Living with changing lake levels

The following article, by Dr. Walter M. Tovell, is reprinted from **Rotunda**, *Volume 10, No. 3, a publication of the Royal Ontario Museum, by kind permission of the editor.*

It is hard to imagine what North America would be like without the Great Lakes. At least since the arrival of Europeans on their shores, they have been the principal transportation route to the continental interior. Today they provide a unique reservoir of fresh water for municipal and industrial use, a source of food both from their waters and from bordering lands, and hydroelectric power. They are an everyday part of our recreational and leisure life – as well as a convenient disposal site for ever-increasing quantities of sewage and industrial waste. They continue to be a major wildlife habitat.

The Great Lakes contain almost 20 per cent of the world's fresh, liquid surface water: enough to cover the whole of North America to a depth of three feet! It was the readily accessible fresh water that attracted such a large portion of the population of North America to their shores. Yet because of their magnitude the Great Lakes have been taken for granted in much the same way as the oceans. Only now are we learning that they can no longer be taken for granted, and that they are not a limitless resource.

Even though the Great Lakes constitute one of our most precious natural resources, their effects on our lives are not always benign. Like other natural phenomena, the behaviour of the lakes is sometimes unpredictable and beyond our control. In recent years, the problem of fluctuating lake levels has become one of increasing concern to property owners, industry, and government. High levels, for example, can cause flooding and erosion, with severe damage to property. In 1972-73, damage to the coastal zone became a matter of major apprehension. Many houses were lost or damaged through flooding or erosion. The loss of property during that year on the Canadian shores of Lakes Ontario, Erie, Huron and Georgian Bay amounted to $19 million, and the loss of land was valued at $9 million.

* * * *

The Great Lakes were formed during the retreat of the last glaciers, which in the Great Lakes Basin began about 14,000 to 15,000 years ago. Over this span of time the configuration, water levels, and directions of discharge underwent constant changes in response to the changing positions of the ice-front, the pre-glaciation topography, and the tilting of the earth's crust. In establishing an equilibrium between their waters and the surrounding lands, the Great Lakes have continuously adjusted to their surroundings.

Gradual, indiscernible trends

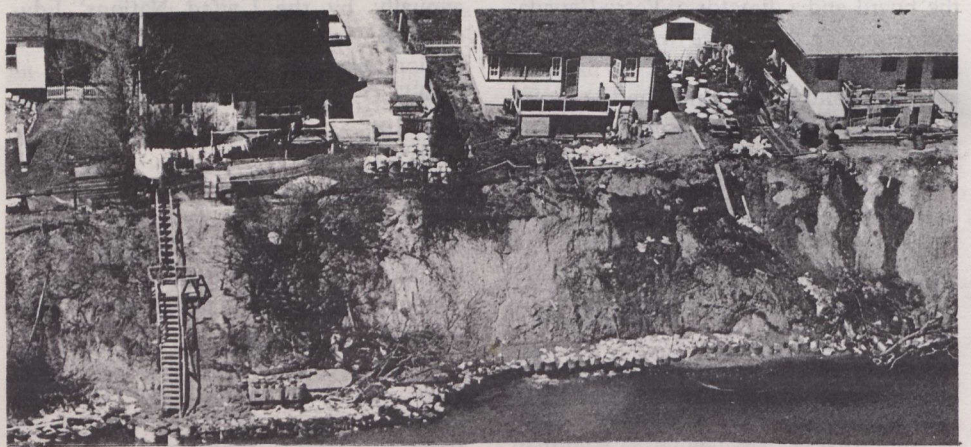
The configuration of the lakes is still evolving, principally through the processes of shore erosion and deposition, and partly as a result of continual crustal tilting. The tilting of the earth's crust in the area occupied by the Great Lakes is raising the northeastern shores, and consequently lowering the water levels on these shores. On the other hand, the water levels on the southern and western shores of the lakes are rising. In the long term, the levels of Lake Erie and Lake Ontario will increase and the level of Lake Huron will fall. These long-term trends are very gradual and hardly discernible to the average property owner. The maximum rate of tilt over the whole Great Lakes Basin is about 1.7 feet *per* century between Michipicoten, at the northeast corner of Lake Superior, and the west end of Lake Erie. Such a rate of uplift results in water level changes of only one to two inches *per* century.

Seasonal changes

Shorter-term variations in lake levels are far more noticeable. The most familiar of these are seasonal changes. All lakes have higher water levels in summer than in winter. The average seasonal variation is less than two feet in each lake, although in Lake Ontario the maximum difference from a winter low to a summer high may be as great as 3.5 feet. Superimposed on these seasonal fluctuations are some extremely short periods of changes, of varying magnitudes. The most temporary of these are caused by winds that blow along the long axis of a lake and drive the waters to one end. Extreme examples occur on Lake Erie, in part because of its position with respect to wind directions, and partly because this lake is relatively shallow. Here, wind set-ups have caused differences of more than 13 feet in water levels between Buffalo, New York, and Toledo, Ohio. A second cause of temporary changes is seiches, which are changes in lake levels due to differences in atmospheric pressure at different ends of a lake. But although they affect lake levels, winds and seiches do not alter the volume of water in the lake.

Long-term variations

The Great Lakes also exhibit long-term water level changes which cannot be accurately termed cycles, since the periods of these changes are not regular and hence not readily predictable. The intervals vary from ten to 30 years. From 1969 through 1976, all lakes had unusually high levels, and in the mid-1960s the lakes generally experienced low levels. In the late 1940s and the early 1950s the lakes were also high, reaching a peak in 1952 before moving to the low stage of the mid-1960s. The magnitudes of these long-term variations are three-and-a-half to six times greater than the average seasonal variations. It is these long-term variations that



Cliff recession, aggravated by periods of high waters, poses a threat to homeowners along the Great Lakes.