A Review of Options for Tackling The Water Level Issue

As you may be aware, the group headed by Mary Muter has been working on the Lake Huron water levels issue for nearly 15 years. We have operated within a number of different charitable organizations but have recently founded the **Georgian Bay Great Lakes Foundation** (GBGLF) under the auspices of the **Huronia Community Foundation**

We have studied the effects of dredging, sand and gravel mining, and the construction of the St. Lawrence Seaway on the flow characteristics of the St. Clair River and have concluded that these activities resulted in a loss of 20 inches in the level of Lake Huron. This loss contributed greatly to the extreme, prolonged low water levels that occurred between 1998 and 2013.

The IJC Recommendation to Government, and Water Levels

As a result of our and others' efforts, The International Joint Commission (IJC), in 2013, issued recommendations to the Canadian and US Governments, urging them to study the placement of ***flexible structures in the St. Clair River to offset the effects of the dredging when low waters occur in Lake Huron but never cause high water levels to increase further still. This is particularly important for certain areas of Lakes Huron/Michigan where high water events cause massive shoreline erosion, such as on the eastern shore of Lake Michigan. The USA will never allow structures to be installed in the St. Clair River that exacerbate high water events.***

Over the decades since the Seaway was constructed, there have been a number of attempts to place "compensating structures" in the St. Clair and Detroit rivers to offset past dredging etc. Bill Bialkowski* of our group has done extensive modeling of the St. Clair River and, indeed, of the entire Great Lakes system, and has designed a set of hydrofoil, flexible structures which would be placed at the bottom of the river in the Sarnia/Port Huron area to hold water back during low water levels. They are designed to raise Lake Huron by up to 20 inches during prolonged low water episodes. During high water levels, the hydrofoils would be hydraulically lowered to lie flat and present virtually no restriction to the water flow and would thus not increase the lake level. Ice booms could also be installed to prevent the formation of water-blocking ice in the river in winter, and such booms could actually assist in lowering the high water.

The IJC and the US Army Corps of Engineers Detroit offices have reviewed all of this work and they are supportive.

New Study Prompts Our Replay of All Proposals

Recently, a new study was carried out by Aecon, a large engineering company, on behalf of Georgian Bay Forever (GBF), to recommend means by which the St. Clair River dredging might be compensated for. It therefore seems appropriate to review all of the proposals that have been made over the years, to see how they fit with the IJC's 2013 recommendations.

1. The original US Army Corps of Engineers proposal was to install **compensating weirs or dykes** on the bottom of both the St. Clair and Detroit Rivers to 'hold back the water' in the upstream lakes. The Detroit River dykes were installed but the weirs in the St Clair, while approved and designed, were never installed. Had they been, they would have raised the level of Lake Huron by about 10 inches during both low water and high water, and would have greatly exacerbated the problems of high water. While this is likely the easiest and cheapest solution, this option is not, therefore, considered viable.

2. Some have suggested placing locks in the river, similar to those in the Welland Canal and St. Lawrence River. This option has been totally rejected by the IJC as both too expensive and disruptive of shipping and the environment.

3. Another suggestion from a number of sources, including Aecon, is to place a number of large turbines in the fast-flowing section of the river near the Blue Water Bridge. These would be designed to both hold back the water and generate power. Canada's National Research Council (NRC) made a detailed study of this proposal and concluded that for the turbines to raise lake levels by a significant amount, they would block the shipping channel, and would produce only a small amount of electricity. The NRC also warned that the upper river is a fish-spawning habitat, and the turbines would be subject to strict environmental review, which may preclude their use. During high water levels, the turbines would present the problem that, even with the blades feathered, the machines are large and would cause noticeable hydraulic drag, hence raising already unacceptably

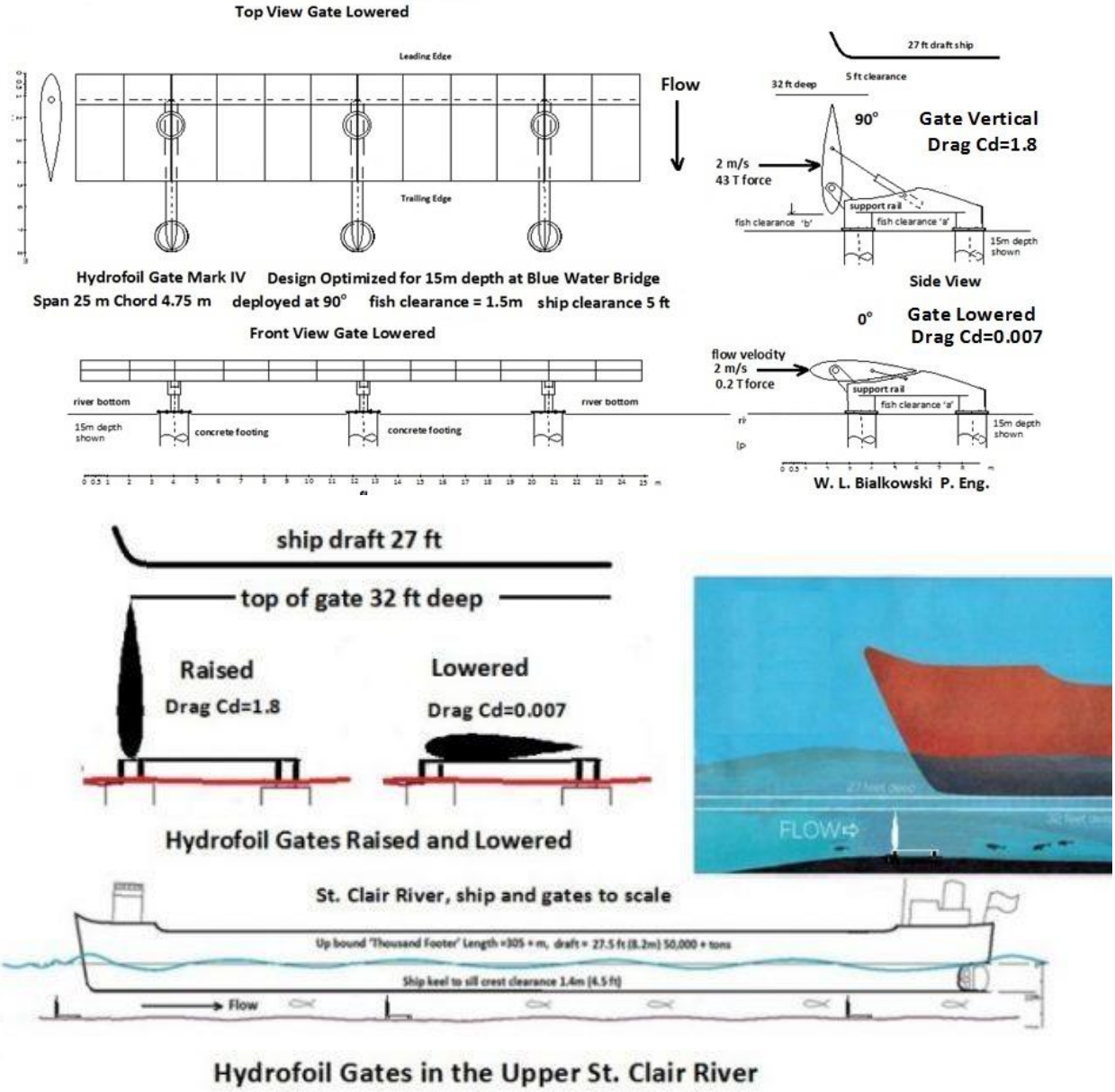
high water levels. So at best this is not an ideal solution, unless the turbines could be removed at high water levels.

4. A third proposal, again suggested by Aecon and others, would be to place inflatable dams between the Canadian shore and Stag and Fawn Islands, downstream from Sarnia. These inflatables have been used successfully elsewhere. At low water levels, the dams would be inflated to hold back water and raise lake levels. During high water, the dams would be deflated to allow the water to flow freely. The problem with such structures is that they require significant foundations and abutments – perhaps occupying 25% of the river's width. This permanent part would tend to exacerbate high lake water levels.

5. Another option, proposed by Aecon, would be to build artificial islands just off the entrance to the Sarnia Yacht Club on the north-east of the opening of the St. Clair River at Sarnia. Between the islands and the mainland there would be gates that could be opened or closed. At high water, the gates would be opened to allow as much water as possible to flow through. At low water, the gates would be closed to impede the flow of water and raise lake levels. There are a number of concerns related to this proposal, the most important being that such islands would cause lake levels to be even higher at high water levels, even with the gates opened. Furthermore, such islands would inevitably cause significant changes in sand transportation to the river and likely result in more river bottom scouring – already a major problem – and greater deposits of sand downstream. This option does not meet the IJC criteria.

6. The option that Bill Bialkowski designed – that of installing hydraulically controlled hydrofoil flap gates – essentially an airplane wing that can be rotated to the upright position or completely lowered – was specifically designed to meet the IJC criteria. The most important design criterion was the need to have a very high drag coefficient when the gates are deployed vertically (1.85) in order to slow the flow and raise low water levels, while having an extremely low drag coefficient (0.007) when lowered during high water events, thus ensuring that water levels are not raised further. While this may appear to be new and undeveloped technology, the design is actually based on 100-year-old airfoil technology which started with the Wright Brothers and today is extremely well document. For simplicity Bill used the NACA 0015 airfoil section for the design calculations. This is a foil of 15%

thickness, and is by no means the ‘slipperiest’ of all foils; so even less hydraulic drag can be achieved for high water when final design calculations are performed. The biggest challenge to Bill in his design was keeping the structures well clear of the river bottom to preserve the fish spawning habitat.



The Solution That Meets The IJC Objective

The future is bright! We believe that designs based on Option 6 represent the only solution currently available that can meet the IJC objectives. We also are convinced that any solution which exacerbates high water levels will be rejected by the Americans, particularly by the very politically connected and vocal group on the eastern shore of Lake Michigan. We would therefore like the Georgian Bay community to get behind a solution that would do no harm at high water levels. Otherwise, we risk alienating our American neighbours when we need their support for anything to be accomplished.

*** Bill Bialkowski** is a Professional Engineer, Fellow Canadian Academy of Engineering, B. Eng. & M.A. Sc. (Control Engineering). Retired consulting engineer experienced in mathematical modeling of hydraulic systems. He has spent almost 15 years analyzing and modeling Upper Great Lakes hydrology and the conveyance capacity of the St. Clair River.