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US Army Corps of Engineers Detroit District

Great Lakes Update

Low Snow = Low Levels

Water levels of Lakes Superior and Michigan-Huron have generally been lower than their historical averages this decade. In fact, Lake Superior experienced its lowest recorded water levels for the months of August and September in 2007. The water levels of each Great Lake rebounded in 2008 and 2009, driven by precipitation that was higher than in recent years. This year, however, the levels of the Great Lakes are down. The rise in water level of the Great Lakes that takes place in spring was substantially lower than average this year. As a result, all the Lakes are lower than their levels of a year ago, and have been so since April.

Precipitation is one of the most important factors influencing Great Lakes water levels. Precipitation increases levels by falling directly on the lakes, and indirectly through runoff, tributary streamflow, and groundwater inflow that are the result of precipitation. In general, precipitation across the Great Lakes basin was well below average this past winter, greatly reducing Great Lakes water levels compared to the past 2 years. This article will examine the water levels and precipitation of the Great Lakes this spring in comparison to what they were the past 2 years, explain why the Great Lakes' seasonal rise in spring was marginal this year, and compare this spring's lake levels with a similar phenomenon that took place in 1987.

This year, water levels of the Great Lakes, in particular Lakes Superior and Michigan-Huron, did not rise nearly as much as they historically do during the spring. In March, Lake Superior's mean water level was 600.68, the same as it was in March of last year. The lake underwent its seasonal rise in spring last year, climbing 6 inches in April and May to 601.20 ft. However, Lake Superior did not rise at all this spring; its monthly water level dropped about one-half inch in April, and rose just one-tenth of an inch in May to 600.65 ft.

In addition, Lake Michigan-Huron's monthly mean level increased just 1.5 inches in April and May, a period in which it typically rises around 7 inches. Furthermore, Lake Ontario's seasonal rise was notably less than average as well. Lake Ontario usually rises 13 inches in April and May, but the lake's monthly mean level increased just 6 inches in that time period in 2010. (Figure 1)

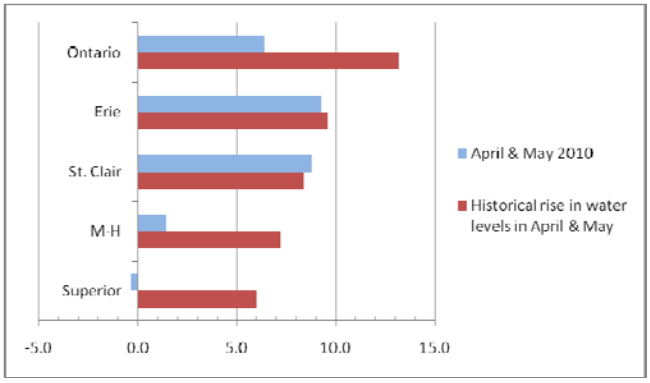

Figure 1: This year's seasonal rise (in inches) of Great Lake Levels for April and May compared to historical averages.

The minimal rise in the Great Lakes water levels this spring has resulted in them all being below their levels of a year ago. As of late June, Lakes Superior, Michigan-Huron, St. Clair, and Erie ranged from 5 to 9 inches below last year's levels. Lake Ontario was 12 inches lower than it was a year ago. Moreover, in late June, Lakes Superior and Michigan-Huron were over a foot below their historical June averages. Lakes St. Clair, Erie, and Ontario received considerable precipitation in early June, and have begun to approach their long-term averages, but Lake Ontario was still about 8 inches below average in mid-June.

Snowpack and Rainfall

The significantly lower rise in Great Lakes water levels this spring is largely due to a lack of precipitation during this past winter, which produced a much lower than average snowpack. Snowpack is the accumulation of snow on the ground surface during the winter. Melting of the snowpack is a major component of the movement of water. As the snow melts in the spring, runoff to the lakes increases, which causes their water levels to rise. In colder climates, much of the springtime runoff and streamflow in rivers is attributable to melting snow and ice. Snowmelt contributes significantly to the tributary stream flows into the Great Lakes.

There was not nearly as much snow to melt in the Great Lakes region this spring as there normally is. This is evident when comparing Lake Superior's snow-water equivalent of the past winter to historical averages. Snow-water equivalent is a common measurement of snowpack. The snow-water equivalent within the Lake Superior basin was 25% below average this winter. (Figure 2)

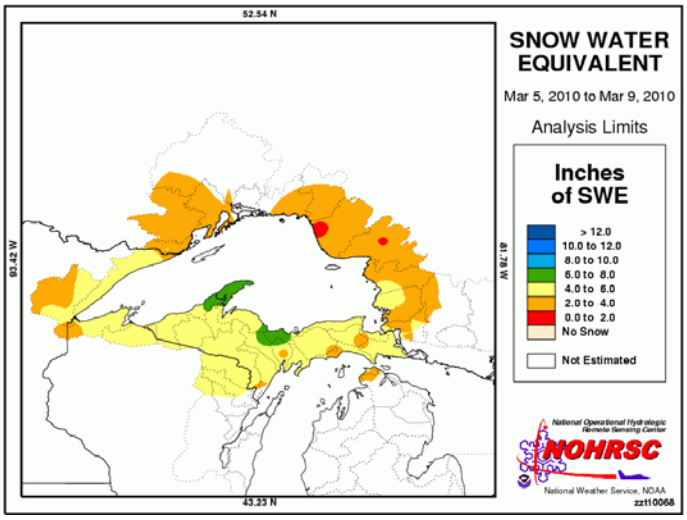

Figure 2: Snow-water equivalent (in inches) in Lake Superior basin in early March 2010

The lack of snowpack can be explained by a lack of precipitation within the Great Lakes region. Lake Superior received only one-half of its average precipitation in January, slightly over one-third of its average precipitation in February, and only one-fourth of its average precipitation in March. Overall, the Great Lakes as a whole experienced precipitation that ranged from 41% to 57 % below average between January and March of this year. (Figure 3)

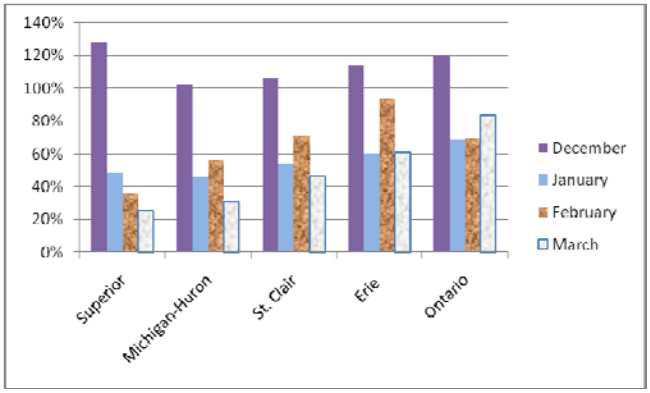

Figure 3: Percentage of average precipitation that fell on the Great Lakes from December to March 2010

Rainfall in April and May also contributes to the rise in lake levels in spring. Lakes Michigan-Huron, St. Clair, and Erie received slightly below average precipitation this past April. In May, those 3 lakes experienced 88%, 115%, and 144%,

respectively, of their normal precipitation. Yet Lake Superior received only 58% and 68%, respectively, of its average precipitation in April and May. In addition, Lake Ontario experienced precipitation that was 57% and 29%, respectively, below normal for April and May. This lower rainfall kept the seasonal rise of Lakes Superior and Ontario lower than average.

The uppermost lakes of the Great Lakes system, Superior and Michigan-Huron, receive a vast majority of their supply of water through precipitation. In fact, Lakes Superior and Michigan-Huron receive 96% and 71%, respectively, of their inflow from precipitation and runoff that comes from precipitation. Thus, the levels of Lakes Superior and Michigan-Huron are quite sensitive to periods of low precipitation.

Wet Weather in 2008 and 2009 led to higher levels in those years

After dropping to unusually low water levels in 2007, the Great Lakes experienced rises in water level in the springs of 2008 and 2009 that were closer to average. These relatively larger rises in levels were spurred by above average precipitation during the preceding winters. The Great Lakes received precipitation that was 28% above average in the winter of 2007/08, and 20% above average in the winter of 2008/09. This is in contrast to this past winter, when the region saw precipitation that was about two-thirds of average during the months of December to March. (Figure 4)

Month	Winter '07-'08	Winter '08-'09	Winter '09-'10
December	129%	172%	113%
January	122%	70%	52%
February	153%	124%	59%
March	110%	113%	43%

Figure 4: Percentage of average precipitation that fell on the Great Lakes during the past 3 winters

The higher snowfall and rainfall across the Great Lakes in the winter and spring of 2008 and 2009 resulted in a higher seasonal rise in water levels than that which occurred this spring. Lake Superior's level climbed 6 inches in April and May 2009, and also rose approximately the same amount during the same time period in 2008. However, Lake Superior essentially stayed flat from March to May this year. In addition, this year, Lake Michigan-Huron rose just 1.5 inches in April and May. Last year and the year before, the lake rose a total of 10 inches in those 2 months. Furthermore, Lake Ontario's seasonal rise of 6 inches in April and May was notably less than average as well. Its water level jumped 17 and 11 inches, respectively, in that 2-month period in 2008 and 2009. Lakes St. Clair and Erie experienced higher water level rises in 2010 than they had in 2008 and 2009. (Figure 5)

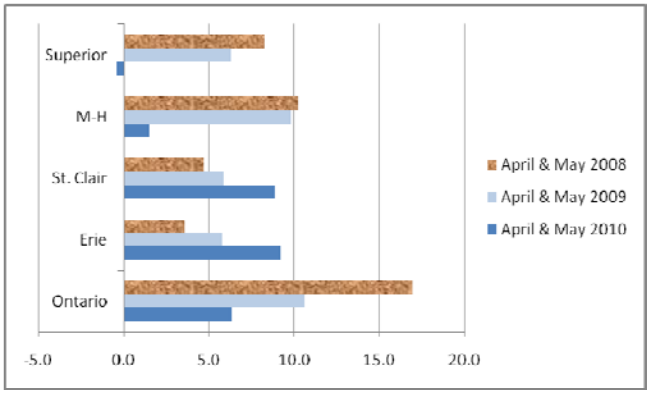

Figure 5: Rise in Great Lakes water levels in April and May, 2008-10

Low Seasonal Water Level rises in 1987

The Great Lakes experienced unusually low seasonal rises in water levels in the spring of 1987 that largely mirror this spring's. In 1986, the lakes had reached tremendously high water levels. Lakes Michigan-Huron, Erie, and Ontario set record highs throughout that year. In 1987, however, the Great Lakes struggled to rise in the spring. Similar to this year, Lakes Superior and Michigan-Huron were flat from March to May, and Lake Ontario rose less than one-half of what

it usual rises in April and May. Even Lakes St. Clair and Erie's 1987 rise was several inches lower than average. (Figure 6)

Lake	1987	2010	Historical Average Rise
Superior	-0.8	-0.4	4.7
Michigan-Huron	0.0	1.6	7.1
St. Clair	3.9	8.7	8.7
Erie	2.4	9.1	9.1
Ontario	5.1	6.3	13.4

Figure 6: Rise in Great Lakes Water Levels (in inches) in April and May of 1987 and 2010 compared to historical averages

Just as in 2010, below average precipitation in the winter and spring of 1987 was a primary cause of the low seasonal rises. Lake Superior received just 4.45 inches of precipitation from December 1986 to March 1987, which was 38% below average for the season. Moreover, precipitation within the Lake Superior basin was 82% of average precipitation in April and May. Lake Michigan-Huron experienced precipitation that was 64% of average during the winter months, and 77% of average in April and May of 1987. All in all, in 1987, the Great Lakes region saw only 70% of its average precipitation in winter, and 77% of its average spring rainfall in April and May. This year, Great Lakes experienced 68% of average precipitation in winter, and 85% of average in April and May.

Above average precipitation this June spurs Great Lakes water level rise

Considerable precipitation fell within the Great Lakes basin this June. Preliminary data indicate each Great Lake received rainfall that was at least 30% above their average June rainfall. Lakes Superior and Michigan-Huron experienced at least double the precipitation in June that they did in both April and May.

The abundant rainfall caused all of the Great Lakes to rise in June 2010. Lake Superior rose about 3 inches from the beginning of the month to the end, while Lake Michigan-Huron climbed about 4 inches. In contrast, Lakes Superior and Michigan-Huron rose less than an inch from the beginning of May to the end of May.

IJC Control Board Meetings with the Public

The International Lake Superior Board of Control held a meeting with the public on June 9, 2010. The meeting was held in Sault Ste Marie, Ontario and included discussion on Great Lakes water levels, St. Clair River issues and invasive species management. For more information on the Lake Superior Board of Control, please visit www.lre.usace.army.mil/IJC/Superior/index.shtml.

The International Niagara River Board of Control will hold a meeting with the public on Wednesday, September 15, 2010 at 7:30 pm. The meeting will be held in the Prospect Room at the Crown Plaza Hotel in Niagara Falls, NY. For more information, please contact Mr. John Kangas at (312) 353-4333 or visit the board's website at http://www.ijc.org/conseil_board/niagara/en/niagara_home_accueil.htm.

The International St. Lawrence River Board of Control will hold a meeting with the public on Tuesday, September 21, 2010. This meeting will be held at locations yet to be determined in Oswego, NY and Cornwall, Ontario from 7:00 to 9:00 pm. More information will be posted to the board's website soon. Please visit http://www.ijc.org/conseil_board/islrbc/en/main_accueil.htm for more information