



**US Army Corps
of Engineers
Detroit District**



Great Lakes Update

Volume 201: Lake Winnebago – An Important Great Lakes Resource

Physical Characteristics and Uses

Lake Winnebago lies within the largest drainage basin to Lake Michigan and the third largest to the Great Lakes. The red shaded area in the image below (Figure 1) illustrates the basin size and location within the Great Lakes.

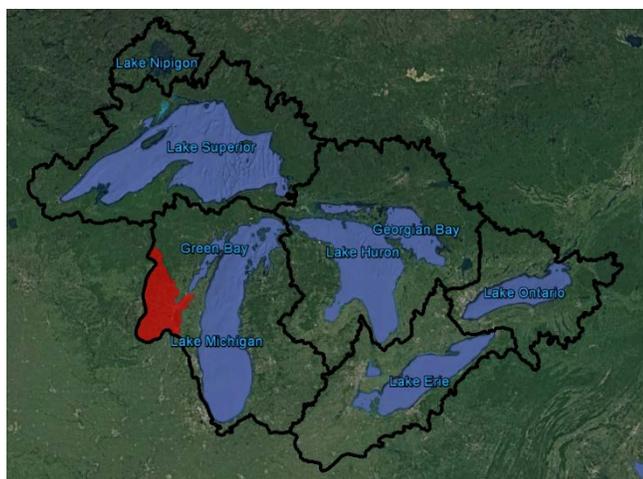


Figure 1: Fox-Wolf River Basin Location

Lake Winnebago is the second largest freshwater lake within any state in the United States (second to Lake Okeechobee in Florida). The Wisconsin lake is about 28 miles (45 km) long and 10 miles (16 km) wide with a surface area of about 206 square miles (534 km²). It is part of the Fox-Wolf River Basin which has an area of 6,430 square miles (16,650 km²). Water flows into Lake Winnebago from the Wolf River and Upper Fox River, then out of the lake through the Lower Fox River and into Green Bay (Figure 2).

The Wolf River originates in the central part of Forest County, Wisconsin, and flows in a southerly

direction through Lake Winneconne, Lake Poygan and several smaller lakes (known as the upper pools). The Upper Fox River flows through flat marshy areas, many with poor drainage. The higher grounds surrounding the floodplain are generally good quality agricultural lands, chiefly devoted to dairy farming.

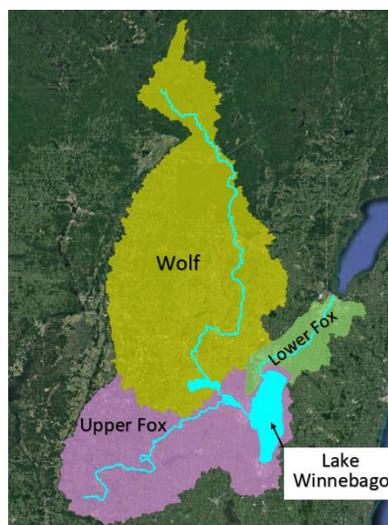


Figure 2: Fox-Wolf River Watershed

The Wolf, Upper Fox, and Lower Fox Rivers, along with Lake Winnebago and the other upper pool lakes, serve as vital water resources to the region. They are used for a variety of commercial, industrial, municipal, environmental, and recreational purposes. Boating, fishing, and hunting, are becoming increasingly popular across the basin. Lake Winnebago, with its many access and launch facilities, is a popular destination for those looking to fish, pleasure boat, and water ski. These activities are making increasing demands on the region's lakes and rivers.

The Fox-Wolf River basin is used by public water utilities and local governments for domestic water supplies and for services such as fire-fighting and street washing. About 20 percent of the water withdrawn in the basin is used by public water utilities and local governments for domestic water supplies, commercial and industrial uses. The four communities of Appleton, Oshkosh, Neenah, and Menasha depend on water supplies from Lake Winnebago; others depend primarily on groundwater.

The water resources of the region are extensively used for recreational activities, particularly fishing, hunting and boating. These activities are increasing demands on the region's lakes and streams. The majority of boating use, primarily for fishing, pleasure cruising, and water skiing, is concentrated around those lakes having adequate access, water depths and launching facilities. Because of its size and character, Lake Winnebago provides the widest range of boating opportunities. The heavy concentration of boaters will continue to increase in the future, bringing increased demands for mooring facilities and associated services.

The demand for increased recreational activities may also impact environmentally sensitive areas adjacent to, and in the rivers and lakes of the Lake Winnebago region. Fluctuations in lake levels, ice and agricultural practices in the watershed have caused the loss of many acres of wetland habitat. The losses have had a direct impact on the abundance and diversity of fish and wildlife.

Each group – municipalities, public utilities, waste treatment plants, industries, and recreational users – who use Lake Winnebago and the surrounding waterways have a stake in the quantity and quality of the water resource. Often, one group's desires for specific water levels and discharges are in conflict with another group's needs. For example,

recreational users want to maintain higher water levels in Lake Winnebago for boating, fishing, sailing and water skiing, whereas higher water levels in the early spring can cause serious environmental damage to sensitive aquatic vegetation.

History of Lake Winnebago Regulation

In the 1850s, Lake Winnebago became part of an important commercial navigation system that connected Green Bay with the Mississippi River. To facilitate navigation, dams were built on the Fox River at Neenah and Menasha, creating Lake Winnebago and the upper pool lakes of Lakes Poygan, Winneconne, and Butte des Morts. A system of locks and dams was also constructed along the lower Fox River to make navigation through the lower Fox River to Green Bay possible.

The construction of dams on the Lower Fox River spurred the development of hydroelectric power generation at many of these dams. The pulp and paper industry facilities line the banks of the Lower Fox River that drops 168 feet (51 m) over 40 miles (64 km) from Lake Winnebago to Green Bay. These industries use the river for their process and cooling water supply.



Figure 3: Paper Mill on the Fox River

Floods have occurred in the adjacent reaches of the Fox River and along the shores of Lake Winnebago during all seasons of the year, with the most extensive flooding occurring in spring. The Wolf and Upper Fox Rivers generally require several days of precipitation or snow melt-off to reach flood stage. Uncontrolled inflows to Lake Winnebago from these rivers during flood stage can result in gradual and sustained rises in the lake level for a week or more. More abrupt rises in the level of Lake Winnebago are primarily due to heavy localized precipitation on the water surface.



Figure 4: Spring 2018 flooding on the Wolf River near Shawano

In order to manage the risk of flooding in the basin, the Marshall Order was established in 1886 to “maintain the level of Lake Winnebago at or below” flood stage (3.45 feet Oshkosh Datum). Oshkosh Datum is a local datum referenced to the crest of the Menasha Dam from which all Lake Winnebago water surface elevations are derived. In 1920, the Marshall Order was modified to address navigation needs on Lake Winnebago by defining “...limits of regulation for Lake Winnebago under existing laws, orders, rules and permits are from 21-1/4 inches above the crest of Menasha Dam (3.45 feet Oshkosh Datum) down to the crest during the navigation season (1.68 feet Oshkosh Datum). The navigation season presently extends from about 1 May to early October. Figure

5 shows the typical water level strategy used for regulating the level on Lake Winnebago annually. During the years the Corps has regulated the lake, water levels have predominately remained within the limits of the Marshall Order.

Current Regulation Strategy

The U.S. Army Corps of Engineers, Detroit District regulates Lake Winnebago water levels on a daily basis, attempting to balance the needs of all competing uses of the basin’s water resources. This is accomplished through frequent coordination, discussion and correspondence with the user communities and conducting an annual regulation meeting that is open to the public. During the annual meeting, input from the public is taken into consideration when establishing the water level strategy for the coming year. Figure 5 shows a typical water level strategy that meets the criteria of flood risk management (the Marshall Order) and balances the needs of the stakeholders.

An important objective of lake operations is to reduce downstream flooding during spring snowmelt and floods. The lake is drawn down in the winter in anticipation of spring rains and snowmelt. The lake’s storage capacity allows it to be used to reduce the incidence of downstream floods. After the threat of spring flooding has passed, the lake level is raised to its summer target for navigation and recreational boating.

In the winter after a solid ice cover forms in the upper reaches of the Lake Winnebago pool, the Corps of Engineers begins a slow drawdown. The drawdown provides storage needed to contain spring flooding. For the sake of the aquatic and semi-aquatic animals that occupy the shallow-water zone during the fall and winter, the water level is not drawn down before a solid ice cover develops.

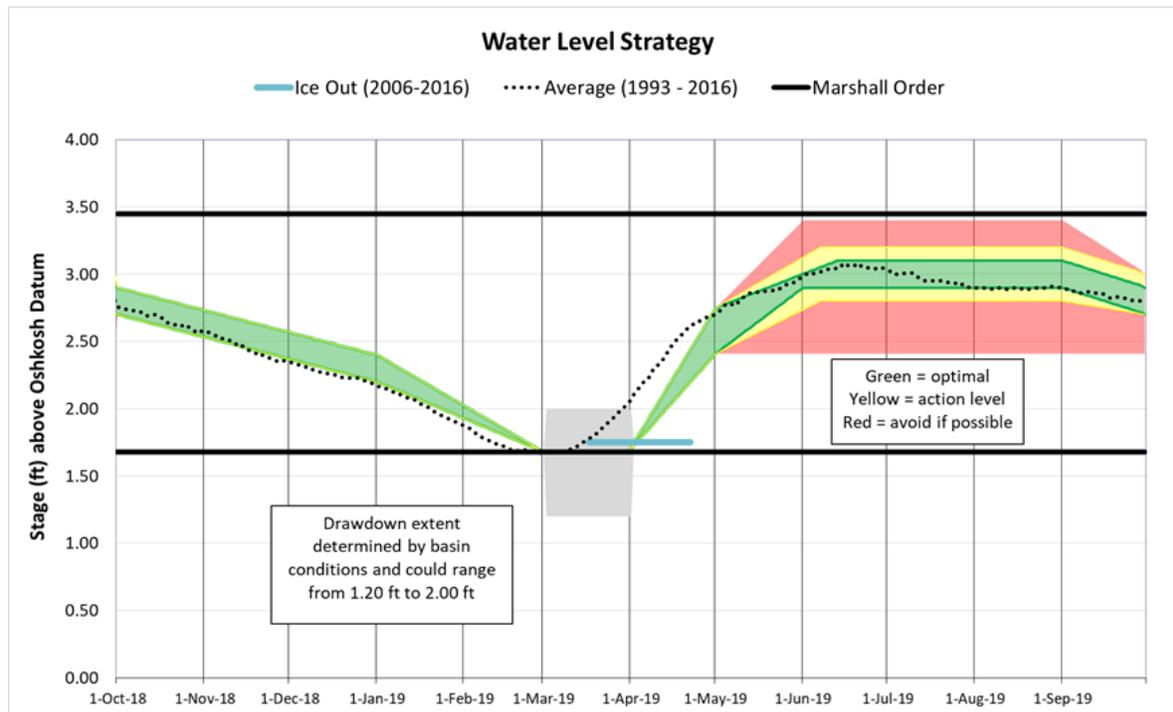


Figure 5: Lake Winnebago Water Level Strategy

Once the drawdown target is achieved, the stage is held constant until the ice cover in the Lake Winnebago pool breaks up and starts moving out. It should be noted that the drawdown target can be altered to a level below the Marshall Order because it occurs during the non-navigation season. The horizontal light blue line in Figure 5 represents about a one month timeframe when ice out has occurred over the past 10 years.

Once the ice has left the lake, the spring refill of the Winnebago pool begins. The pool is refilled to achieve the target navigation level in late spring (typically June 1). In recent years, the spring refill has been accomplished in a more gradual manner to avoid excessively high levels that can cause serious environmental damage to aquatic plants.

The level of Lake Winnebago is held as close as possible to the target stage during the remainder of the navigation season. Daily reviews and analyses of current basin conditions and forecasts are

performed to keep the 206 square mile lake within the 2.5 inch green band of the graph. Despite efforts, the lake has been both above and below the target at times. Heavy precipitation can cause uncontrolled inflows to soar above maximum outflow capacity causing the level to climb quickly. On the contrary, the stage may fall three or four tenths of a foot below the target due to lack of precipitation and increased evaporation. When navigation season ends, the lake is drawn down again, aiming for a level of about 2.5 feet Oshkosh datum by mid-October.

The Army Corps of Engineers works closely with the WiDNR, U.S. Fish and Wildlife Service, local municipalities, hydroelectric users, wastewater regulators, and other groups to establish specific regulation strategies and to facilitate cooperation between the various users of the basin's water resources.