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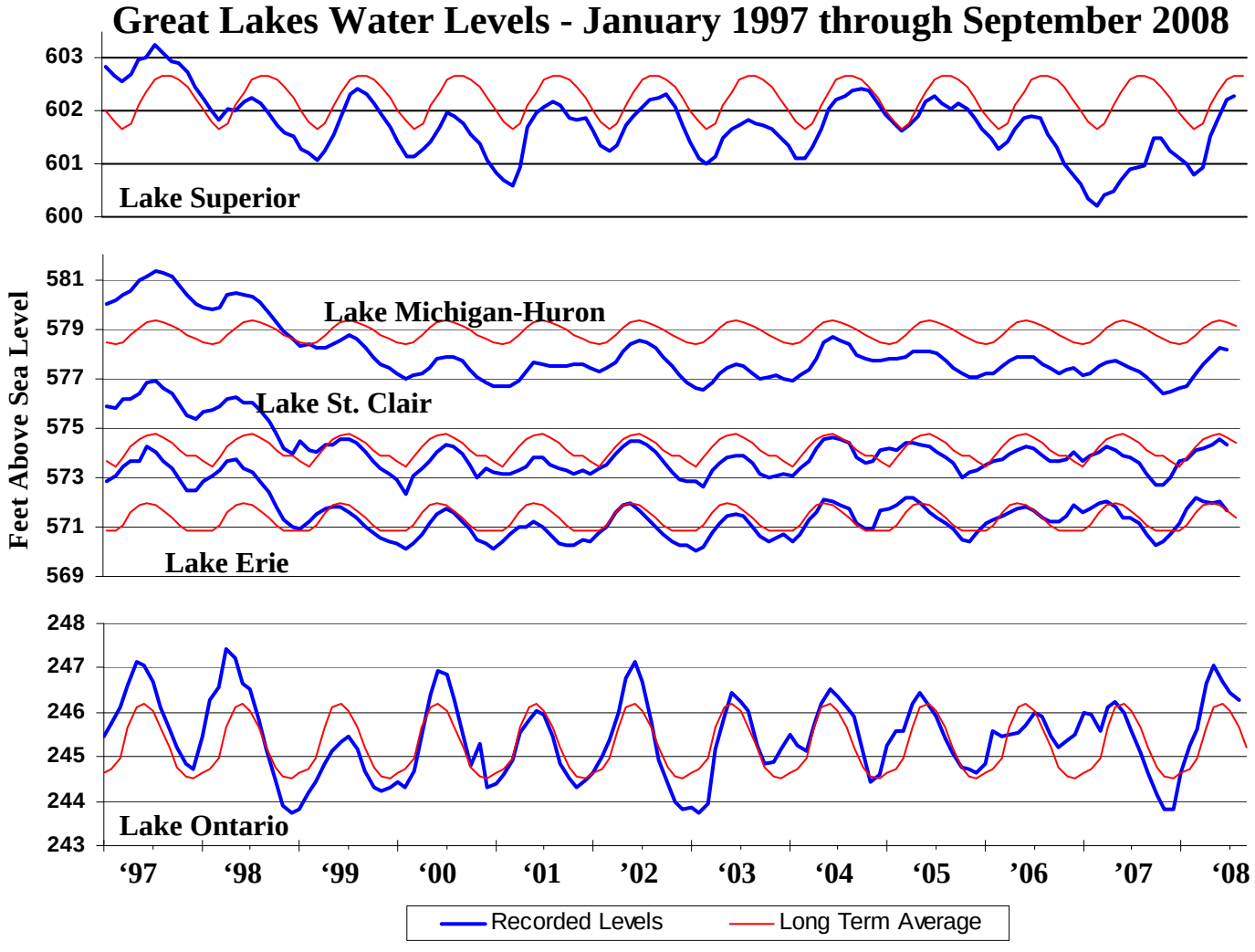
Great Lakes Update

Frequently Asked Questions on Current Water Levels

Over the past decade, Great Lakes water levels have undergone dramatic changes. In the first half of 1997, levels on the upper Great Lakes were much above average. Since the late 90's, the lakes have struggled to get above their respective long term averages (LTA's). In fact, Lake Superior set new record lows in August and September of 2007 and Lake Michigan-Huron came within several inches of its record low levels during the winter of 2007-2008. Many factors have contributed to this decline in water levels including precipitation patterns, evaporation, and snow pack. This update article addresses several key questions regarding current water level conditions.



What are the current conditions and what is expected over the next several months?

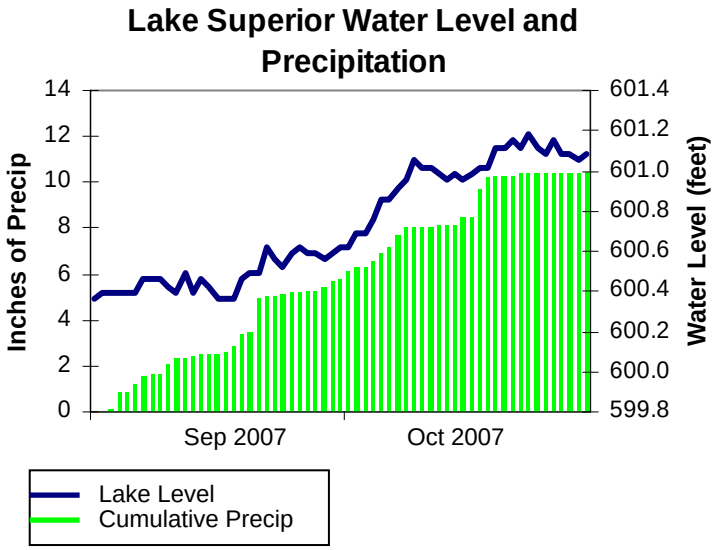
Although water levels on the upper Great Lakes remain below average, they are several inches higher than they were one year ago. The past snowy winter was followed by a wet spring which provided a greater than average seasonal rise in water levels on all of the Great Lakes. The abundant snow pack set up favorable conditions for higher water levels this past summer on Lakes Superior and Michigan-Huron. The remaining Great Lakes began their seasonal rise a couple of months early thanks to the record setting snowfall that blanketed the region.

For the remainder of 2008, water levels on Lakes Superior, Michigan-Huron, St. Clair, and Erie are expected to remain below their respective LTA's. Lake Ontario is currently just above its LTA and is expected to dip below average in the next month.

What role has precipitation played in the fluctuation of water levels?

Precipitation and surface water runoff (which is driven by precipitation) play a key role in influencing water levels of the Great Lakes. The influence is greater the further upstream in the system you go. For example, precipitation and runoff account for 96 percent of the water volume entering Lake Superior on an average annual basis. Precipitation and runoff account for 71 percent of the water volume entering Lakes Michigan-Huron. This factor is only 22 percent in Lake Erie and 20 percent in Lake Ontario.

During the fall of 2007, much of the Lake Superior basin was experiencing severe to extreme drought conditions. Lake Superior set new record low levels for the months of August and September. Although a combination of factors led to the record low levels, precipitation played a major role in helping the lake levels rebound. September and October of 2007 brought back to back months of more than double their respective average precipitation amounts. The graph below illustrates the impact the precipitation had on Lake Superior's water level. From September to October, the water level rose about six inches when on average it falls approximately one inch.



The recent increase in water levels across the Great Lakes can be partly attributed to the above average precipitation that has fallen over the past 12 months. Although there have been times when precipitation has been below average for several months in a row over the past ten years, it should be noted that precipitation for the entire Great Lakes basin has been near average since 1997.

Probably more important than the annual precipitation values is the amount of precipitation that has fallen as snow. Snowmelt in the spring drives the seasonal rise on Lake Superior and thus has a significant impact on water levels throughout the rest of the Great Lakes basin. Overall, the lack of snowfall over the past ten years has contributed to the sustained below average water levels. In 2000 and 2007, the snow water equivalent over the Lake Superior basin was 71 percent and 40 percent below average, respectively. As expected, the seasonal rise following these two low-snow winters was less than average.

A very active storm track brought abundant moisture to the Great Lakes basin this past

winter. Many locations set new snowfall records and snow water equivalent values across the Lake Superior basin were nearly double the values experienced in 2007.

How significant is evaporation on the Great Lakes?

Water that has entered the Great Lakes has two ways to exit—leaving as outflows from each of the Great Lakes (such as the St. Marys River outlet from Lake Superior) or through evaporation. Evaporation is a very significant component, especially in the upper lakes. For Lake Superior, 40 percent of the water volume exiting the lake leaves through evaporation and 60 percent leaves through the St. Marys River. On Lakes Michigan-Huron, evaporation accounts for 31 percent of the water losses, with the remaining 68 percent exiting through the St. Clair River and 1 percent through the Chicago Diversion.

Maximum evaporation occurs when the Great Lakes water temperatures are much warmer than the air moving across them. This situation occurs primarily in the fall and early winter.

What effect does ice cover have on water levels?

It is clear that precipitation and evaporation play a significant role in the rise and fall of water levels on the Great Lakes. When there is little or no ice cover, evaporation can continue through the winter. While the majority of evaporation occurs in the fall and early winter when the temperature difference between the air and water is the greatest, a lake with considerable ice cover does not significantly reduce annual evaporation.

A significant ice cover can offer some benefits, however. While the ice will not cause an immediate increase in water levels or foretell a higher summer peak level, significant ice cover can affect water temperatures. A benefit of a significant ice cover this year, in addition to the rather cool spring and summer, is that the water temperatures in the Great Lakes were lower than they have been in the past few years. Evaporation may be less of a factor this fall because of the cooler water temperatures.

For example, when arctic air arrived in mid-January 2007, Lake Superior was largely ice free. This provided favorable conditions for large scale evaporation. Nine inches of water evaporated during January and February of 2007 which is the equivalent of about 5.5 trillion gallons of water.

The formation and break-up of ice cover can also bring about short-term water level changes. Ice cover on the connecting channels reduces the amount of water that flows from one lake into another. Further reductions can occur when broken lake ice moves into a channel and builds up behind an existing ice cover. These ice jams have the potential to drastically slow the flow in the river. Severe ice jams can lead to major flooding upstream of the jam and very low water levels downstream.

Where are the diversions and how much can they affect Great Lake water levels?

The major diversions in the Great Lakes basin that affect water levels to a measurable extent are: (1) diversions into Lake Superior at Long Lac and Ogoki; (2) a diversion out of Lake Michigan at Chicago; and (3) a diversion between lakes Erie and Ontario through the Welland Canal. These diversions have a minor effect on water levels compared to natural factors and regulation of Lakes Superior and Ontario.

The average annual flow rate into Lake Superior from the Long Lac and Ogoki diversions is 5,300 cfs (150 cms). These diversions, entirely in the Province of Ontario, were authorized between the United States and Canada in 1940. The flow through the Lake Michigan diversion at Chicago is 3,200 cfs (91 cms) and the flow from Lake Erie to Lake Ontario through the Welland Canal is 7,800 cfs (221 cms). This compares to the average outflow of 76,000 cfs (2,140 cms) from

Lake Superior, 184,000 cfs (5,200 cms) from Lake Michigan-Huron at Port Huron, Michigan, 202,000 cfs (5,710 cms) from Lake Erie through the Niagara River, and 243,000 cfs (6,870 cms) from Lake Ontario.

Great Lakes Diversions

According to a 1985 report by the IJC, these diversions alter the supply of water to the Great Lakes, resulting in changes to water levels. The long-term effect has been to increase the mean water levels on Lake Superior by 1 inch (2.5 cm) and decrease Lake Michigan-Huron by 0.25 inches (0.5 cm).

The Welland Canal diversion is a canal for locking ships through from Lake Ontario to Lake Erie. Since the diversion occurs within the Great Lakes basin, it does not alter the supply of water to the Great Lakes. It's important to note that the total volume of diversions into the basin is greater than the volume of diversions out of the basin.

Could the Chicago Diversion be decreased to keep more water on Lake Michigan-Huron?

Generally, no, the amount of water diverted at Chicago is a small fraction of the outflow from Lakes Michigan-Huron. The Chicago Diversion represents only one percent of the water volume leaving Lakes Michigan-Huron on a daily basis. The majority of water exits the system through the St. Clair River. Also, any decrease would require Supreme Court action and would have significant environmental consequences.
Water from Lake Michigan and its drainage basin is diverted into the Des Plaines River, a tributary of the Illinois River and a part of the Mississippi River drainage basin. The Lake Michigan Diversion has an average flow rate of 3,200 cfs (91 cms), which is managed in accordance to U.S. Supreme Court decrees. The diversion has been below this rate, however, since 1994. For comparison, the average flow in the St. Clair River is 184,000 cfs (5,710 cms).

What is chart datum and why are the water levels referenced to it?

Chart Datum is a vertical plane of reference used to measure water depth. There is a distinct Chart Datum for each lake which is determined from historical water level records. These datum planes have fixed elevations relative to the International Great Lakes Datum of 1985 (IGLD 1985). The IGLD 1985 has its zero base at Rimouski, Quebec near the mouth of the St. Lawrence River (approximately sea level).

Water levels are referenced to chart datum in order to agree with navigation charts. According to the Canadian Hydrographic Service, "Chart datum is selected so that the water level will seldom fall below it and only rarely will there be less depth available than what is portrayed on the chart." Chart Datum is also referred to as Low Water Datum.

Summary

This article summarizes current conditions and discusses some of the key factors that have contributed to current Great Lakes water level conditions. An increase in water temperatures, which led to increased evaporation, is one of the main factors that has produced the lower water levels. Although the past year has shown signs of increasing water levels, a sustained increase in precipitation and decrease in evaporation will be needed before a significant rise in water levels occurs on the upper Great Lakes.