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US Army Corps of Engineers
Detroit District

Great Lakes Update

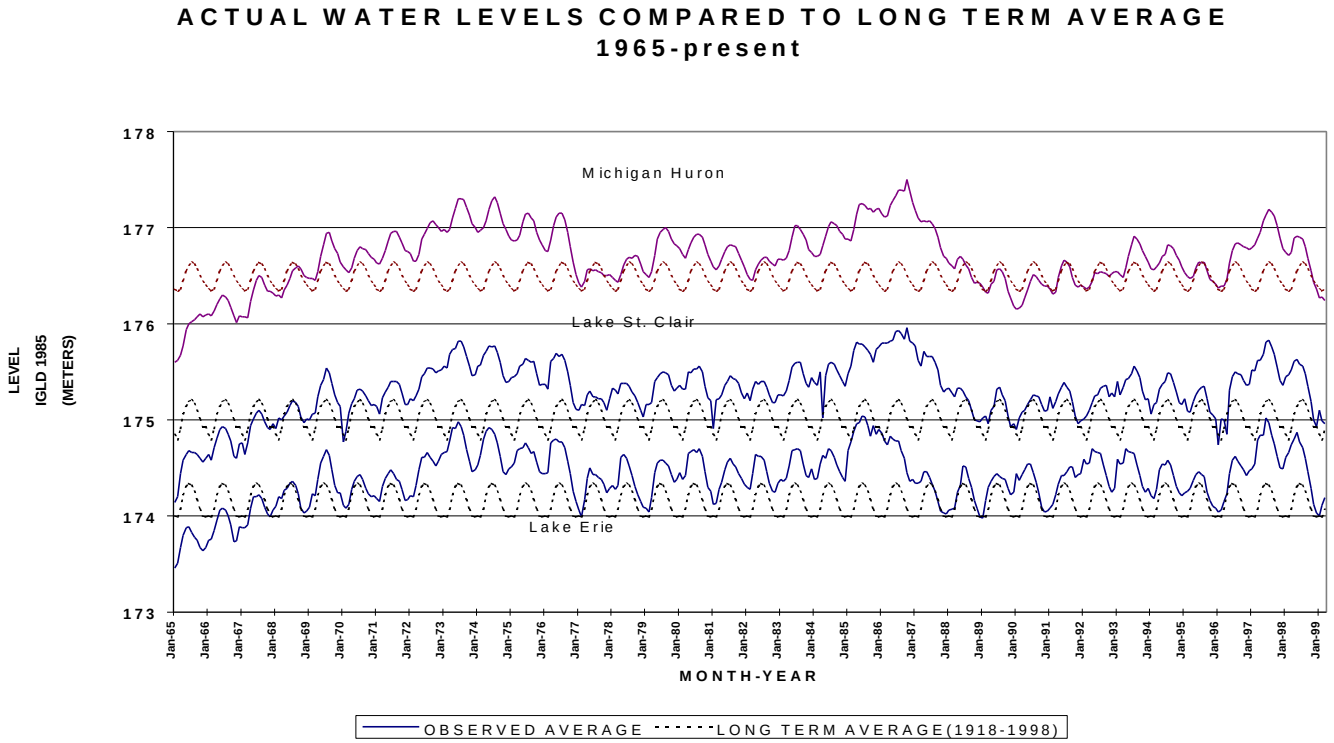
"Low" Water Levels

What a difference a year can make. In 1997 and 1998, water levels were significantly above average. Starting in the fall of 1998, water levels began to plunge to near or below average levels on the Great Lakes. The winter before last (1997-98) was one of the mildest on record. This past winter was near normal in terms of temperatures, but seasonal precipitation was below normal, particularly snowfall in the northern latitudes around lakes Superior, Michigan, and Huron.

The difference between the amount of water coming into a lake and the amount going out is the determining factor in whether water levels will rise or precipitation coincide with cooler cloudy conditions that cause less evaporation, water levels generally rise. Likewise, prolonged periods of lower than average precipitation and warmer than average temperatures generally result in lowering of water levels.

Figure 1. illustrates that over the last 30 years water levels on the middle Great Lakes have been above average, and that there have been brief periods when water levels were close to average.

Figure 1.



Lake Superior
The average monthly water level for Lake Superior in March was 9 inches below what it was in March 1998. The water level was about 8 inches below the long term (1918-1998) monthly mean. Furthermore the March monthly water level was about 6 inches below Chart Datum. While the water level is still about 13 inches above the record low water level for March, set in 1926, Lake Superior water levels have not been this low since 1927.

Lake Superior is expected to begin its seasonal rise in April and continue into September. The forecasted water level in September is expected to be about 12 inches above the current water level. However, it is expected to be about 7 inches below the average for September.

Lakes Michigan-Huron
The average monthly water levels for lakes Michigan-Huron in March was 20 inches below what it was in March 1998. The water levels were about 5 inches below the long term (1918-1998) monthly mean. While the water levels were still about 26 inches above the record low water level for March, set in 1964, lakes Michigan-Huron water levels have not been this low since 1990.

Lakes Michigan-Huron are expected to begin their seasonal rise in April and continue into July. The forecasted water level in July is expected to about 7 inches above the current water level. However, lakes Michigan-Huron levels are expected to still be about 9 inches below their average for July.

Lake St. Clair
The average monthly water level for Lake St. Clair in March was 22 inches below what it was in March 1998, even though this level is still about 2 inches above the long-term average for March. The water level was still about 36 inches above the record low set in 1934 for March.

Lake St. Clair is expected to begin its seasonal rise in April and continue into June. The forecasted water level in June is expected to be about 6 inches above the current water level, but remain below its long term average by as much as 4 inches. Water levels have not been this low, during the 5 month period April to August, since 1961.

Lake Erie
The average monthly water level for Lake Erie in March was 22 inches below what it was in March 1998. The March level was about 5 inches above the long term (1918-1998) monthly mean. The water level is still more than 3 feet above the record low water level for March, set in 1934.

Lake Erie began its seasonal rise in March and is expected to continue to rise into June. The forecasted water level in June is expected to about 4 inches above the current water level. However, it is expected to still be about 2 inches below the average for June. Water levels have not been this low, during the recreational boating season since 1967.

Lake Ontario
The average monthly water level for Lake Ontario in March was 26 inches below what it was in March 1998. The water level was about 7 inches below the long term average for March. While the water level is still more than 22 inches above the record low water level for March, set in 1935, Lake Ontario water levels have not been this low since 1989.

Lake Ontario is expected to complete its seasonal rise in June. The forecasted water level in June is expected to about 17 inches above the current water level. However, it is expected to be about 4 inches below the average for June.

Dynamic Climate

Although the lake levels dramatically declined, especially during the fall, they still tended to follow their general seasonal pattern; that is, rising in the spring, peaking in the summer and declining in the fall to a low in the winter. This pattern is shown by the long-term averages shown on the graphs in the *Monthly Bulletin of Lake Levels for the Great Lakes.*

Due to an El-Nino, the winter of 1997-98 was one of the top five mildest on record. Many cities within the Great Lakes region recorded record daily highs, record warm lows and record monthly average temperatures. Single-digit temperatures never occurred at several cities in the region for the first

time in modern history. Ice formation on the Great Lakes was reduced. This change eliminated the threat of ice-jam flooding in the connecting channels, but opened the lakes to greater evaporation.

During the winter of 1998-99 La Nina patterns brought slightly below average temperatures and above average precipitation to the Great Lakes basin. However, these weather patterns were inconsistent. The precipitation total on the Lake Superior, for the December to March period was below average. In fact, much of the snowfall was lake effect snow. The situation was the same on the Michigan-Huron basin. Most of the La Nina influences were felt in southern latitudes of the Great Lakes basin where snow storms in the first 10 days of January 1999 dropped 20-30 inches of snow from southeastern Michigan to upstate New York. However snow totals for the entire winter were below average on all of the Great Lakes basins except on Lake Ontario where it was near average.

Temperatures in the northern latitudes were near normal. While the southern portion of the Great Lakes basin received a mix of temperatures that went from well below average to well above average within the same month. In fact temperatures in the first two weeks of January indicated it would be one of the coldest months on record in many places across the basin. However, the last two weeks of January saw a complete reversal in weather patterns. In February and March, dryer and warmer conditions continued across much of the Great Lakes. Precipitation for the Great Lakes basin in February was near average, but declined in March to be nearly 60% less than average.

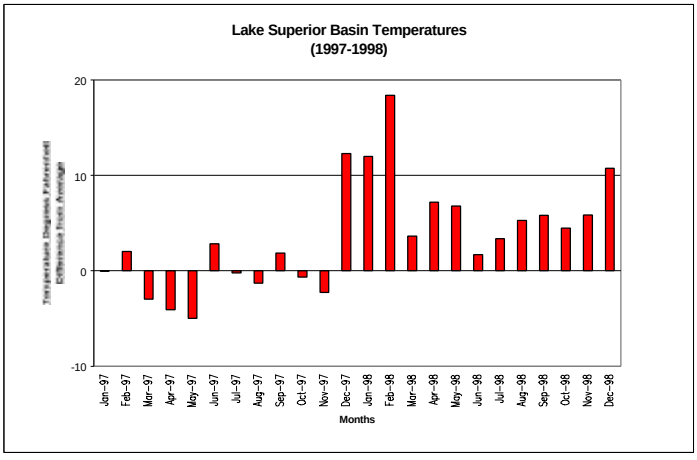


Figure 2.

Snowmelt is a key component of the Great Lakes hydrologic cycle that affects water levels. The water from the snow that melts saturates the ground or becomes overland runoff and flows into waterways and into the Great Lakes. Airborne snow surveys conducted during the time of normal peak snow accumulation around the Lake Superior drainage basin showed that the snowpack holds only 5 to 6 inches of water on average (See Figure 3). This is slightly less than normal for this time of year. Some of this water will eventually make its way to Lake Superior during the spring thaw.

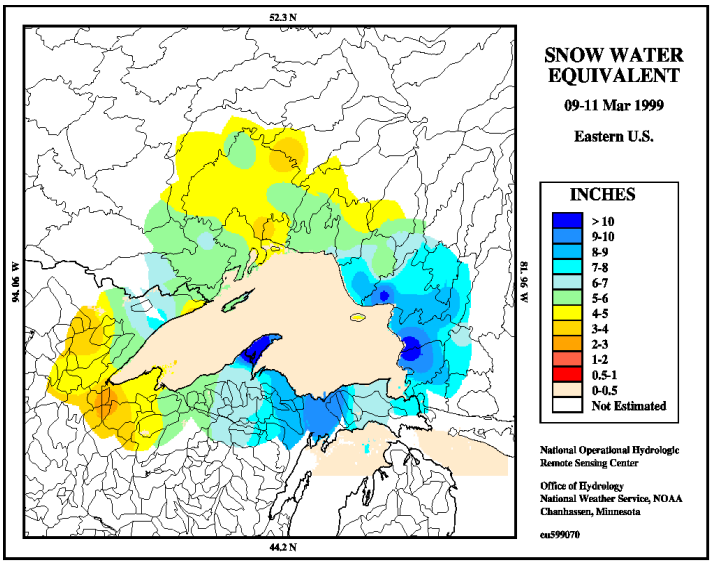


Figure 3.

Water Level Control and Factors Affecting Fluctuations

Short term fluctuations are due to storms, wind or ice jams and usually last from a couple hours to several days. Ice jams will decrease the amount of water flowing out of a lake, which will temporarily increase its level until it is cleared. For example, ice jams have occurred in the St. Clair River delta, causing a increase in water levels upstream of the blockage and reduction in the inflow to Lake St. Clair. During this winter, ice conditions in this area were significantly less than normal.

Sustained high winds also can cause short-term fluctuations. High winds, especially strong from one

direction, can push the water level up at one end of the lake and make the level drop by a corresponding amount at the opposite end. This is called wind set-up. When the winds ceases, the water will eventually return to its original position.

Seasonal fluctuations in water levels also occur throughout the Great Lakes. The Great Lakes are generally at their lowest levels in the winter months. Though the precipitation is fairly constant throughout the year, the winter snow pack does not contribute to lake level rise until the spring thaw and corresponding runoff. The combination of snow melting and rain in the spring contribute to the increase in lake levels from around March through August, depending on the lake. Evaporation is the greatest in the fall and early winter when the air above the lakes is cold and dry and the lakes are relatively warm.

Long term fluctuations occur over a period of years and depend on how wet or dry and hot or cold the weather is. The Great Lakes system experienced extremely low levels in the late 1920s, mid-1930s and in the mi-1960s. Extremely high water levels were experienced in the early 1950s, early 1970s, mid-1980s and mid-1990s.

Shipping and Marina Concerns

The water levels of the Great Lakes significantly affect the shipping industry and recreational boating as well.

Commercial carriers experience decreased revenue when water levels are low. This is because shipping is dependent upon the available draft in the maintained channel-ways, including the St. Marys, St. Clair, Detroit rivers and in the Welland Canal, and St. Lawrence Seaway. A 1,000-foot-long vessel forfeits carrying 270 tons of cargo for each 1-inch reduction in draft. According to the Great Lakes Carriers Association, the shipping companies have learned to effectively deal with the water level changes. Presently, the carriers are loading lighter drafts, decreased by up to one foot.

In an interview with the Detroit News, Mr. George Ryan, president of the Lake Carrier's Association in Cleveland, said that during low water periods greater care must be taken navigating the approaches to many areas, particularly in the Detroit and St. Clair rivers, and in the approaches to the Soo Locks in the St. Marys River. An even bigger impact on freighter companies is the loss of cargo capacity -- loads must be lightened to clear shallow areas. (See Figure 4.)

Low water can make it difficult for private boaters and marina operators to get their boats into and out of the water. Damage to boats could result from props, keels, or hulls striking boulders or shoals.

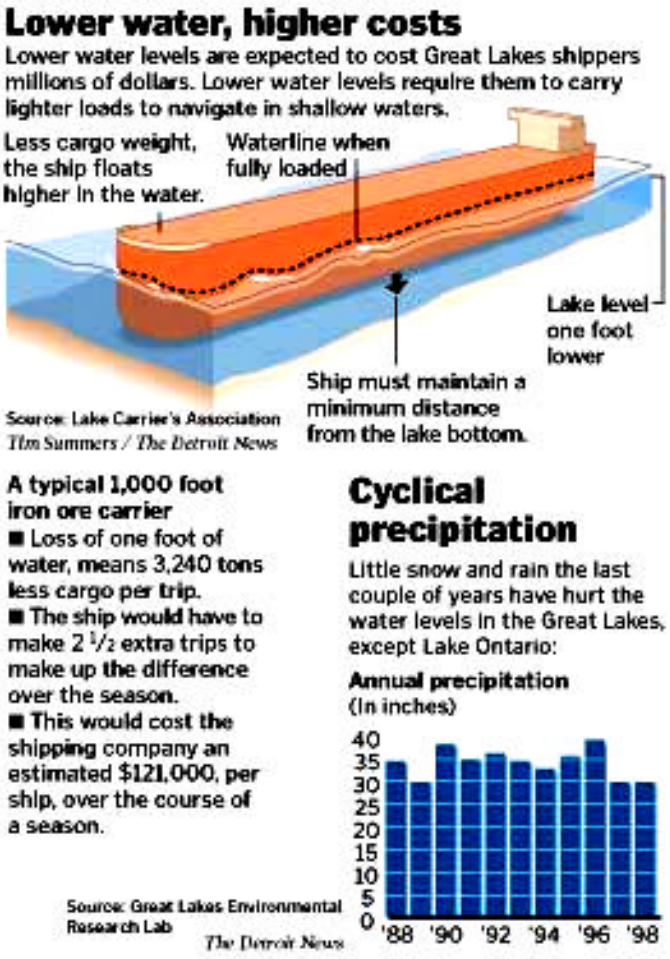


Figure 4. Taken from Detroit News article

Permits for Dredging

Lower water levels are also a reason that the U.S. Army Corps of Engineers is seeing an increase in the number of permit applications for private and commercial dredging and excavation. The Corps reviews approximately 1,000-1,100 private and commercial dredging and dredged material disposal permit applications each year throughout the Great Lakes shorelines.

Dredging and excavation activities in the Great Lakes are regulated by Section 10 of the Rivers and Harbors Act of 1899. Disposal of the dredged materials into the waters of the United States, including wetlands, is regulated by Section 404 of the Clean Water Act. Under Section 10, a Department of the Army (DA) permit must be obtained for all structures or work in or affecting navigable waters of the United States prior to any work commencing. Navigable waters in freshwater systems are defined as waterward of the ordinary high water mark. These waters are presently used, or have been used, in the past or may be susceptible for use to transport interstate or foreign commerce.

After dredging work is completed, the dredged material must be disposed of properly. Section 404 of the Clean Water Act covers the permitting involved with discharging the dredged material in wetlands and other waters of the United States. This permit is also available from the Army Corps of Engineers. Section 404 does not allow placement of dredged material in the proximity of a public water supply intake except if it is for repair of the public water supply intake structures or adjacent bank stabilization. If the dredged material is contaminated with trash, asphalt, debris, or toxic pollutants in toxic amounts then no discharge to land or water may occur. Discharges must not permanently restrict or impede the passage of normal or expected high flows or cause relocation of the water. Any temporary fills from the dredging site must be removed in their entirety and the affected areas returned to their pre-existing elevation.

Dredging or excavation performed in waters of the United States without a permit or not complying with a permit is considered a violation of Federal law and could result in the required restoration of land/water, fines or jail sentences. The Army Corps monitors and enforces the permit program with the help of various state agencies.

Coastal Erosion and Bluff Recession

On the Great Lakes, lake levels are one factor affecting coastal erosion. The other factors include storms with punishing wave attack, sediment supply (both on-shore and along-shore), bluff stability and groundwater. Variation in lake levels, whether short or long term, have little effect on the creation of waves, the primary erosion agent. Most waves are generated far offshore in deep water where relatively small water level variations (1-2 feet) are insignificant.

As long as the long term meteorological and hydrographic factors that determine wave energy remain the same, the long term erosion rate would remain essentially unchanged. The lake level does, however, have an effect on where wave energy is dissipated on the beach profile, and thus may affect bluff recession rates over a short time period.

During periods of rapidly declining water levels, off-shore sediments are typically brought on-shore, causing beaches to expand. This phenomenon is not constant nor permanent. Over periods of stable water levels, even at a lower profile, beach erosion can and will occur, since waves will constantly move these materials. Wider beaches provide a natural armoring feature to reduce the waves abilities to attack the bottom or the “toe”of the bluff. Under lower water level conditions, it is expected that bluff recession will be reduced temporarily in most areas. This condition is not universal, however, since bluff collapses can, and do, occur completely independent of lake levels and wave attack.

Upcoming Public Meetings

On June 2, 1999 the International St. Lawrence Board of Control will have its annual meeting at the civic center in Cornwall, Ontario.

On July 6, 1999 the International Lake Superior Board of Control will hold its annual meeting in Sault Ste. Marie, Ontario.

General Notes

All elevations shown in this article are referenced to the IGLD 1985 datum.

Information about Great Lakes water levels, outflows, and weather is available on the World Wide Web. The Internet address for the Detroit District's Home Page is as follows:

http://www.lre.usace.army.mil

or from the Great Lake Information Network at the follow:

http://www.great-lakes.net
http://www.great-lakes.net/envt/water/hydro.html

Information is updated daily and monthly as required.