LEVEL news

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Great Lakes – St. Lawrence River Water Levels

Very dry conditions result in significant lake level decreases on Lakes Superior, Michigan-Huron, and Erie

During January, the Great Lakes Basin experienced the following:

- Very low precipitation amounts throughout the Great Lakes Basin. Record low water supply conditions were experienced in the Lake Superior Basin, while very low to extremely low water supply conditions were experienced in the remainder of the basin;
- Lakes Superior was tied for its largest January decline, Lake Michigan-Huron had its second largest January decline on record, while Lake Erie had its fifth largest decline on record. Lake Ontario's level did not change;
- Lake Superior's mean monthly level was below average, while Lakes Michigan-Huron, Erie, and Ontario were above or well above average. Lake Erie experienced its ninth highest January water level;

Relative to their beginning-of-February levels and with average water supplies for this time of year, Lake Superior is expected to continue its seasonal decline into late winter, while the other lakes are expected to begin the transition from their seasonal decline to their seasonal rise in the coming months. Lake Superior water levels are expected to remain below average under typical water supply conditions. Wetter than average conditions could result in Lake Superior levels increasing above average, and drier than typical conditions may result in levels moving further below average. The water levels of Lakes

Great Lakes Water Level Information

Lake	January 2022 Monthly Mean Level		Beginning-of-February 2022 Level	
	Compared to Monthly Average (1918–2020)	Compared to January 2021	Compared to Beginning-of-Month Average (1918–2020)	Compared to February 2021
Superior	9 cm below	30 cm below	12 cm below	30 cm below
Michigan–Huron	29 cm above	47 cm below	26 cm above	44 cm below
St. Clair	46 cm above	30 cm below	31 cm above	56 cm below
Erie	52 cm above	15 cm below	45 cm above	22 cm below
Ontario	29 cm above	24 cm above	27 cm above	30 cm above

Michigan-Huron and Erie are expected to remain above average under any water supply scenario. Lake Ontario levels are above average and are expected to remain so under average conditions. In the event of wetter than average conditions, Lake Ontario could rise well above average by mid-winter, whereas drier than average conditions could result in lower than average levels.

With water levels remaining above average on some lakes and the possibility of large storms and winds during the winter months, low-lying areas are at risk for accelerated coastline erosion and flooding. For current information and forecasts, please refer to the sources listed below.

Water supply conditions in this and future editions of LEVELnews will be reported using a metric called net basin supply (NBS). A description of NBS is presented later in this bulletin.

January monthly levels

Lake Superior's monthly mean level was 183.24 m (IGLD85[1]), 9 cm below long-term average (1918-2020) and 30 cm lower than this time last year.

Lake Michigan-Huron's monthly mean level 176.60 m (IGLD85). This was 29 cm above its January monthly mean water level and 47 cm lower than last year.

Lake Erie had an average monthly water level of 174.54 m (IGLD85), 52 cm above average and 15 cm below last year's level. This is Lake Erie's ninth highest January water level on record.

Lake Ontario's January monthly mean level was 74.86 m (IGLD85), 29 cm above average and 24 cm higher than the level from a year ago.

Lake level changes

Lake Superior declined by 12 cm in January, close to double its typical January decline of 7 cm. This is tied with 1957 and 2003 for the largest January lake level decline on record.

January Basin Statistics

Lake	Precipitation (percentage of LTA) [a,b]	Net Basin Supply (Probability of Exceedance) [c]	Outflows (Percentage of LTA)[a]
Great Lakes Basin	44%	-	-
Superior	55%	>99% (extremely dry)	89%
Michigan-Huron	35%	93% (very dry)	121%
Erie (including Lake St. Clair)	36%	88% (very dry)	123%
Ontario	63%	84% (very dry)	117%

[a] As a percentage of the long-term average (LTA) period of record (1918-2020) for the month of January.
[b] United States Army Corps of Engineers (https://lre-wm.usace.army.mil/reports/GreatLakes/GLP-LastMonth.pdf)
[c] <5% extremely wet; <25% very wet; <45% wet; 45-55% average; >55% dry; >75% very dry; >95% extremely dry.
Note: The figures contained in this report are provisional and are subject to change. Data are calculated from the best available observations at the time of posting.

[1]Water levels are referenced to International Great Lakes (Vertical) Datum 1985 (IGLD85). For more information, please visit http://www.greatlakescc.org/wp36/home-2/international-great-lakes-datum-update/.

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Lake Michigan-Huron declined by 10 cm, five times its typical January monthly decline of 2 cm. This is the second largest decline during the period of record.

Lake Erie declined by 16 cm, during a month when the lake level generally does not change. This is the fifth largest decline for Lake Erie.

Lake Ontario's level did not change in January, while it typically increases by 6 cm.

(Note: lake level changes are based on the levels at the beginning of the month and not the monthly average levels.)

Beginning-of-February lake levels

Lake Superior's beginning-of-February level was 12 cm below average, which is 30 cm lower than last year. This is the lowest beginning-of-February level since 2013.

Lake Michigan–Huron's level was 26 cm above average at the beginning of February and 44 cm lower than this time last year. This is Lake Michigan-Huron's lowest level since 2017.

Lake Erie was 45 cm above average at the beginning of February and 22 cm lower than last year at this time.

Lake Ontario's level at the start of February was 27 cm above average and 30 cm higher than this time last year.

At the beginning of February, all of the Great Lakes except for Lake Superior were at least 56 cm above their chart datum level, while Lake Superior was 2 cm below its chart datum. Chart datum is a reference elevation for each lake that provides more information on the depth of water for safe boat navigation on the lakes. For more information, please visit Low Water Datum – Great Lakes Coordinating Committee (greatlakescc.org).

Water levels forecast

Relative to their beginning-of-February levels and with average water supplies for this time of year, Lake Superior is expected to continue its seasonal decline into late winter, while the other lakes are expected to begin the transition from their seasonal decline to their seasonal rise in the coming months.

Lake Superior is currently below its average level and is expected to remain so under average conditions. Drier than average conditions could result in lake levels dropping further below average in the coming months, while wetter than average conditions may result in lake levels moving above average.

The level of Lake Michigan-Huron is currently above average and expected to remain so under average and wetter than average water supply conditions. In the event of drier than average conditions, lake levels could approach average.

Lake Erie levels are currently well above average and are expected to remain high under average and wetter than average water supply conditions. In the event of dry conditions, lake levels could approach average in the next six months.

Lake Ontario levels are above average and are expected to remain so under typical water supply conditions. Drier than average conditions could result in Lake Ontario levels falling below average, while wetter than average conditions may result in lake levels rising well above

average throughout the spring and summer months.

For more information on the probable range of water levels, consult LEVELnews note on projections.

For a graphical representation of recent and forecasted water levels on the Great Lakes, refer to the Canadian Hydrographic Service's Monthly Water Levels Bulletin.

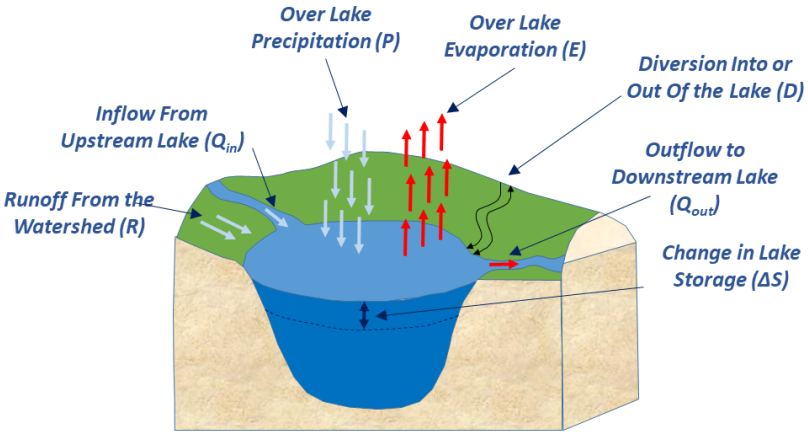
What is net basin supply (NBS)?

The primary driver of water levels across the Great Lakes-St. Lawrence River basin is the amount of water coming into the system, referred to as *water supplies*. Total water supplies to the lakes is the combination of the water that is entering from the upstream lake as well as water entering from the lake's basin itself, known as net basin supply (NBS). NBS is the total of the precipitation that falls directly on the lake surface and the runoff that enters the lake through the drainage basin, minus the evaporation that comes off the lake. NBS is calculated as follows and is a function of the water balance of the basins:

$$\underbrace{\Delta S - Q_{in} + Q_{out} \pm D}_{\text{Residual NBS}} = \underbrace{P + R - E + \varepsilon}_{\text{Component NBS}}$$

Residual NBS is a measure of the change in storage (ΔS) minus inflow (Q_{in}) from an upstream lake, plus outflow (Q_{out}) to a downstream lake, plus or minus any diversions (D) that exist[2]. Component NBS is calculated by adding over lake precipitation (P) and runoff (R) and subtracting over lake evaporation (E). These are established through measurements and modelled estimates. A figure showing the components of residual and component NBS are provided below.

Residual NBS is computed with a great deal of accuracy due to extensive gauging on the connecting channels and lake level measurements. There is more uncertainty in the over lake precipitation and evaporation, due to the difficultly in establishing monitoring stations on the lakes and the large surface area of the lakes. Runoff from the land surface is not measured at every river entering the lakes and the inflow from the ungauged rivers must be estimated. Due to the higher level of uncertainty in the component NBS measurements, an error term (ε) is added to that side of the water balance. For these reasons, residual NBS is considered to have a higher degree of accuracy in its measurement.



In previous versions of LEVELnews, we have commonly referred to basin water supply conditions, which is in reference to NBS. Since it has such an important role in describing the basin scale water balance, we will include residual NBS for each basin, in addition to precipitation, in the current and future editions.

Information on flooding

With water levels remaining high on some lakes, there is a high risk of flooding. Great Lakes water levels are difficult to predict weeks in advance due to natural variations in weather. To stay informed about Great Lakes water levels and flooding, visit the Ontario flood forecasting and warning program website at https://www.ontario.ca/flooding.

[2] The major diversions in the Great Lakes basin that affect water levels are diversions into Lake Superior at Long Lac and Ogoki, the Chicago diversion out of Lake Michigan and a diversion between lakes Erie and Ontario through the Welland Canal. For more information on diversions visit An Overview of Great Lakes Diversions | International Joint Commission

Additional information can also be found on the International Lake Superior Board of Control website, and the International Lake Ontario–St. Lawrence River Board website.

Information on current water levels and marine forecasts

Daily levels: Current daily lake-wide average levels of all the Great Lakes are available on the Great Lakes water levels and related data webpage by clicking on "Daily water levels for the current month". The daily average water level is an average taken from a number of gauges across each lake and is a good indicator of the overall lake level when it is changing relatively rapidly due to recent high precipitation.

Hourly levels: Hourly lake levels from individual gauge sites can be found at the Government of Canada Great Lakes Water Level Gauging Stations website at Great Lakes water levels and related data - Canada.ca (adobecqms.net). These levels are useful for determining real-time water levels at a given site, however, it should be noted that they are subject to local, temporary effects on water levels such as wind and waves.

Marine forecasts: A link to current Government of Canada marine forecasts for wave heights for each of the Great Lakes can be found on the Great Lakes water levels and related data webpage under the "Wave and wind data heading". Current marine forecasts for Lakes Superior, Huron, Erie and Ontario are available by clicking on the link of the lake in which you are interested. To view a text bulletin of recent wave height forecasts for all of the Great Lakes, click on the "Text bulletin wave height forecasts for the Great Lakes and St. Lawrence River" link.

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