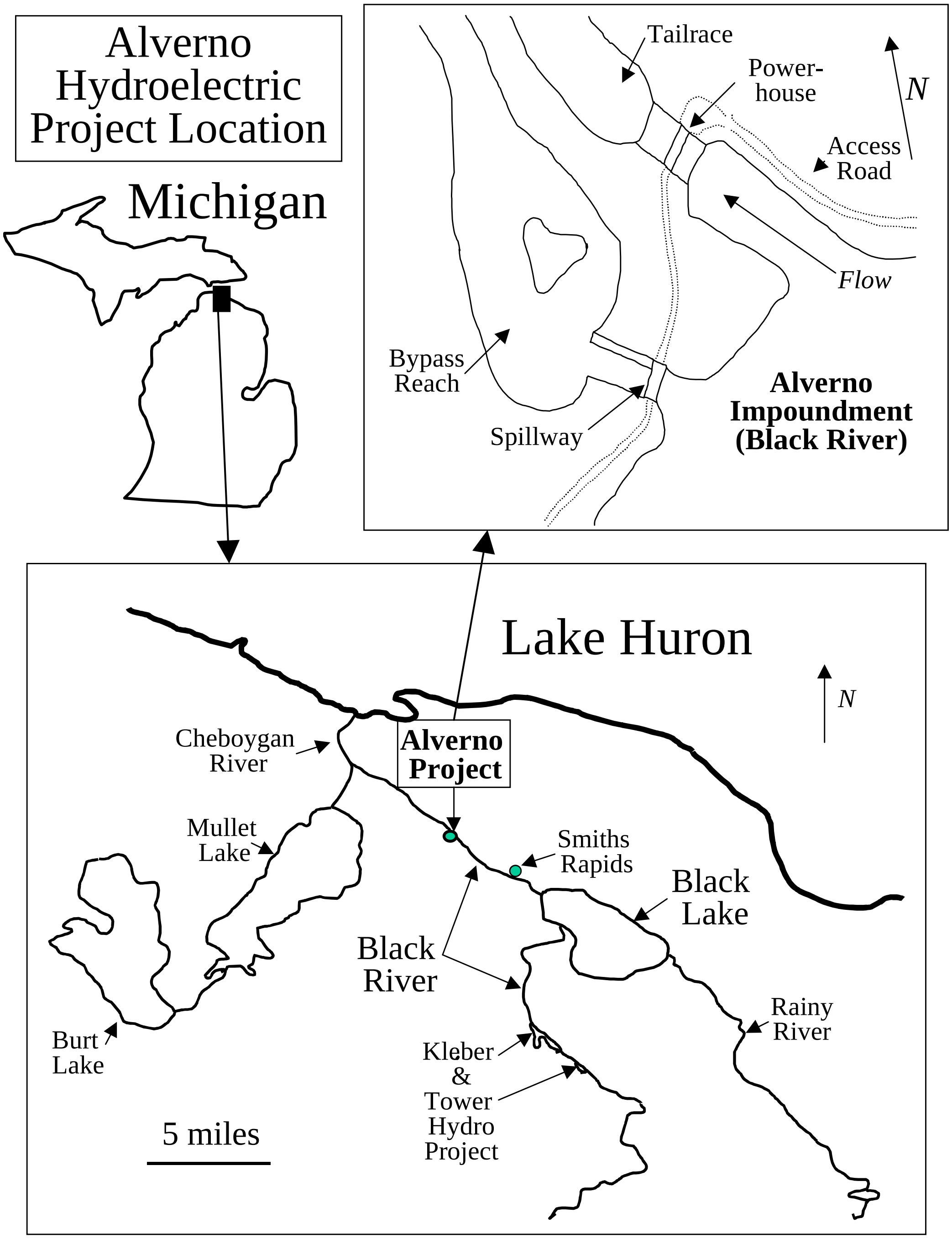

Figure 1. Location of the Alverno Hydroelectric Project FERC No. 11730-000 (Source: BRLP, 1999, as modified by staff).

B. Need for Power

If licensed with our recommendations, the Alverno Project will generate an average of 4,000 MWh of energy annually.

To assess the need for power, we reviewed the needs in the operating region in which the projects are located. The Alverno Project is located in the East Central Area Reliability Coordination Agreement Region (ECAR) of the North American Electric Reliability Council (NERC). NERC annually forecasts electrical supply and demand in the nation and the region for a ten-year period. NERC's most recent report[23] on annual supply and demand projections indicates that, for the period 1998 through 2007, the demand for electric energy in the East Central region will grow at an average rate of 1.59 percent annually (from 524,414 MWh to 624,683 MWh). The project could displace existing and planned nonrenewable fossil-fueled generation which contributes to the production of nitrous oxides and sulfurous oxides which contribute to air pollution, and carbon dioxide, which may contribute to global warming. In addition, the hydroelectric generation could contribute to diversification of the generation mix in the East Central region.

We conclude that the project's power could displace nonrenewable fossil-fired generation, contribute to a diversified generation mix, and help meet a need for power in the ECAR area.

III. PROPOSED ACTION AND ALTERNATIVES

A. Proposed Action

1. Project Facilities

The Alverno Project is located on the Black River in the northern region of the lower peninsula of Michigan (Figure 1). The constructed project consists of a powerhouse located on the eastern riverbank that is integral with a 360-foot-long earth-filled dam (Figure 1). The dam includes a concrete spillway towards the western river bank that is controlled by a 16-foot high radial gate. A three-foot wide abandoned log chute and fish ladder is located adjacent to the spillway. The impoundment formed by Alverno dam extends approximately 2.5 miles upstream and has a normal surface area of 80 acres and a gross storage capacity of 480 acre-feet.

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[23]ECAR's Electricity Supply and Demand Database, Data set 1997-2006.

The 76-foot by 46-foot concrete powerhouse contains two horizontal, 6-foot diameter propeller turbines and accompanying 2,400-volt generators that generate 3.8 gigawatt-hours (GWh) of energy annually. The two turbine intakes have trashracks that are 17-feet deep by 21-feet long and constructed of 0.25-inch vertical steel bars, having a clear bar spacing of 1.25 inches.

2. Existing and Proposed Project Operations

The BRLP operates the Alverno Project in a non-peaking, modified run-of-river mode. At some flow levels, operation of the Alverno Project has a direct influence on water surface elevations of Black Lake, a 10,130-acre natural lake located 4.3 miles upstream of Alverno dam. Black Lake is not part of the Alverno Project. A 1965 court order dictated that Black Lake be maintained near an elevation of 612.2 feet from May 15 through October 31, and near an elevation of 610.5 feet from December 1 through April 15. Because the Alverno Project serves as the hydraulic control for Black Lake at some flow levels, depending on the season, the Alverno Project may be operated to pass more or less than inflow to maintain the water surface elevation of Black Lake at the court-ordered level. Within these seasonally-occurring operational constraints, the BRLP operates the Alverno Project in a run-of-river mode whenever possible. The BRLP proposes to continue to operate the Alverno Project in a non-peaking, modified run-of-river mode.

The applicant proposes to install a third generating unit that would provide finer-scale control over flows through the project. The third unit would have a hydraulic capacity of 20 to 75 cfs, which would enable the BRLP to provide flows downstream of the project on a more continual basis than what is currently possible with the existing turbines.

3. Proposed Environmental Measures

To protect, mitigate, and enhance project-related environmental resources, the BRLP proposes to:

(1) install a third turbine, having a low flow capacity (20 to 75 cfs), to maintain a minimum flow (unspecified) downstream of the Alverno Project at all times;

(2) operate the project in a modified run-of-river mode to maintain Black Lake elevations near 612.2 feet in summer (May 15 through October 31) and 610.5 feet in winter (December 1 through April 15);

(3) give $2,000 each year to the MDNR for unavoidable losses of fish from entrainment mortality at the project;

(4) complete a bank stabilization program, including transplanting native brush into existing erosion areas and establishing emergent aquatic vegetation along the impoundment's waterline;

(5) construct and operate a sluiceway to transport woody debris accumulating at the project; and

(6) provide new parking and fishing areas, and a restroom facility that are accessible for persons with disabilities, and additional downstream shoreline areas for fishing sites, and a canoe portage.

B. Proposed Action with Additional Staff-Recommended Measures

In addition to Alverno's proposed actions, the staff recommends several additional environmental enhancement measures, including:

(1) operate the Alverno Project in a manner consistent with the State of Michigan's water quality standards set forth in the 401 Water Quality Certificate;

(2) in consultation with the resource agencies, develop and implement a water quality monitoring program the fifth year after license issuance and every five years thereafter;

(3) consult with resource agencies before performing any activities, which may cause a significant mobilization of sediments;

(4) operate the project in a modified run-of-river mode to maintain the water surface elevation of Black Lake at court-ordered levels;

(5) develop and implement a gaging and flow compliance monitoring plan, in consultation with the resource agencies, including monitoring Black Lake water surface elevation, Alverno impoundment water surface elevation, and project operations;

(6) cooperate with the resource agencies and non-governmental organizations (NGOs) in the management of lake sturgeon in the Black River;

(7) develop and implement provisions to immediately provide flow to downstream reaches in the event of a project shutdown;

(8) develop and implement a reservoir drawdown management plan, in consultation with the resources agencies, to prevent adverse effects on aquatic resources from planned reservoir drawdowns for project maintenance;

(9) develop and implement a natural organic debris management plan, in consultation with the resource agencies, focusing on passing debris downstream of the project, to enhance habitat resources in the Black River; .

(10) develop and implement an erosion and sediment control plan;

(11) develop and implement an wildlife management plan;

(12) develop and implement an recreation management plan; and

(13) measures to protect any undiscovered cultural resources.

C. No-Action

We define no-action as maintaining the environmental status quo. The project would not be licensed and the project would continue to operate without any environmental measures. We use this alternative to establish the baseline environmental conditions for comparison with other alternatives.

D. Alternatives Considered but Eliminated from Further Consideration

Federal Takeover and Decommissioning

Federal takeover and decommissioning relate to projects already licensed by the Commission and so these are not viable potential alternatives, because the Alverno Project has never been licensed by the Commission.

IV. CONSULTATION AND COMPLIANCE

A. Consultation

The Commission's regulations require applicants to consult with appropriate state and federal environmental resource agencies and the public before filing a license application. This consultation is required to comply with the Fish and Wildlife Coordination Act, the Endangered Species Act (ESA), the National Historic Preservation Act (NHPA), and other federal statutes. Pre-filing consultation must be complete and documented in accordance with the Commission's regulations. After an application is accepted, the Commission issues a public notice and seeks formal comment in accordance with federal statutes. Comments become part of the record.

The following entities commented on the application in response to the January 28, 2000 issuance of the Notice that the Application is Ready for Environmental Analysis.

Source	Date of Letter
Michigan Department of Natural Resources (MDNR)	March 24, 2000
U.S. Department of the Interior (Interior)	March 27, 2000
Black Lake Association (BLA)	April 14, 2000

B. Interventions

On August 19, 1999, the Commission issued a notice that BRLP had filed an application to license the Alverno Project. This notice set October 19, 1999 as the deadline for filing protests and motions to intervene. In response to this public notice for the project, the following entities filed motions to intervene, but not in opposition to the proceeding:

Intervenor	Date of Motion
Michigan Department of Natural Resources and Michigan Department of Environmental Quality (MDEQ)	October 14, 1999
The Michigan Hydro Relicensing Coalition (MHRC)	October 13, 1999

The State of Michigan, represented by the MDNR and MDEQ in this proceeding, intervened for the project citing concerns regarding the project's impact on the natural reproducing lake sturgeon population in Black Lake, located upstream of the Alverno Project. The MHRC intervened for the project citing their general interest in fishing, boating, and other recreational activities and their goal of protecting and enhancing riverine ecosystems through the relicensing process. We address intervenor concerns in the environmental analysis section (Section V) of this EA.

C. Scoping

Before preparing this EA, we conducted scoping to determine what issues and alternatives should be addressed. A scoping document was distributed to interested agencies and others on August 17, 1999. The scoping document described the environmental resources that would and would not be analyzed in detail, and identified cumulatively affected resources, based on information contained in the license applications, agency and public comments, and the intervention process. Two public scoping meetings were held on September 21, 1999, in the town of Benton, Michigan.

The Notice of Scoping Meetings and Site Visit and Soliciting Scoping Comments set October 17, 1999, as the deadline for filing comments. By letter dated October 15, 1999, the MDNR provided comments on the Scoping Document.

Comments on the Scoping Document provided by the MDNR as well as responses and comments provided at the scoping meetings were considered and incorporated into the analysis of this EA.

D. Section 18 Fishway Prescriptions

Section 18 of the FPA states that the Commission shall require the construction, maintenance, and operation by a licensee of such fishways as may be prescribed by the Secretary of the Interior, or the Secretary of Commerce, as appropriate.[24]

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[24] Section 18 of the FPA provides that "the Commission shall require construction, maintenance, and operation by a licensee at its own expense such fishways as may be prescribed by the Secretary of Commerce or the Secretary of the Interior, as appropriate."

Pursuant to Section 18 of the FPA, Interior filed with the Commission on March 28, 2000, a request for the reservation of authority to prescribe the construction, operation, and maintenance of upstream and downstream fishways.

The Commission recognizes that future fish passage needs and management objectives cannot always be determined at the time of project licensing. Under these circumstances, and upon receiving a specific request from Interior, we recommend the Commission follow its practice of reserving the Commission's authority to require such fishways as may be prescribed by the Secretary of the Interior, or to require modification to the fishways prescribed by Interior, as needed.[25]

E. Water Quality Certificate (WQC)

Under Section 401 (a)(1) of the Clean Water Act (CWA), the Commission may not issue a license for a hydroelectric project unless either the licensee obtains water quality certification from the certifying agency of the state in which the project discharge will originate, or the certifying agency waives certification. Section 401(a)(1) states that certification is deemed waived if the certifying agency fails to act on a water quality certification request within a reasonable period of time, not to exceed one year.[26] Section 401(d) of the CWA provides that state certification shall set forth conditions necessary to ensure that licensees comply with specific portions of the CWA and with appropriate requirements of state law.[27]

On April 16, 1999, the applicant requested a water quality certification for the Alverno Project from the MDEQ, as required by Section 401 of the CWA. On March 21, 2000, the MDEQ issued the WQC for the project, subject to 23 conditions pertaining to project operations, measures to maintain water quality, erosion control, debris removal, and monitoring. We discuss and analyze the WQC conditions related to water, fisheries,

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[25] The Commission has specifically sanctioned the reservation of fishway prescription authority at relicensing. See Wisconsin Public Service Corporation, 62 ¶ 61,095 (1993); affirmed, Wisconsin Public Service Corporation v. FERC, 32 F.3d 1165 (1994).

[26] Section 401(a)(1) requires an applicant for a federal license or permit to conduct any activity that may result in any discharge into navigable waters to obtain from the state in which the discharge originates certification that any such discharge will comply with applicable water quality standards.

[27] 33 U.S.C. Section 1341(d).

and wildlife resources in the Environmental Analysis section of this draft EA (Section V.C.2).

F. Coastal Zone Consistency Determination

The MDNR's Land and Water Management Division is responsible for reviewing hydroelectric projects for consistency with the state's Coastal Management Program (CMP). On December 20, 1999, the BRLP filed with the Commission a letter from Christy L. Fox of the MDNR's Land and Water Management Division, stating that the Alverno Project is consistent with Michigan's Coastal Management Program.

V. ENVIRONMENTAL ANALYSIS

In this section, we describe the Black River Basin, including the project drainage area and other man-made and natural features that could affect the resources analyzed. We also discuss the environmental resources subject to cumulative effects from the project when considered in combination with other actions affecting the resources. Then, for each resource, we describe the affected environment, the environmental effects and recommendations, cumulative effects (where applicable), and the unavoidable adverse effects of the proposed action with additional staff-recommended measures.

We address in detail only those resources affected by the operation of the Alverno Project, and include analysis of comments by interested parties on the project's proposed operation. Unless otherwise mentioned, the sources of our information include the license application (BRLP, 1999) and supplemental filings made by the applicant, resource agencies, and NGOs providing comments on the proceeding.

A. General Description of the Black River Basin

The Alverno Project is located on the Black River, which is a tributary of the Cheboygan River located in the northern region of the lower peninsula of Michigan (Figure 1). The Black River originates in the western end of Presque Isle County, Michigan, located east of Cheboygan County. From the headwaters in Presque Isle County, the Black River flows through the Tower and Kleber Hydroelectric Project (FERC No. 10615), which has two developments, and into the 10,130-acre Black Lake (Figure 1). From Black Lake, the Black River flows 4.3 miles to the Alverno Project and then 5.3 miles to the Cheboygan River, which discharges into western Lake Huron. The Black River basin drains an area of approximately 620 square miles upstream of Alverno dam, of which, about 597 square miles are comprised of Black Lake and its tributaries.

The Cheboygan River watershed contains an "inland waterway system" that consists of several large inland lakes, including Burt and Mullet lakes, that are inter-connected by riverine reaches (Figure 1). A lock system, located in the city of Cheboygan at the mouth of the Cheboygan River, provides boat access to and from the inland waterway to Lake Huron. The lock system also enables the passage of fish and other aquatic organisms to and from Lake Huron and inland areas connected by the inland waterway. At present, Alverno dam functionally isolates Black Lake and the upper Black River from the inland waterway and, hence, a direct ecological connection to Lake Huron and Burt and Mullet lakes.

The Black River watershed is mostly forested and open space, much of which is State land. Agriculture comprises a relatively small percentage of the entire watershed. Minimal urban development exists in the watershed and this development is contained in several small communities and strips of residential development along roads and the shoreline of the Alverno impoundment and Black Lake.

B. Scope of the Cumulative Effects Analysis

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) (C.F.R. § 1508.7), cumulative effects are the effects on the environment, which result from the incremental effect of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time, including hydropower and other land and water development activities.

Based on the license applications, comments from agencies and other interested parties, and our preliminary analysis, we reviewed all resources to determine if they could be affected in a cumulative manner by the licensing of the Alverno Project. We used this review to determine the geographic and temporal scope of our cumulative effects analysis.

We identified possible cumulative effects on water quality and fisheries resources. Cumulative effects on fisheries resources include the potamodromous lake sturgeon inhabiting the Cheboygan River watershed, including Black Lake and the upper Black River. Lake sturgeon originating in Lake Huron may also use the Cheboygan River and its tributaries for spawning and juvenile rearing. Operation of the Alverno Project, along with the Tower and Kleber Hydroelectric Project, and the presence of other non-hydro dams could cumulatively affect habitat availability and upstream and downstream movements of juvenile and adult lake sturgeon.

1. Geographic Scope

We define the geographical boundary of our cumulative effects analysis as portions of the Cheboygan River watershed that include Burt and Mullet lakes, and associated riverine reaches of the inland waterway system, the Black River, from its confluence with the Cheboygan River to Black Lake, and the upper Black River, upstream to the Kleber development (Figure 1). This geographic scope includes the physical limits or boundaries of the proposed action's effects on potamodromous lake sturgeon inhabiting the Cheboygan River watershed as well as lake sturgeon originating in Lake Huron that may use the watershed for spawning and rearing of juveniles.

2. Temporal Scope

The temporal scope of our analysis includes a discussion of past, present and future actions and their effects on cumulatively affected resource areas. Based on the term of the proposed license, we looked 30 to 50 years into the future, concentrating on the effect on the resource from reasonable foreseeable future actions. The effects of past actions on cumulatively affected resources is by necessity limited to the available information for each resource. We identified the present resource conditions based on the license application, comprehensive plans, and scoping comments received from agencies.

C. Environmental Analysis of the Proposed Action and Alternatives

Only those resources that are involved in substantial project-related issues are analyzed in detail in this section. We have eliminated socioeconomics from our detailed analysis. We note, however, that construction activities associated with the installation of a third generating unit at the Alverno Project would have minor effects on business, infrastructure, and tax revenues.

1. Geology and Soils

a. Affected environment

Surface geology in the project area consists primarily of glacial moraine deposits that have been cut through by the river. The river shoreline includes both natural banks and river terraces that have been disturbed by residential developments.

Copeland (1995) conducted a Phase I environmental assessment of sediment PCBs near the Alverno Project. Soil and sediment samples from six locations were analyzed for seven PCB aroclors and in all instances, PCB concentrations were below limits of detection. No spills or leaks of chemicals have been reported within the project area. No hazardous waste sites are located near the project.

The BRLP completed a survey of erosion along the Alverno impoundment on August 18, 1998. The majority of the impoundment shoreline has low slope (less than 15%) that is densely covered with bulrushes and cattails. Shoreline areas having higher slope have stable vegetative cover of grass, bulrushes, cattails, and brush. Unvegetated shoreline along the Alverno impoundment consists of exposed stones, cobbles, and larger rocks along both developed and undeveloped frontage. Past evidence of erosion was found to be stabilized by dense growths of bulrushes and cattails. Minor existing erosion was found near the Alverno dam on the east bank of the river where the slope is greater than 50 percent.

b. Environmental impacts and recommendations

The applicant proposes to complete vegetative plantings to control soil erosion observed during the August 18, 1998 survey. The MDNR, in it's March 24, 2000, 10(j) letter recommends that the BRLP, in consultation with the resource agencies, develop and implement a plan to inventory, control, and repair present and future shoreline erosion sites on the three reservoirs and downstream of the Project in the project influence zone. The MDNR recognizes that reduction of the amount of flow fluctuation in the riverine sections and the stabilization of reservoir levels, as recommended by the applicant, will assist in alleviating erosion on this project. In it's March 27, 2000, 10(j) letter, Interior recommends that the BRLP develop a plan to periodically evaluate the condition of eroding shoreline within the project boundary and stabilize heaving shoreline areas on licensee-owned project land. Interior also encourages the BRLP to work with owners of other shoreline property to address erosion on their land.

Our Analysis

Only minor soil erosion occurs in the Alverno impoundment. We agree with the applicant's approach of using vegetative planting to control soil erosion and the MDNR concurs that this is a reasonable way of minimizing effects of erosion. The re-stabilization of eroded riparian habitats using vegetative planting, in addition to reducing sediment loads to the Black River, could have indirect benefits by providing habitat for wildlife resources.

The applicant's proposes to continue the existing modified run-of-river operating mode, which causes minor fluctuations in impoundment levels within existing ranges. Thus, shoreline erosion should continue to be minimal. We conclude that the project will have minor, insignificant impacts on the geological and soil resources. Further, we recommend that any license issued for the project require that a erosion control and sediment control plan be develop, in consultation with the resource agencies, that would detail procedures for monitoring erosion, the stabilization method, and provide a schedule for implementing the measures.

c. Unavoidable adverse impacts

Minor, short-term soil erosion impacts would occur during the construction and installation of a third generating unit and construction of recommended recreation enhancements, discussed in Section V.B.5.

2. Water Resources

a. Affected environment

Water Use and Quantity

Discharge

Flow data (1942 to 1970) for the Black River in the vicinity of the Alverno Project are available from US Geological Survey (USGS) gage No. 4132000, located at the outlet of Black Lake. We adjusted flows recorded at the gage to account for the difference in basin area between the outlet of Black Lake (597 square miles) and the Alverno Project (620 square miles). Percent exceedance flows at the Alverno Project are as follows: 90 percent = 132 cfs; 50 percent = 394 cfs; and 10 percent = 895 cfs. Flow patterns in the Black River are typical of those in northern temperate regions, where peaks occur in April and May with low flows occurring between July and September. Lowest flows in the Black River consistently occur in August.

Tailrace Flows and Wetted Area

Flows in the Black River downstream of Alverno are influenced by the Cheboygan dam located 5 miles downstream on the Cheboygan River. The Black River immediately downstream of the Alverno Project is the upstream extent of the backwater of Cheboygan dam. As a result, the Alverno tailrace remains wetted even when only minor (3-5 cfs) leakage flows occur at the project.

The applicant completed studies in the summer of 1998 to quantify the water surface profile and river cross-section in the reach downstream of Alverno dam. Water surface profiles were recorded at five locations from Alverno dam to the confluence of the Black and Cheboygan rivers under three flow conditions: (1) no flow through the turbines; (2) gates open 70 percent on one turbine; and (3) gates open 100 percent on one turbine.

The BRLP found the water surface elevation in the tailrace increases slightly with turbine discharge. The tailrace elevation increased 0.54 feet from no flow to 100 percent gate open on one turbine. At a distance of 2.21 river miles downstream of Alverno, the water surface elevation increased 0.34 feet with one turbine running at 100 percent gate opening and 0.24 feet with the same turbine running at 70 percent gate opening.[28] Minor changes in the wetted perimeter of the river of less than or equal to one percent were also observed under the different flow conditions.

Black Lake Elevation Control

As noted in Section III.A.2, at some flow levels, operation of the Alverno Project has a direct influence on water surface elevations of Black Lake. At summer lake levels, operation of the project directly influences the level of Black Lake when the lake's outflow is between 0 and about 800 cfs. As outflow increases to greater than 800 cfs, the restriction at Smiths Rapids, not the operation of the Alverno Project, serves as the hydraulic control for Black Lake. Smiths Rapids continues to exert greater hydraulic control over Black Lake levels as outflows from the lake increase to greater than 800 cfs. In winter, the cross-sectional area at Smiths Rapids is smaller than in summer, because of lowered water levels in Black Lake and in the river system in general. The formation of ice along the banks and on rocks on the river bottom in winter further restricts the available channel cross-sectional area at Smiths Rapids. The BRLP estimates that in winter, Smiths Rapids becomes the primary hydraulic control for Black Lake at outflows of approximately 400 cfs.

Other Discharges

There are no known public water supplies or public wastewater discharges on any tributary in the Black River basin. The Wolverine Power Supply Cooperative holds a NPDES discharge permit to discharge 248,000 gallons-per-day of non-contact cooling

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[28] The flow through the turbine at 70 percent opening is estimated at 245 cfs and 375 cfs for the 100 percent opening.

water to the river near Tower, Michigan, upstream of Alverno. There are no known industrial, commercial, domestic, or irrigational users of the Black River between Black Lake and the Cheboygan River.

Water Quality

The Black River from Black Lake to the Cheboygan River is designated as a warmwater fishery by the MDNR. The MDEQ has designated the Black River in the vicinity of the project as Class B waters, suitable for body-contact and recreation, with a minimum acceptable dissolved oxygen (DO) concentration of 5 mg/l. Water quality testing completed in 1990 by the MDNR Surface Water Quality Division, two miles downstream of Black Lake, found water temperature ranged from 39.2 to 73.4 ^{o}F, DO from 7.8 to 12.7 mg/l, total dissolved solids from 188 to 207 mg/l, and pH in the 8.1 to 8.4 range.

The applicant monitored water temperature and DO at the Alverno Project in 1996 and 1997. From June 19, 1996, through October 18, 1996, water temperature and DO were continuously monitored at Smiths Rapids (about 2.5 miles upstream of Alverno) and in the Alverno Project's tailrace. Water temperatures did not exceed state standards and exhibited no significant differences between the upstream and downstream sampling locations. The average water temperature upstream of the project was 69.6 ^{o}F and 66.4 ^{o}F downstream of the project (table 1).

Dissolved oxygen concentrations exceeded the minimum water quality standard 5.0 mg/l at all times (table 1). The average DO concentration downstream of Alverno was 9.0 mg/l and the lowest concentration, recorded in August/September, was 6.8 mg/l. Upstream of the project, the average DO concentration was 8.9 mg/l. Dissolved oxygen minima of 3.0 and 4.5 mg/l were recorded at Smiths Rapids, but after further review of the data, the MDNR concluded the values were erroneous and not representative of water quality in the Black River.

Table 1. Seasonal average, minimum, and maximum (A) water temperature (ºF) and (B) dissolved oxygen measured upstream and downstream of Alverno dam (source: BRLP, 1999). The upstream location was just upstream of Smith Rapids (2.5 miles upstream of the project) and the downstream location was in the tailrace.

(A) Water temperature

	Upstream			Downstream		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
June/July	70.5	62.6	79.9	64.9	64.2	65.8
July/August	72.7	65.8	80.1	72.9	66.7	80.2
August/ September	71.4	61.3	77.4	71.1	61.7	76.6
September/ October	64.0	48.0	77.4	56.7	48.9	65.7

(B) Dissolved oxygen

	Upstream			Downstream		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
June/July	9.3	3.0	11.0	9.3	8.9	10.2
July/August	8.2	4.5	10.0	8.6	7.0	9.6
August/ September	8.6	6.3	10.3	8.2	6.8	10.1
September/ October	9.4	6.3	11.8	10.0	8.7	11.8

b. Environmental effects and recommendations

Water Quantity

Although the project's operating mode relates to water quality, the effects pertain mostly to fisheries and other aquatic biota. Therefore, we discuss these effects in section V.C.3, Fisheries Resources.

Water Quality

The applicant proposes no additional water quality monitoring at the Alverno Project.

The WQC issued for the Alverno Project states that the project would comply with Section 401(a) of the CWA and the applicable State of Michigan water quality standards if it operates according to the terms and conditions set forth in the WQC, as follows:

- The BRLP shall not warm the Black River downstream from the Alverno Project, by operation of the project, to temperatures in degrees Fahrenheit higher than the following monthly average temperatures: January = 38 °F; February = 38 °F; March = 41 °F; April = 56 °F; May = 70 °F; June = 80 °F; July = 83 °F; August = 81 °F; September = 74 °F; October = 64 °F; November = 49 °F; and December = 39 °F.[29]

- The BRLP shall not cause the DO concentration measured in the Black River downstream of the Alverno Project to be less than 5.0 mg/l at any time.[30]

- In the event that any of the water quality limitations listed above cannot be met, or if conditions change to indicate that they may not be met, the BRLP should notify the Cadillac District Supervisor of the MDEQ, SWQD, and take all practical steps to achieve compliance and minimize impacts on downstream waters.

- The BRLP shall monitor the temperature and DO of the Black River from June 1 to September 30 at representative locations upstream of the impoundment and

[29] This section shall not apply when the natural temperatures of the Black River measured upstream of the Alverno impoundment exceed the above monthly average temperature values.

[30] This section shall not apply when the DO of the Black River measured upstream of the Alverno impoundment is less than 5.0 mg/l.

immediately downstream of the Alverno Project, beginning five years after the issuance of a license and every five years thereafter.

- During the years when DO and temperature are monitored, the BRLP shall also measure the temperature and DO profile in the deepest part of the impoundment, at 0.5-meter increments, and record Secchi disc depth readings every two weeks from June through September.

- Ten years after the issuance of license, and every ten years thereafter, the BRLP shall analyze the sediments in the Alverno impoundment for the following parameters: (1) oil and grease; (2) total cadmium; (3) total copper; (4) total mercury; (5) total organic carbon; (6) total selenium; (7) total zinc; (8) total polychlorinated biphenyls (PCBs); (9) total arsenic; (10) total chromium; (11) total lead; (12) total nickel; (13) total phosphorous; (14) total silver; and (15) acid volatile sulfides.

The MDNR's recommendations regarding water quality at the Alverno Project are encompassed by conditions of the WQC. Additionally, the MDNR recommends the licensee not warm the Black River downstream of the Alverno dam more than 5 ^{o}F greater than the temperature as measured upstream of the Alverno impoundment. The MDNR also specifies the licensee should monitor compliance with DO and water temperature standards (see WQC) in the discharge channel immediately downstream of Alverno dam. The MDNR indicates that all violations of water quality standards may require the payment of liquidated damages for each event.

Interior recommends the licensee: (1) develop and implement a water quality monitoring plan within 24 months of license issuance, in consultation with the MDEQ; (2) maintain State of Michigan water quality standards in the project's discharge; and (3) conduct periodic water quality monitoring over the term of the license in accordance with a schedule approved by the MDEQ.

Our Analysis

The applicant's study confirmed that water quality in the Black River in the vicinity of the Alverno Project meets state standards. Good water quality in the Black River reflects the undeveloped nature of the watershed and lack of significant point source inputs (industrial or municipal) of pollution. No industrial processes that may influence water quality, such as waste water treatment facilities, are dependent upon flows from the Alverno Project. The Alverno impoundment is riverine in nature, shallow, and has a short hydraulic retention time and, thus, minimal potential to have adverse effects on water quality. The modified run-of-river operation recommended by the resource agencies, along with provisions for minimum flow, will ensure that the project continues to support good water quality in the Black River.[31] Operation of the Alverno Project, as recommended, will maintain water quality standards outlined in the WQC. Licensing and continued operation of the Alverno Project would not have significant adverse effects on water quality and thus aquatic resources in the Black River.

We agree with the WQC condition and resource agency recommendation to periodically monitor water temperature and DO during the term of the license. The June 1 to September 30 period for continuous water temperature and DO monitoring upstream and downstream, as required by the WQC, is a suitable seasonal monitoring interval for the Alverno Project. We agree with Interior's recommendation for the licensee to develop a water quality monitoring plan and consult with the resource agencies regarding the frequency of sampling. It is likely that unless significant changes occur to existing land-use and development patterns in the Black River watershed, that monitoring water temperature and DO the fifth year after licensing and every five years thereafter, will be sufficient for detecting any potential project-related changes in water quality in the Black River.

The MDNR's recommendation that the licensee not warm the Black River more than 5 °F by operating the Alverno Project has little relevance to potential effects on aquatic resources. Water temperatures recorded by the BRLP both upstream and downstream of the Alverno Project are well within those considered optimal for survival and growth for fishes common to the lower peninsula of Michigan (Wehrly, *et al.* 1998). It is evident that the Alverno Project has a minimal and essentially an undiscernable effect on water temperatures in the Black River (table 1). With our recommendations for project operations (section V.C.2), the Alverno Project will continue to have minor effects on water temperature warming in the Black River.

The BRLP proposes to install a third generating unit, which would require some minor construction and ground disturbing activity. The BRLP's analysis of sediments revealed no detectable concentrations of potentially harmful toxicants. Further, although the operation of the Alverno Project and impounding of the Black River may indirectly affect the transport of chemical constituents, we find the operation of the project is not directly related to the presence of chemical compounds in project sediments. Therefore, at this time, we do not agree with the WQC condition for the licensee to monitor the 12

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[31] The 401 WQC includes a condition for a 75 cfs minimum flow between flows of 75 and 245 cfs.

chemical constituents of impoundment sediments ten years after the issuance of the license and every ten years thereafter. We agree that the BRLP should consult with the resource agencies, and potentially conduct additional sampling for sediment chemical constituents, before performing any activities which may cause a significant mobilization of sediments. Consultation among the BRLP and resource agencies on approaches to minimize indirect environmental effects associated with construction would be beneficial to Black River aquatic resources.

We do not consider it appropriate for the BRLP to pay liquidated damages to the state for water quality violations. Assessing damages for water quality violations is beyond the purview of the Commission and, therefore, we do not recommend it as a term or condition of any license issued for the Alverno Project.

c. Cumulative effects

Cumulative effects on water quality could occur in the Black River through the operation of the Alverno Project along with other hydro and non-hydro projects and development activities in the Black River basin. The upper Black River basin is primarily undeveloped and has no known industrial developments that negatively affect water quality. The upstream Tower and Kleber Project is operated in a run-of-river mode, which minimizes any adverse effects on water quality of flows in the upper Black River that discharge into Black Lake. Subsequent outflows from Black Lake into the Alverno impoundment exceed state water quality standards. Water quality monitoring showed that the Alverno Project does not cause significant water temperature warming or decreases in DO and that waters discharged from the project meet state water quality standards. The project's reservoir is shallow, riverine in nature, and has a short hydraulic residence time, all of which serve to minimize the project's potential to affect water quality of inflowing waters. The modified run-of-river operation, necessary to maintain court-ordered Black Lake levels, would provide sufficient flow downstream of the project to prevent the diminishment of water quality. We conclude that with our recommended measures, the Alverno Project would not contribute to cumulative negative effects on water quality, and in turn fish and aquatic resources in the Black River.

d. Unavoidable adverse effects

None.

3. Fisheries Resources

a. Affected environment

The Alverno impoundment is integral with Black Lake as the outlet of the lake connects directly to the Black River. Biota may freely move between Black Lake and the Alverno impoundment. We presume that the fisheries community in the Black River in the vicinity of the project resembles that occurring in Black Lake. The MDNR has periodically sampled Black Lake by gill net and trap net over the last 30 years. Generally, the fisheries community is typical for a north-temperate lentic ecosystem and includes northern pike, perch, walleye, smallmouth and largemouth bass, sucker species, and various sunfishes. Walleye were last stocked in Black Lake in 1993 (MDNR stocking records). Suckers, walleye, and smallmouth bass have been observed spawning in the Smiths Rapids section of the Alverno impoundment.

The Michigan Natural Features Inventory (MNFI) identified pugnose shiner, a state-endangered species as being indigenous to glacial lakes, such as Black Lake, that have clear weedy shoals. However, no specimens have been directly observed in Black Lake.

Between 1993 and 1998, the MDNR stocked approximately 10,000 to 15,000 steelhead smolts in the Cheboygan River, downstream of the Alverno project (MNDR Fisheries Division Stocking Reports). Although upstream passage of adult steelhead to Alverno dam is possible, no substantive fishery is known to exist for adult steelhead in the vicinity of Alverno dam.

The inter-connection of the other large inland lakes in the Cheboygan River watershed with Lake Huron has made them susceptible to invasion from exotic biota, including zebra mussels. In contrast, habitats upstream of the Alverno dam, including Black Lake, have, to date, remained largely free of invasion by exotic species. Because Alverno dam impedes the upstream invasion of noxious species, fisheries communities in Black Lake and the upper Black River have maintained their status as above average fisheries.

Lake Sturgeon

Black Lake supports a naturally-reproducing population of potamodromous lake sturgeon. The MDNR has managed the Black Lake sturgeon population since the 1920's, including constructing spawning reefs (1973) in the upper Black River and initiating an egg-taking program (1982). Lake sturgeon spawn in reaches of the Black River upstream of Black Lake, downstream of the Tower and Kleber hydroelectric projects. The Commission issued a license in 1994 requiring the Tower and Kleber Project licensee to cooperate with the MDNR in managing lake sturgeon in the Black River, focusing on operational considerations (67 FERC ¶ 62,126 (1994)). The Tower and Kleber Project is operated in a run-of-river mode to enhance lake sturgeon spawning (see Auer, 1996).

Both the habitat use characteristics as well as the population trends of lake sturgeon in Black Lake have been studied by the MDNR. Radiotagging studies have found that adult lake sturgeon use a diversity of habitats in Black Lake, with most found at depths of 23 feet in winter and 34 feet in summer (Hay-Chmielewski, 1987). Recent gill-net studies characterizing the lake sturgeon population found individuals ranging in age from age-9 through age-64. The age distribution of lake sturgeon was highly skewed toward younger individuals, as 50 percent of the sampled population was age-14 or less (Baker and Borgeson, 1999). The population size of greater than 90 cm lake sturgeon in Black Lake, those of harvestable size, declined from 1,599 fish in 1975 to 1,241 fish in 1997, with legal harvest accounting for 40 percent of the population decline (Baker and Borgeson, 1999). Given the low population size of lake sturgeon and the current rates of harvest, it is estimated that harvestable size lake sturgeon could be extirpated from Black Lake by 2011 (Baker and Borgeson, 1999).

Diminished populations of lake sturgeon throughout Michigan led to their listing as a state threatened species in 1994 (Section 36505(1a), Part 324, Endangered Species Protection, of Act No. 451 of the Public Acts of 1994). The MDNR has outlined a detailed strategy for rehabilitating and restoring lake sturgeon populations in Michigan (Hay-Chmielewski and Whelan, 1997). The MDNR considered Black Lake, as well as Burt and Mullet lakes, to have a high suitability for lake sturgeon rehabilitation or enhancement amongst other candidate Michigan lakes (Hay-Chmielewski and Whelan, 1997).[32]

Because the lower Black River is directly connected to the inland waterway system, lake sturgeon originating in either Lake Huron or Burt and Mullet lakes may migrate to the base of Alverno dam seeking upstream passage during the spring spawning period. The MDNR estimates the upper Black River upstream of Black Lake may be the only suitable spawning reach in the entire Cheboygan River watershed. Therefore, adult sturgeon congregating downstream of Alverno dam in spring likely fail to successfully spawn.

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[32] In the lake sturgeon plan, the MDNR recommended that lakes considered to be highly suitable for lake sturgeon rehabilitation and enhancement, such as Black Lake, should receive the highest priority for population restoration or rehabilitation activities (Hay-Chmielewski and Whelan, 1997).

b. Environmental effects and recommendations

Project Operations

The BRLP proposes to continue operating the Alverno Project in a modified run-of-river mode and to install a third turbine to enhance the control over Black Lake levels and improve downstream flow conditions.

The WQC issued for the Alverno project includes the following conditions regarding project operations:

- The BRLP shall, within six months of license issuance, install a calibrated staff gage in the Alverno impoundment at a location clearly visible to the public that shows the impoundment level referenced to the National Geodetic Vertical Datum. The impoundment level and the level of Black Lake shall be recorded hourly. An annual report of all recorded impoundment and Black Lake levels shall be submitted to the MDNR.

- The BRLP shall operate the Alverno Project in a run-of-river mode except as necessary to maintain Black Lake at court-ordered levels and except as provided under some flow conditions (see following condition). Run-of-river is defined as the instantaneous flow through the dam shall approximately equal instantaneous impoundment inflow as monitored by impoundment level elevations and stream flow downstream of the Alverno Project.

- When there are more than 75 cfs but less than 245 cfs available to operate the turbines, the Alverno Project may be operated in a limited store and release mode. During the limited store and release mode of operation, the BRLP shall: (1) maintain Black Lake at the court-ordered level; (2) minimize the frequency and magnitude of turbine flow release changes; and (3) provide a minimum flow release from the turbines of at least 75 cfs.

- The BRLP shall, within one year of license issuance, provide a plan for approval by the MDEQ, in consultation with the MDNR, to monitor flow of the Black River downstream of Alverno dam. This plan shall contain a timetable for implementation of monitoring within one full construction season after plan approval, annual submission of summary results to the MDNR, and a provision for submission of all data upon request.

- The BRLP will be given a three-year test period beginning after the flow monitoring plan is implemented, to determine BRLP's ability to comply with the requirements regarding operating mode and flows.

The MDNR's recommendations regarding project operations for the Alverno Project are essentially the same as those outlined above in the WQC by the MDEQ, including the key components to maintain the court-ordered lake levels of Black Lake at all times, operate the project run-of-river when possible, and provide a continuous minimum flow of 75 cfs, when flows are between 75 and 245 cfs. The MDNR also recommends the licensee develop and implement a gaging and compliance plan within 12 months of license issuance, in consultation with the FWS, the USGS, MDNR, and MDEQ. The MDNR recommends the plan include a means to continuously record flow and have these data made available via telephone or posted on the Internet on a daily basis; however, the MDNR did not specify which flows (project or river flows) should be continuously recorded.

The MDNR also recommends the licensee: (1) maintain a record of headwater elevations of the impoundment and Black Lake, recorded hourly, and that these recordings be provided to the MNDR in an annual report to include all recorded storage basin levels and all gate-opening changes in electronic form; (2) install a calibrated staff gage on the upstream wall of the dam, in a location clearly visible to the public (as required by the WQC); and (3) post interpretive signs near the gages and respective reservoir boat launch sites that describe the operation of the reservoirs.

The MDNR recommends a three-year test period be used to determine the ability of the licensee to maintain the above compliance standards for flow and Black Lake elevations, with the test protocol to be determined in consultation with the resource agencies. At the end of the three-year period, the MDNR recommends the licensee prepare a report to the Commission (within 90 days of the end of the test period), in consultation with the resource agencies, documenting their ability to maintain and comply with the above recommended operational requirements.

Interior recommends the licensee: (1) operate the Alverno Project in an instantaneous run-of-river mode, with no hydro peaking, to ensure the protection of fish and wildlife resources and water quality; (2) act to minimize the fluctuation of the reservoir's surface elevation, at all times, by maintaining a discharge from the project so that flows at any point in time, as measured immediately downstream from the reservoir, approximate the sum of inflows to the reservoir; and (3) maintain a variance of not more than 0.25 feet from the legally established pool elevation.[33]

Interior also recommends the licensee, within 12 months of license issuance, develop a plan to monitor compliance with run-of-river operation, including: (1) construct, maintain, and fund a USGS flow gaging station, or comparable equipment, upstream and downstream of the dam to measure inflow and discharge, equipped with telemetry and funded by the licensee for the term of the license; (2) have no more than plus or minus 10 percent difference in discharge upstream and downstream of the project corrected for travel and accretion; (3) install a staff gage on the upstream wall of the dam or other appropriate location that is clearly visible to the public; (4) maintain a daily record of operation and provide pertinent information, including turbine operations, headwater and tailwater elevations, and hourly flow releases through the powerhouse and spillway, to the resource agencies upon request; and (5) maintain an automatic water-level sensor to continuously record headwater and tailwater elevations.

Our Analysis

Project Operations

We concur with the applicant's proposal, and the MDEQ's and the MDNR's endorsement of the proposal, to operate the Alverno Project in a modified store and release mode to maintain court-ordered Black Lake elevations. A modified store and release mode at the Alverno Project will continue to support the existing extensive productive shallow-water zones in Black Lake that are important fish and macroinvertabrate production areas.

Interior's recommendation for an instantaneous run-of-river operation for the project is at odds with both the WQC and the MDNR's recommendation. It is not possible to operate the Alverno Project in an instantaneous run-of-river mode and achieve the court-ordered water levels in Black Lake. Operating the Alverno Project with emphasis on maintaining state-ordered water elevations is critical for maintaining the extensive, productive shallow-water habitat found in Black Lake. Biologists from the MDNR have estimated that the water's edge in Black Lake would receded from one-half

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[33]Interior did not specify in this recommendation which pool elevation should be maintained with a variance of no more than 0.25 feet. Because Interior defined the pool elevations as ones that are legally defined, we presume the recommendation applies to Black Lake water surface elevations.

to three-quarters of a mile from its present location under natural flow conditions or those comparable to operating Alverno as a run-of-river facility (BRLP, 1998). This would cause a loss of one-third of the fish producing (spawning) area of the lake and have significant adverse effects.

We agree with the WQC condition and the MDNR's recommendation to minimize the frequency and magnitude of turbine flow release changes and to operate the project in a run-of-river mode at all times possible, after achieving court-ordered Black Lake water levels. A run-of-river operation reduces residence time in hydro impoundments, which minimizes project effects on water quality and downstream habitats.

Between flows of 75 to 245 cfs, the WQC requires, and the MDNR recommends, the BRLP to release a minimum flow of 75 cfs downstream of the project, while maintaining Black Lake at court-ordered elevations. The Black River reach downstream of the Alverno dam is the backwater of the Cheboygan dam located approximately 5 miles downstream. Thus, only a small riverine reach exists downstream of the project to be potentially enhanced by increased minimum flows. Studies by the applicant showed that only minor differences in wetted perimeter occur during operating and non-operating conditions at Alverno. As such, a minimum flow of 75 cfs is unlikely to provide significant enhancement in habitat conditions, particularly because only a small river reach will be affected by the higher flows.

We agree with the MDNR that a minimum flow downstream of the project would provide benefits to fish and aquatic resources. However, we find a lower flow, perhaps in the 25 cfs range, would be sufficient for maintaining water quality and suitable habitat downstream of Alverno dam. A lower minimum flow would also enable releases to occur on a more continual basis, which would have greater benefits to fish and aquatic resources than releases of a higher minimum flow of 75 cfs, potentially, on a less than continual basis. In follow-up comments on the Section 10(j) meeting, the BRLP notes that the three year test period for determining operational compliance with 401 WQC conditions and recommended measures, and further ongoing consultation with resource agencies that would occur during that period, could be used to determine the practicality of minimum flow recommendations. In support of their recommendation, the MDNR notes that the goal for project operations at the Alverno Project is to operate the project in a run-of-river mode as often as possible within the constraints of maintaining Black Lake water surface elevations within the court-ordered levels. Commission staff acknowledged that a minimum flow of 75 cfs between inflows of 75 and 245 cfs is a condition of the 401 WQC and agrees that the practicality of this recommendation would be determined during its implementation during the three year test period.

We agree with the BRLP's proposal to install a third generating unit having a low flow capacity, as this would provide the means of releasing lower minimum flows of 25 cfs. A third, low-flow generating unit would also enable the BRLP to exert fine-scale control over Black Lake levels and minimize the magnitude of flow release changes, as recommended by the resource agencies. Improving control over Black Lake levels would limit the potential for lake level fluctuations known to disturb shallow water habitats to the detriment of fish production.

Flow and Operational Compliance

The MDEQ, MDNR, and Interior, collectively, provided a number of recommendations for compliance monitoring of project operations for the Alverno Project. We agree with the resource agency recommendations that river flow, impoundment elevation, and project operations monitoring is necessary at the Alverno Project. We agree with these recommendations because, being unlicensed, the Alverno Project has not been evaluated by the Commission for operational compliance. Information garnered for compliance monitoring will provide a means to compare environmental conditions in the Black River to operations at Alverno, which will aid in minimizing any potential adverse effects of the project on fish and aquatic resources.

We disagree with the resource agency recommendation for gaging and monitoring of Black River flows downstream of the project. The WQC conditions and the MDNR recommendations emphasize, as their highest priority, the maintenance of court-ordered water levels in Black Lake. As noted by the MDEQ and the MDNR, a store and release mode is necessary for achieving court-ordered Black Lake levels. It is unclear how downstream gaging would be used to ensure compliance with WQC conditions and the MNDR's recommendations, when the licensee has the discretion to flexibly operate the project to achieve court-ordered Black Lake levels. Because the MDEQ's WQC conditions and the MDNR's recommendation focus on achieving court-ordered water levels in Black Lake, gaging Black River flows downstream of Alverno dam would provide little benefit to operational compliance efforts. Because the tailwater of the Alverno Project is a backwater area of the downstream dam, the accuracy of any stream gage station in the tailrace would be questionable. As noted above, we do not agree with Interior's recommendation for an instantaneous run-of-river operation for the Alverno Project and we therefore do not support downstream gaging as part of a flow-based compliance standard for run-of-river operations. The MDEQ's 401 WQC condition for the licensee to engage in a three-year test period for operational compliance, in consultation with the resource agencies, would enable the full evaluation of the need for downstream gaging. The need for downstream gaging could be assessed during the test period, and considered as an option for compliance if deemed necessary after or during the test period.

We also disagree with Interior's recommendation to establish and fund a USGS-type gage upstream of the project. The BRLP has noted that the operation of the Alverno Project, while affected by river discharge, is not linked directly to river discharge. The operation of the project is linked directly to the elevation of Black Lake. Gaging Black River flows upstream of the project, therefore, provides no additional benefit to compliance efforts. Using the equipment in-place, the BRLP has successfully operated the project to maintain Black Lake elevations within acceptable limits even with the existing constraints of the flow-dependent hydraulic control exerted by Smiths Rapids.

We agree with the MDNR's recommendation to record water surface elevation of Black Lake. Through an informal agreement, the BRLP has access to a lake water surface elevation gage located near the outlet of Black Lake. It is necessary that water surface elevation data for Black Lake be available to the licensee and resource agencies throughout the term of the license for the Alverno Project. Therefore, we recommend that in consultation with the resource agencies, the licensee: (1) formalize the agreement that provides the BRLP access to data from the existing Black Lake outlet gage; and (2) install and operate a similar gage, should data from the existing gage cease to become available.

We agree with the resource agency recommendation to install a staff gage on the upstream side of Alverno dam in a location clearly visible to the public. The WQC requires the licensee to record the Alverno impoundment level hourly, but we find this is excessive, given the project is staffed by one individual. Less frequent monitoring of staff gages would be sufficient for compliance monitoring. We agree with Interior's recommendation for an automated water surface elevation sensor for the Alverno headpond. An automated headpond water surface elevation sensor should provide the necessary hourly data, precluding the need to manually record water surface elevation on an hourly basis.

We also agree with Interior's recommendation to record project operations data, such as turbine flows. Project operations information coupled with gaging of the Black Lake and Alverno headpond water surface elevations will provide the necessary data to ensure the licensee complies with our recommended measures. We find a tailwater water surface elevation sensor, as recommended by Interior, is not necessary, because monitoring project operations and Alverno impoundment water surface elevation will be sufficient for operations compliance monitoring.

Our recommendations for monitoring of Black Lake water surface elevation, Alverno headpond elevation, and project operations, will aid in minimizing any potential adverse effects of the project on fish and aquatic resources.

We agree with Interior's recommendation to limit the Black Lake water surface elevation to plus or minus 0.25 feet. The applicant's proposed method of operating the Alverno Project, with the addition of a third, low-flow generating unit, would limit water surface elevation changes in Black Lake to plus or minus 0.05-feet. Minimizing water surface elevation fluctuations in Black Lake is necessary for ensuring that the extensive shallow-water habitat in the lake supports fish and aquatic resource production.

The WQC for the Alverno Project requires the licensee to provide a plan to monitor the flow of the Black River downstream of Alverno dam. The MDNR provided a more detailed recommendation for a gaging and compliance plan, without specifying which flows (project or river flows) should be monitored and at what locations. Interior also recommended the licensee develop an operations (run-of-river) compliance plan.

We agree with the resource agencies that the BRLP should develop and implement a gaging and flow compliance plan for the Alverno Project that includes gaging of Black Lake water surface elevation, monitoring water surface elevation in Alverno impoundment, and recording project operations data. We recommend that all automated gages be telemetered to enable resource agencies to access gage data for compliance monitoring. If telemetering is not feasible, we recommend the licensee evaluate other means of making gage data in electronic form easily accessible from remote locations; for example, posting data on the Internet on a daily basis, as per the MDNR's recommendation. We recommend that the gaging and flow compliance plan for the project include: (1) a timetable for consulting with resource agencies regarding installation of the recommended monitoring equipment; (2) protocols for recording monitoring data, such as pond elevations and turbine flow; (3) a reporting schedule for data collected on Black Lake water surface elevation, Alverno headpond water surface elevation, and project operations; and (4) a timetable for telemetering recommended equipment or making gage data accessible from remote locations in electronic form.

We agree with the WQC condition and the MDNR's recommendation to provide the licensee a three-year test period for determining feasibility of compliance with recommended flows and project operations. As noted above, being unlicensed, the Commission has not evaluated the Alverno Project for flow and operational compliance. Depending on the outcome of flow and operations compliance monitoring and evaluation, additional gaging can be recommended if it is determined to be needed to achieve or refine the modified run-of-river operation recommended for the Alverno Project. Our recommendation for a gaging and flow compliance plan provides the necessary mechanism for continuing consultation on project operations and river flows at the Alverno Project.

The benefits of the MDNR's recommendation for the licensee to post interpretive signs near recommended gages and boat launches that describe the operation of the "reservoirs." are not clear. We find these signs to be unnecessary and potentially detrimental to flow compliance monitoring, as signs near gages could draw public attention, thereby increasing the potential for vandalism.

Fish Passage

The BRLP has proposed no measures to provide upstream fish passage at the Alverno Project and strongly opposes upstream fish passage at the project. Non-governmental organizations (NGO) including the Black Lake Association and Black Lake Sportsmans Club, and representatives of North Allis (Presque Isle County) and Grant (Cheboygan County) townships, commented in opposition to fish passage at Alverno dam. Collectively, these entities cite concerns over the potential for exotic species, including lamprey and zebra mussels, to invade Black Lake and negatively affect the lake's uniqueness and potentially the lake's sturgeon population. The BLA also argued that providing upstream passage at Alverno dam may enable genetically dissimilar lake sturgeon to spawn with the isolated Black Lake population to the detriment of the Black Lake population.

The MDNR, at this time, has not recommended upstream passage be provided at the Alverno Project. The MDNR requests that language be included in the Order Issuing License stating that a standard license re-opener may be used for unforseen future fish passage needs.

Our Analysis

We agree with the MDNR's recommendation to defer upstream passage at the Alverno Project, at this time. As noted, local entities have expressed concern over the potential negative effects resulting from the invasion of non-native species (*e.g.*, lampreys and zebra mussels) into Black Lake. We agree that upstream fish passage at Alverno could facilitate the introduction of exotic species into Black Lake and diminish the lake's productivity and desirable fisheries. It is possible for exotic aquatic species to be transferred to Black Lake through other means (*e.g.*, via watercraft) than direct migration through an upstream passageway at Alverno dam, if one existed. It is also possible to design upstream fish passageways to minimize the potential for exotic species to pass upstream. However, we find the concerns of local entities regarding the potential negative effects of providing fish passage at Alverno dam to be well founded (Alevras and Whalen, 1993). We conclude that maintaining Alverno dam as a functional impediment to the invasion of exotic species would be the most effective way to protect the diverse and unique fisheries community present in Black Lake.

As the MDNR indicated during public scoping, there are significant potential benefits to passing lake sturgeon over Alverno dam, including reconnecting population elements isolated by Alverno dam, improving the spawning stock biomass, and enhancing genetic diversity through increases in effective population spawning size. Recent research has shown that the population of lake sturgeon inhabiting Black Lake is depleted and bordering on extirpation, if natural and fishing mortality rates are not reduced (Baker and Borgeson, 1999). For populations such as Black lake sturgeon, that are small, isolated, and declining in size, the failure to bolster effective population size could result in inbreeding depression and genetic drift and cause irreparable genetic harm (Hartl, 1988).

As the BLA indicated, the associated risk of providing upstream passage includes potential outbreeding effects, caused by introducing potentially genetically dissimilar lake sturgeon stock into Black Lake. The risk hinges on whether lake sturgeon originating downstream of the Alverno Project are sufficiently genetically similar to sturgeon in Black Lake so that providing downstream stock access to the upper Black River will have beneficial as opposed to negative effects. The genetic risks of introducing potentially dissimilar genetic stock into an isolated population is a primary concern identified in the State of Michigan's lake sturgeon rehabilitation strategy Hay-Chmielewski and Whelan, 1997). The MDNR noted during public scoping that the issue of genetic similarity of upstream and downstream sturgeon stock in the Black River has not been evaluated; therefore, the risks of upstream passage remain unresolved.

We reason that maintaining Alverno dam as an effective impediment to the upstream invasion of exotic species would have large benefits relative to the benefits of providing facilities for upstream passage for lake sturgeon at the project. In drawing this conclusion, we recognize that upstream passage of lake sturgeon at Alverno dam is not dependent on a fishway at the project. Independent of the Commission's licensing action for Alverno, trap and transfer of lake sturgeon from downstream to upstream of the project could be undertaken by the resource agencies. We acknowledge the BLA's objection to the transfer of lake sturgeon to areas upstream of Alverno dam, including Black Lake. However, the Commission's jurisdiction is limited to the facilities and operation of the Alverno Project and how lake sturgeon management relates directly to the project.

Although the MDNR is not recommending upstream fish passage be part of the Alverno Project license at this time, the Black River system remains a water body considered to have high potential for successful restoration of lake sturgeon (Hay-Chmielewski and Whelan, 1997). Because we anticipate lake sturgeon passage at Alverno dam to remain an issue of concern, we recommend the licensee cooperate with the MDNR and local NGOs in managing lake sturgeon in the Black River. We recommend the licensee consult with resource agencies regarding measures for enhancing lake sturgeon survival and production as they relate to the operation of the project (see McKinley *et al.*, 1993; Auer, 1996). The Commission has made similar recommendations for a licensee to cooperate with the resource agencies in managing lake sturgeon in the upper Black River, at the Tower and Kleber Project.

We find no basis to recommend a separate "standard license re-opener" be included in the Order Issuing License for the Alverno Project, as recommended by the MDNR. The MDNR may continue consultation on fish passage after license issuance through provisions of standard license articles. Interior also exercised its Section 18 authority to prescribe the construction, operation, and maintenance of any fishways deemed necessary at the Alverno Project.

Downstream Passage and Fish Protection

The applicant has agreed to pay $2,000 per year for fish losses stemming from entrainment mortality to a general fund for project-related enhancements in lieu of entrainment studies and installation of downstream protection devices.

The MDNR recommends the licensee install fish protection and downstream passage devices at the Alverno powerhouse. Within 12 months from the date of license issuance, the MDNR recommends the licensee develop and implement a fish protection and downstream protection plan to include:

(a) consultation with the resource agencies in the selection of a consultant experienced in analyzing, designing and installing fish protection and downstream passage devices and contracting with the selected consultant;

(b) evaluation of potential fish protection and downstream passage devices to prevent fish losses and provide for downstream migration of fish at the Alverno powerhouse, in consultation with and approval of the resource agencies of the devices selected for evaluation;

(c) the design of selected fish protection and downstream fish passage devices to prevent turbine entrainment and mortality at the Alverno powerhouse and provide for the downstream migration of fish, in consultation with and approval of the resource agencies;

(d) installation of the selected and approved fish protection and passage devices at the Alverno powerhouse, to be completed within 5 years of license issuance;

(e) development of operation and maintenance procedures for the selected devices, in consultation with and approval of the resource agencies;

(f) development and implementation of a protective device effectiveness study to determine residual losses, in consultation with the resource agencies; and

(g) completion of a residual damage assessment to determine if addition protective measures are warranted, or if not, compensation for all residual fish losses.

In the event the licensee cannot fund the installation of fish protection and downstream passage devices, the MDNR recommends the licensee, within five years of license issuance, establish an escrow account with annual contributions to fund fish protection and downstream passage at the Alverno powerhouse. The MDNR recommends that funding for fish protection and downstream passage be provided as soon as possible, but at least within 20 years of license issuance.

Interior recommends the licensee, in consultation with the resource agencies, develop a Fish Protection Fund (FPF) to escrow an initial and/or annual payment to finance appropriate fish protection measures to be installed in the intake areas of the Alverno Project. Interior recommends the level of funding be determined by mutual agreement between the licensee and the resource agencies. Interior recommends that: (1) any protection measures/devices installed shall be evaluated for their effectiveness; and (2) the licensee compensate the State of Michigan for any fish lost to turbine mortality occurring after the protection measures/devices have been installed.

Our Analysis

Fish moving downstream can be entrained into project intakes and suffer injury or death when passing through hydroelectric turbines (Electric Power Research Institute (EPRI), 1987). The applicant measured velocities immediately upstream of the intake of unit 2 at 70 and 100 percent gate opening. At 70 percent gate opening, the average water velocity over 16 measurements was 0.83 feet per-second (fps) and 1.26 fps at 100 percent gate opening. From the bottom to the top of the intake, water velocities ranged between 0.3 and 1.3 fps at 70 percent gate opening and from 0.2 to 1.9 fps between the bottom and middle intake sections at 100 percent gate opening. Because localized areas of high velocity exist at the Alverno trashracks, entrainment of some fishes is likely to occur.

No entrainment studies were conducted at Alverno to directly estimate the magnitude of entrainment or mortality resulting from turbine passage. Although each hydro project has different physical and operating characteristics that influence entrainment rate and turbine passage survival (Federal Energy Regulatory Commission (FERC), 1995), general, qualitative characterizations are possible among projects because patterns in species composition and survival of entrained fish reoccur (EPRI, 1992; FERC, 1995).

Although entrainment catches may include a number of species, typically only several species dominate entrainment collections and the dominant fishes entrained usually represent species that are highly abundant (FERC, 1995). Top-level predatory fish (sportfish), such as smallmouth and largemouth bass, walleye, channel catfish, and northern pike, are collected in entrainment samples, but typically comprise only a small component of the catch relative to more abundant, forage fishes (*e.g.*, minnows and sunfish). Extensive sampling has also shown that the majority of fish entrained are small (less than eight inches) and experience low mortality resulting from turbine passage (about six percent; EPRI, 1992; FERC, 1995). At Alverno, the turbines have near full-depth trashracks consisting of steel grating having 1.25-inch bar spacing. The 1.25-inch width of the turbine trashrack would be an effective physical and (or) behavioral barrier to turbine entry for most large fish (greater than eight inches). Hence, most fish likely to pass through the trashracks and be entrained would be small fish (less than 8 inches) that would have a reasonably high probability of surviving (EPRI, 1992).

Consequently, although turbine entrainment and mortality at Alverno causes losses of resident fish, losses likely do not approach a magnitude that adversely affects fish populations. For Alverno, evidence supporting this conclusion is that the majority of resident fish populations in the project area are maintained through natural reproduction without direct intervention, such as stocking. Features of the life history of the local fishes, including early maturity, short generation time, and high fecundity (Scott and Crossman, 1973), may contribute to their resiliency to non-natural sources of mortality, such as those stemming from turbine entrainment. Research in impounded portions of large rivers has shown that year-class strength of common resident fishes is most influenced by large-scale abiotic factors, such as river water temperature and discharge during certain critical seasonal periods (Maceina and Bettoli, 1998; Maceina and Stimpert, 1998; Slipke *et al.*, 1998). Thus, for the common resident fish species found in the Alverno Project area, large-scale environmental factors are more likely to affect population levels than the localized influence of turbine entrainment mortality.

Therefore, we do not find fish protection, as recommended by the resources agencies, to be necessary at the Alverno Project. The MDNR contends that failure to address turbine mortality at the project will negate the benefits of other recommended measures. We disagree. The Black River, including the Alverno impoundment, continues to be a normal functioning ecosystem in spite of the continual and likely small-scale loss of some resident fishes. Enhancements garnered from other resource agency recommendations, including those for bank stabilization, maintenance of court-ordered water levels in Black Lake, and a minimum flow, that maintain or improve the overall suitability of physical habitat, are likely to benefit a wider range of aquatic resources than would reducing the entrainment of some fishes.

The addition of a third generating unit, as proposed by the applicant, would increase entrainment at the Alverno Project. The third unit would have a singular trashrack, 7-feet deep by 8-feet wide, constructed of 0.25-inch steel bar having clear bar spacing of 1.25-inches. The third unit would draw only low flows in the 25 to 75 cfs range, have a small withdrawal zone, and low intake velocities. Staff conclude the addition of the third turbine would have minor adverse effects on the fish community in the Black River.

Lake Sturgeon

Juvenile lake sturgeon have been collected in entrainment samples at hydroelectric projects in the midwest (FERC, 1996). The MDNR noted during public scoping, that juvenile lake sturgeon dispersing downstream may be susceptible to entrainment and mortality at the Alverno Project. Our review indicates, however, that entrainment mortality of lake sturgeon at the Alverno Project is likely minimal.

The greatest downstream movement of juvenile lake sturgeon occurs within several weeks after spawning (Kempinger, 1988; LaHaye *et al.*, 1992). At this time, juveniles (larvae) are less than 1 inch in length, tend to drift passively with river currents, and exhibit punctuated downstream movements over a brief three to four week period. We suspect that the majority of sturgeon progeny produced at the spawning site on the upper Black River, upstream of Black Lake, would drift to and settle in Black Lake rather than pass downstream. We also suspect that any larvae continuing to drift through Black Lake and downstream to the Black River, would likely have a high probability of surviving turbine passage at the Alverno Project because of their small size.

After the larval stage, juvenile sturgeon are not know to make large scale, population-level habitat shifts; rather, downstream movements, when they occur, may be characterized as being exploratory or associated with individual seasonal habitat shifts. There is also evidence that downstream movements of juvenile sturgeon may be genetically based and therefore stock-specific (Thuemler, 1988). In these cases, the downstream movement of juveniles appear to be an adaptation facilitating the return of juveniles to rearing habitats occupied by older conspecifics. Because all sturgeon spawning upstream of Black Lake originate from upstream of Alverno dam, there is no adaptive basis for juveniles spawned in the upper Black River to migrate downstream of Alverno dam.

The decline in numbers of large sturgeon in Black Lake (Baker and Borgeson, 1999), and its presumed effects on juvenile production, would suggest that Black Lake is well below its carrying capacity for juvenile lake sturgeon. Hence, currently and for the foreseeable future, Black Lake will likely act as a "sink" for juvenile sturgeon, rather than as source of downstream migrants having the potential to be entrained at the Alverno Project.

For the reasons outlined above, we find that, at present, it unlikely that the entrainment and mortality of juvenile lake sturgeon at the Alverno Project has any substantial negative effect on the sturgeon population in the Black River. Therefore, we do not find that downstream passage protection is necessary for lake sturgeon at the Alverno Project, at this time. We recognize that existing and future management efforts may enhance the sturgeon population in Black Lake and increase the chance for downstream movements and turbine mortality of juvenile sturgeon at the Alverno Project. If in the future, high rates of entrainment and mortality of juvenile sturgeon are identified, we recommend the licensee consult and cooperate with the resource agencies to enhance downstream passage and minimize turbine entrainment.

Compensation and Restitution for Entrainment Losses

The MDNR provided an extensive overview of their position on compensation for fishes lost to entrainment at the Alverno Project. Staff concludes that turbine entrainment and mortality is not adversely affecting fish populations in the Black River and so we do not recommend a fisheries damage assessment or establishment of any escrow fund for fish losses. Further, fisheries damage assessments, as recommended by the resource agencies, are outside of the Commission's regulatory purview for the Alverno Project. We do not recommend the payment of damages for fisheries losses as a term or condition in any license issued for the Alverno Project.

Flow Continuation During Project Shutdown

Interior recommends that the BRLP pass river inflow within a few minutes through the Alverno Project in the event of project shutdown.

Our Analysis

We agree with Interior's recommendation regarding downstream flow provisions in the event of a shutdown of the Alverno Project. Decreases in water surface elevation coupled with a lack of flow in downstream riverine habitats that could occur if the project unexpectedly shutdown could have adverse effects on aquatic organisms. In follow-up comments to the Section 10(j) meeting, the BRLP reiterates that the riverbed of the tailrace does not dewater when no or minimal flow occurs at the Alverno Project. Maintaining flow through the project, however, is necessary for ensuring no adverse effects occur to water quality and thus aquatic resources in the event of a project shutdown. While staff acknowledge that the potential for adverse effects to occur during unexpected project shutdown events is likely minimal, we recommend that the applicant engage in reasonable measures to provide downstream flows to prevent adverse effects. We recommend that provisions for providing downstream flow in the event of a project shutdown be included as part of the gaging and flow compliance plan recommended above for the project.

Reservoir Drawdowns

The BRLP proposed to continue pre-high-flow drawdowns to provide high-flow abatement benefits to shoreline property owners on Black Lake and along the Alverno impoundment.

The MDNR recommends that the BRLP provide notification at the earliest possible opportunity (*i.e.*, within 24 hours), of any proposed or already completed emergency flowage drawdown done to prevent dam failure and (or) imminent risk to public health and safety. The MDNR recommends that the BRLP: (1) consult with the MDNR to determine the amount, if any, of resource damage and appropriate response measures and proposed remedial measures, mitigation and appropriate methodology and timing of the flowage level restoration; and (2) obtain necessary Departmental permits for all reservoir drawdowns (and refills) for dam maintenance purposes that exceed one foot.

Interior's recommendations regarding emergency and controlled reservoir drawdowns are, in essence, the same as those detailed by the MDNR. In addition, Interior recommends the licensee prepare a plan to coordinate with the MDNR and FWS on all emergency and maintenance drawdowns. For planned non-emergency drawdowns, Interior additionally recommends that the licensee: (1) consult with the resource agencies to minimize potential adverse environmental effects; (2) provide at least two months advance notice of any proposed drawdown; and (3) avoid conducting drawdowns during the months of March, April, May, and June.

Our Analysis

The timing, duration, and rate of drawdowns can have significant adverse effects on aquatic biota and their habitats. Drawdowns may strand fish, mussels, and aquatic insects, and disrupt their life cycles.

We agree with the resource agency recommendations for the BRLP to provide sufficient prior notification of drawdowns to enable consultation with the resource agencies to minimize the effects of drawdowns other than those associated with an imminent public safety issue. Providing maximum notice for the need for planned drawdowns will allow a thorough evaluation of the possible effects of the drawdown, which will increase options for minimizing potential adverse effects.

We agree with Interior's recommendation that drawdowns for project maintenance should not be scheduled from March through June. Many fishes found in the projects' impoundments spawn in nearshore areas from March through June. Larval and juvenile fishes, or those individuals with poor swimming ability, may also be present at this time in nearshore areas. Large-scale dewatering of the littoral zone during the March through June period could have significant adverse effects on fish spawning success and recruitment.

The applicant proposes to continue to conduct pre-high flow drawdowns of the Alverno impoundment to provide flood abatement benefits to the Black River community. The MDNR has expressed concern that drawdowns may affect aquatic and terrestrial resources in the impoundment and downstream areas. During high flow events, the BRLP communicates with operators at the Tower and Kleber Project on the upper Black River to determine inflows into Black Lake. In turn, operations are adjusted at Alverno to decrease the elevation of the Alverno impoundment to minimize flooding of shorelines in both Black Lake and the Alverno impoundment. Because the BRLP's pre-high flow drawdowns of the Alverno impoundment are, in part, necessary to maintain court-ordered Black Lake elevations, pre-high flow drawdowns are consistent with the project's WQC.

We recommend that the BRLP consult with the resource agencies to develop a reservoir drawdown management plan that identifies protocols for coordinating planned drawdowns. We recommend that the BRLP formalize their high flow operating procedures as part of the reservoir drawdown management plan. Our recommendations will minimize the potential for both site-specific and cumulative adverse effects to occur to Black River aquatic resources as the result of reservoir drawdowns.

Natural Organic Debris

The BRLP proposes to pass downstream woody debris collecting on the project's trashracks that is cleared during normal operation and maintenance, by constructing a sluiceway at the project.

The MDEQ included a condition in the WQC for the licensee to develop and implement a program to pass natural organic vegetative debris (logs, stumps, sticks, limbs, leaves, and aquatic vegetation) collected on the trashracks and log booms over the Alverno dam in a manner that will not create a navigational hazard. The MDNR makes a similar recommendation for the licensee to develop and implement a plan, in consultation with the resource agencies, to pass natural organic debris over the Alverno dam, within 12 months of license issuance.

Our Analysis

Organic debris that is naturally recruited into rivers from riparian areas provides habitat for macroinvertebrates and fish (Todd and Rabeni, 1989). Organic debris sustains lower order trophic organisms and in-turn, influences the productivity of the Black River for higher order organisms. The passing of large woody debris would improve habitat structure downstream of the project and enhance the carrying capacity of the Black River for macroinvertebrates and juvenile and adult fishes. Therefore, we agree with the MDEQ WQC condition, and the MDNR's recommendation, for the licensee to pass organic debris downstream, as this would benefit the Black River ecosystem.

We agree with the resource agency recommendation for the licensee to develop and implement a plan, in consultation with the resource agencies, to pass woody debris downstream and submit the plan for Commission approval. We recommend that the BRLP consult with the resource agencies on their plans for constructing a sluiceway to pass organic debris, and file the plans with the Commission for approval.

We presume that any large woody debris accumulating on the spillway or log boom would be mobilized naturally by high flow events. Such a scenario simulates patterns of mobilization of larger vegetative matter in natural, unregulated streams (Berg *et al.*, 1998). Therefore, we find it unnecessary to require the licensee to move downstream, woody debris accumulating on the either the dam spillway or log boom. We recommend the woody debris management plan for the Alverno Project focus on moving downstream woody debris accumulating on the project's trashracks.

c. Cumulative effects

Cumulative effects on fisheries in the Black River could occur through the operation of the Alverno Project. We defined the geographical boundary of our cumulative effects analysis as portions of the Cheboygan River watershed as follows: Burt and Mullet lakes, and associated riverine reaches of the inland waterway system, the Black River, from its confluence with the Cheboygan River to Black Lake, and the upper Black River, upstream to the Kleber development (Figure 1). This geographic scope defines the physical limits or boundaries of the proposed action's effects on potamodromous lake sturgeon inhabiting the Cheboygan River watershed as well as lake sturgeon originating in Lake Huron that may use the watershed for spawning and rearing of juveniles. Operation of the Alverno Project, along with the Tower and Kleber Project, and the presence and operation of other non-hydro dams, could cumulatively affect habitat availability and upstream and downstream movements of juvenile and adult lake sturgeon.

At present, without fish passage, the Alverno Project acts as a barrier to upstream passage of adult lake sturgeon originating from downstream areas. No suitable spawning sites are known to exist in the Cheboygan River watershed downstream of Alverno dam. Hence, the loss of juvenile recruitment stemming from a lack of passage at the project could contribute to the ongoing diminishment of downstream sturgeon populations, caused cumulatively by a lack of suitable habitat, over-fishing (illegal take), migratory barriers, and other factors. However, because uncertainty exists regarding the genetic uniqueness of upstream versus downstream populations, the current lack of upstream passage at the project may also be preventing adverse cumulative effects to the upstream population. Due to this present uncertainty, we conclude that licensing the Alverno Project would not contribute to adverse cumulative effects on sturgeon populations, if as we recommend, the licensee cooperates with efforts to enhance lake sturgeon in the Black River.

Operation of the Alverno Project could also contribute to adverse cumulative effects on fish mortality in conjunction with entrainment and mortality occurring at the Tower and Kleber hydro developments. Although resident fishes are entrained and killed by passage through the Alverno Project's turbines, as we reviewed above, the losses do not appear to adversely affect Black River fish populations. We conclude that the project does not appreciably contribute to adverse cumulative effects on fisheries resources in the Black River.

At the present time, no anadromous fishes are present in the upper Black River so cumulative adverse effects of the Alverno Project on anadromous fishes are absent.

d. Unavoidable adverse effects

Some fish would continue to be lost to turbine entrainment mortality throughout the term of the license.

4. Terrestrial Resources

a. Affected environment

The area primarily affected by the project includes the reservoir that extends upstream to Smiths Rapids and a short distance of tailrace downstream of the dam. A large variety of birds and small and large mammals can be found in the project area.

Vegetation of the surrounding lands consists primarily of white and black spruce. Balsam fir, sugar and red maple, big tooth and quaking aspen, eastern white pine, red pine, and northern white cedar. In addition there are ornamental and non-natural trees that have been planted along the shoreline in the residential areas. The shoreline also supports a variety above the waterline in the non-residential areas. Bulrushes and cattails are present in and below the waterline for almost the entire length of the shoreline around the impoundment.

The BRLP contacted the MDNR to determine if any terrestrial species were listed by the State as threatened, endangered, or of special concern. No terrestrial species were identified by the MDNR (letter from Lori G. Sargent, Endangered Species Specialist, Department of Natural Resources, Lansing, Michigan, November 26, 1997)

b. Environmental effects and recommendations

The MDNR in it's March 24, 2000, Section 10(j) letter, recommends that the BRLP develop and implement a wildlife management plan that includes provisions for: (1) biennial consultation on the status of wildlife populations and measures to protect wildlife; (2) protection and enhancement of habitat for threatened, endangered, or sensitive species on project land; (3) protection of environmentally sensitive areas on project lands; (4) protecting riparian buffer strip along project lands adjacent to the reservoir and riverine sections; (5) a vegetation management plan; and (6) nesting structures. In it's March 27, 2000, Section 10(j) letter Interior also recommends a wildlife management plan which would include provisions for providing nesting structures and planting vegetation to enhance habitat. As part of the plan the BRLP should monitor wildlife populations and annually consult with the resources agencies for the purposes of determining the effectiveness of the enhancement measures.

Our analysis

The measures recommended by the MDNR and Interior should provide a greater level of enhancement for a greater number of wildlife species than currently exist. Although agency-recommended measures should provide a greater level of wildlife enhancement, several measures seem excessive or would provide limited benefit. Specifically, Interior's recommendations for planting vegetation to enhance habitat and annual monitoring and consultation, and the MDNR's recommendation for a vegetative management plan, seem inappropriate for the small amount of project lands located at the impoundment.

Development of a wildlife management plan, incorporating measures from Interior and the MDNR, with consideration of modifications, would provide for wildlife enhancement in the project area. However, the development of any plan should be done in consultation with the MDNR and Interior and involve a closer evaluation of site values and limitations before finalizing the types and extent of enhancements. The number of nesting structures and their locations should also be addressed in the plan. We recommend that any license issued for this project include provisions for preparing and implementing a wildlife management plan.

Threatened and Endangered Species

The BRLP contacted the U.S. Fish and Wildlife Service (FWS) to determine if there are any threatened or endangered species that may exist in the project area. The FWS has determined that there are presently no federally listed threatened, endangered or proposed species in the project area. This precludes the need for further action on this project as required by the Endangered Species Act of 1973, as amended. However, consultation with the USFWS should be initiated if the project is modified or new information about the project becomes available that indicates listed or proposed species may be present and/or affected or if, during the term of the license, any species occurring in the project area become federally listed or proposed for listing (letter from Michael T. Chezik, Regional Environmental Officer, U.S. Department of the Interior, Office of the

Secretary, Philadelphia, Pennsylvania, March 27, 2000). Thus further consultation is not required.

5. Recreation and Land use

a. Affected environment

The Alverno Project is located in Cheboygan County in northeast Michigan within an hour drive from Lakes Michigan and Huron. There are many recreational opportunities including snowmobiling, boating, fishing, cross country skiing, hiking, and camping. The region has an extensive system of connecting inland lakes and rivers, which allows boaters to navigate through Mullett and Burt lakes, and access several towns. In addition, the Michigan State Park system has several recreation areas located in Cheboygan County that are associated with Lakes Michigan and Huron.

The most popular recreation activities at the project are fishing and boating. To support these activities, the BRLP maintains recreational facilities at the impoundment. They consist of two boat launches, one into the impoundment that allows boat traffic to travel upriver into Black Lake, and second boat launch in to the river below the tailrace, which allows access to the Cheboygan River and numerous other inland lakes and rivers to the north and west, as well as access into Lake Huron on the east. The boat launches also serve as a canoe portage around the dam. A fishing area with picnic facilities is located adjacent to the tailrace near the powerhouse. Parking is also provided at the powerhouse and both boat launches.

A total of 1,500 feet of shoreline is available for fishing. Existing fishing access is provided along the east side of the reservoir and along the east side of the tailrace and down the river channel. The southeastern bank of the impoundment near the powerhouse is inaccessible because of high steep banks extending from near the dam upstream onto private property. The western bank from the dam upstream is all private property. Expect for the fenced hazardous areas of the dam and powerhouse, all property owned by the applicant is available to the public for recreational use.

The predominate land uses in the project area are agriculture and forest. The land around the project impoundment is all privately owned including some residences.

b. Environmental effects and recommendations

The applicant proposes to provide new parking and fishing areas, and a restroom facility that are accessible for people with disabilities. Further, the BRLP proposes to provide additional shoreline protection at the fishing sites and canoe portage.

The MDNR in the it's March 24, 2000, letter, recommends that the BRLP provide directional signage from major roadways so that recreationists can more easily find the project and it's associated recreational opportunities and a fishing pier for access to the reservoir. The MDNR recommends that all the recreation facilities (boat launches, tailrace and reservoir fishing sites) be accessible for people with disabilities and maintained for year around access. Further, the MDNR recommends that the boat launch on the impoundment be functional at all ice-free elevations.

Our analysis

The applicant's proposal includes plans to improve the existing recreation sites so that they are accessible for people with disabilities, and provide a restroom facility is consistent with the MDNR's recommendation. We concur with this proposal and recommend that any license issued for the project require that the BRLP prepare a recreation management plan that includes provisions for improving accessibility, and installing a restroom. We do not agree with the MDNR's recommendation to provide maintenance so that the sites are accessible year round. Requiring the BRLP to provide access for recreationist during the winter months is not necessary. Currently, the county maintains most of the road used to access the impoundment and recreationist can access the impoundment area at any time of the year. The MDNR did not provide evidence that the current situation is not adequate.

In summary, the applicant's completed and proposed improvements will enhance boating, fishing, and accessibility for people with disabilities. The measures to enhance opportunities seem justified and appropriate. We recommend that the BRLP, in consultation with the MDNR, and FWS, prepare final details and a schedule to construct the remaining recreational facilities as part of the recreation management plan and submit the plan for Commission approval. The plan should include a proposal for directional signage to inform users of the project's recreational opportunities.

The applicant proposes no specific land management measures. The MDNR recommends that the BRLP maintain all current land within the project boundary and manage these lands using a comprehensive land management plan (CLMP). The plan shall be reviewed and updated, if necessary, on a biennial basis in consultation with the resource agencies. The MDNR further, recommends that any proposal to withdraw lands that are within the project boundary or restrict public access to these lands shall be reviewed by the MDNR prior to approval by the Commission.

Maintaining ownership of protect lands and maintaining lands adjacent to the project's impoundment and tailwater through a CLMP would provide additional protection for project lands by providing a unified approach for addressing land development and conservation needs. However, the Alverno Project has minimal project lands consisting of the lands surrounding the powerhouse, existing recreation areas, and lands downstream of the tailrace. Much of the existing shoreline along the project's impoundment is in private ownership and the impoundment's westside is bordered by private residents. The BRLP has not proposed to sell any project lands. Modifications of project lands would require Commission approval after consultation with agencies. As such, we do not consider a CLMP, including specific provisions for the licensee to maintain ownership of project lands, to be necessary for the Alverno Project.

c. Unavoidable adverse effects

None.

6. Aesthetic Resources

The characteristic landscape surrounding the Black River from Black Lake to downstream of the dam is primarily rural and agricultural. More intense residential development exists along the river. The area surrounding Black Lake is a mixture of forested area, wetlands and agricultural with a significant residential development immediately adjacent to the shoreline.

The applicant does not propose to materially alter the operating scenario at the project site, the existing conditions and resources will not be altered or affected by the proposed operation under the proposed action. The BRLP also partakes in an ongoing process to maintain the condition of the Alverno Project facilities, which directly improves their appearance. Any refurbishment or construction activities associated with the installation of a third generating unit or recreation facilities would have a minor, short-term adverse effect on the visual resources of the project area.

7. Cultural Resources

a. Affected environment

The original dam was constructed at the site in 1905. It consisted of a rock filled timber crib dam with a gated spillway, a log sluice, a boat dock, and a powerhouse. In 1918 the original powerhouse was demolished and the current powerhouse was constructed. Between 1920 and 1985 various modifications and improvements were made to the dam, including the filling of all timber crib structures and converting the dam to an earth fill facility with a steel sheet piling cutoff wall on the upstream side. The State Historic Preservation Officer (SHPO) states that the above ground structures at the Alverno hydroelectric plant complex are not eligible for listing in the National Register of Historic Places and no further evaluation if the structures is necessary (letter from John R. Halsey, State Historic Preservation Officer, State Historic Preservation Office, Lansing, Michigan, December 3, 1997). Staff concurs with this determination.

The Michigan SHPO states that a fair amount of archaeological survey has been conducted along both the Black River and in the surrounding region to the northwest of the dam. No sites were found during those surveys. In addition, the shoreline behind the dam has been altered relative to the original shoreline. Due to these factors, the SHPO concludes that no historic properties exist within the area of potential effects for the project (letter from Brian D. Conway, State Historic Preservation Officer, State Historic Preservation Office, Lansing, Michigan, August 3, 1998). Staff concurs in this determination.

b. Environmental effects and recommendations

If archeological or historic sites are discovered during project operation or while constructing the recreation facilities, the Applicant should: (1) consult with the SHPO about the discovered sites; (2) prepare a site-specific plan, including a schedule, to evaluate the significance of the sites and to avoid or mitigate any impacts to sites found eligible for inclusion in the National Register of Historic Places; (3) base the site-specific plan on recommendations of the SHPO, and the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation; (4) file the site-specific plan for Commission approval, together with the written comments of the SHPO; and (5) take the necessary steps to protect the discovered archeological or historic sites from further impact until notified by the Commission that all of these requirements have been satisfied.

D. No-Action

Under the no-action alternative, the BRLP would continue to operate the project and there would be no change to the existing environment. No measures to protect, mitigate, or enhance existing environmental resources would be implemented.

VI. DEVELOPMENTAL ANALYSIS

In this section, we analyze the project's use of the Black River's available water resources to generate hydropower; estimate the economic benefits of the proposed project; and estimate the cost of various environmental protection, mitigation, and enhancement measures and the effects of these measures on project operations.

A. Power and Economic Benefits of the Project

Our independent economic studies are based on existing electric power conditions, with no considerations for future inflation, escalation, or deflation beyond the potential license issuance date.[34]

We base the net investment cost for the project on the undepreciated blue book value provided by the applicant. For our economic analysis of the alternatives, we use the assumptions, values, and sources shown in table 2.[35] The proposed action consists of the operation of the Alverno Project with the BRLP's proposed environmental and safety measures as shown in table 3.

Based on the assumptions in table 2 and the costs of enhancements shown in table 3, we estimate that the annual cost of the Alverno Project would be $85,000, or about $34,000 (8.45 mills/kWh) less than the annual power value of $119,000. The estimated

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[34] See Mead Corporation, Publishing Paper Division, 72 FERC ¶61,027 (July 13, 1995).

[35] Our estimate of the cost of alternative power is based on the current cost of energy generation in natural gas-fueled combined cycle combustion turbine (CCCT) generating plants in the ECAR region, plus a value of $109 per kilowatt year for the project's average annual capacity of 1,000 kW. We compute the regional energy value to be 17.34 mills/kWh and the capacity value to be 12.43 mills/kWh, for a total power value of 29.77 mills/kWh. Our estimate of the energy value is based on the cost of fuel that would be displaced by the hydroelectric generation in a natural gas-fueled CCCT generating plant, operating at a heat rate of 6,200 Btu/kWh. We estimate the cost of fuel based on the Energy Information Administration's reference-case estimate of average real fossil fuel costs for electric utilities, as published by the Energy Information Administration (EIA) in their Annual Energy Outlook for 1998 and its supplemental data on the EIA Internet Homepage.

average annual output of the project would be 4,000 MWh.

Table 2. Staff's assumptions for economic analyses of the Alverno Project (Source: Staff)

Assumption	Value	Source
Energy value (2000)	17.34 mills/kWh	Staff
Capacity value (2000)	$109/kW-yr	Staff
Operation & maintenance costs (1999)	$58,500.00	BRLP
Period of analysis	30 years	Staff (Mead)
Discount rate	10%	Staff
Net investment	$552,100.00	BRLP

Table 3. Summary of annual costs of BRLP's proposed enhancements for the Alverno Project (Source: Staff)

Protection, mitigation, or enhancement measure	Capital cost (2000$)	O&M cost * (2000$)	Annual cost (2000$)
Third turbine/generator	$200,000	0	$21,200
Entrainment mortality compensation	0	0	$2,000
Bank stabilization program	$2,500	0	$265
Construct and operate sluiceway	$10,000	$200	$1,260
New parking and fishing areas with restrooms and canoe portage	$8,700	$300	$1,200

* O&M cost for third generating unit is included Table 2 O&M assumptions

B. Proposed Action with Additional Staff-recommended Measures

In this section, we present the annual costs of the proposed action with the staff's recommended measures. Table 4 shows the annual costs of enhancements for staff-recommended measures.

Based on these assumptions, we estimate that the annual cost of the proposed action with the staff's recommended measures would be about $87,000, or about $32,000

(7.96 mills/kWh) less than the annual power value of $119,000. The estimated average annual output of the project would be 4,000 MWh.

Table 4. Summary of annual costs of enhancements of the staff and agency-recommended measures for BRLP's proposed Alverno Project (Source: Staff)

Protection, mitigation, or enhancement measure	Capital cost (2000$)	O&M cost (2000$)	Annual cost (2000$)
Water quality monitoring program	$72,000	0	$7,640
gaging and flow compliance monitoring plan	$10,000	$1,000	$2,060
Reservoir drawdown management plan	$1,500	0	$159
Natural organic debris management plan	$5,000	0	$530
Wildlife management plan	$2,000	$300	$512

C. No-action

Under the no-action alternative, the project would continue to operate as it does now, with no change in existing environmental conditions.

The annual cost of the existing project, is about $81,000.00 (21.29 mills/kWh) for the existing generation of about 3,800 MWh annually. As stated above, we assume that the cost of alternative power is 29.77 mills/kWh. Therefore, the existing project would produce power at a cost of about $32,000 (8.50 mills/kWh) less than the currently available alternative.

D. Economic Comparison of the Alternatives

Table 5 presents a summary of the current net annual power benefits for no action, the proposed action, and the proposed action with additional staff-recommended measures.

Table 5. Summary of the net annual benefits of alternatives for BRLP's proposed Alverno Project (Source: Staff)

	BRLP's Proposed action	Proposed action with additional staff-recommended measures	No action
Annual generation (MWh)	4,000	4,000	3,800
Annual power benefit			
($)	119,000	119,000	113,000
(mills/kWh)	29.77	29.77	29.78
Annual cost [a]			
($)	85,000	87,000	81,000
(mills/kWh)	21.32	21.80	21.29
Annual net benefit			
($)	34,000	32,000	32,000
(mills/kWh)	8.45	7.96	8.5

Project economics is only one of the many public interest factors that is considered in determining whether or not to issue a license. The construction and operation of a project may be desirable for other reasons, such as to diversify the mix of energy sources in the area, to promote local employment, to provide a fixed-cost source of power and reduce contract needs, and to conserve fossil fuels and reduce atmospheric pollution.

E. Pollution Abatement

The Alverno Project would annually generates about 4,000 MWh of electricity. This amount of hydropower generation, when contrasted with the generation of an equal amount of energy by fossil-fueled facilities, avoids the unnecessary emission of atmospheric pollutants. Assuming that the 4,000 MWh of hydropower generation would be replaced by an equal amount of natural gas-fired generation, generating electrical power equivalent to that produced by the Alverno Project would require combustion of about 41.2 million cubic feet of natural gas annually. Removal of pollutants from the emissions to levels presently achievable by state-of-the-art technology would cost about $2,217.00 (1999 $) annually.

VII. COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a) of the FPA require the Commission to give equal consideration to all uses of the water way on which the project is located. When we review a hydropower project, we consider the water quality, fish and wildlife, recreational, cultural and other nondevelopmental values of the involved waterway equally with its electric energy and other developmental values. In determining whether, and under what conditions, to license a project, the Commission must weigh the various economic and environmental tradeoffs involved in the decision.

This section contains the basis for, and a summary of, our recommendations to the Commission for licensing the Alverno Project. We weighed the costs and benefits of our recommended alternative against other proposed measures.

A. Recommended Alternative

Based on our independent review and evaluation of the proposed project, the proposed action with additional staff-recommended measures, and no-action, we select the proposed action with our recommended alternative as the preferred alternative.

We recommend this alternative because: (1) issuance of a license would allow the BRLP to continue to operate the project as a dependable source of electric energy; (2) the 1,100-kW project would avoid the need for an equivalent amount of fossil-fuel fired electric generation and capacity, continuing to help conserve these nonrenewable energy resources and reduce atmospheric pollution; and (3) the recommended environmental protection, mitigation, and enhancement measures would improve water quality, protect fish and terrestrial resources, improve public use of recreation facilities and resources, improve multiple use and management of project lands, and maintain and protect historic and archeological resources within the area affected by project operations.

We recommend including the following environmental measures in any license issued by the Commission for the Alverno Project:

(1) operate the Alverno Project in a manner consistent with the State of Michigan's water quality standards set forth in the 401 Water Quality Certificate;

(2) in consultation with the resource agencies, develop and implement a water quality monitoring program the fifth year after license issuance and every five years thereafter;

(3) consult with resource agencies before performing any activities which may cause a significant mobilization of sediments;

(4) operate the project in a modified run-of-river mode to maintain the water surface elevation of Black Lake within court-ordered levels;

(5) develop and implement a gaging and flow compliance monitoring plan, in consultation with the resource agencies, including monitoring Black Lake water surface elevation, Alverno impoundment water surface elevation, and project operations;

(6) cooperate with the resource agencies and NGOs in the management of lake sturgeon in the Black River;

(7) develop and implement provisions to immediately provide flow to downstream reaches in the event of a project shutdown;

;

(8) develop and implement a reservoir drawdown management plan, in consultation with the resources agencies, to prevent adverse effects on aquatic resources from planned reservoir drawdowns for project maintenance;

(9) develop and implement a natural organic debris management plan, in consultation with the resource agencies, focusing on passing debris downstream of the project, to enhance habitat resources in the Black River;

(10) develop and implement a wildlife management plan, in consultation with the resource agencies, focusing on nesting structures, habitat enhancement, and vegetation management;

(11) develop and implement a shoreline erosion control plan, in consultation with the resource agencies, for the Alverno impoundment;

(12) development and implement a recreation management plan, in consultation with the MDNR, focusing on enhancing existing facilities; and

(13) reserve authority for the Secretary of the Interior to prescribe the construction, operation, and maintenance of fishways.

Because our recommendations for water quality monitoring, and plans for operations gaging and compliance, reservoir drawdown management, natural organic debris management, and a wildlife management represent tradeoffs between developmental and non-developmental resources, we present our justification for these measures and a comparison of the alternatives in the following section.

Implementation of these measures would protect and enhance water quality, fisheries and wildlife, and recreational resources in the project area and provide for the best use of the waterway.

The costs of some of these measures would reduce the net benefit of the project. As discussed in section VI, we estimate that the project as proposed by the BRLP would cost $85,000. Specifically, five of our additional recommended measures would further reduce the economic benefits of the project. These include the development and implementation of plans for: (1) monitoring water temperature and DO at the project; (2) gaging and compliance for operations monitoring; (3) reservoir drawdown management; (4) natural organic debris management plan; and (5) wildlife management. The staff recommended release of a minimum flow of 25 cfs downstream of Alverno dam are within the hydraulic range of the proposed third turbine. Thus this recommendation will not affect project costs.

1. Water Quality Monitoring

The WQC requires, and the resource agencies recommend, the licensee develop and implement a water quality monitoring plan that includes continuous monitoring of DO and water temperature upstream and downstream of the project. A water quality monitoring plan will provide benefits to the Grand River environment by ensuring that water quality at the project remains supportive of a healthy aquatic community.

We recommend that the BRLP monitor water temperature and DO every fifth year following the issuance of a license for the Alverno Project. We estimate that the current annual cost of developing and implementing a plan to monitor water temperature and DO at the project would be about $7,640.

2. Operations Gaging and Compliance Plan

The WQC requires, and the resource agencies recommend, that the BRLP monitor project operations, including funding for monitoring Black Lake and Alverno impoundment water surface elevations, project operations, and establishment of USGS flow gages. Because the suitability of aquatic environments could be adversely affected by inconsistent flow releases and water surface elevations, compliance with our recommended operating mode and water surface elevation management regime should be monitored.

We recommend that the BRLP develop and implement an operations gaging and compliance plan, for measuring Black Lake and Alverno impoundment water surface elevations and project operations data. Because the funding and installation of a USGS type gage downstream of Alverno dam is a requirement of the WQC, we recommend that the BRLP include this as part of the operations gaging and compliance plan. We estimate that the current annual cost of this monitoring and documentation of compliance with our recommended operating mode and water surface elevation regimes would be about $2,060.

3. Reservoir Drawdown Management Plan

Both the MDNR and Interior recommend that the licensee develop and implement a reservoir drawdown plan that includes consulting with the agencies to minimize resource damage, timing of flowage restoration, and to obtain necessary permits.

We recommend that the BRLP consult with the resource agencies to develop a reservoir drawdown management plan that identifies protocols for coordinating planned drawdowns with the resource agencies. We recommend that the BRLP formalize their high flow operating procedures as part of the reservoir drawdown management plan. Our recommendations will minimize the potential for both site-specific and cumulative adverse effects to occur to Black River aquatic resources as the result of reservoir drawdowns. The estimate that the annual costs associated with consulting would be minimal. We estimate that the current annual cost of coordinating with the agencies would be about $159.

4. Natural Organic Debris Management Plan

The applicant proposes to pass downstream woody debris collecting on the project's trashracks that is cleared during normal operation and maintenance by constructing a sluiceway at the project. The MDNR makes a similar recommendation for the licensee to develop and implement a plan, in consultation with the resource agencies, to pass natural organic debris over the Alverno dam.

We agree with MDNR's recommendation for the licensee to develop and implement a plan, in consultation with the resource agencies, to pass woody debris downstream and submit the plan for Commission approval. We recommend that the

BRLP consult with the resource agencies on their plans for constructing a sluiceway to pass organic debris. The estimate that the annual costs associated with developing and implementing the plan would be about $530.

5. Wildlife Management Plan

Both the MDNR and Interior recommend that the BRLP develop and implement a wildlife management plan, in consultation with the resource agencies, that includes provisions for nesting enhancements for waterfowl, osprey, purple martin eastern bluebrids, and bats and vegetation and buffer strip management. This will benefit terrestrial resources in the project area by improving habitat suitability and, thus, providing for the enhancement of wildlife populations.

We recommend the licensee develop and implement a wildlife management plan for project lands, including the installation of nesting structures, vegetation planting to benefit wildlife, and protecting riparian buffer strip along project lands. We estimate that the current annual cost of developing and implementing a wildlife management plan would be about $512.

B. Conclusion

Based on our independent analysis of the Alverno Project, we conclude that operation of the project with our recommended protection, mitigation, and enhancement measures would improve environmental conditions in the project area and would be a beneficial use of the resources.

VIII. RECOMMENDATIONS OF FISH AND WILDLIFE AGENCIES

Under the provisions of Section 10(j) of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by federal and state fish and wildlife agencies submitted to adequately and equitably protect, mitigate damages to, and enhance fish and wildlife resources affected by the project, to the extent that such conditions are consistent with the FPA and other applicable law.

Section 10(j) of the FPA states that, whenever the Commission believes that any fish and wildlife agency recommendation is inconsistent with the purposes and the requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve any such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of the agency.

Pursuant to Section 10(j) of the FPA, we made a preliminary determination that four of the recommendations of the fish and wildlife agencies may be inconsistent with the purposes and requirements of Part I of the FPA or other applicable law for the following reasons:

(1) Interior's recommendation to operate the project in an instantaneous run-of-river mode at all times (with no hydro peaking) would cause Black Lake water surface elevations to range outside of court-ordered limits and have negative effects on habitat for fish and aquatic resources.

(2) Interior's recommendation to construct, maintain, and fund USGS flow gaging stations upstream and downstream of Alverno dam to measure inflow and discharge is not necessary, because compliance with the recommended operating regime will be determined using water surface elevation data from Black Lake and Alverno impoundment and project operations data.

(3) Interiors recommendation to maintain compliance with run-of-river operation by having no more than a 10 percent difference in discharge upstream and downstream of the project is unnecessary, because we do not recommend a strict run-of-river operation for the project because it would have significant adverse effects on fish and aquatic resources in Black Lake.

(4) The MDNR's recommended minimum flow downstream of the project of 75 cfs, between inflows of 75 and 245 cfs, is unnecessary for maintaining and enhancing aquatic resources downstream of the project. We find a lower minimum flow in the 25 cfs range would be sufficient for maintaining water quality and suitable habitat in the small riverine reach downstream of Alverno dam. A lower minimum flow would also enable releases to occur on a more continual basis, which would have greater benefits to fish and aquatic resources than releases of a higher minimum flow of 75 cfs, potentially, on a less continual basis.

Pursuant to Section 10(j) of the FPA, Commission staff consulted with the Federal and state resource agencies in an attempt to resolve the remaining conflicts between the requirements of the FPA and the resource enhancement measures of the state and Federal agencies. Commission staff and the MDNR clarified issues related to project operations, recommended minimum flows, and Black Lake water surface elevations. The MDNR acknowledged that the highest priority with regard to project operations is to maintain court-ordered water surface levels in Black Lake. The release of 75 cfs minimum flows, between inflows of 75 and 245 cfs, along with the potential to operate the project in a run-of-river mode as often as possible, are both contingent on first ensuring Black Lake is within seasonal court-ordered limits. The MDNR clarified that at inflows of less than 75 cfs, the applicant could use the low flow turbine to maintain unspecified minimum flows downstream of the project. Based on the MDNR's clarification, staff concludes that the operational scenario recommended for the Alervno Project is not inconsistent with the FPA.

The BRLP notes that the three year test period required by the WQC, for determining operational compliance with 401 WQC conditions and measures, and further ongoing consultation with resource agencies that would occur during that period, could be used to determine the practicality of minimum flow recommendations. Commission staff had objected to the recommendation of the MDNR for a minimum flow of 75 cfs to be provided when inflows were between 75 and 245 cfs, recommending that a lower minimum flow of 25 cfs would be sufficient to support fish and aquatic resources downstream of the project. In support of their recommendation, the MDNR notes that the goal for project operations at the Alverno Project is to operate the project in a run-of-river mode as often as possible within the constraints of maintaining Black Lake water surface elevations within the court-ordered levels. Commission staff acknowledges that a minimum flow of 75 cfs between inflows of 75 and 245 cfs is a condition of the 401 WQC and agrees that the practicality of this recommendation would be determined during its implementation during the three year test period.

Commission staff was unable to resolve inconsistencies related to three of Interior's recommendations regarding run-of-river operations and associated compliance monitoring of run-of-river operations. Our preliminary determination that Interiors' recommendations to operate the project in a instantaneous run-of-river mode, install flow gaging stations to track compliance with run-of-river operations, and maintain a flow-based run-of-river compliance standard, are inconsistent with applicable sections of the FPA remains unresolved. As discussed in section V.b.2, staff determined that an instantaneous run-of-river mode at the Alverno Project would cause a significant loss of fish and aquatic resources habitat in Black Lake. Operation of the Alverno Project in an instantaneous run-of-river mode is also inconsistent with the 401 WQC issued by the MDEQ.

Table 6 presents a summary of the MDNR’s and Interior’s recommendations and our preliminary determination of whether they are within the scope of Section 10(j), and whether or not we would recommend adopting the measures under the proposed action with additional staff-recommended measures.

Table 6. Analysis of fish and wildlife agency recommendations for the Alverno Project (Source: the staff).

Recommendation	Agency	Within Scope of Section 10(j)?	Annual cost	Recommend Adopting?
1. Maintain Alverno impoundment such that court ordered lake levels for Black Lake are maintained at all times	MDNR	Yes	$0	Yes
2. Operate the project in a run-of-river mode when possible after maintaining court-ordered Black Lake levels	MDNR	Yes	$0	Yes
3. Operate the project in an instantaneous run-of-river mode, with no hydro-peaking	Interior	Yes	$0	No, instantaneous run-of-river mode at all times would cause Black Lake to range outside of court-ordered limits and have negative effects on fish and aquatic resources
4. Provide a minimum flow of 75 cfs between flows of 75 and 245 cfs	MDNR	Yes	$0	Yes, as resolved at 10(j) negotiations
5. Limit Black Lake level fluctuations to $\pm$ 0.25	Interior	Yes	$0	Yes
6. Develop and implement an operational gaging and compliance plan	MDNR Interior	Yes	$2,060	Yes

Recommendation	Agency	Within Scope of Section 10(j)?	Annual cost	Recommend Adopting?
7. Maintain a record of headwater elevations of Alverno impoundment and Black Lake, recorded hourly	MDNR	Yes	$0	Yes
8. Install staff gages on the upstream wall of the dam in a clearly visible location	MDNR Interior	Yes	$550	Yes
9. Install telemetered, continuous water level automated recording devices on the project's reservoir and tailwater	Interior	Yes	$2,600	No, we find a tailwater elevation sensor to be unnecessary.
10. Maintain daily record of operations, including turbine operations, headwater and tailwater elevations, and hourly flow releases through the powerhouse and spillway, and provide this information to the agencies upon request	Interior	Yes	Nominal	Yes
11. Post interpretive signs near flow gages and respective reservoir boat launch sites that describe the operation of the reservoirs	MDNR	No, not a specific measure for fish and wildlife	$150	No, signs could lead to vandalism and destruction of monitoring equipment

Recommendation	Agency	Within Scope of Section 10(j)?	Annual cost	Recommend Adopting?
12. Prepare a report to the Commission documenting 3 years of compliance with recommended operating standards	MDNR	Yes	$425	Yes
13. Construct, maintain, and fund USGS flow gaging stations or comparable equipment, upstream and downstream of dam to measure inflow and discharge	Interior	Yes	$10,500	No, compliance with recommended operating regime will be determined using elevation data from Black Lake and water surface elevations in Alverno impoundment
14. Maintain compliance with run-of-river by having no more than 10 percent difference in discharge upstream and downstream of project	Interior	Yes	$0	No, we do not recommend run-of-river because of adverse effects on fish habitat in Black Lake; also we do not recommend flow-based operational compliance monitoring
15. Pass river inflow within a few minutes through the project in the event of a shutdown	Interior	Yes	Nominal	Yes

Recommendation	Agency	Within Scope of Section 10(j)?	Annual cost	Recommend Adopting?
16. Prepare a plan to coordinate with the MDNR and FWS on all emergency and maintenance drawdowns	Interior	No, not a specific fish and wildlife measure	$160	Yes, under Section 10(a)
17. Maintain DO concentrations in the project tailwater not less than 5 mg/l at any time	MDNR Interior	Yes	$0	Yes
18. Maintain water temperature downstream of the project less than temperatures specified	MDNR Interior	Yes	$0	Yes
19. Do not warm Black River downstream of Alverno dam more than 5 ^{o}F greater than temperatures as measured upstream of the Alverno impoundment	MDNR	Yes	$0	Yes
20. Develop and implement a water quality monitoring plan, including water temperature and DO monitoring	MDNR Interior	Yes	$7,600	Yes
21. Pay liquidated damages to the State of Michigan for each violation of water quality standards	MDNR	No, not a specific fish and wildlife measure	Undeter-mined	No, outside Commissions purview to require payment of damages

Recommendation	Agency	Within Scope of Section 10(j)?	Annual cost	Recommend Adopting?
22. Include a standard re-opener for fish passage	MDNR Interior	No, not a specific fish and wildlife measure	$0	No, standard L-form license article provides similar provisions
23. Develop and implement a downstream fish passage protection plan	MDNR	No, not a specific fish and wildlife measure	Nominal	No, no evidence entrainment adversely affects fish populations
24. Design and evaluate all potential protective devices; install fish protection devices at the project; develop operation and maintenance procedures for selected device; and conduct study to determine effectiveness of installed fish protection devices	MDNR	No, not a specific fish and wildlife measure	$130,000	No, no evidence entrainment mortality adversely affects fish populations
25. Develop a Fish Protection Fund (FPF) to escrow an initial and/or annual payment to finance appropriate fish protection measures	MDNR Interior	No, not a specific fish and wildlife measure	Undeter-mined	No, no evidence entrainment mortality adversely affects fish populations

Recommendation	Agency	Within Scope of Section 10(j)?	Annual cost	Recommend Adopting?
26. Conduct a fisheries damage assessment and pay (compensate) Michigan an annual restitution value	MDNR Interior	No, not a specific fish and wildlife measure	Undeter-mined	No, outside of Commission's regulatory authority to require payment of damages for fish losses
27. Develop and implement a plan to pass natural organic debris collected on trash racks and log booms over the Alverno dam to improve fish habitat	MDNR	Yes	$530	Yes
28. Prepare a plan for studying costs of: (1) permanent non-power operation; (2) partial project removal; or (3) complete project removal of the Alverno Project	MDNR	No, not a specific fish and wildlife measure	Undeter-mined	No,
29. Purple Loosestrife and Eurasian Watermilfoil Control	Interior MDNR	Yes	Minimal	Yes

Recommendation	Agency	Within Scope of Section 10(j)?	Annual cost	Recommend Adopting?
30. Wildlife Management Plan including provisions for; wood duck boxes, mallard hen house, purple martin houses, osprey nest platforms, bat house, bluebird nest boxes, protect and enhance habitat, protect sensitive areas and riparian buffer strip, vegetation management, and consultation with agencies.	Interior MDRN	Yes	$512	Yes
31. Shoreline Erosion Control Plan	Interior MDNR	Yes	Minimal	No, we recommend that the licensee control erosion at the project impoundment
32. Operate existing recreation facilities; tailwater fishing site, impoundment fishing site/pier, impoundment boat launch, boat launch downstream of dam, canoe portage and signs	MDNR	No, not a specific fish and wildlife measure	Undeter-mined	Yes, under Section 10(a)

Recommendation	Agency	Within Scope of Section 10(j)?	Annual cost	Recommend Adopting?
33. Provide for construction, maintenance, and operation of such reasonable facilities and modifications to project structures and operation as part of fish and wildlife reopener license article	MDNR	No, not a specific fish and wildlife measure	Undetermined	No, standard L-form license article provides similar provisions
34. Comprehensive Land Management Plan	MDNR	No, not a specific fish and wildlife measure	Nominal	No, commitment to protect lands and wildlife plan meets needs for protection

Recommendations Outside the Scope of Section 10(j)

As identified in Table 6 we determined that 12 of the 34 recommendations made by MDNR or Interior are outside the scope of Section 10(j) because they are not specific measures to protect fish and wildlife. We considered, and recommended adopting, two of these recommendations under the public interest standard of Section 10(a) of the FPA.

We do not recommend adopting the MDNR's recommendation for the BRLP to prepare a plan for studying the cost of: (1) permanent non-power operation; (2) partial project removal; or (3) complete project removal of the Alverno Project. Because there is no evidence that the Alverno Project is in poor physical condition or has marginal economics such that the project would not remain viable throughout the term of the license, there is no reason to require the BRLP to fund the cost of studying project retirement. The Commission has also stated that it will not generically impose retirement funding requirements on licensees.[36] However, the licensee would be ultimately responsible for meeting a reasonable level of retirement costs when the project is retired.

[36] FERC Statutes and Regulations ¶ 31,011 (1994).

IX. CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2) of the FPA requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project.

Accordingly, federal and state agencies filed 55 plans with the Commission that address various resources in Michigan. Only one plan is relevant to this project.[37] No conflicts were found.

X. FINDING OF NO SIGNIFICANT IMPACT

We've prepared this EA for the Alverno project pursuant to the National Environmental Policy Act of 1969.

If the Alverno Project is licensed as proposed with the additional staff-recommended measures, the project would continue to operate while providing enhancements to fish and wildlife resources, improvements to recreation facilities, and protection of cultural resources in the project area.

Based on our independent analysis, issuing a license for the project, as proposed with the additional staff-recommended measures, would not constitute a major federal action significantly affecting the quality of the human environment.

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XII. LIST OF PREPARERS

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APPENDIX A

Comments and Commission Staff Responses on the Alverno Hydroelectric Project Draft Environmental Assessment

The Michigan Department of Natural Resources (MDNR), Michigan Department of Environmental Quality (MDEQ), and the Black River Limited Partnership (BRLP) commented on the Draft Environmental Assessment (EA) by letters dated November 16, November 16, 2000, and January 23, 2001, respectively. Specific comments on the EA are summarized into the 18 general comment areas below. Each general comment is followed by our response, including any changes made to the EA. Typographical changes or minor clarification to the EA are not summarized, but have been incorporated into the EA. Copies of the comment letters can be viewed on the web at www.ferc.fed.us/online/rims.htm. Call (202) 208-2222 for assistance.

Comment-1: The MDNR notes that the EA appears to contradict itself by not accepting provision included in the water quality certification (WQC). The Commission staff indicates its disagreement with the WQC provision to provide flows of 75 cfs during periods when flows to the project are between 75 and 245 cfs. The MDEQ insists provisions of the WQC be included in any license issued for the Alverno Project.

Response-1: In Sections V.C of the EA, staff completes an independent analysis of the WQC to determine if conditions of the WQC are in the public interest as related to licensing the Alverno Project. Staff's does not concur with the MDEQ that all provisions of the WQC were in the public interest. Irrespective of staff's analysis, conditions of the WQC will be included in any license issued for the Alverno Project, as required by federal law.

Comment-2: The MDNR concurs with the EA's position regarding the development of a shoreline erosion control plan. The plan should include provisions to periodically monitor the impoundment and work with riparian owners on the portions of the impoundment not directly controlled by the Alverno Project.

Response-2: We agree. In Section V.C.1 of the EA staff recommends that monitoring for erosion be included in the recommended erosion and sediment control plan. Further, we recommend that the private land owners be invited to voluntarily participate in controlling erosion.

Comment-3: The MDNR concurs with the EA's position regarding the development of a recreation plan. The plan should include provisions to provide accessible fishing opportunities for the impoundment and tailrace areas, boat launches, and restroom facilities.

Response-3: We agree that the recreation facilities should be accessible for people with disabilities and the applicant proposes to provide facilities that accessible. The specific design details, such as; location, materials, etc., of the facilities will be determined, in consultation with the agencies, as part of the proposed recreation plan. The applicant is responsible for constructing facilities that are consistent with the Americans with Disabilities Act.

Comment-4: The MDNR concurs with the EA's position regarding flow gaging. The downstream gage should monitor river flows to encompass project flows and spill; operational records should provide information regarding project flows; all automated gages should be telemetered.

Response-4: The WQC allows the licensee to, potentially, use gaging of project operations data in lieu of downstream gaging. As discussed in Section V.C of the EA, staff maintain that downstream gaging at the Alverno Project is unlikely to be effective because the Alverno Project tailrace is the backwater area for the Cheboygan dam. Staff recommended including the downstream gage in the operations and compliance monitoring plan, because it is a requirement of the WQC.

Comment-5: The MDNR agrees that the Alverno Project implement and monitor water quality parameters after five years and every five years thereafter. The MDNR, however, disagrees with the EA's position that BRLP need not monitor chemical constituents of the impoundment sediments ten years after license issuance and every ten years thereafter. MDEQ commented that since contaminant monitoring is a condition of the WQC, the Commission is obligated to include this provision in any license issued for the Alverno Project.

Response-5: As discussed in Section V.C. of the EA, staff maintain that sediment contaminant monitoring, as required by the WQC, is not necessary, because although the Alverno Project may influence patterns of sedimentation, the operation and maintenance of the project has no link to any contaminants found in Black River sediments. Staff recognize, however, that because sediment contaminant monitoring is a condition of the WQC, it will be included in any license issued for the Alverno Project.

Comment-6: The MDNR concurs that any license issued for the Alverno Project require a reservoir drawdown management plan, to minimize negative aspects of drawdowns necessary for operation and maintenance of the Alverno Project.

Response-6: No response required.

Comment-7: The MDNR concurs with the recommendation to require cooperation with agencies and other entities regarding lake sturgeon management efforts. It is imperative that any license issued for the Alverno Project include provisions to cooperate with agency (and others) efforts to enhance lake sturgeon.

Response-7: No response required.

Comment-8: The MDNR and MDEQ recommend passing large woody debris that accumulates on log booms or spillways.

Response-8: We agree. See Section V.C. recommending that any license issued require downstream movement of woody debris accumulating on the project spillway and log boom, as appropriate.

Comment-9: The MDNR concurs that a wildlife management plan be developed in consultation with the agencies and others.

Response-9: No response required.

Comment-10: The MDNR says that a land management plan (LMP) is essential to protect potential habitat for wildlife species, since most of the land surrounding the impoundment and areas downstream of the project will not be protected from future development. The MDNR requests that any license issued for the Alverno Project include provision for developing a LMP in consultation with the agencies (and others).

Response-10: Staff does not recommend a LMP because BRLP has very little land necessitating the need for a specific management plan. In addition, the recommended shoreline management plan and wildlife management plan will address the resource concerns raised by MDNR.

Comment-11: The MDNR agrees to deferring fish passage at this time, but considers a re-opener for fish passage in the future to be necessary.

Response-11: In Section III.C of the EA, staff conclude that the uncertainty of providing upstream passage for lake sturgeon at the Alverno Project, at present, outweigh the potential benefits. This conclusion was based in part on the MDNR's guidance that lake sturgeon restoration efforts consider population genetics and uniqueness of lake sturgeon populations, both of which are currently unknown for the Black Lake population.

Standard fish and wildlife re-openers included in any license issued can be used to address any potential future fish passage needs at the Alverno Project.

Comment-12: The MDNR disagrees with the assertion that the Alverno Dam has maintained the status of the fisheries communities in Black Lake by virtue of blocking fish movement upstream.

Response-12: As discussed in section V.C. of the EA, staff maintain that Alverno dam, acting as a functional barrier to upstream fish passage from Lake Huron, has helped maintain the high quality status of the Black Lake fishery. We acknowledge that the invasion of exotic noxious species can occur absent fish passage at Alverno Dam, as we indicate in the EA.

Comment-13: The EA concludes that downstream fish protection devices are not necessary at the Alverno Project based on the fact that no data exists showing entrainment adversely affects Black River/Black Lake fish populations. Further, fish surveys show the lake and impoundment support diverse, naturally reproducing populations. Nevertheless, the MDNR continues to recommend that permanent downstream protection be installed to protect all fish species throughout the entire year.

Response-13: Our analysis and conclusions regarding downstream fish protection remain unchanged. Although, we acknowledge that some fishes must certainly be lost to entrainment mortality, there is no evidence showing that entrainment mortality is adversely affecting fish populations in the Black River (see Section V.C of the EA). Conversely, the diversity of fish species present in the project area, along with the fact that they are naturally reproducing, indicates a normal functioning fish community in the Black Lake/Black River area.

Comment-14: The MDNR notes that out-migration of lake sturgeon has been identified as a potential problem. Fish which pass downstream of the Alervno Project through the turbines or by other means are killed or entrained or are isolated from Black Lake and unable to return to their natural spawning grounds.

Response-14: In Section V.C. of the EA, we conclude that downstream passage protection for lake sturgeon was not warranted. Among other reasons, the low population size of sturgeon in Black Lake would likely cause the lake to function as a sink for recruitment rather than a source. In the EA we state the following: "We recognize that existing and future management efforts may enhance the sturgeon population in Black Lake and increase the chance for downstream movements and turbine mortality of juvenile sturgeon at the Alverno Project. If in the future, high rates of entrainment and mortality of juvenile sturgeon are identified, we recommend the licensee consult and cooperate with the resource agencies to enhance downstream passage and minimize turbine entrainment." We believe our recommendation provides sufficient latitude for downstream passage management for sturgeon, should sturgeon entrainment be identified as a limiting factor in the future.

Comment-15: The MDNR disagrees that the payment of compensation and restitution for entrainment losses is not addressed by the federal licensing authority of the Commission. Because the terms of a license issued by the Commission enable the project to kill fish, either the licensee, due to the operation of the hydroelectric project or the Commission, through licensing, should be responsible for compensating the State of Michigan for taking its Public Trust Resources.

Response-15: As indicated in the EA, a requirement for the licensee to pay to the State of Michigan the replacement costs or restitution value for fish lost at the Alverno Project is beyond the Commission's purview. Our conclusion regarding payments for fish lost at the project remains unchanged.

Comment-16: The MDNR disagrees with the conclusion regarding retirement of the Alverno Project and supports the position that the licensee post a cash bond or establish a payment schedule for meeting the cash bond requirements for the amount deemed necessary from a dam retirement study.

Response-16: Your position is noted. As discussed in Section VIII, while we conclude that retirement funding is not necessary, the licensee would ultimately be responsible for meeting a reasonable level of of retirement costs when the project is retired.

Comment-17: The BRLP notes that staff has mis-characterized the effects of a potential project shutdown on downstream resources. It is impossible to dewater the Alverno tailrace, and we question the need for including staff's statement on page 53, item 8 in the draft EA: "develop and implement provisions to prevent the dewatering of downstream reaches in the event of a project shutdown."

Response-17: See Section V.C. We have changed the wording in our recommendation to the following regarding project shutdowns: "develop and implement provisions to immediately provide flow to downstream reaches in the event of a project shutdown."

Comment-18: The BRLP request that conditions of the WQC, which include a three-year test period and development of a monitoring plan, be used to cover flow-monitoring requirements in a license for the Alervno Project. Consultation with the resource agencies to develop a flow monitoring plan could preclude the need for downstream gaging.

Response-18: In Section V.C. of the EA, we discuss the need for a downstream gage. We have also added language indicating that a downstream gage may have limited accuracy because the Alverno tailgate is the backwater area from the downstream dam. Additionally, we note that the MDEQ's WQC condition for the licensee to engage in a three-year test period for operational compliance, in consultation with the resource agencies, would enable the full evaluation of the need for downstream gaging. We recommend the need for downstream gaging be assessed during the test period, and considered as an option if deemed necessary after or during the test period.

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Appendix C

Known past and present fish distributions in the Cheboygan River system. Distribution of fishes were compiled from Bailey et al. (2004) and from records located at the Michigan Department of Natural Resources Gaylord Operations Service Center, the Michigan Department of Natural Resources, Hunt Creek Fisheries Research Station, and from the Michigan Department of Natural Resources Fish Collection System. For species that are listed under Michigan's Endangered Species Act (Part 365, Endangered Species Protection, of the Natural Resource and Environmental Protection Act, Act 451 of the Public Acts of 1994), their status follows their scientific name. Categories are decline, rare, special concern, threatened, extinct, and locally extinct.

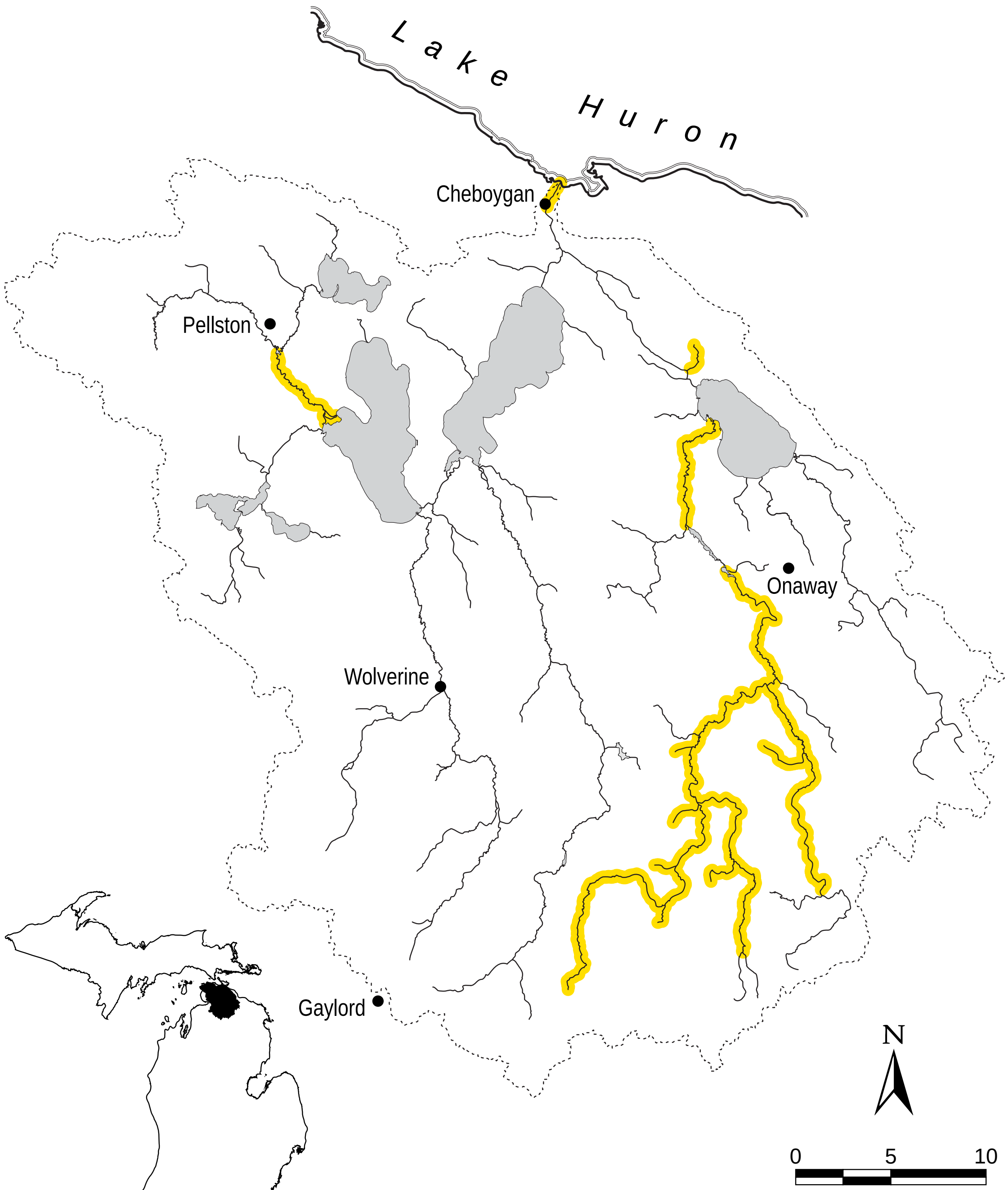
Habitat descriptions were compiled from the Fishes of Ohio (Trautman 1981), Freshwater Fishes of Canada (Scott and Crossman 1973), Fishes of Wisconsin (Becker 1983), Fishes of Missouri (Pflieger 1975), and Fishes of the Great Lakes Region (Hubbs and Lagler 1947).

APPENDIX C INDEX

Northern brook lamprey *Ichthyomyzon fossor*

Habitat**:**

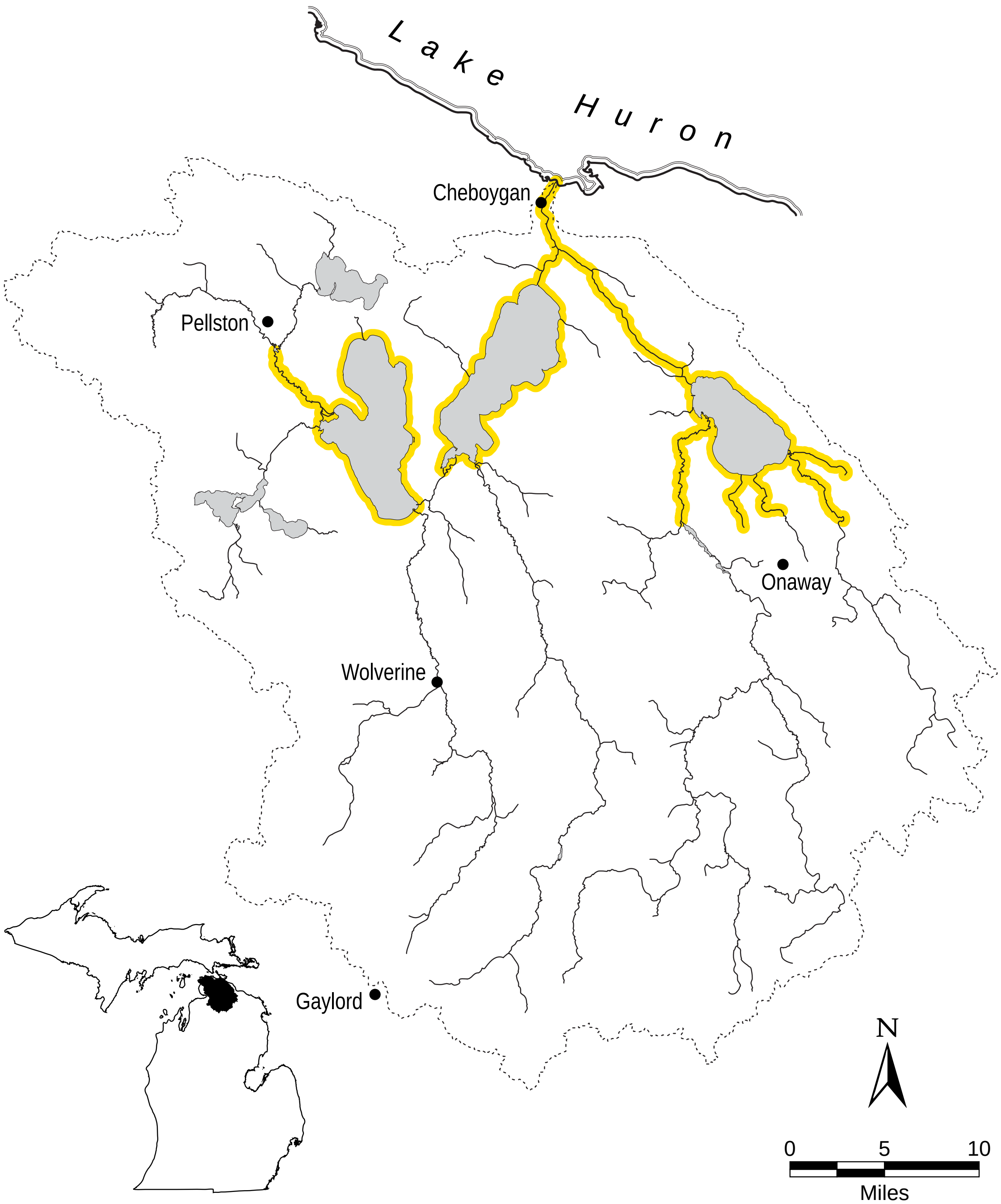
feeding	-	young: low gradient, substrate with bars and beds of mixed sand and organic debris
	-	moderately warm water
spawning	-	clear, high gradient streams (<15 feet wide)
	-	riffles with sand or gravel substrate



Silver lamprey *Ichthyomyzon unicuspis*

Habitat:

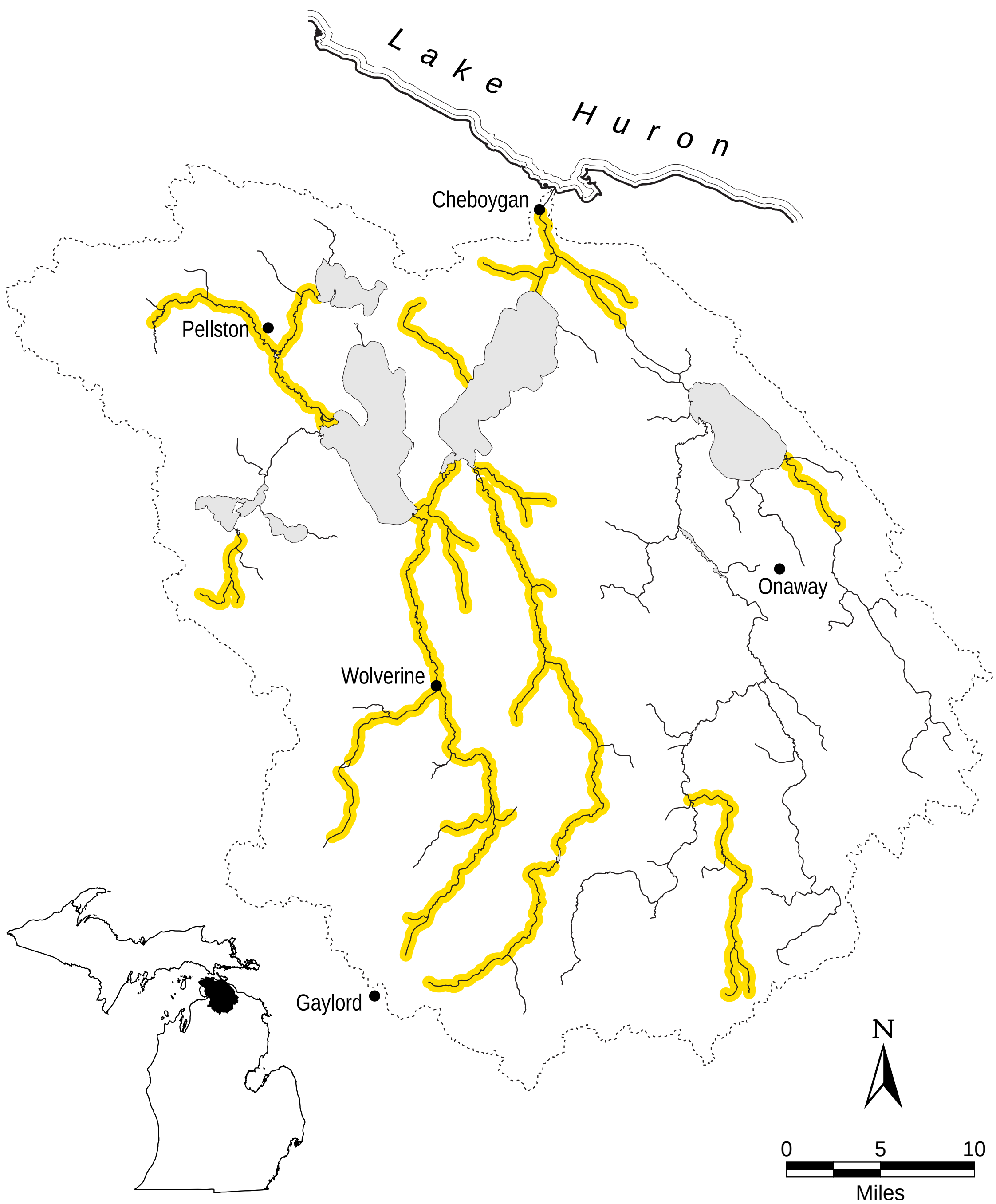
feeding	-	young: sand, muck, or organic debris substrate
	-	adults: clear river water with prey species
spawning	-	gravel and sand substrate
	-	moderate gradient
	-	moderate size stream
	-	cannot tolerate silt
	-	no dams
winter refuge	-	ammocoetes burrow for 4 to 7 years in mud and silt at river margins



American brook lamprey *Lampetra appendix*

Habitat:

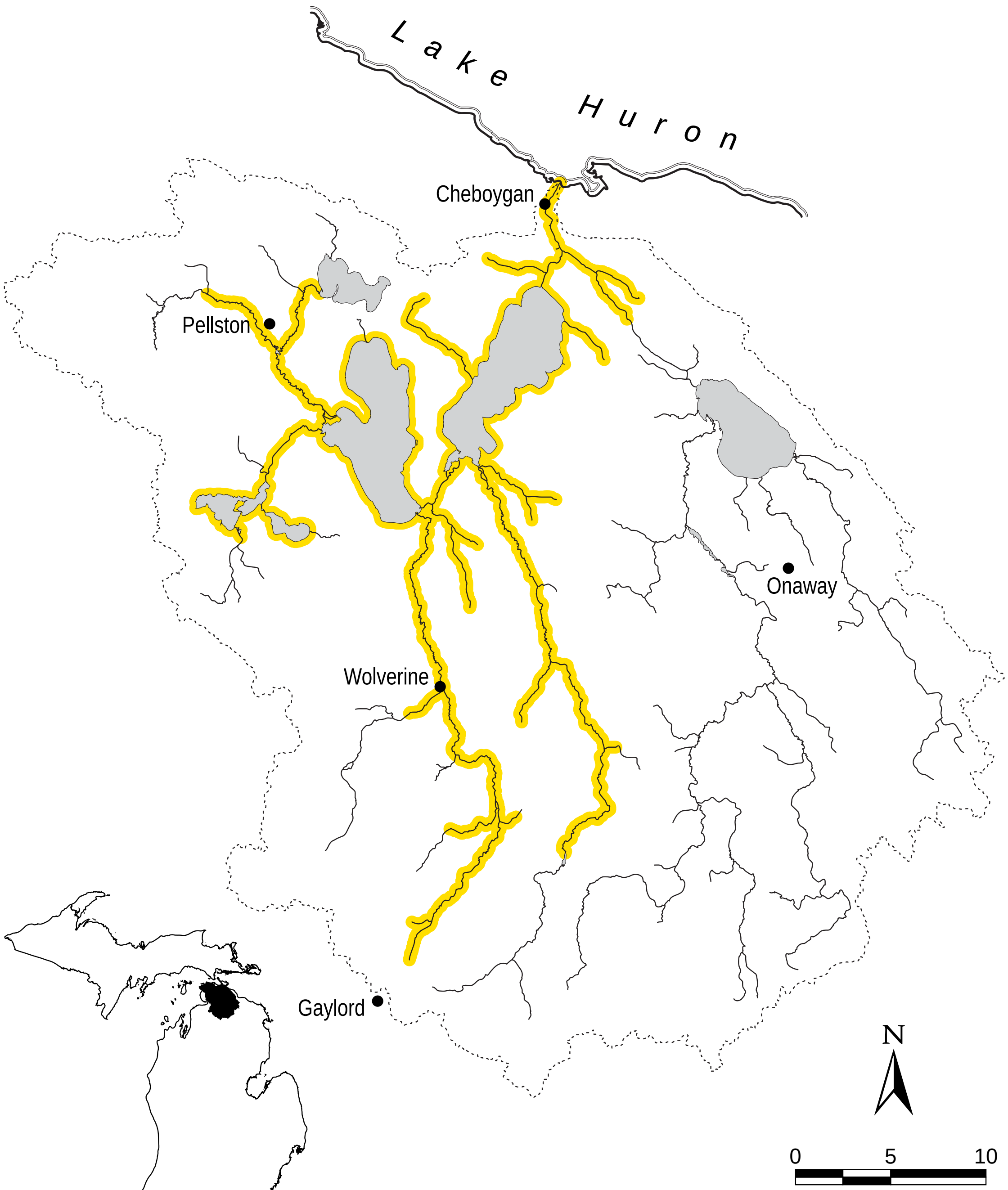
feeding	-	young: low gradient, substrate with bars and beds of mixed sand and organic debris
	-	clear cool stream water, sensitive to turbidity
spawning	-	clear, high gradient streams (>15 feet wide)
	-	cold water
	-	gravel substrate
winter refuge	-	sand or silt substrate for ammocoetes



Sea lamprey *Petromyzon marinus*

Habitat:

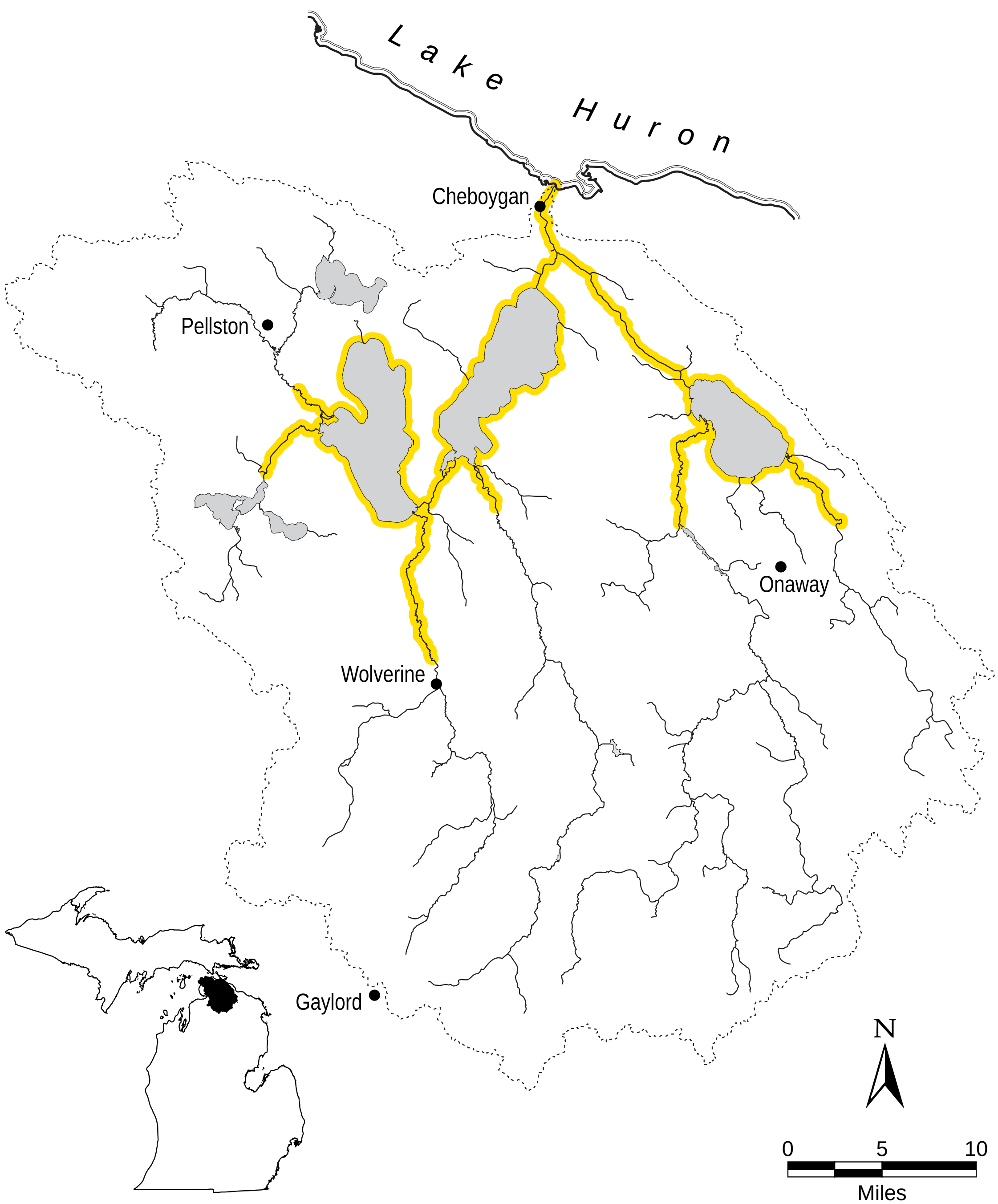
feeding	-	young: substrate with beds of sand mixed with organic debris
	-	cannot tolerate silt
	-	adults: clear cool water of Lake Huron
spawning	-	no dams
	-	riffles with sand and gravel substrates



Lake sturgeon *Acipenser fulvescens* - threatened

Habitat:

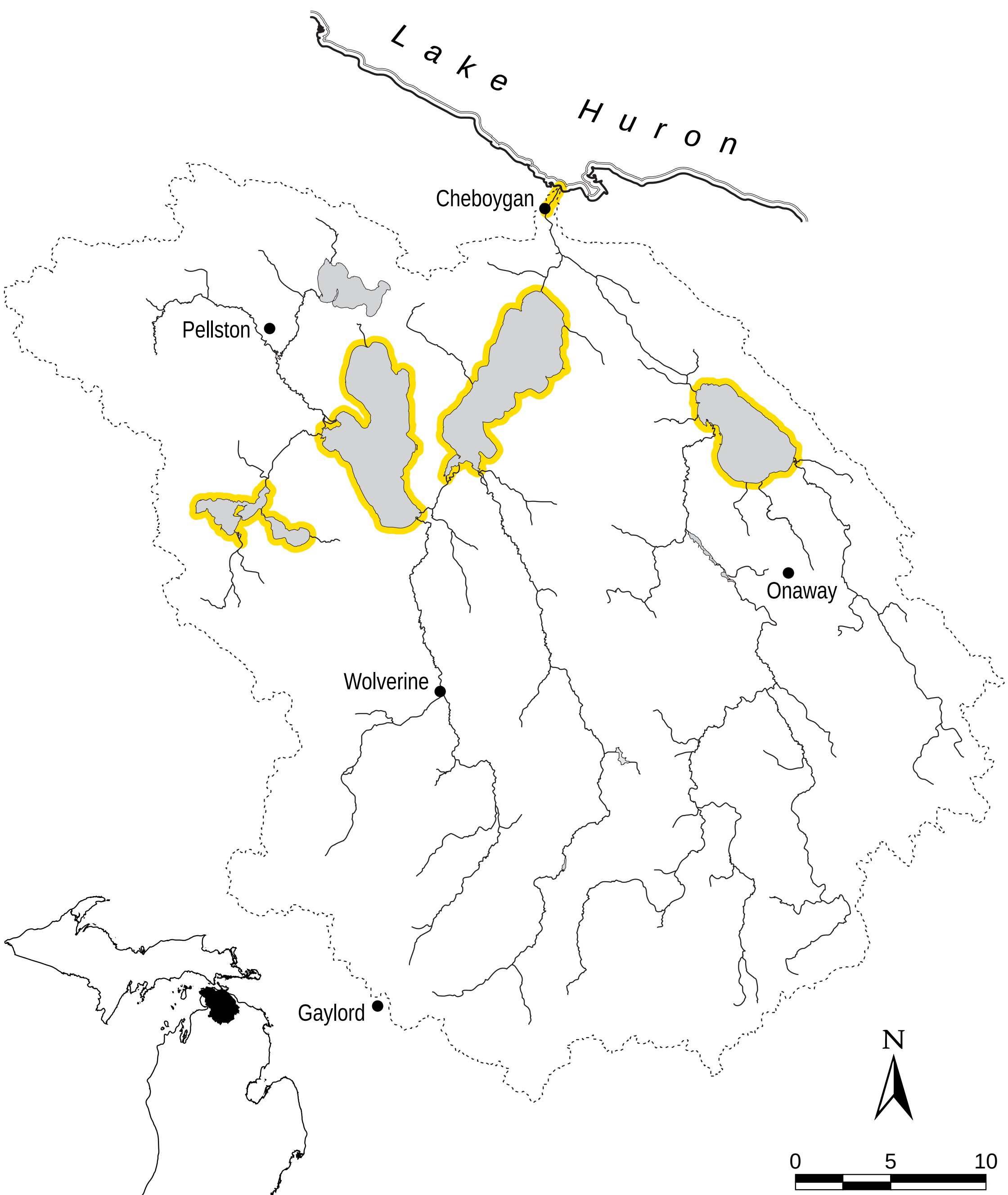
feeding	-	shoal areas of large rivers, lakes, and impoundments
	-	gravel, sand, rock substrates
spawning	-	in or before rapids, at the base of dams in rivers
	-	in 2-15 feet of water
	-	swift current
	-	rocky ledges or around rocky islands in Great Lakes



Longnose gar *Lepisosteus osseus*

Habitat**:**

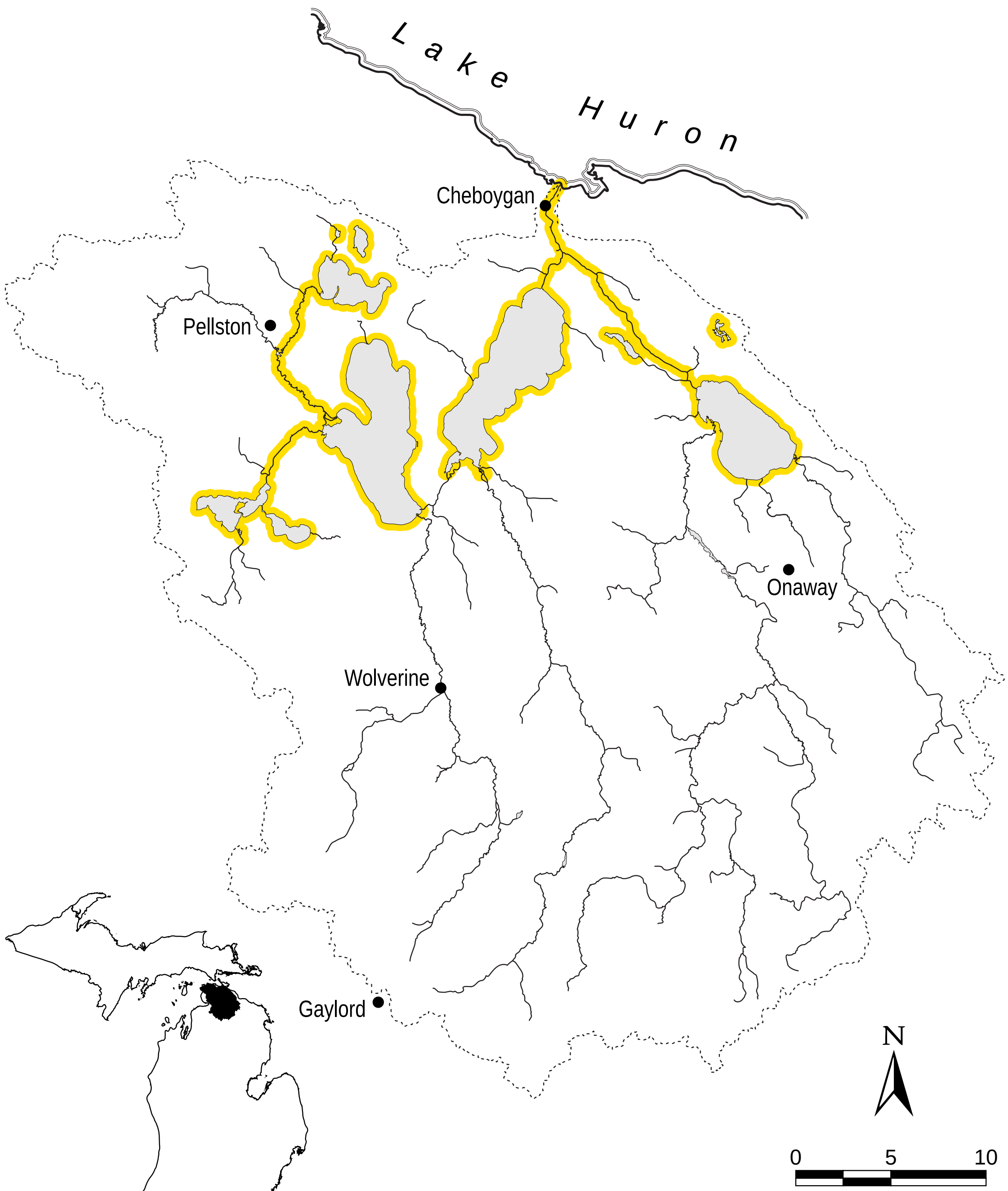
feeding	-	adults: in deeper water
	-	young: in shallows
	-	clear water, low-gradient streams, lakes, and impoundments
	-	will feed in moderate current
	-	aquatic vegetation preferred, but not necessary
	-	open water fish
spawning	-	warm shallow water of lakes or streams over vegetation



Bowfin *Amia calva*

Habitat:

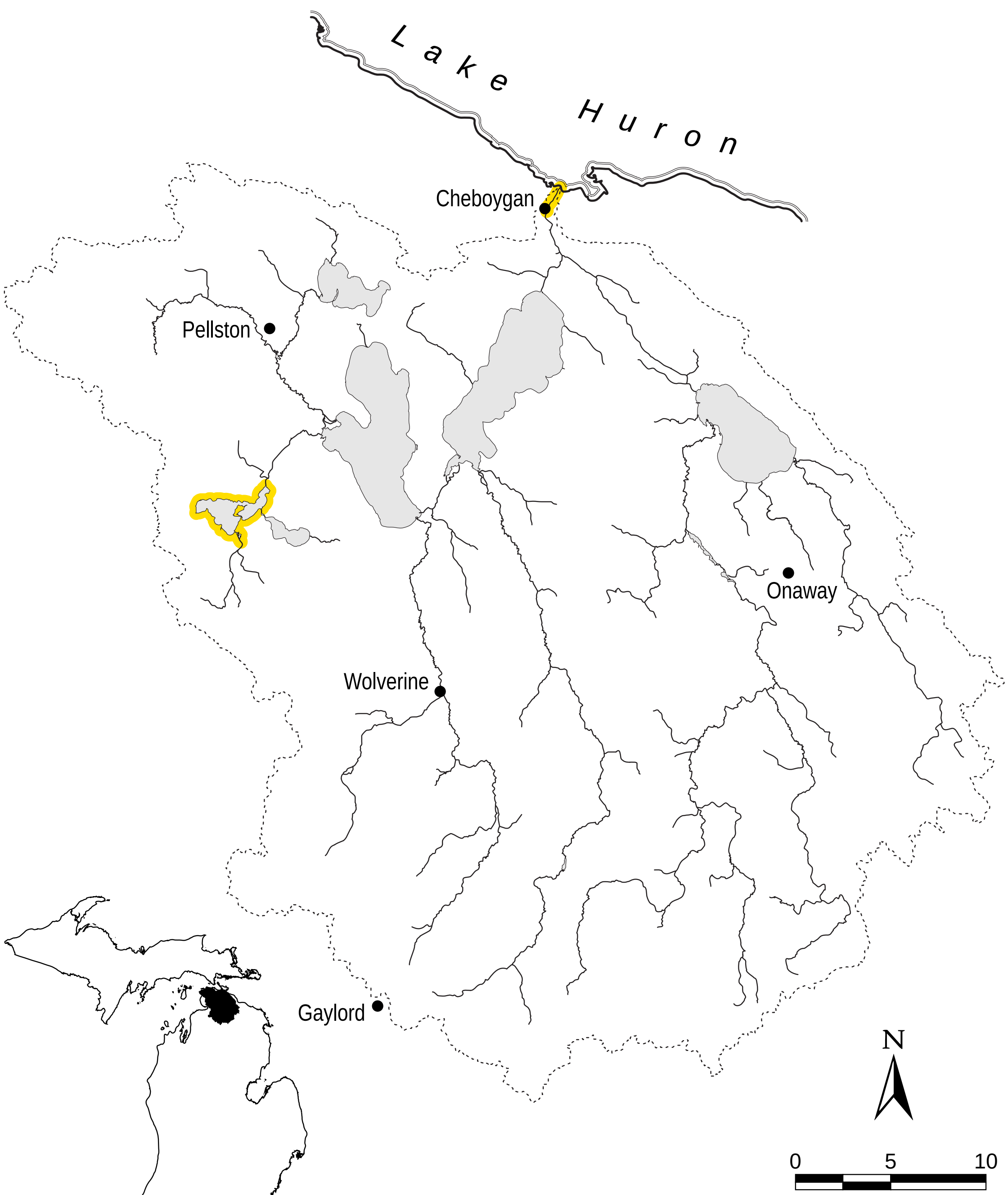
feeding	-	clear water
	-	abundant rooted aquatic vegetation
	-	low gradient streams, lakes, and impoundments
	-	tolerate only small amount of silt
spawning	-	need vegetated water, 1 to 2 feet deep
	-	can spawn under logs, stumps, or bushes
winter refuge	-	gravelly pockets among aquatic vegetation



Alewife *Alosa pseudoharengus*

Habitat:

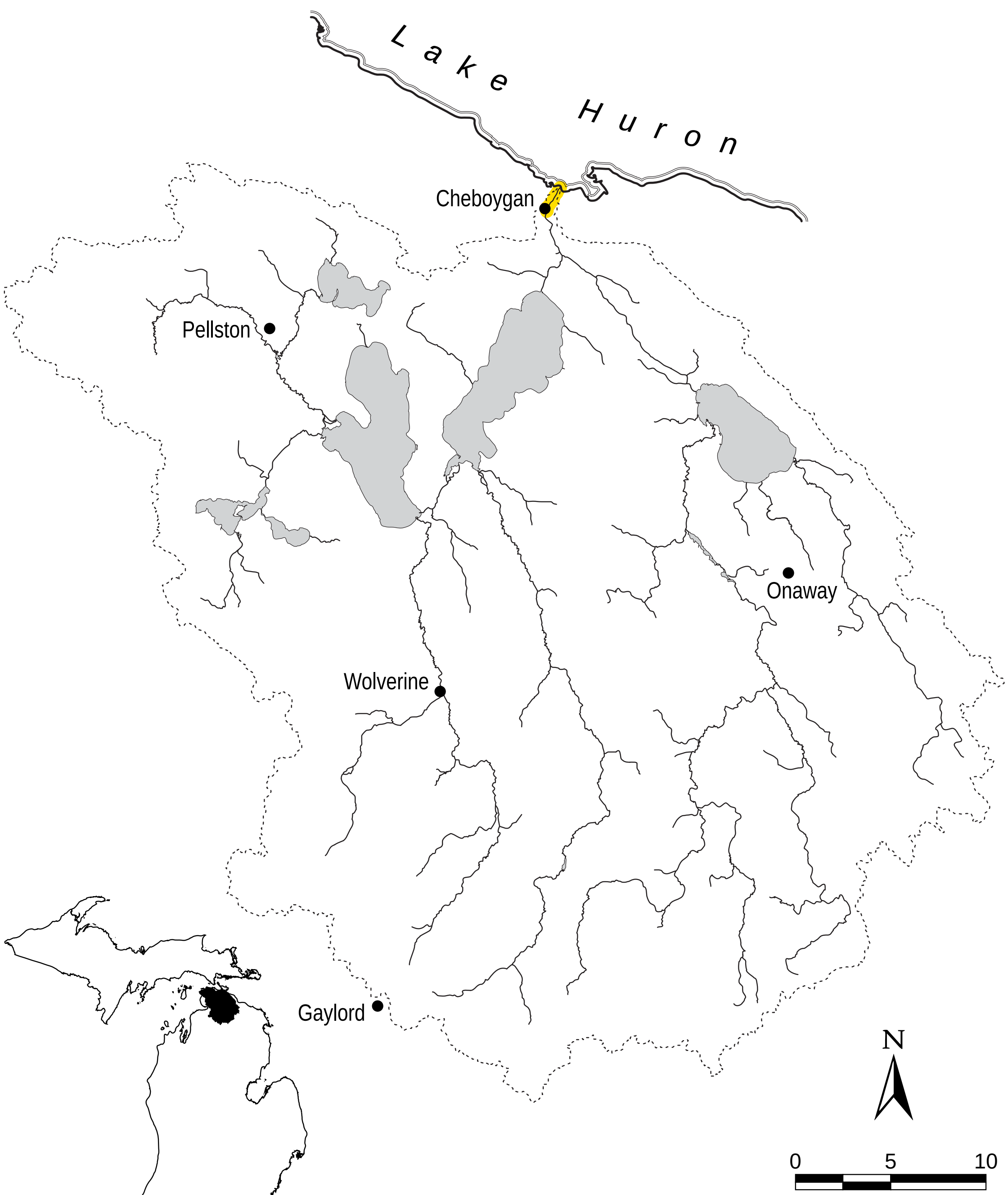
feeding	- adults: deep water of Lake Huron
	- young: shallow water of Lake Huron
	- prefers warmer waters
spawning	- streams or shallow beaches of lake
	- sand or gravelly substrate
winter refuge	- deep water



Spotfin shiner *Cyprinella spiloptera*

Habitat**:**

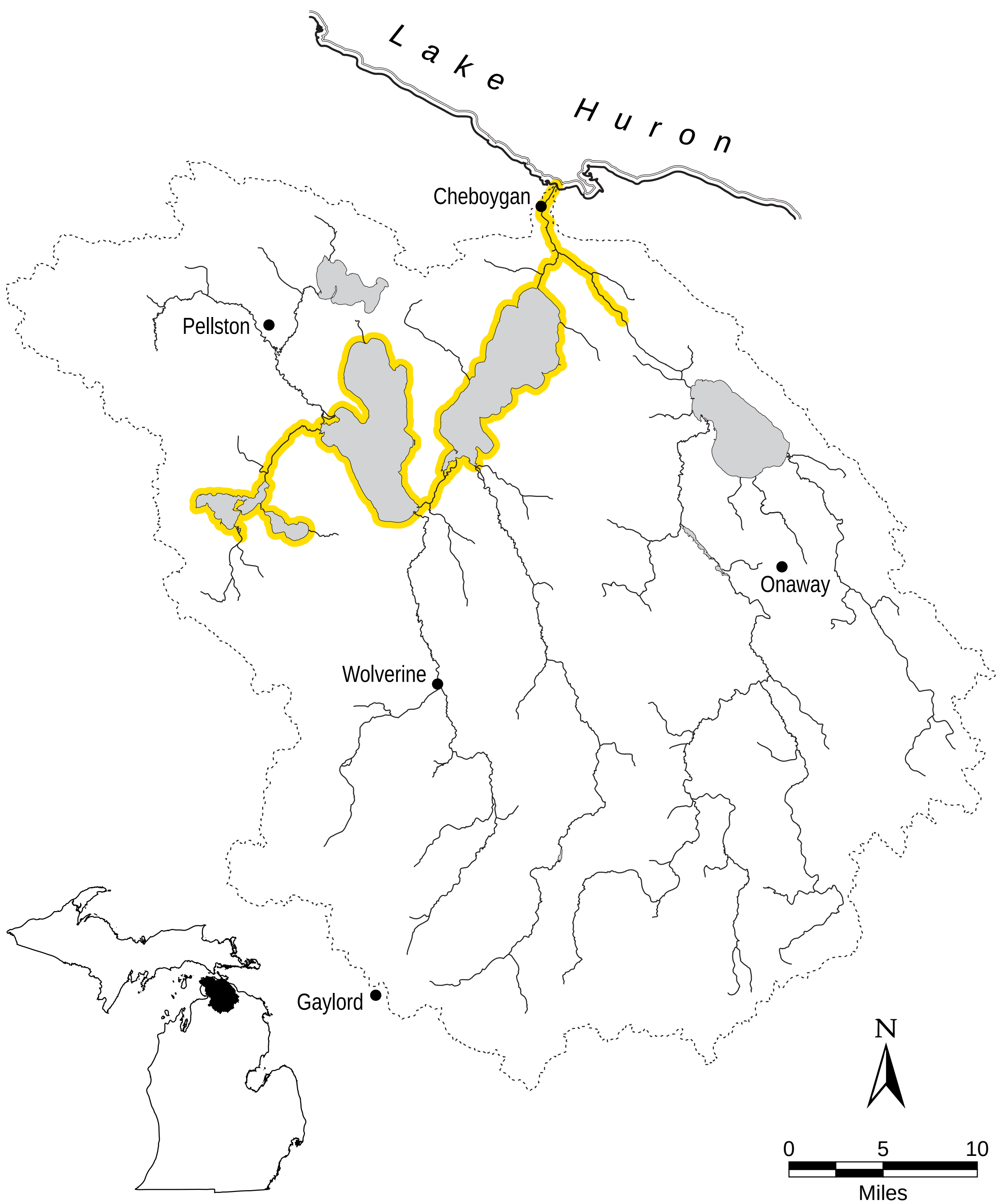
feeding	-	clear water tolerant of turbidity and siltation
	-	some current
	-	shallow depths
	-	medium sized streams, lakes, and impoundments
	-	clear sand or gravel substrate
spawning	-	swift current
	-	crevice spawner or on underside of submerged logs and roots



Common carp *Cyprinus carpio*

Habitat**:**

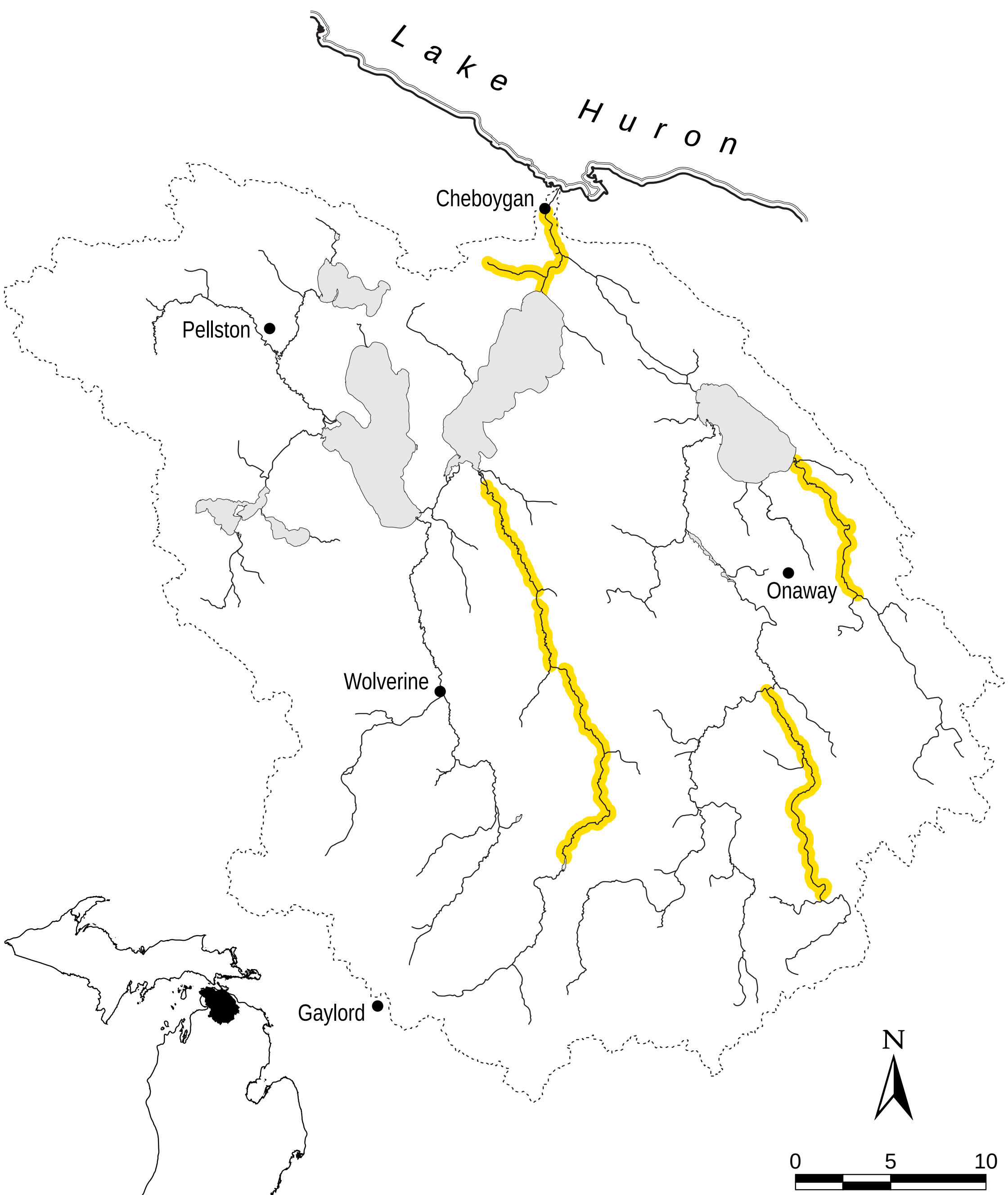
feeding	-	low gradient fertile streams, rivers, lakes, and impoundments
	-	abundance of aquatic vegetation or organic matter
	-	tolerant of all substrates and clear to turbid water
spawning	-	weedy or grassy shallows



Brassy minnow *Hybognathus hankinsoni*

Habitat:

feeding - cool acidic streams
- slow to moderate current
- sand or gravel substrate

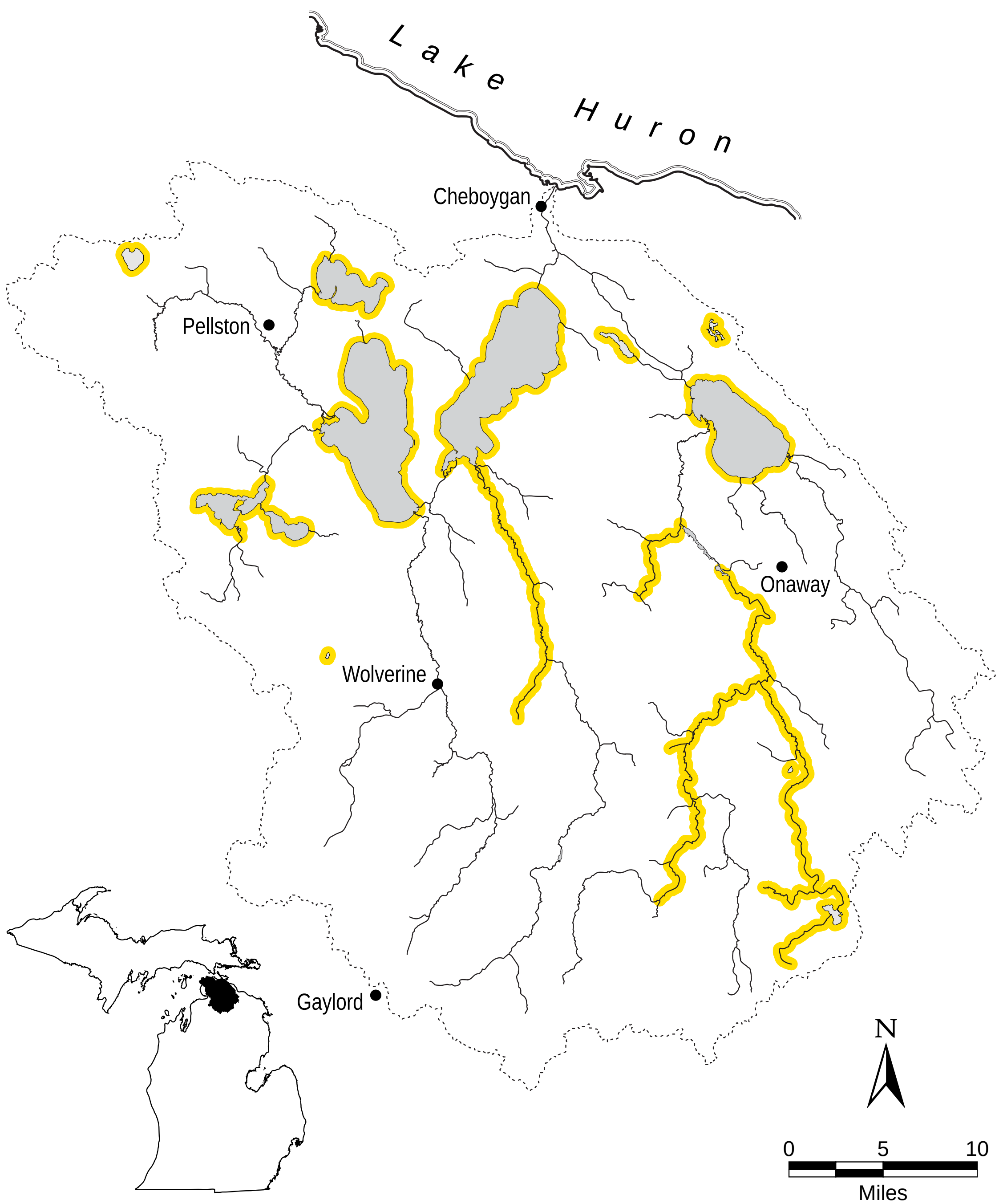


Common shiner *Luxilus cornutus*

Habitat**:**

feeding - small, clear, high-gradient streams and rivers, or shores of clear water lakes and impoundments
- gravel substrate
- can tolerate some submerged aquatic vegetation
- not very tolerant of turbidity or silted waters

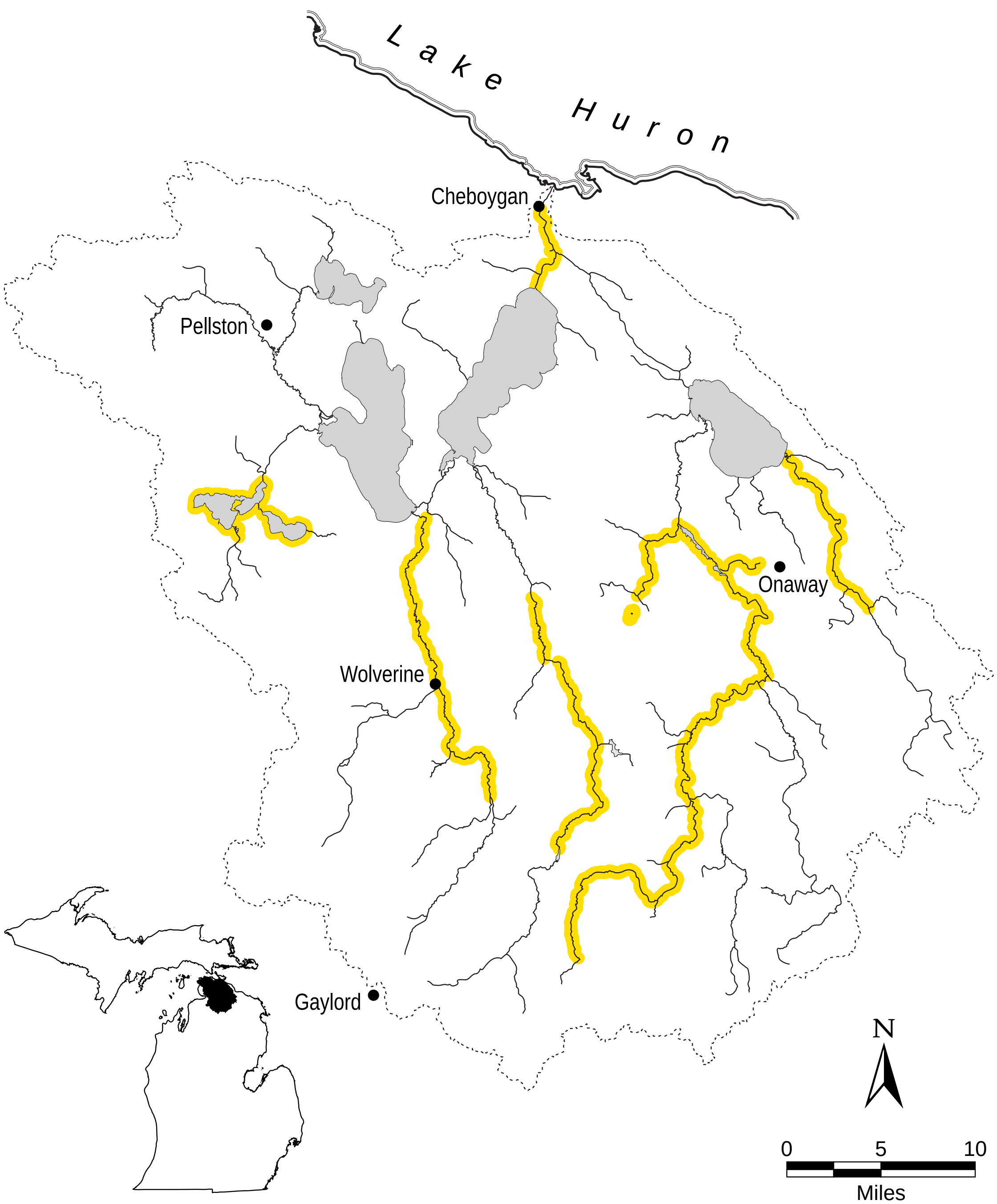
spawning - gravel nests of other fish, especially those at the head of a riffle



Northern pearl dace *Margariscus nachtriebi*

Habitat:

feeding	-	cool, neutral to acidic streams and lakes
	-	clear to slightly turbid water
spawning	-	males are territorial
	-	clear water, 18-24 inches deep
	-	sand or gravel substrate
	-	weak to moderate current

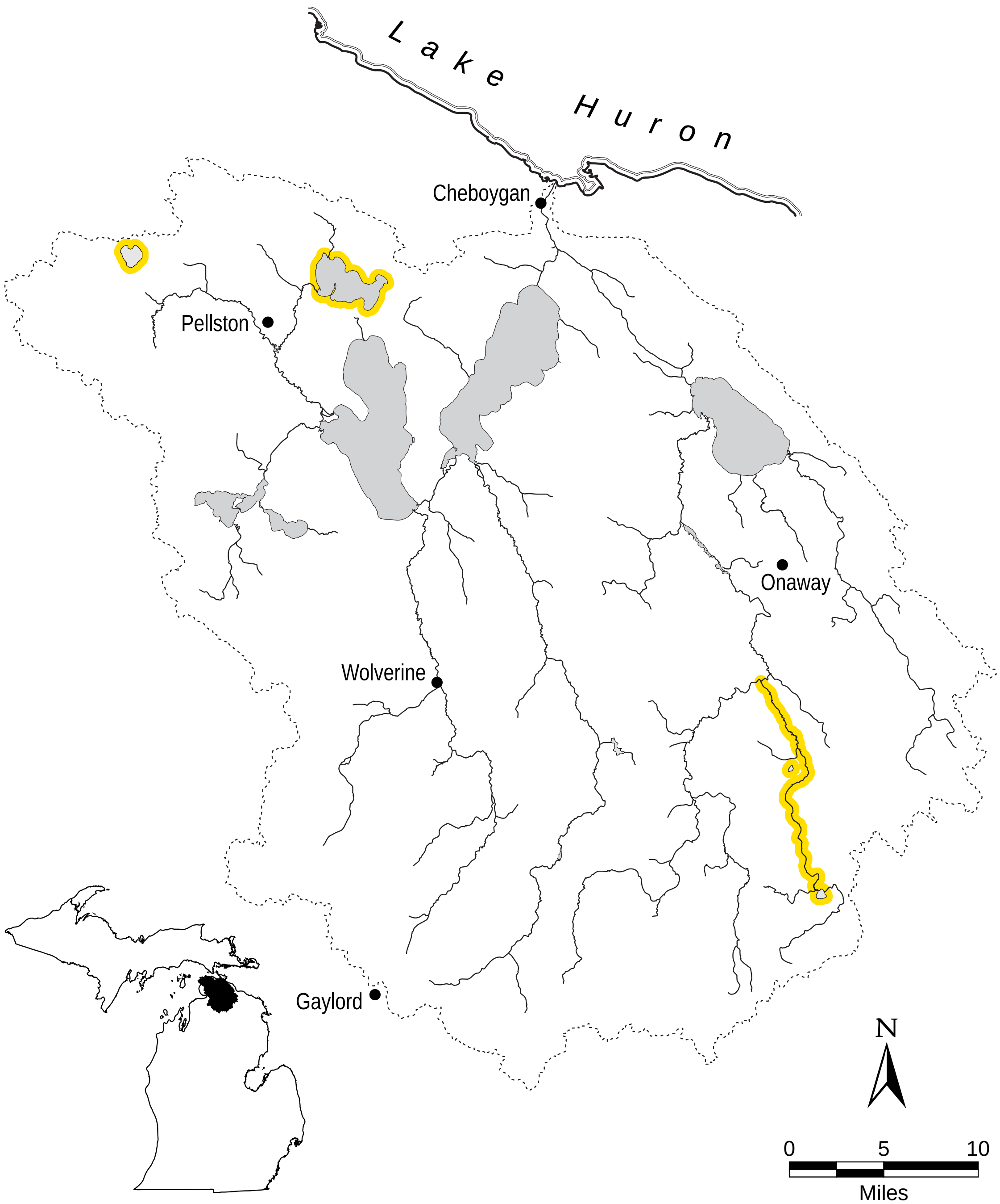


Hornyhead chub *Nocomis biguttatus*

Habitat:

feeding
- adults: near riffles
- young: near vegetation
- clear water, does not tolerate turbidity
- gravel substrate
- low gradient streams that are tributaries to large streams

spawning
- large stones and pebbles present
- often below a riffle in shallow water
- gravel substrate

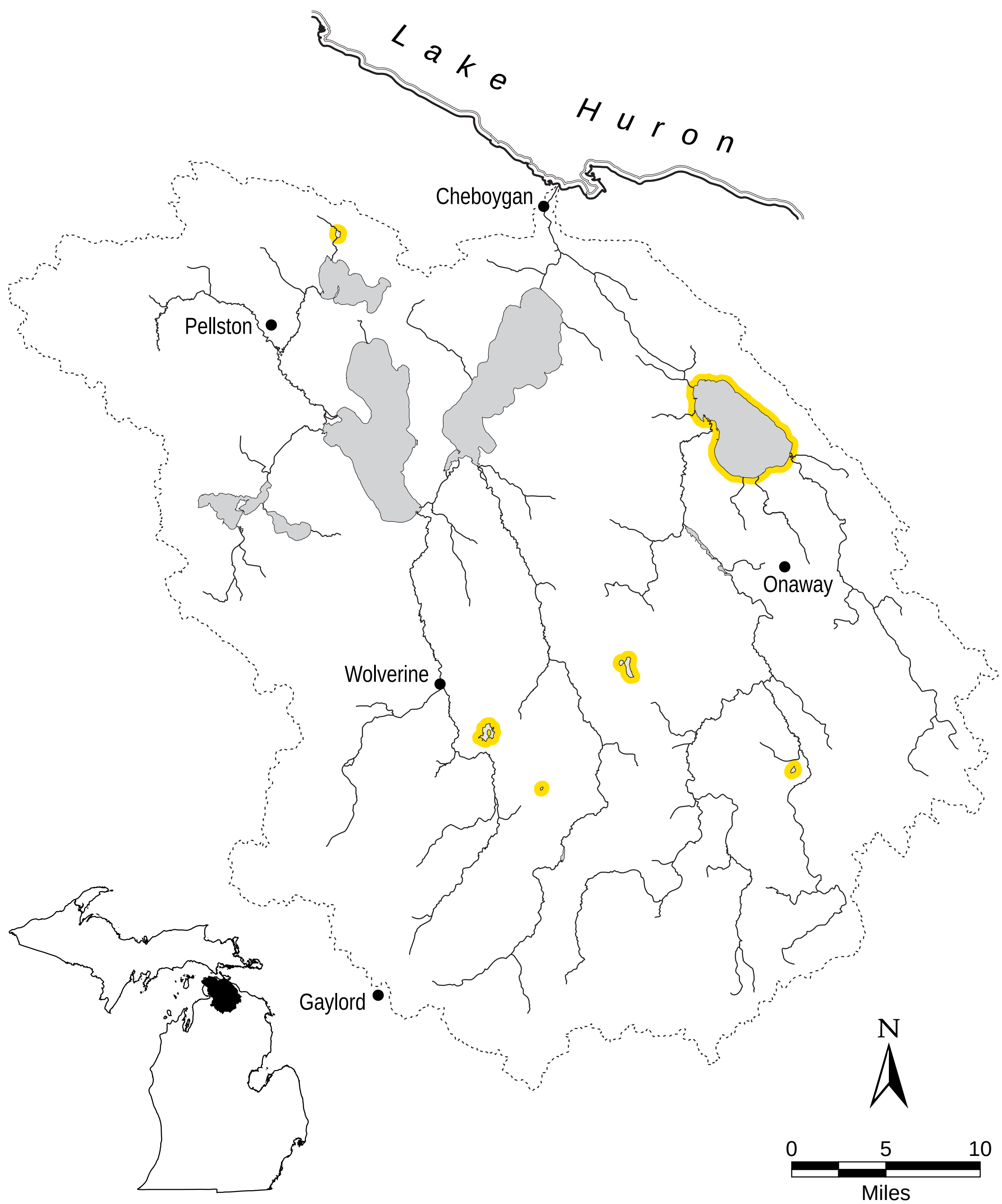


Golden shiner *Notemigonus crysoleucas*

Habitat**:**

feeding - lakes and impoundments and quiet pools of low gradient streams
- clear shallow water
- heavy vegetation

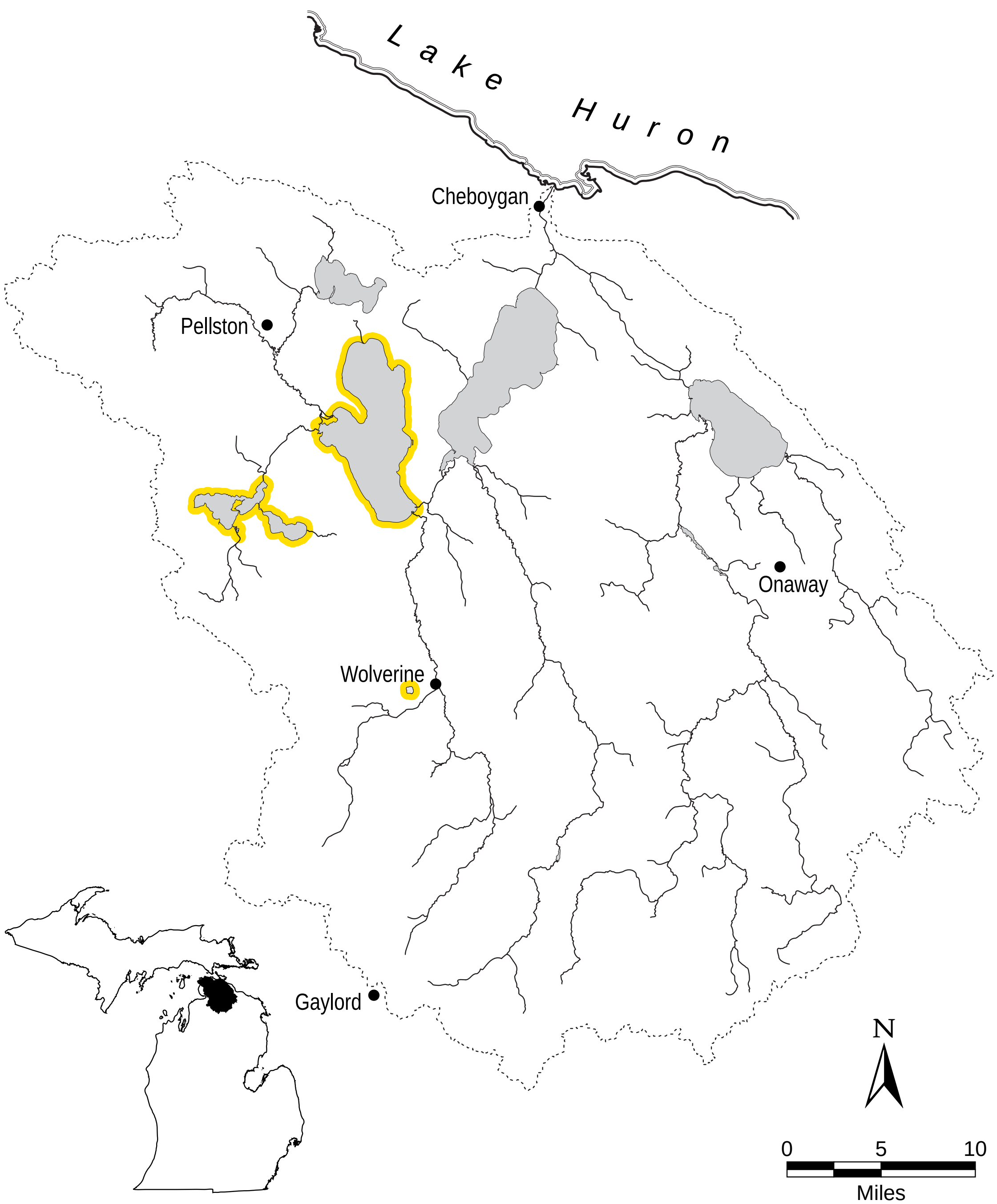
spawning - vegetation



Emerald shiner *Notropis atherinoides*

Habitat:

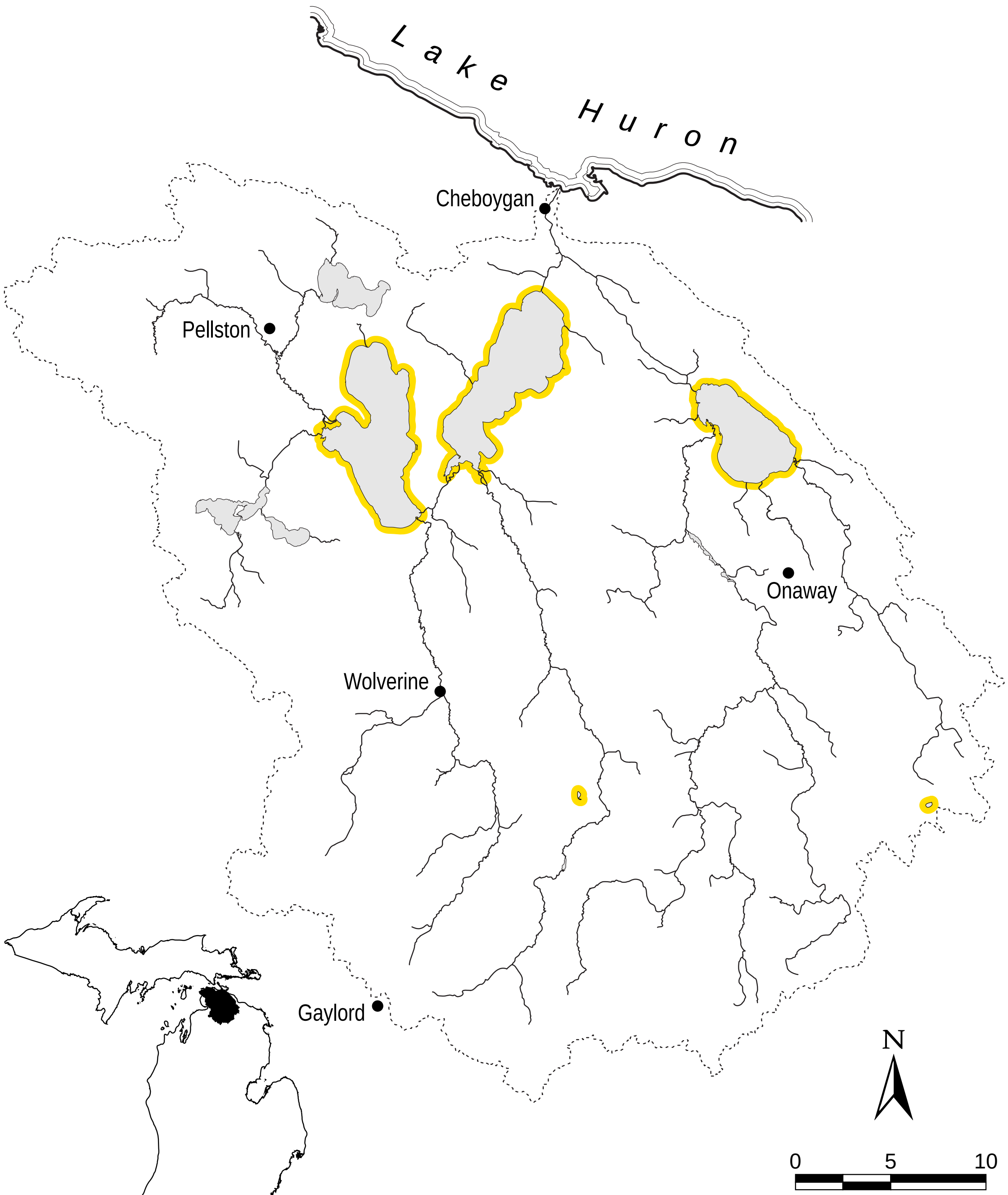
feeding	-	open-large stream channels and lake
	-	low to moderate gradient
	-	range of turbidities and bottom types
	-	midwater or surface preferred, substrate of little importance
	-	avoids rooted vegetation
spawning	-	sand or firm mud substrate or gravel shoals



Blackchin shiner *Notropis heterodon*

Habitat**:**

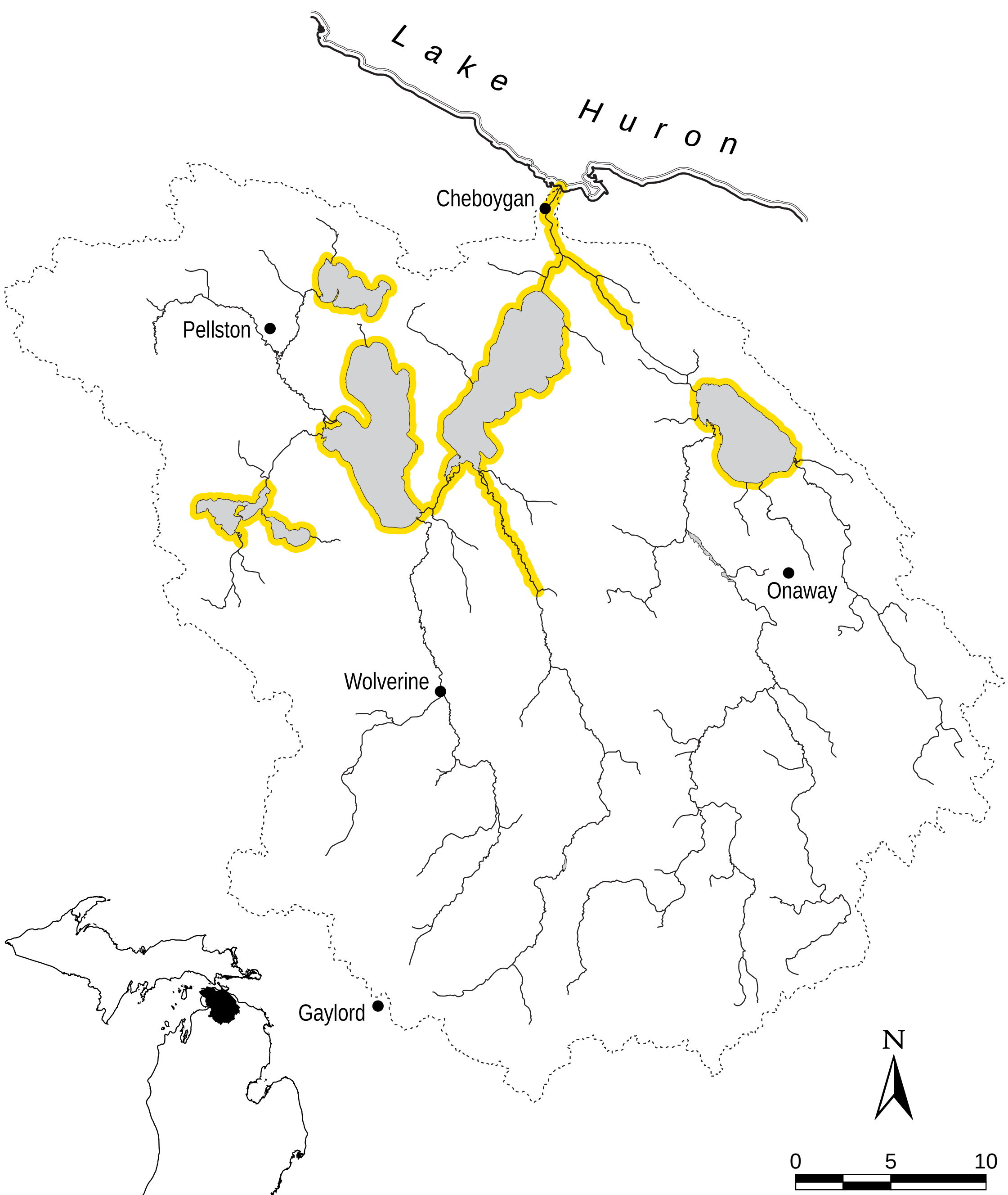
feeding
- lakes, impoundments, and quiet pools in streams and rivers
- clear water
- clean sand, gravel, or organic debris substrate
- dense beds of submerged aquatic vegetation
- cannot tolerate turbidity, silt, or loss of aquatic vegetation



Spottail shiner *Notropis hudsonius*

Habitat**:**

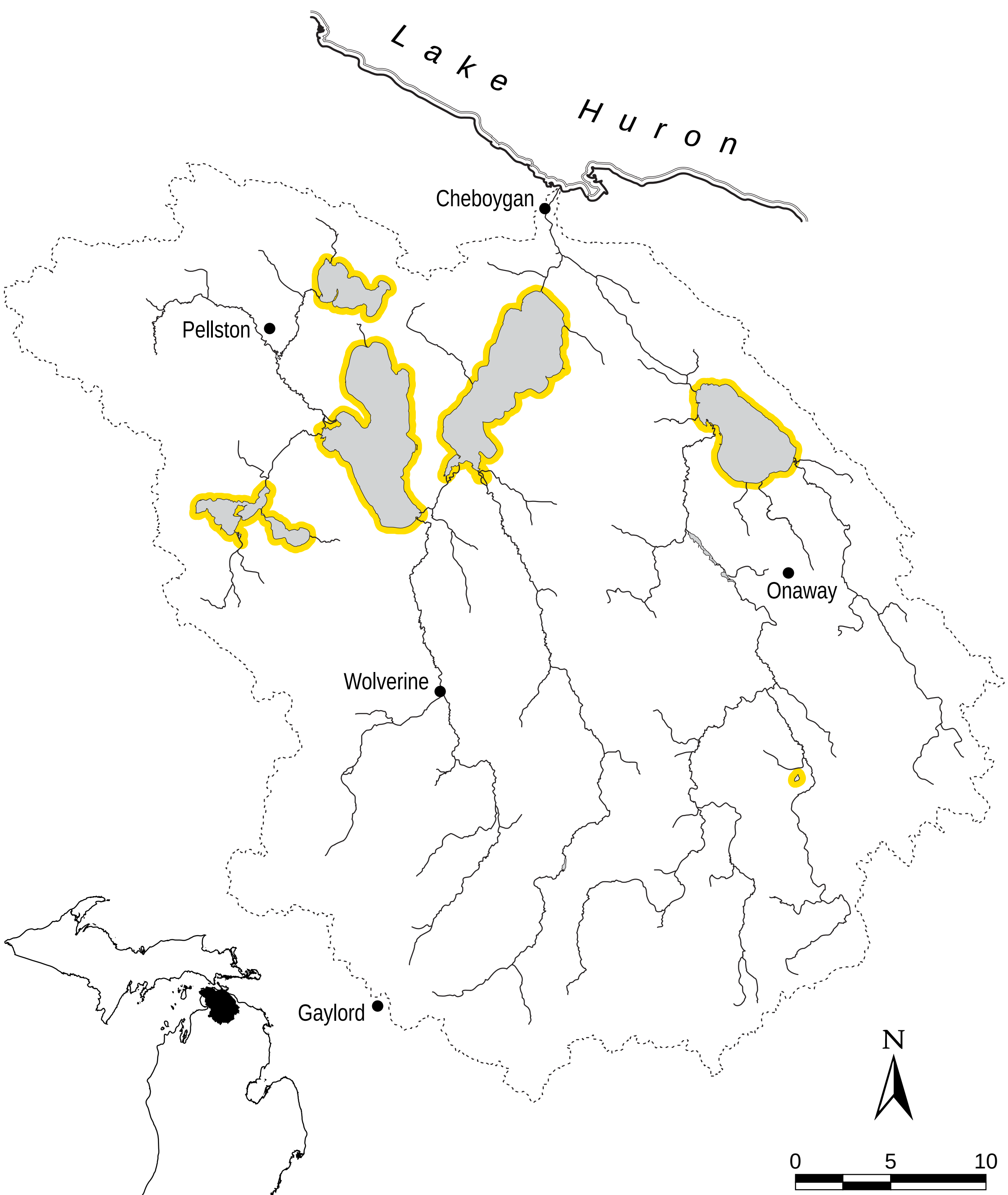
feeding	-	large rivers, lakes, and impoundments
	-	firm sand and gravel substrate
	-	low current
	-	sparse to moderate vegetation
	-	avoids turbidity
spawning	-	over sandy shoals or gravelly riffles
	-	near the mouths of small streams



Sand shiner *Notropis stramineus*

Habitat**:**

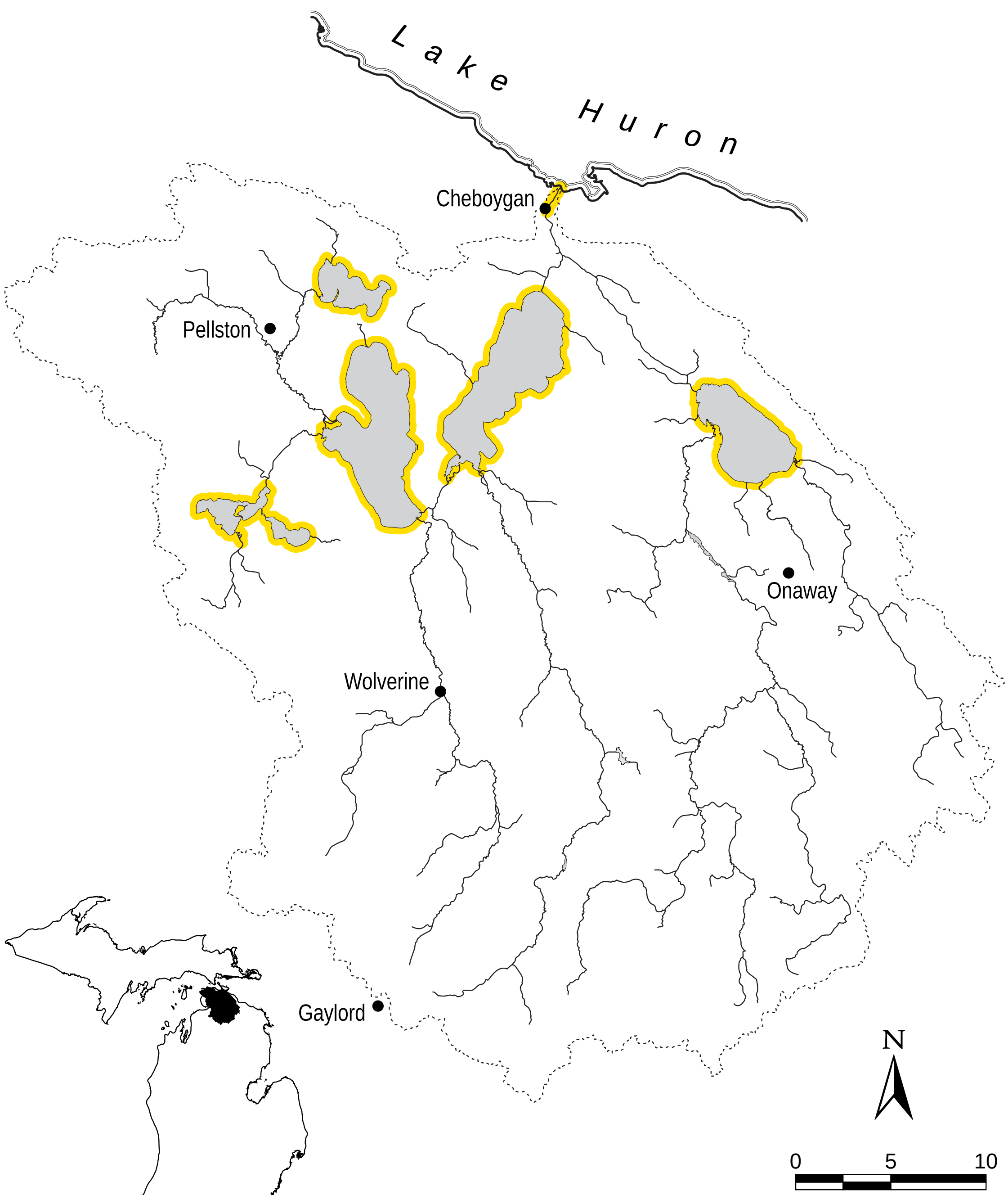
feeding	- sand and gravel substrate
	- shallow pools in medium size streams, lakes, and impoundments
	- clear water and low gradient
	- rooted aquatic vegetation preferred
	- tolerant of some inorganic pollutants provided substrate is not covered
spawning	- clean gravel or sand substrate



Mimic shiner *Notropis volucellus*

Habitat**:**

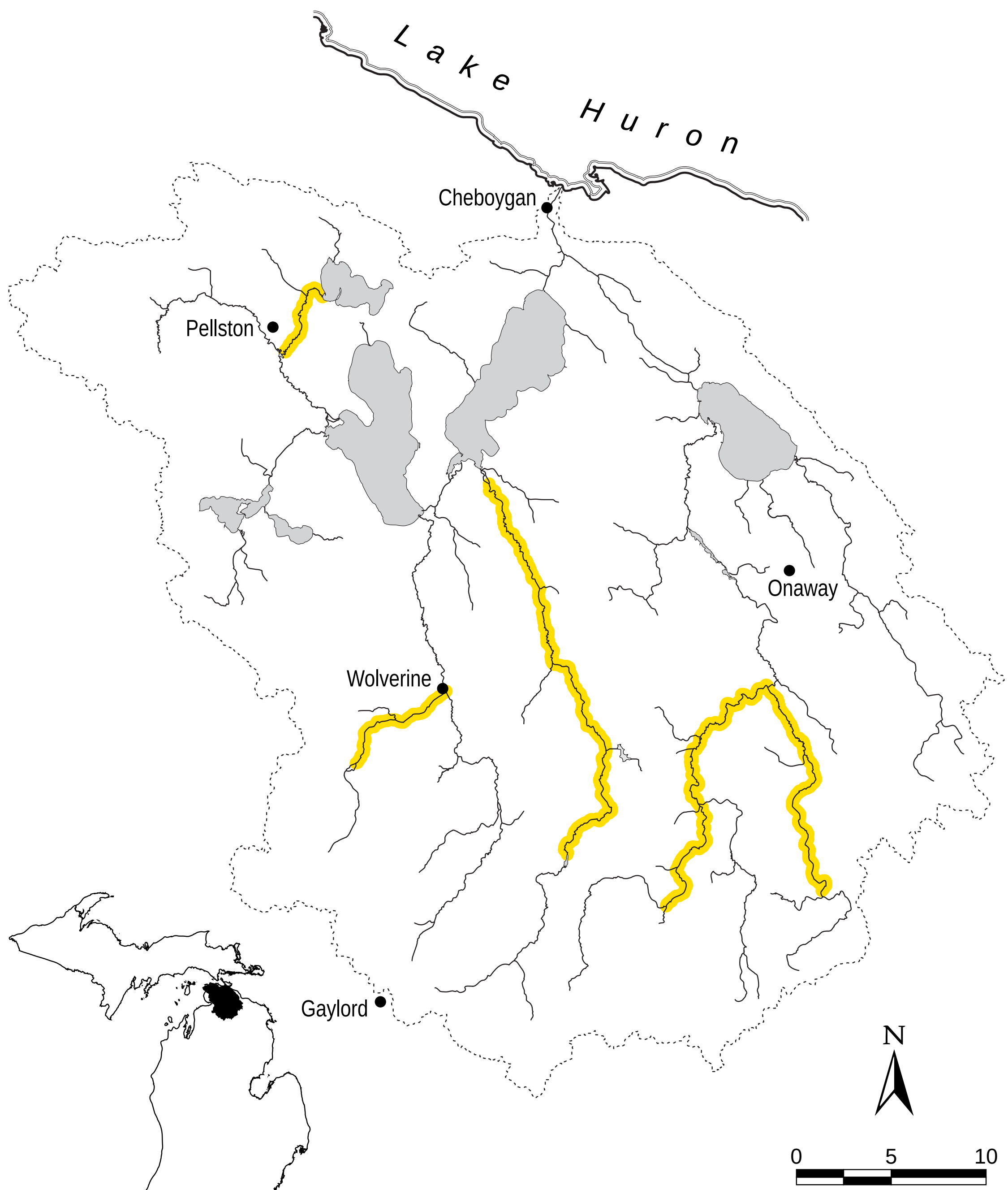
feeding	-	pools and backwater of streams, moderately weedy lakes and impoundments
	-	quiet or still water
	-	clear shallow water
spawning	-	aquatic vegetation necessary



Northern redbelly dace *Phoxinus eos*

Habitat**:**

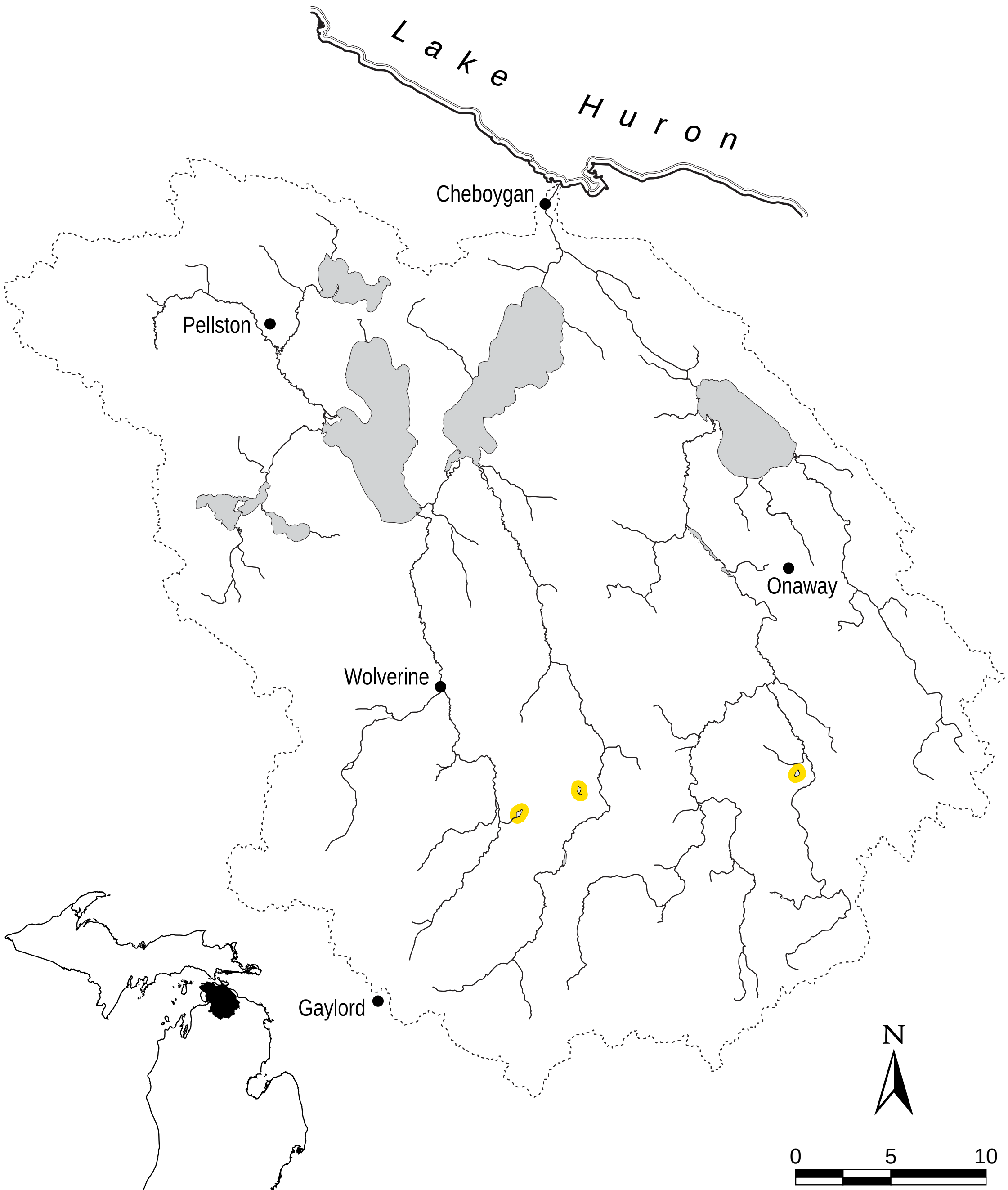
feeding	-	slow current
	-	in boggy lakes and streams
	-	detritus or silt substrate
	-	clear to slightly turbid water
spawning	-	filamentous algae needed for egg deposition



Finescale dace *Phoxinus neogaeus*

Habitat:

feeding - cool bog lakes and streams
- neutral to slightly acidic waters
- various substrates

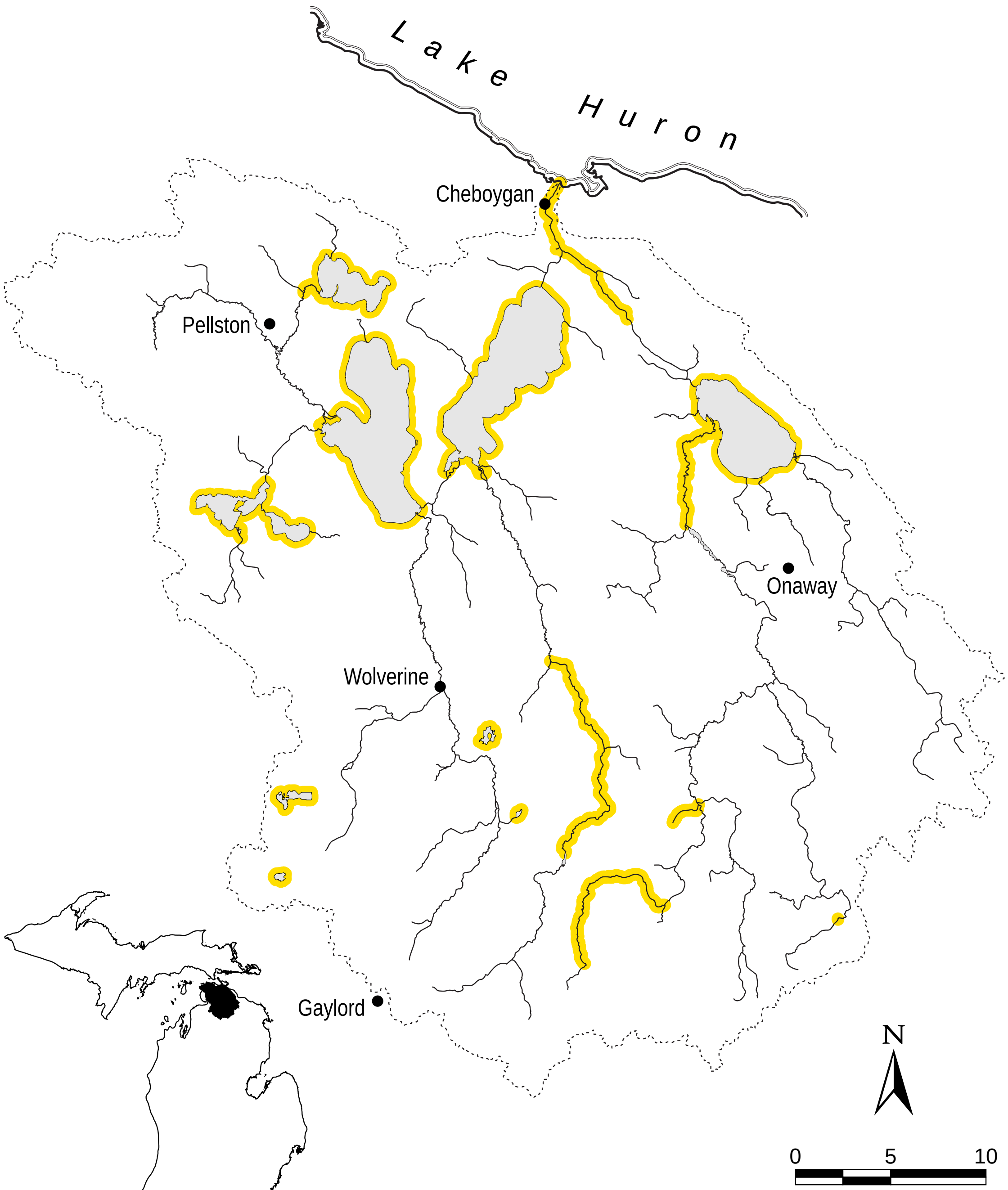


Bluntnose minnow *Pimephales notatus*

Habitat**:**

feeding - quiet pools and backwaters of medium to large streams, lakes, and impoundments
- clear warm water
- some aquatic vegetation
- firm substrates
- tolerates all gradients, turbidity, organic and inorganic pollutants

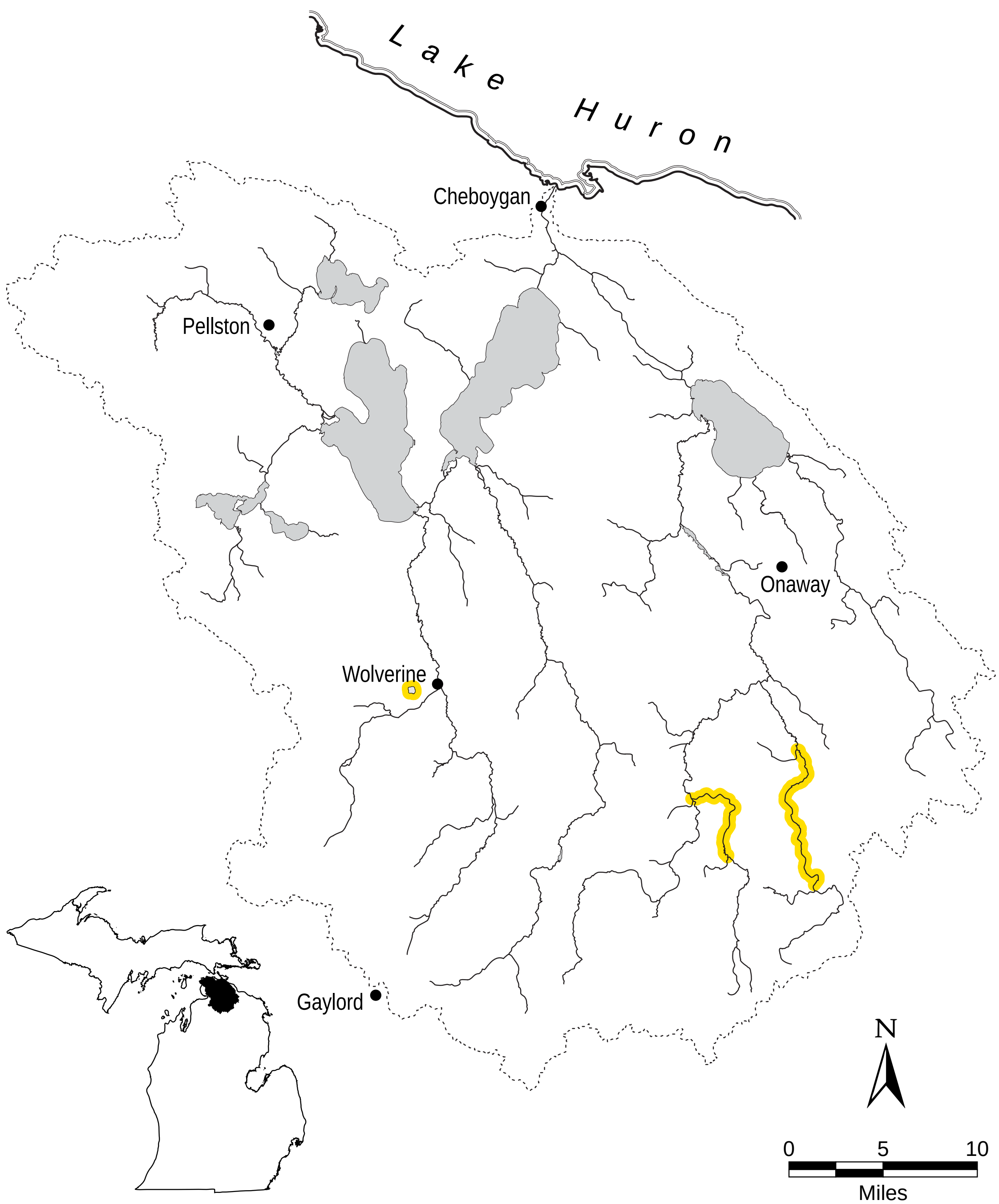
spawning - eggs deposited on the underside of flat stones or objects
- nests in sand or gravel substrate



Fathead minnow *Pimephales promelas*

Habitat**:**

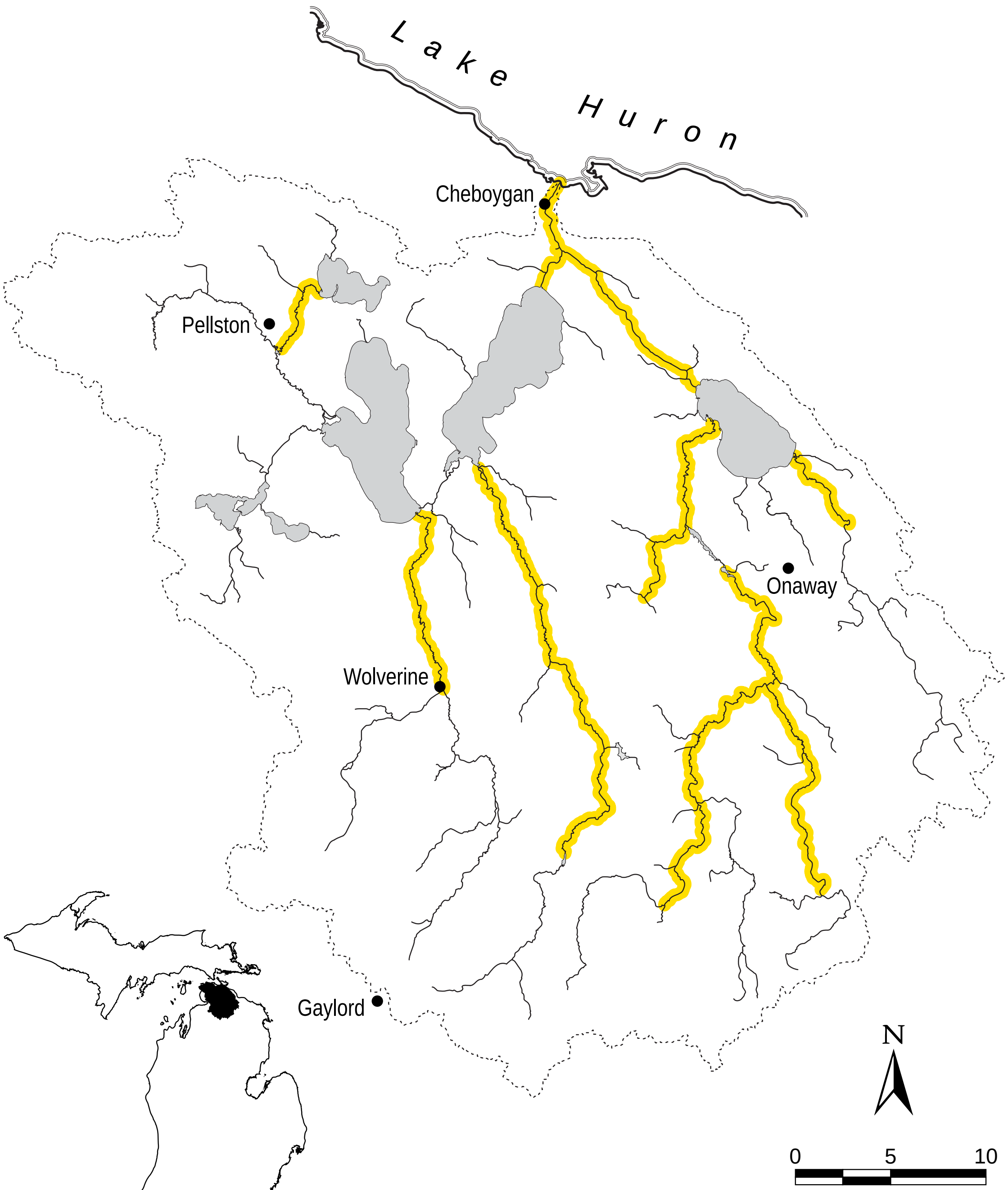
feeding	-	pools of small streams, lakes, and impoundments
	-	tolerant of turbidity, high temperatures, and low oxygen
spawning	-	on underside of objects in water 2 to 3 feet deep
	-	prefer sand, marl, or gravel substrate



Longnose dace *Rhinichthys cataractae*

Habitat**:**

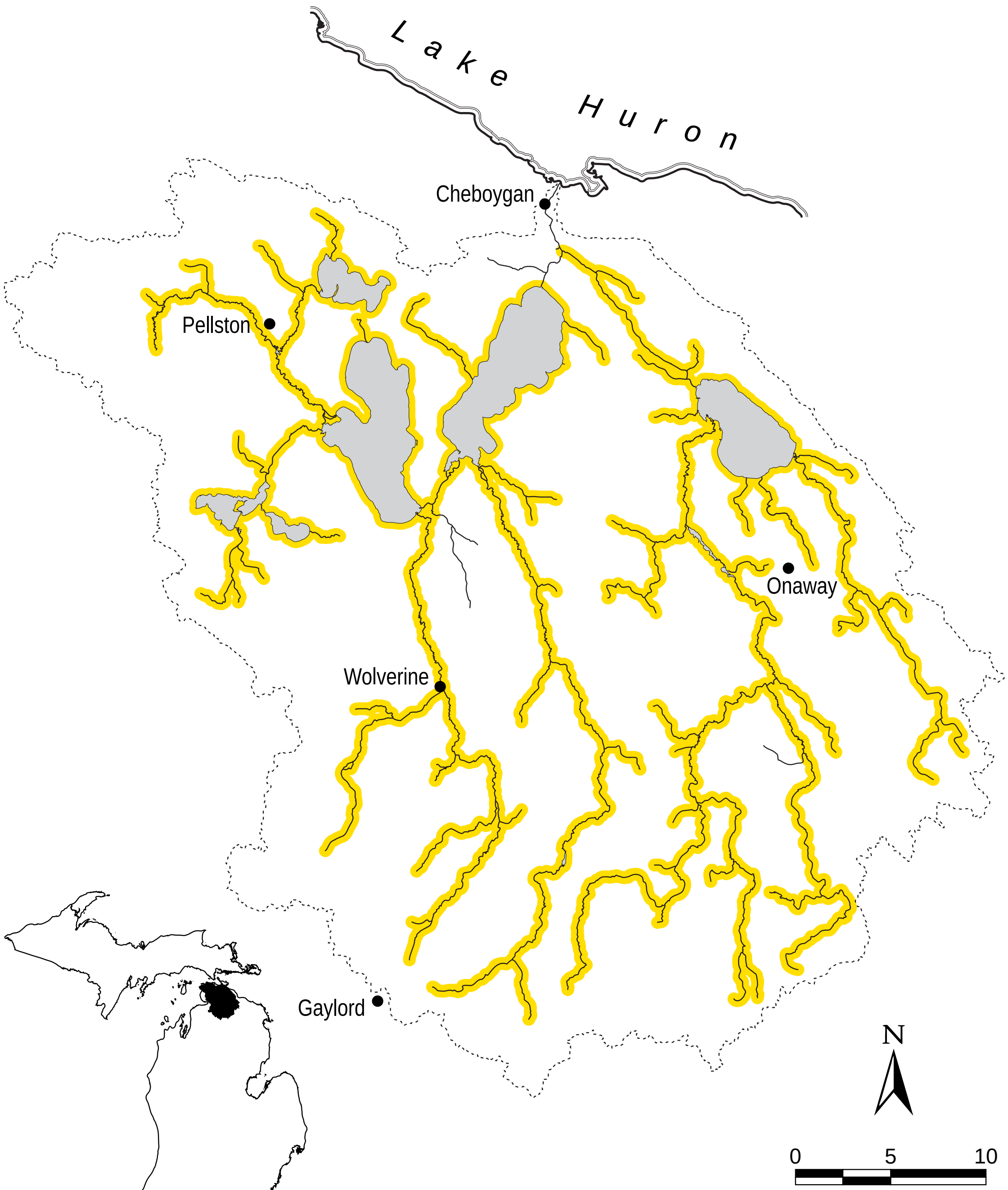
feeding	-	lakes and streams
	-	high gradient
	-	gravel or boulder substrate



Western blacknose dace *Rhinichthys obtusus*

Habitat:

feeding	-	moderate to high gradient streams
	-	sand and gravel substrate
	-	clear cool water in pools with deep holes and undercut banks
	-	does not tolerate turbidity and silt well
spawning	-	riffles with gravel substrate and fast current
winter refuge	-	larger waters



Creek chub *Semotilus atromaculatus*

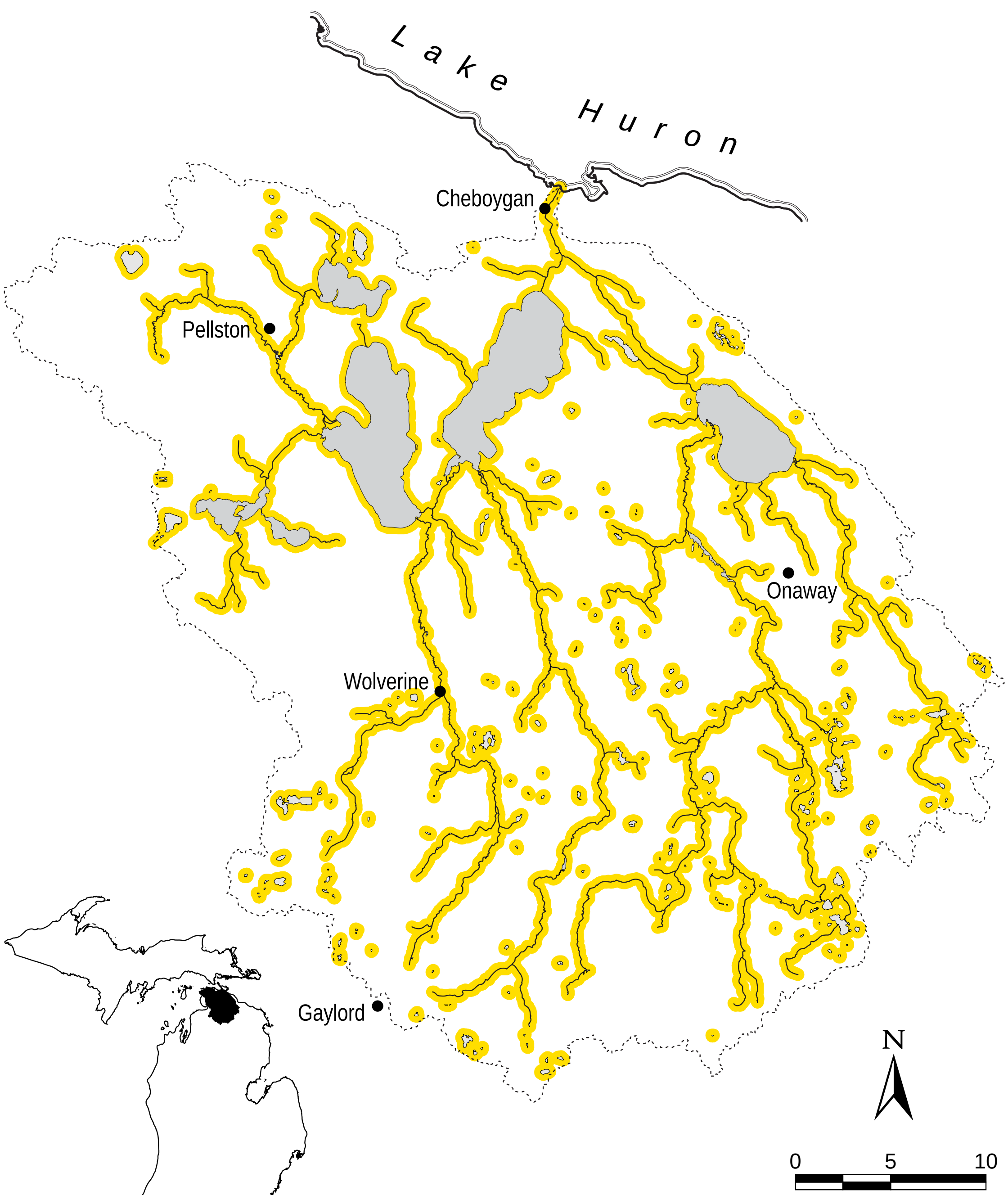
Habitat**:**

feeding	-	streams, rivers, or shore waters of lakes and impoundments
	-	can tolerate intermittent flows
	-	tolerates moderate turbidity
spawning	-	gravel nests
	-	low current
winter refuge	-	deeper pools and runs

White sucker *Catostomus commersonii*

Habitat:

feeding	-	streams, rivers, lakes, and impoundments
	-	can inhabit highly turbid and polluted waters
spawning	-	quiet gravelly shallow areas of streams



Silver redhorse *Moxostoma anisurum*

Habitat:

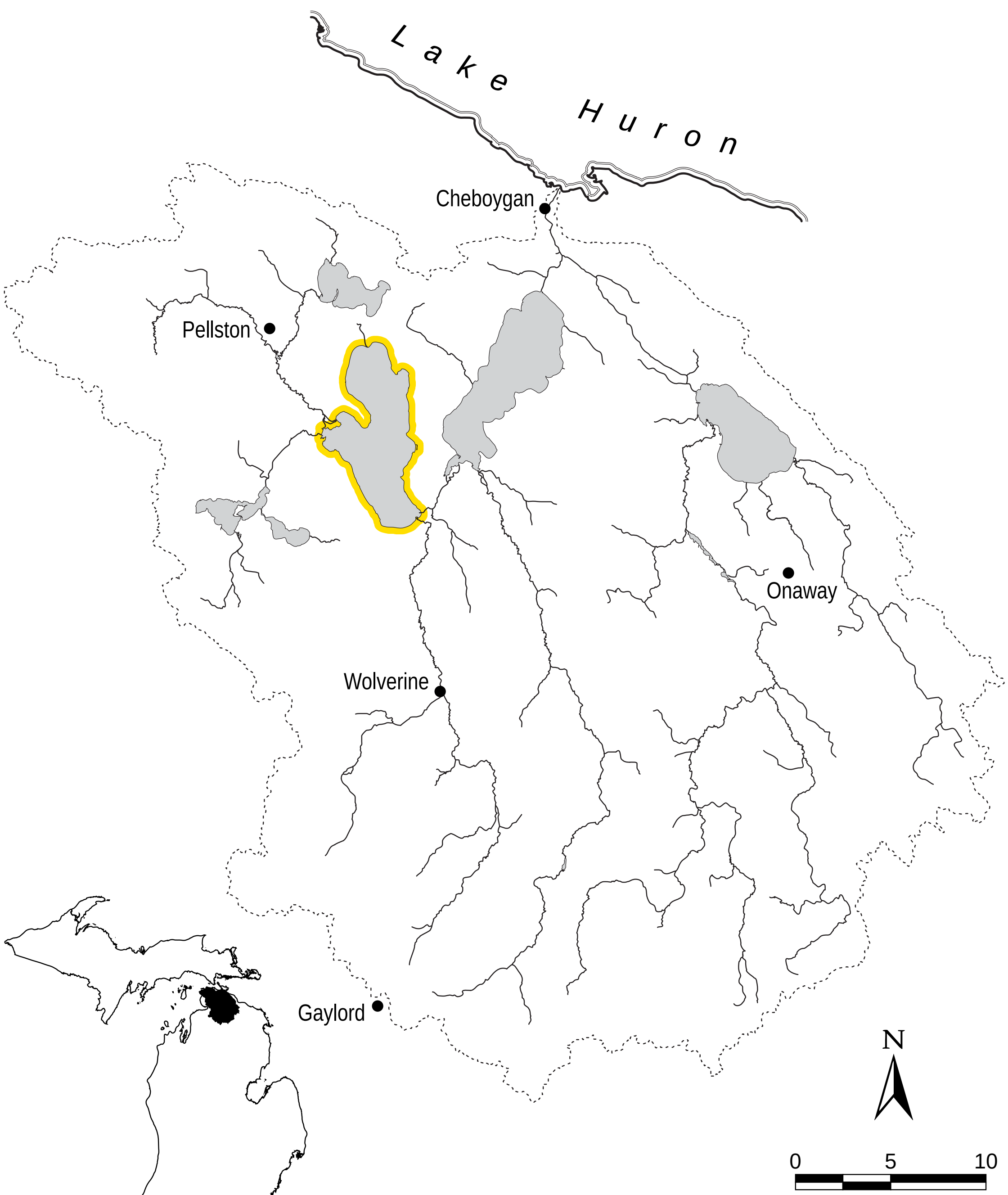
feeding - streams, rivers, lakes, and impoundments
- low current
- pollution and turbidity intolerant

spawning - swift current in rivers, do not spawn in tributaries
- males territorial
- gravel to rubble substrate

Golden redhorse *Moxostoma erythrurum*

Habitat**:**

feeding	-	warm medium gradient streams and rivers
	-	lakes and impoundments
	-	clear riffly streams
	-	medium size streams and rivers
	-	tolerates some turbidity and silt
spawning	-	shallow gravelly riffles
winter refuge	-	larger streams



Greater redhorse *Moxostoma valenciennesi*

Habitat**:**

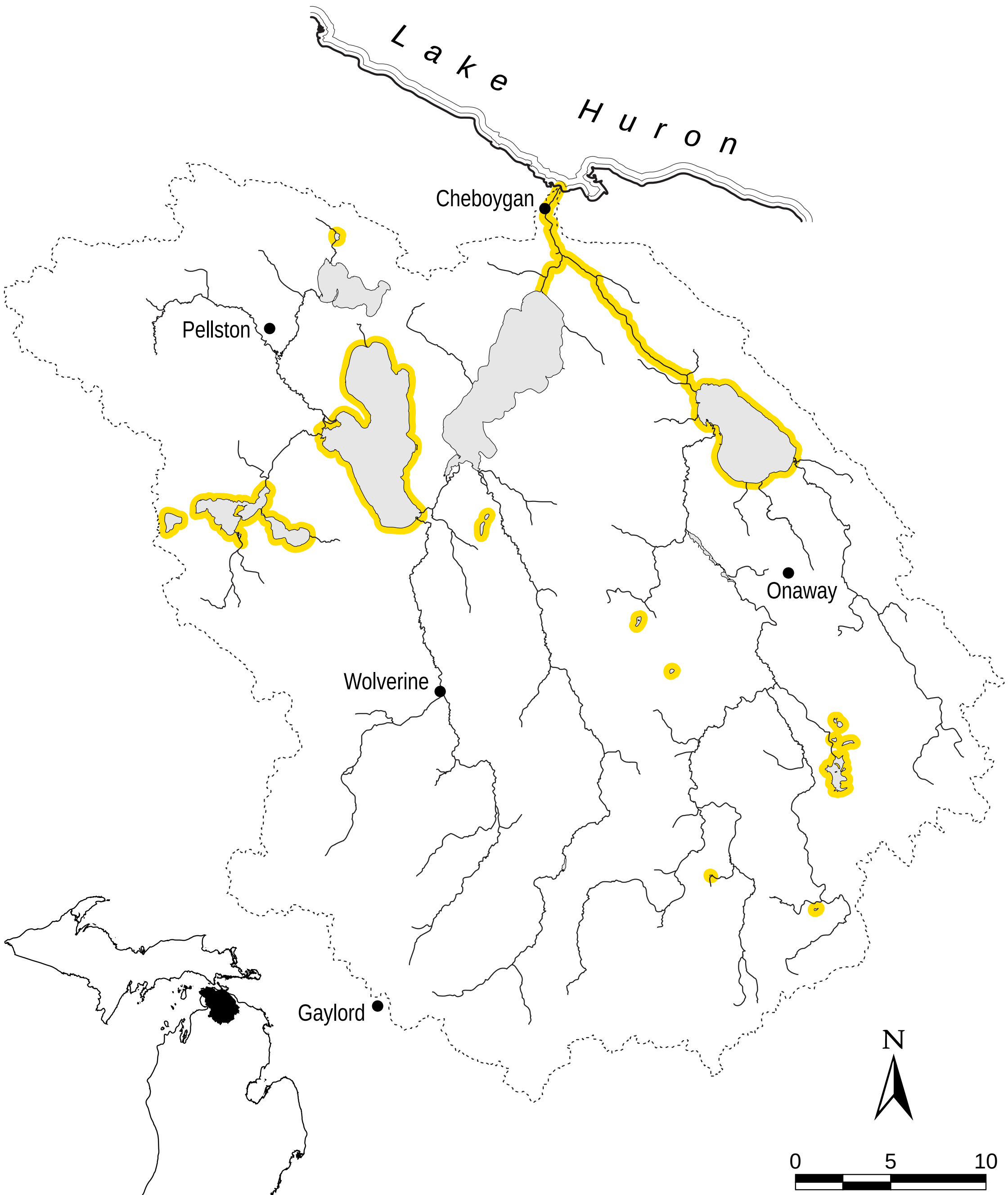
feeding	-	large clear streams
	-	lakes and impoundments
	-	clean sand, gravel, or boulder substrate
	-	intolerant of excessive turbidity and chemical pollutants
spawning	-	moderately rapid current

Black bullhead *Ameiurus melas*

Habitat:

feeding - turbid water
- silt bottom
- low gradient small to medium streams, pools, and headwaters of large rivers; also in lakes and impoundments
- can tolerate very warm water and very low dissolved oxygen

spawning - nest in moderate to heavy vegetation or woody debris and under overhanging banks

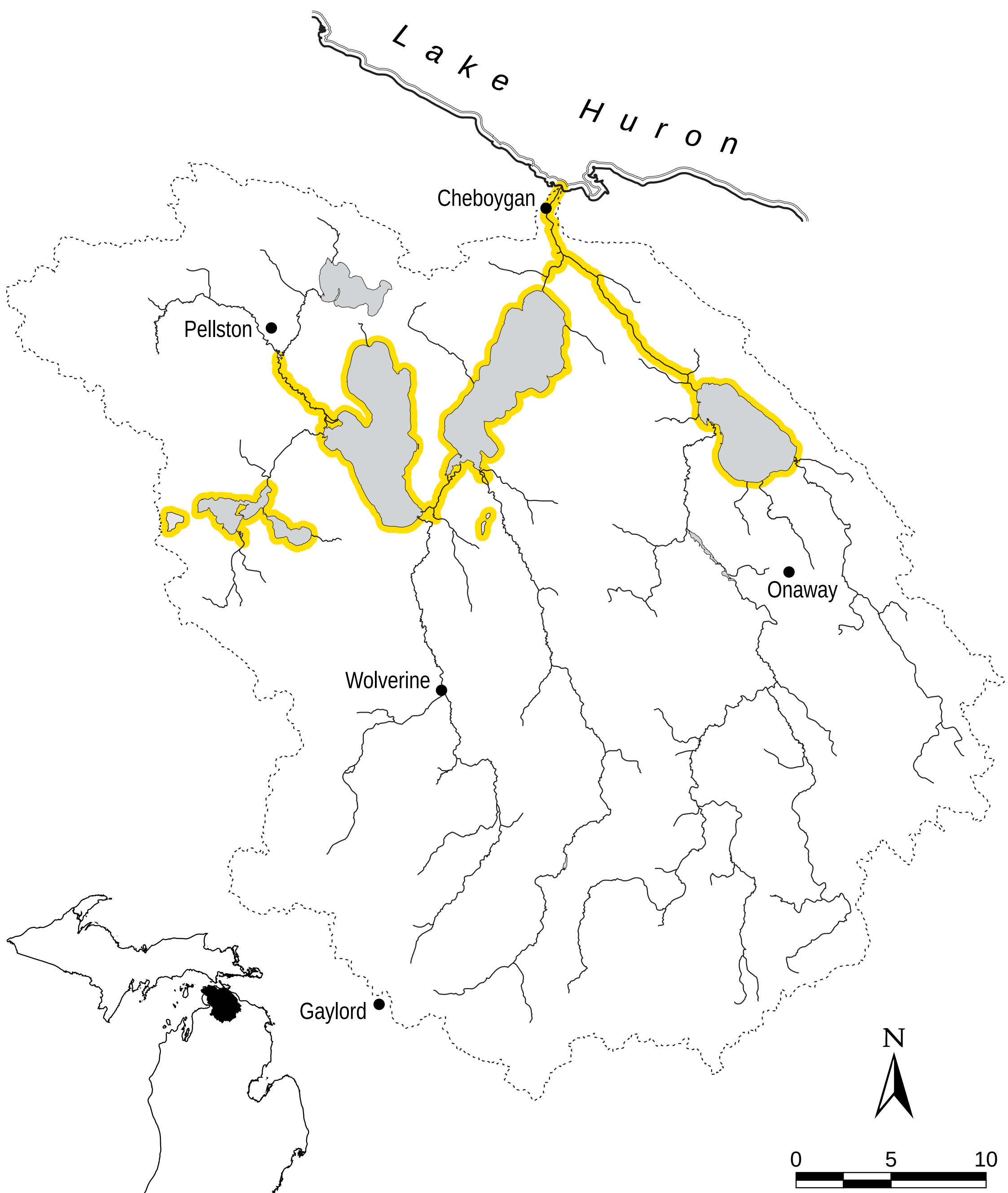


Yellow bullhead *Ameiurus natalis*

Habitat**:**

feeding - clear flowing water
- heavy vegetation
- low gradient streams, lakes, and impoundments
- tolerant of low oxygen

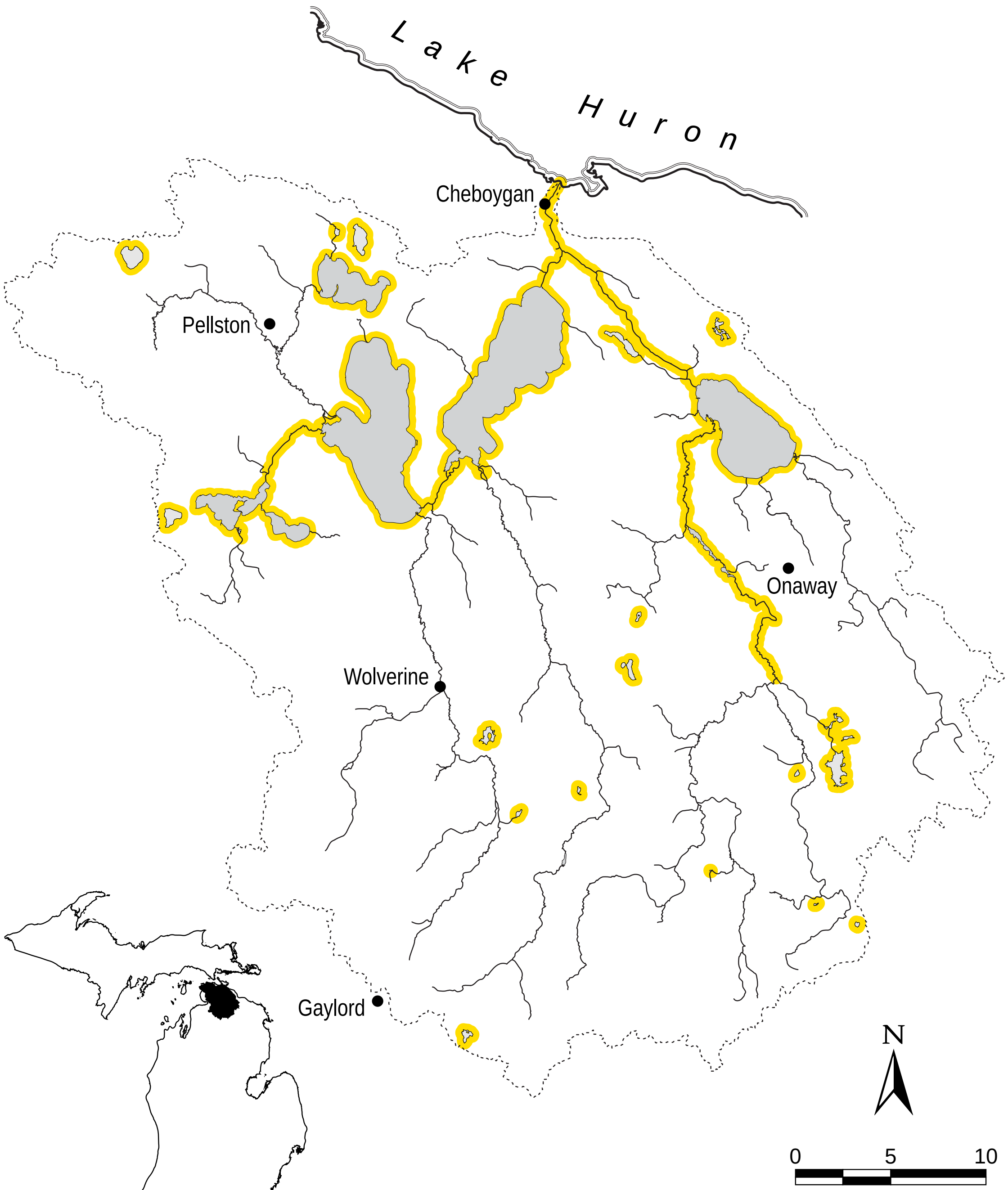
spawning - nest under a stream bank or near stones or stumps



Brown bullhead *Ameiurus nebulosus*

Habitat**:**

feeding	-	larger streams and rivers, lakes and impoundments
	-	clear cool water with little clayey silt
	-	moderate amounts of aquatic vegetation
	-	sand, gravel, or muck substrate
	-	not tolerant of turbid water
	-	tolerant of warm water and low oxygen
spawning	-	nest in mud or sand substrate among rooted aquatic vegetation usually near a stump, tree, or rock
winter refuge	-	in muddy bottoms

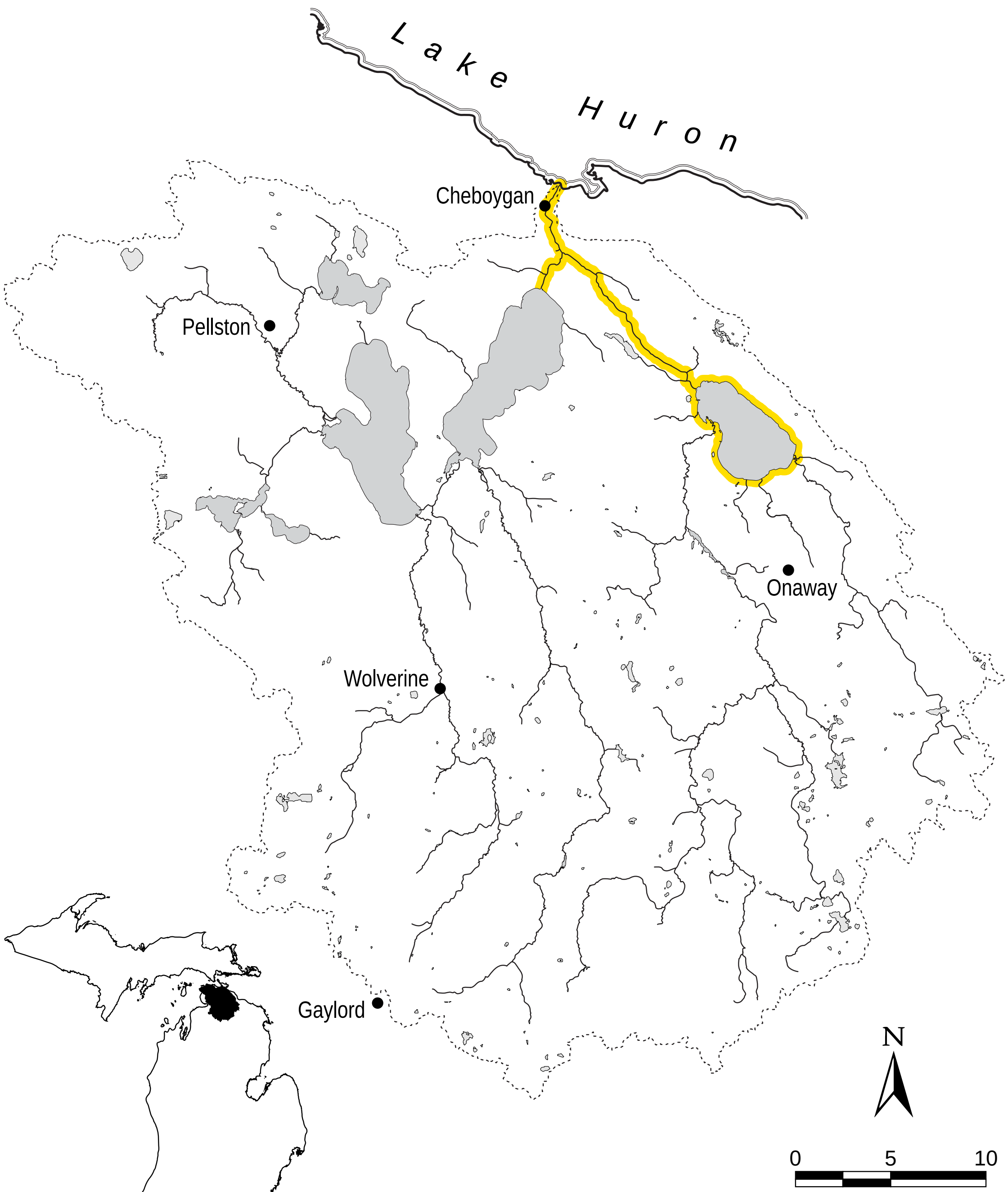


Channel catfish *Ictalurus punctatus*

Habitat**:**

feeding - moderately-clear, deeper waters of rivers, lakes, and impoundments
- sand, gravel, or rubble substrate
- low to moderate gradient

spawning - secluded semi-dark areas such as holes, under banks, log jams, or rocks

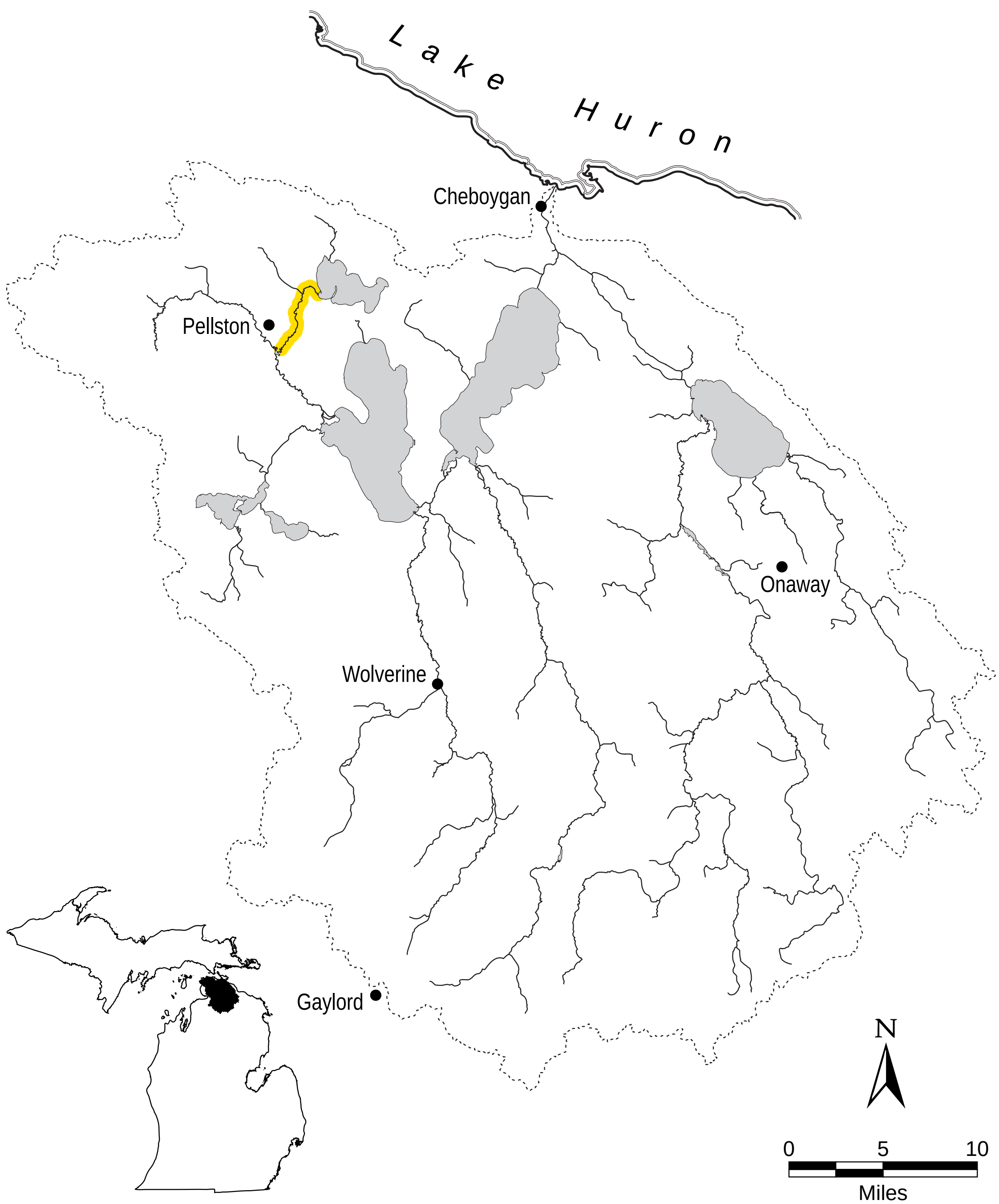


Grass pickerel *Esox americanus vermiculatus*

Habitat**:**

feeding
- juveniles: along shore
- adults: in deeper portions of streams, rivers, lakes, and impoundments
- clear water, little current, dense vegetation
- tolerates low oxygen concentrations

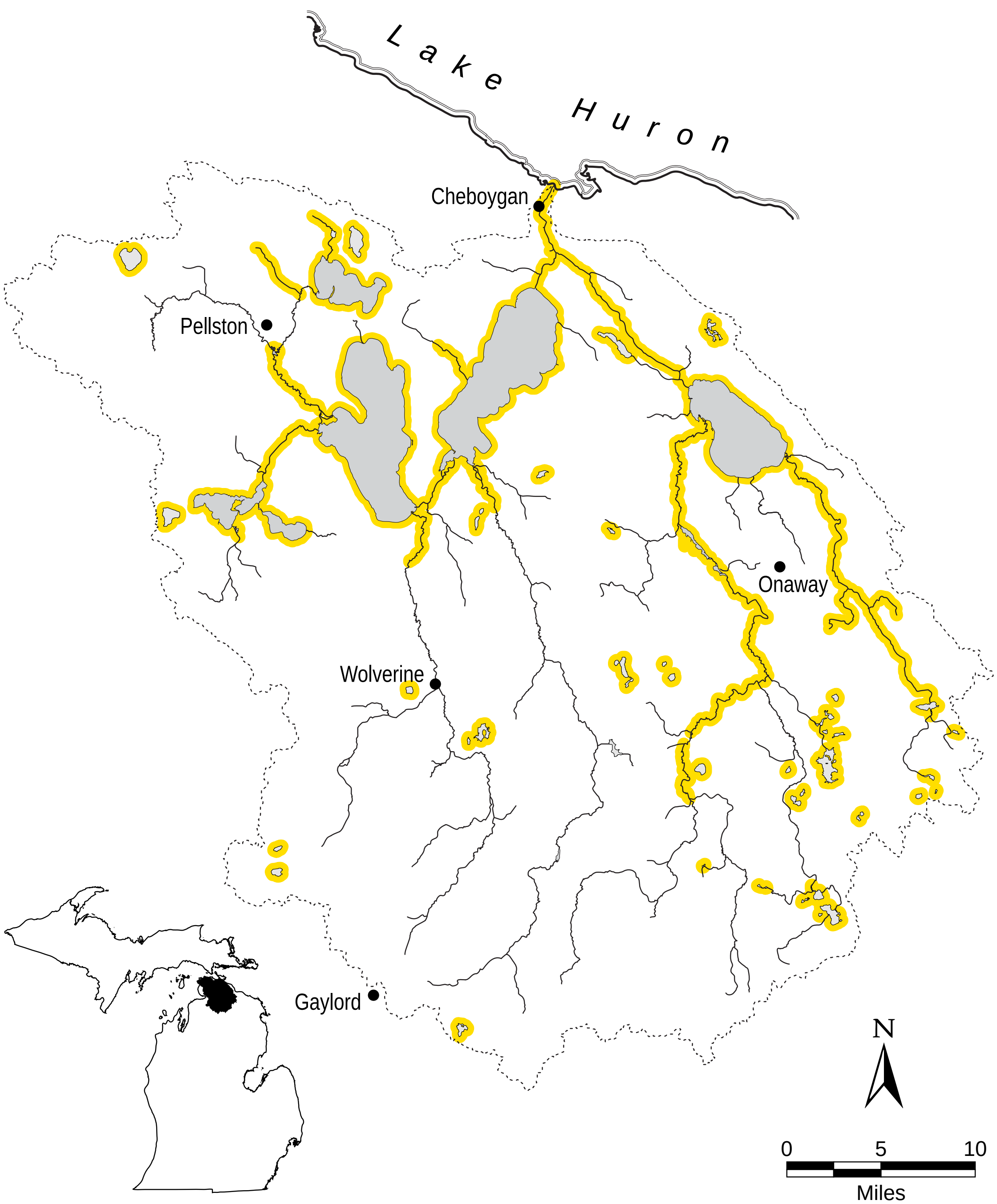
spawning
- broadcast spawner over submerged vegetation



Northern pike *Esox lucius*

Habitat**:**

feeding	-	cool to moderately warm streams, rivers, lakes, and impoundments
	-	vegetation in slow to moderate current
spawning	-	submerged vegetation with slow current in shallow water



Muskellunge *Esox masquinongy*

Habitat:

feeding - warm, heavily vegetated lakes, stumpy weedy bays, and slow heavily vegetated medium to large rivers
- shallow cool water
- tolerant of low oxygen

spawning - clear shallow waters (15-20") in heavily vegetated areas

Central mudminnow *Umbra limi*

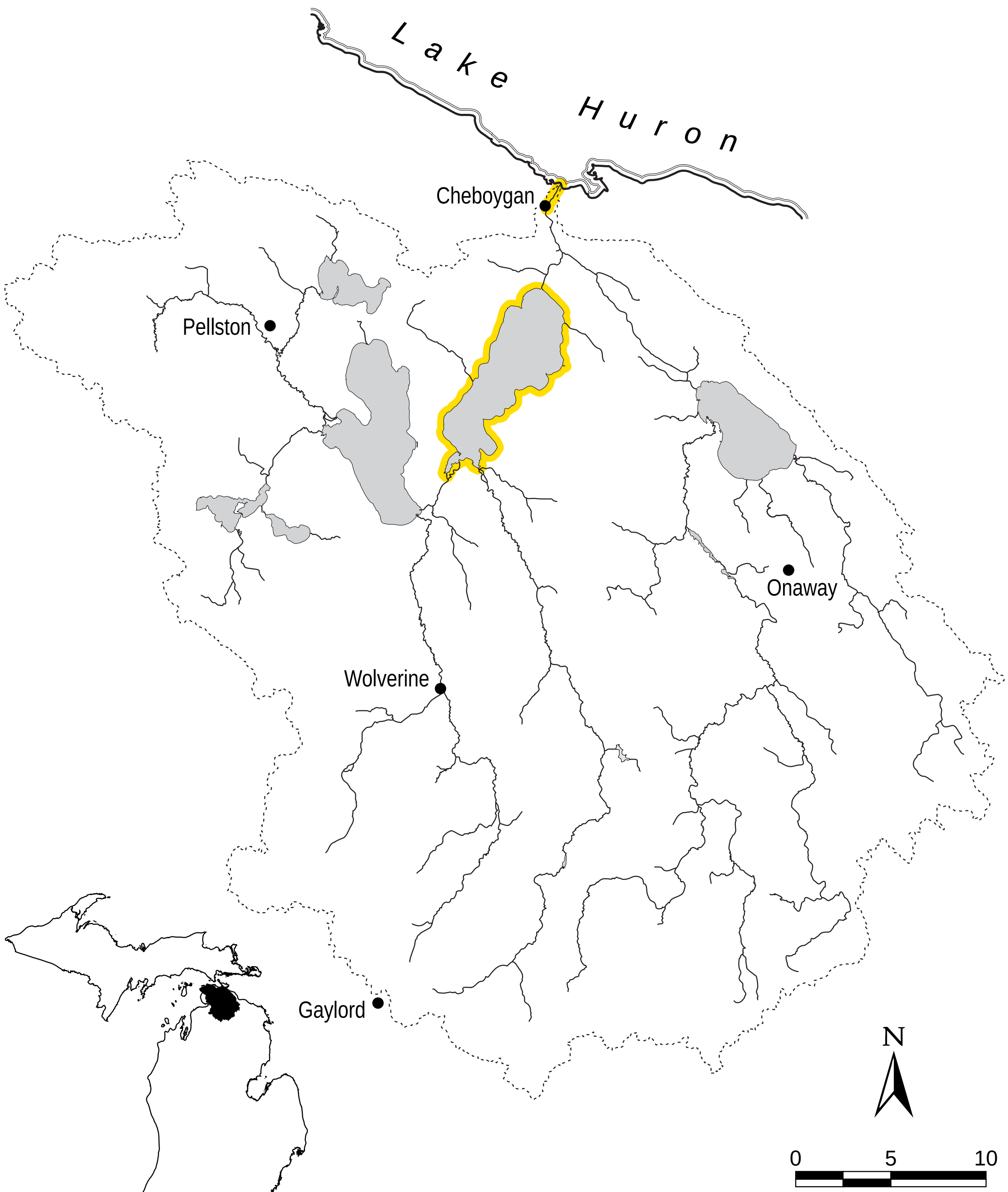
Habitat**:**

feeding	-	undisturbed clear, low-gradient streams or rivers and lakes and impoundments
	-	organic debris, muck, or peat substrates
	-	aquatic vegetation
spawning	-	floodplain areas, on vegetation

Rainbow smelt *Osmerus mordax*

Habitat:

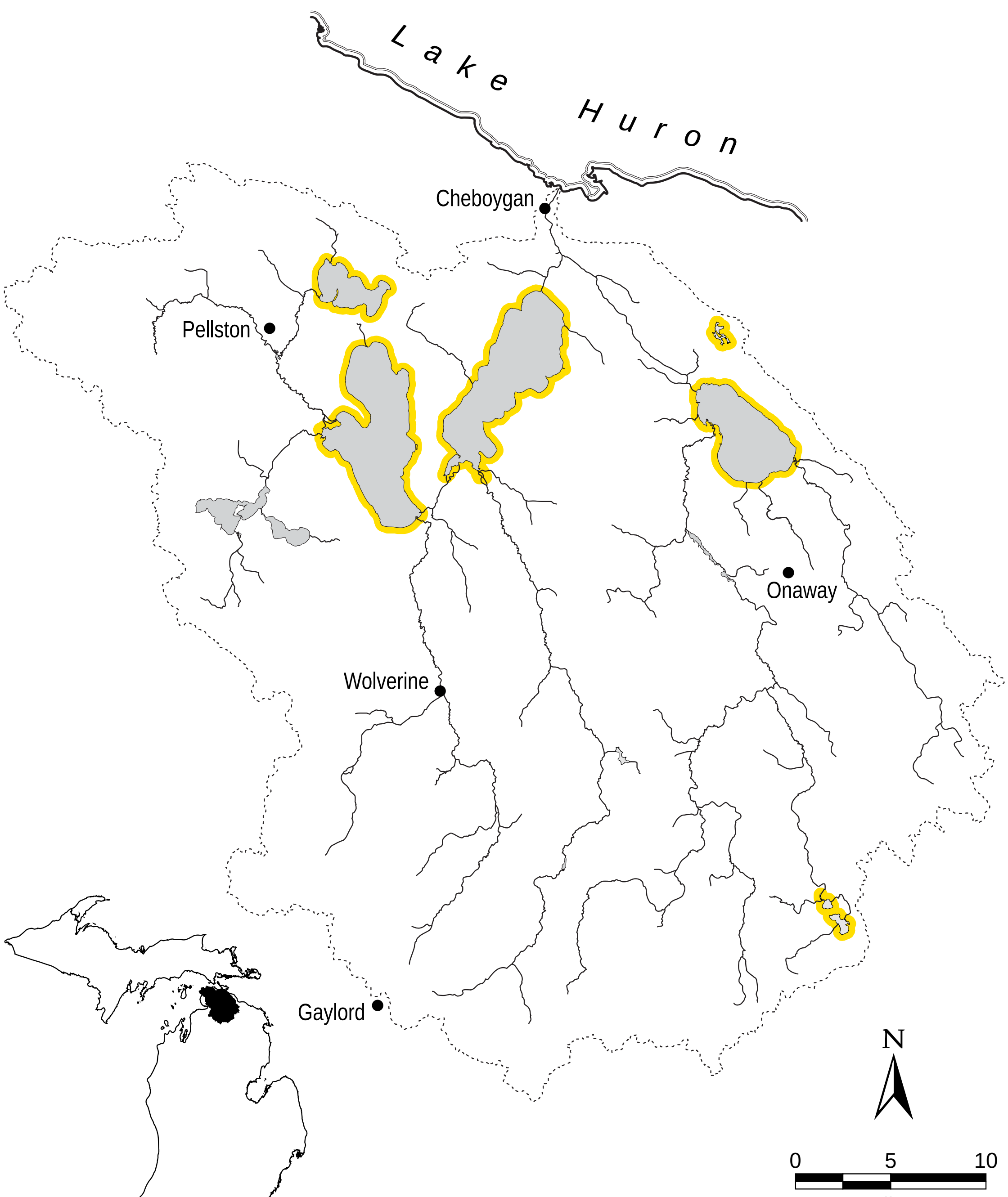
feeding	-	young: close inshore lake habitat along sand and gravel beaches
	-	cold water
spawning	-	clear high-gradient streams or wave swept shoreline
	-	riffles with coarse sand or gravel substrate
winter refuge	-	midwaters of lakes or inshore coastal waters



Cisco {Lake herring} *Coregonus artedi* - threatened

Habitat:

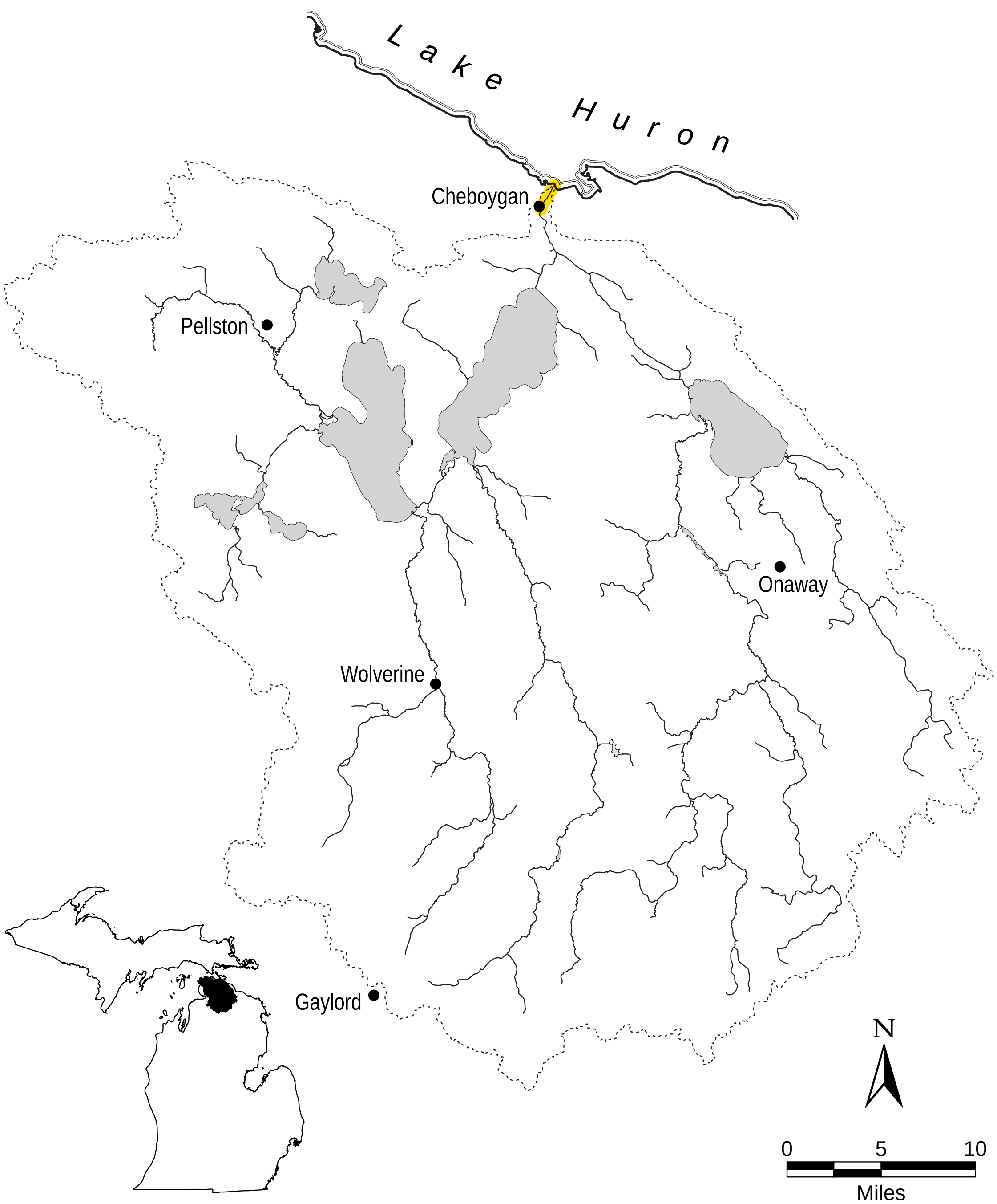
feeding	-	deep cool lakes, preferably oligotrophic
spawning	-	usually in lakes
	-	3 to 6 feet of water with no vegetation
	-	often over gravel or stony substrate



Lake whitefish *Coregonus clupeaformis*

Habitat:

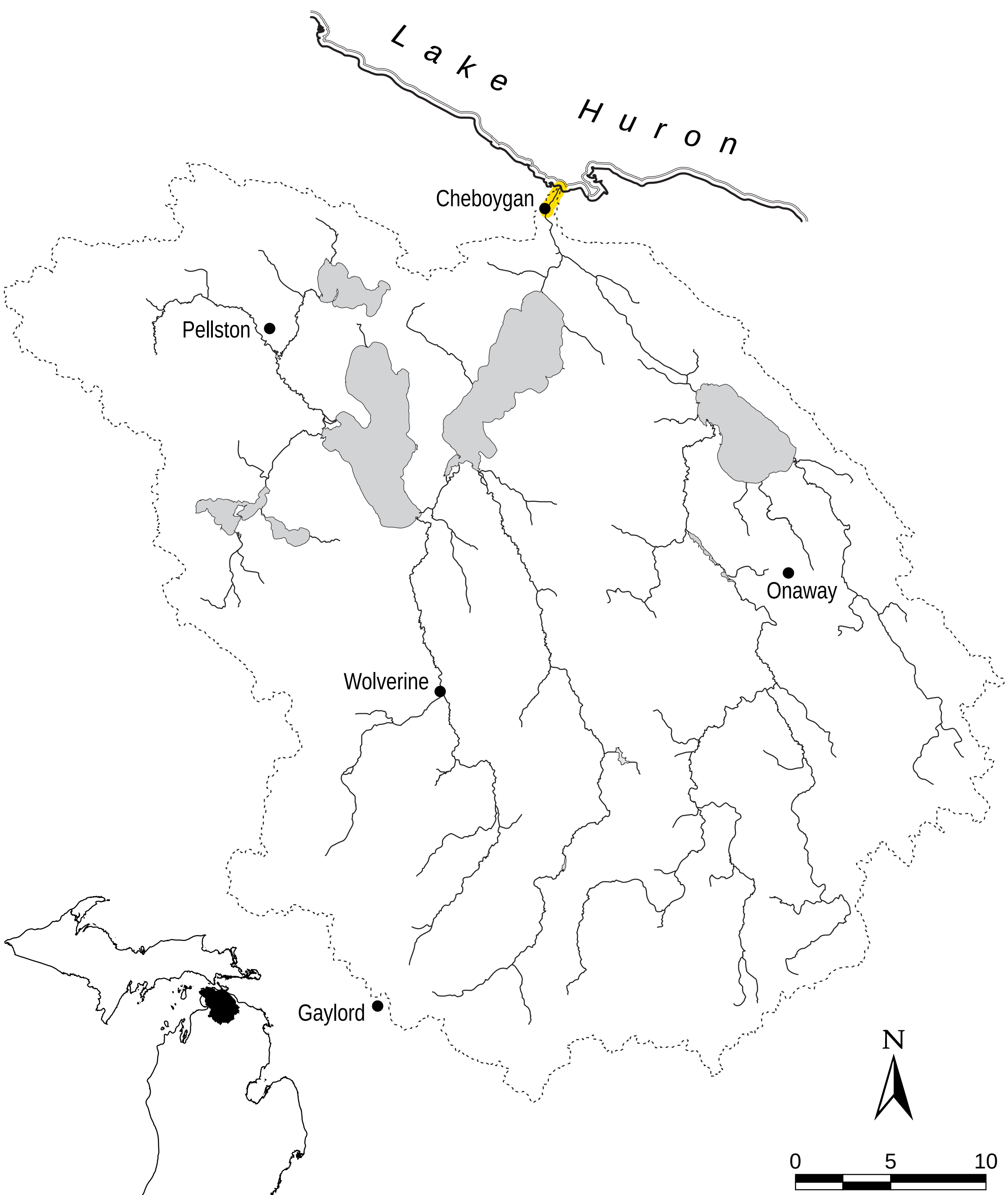
feeding	-	shallow water (for coregonids; 55-105 ft.)
spawning	-	cold shallow water (<25 ft.)
	-	hard, stony, or sand substrate



Pink salmon *Oncorhynchus gorbuscha*

Habitat:

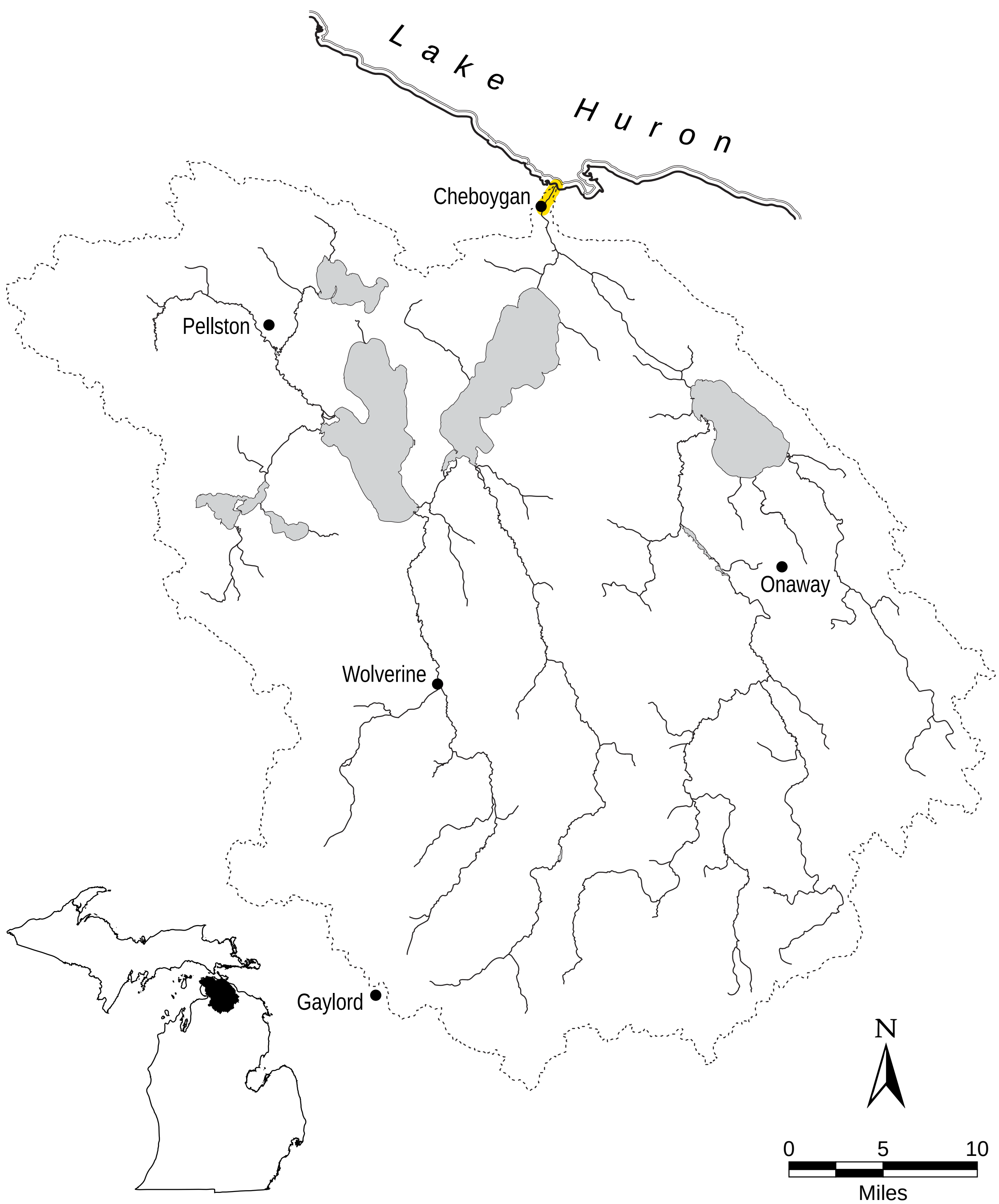
feeding	-	large cold deep lakes - Lake Huron
spawning	-	gravel substrate in rivers
	-	female prepares and guards nest until death



Coho salmon *Oncorhynchus kisutch*

Habitat**:**

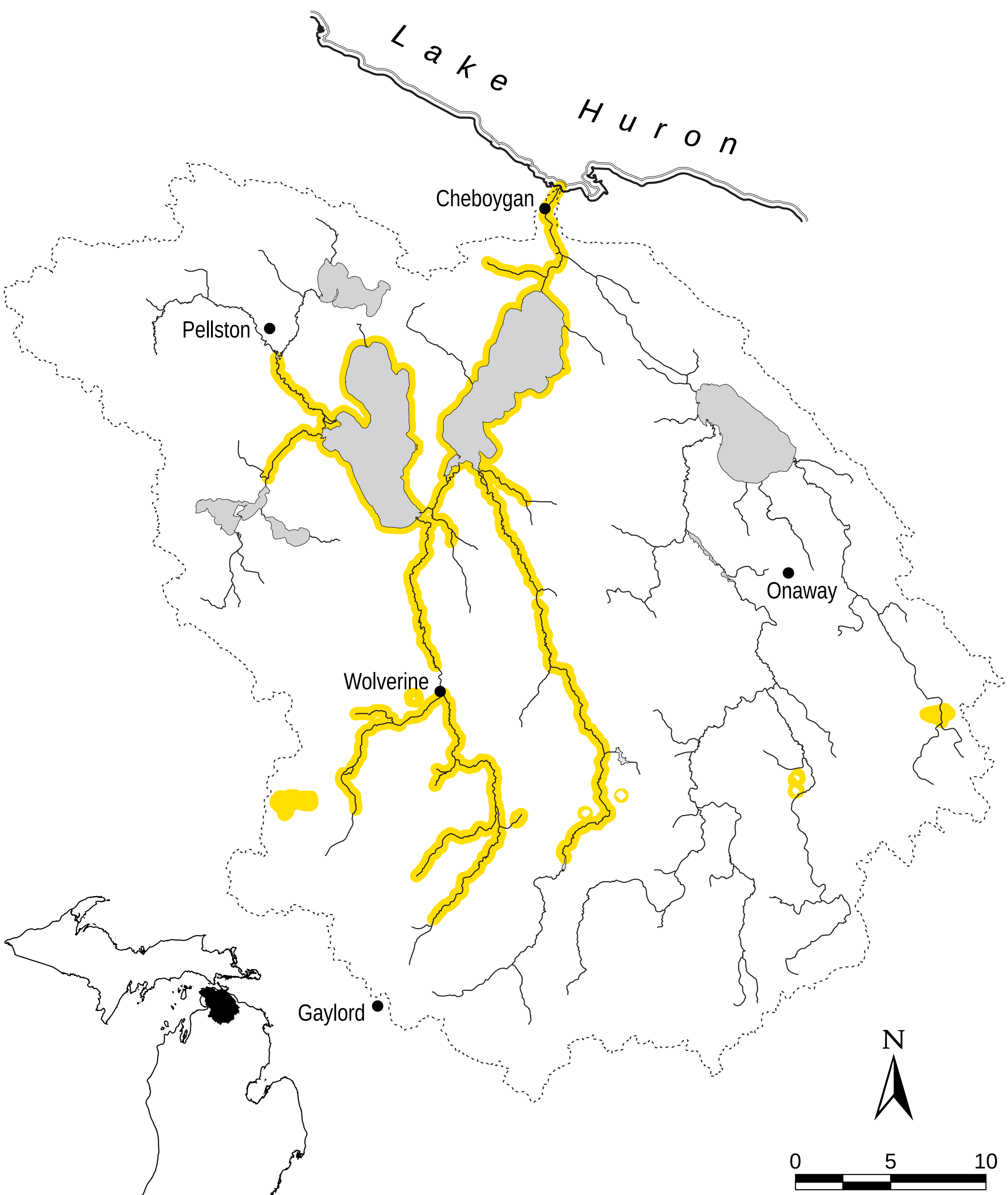
feeding	- adults: Lake Huron
	- young: shallow gravel substrate in cold streams, later into pools
spawning	- cold streams and rivers
	- swifter water of shallow gravelly substrate



Rainbow trout *Oncorhynchus mykiss*

Habitat:

feeding	-	cold clear water of rivers and Lake Huron
	-	moderate current
spawning	-	gravelly riffles above a pool
	-	smaller tributaries

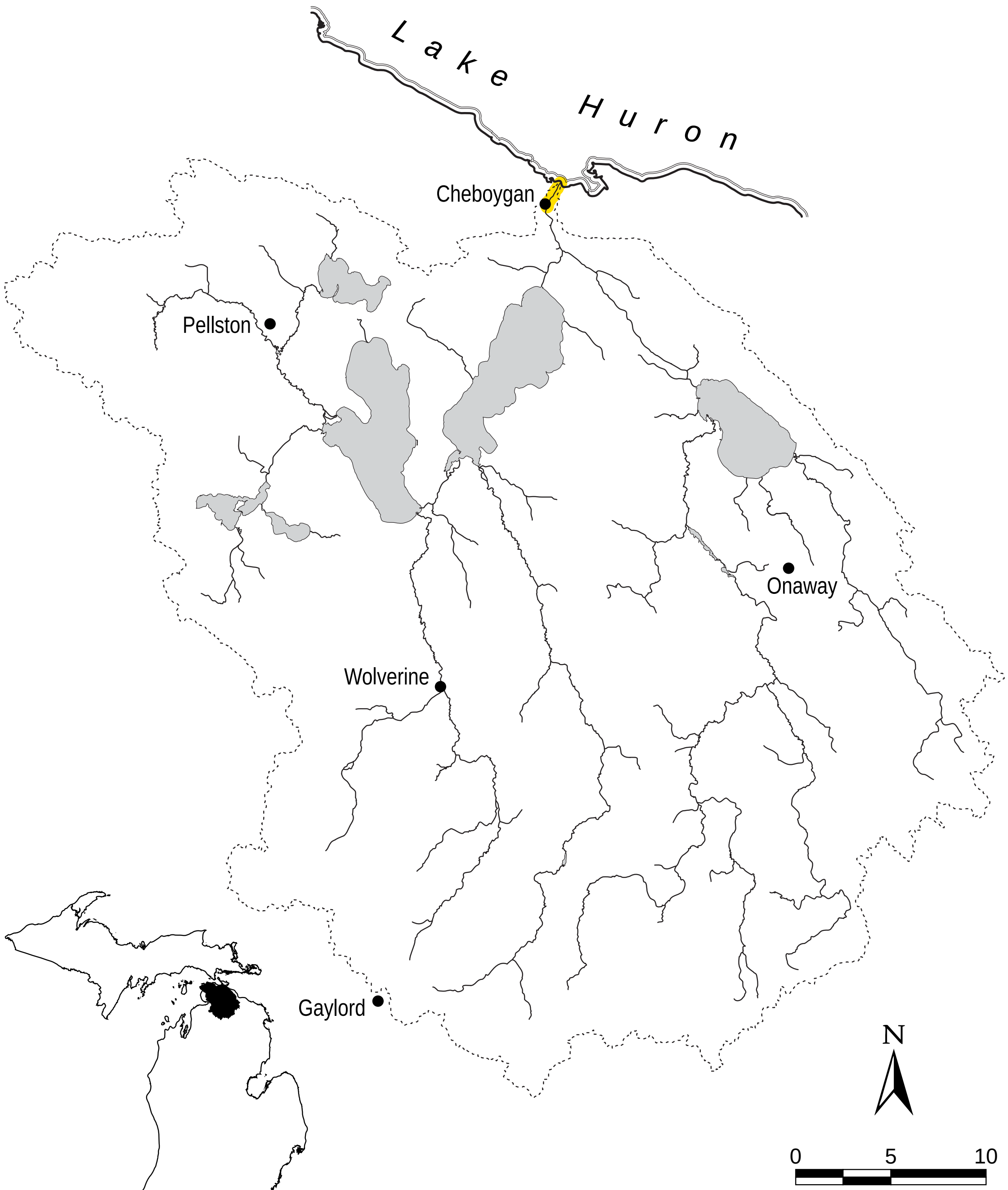


Chinook salmon *Oncorhynchus tshawytscha*

Habitat**:**

feeding - adults: Lake Huron
- young: shallow gravel substrate in cool streams, later into pools

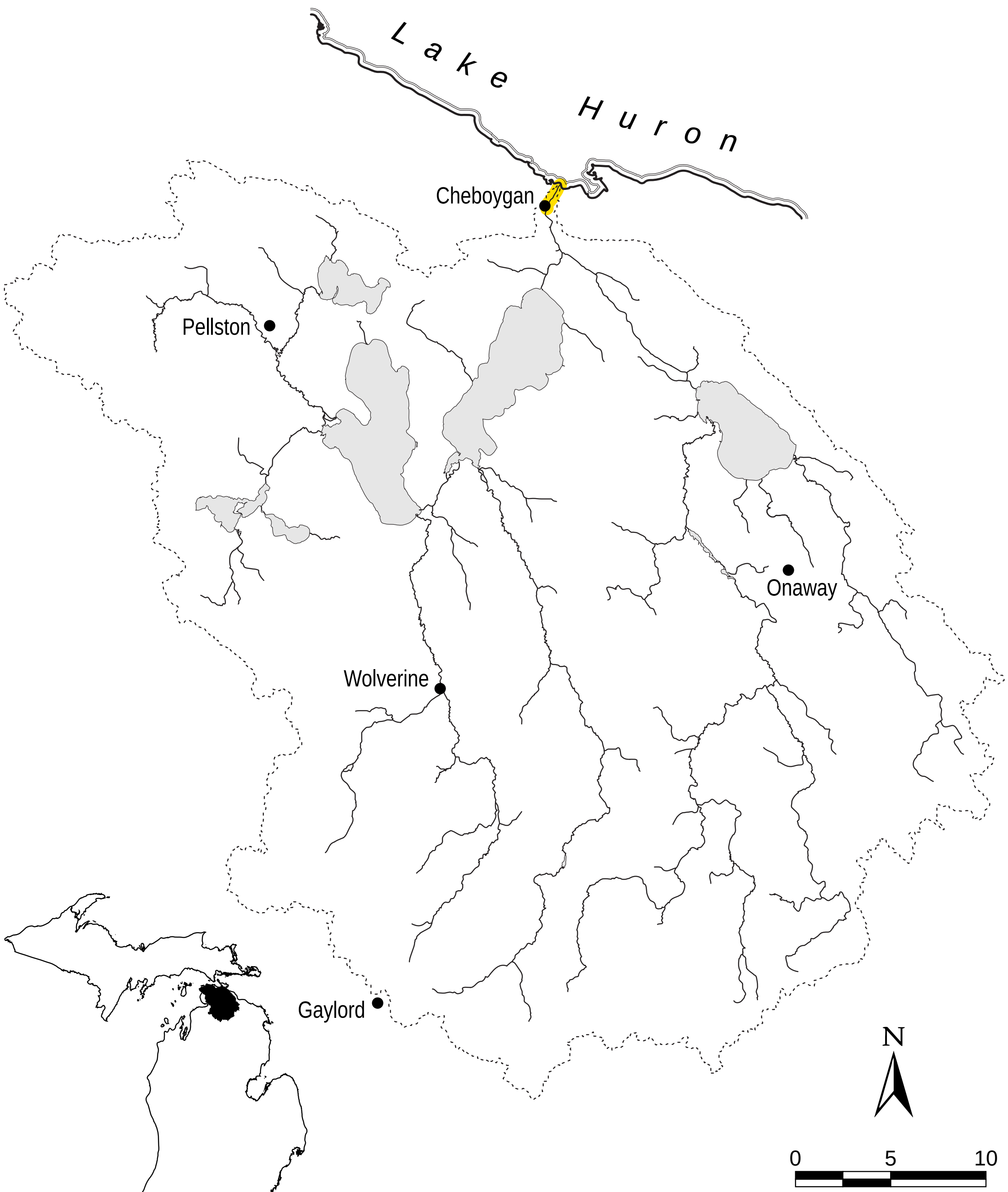
spawning - gravelly substrate in cool streams



Atlantic salmon *Salmo salar*

Habitat:

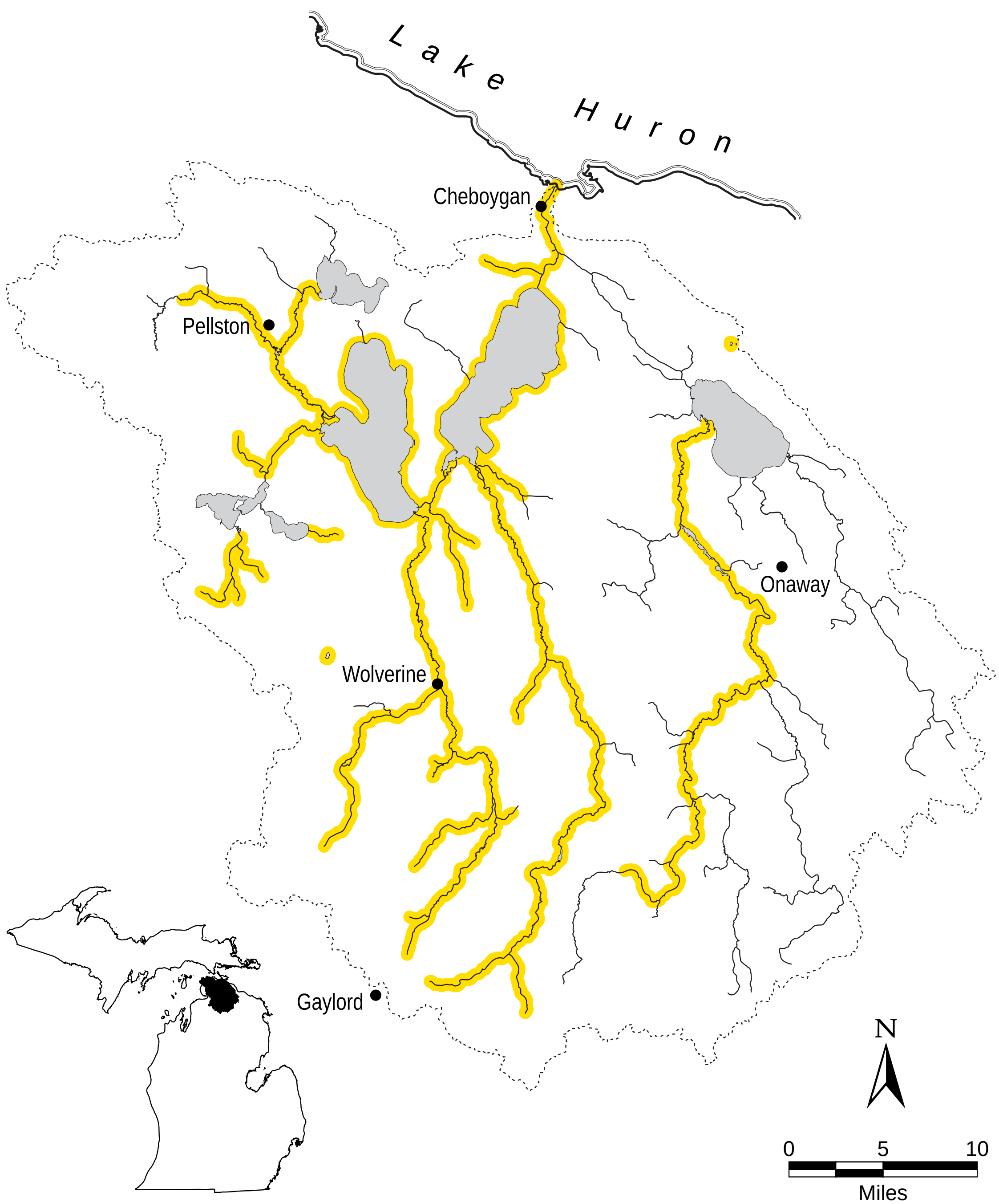
feeding	-	young: gravel substrate streams
	-	adults: Lake Huron
spawning	-	streams and rivers
	-	nests in gravel substrate
	-	swift current



Brown trout *Salmo trutta*

Habitat**:**

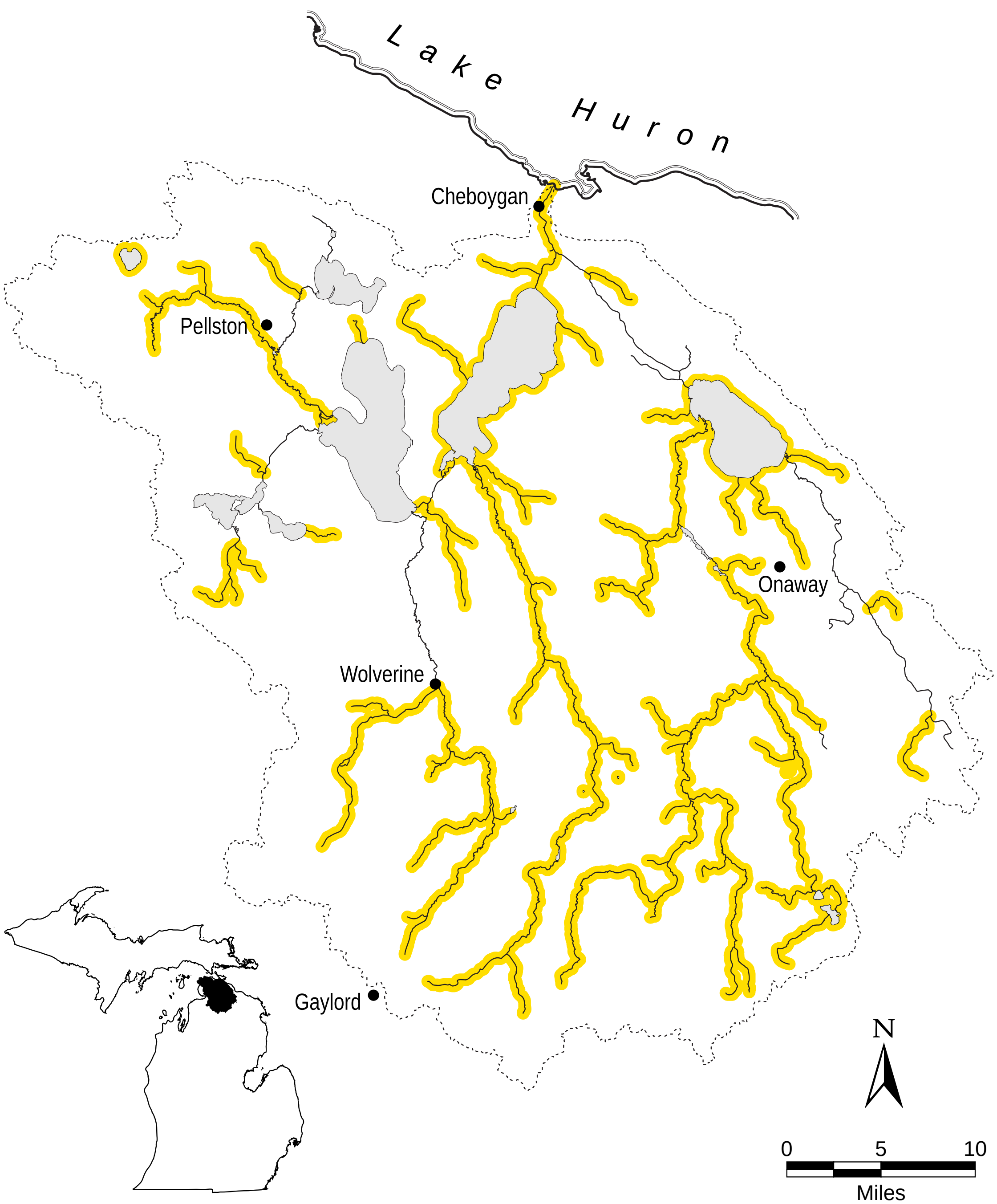
feeding	-	cold, clear streams, rivers, and lakes (not >70°F)
	-	medium to swift current in streams
	-	does not tolerate silt well
	-	prefers few individuals and species around
	-	abundance of aquatic and land insects
spawning	-	gravelly riffles; shallow headwater areas



Brook trout *Salvelinus fontinalis*

Habitat**:**

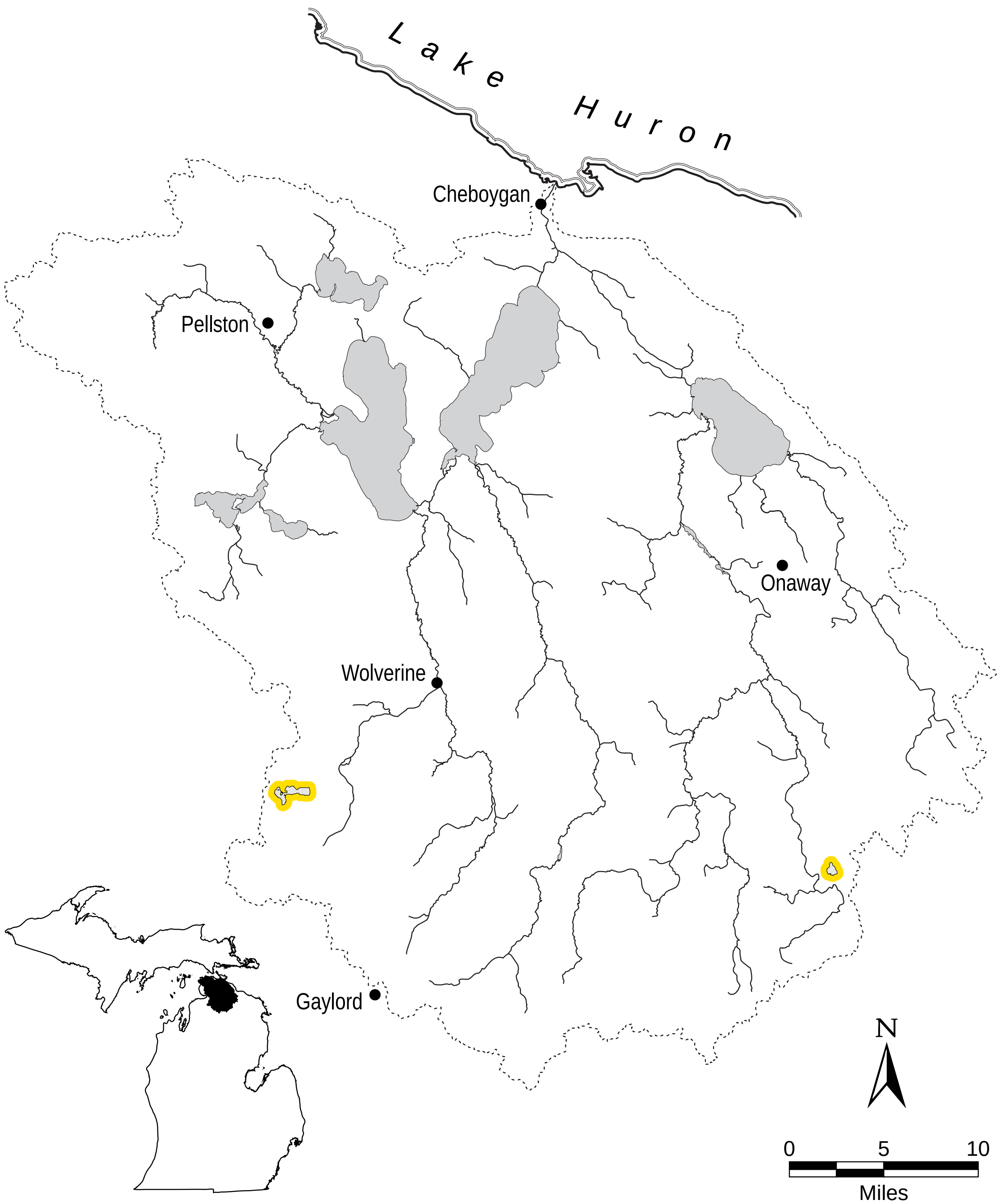
feeding	-	cold, clear streams, rivers, and lakes (not >65°F)
	-	low current
	-	well oxygenated water
spawning	-	gravelly riffles; shallow or headwater streams



Splake *Salvelinus fontinalis* x *Salvelinus namaycush*

Habitat:

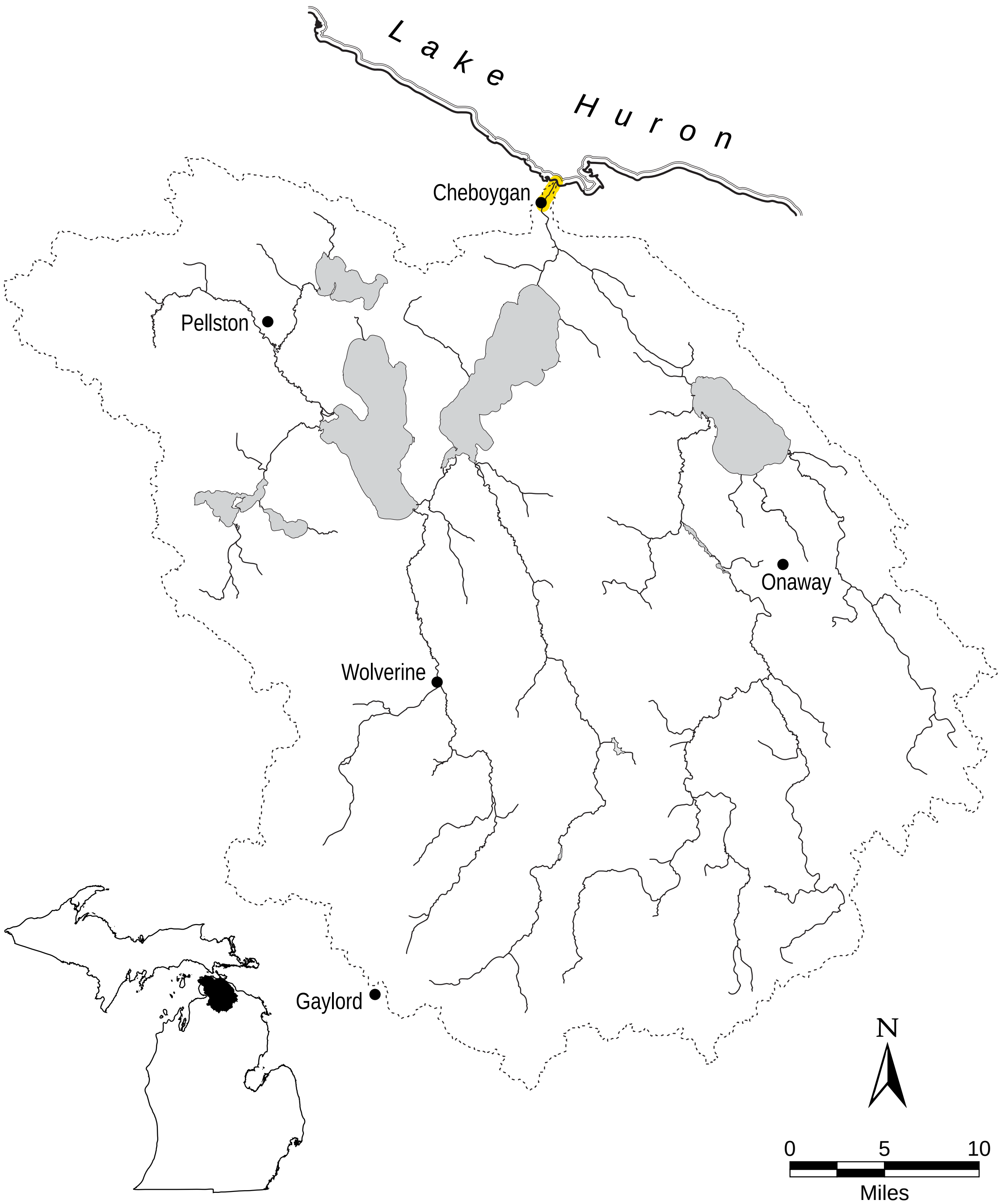
feeding	-	littoral habitat
	-	cool water lakes; also Lake Huron
spawning	-	hatchery produced cross of brook and lake trout
	-	offspring usually fertile, but with lower fecundity than either parent species



Lake trout *Salvelinus namaycush*

Habitat:

feeding	-	cold lakes and rivers
spawning	-	large boulder or rubble substrate
	-	shallow water of lakes and rivers



Trout-perch *Percopsis omiscomaycus*

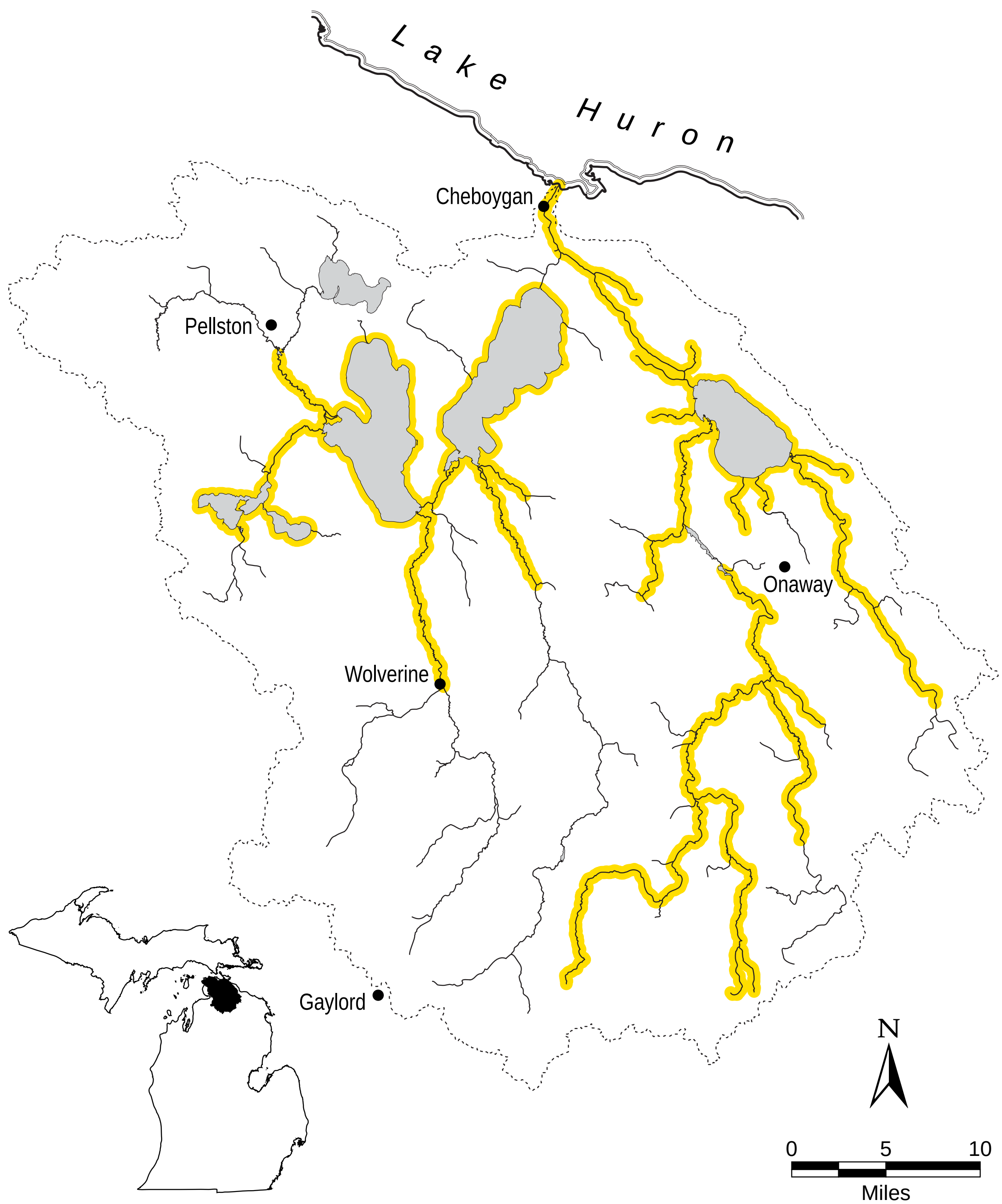
Habitat**:**

feeding	-	clean sand or fine gravel substrate
	-	long deep pools in low gradient streams and Lake Huron
	-	highly intolerant of clayey silts
	-	avoids rooted aquatic vegetation
spawning	-	over rocks in shallows
	-	over sand and gravel substrates in Lake Huron

Burbot *Lota lota*

Habitat:

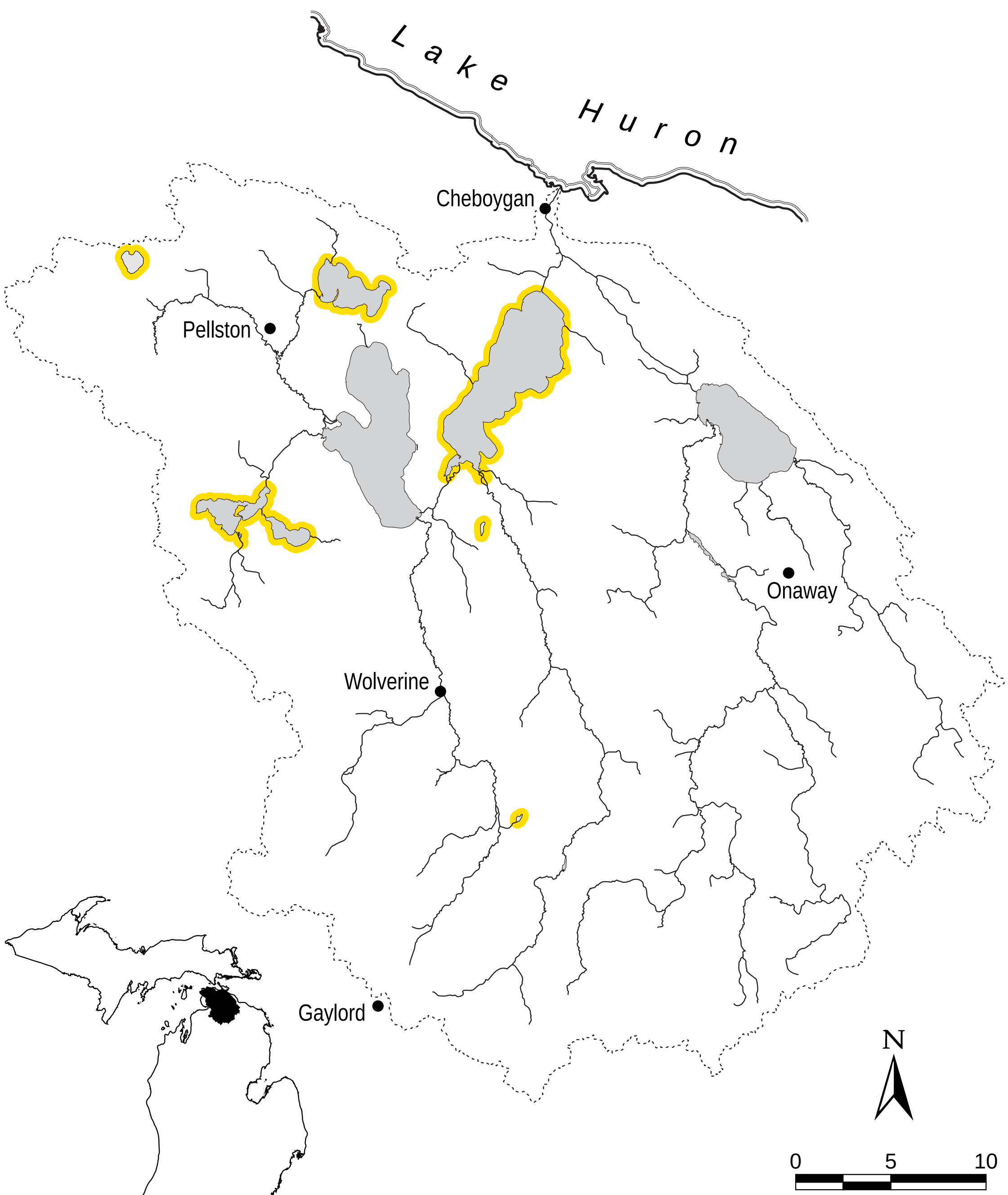
feeding	-	deep cold lakes and large cool rivers
	-	mud, sand, rubble, boulder, silt, and gravel substrates
spawning	-	in 1 to 4 feet of water in shallow bays or on shoals 5-10 feet deep usually in lakes, sometimes rivers
	-	over sand or gravel substrate
	-	under ice



Western banded killifish *Fundulus diaphanus menona*

Habitat**:**

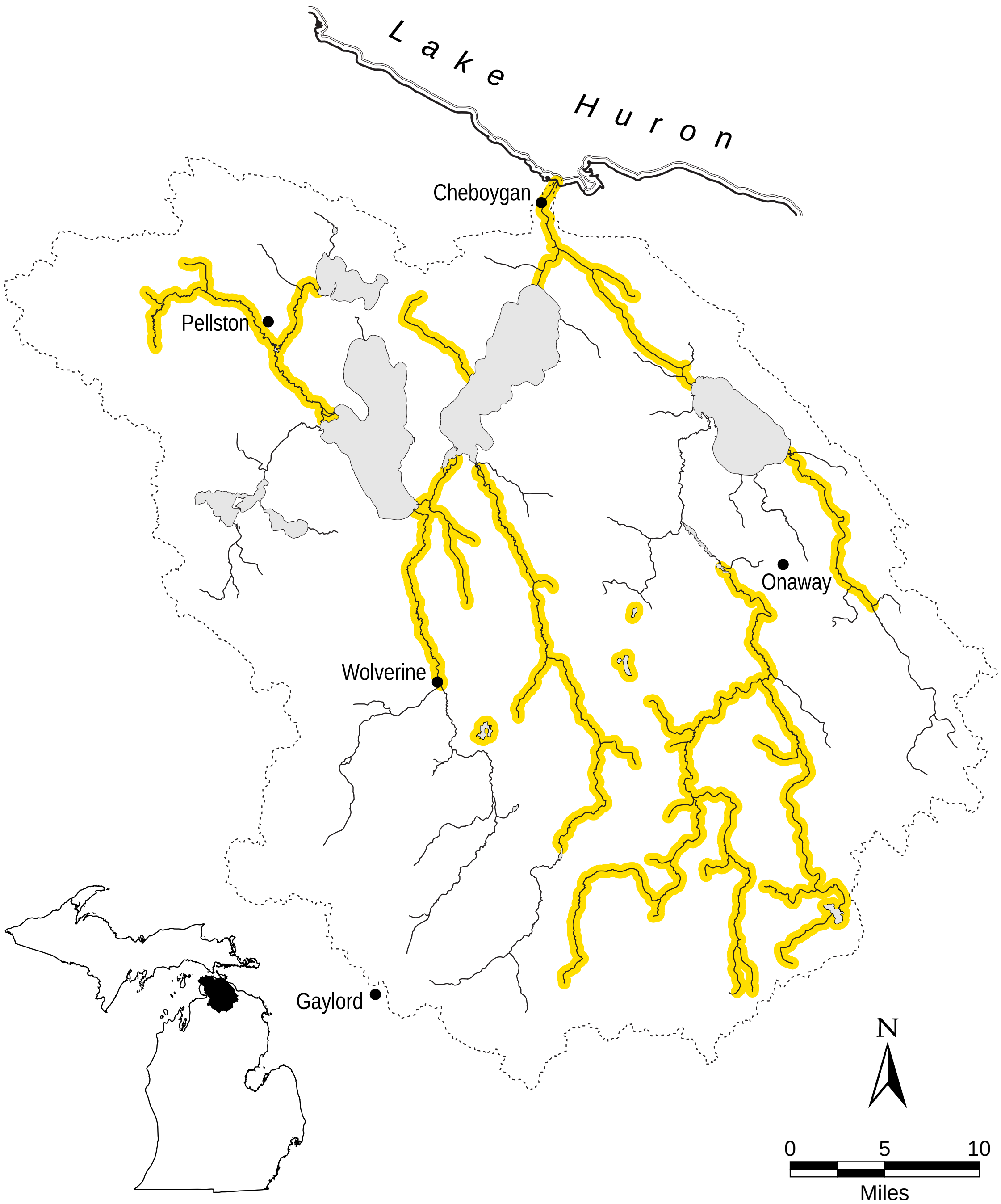
feeding	-	quiet backwaters at the mouths of streams and lakes
	-	substrate of sand, gravel, and a few boulders
	-	also found over detritus substrate where patches of submerged aquatic vegetation are present
spawning	-	quiet areas of weedy pools



Brook stickleback *Culaea inconstans*

Habitat**:**

feeding	-	clear, cold, densely vegetated streams, and swampy margins of lakes
	-	low gradient
	-	muck, peat, or marl substrate
	-	not tolerant of turbidity
spawning	-	shallow cool (<66°F) water
	-	aquatic reeds or grasses necessary

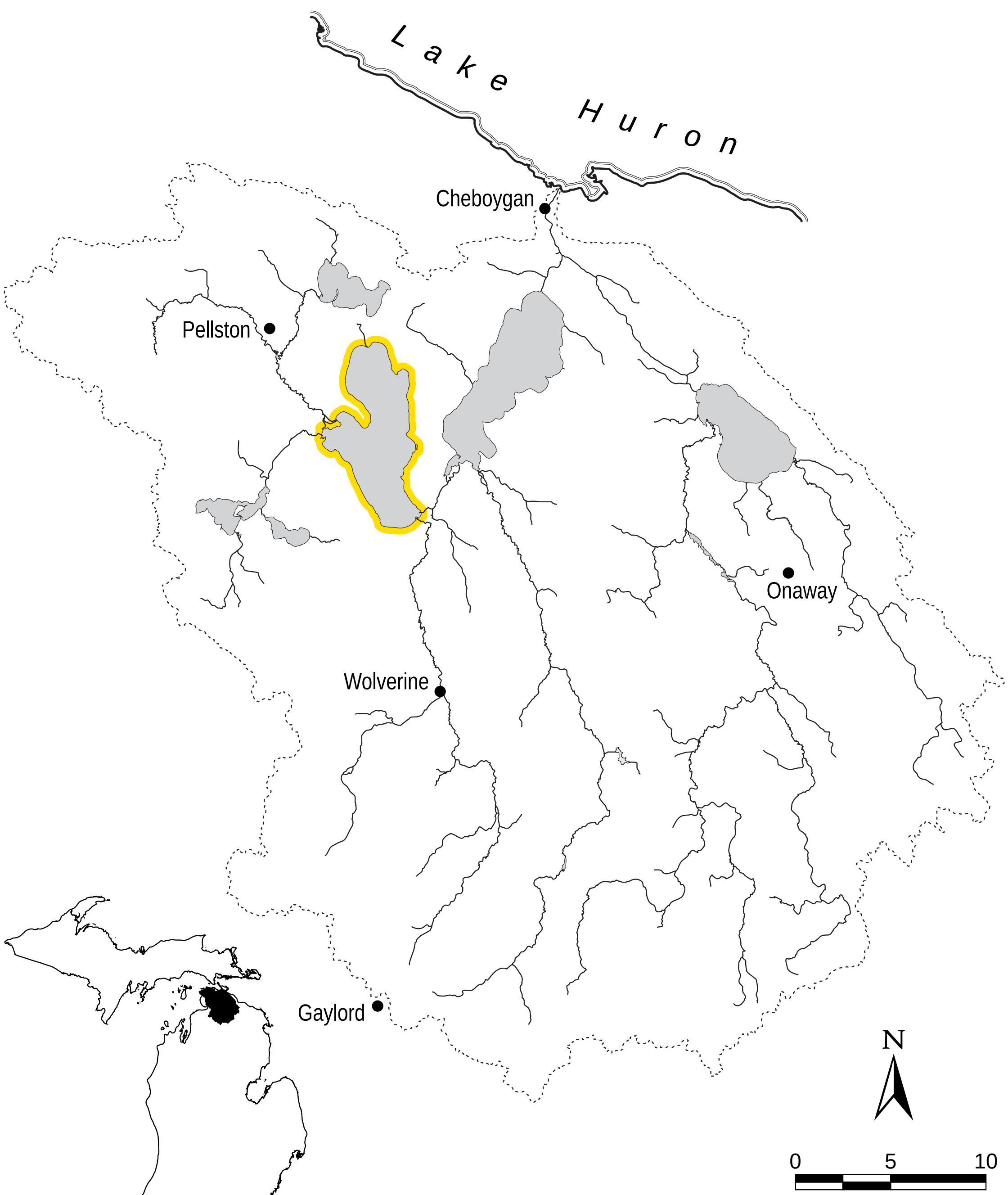


Ninespine stickleback *Pungitius pungitius*

Habitat:

feeding - open water of lakes; also Lake Huron
- cool quiet waters

spawning - builds nests among aquatic vegetation in creeks and streams



Mottled sculpin *Cottus bairdii*

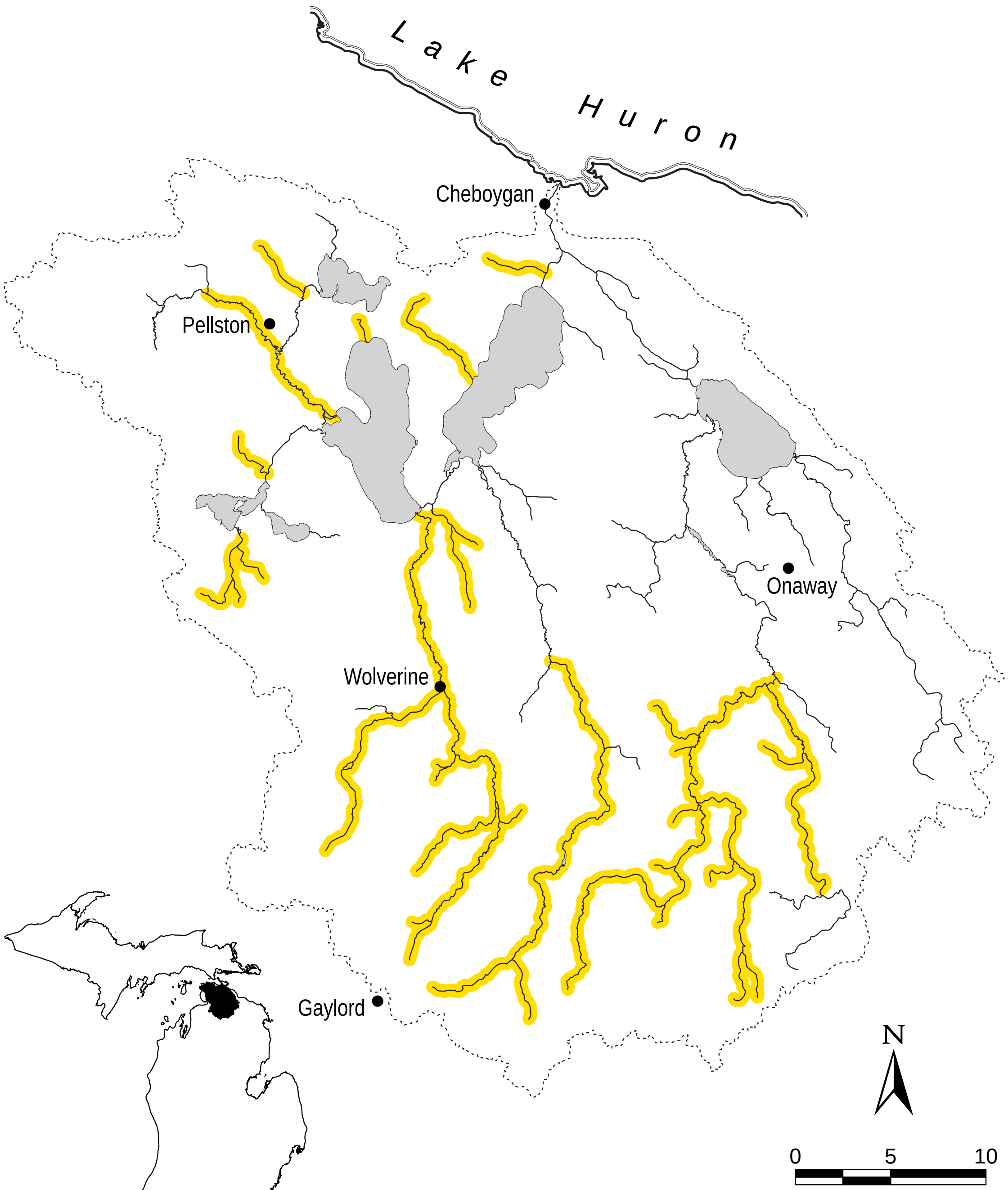
Habitat**:**

feeding	-	cool to cold streams
	-	riffle and rock substrates preferred
	-	clear to slightly turbid shallow water
spawning	-	nests under logs or rock

Slimy sculpin *Cottus cognatus*

Habitat:

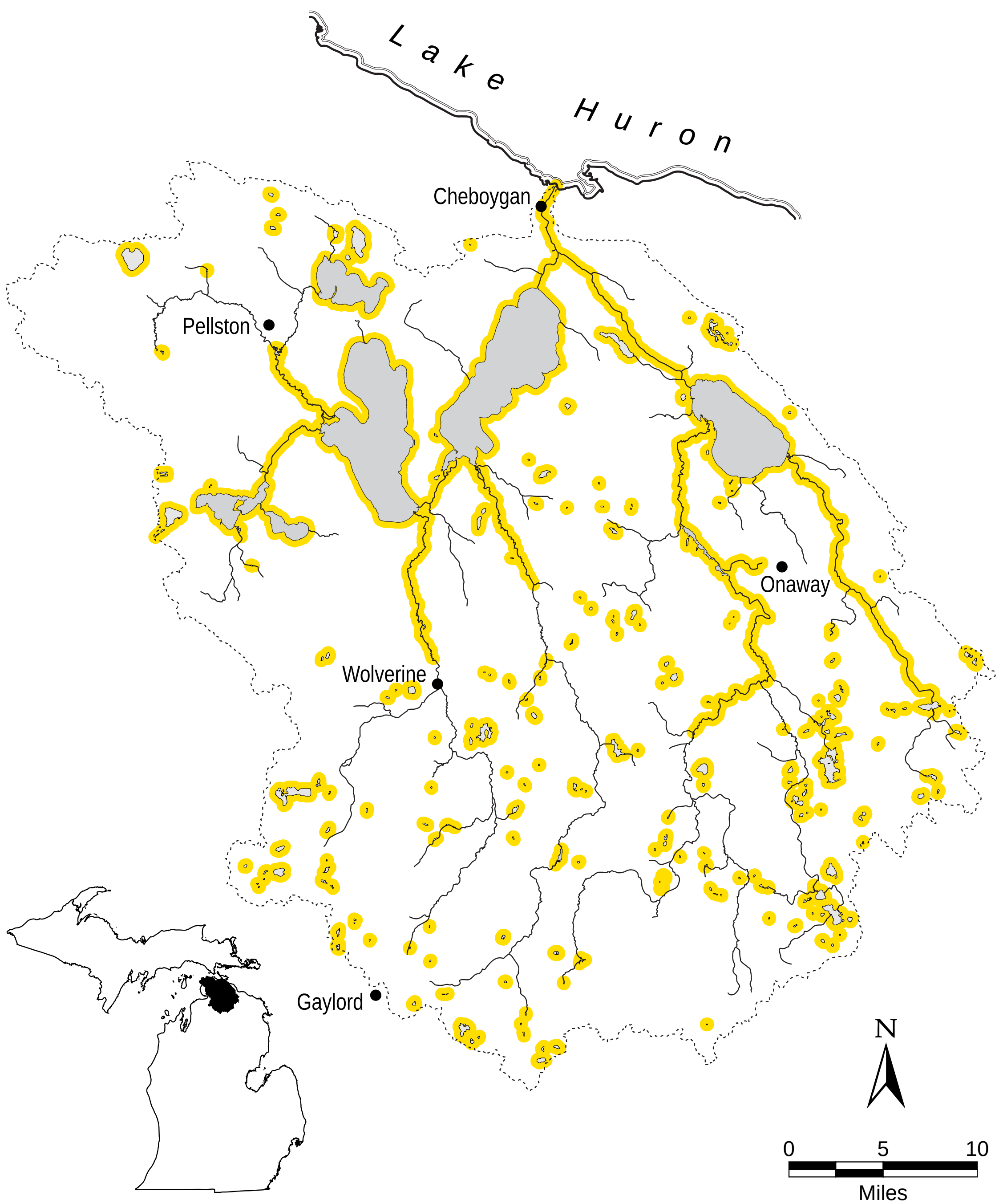
feeding	-	cool lakes, impoundments, rivers, and streams
	-	gravel or rock substrate
spawning	-	nest in shallow areas of lakes
	-	gravel substrate or rock ledge
	-	male parental care



Rock bass *Ambloplites rupestris*

Habitat**:**

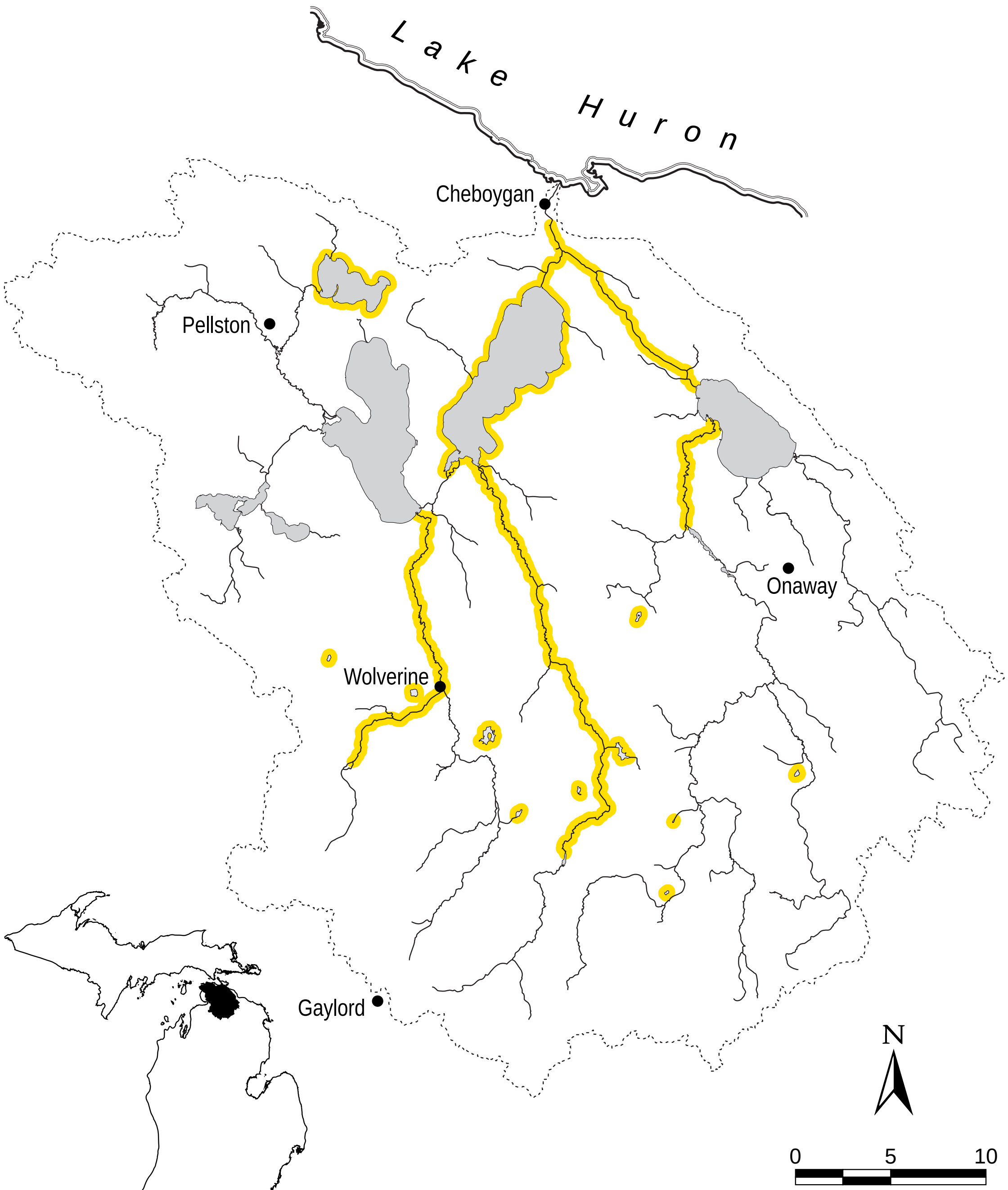
feeding	-	clear, cool streams, rivers, and lakes
	-	rocky to sand substrate
	-	woody or vegetative cover
spawning	-	sand or gravel nests
	-	shallow water
winter refuge	-	deep water



Green sunfish *Lepomis cyanellus*

Habitat**:**

feeding	-	impoundments and lakes, and low-current streams and rivers
	-	no substrate preference
spawning	-	nests in shallow areas sheltered by rocks, logs, or aquatic vegetation

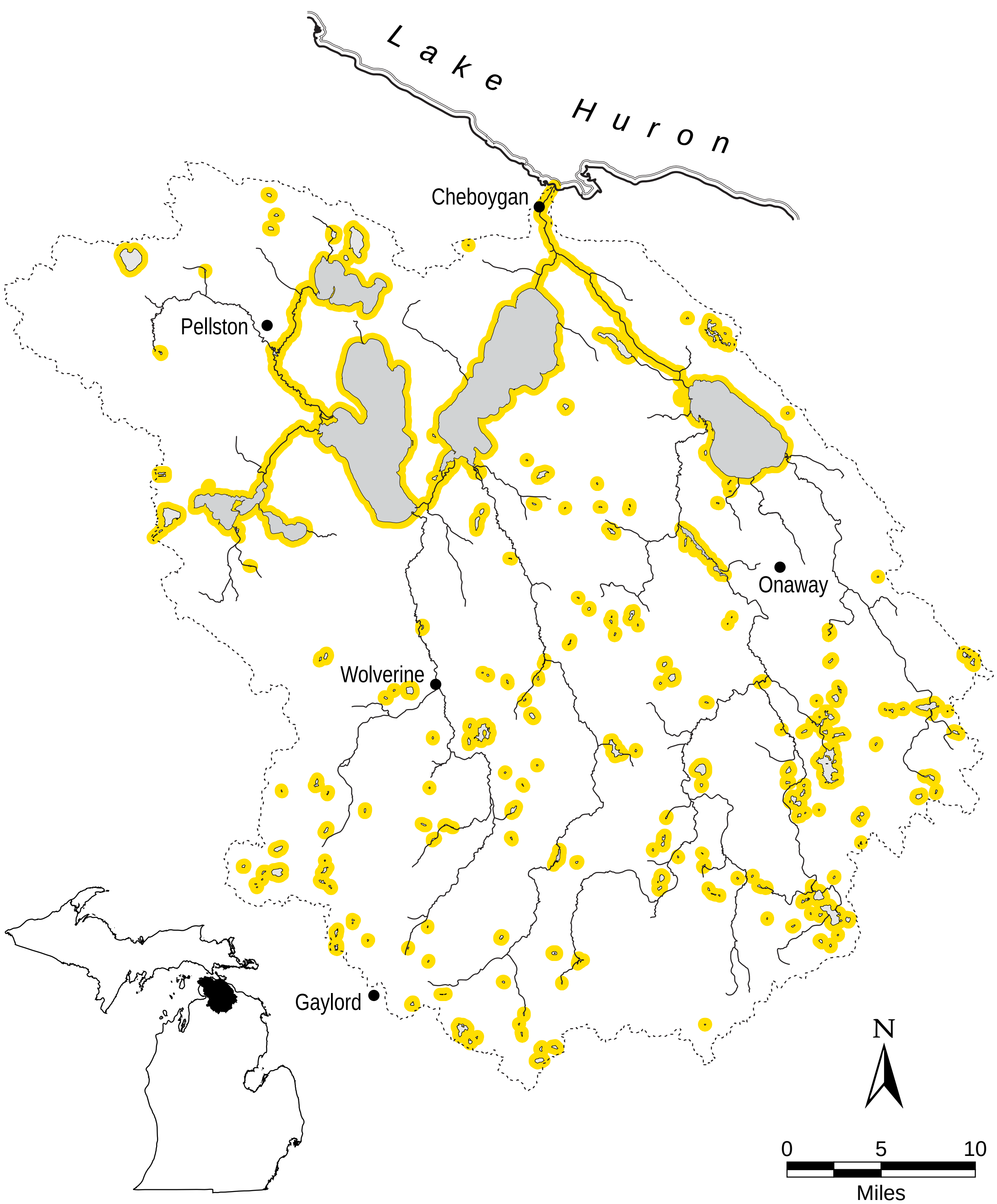


Pumpkinseed *Lepomis gibbosus*

Habitat**:**

feeding - non-flowing clear water in streams and rivers; also lakes and impoundments
- muck or sand partly covered with organic debris substrate
- dense beds of submerged aquatic vegetation

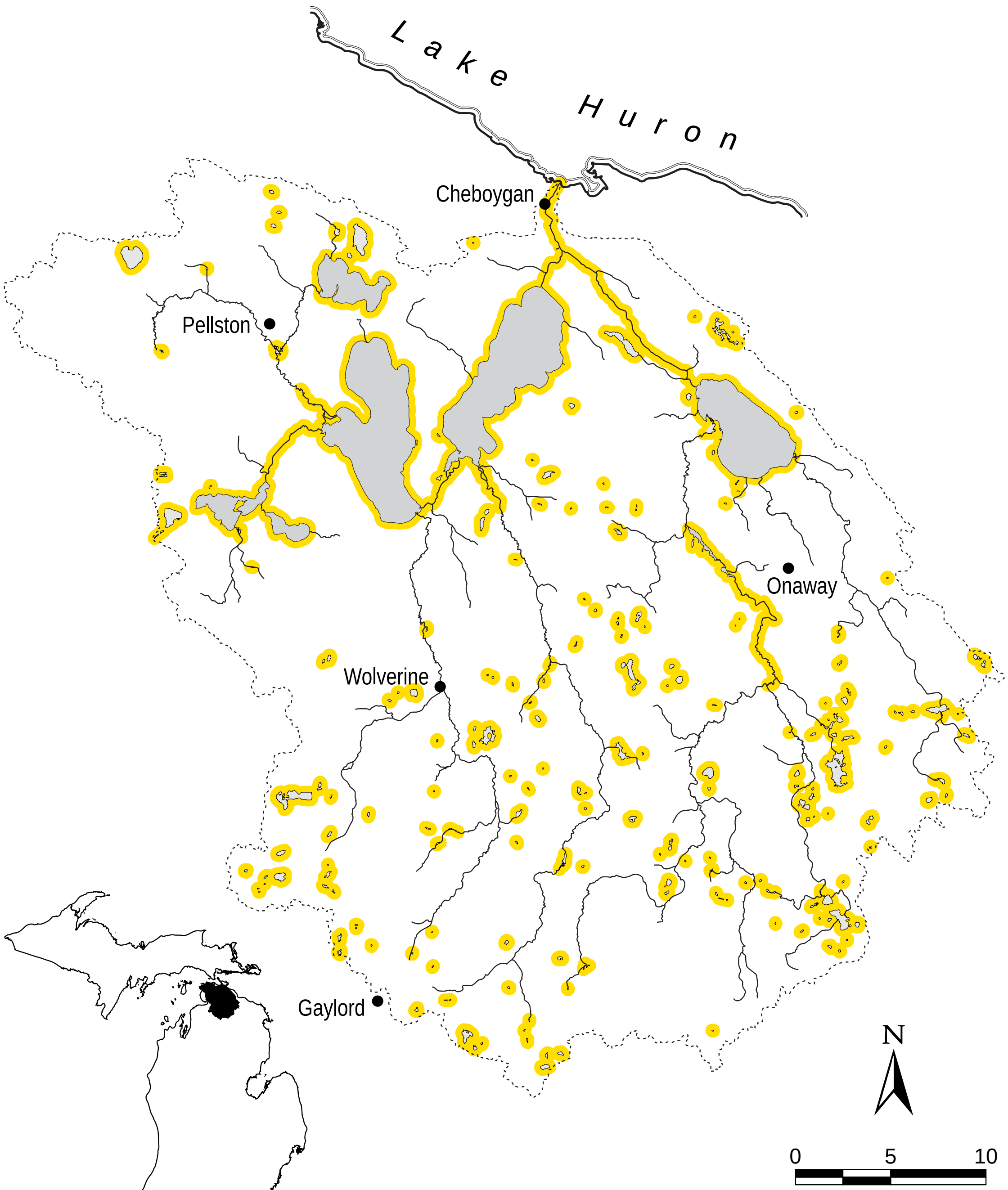
spawning - nest in sand, gravel, or rock substrate
- in shallow water near submerged vegetation



Bluegill *Lepomis macochirus*

Habitat:

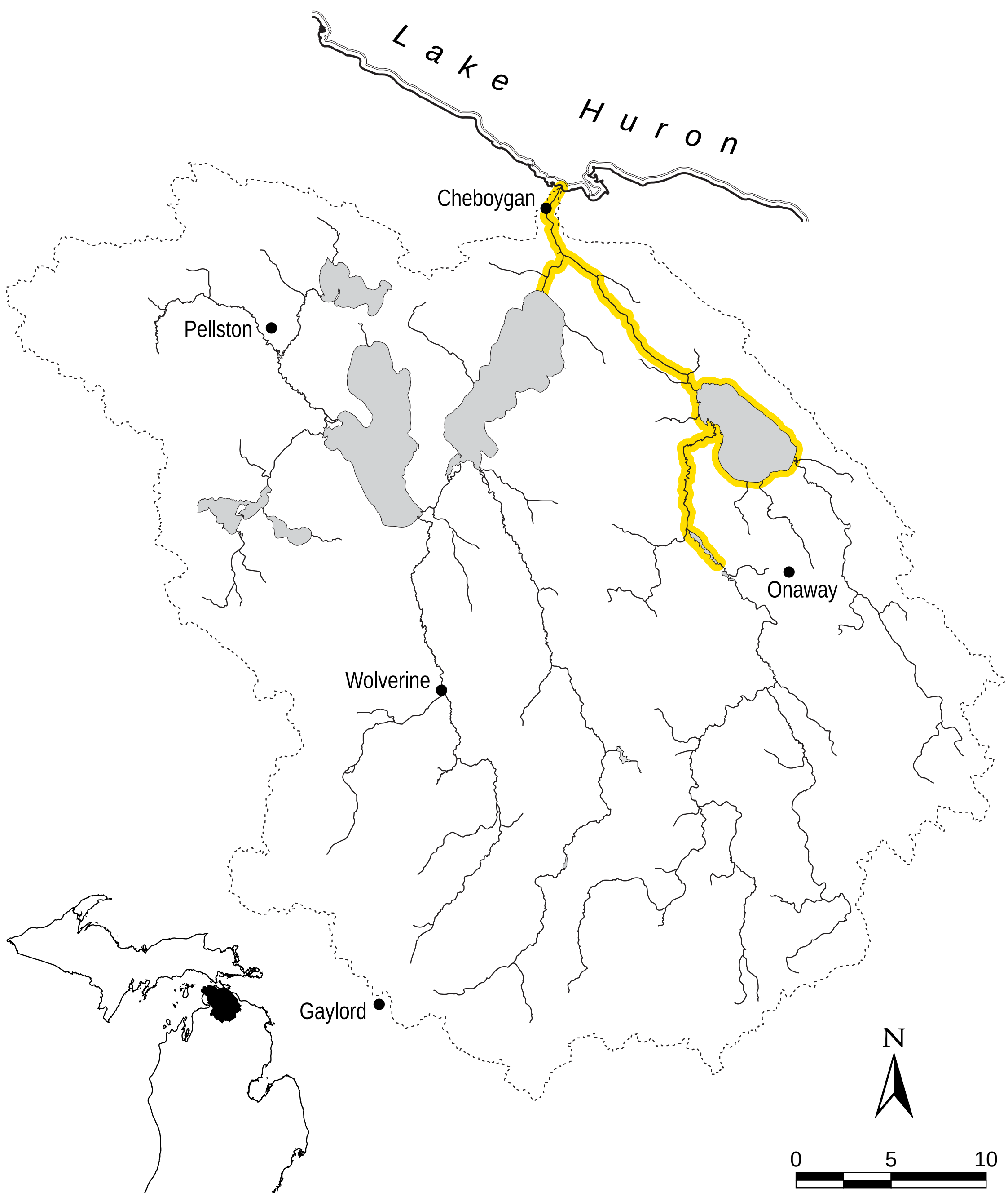
feeding	-	non-flowing clear streams and rivers; also lakes and impoundments
	-	sand, gravel, or muck containing organic debris substrate
	-	scattered beds of aquatic vegetation
	-	cannot tolerate low oxygen or continuous high turbidity and siltation
spawning	-	nests in firm substrate of gravel, sand, or mud
winter refuge	-	deep water



Northern longear sunfish *Lepomis peltastes*

Habitat:

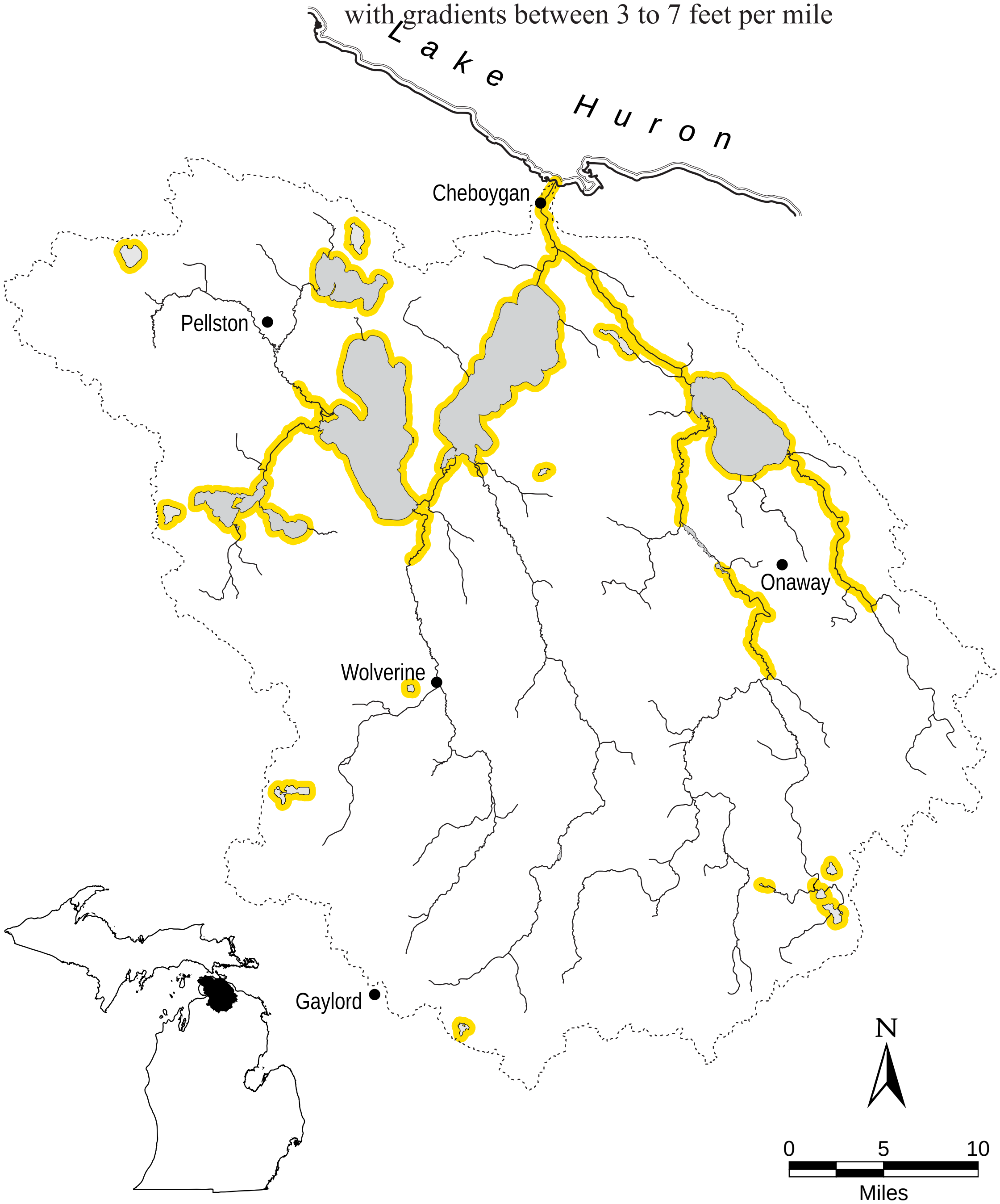
feeding	-	clear moderate-sized shallow streams with moderate vegetation
	-	rocky substrates
	-	little to no current
spawning	-	nests in gravel, sand, or hard rock substrate



Smallmouth bass *Micropterus dolomieu*

Habitat**:**

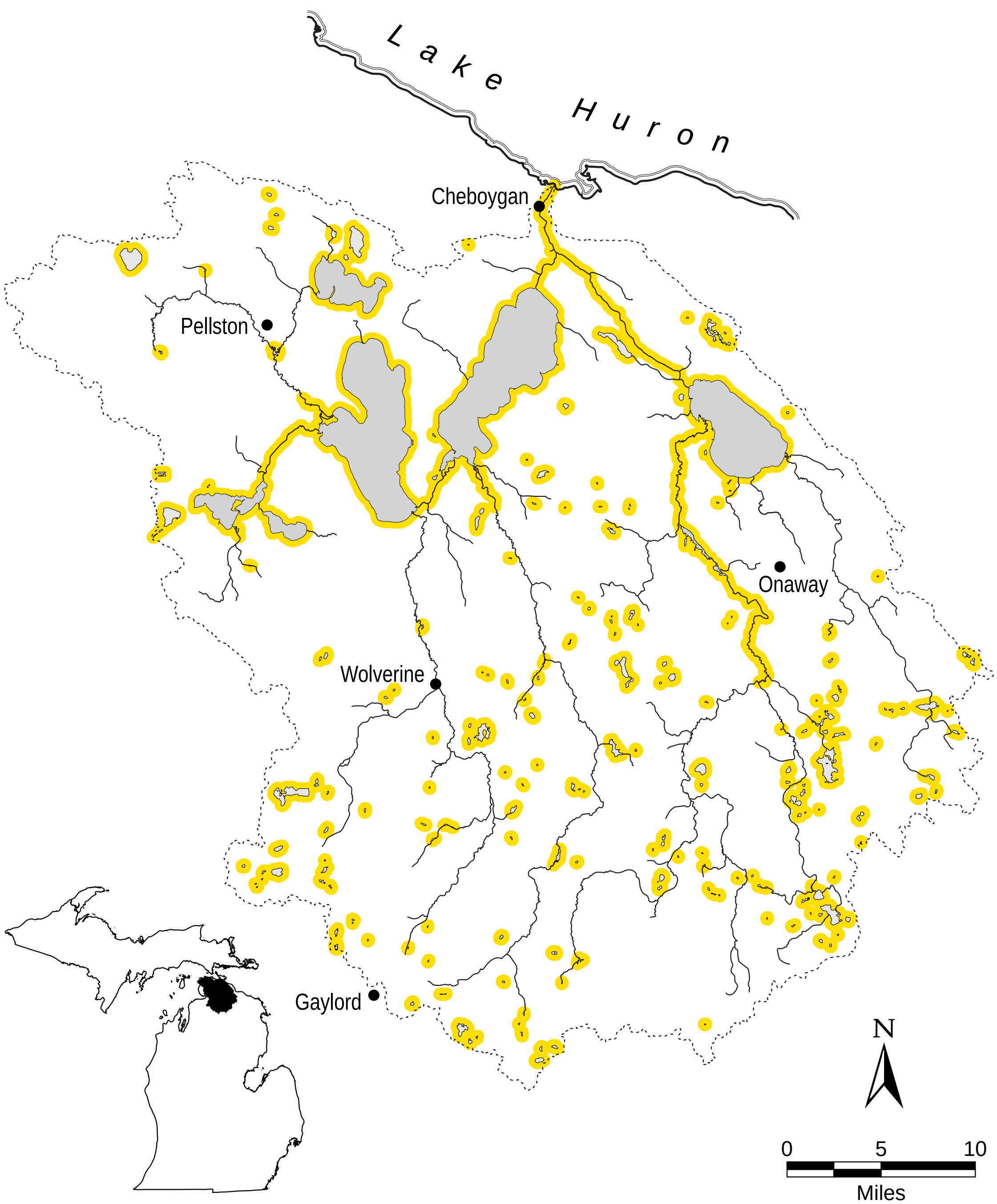
feeding	-	clear, cool, deep lakes and rivers
	-	streams where 40% consists of riffles over clean gravel, boulder, or bedrock substrate
	-	in pools with a current and >4 feet of depth
	-	gradients between 4 and 25 feet per mile
spawning	-	nest in sandy, gravel, or rocky substrate
	-	gradients 7 to 25 feet per mile
	-	streams 20 to 100 feet wide
winter refuge	-	larger deeper waters with gradients between 3 to 7 feet per mile



Largemouth bass *Micropterus salmoides*

Habitat**:**

feeding	-	non-flowing clear waters - lakes, impoundments, and pools of streams
	-	abundant aquatic vegetation
	-	soft muck, organic debris, gravel, sand, and hard non-flocculent clay substrates
spawning	-	nest in gravelly sand to marl and soft mud substrates
	-	emergent vegetation
	-	quiet shallow bays; no current

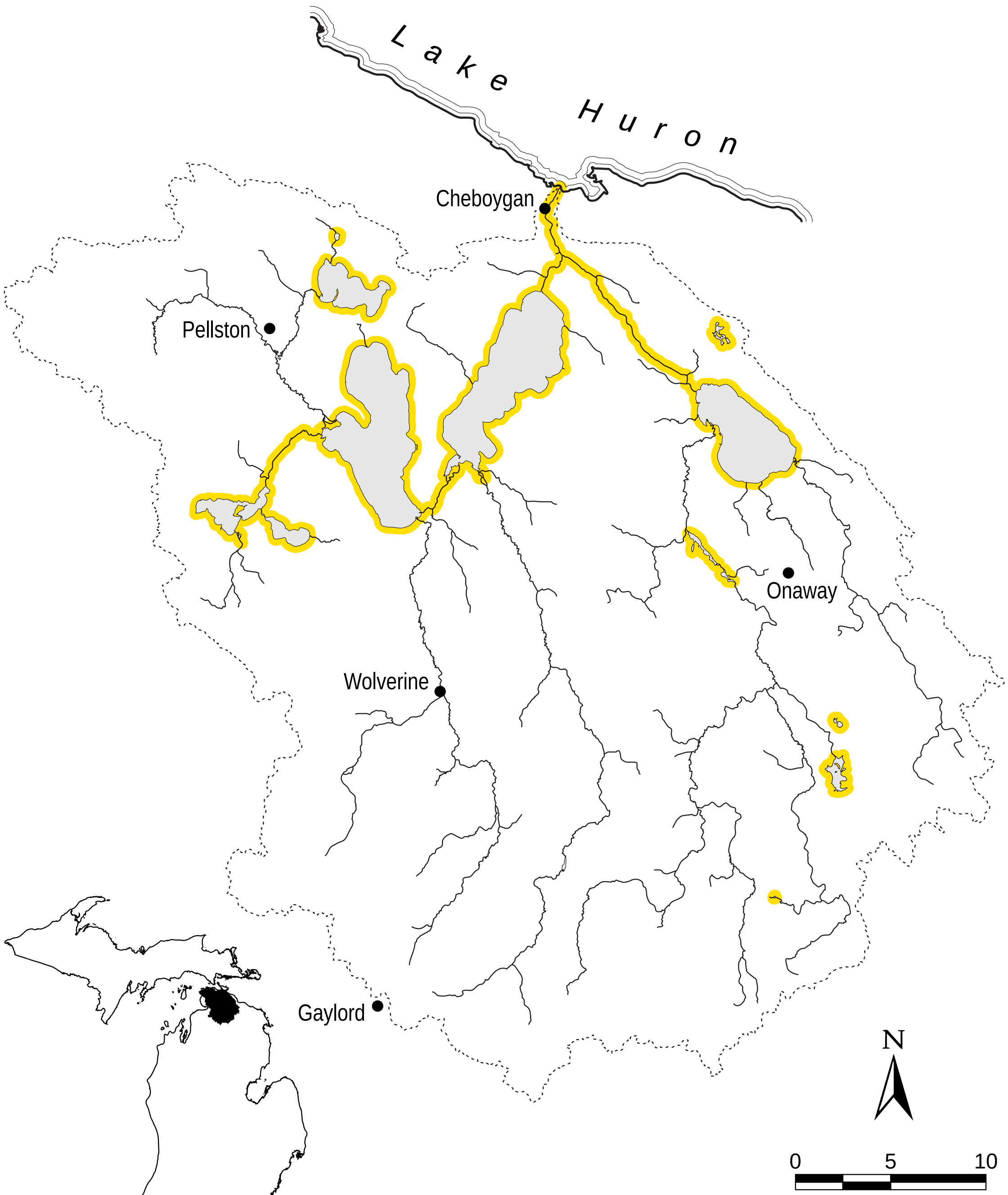


Black crappie *Pomoxis nigromaculatus*

Habitat:

feeding - larger clear non-silty low-gradient rivers; also in lakes and impoundments
- clean hard sand or muck substrate
- associated with submerged aquatic vegetation
- does not tolerate silt or turbidity well

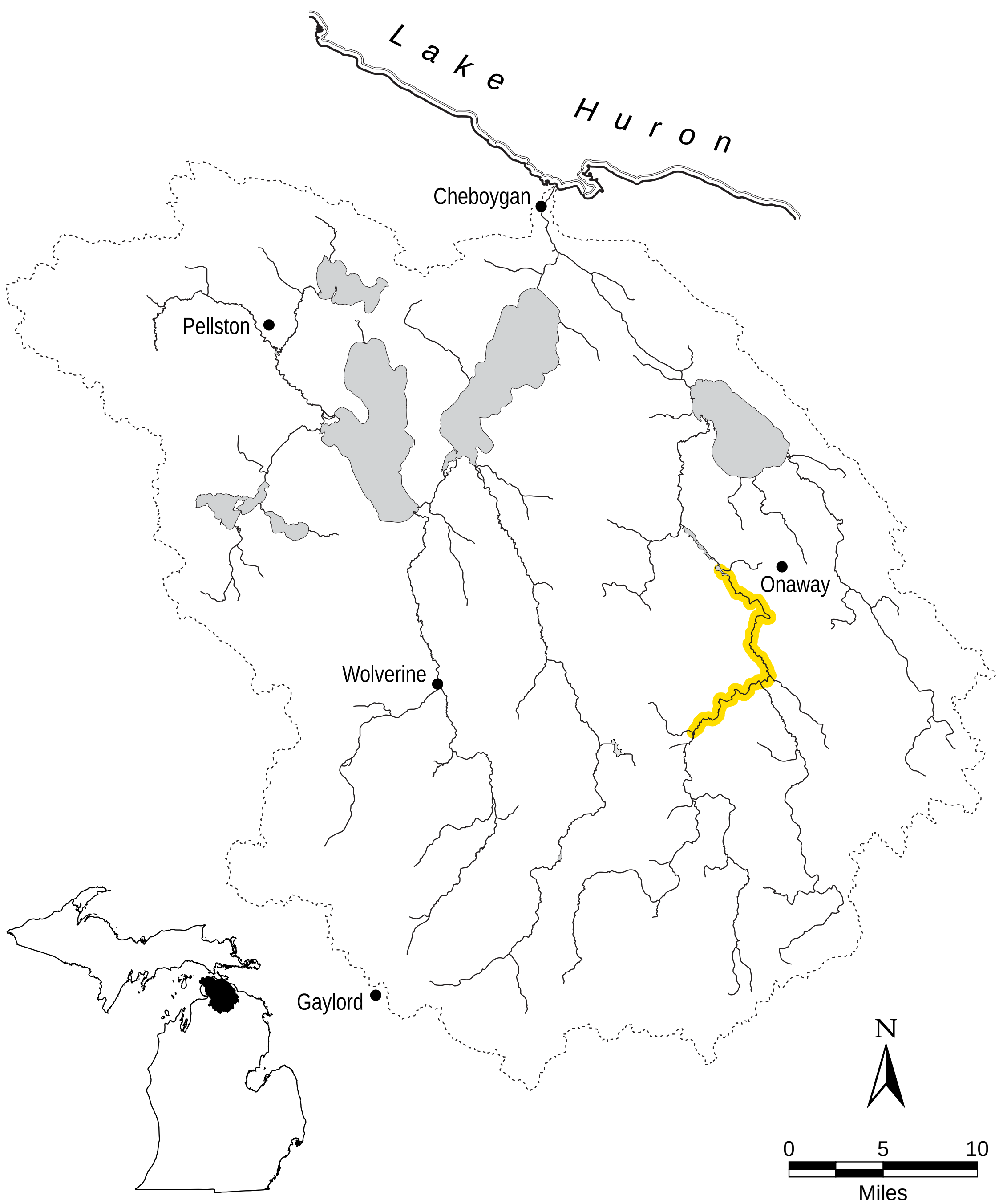
spawning - nests in gravel, sand, or mud substrate
- some vegetation must be present
- sometimes nests under banks



Rainbow darter *Etheostoma caeruleum*

Habitat**:**

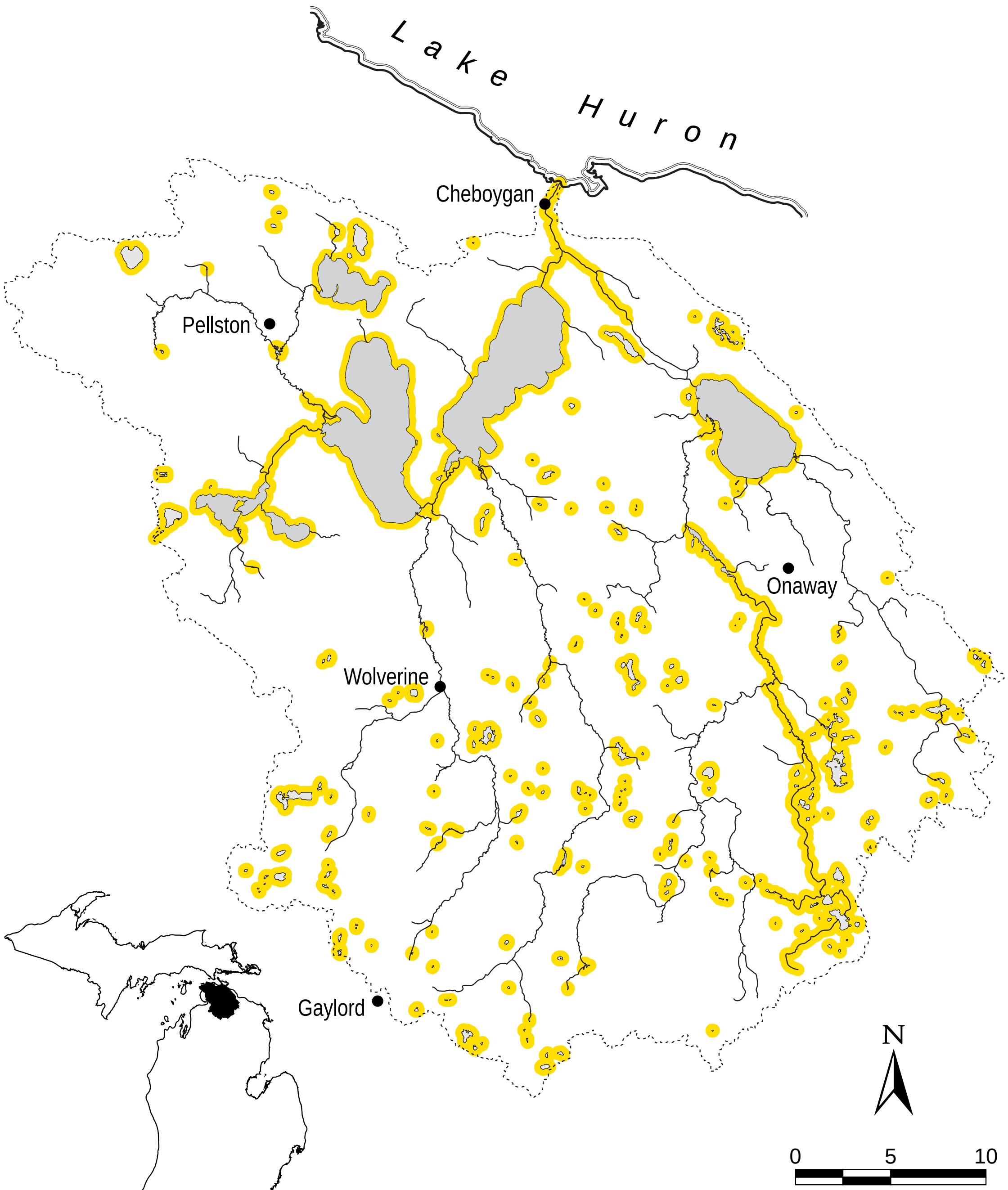
feeding	-	gravelly high gradient riffles
	-	clear, moderate to large streams
	-	in shallows (average 1 foot)
spawning	-	gravel or rubble riffles



Iowa darter *Etheostoma exile*

Habitat**:**

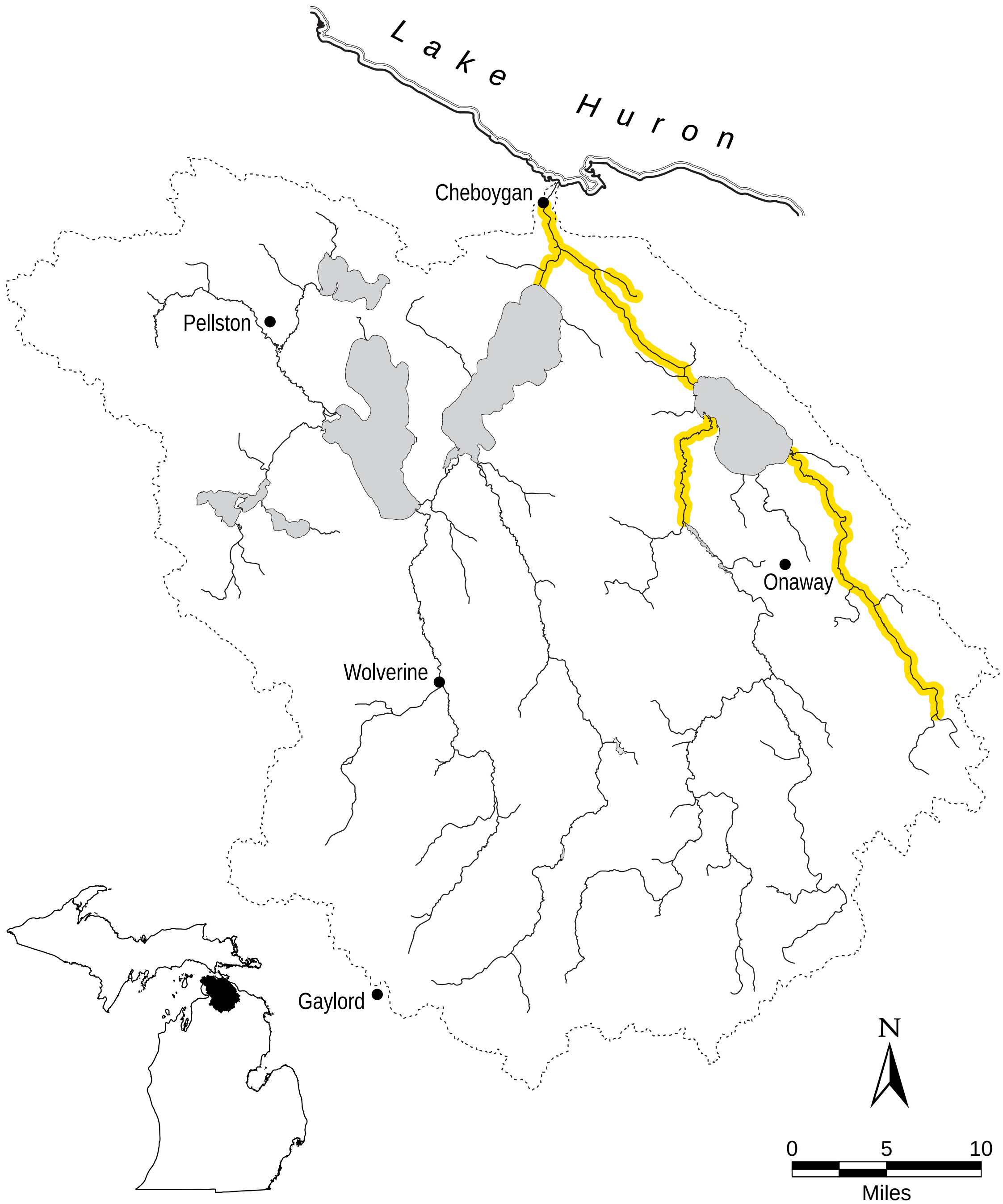
feeding	-	clear, slow moving streams and lakes
	-	sandy to muddy substrates
	-	intolerant of turbid water
	-	lives in rooted aquatic vegetation
spawning	-	in pond-like extensions of streams on organic matter or roots
	-	in shallows



Least darter *Etheostoma microperca*

Habitat:

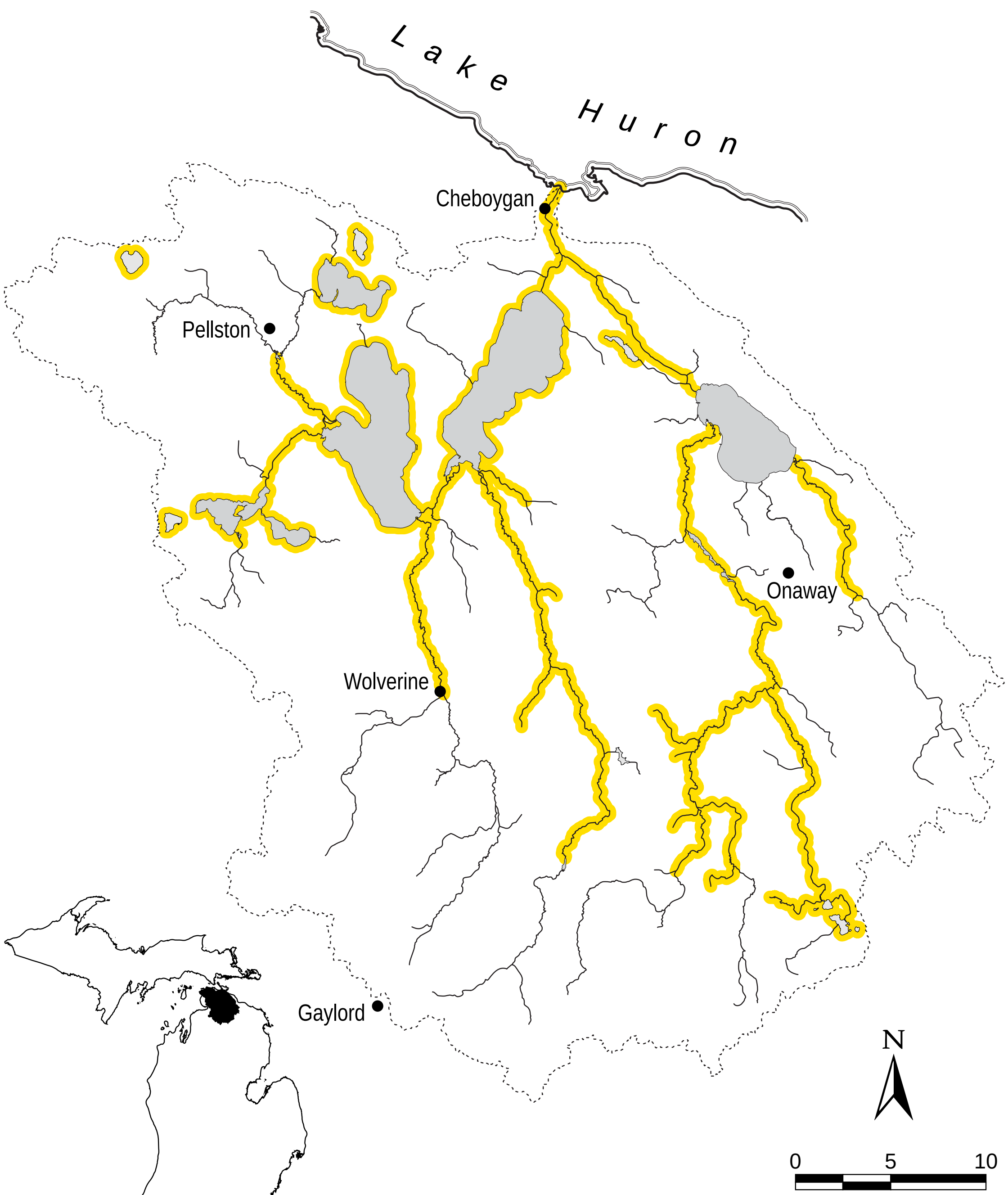
feeding	-	moderate to warm temperature
	-	clear quiet low-gradient vegetated streams (wetlands, floodplains)
	-	soft substrate
spawning	-	spawning occurs on stems of plants
	-	male guards a territory in a vegetated area



Johnny darter *Etheostoma nigrum*

Habitat**:**

feeding	-	sand and silt substrate
	-	little to moderate current
	-	shallow areas of streams, rivers, lakes, and impoundments
	-	tolerant of many organic and inorganic pollutants and turbidity
spawning	-	underneath rocks
	-	in stream pools or protected shallows of lakes

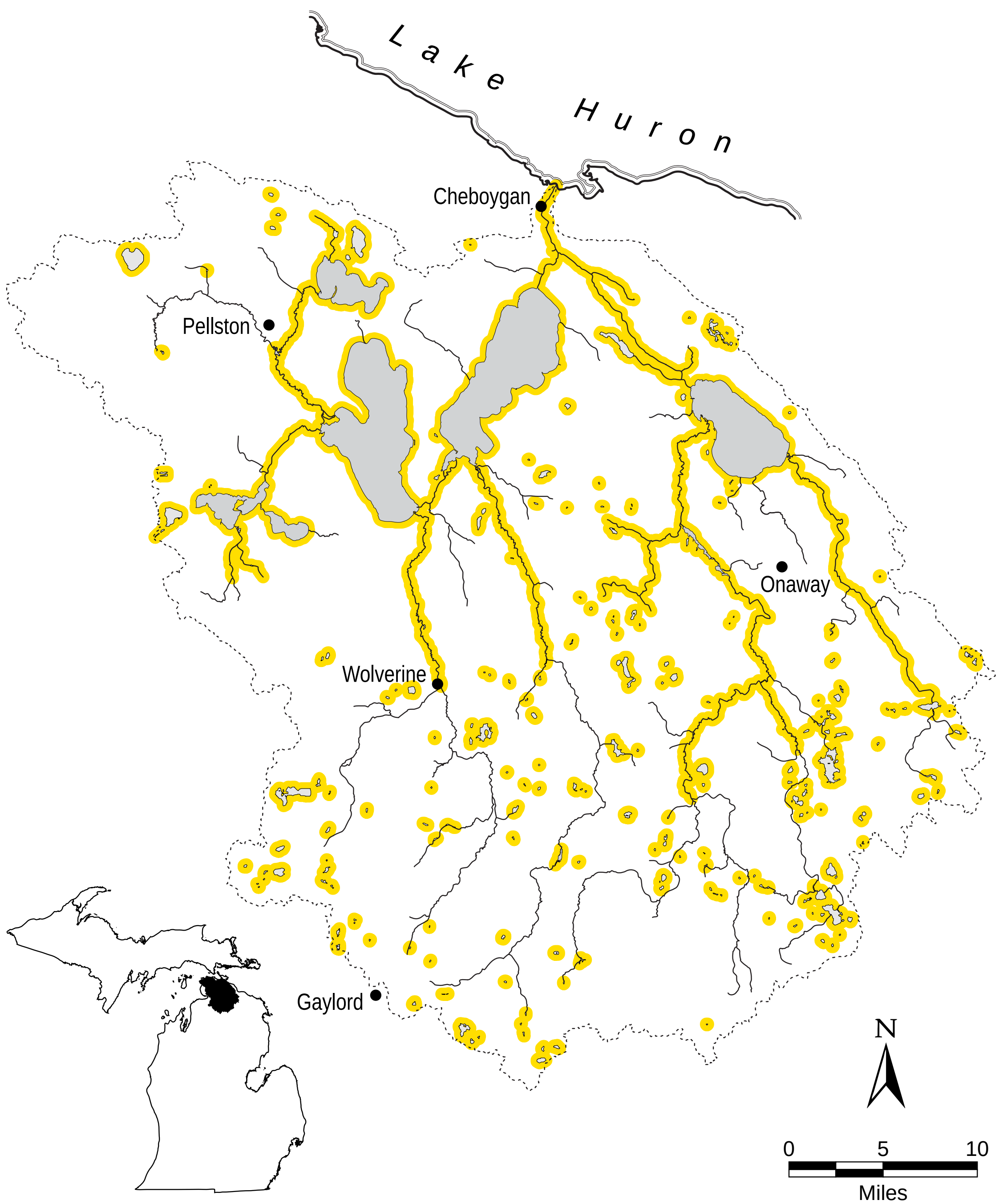


Yellow perch *Perca flavescens*

Habitat**:**

feeding
- clear lakes and impoundments; also Lake Huron
- low gradient rivers
- abundance of rooted aquatics
- muck, organic debris, sand, or gravel substrate
- does not tolerate turbidity and siltation

spawning
- shallows of lakes, tributaries of streams
- occurs over rooted vegetation, submerged brush, fallen trees
- may occur over sand or gravel

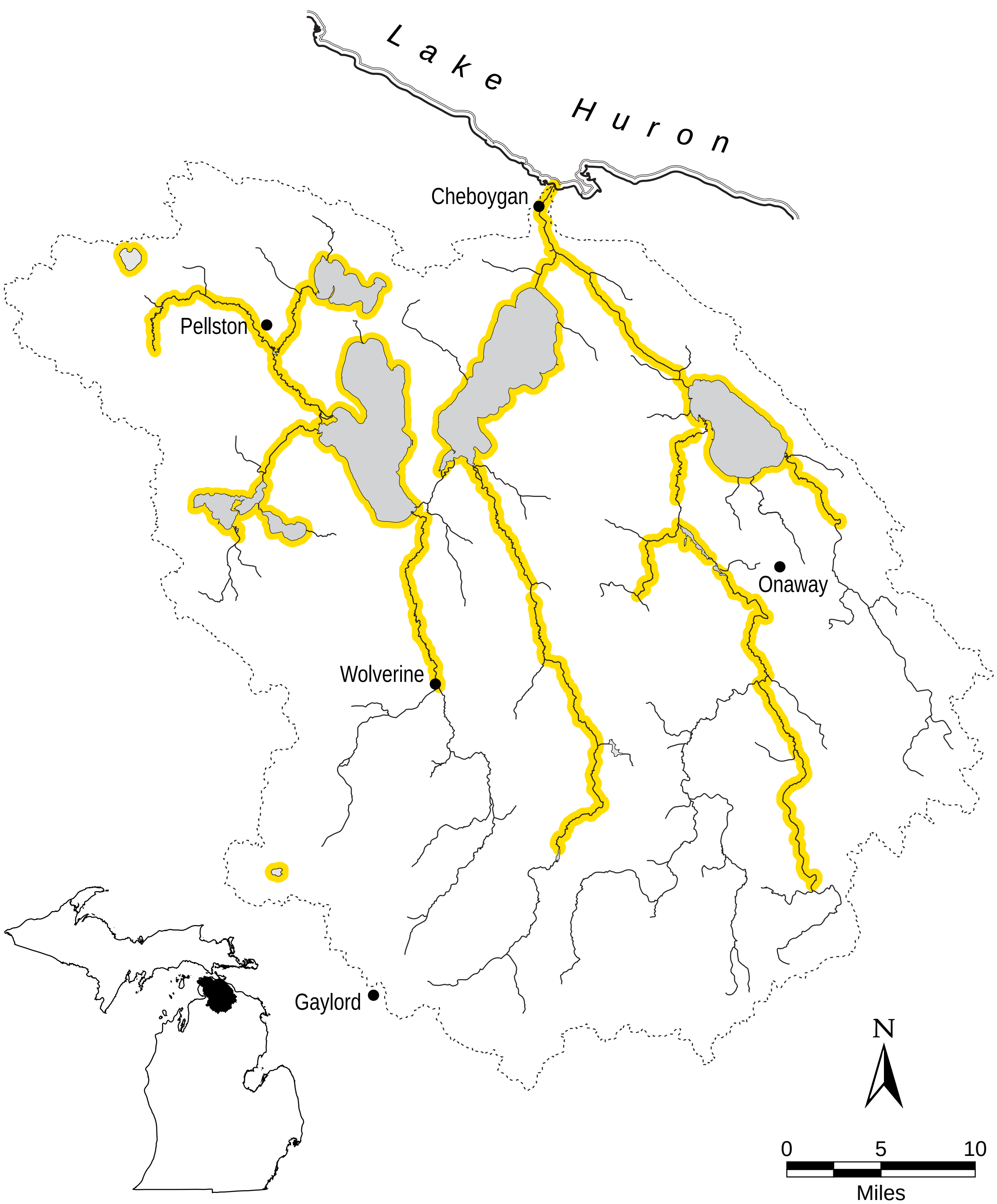


Northern logperch *Percina caprodes semifasciata*

Habitat:

feeding - gravel riffles, deeper slower sections of rivers
- medium size streams; also lakes, impoundments, and Lake Huron
- sand, gravel, or rock substrate
- avoids turbidity and silt

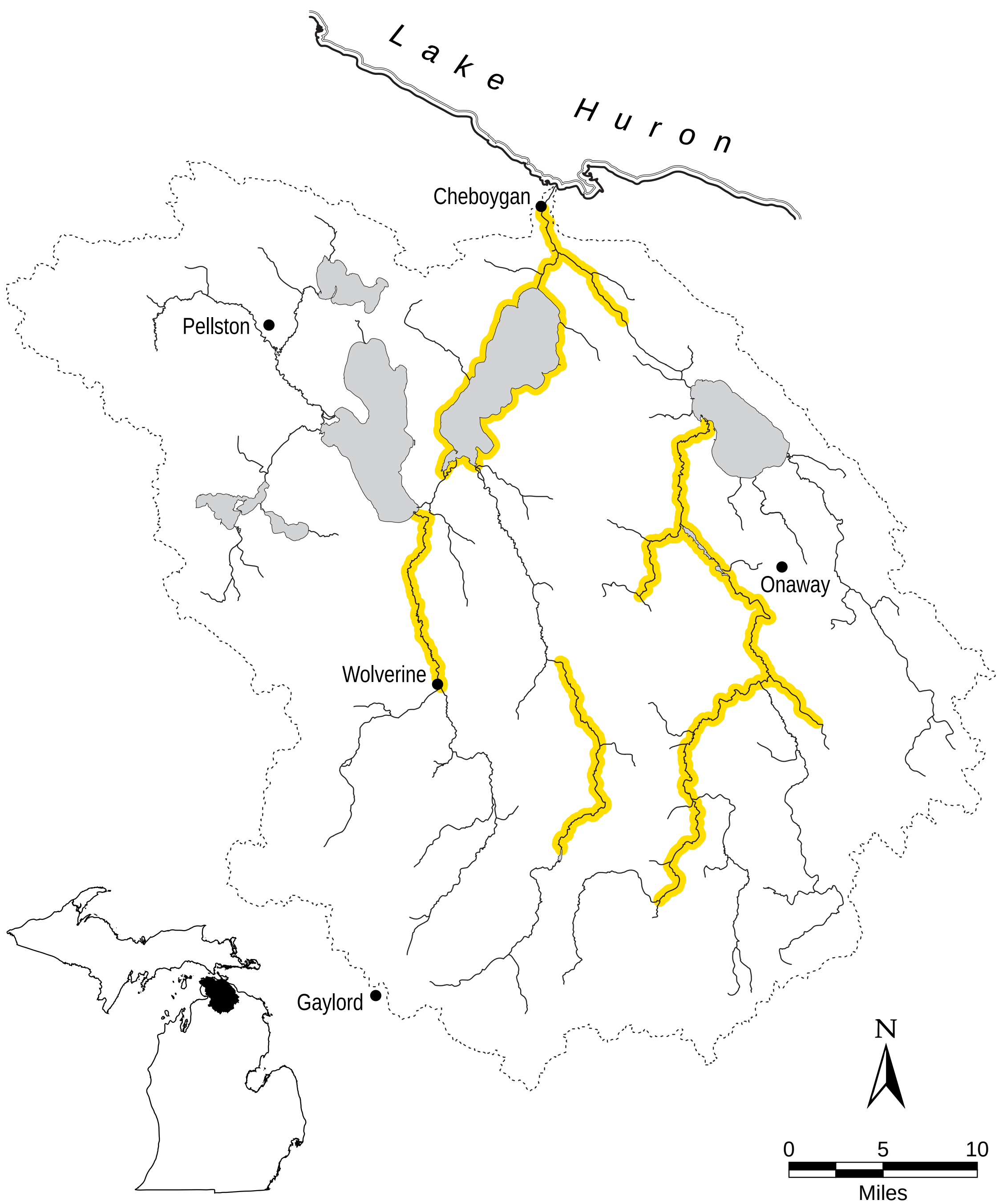
spawning - riffles or sandy in-shore shallows



Blackside darter *Percina maculata*

Habitat**:**

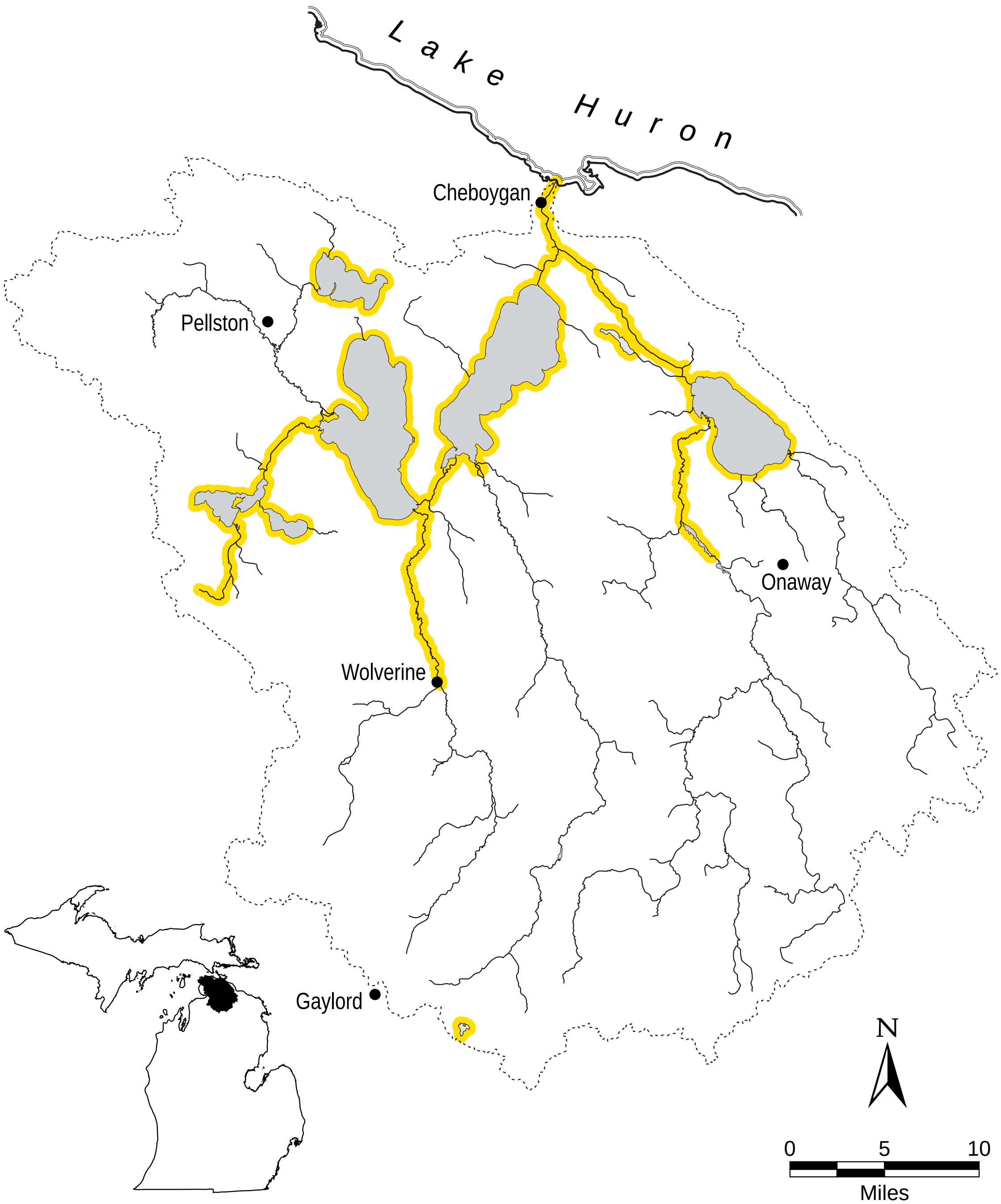
feeding	-	small to medium streams
	-	low to medium gradient
	-	gravel and sand substrate
	-	tolerate some turbidity
spawning	-	gravel and sand substrate



Walleye *Sander vitreus*

Habitat**:**

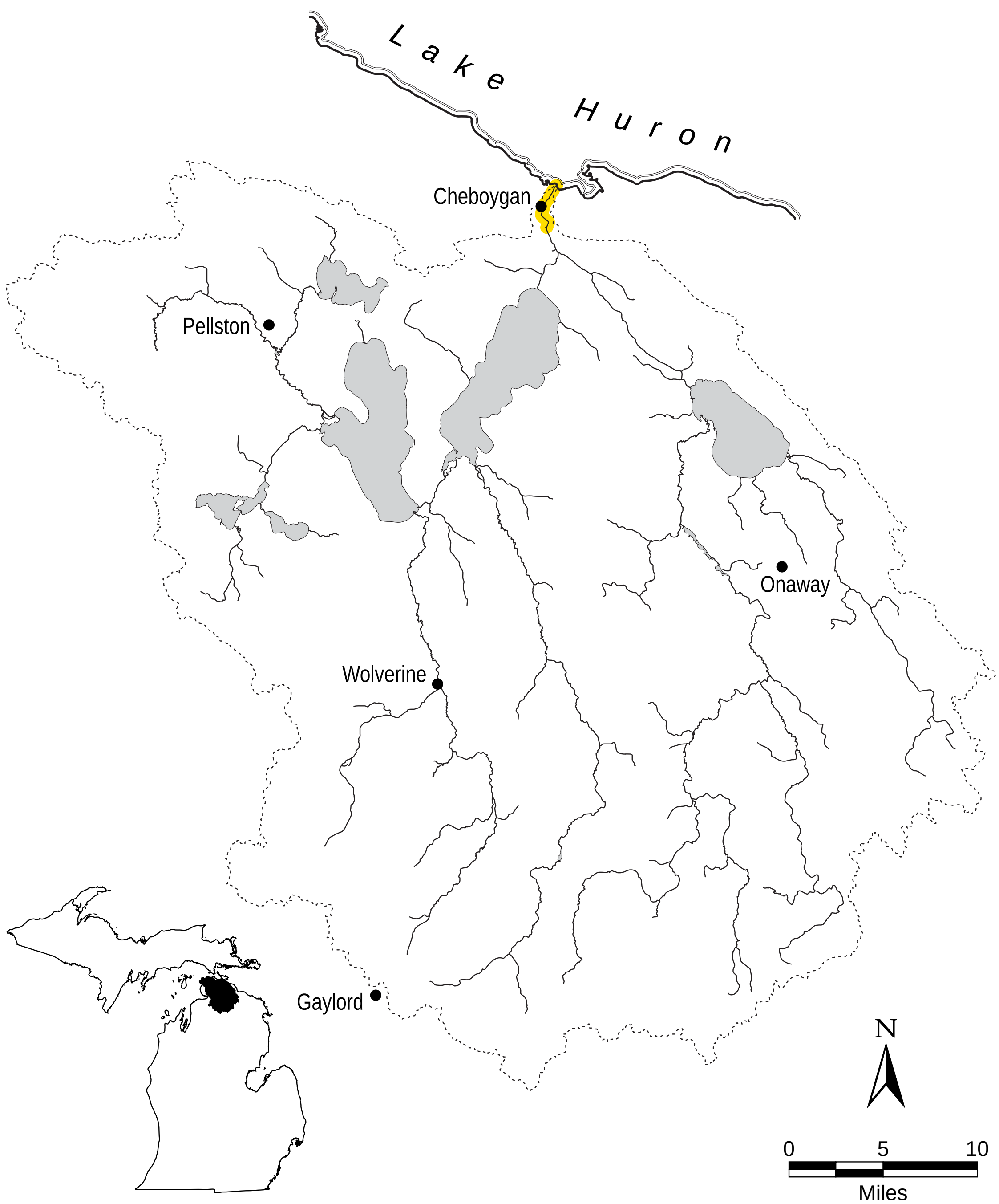
feeding	-	larger, deeper streams and in large, shallow, turbid lakes and impoundments; also Lake Huron
	-	gravel, bedrock, and firm substrates preferred
	-	does not tolerate a lot of turbidity or low oxygen
spawning	-	rocky substrates in high gradient water in rivers
	-	boulder to coarse gravel shoals in lakes
winter refuge	-	avoids strong currents



Freshwater drum *Aplodinotus grunniens*

Habitat:

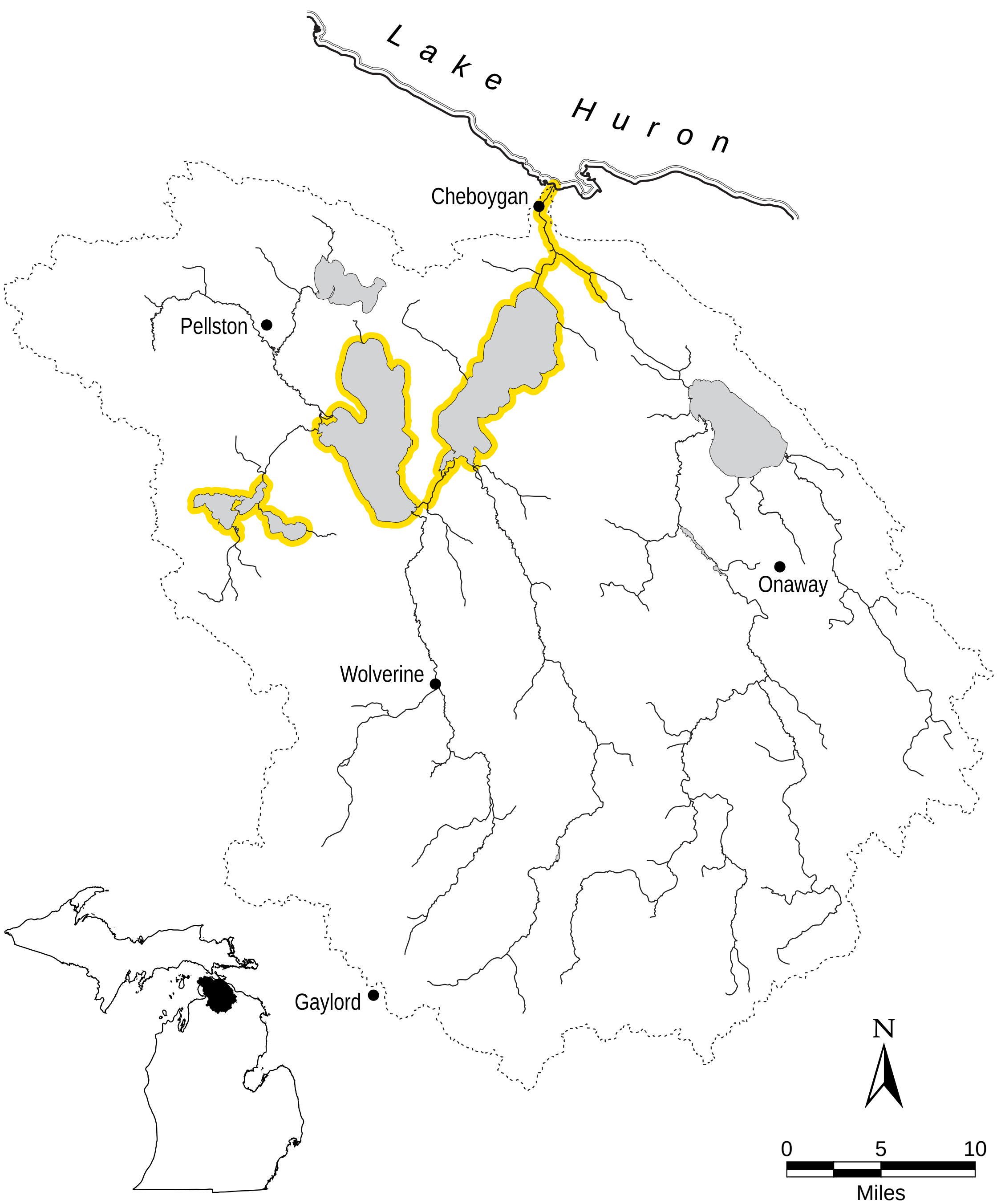
feeding	-	deeper pools of rivers and Lake Huron
	-	in shallows
	-	prefers clear waters and clean substrates
	-	can adapt to high turbidity levels
spawning	-	pelagically, in open water, over sand or mud substrate
	-	occurs in bays or lower portions of marshes



Round goby *Neogobius melanostomus* - **non-native species**

Habitat**:**

feeding	-	rock,cobble,riprap,and vegetate areas of rivers and lakes
	-	young found over sand substrate
spawning	-	rocky substrate with large interstitial spaces
winter refuge	-	rocky substrate with large interstitial spaces
	-	deep water



Appendix D.–Direct contact angler creel data for various streams and lakes in the Cheboygan River watershed. Numbers are direct observations from conservation officers and not subject to number expansion over time.

County Lake/River	Year	Total hours	Species Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
Charlevoix																			
Hoffman Lake	35–46	111.50	21		13	6		10		2									
Lake Louise (Thumb Lake)	28–29	312.50	2		6	4						613							
	31–34	92.50					1			30		645							
	40–49	1,777.25	50		75	142	49	100	25	10		369							
	50–59	4,902.00	489	6	726	142	54	259	54	32		228					2		
	60–65	2,374.00			576	9		17	5			104					69		
Sturgeon River	38	23.50	11																
	42	16.00	10																
	52	1.50	1																
Sturgeon River West Branch	43–46	55.50	53																
	51–53	31.50	76																
	62	2.00		2															
Charlevoix and Otsego																			
Booth Lake (Standard Lake)	42–49	206.50				2	20	49				3							
	50–59	406.50				9	55	257	11			1							
	62–64	8.00						13											
Cheboygan																			
Black Lake	30–39	276.00				6	4	15	16	24		100	73	64	27	2			
	40–41	318.50				8		11	56	31		31		9	3				
Burt Lake	28–29	441.00			2	2		7		1		32	57	235			1		
	30–39	725.00	1		59	10	2		5	11		544	86	548		1			
	40–49	3,438.55			14	6	3			88		604		517	73		2		
	50–59	8,506.00	2	2	56	8		3	4	60		1,303		856	71	1	16		
	60–65	11,799.75		1	18	18	5	11	11	80		1,418	25	1,133	53	2	1		

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
			Species																
Cedar Creek	39	5.00			1														
Cheboygan River	37–38	25.75				3		10		21		3		3	2				
	40–49	1,401.25				35	2		31	293		1,546		30	42		1		
	50–59	1,227.50				15	1	10	16	232		1,420		17	18		1		
	60–64	338.00				17	2	15	29	78		347		44	1				
Cochran Lake (North Twin Lake)	46	4.50																	
	50–59	124.75				4	5	129	3			181			1	1			
	60–62	89.00			33			1											
Crooked River	30	5.00											1	1					
	62–63	6.00								1									
Devereaux Lake	41–46	33.50				2			9										
	53–54	13.00								2		44							
Dog Lake	32–39	12.50											4						
	40–47	77.75													3				
Douglas Lake	28–30	184.00				8	6		8	31		6	55	2					
	40–49	878.25				24	17	17	78	57		46			67	1	9		
	50–59	2,200.50				28	32	368	444	264		110		5	171	1	13		
	60–64	1,184.00				44	17	451	86	173		154		4	83	8			
Hemlock Lake	34–35	668.00	315																
	40–47	35.00	4		10														
Lancaster Lake	48–56	17.00	1			1			4					1	1				
	61	67.50						49											
Lance Lake	29–38	13.50					3	40	1			8							
	51–63	16.75						3				22							
Laperell Creek	30	2.00	6																
	41–49	154.00	98	1															
	56–59	17.00	3																
	60	25.00	6																

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
			Species																
Little Carp River	44–48	25.00	4		1														
	53–59	68.00	31	1	4														
	61	45.00	38	2	16														
Little Pigeon River	29	36.00	32																
	40–48	140.50	50																
	50–58	11.50	4																
	61–62	10.00	8																
Long Lake	40–49	166.00				6	2	1	2	43		1			7		3		
	60–62	95.00				2	1	26		8		3		3	3				
Lost Lake	34	69.00	27																
Maple River	28	13.00	15										4				2		
	30–39	32.00	56		2														
	41–48	56.00	7	3	72					1									
	58	14.00																	
McLavey Lake	42–59	40.00										12			5				
McPhee Creek	35	3.50	1																
Mud Creek	29	4.00	6																
Mud Lake	43–58	5.00													1				
Mullett Lake	28–29	102.00				1				8		10	19	2		5	1		
	30–38	216.50				1						1	37	64			2		
	40–49	2,745.05				25	5	18	30	105		612	1	105	92	3	1		
	50–59	4,588.00				30	1		6	148		796		135	95	13			
	60–64	2,146.25				19	10	2	3	47		587		91	52		29		
Munro Lake	41–48	108.50				2	5	5	7	1		21			15				
	60–62	108.00										7			12				
Osmun Lake	42–47	121.00				9	17	21	23			2							
	50–54	12.50					1		7			5							

Appendix D.–Continued.

County Lake/River	Year	Total hours	Species: Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
Pigeon River	28–29	186.50	175		24								28	6					
	30–39	939.00	652	6	94								7	13					
	40–49	1,740.20	753	388	382					1				2	5		3		
	50–59	173.25	28	9	115					2				1	1		127		
Silver Creek	35	2.00	8																
Silver Lake	28–29	30.50				4						84							
	30–38	19.50				3	7			10		13	11	1					
	40–48	184.25	7		9		35	1		13		40		6					
	50–59	1,563.50			538	4		10		4		5		5			11		
	60–64	945.25			380			4	12	29		14							
Stewart Creek	38	16.25																	
	42–49	15.50			3														
	59	2.00	5																
Sturgeon River	28–29	816.50																	
	30–39	4,391.00	216	220	2,151	9	3	1	1	3		5	1	77		4	31		
	40–49	3,437.65	101	765	950									152			121		
	50–59	4,934.00	200	343	1,646		1							14			374		
	60–64	1,910.10	26	156	470									5			327		
Sturgeon River West Branch	28–29	143.00	106		11														
	30–39	271.50	236		84														
	40–49	1,305.15	835	162	203														
	50–59	1,386.25	654	119	557														
	60–63	310.50	187	39	81														
Tower Pond (Black River)	43–49	621.50	2			3		3							70	14	157		
	62–64	60.00			1							2				3	1		
	50–59	276.50													41		17		

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
Twin Lake	32–39	132.00				1		99	27	24			35			33			
	40–49	371.50				7	2	174	53	14	1	9	4	1	1	1			
	50–59	467.00				6	26	270	32	7		3			12				
	60–61	108.00				2	9	56	2	3									
Twin Lake North+South (Cochran+Roberts Lake)	45–49	367.25				3	9	123	14	27		16			13				
Twin Lake South (Roberts Lake)	42–43	35.00				7	1		4										
	50–59	85.00						128				27			2				
	60	15.50													1				
Weber Lake	41–48	68.50	6			1	6	1				134							
	50–59	1,498.50	994		89			145											
	60–64	576.75	91	112															
Cheboygan and Presque Isle																			
Black Lake	42–49	2,823.50				21			7	91		45		218	112		6		
	50–59	5,166.50				17	4	1	34	245		348		218	139		1		
	60–64	3,488.50				19	3	2	10	81		114		320	32				
Emmet																			
Arndts Lake (Arnott Lake?)	28	21.00					11												
Brush Creek	33–34	18.50	21																
Cedar Creek	28–29	16.00	15																
	31–39	11.00	11																
	42–48	118.50	227		1								2						
	50–58	91.75	134																
	60	5.00	5																
Cold Creek	46	1.25	1																

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
			Species																
Crooked Lake	29	98.50						5	1	11		58	37	25		41			
	31–39	614.50				26	3	54	47	34		789	41	17	1	12	26		
	40–49	3,810.20			2	112	8	268	358	221		5,059		146	353		157		
	50–59	3,864.00			1	174	2	1,902	653	732	5	2,547		168	141		53		
	60–64	2,102.50				76	11	679	87	233	12	660		68	28	12	6		
Crooked River	28–29	276.50				9		2	1	6	15	12	12	226	10				
	31–39	163.50					23	22	14	60		17	31	66	23				
	40–48	412.50				4		13	27	256		70		57	33	30			
	53–59	79.50			8			6		35		30		10	21				
	60–63	160.00			2			9	1	8		17		8	2				
Larks Lake	42–48	46.50				7	2	11	16	14		1			4	3			
	54–58	126.00				2	6	71	45	15		20			1				
	62–63	75.00						13	88										
Maple River	28–29	573.00	655	6	6									2					
	30–39	449.50	417	7	69														
	40–49	473.25	202	203	263									1					
	50–59	553.50	113	179	306												5		
	60–64	265.00	40	11	55									1			11		
Maple River, East Branch	30–35	18.25	34	13															
	40–49	120.25	9	343	1														
	50–58	62.00	7	61	16					2							5		
	60	6.50	1		1														
	30–39	154.00	161		2														
	40–49	768.40	1,038	18	8														
	50–56	599.50	553		1														
	60–63	276.50	237	4	206			1											

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
			Species																
McPhee Creek	29	8.00	13																
	30–37	9.25	12																
	44–49	103.50	340																
	50–59	56.00	73																
Minnehaha Creek, West Branch	56	13.00	5		1														
Mud Creek	29	3.00	7																
Mud Lake	42–43	20.00						2	3	7					3				
Pickerel Lake	28–29	101.50				6	3		11	10		24	5	14		3			
	31–39	84.75					4	17	20	20		38	23	36	2		2		
	40–49	385.75				17	2	18	1	10		162	0	25	44		23		
	50–59	941.50				40	5	406	165	179		390	0	64	12		3		
	60–64	867.50				34	21	108	11	80		82	0	38	3				
Round Lake	29	9.00				2							35						
	30–39	256.25				26	19	142	132	96		17	55	16					
	40–49	1,041.55				63	20	304	174	258		59	23	35	258		2		
	50–59	764.50				49	22	730	275	143		143			77	3			
	60–64	512.00				10	4	499	92	26	3	46		1	11				
Silver Creek	29	65.50	192																
	31–39	85.25	144																
	40–48	112.25	185	1															
	50–59	91.00	154		2														
	62	6.00	11																
Van Creek	28–43	18.50	37																
Whites Creek	44	4.00																	

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
			Species																
Montmorency																			
Brush Creek	28–29	18.50	36		2														
	32–39	64.00	70										17						
	40–49	674.75	446		2							1			2				
	50–59	934.00	921	2	3												8		
	60–64	104.00	58																
Clear Lake	30–35	870.00	5		1	262			6	110		433				2	35		
	40–49	929.25			41	19	3	11	5	5		82			4				
	50–59	1,732.50	16		537	5						61					134		
	60–64	3,129.50		7	943							131					10		
Foch Lakes	59	3.00													1				
	60–64	107.00						44				41			12				
Jackson Lake	34–38	52.50				5	22	7	130			22							
	42–49	260.25				34	7	232	12			23							
	51–59	24.00						58				7							
	61–64	118.00					2	242	10	4		19							
Lake Valentine	38	5.00				7													
Little Joe Lake	32	3.50				2				1		2							
Little Tomahawk Lake	55	15.00				2			6										
Muskellunge Lake	34–37	302.50										28	12		9		7		
	46	11.00													2				
Northern Tomahawk Lake	32	2.00											1						
Pug Lakes	48	6.00					1	2											
	55	11.00	1					5	1			7			2				
	62–63	15.00					1	8		1		7					2		
Tomahawk Lake	36	8.50					9						10						

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
			Species																
Town Carrier Lake (Town Corner Lake)	29												1						
	40–41	16.00				2		17	8						2				
	62–64	20.00													4				
Twin Tomahawk Lake	40–49	97.00					1	45	61			5			14				
	50–59	78.00					2	26	18	4		7			13				
	61–64	51.00					3	35		3		11			7				
Walled Lake	30	3.00										8							
West Town Corner Lake	42	43.00	1			25													
	61–63	53.00					4	31				4			4				
Otsego																			
Big Lake	51–58	390.50			170										2				
	60–62	72.25			35							2			1				
Club Stream	28–29	6.50	19	2															
	47–49	23.00	42																
	59	1.00	1																
Finnigan Lake	37	24.00	18																
Ford Lake	42–48	17.50	25					4											
	51–56	9.00	2					4											
Grass Lake	38	10.50				15		3											
	42–48	50.50				2	1	67	30						4	2			
	50–59	124.50				13		202	9						11				
	60–63	15.50		2				8	19										
Lost Lake	30–39	1,242.75	570		1														
	44–48	51.50	58																
North Twin Lake	45–48	34.50	26		1														
	50	42.00		43															

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
Pickerel Lake	42–49	139.00			44	2	2	146	1										
	50–59	2,699.00	25	4	2,189	1	23	175	27			17				120			
	60–64	302.00			209			6				1							
Pigeon River	28–29	979.50	1,106	1	76														
	30–39	1,567.25	1,944	37	151														
	40–49	1,406.75	1,113	135	178														
	50–59	590.50	471	86	40														
	60–64	93.50	119	1					2			6							
Round Lake	29	22.00					1					13							
	30	6.00					1					4							
	42–49	23.00						2						1					
Section Four Lake	38	5.00			2														
	50–55	18.00		14				21											
South Twin Lake	38–39	5.25	1		3														
	42–47	102.50	23		8							4							
Sturgeon River	28–29	66.00	77		9														
	32–39	119.00	71	2	33														
	40–49	575.50	226	60	126														
	50–59	332.50	169	48	66														
	60–64	49.50	15	9	11														
Sturgeon River, West Branch	28	3.50	18																
	30–32	13.00	31																
	40–48	51.00	42																
	50–59	85.00	83	2	18														
	60–63	14.00	11	4	1														
West Lost Lake	34–35	597.75	234																
	44–47	28.50	4		5							9							

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
Woodin Lake	49	8.00					1												
	50–52	33.00					6												
Presque Isle																			
Bear Den Lake	30–39	19.00				2		29					6		2				
	40–49	66.00	1			2	5	22	3			7			2				
	51–56	273.00	347	3															
	60–64	207.00	100												1				
Francis Lake	47–49	173.00				3	10	27	7		4	32			13				
	50–57	311.00				6		22							26				
	62–64	16.00						8	6			2							
Hackett (Hacket) Lake	46–47	10.00							22										
Healy Lake	38–39	8.25	2					4	1			3			3				
Hessler Lake	43–49	102.00					1					13							
Krauth Lake	46–48	26.00										1							
Little Tomahawk	42–48	93.75				11	7	38		2					3				
Loon Lake	42–49	72.50						2	2			124				36			
McAvoy Lake	40–49	50.00				5		38				20							
	51	20.00				1		62											
Mud Lake	32–39	16.50					3	26	3						11				
	40–49	78.00													24				
	59	2.00						9	2			1							
	62	10.00													1				
Rainey Lake	63	14.00										6							
Shoepac Lake	42–49	125.00				5		48	1	23				1	3				
	50–58	179.00				37		100		11		4			15				
	64	4.00																	

Appendix D.–Continued.

County Lake/River	Year	Total hours	Brook trout	Brown trout	Rainbow trout	Smallmouth	Largemouth	Bluegill	Pumpkinseed	Rock bass	Crappie	Perch	Grass pike	Walleye	Northern pike	Bullheads	Suckers	Smelt	Other
			Species																
Silver Creek	36–39	2.75	6																
	40–49	183.75	181	2	14														
	50–51	12.00																	
	63	12.00	1																
Spring Lake	41–48	17.50	15									1			2				
Tomahawk Lake	63–64	9.00							6			11							