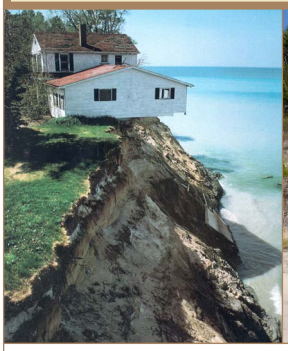
Preparing for Variable Lake Levels

THE DYNAMIC GREAT LAKES



With more than 3,000 miles of Great Lakes shoreline, lake levels have a huge impact on Michigan's coastal communities and economies. Lake levels affect coastal properties and infrastructure, as well as plant and wildlife habitat. They also affect shipping, recreation and manufacturing.

When levels fluctuate much above or below the long-term average, the impacts can be significant, especially in highly developed areas where infrastructure was not designed to withstand changing levels. It is not surprising that a common concern regarding climate change is how it will affect lake levels. It's a good news/bad news situation. **The bad news: we don't know exactly how things will change. The good news: we don't need to know exactly.**

The Dynamic Great Lakes

Water levels in the Great Lakes have always been highly variable. They fluctuate over many time frames – from hours to millennia – in response to wind, storms, precipitation, evaporation from the lakes' surfaces and runoff from tributaries. For example, a storm in summer of 1995 pushed water across Lake Huron, causing a four-foot rise at some locations and a corresponding drop of four feet at others. Seasonal variation occurs every year as the lakes rise an average of 12-18 inches from winter to early summer. Long-term fluctuations lasting many years, decades or longer are visible in the historical record (see Figure 1).

Long-term lake levels are also influenced by geology. The land in the Great Lakes drainage basin is slowly rising in elevation as it readjusts from the last glacial period. Some areas are rising more rapidly than others, changing the slope of the land and resulting in long-term lake level changes.

Each Great Lake is unique in how it responds to the factors that influence lake levels: it depends on the size and composition of the lake's watershed, total volume of the lake's basin and other characteristics. The lakes also influence each other's levels, as they are all interconnected.

Long-term Cycles

After three decades of water levels above the long-term average, levels have recently come down. Most modeling efforts suggest this decline will continue. These changes are not necessarily an indicator or a result of climate change; they may be part of a natural cycle of variability. Using geologic features deposited along the coasts, scientists have reconstructed the lake level history of Lake Michigan-Huron over the past 4,700 years. They have identified a general rise and fall cycle that lasts about 120-200 years. The instrumental record of the past 150 years indicates an additional rise and fall cycle of 26-38 years that occurs within the longer cycle. There has been no clear trend toward lower water levels from the late 1800s to the present. In fact, recorded lake levels since 1860 appear to be a single repetition of the 120-200-year cycle.

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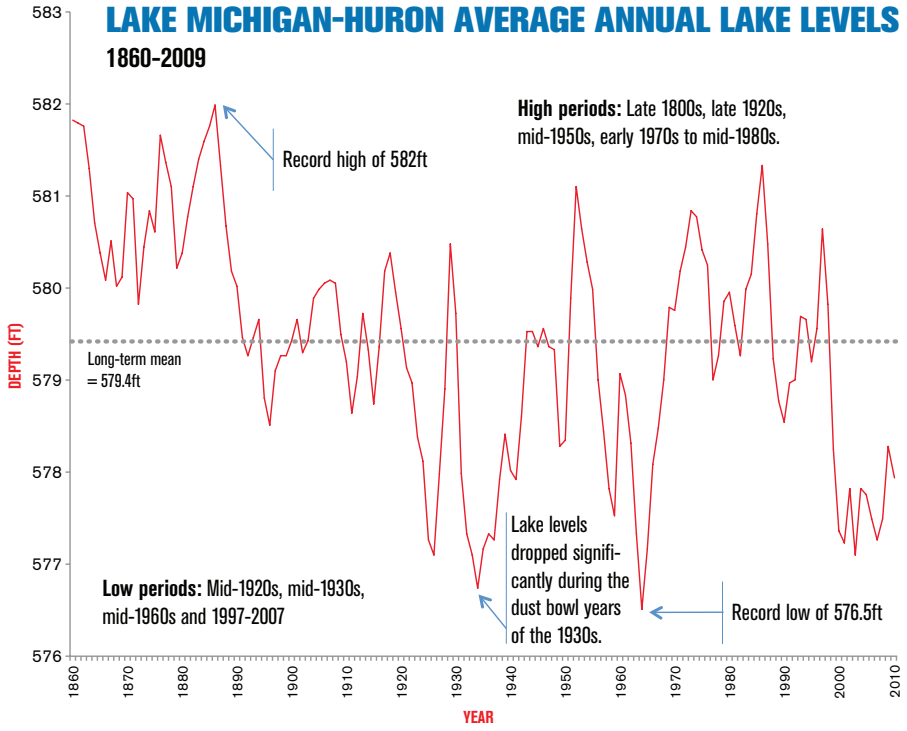
FIGURE 1



Although the impacts of climate change on lake levels are not clear, it is clear that the Great Lakes are always in flux.

Prepare for Fluctuation

We don't need to know exactly how the lake levels will change because we know that any change will not be permanent. No matter what happens with climate change, lake levels will continue to fluctuate, just as they have in the past.

Much of Michigan's coastal infrastructure (marinas, boat launches, shore protection) was built during the 1960s, 70s and 80s, when water levels were higher than today. This means we are less prepared for the impacts of lake level decreases than increases. Yet, we are not immune to the impacts of high water. Short-term rises due to storm surges will continue to occur regardless of lake levels, and levels are bound to go up again in the long-term.

Possible impacts of low lake levels include:

- Reduced access to marinas, harbors and shipping channels
- Stranded docks and boat ramps
- Exposure of boats to navigation hazards like shoals
- Changes to pumping efficiency of water intake pipes
- Increased coastal vegetation, including invasive species, along exposed bottomlands

Possible impacts of high lake levels include:

- Shoreline erosion
- Flooded docks, boat ramps, marinas, houses and other coastal infrastructure
- Flooding on shorelines and along rivers that empty into the Great Lakes

These impacts affect coastal property owners and those who use the lake for shipping, recreation and manufacturing.

Preparing for fluctuating lake levels means planning shoreline infrastructure and communities so they are resilient to both high and low water levels. To do this, we need coastal infrastructure that can adapt to changing conditions. For example, floating docks that move up and down with the lake allow convenient access to the water as lake levels fluctuate. Another example is softshore engineering, which is the use of natural features to protect shorelines instead of hard infrastructure (sea walls, rip-rap, groins, etc.). This approach encourages interaction between the lake and the shoreline, allowing the shoreline to naturally respond as lake levels fluctuate. Softshore engineering is most suitable where hard infrastructure is not needed for shoreline access or for protection from wave erosion.

In addition to on-the-ground projects, policy and planning can help guide development away from the most vulnerable areas and help communities think ahead about what to do to offset extremes. For example, communities can enact shoreline setbacks that incorporate potential lake-level rise, drought contingency plans and strategies for navigation and dredging under low water conditions.

High water on Lake St. Clair

Low water on Lake Huron

Left: Floating docks at Straits State Marina in Mackinaw City.
Right: Softshore engineering on the Detroit River.

We can never be 100% sure of what will happen in the future, but we can look to the past for help: preparing for the water level changes we've seen in the last 100 years is likely sufficient to address much of the variability we will see in the next 100 years.

References

Wilcox, D.A., Thompson, T.A., Booth, R.K., and Nicholas, J.R. 2007. *Lake-Level Variability and Water Availability in the Great Lakes: U.S. Geological Survey Circular* 1311, 25p

Daniels, Joyce. *Great Lakes Water Levels: Adapting to Uncertainty*. Upwellings. May 2008 Available at www.miseagrant.umich.edu/upwellings/issues/08may/index.html

For more information on how to prepare, see the *Preparing for Extremes* fact sheet.

Sea Grant Michigan

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