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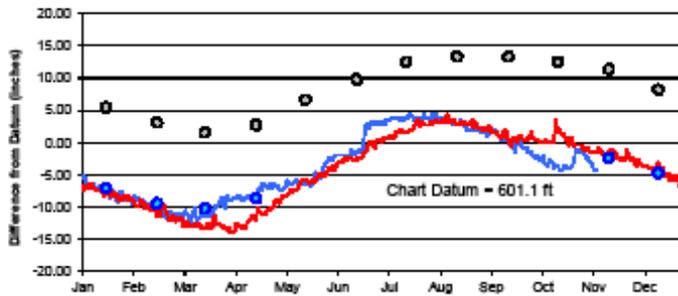
# Restoring Lake Michigan Huron Water Levels Responsibly

Bill Bialkowski, P.Eng.

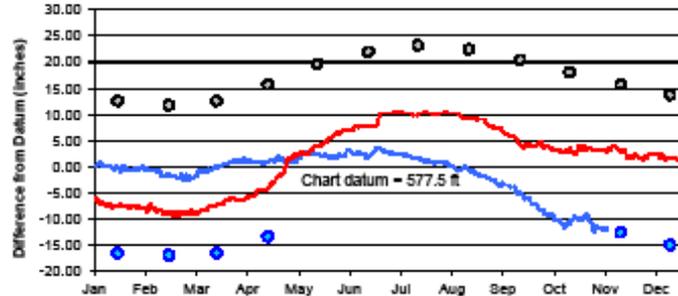
Mary Muter, Chair, Great Lakes Section and  
member of

Sierra Club Bi-national Coordinating Committee  
for all nine Sierra Club Great Lakes Chapters

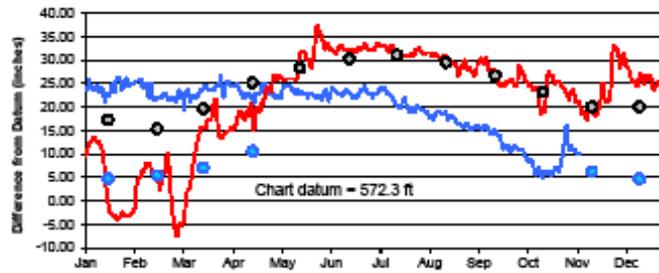
Lake Superior



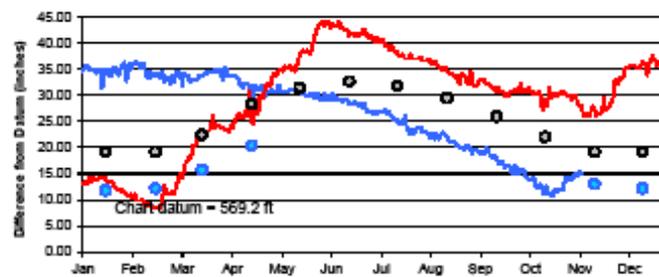
Lake Michigan-Huron



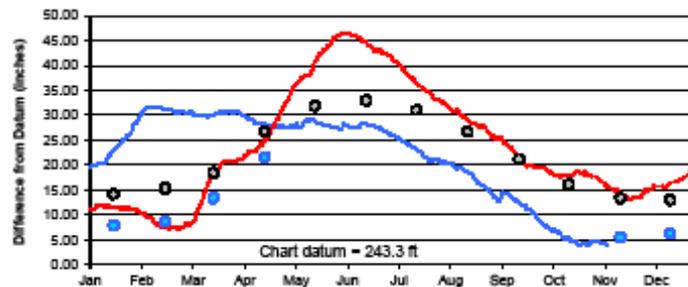
Lake St. Clair



Lake Erie



Lake Ontario



U.S. Army Corps of Engineers  
 Detroit District  
<http://www.lre.usace.army.mil>

# What does restoration mean?

Restoration means simply that:

- the conveyance capacity of the SCR will be restored gradually and responsibly to the level prior to the 1958-62 dredging of the St Clair River.
- It leaves Lakes Michigan/Huron/Georgian Bay otherwise unregulated and levels allowed to fluctuate naturally
- No control boards are required. Nature will continue to supply water and the lakes will fluctuate naturally.
- Restoration is supported by FoTTSA, all the large Great Lakes engos, the Great Lakes Mayors and several US groups

# Bad News - Water Levels Today

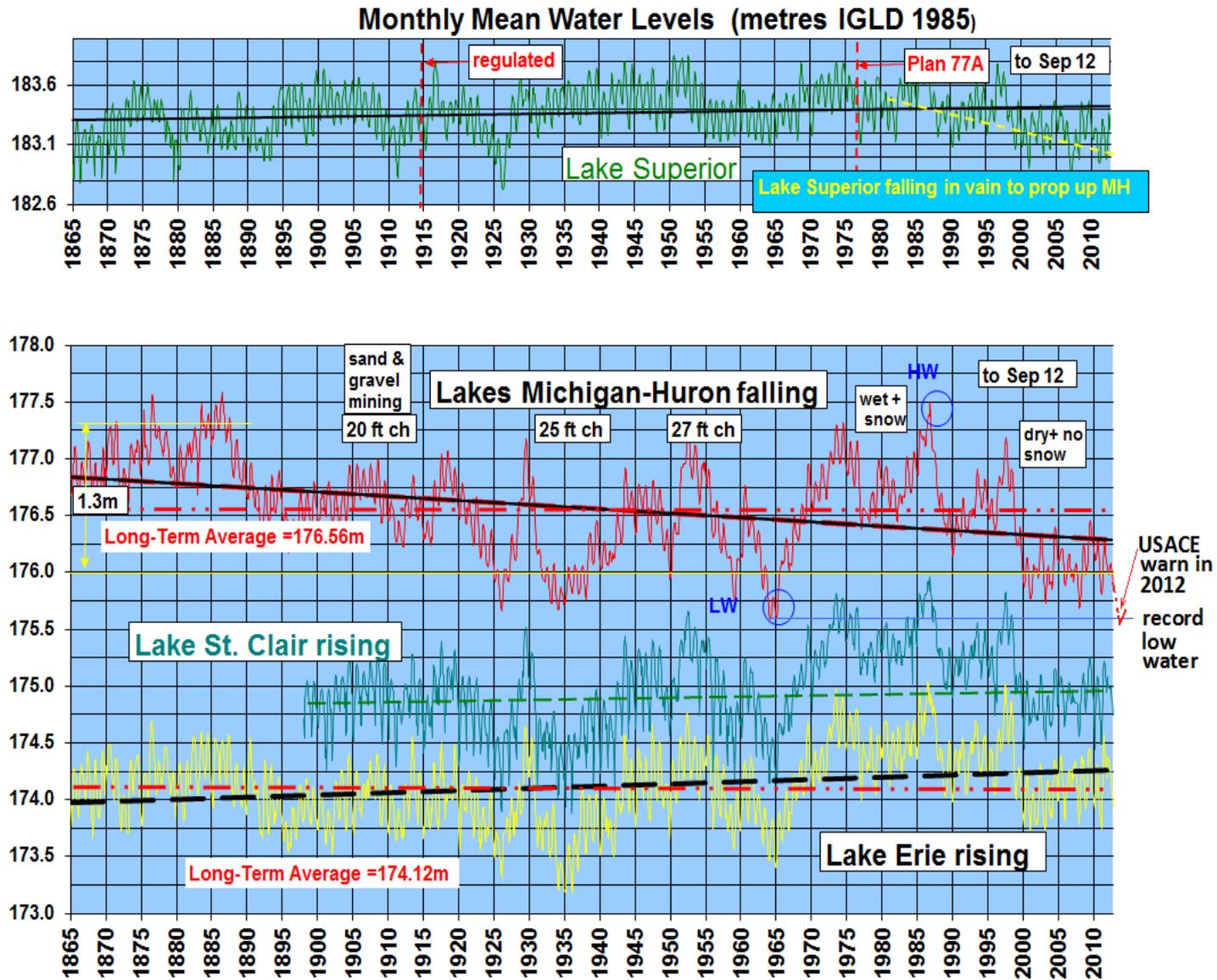


Snug Harbour.  
2 November, 2012.  
Water Level 15 ½ inches  
below chart datum.  
1 inch above record low

# Outline

- 1. Introduction – declining trends**
- 2. What is MLR?**
- 3. What is Restoration?**
- 4. Sierra Club Sills**
- 5. Where the should water levels be today?**
- 6. Conclusion**

# Figure 1: Water Level Trends



# Multi-Lake Regulation (MLR)?

- MLR, involves additional control structures to be built in the St. Clair (SCR) and/or the Niagara Rivers (NR)
- In MLR the SCR & NR would need:
  - excavation (\$10+B's) to ensure adequate conveyance capacity during wet climate.
  - At least one control structure in each (2 x \$0.5B)
- MLR needs Boards of Control on the SCR & NR, just like SU & ON today.
  - Meet monthly to decide outflows, and apply man-made rules
  - May differ from needs /desires of upstream & downstream interests – leads to conflict
  - US ENGO's violently opposed to this concept
- MLR in the upper lakes will upset the lower St. Lawrence River and the Port of Montreal.
  - mitigation needs excavation and control structures near Montreal & downstream at cost of \$6 to \$14 billion.

# Multi-Lake Regulation (MLR)

From the IUGLS Final Report – 4 options emerged

**Table 8-2: Best-performing Tradeoff Plans**

Plan	Frequency-Based Objective Value <sup>1</sup>	Structure Costs (billion \$US)		Excavation Costs (billion \$US)	
		St. Clair	Niagara	St. Clair	Niagara
\$29 billion Four-point	-22	\$0.5	\$0.5	\$27.0	\$1.3
\$6 billion Four-point	-13	\$0.5	\$0.5	\$3.9	\$1.2
\$23 billion St. Clair Three-pt.	159	\$0.5	—	\$22.4	—
\$2 billion Niagara Three-pt.	-17	—	\$0.5	—	\$1.4

<sup>1</sup> The frequency-based objective function does not have interpretable units; however, a negative value describes generally improved performance overall (see note in Figure 8-6). The plans shown in this table provided the best frequency-based objective function value for each combination of regulation scenario and cost.

# MLR Conclusion

- There are two MLR options – both require excavation & structures in the lower St. Lawrence at a cost of \$4 to \$6 billion
  1. “\$6b 4-point plan” includes both SCR construction (excavation & structure) and also on the NR. Total cost = \$10 to \$12b
  2. “\$2b NR 3-point plan” includes only NR construction (excavation & structure) & none on SCR. Total cost = \$6 to \$8b
- Control Boards will be needed at both SCR & NR
- It is a lot more expensive to excavate the SCR (very gradual 65 km long with only 1m fall).The SCR is also full of contaminated sediment (environmental disaster). In comparison the NR (35km with 2.6m fall).
- The NR is less expensive to excavate as at the head there is a narrow rock weir which holds back the water - formed 5000 years ago
- In my opinion, It would be irresponsible to excavate through this natural weir and cause worse damage than in SCR new approach channel.

# MH Restoration means?

- ‘Restoration’ is an IJC term – from IJC directive to the Study Board to investigate feasibility of restoring MH levels by 0, 10, 25, 40, and 50 cm.
- Restoration means that the conveyance capacity of the SCR will be reduced/restored to some value that existed earlier.
- It leaves the upper lakes otherwise unchanged, as a passive ‘self-regulating’ system. No man-made rules- nature takes care of levels.
- No control boards are required.
- Nature will continue to supply water and the lakes will respond as before.
- The only difference will be that with the SCR conveyance capacity will be lower, and Lake MH will ride higher than before.
- A 10% reduction in SCR conveyance will raise MH by about 25cm
- USACE designed sills in ‘77, started to build, but due to ‘86 HW abandoned

# MH Restoration

Lake MH to reduction in SCR conveyance reductions – self-regulating process  
From Bialkowski Report showing a 10% SCR reduction

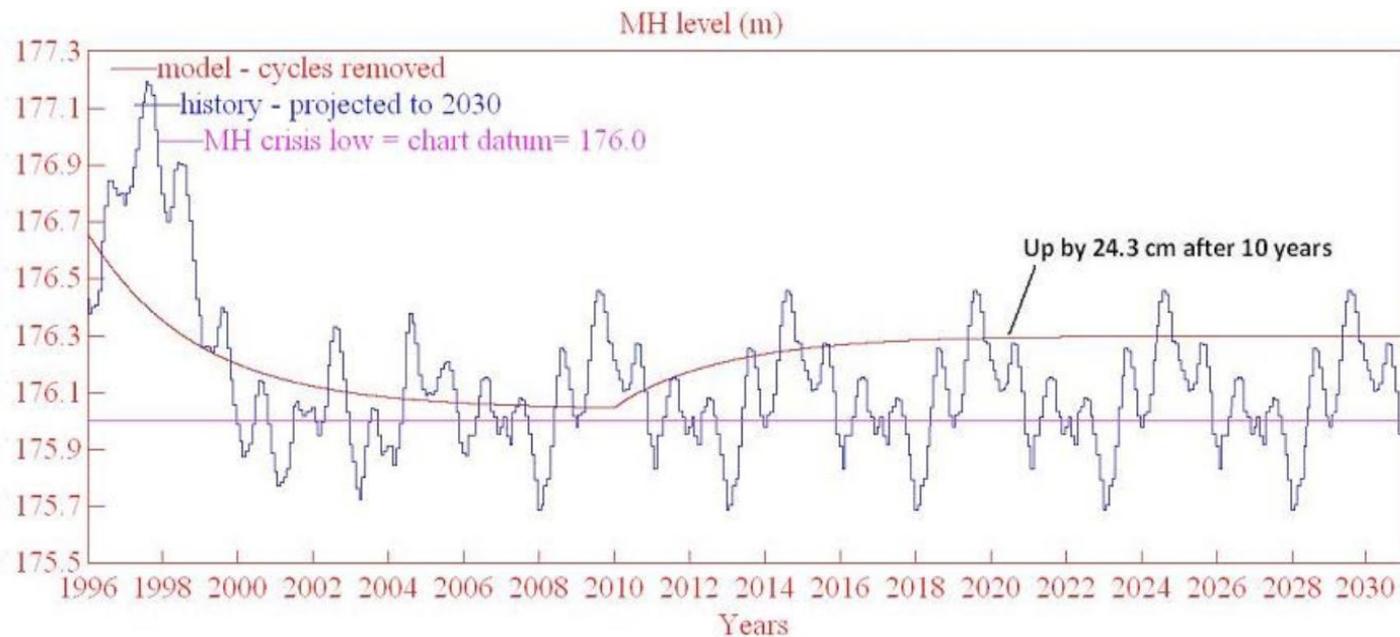


Figure 4.1.1.2 of 'Demo 1' shows that the level of Lake MH starts to increase right after the conveyance reduction and rises gradually until a new equilibrium or 'steady state' is established 10 years later.

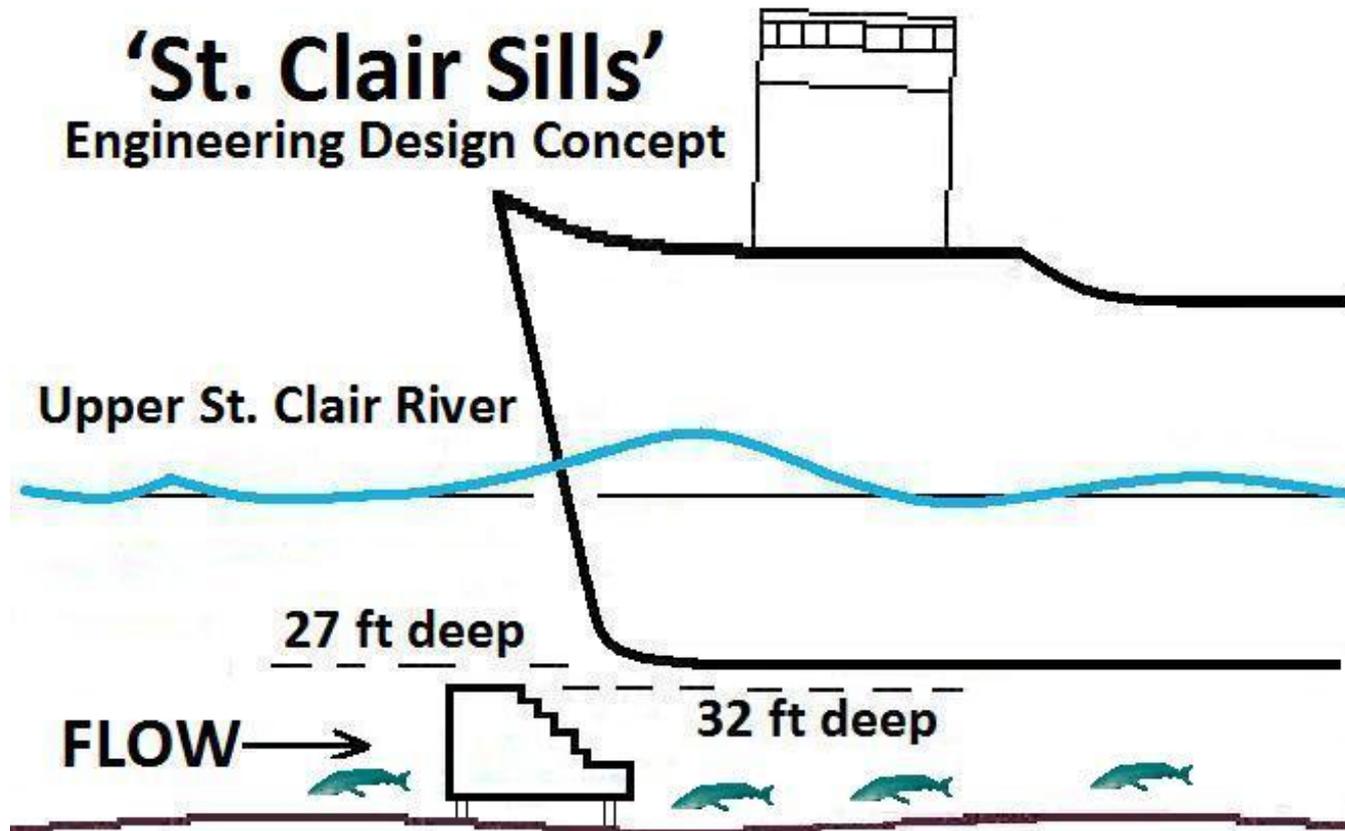
# MH Restoration Conclusion

- The Study Board said that 'Restoration' is feasible.
- As long as it is achieved in a gradually over say ten years, the impact on Lakes SC & ER can be contained to less than a dip of 10 cm (4 inches)
- Fixed structures such as the USCAE sills designed in 1977 will threaten flooding in Sarnia/ Port Huron should HW occur (5% chance but not zero)
- By contrast submerged sills could be rotated or removed if needed
- Study Board claim (exaggerated) that sturgeon habitat prevents structures in the SCR

# Submerged Sills

- The sills are designed as 'submersible structures' that in the event of high water can be re-floated, rotated, or removed
- They stand on legs off the bottom & leave the fish habitat otherwise undisturbed

# St. Clair Sills - Concept



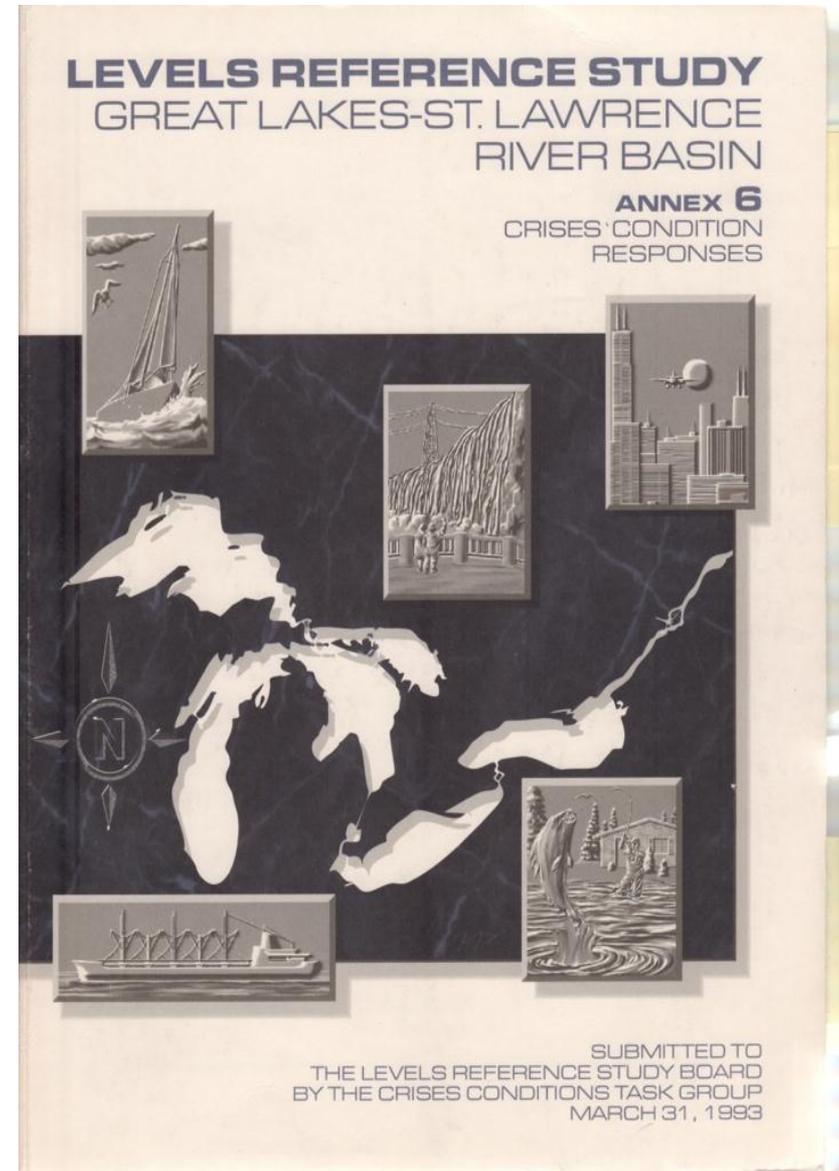
SC Sills are designed to sit on legs 3 ft off the bottom and leave the fish habitat undisturbed. In the unlikely event of a future high water crisis, they can be rotated 90° to lie with the flow, or be completely removed.

# MH Restoration design & installation

- The sills designs will be finalized using a full 3-D hydraulic model of the upper SCR to determine the best sill dimensions and locations. Some 50 are expected
- An experimental sill with legs of adjustable height will be used during the trials, and environmental assessment period, to determine best stand-off height above the bottom to minimize fish habitat impact, as well as impact on sturgeon spawning
- The sills will be installed over a staged period of at least 10 years (5 per year) or possibly longer. The exact period will depend on ensuring that downstream impacts are minimized, and will also depend on both SC & ER levels being above their long term mean values (as in 2012 & rising)
- The downstream impacts can be kept to a temporary level lowering in Lakes SC & ER of less than 10 cm
- Once installed the sills will allow MH levels to fluctuate naturally to allow for wetland diversity and reduce the invasive reed *Phragmites australis*, unless a high level crisis occurs, and sills need to be moved/removed.
- The cost of the SC sills is estimated to be about \$200 million

# MH Restoration operation

- **The sills will be installed on a permanent basis, however their potential 'rotation' and or removal will be subject to crisis response as defined in the IJC 1993 Level Reference Study, Annex 6**
- **The Great Lakes-St Lawrence River Levels Advisory Board will determine if and when the sills will be rotated to lie with the flow, or when sill removal will commence during impending high water, or when sills will be re-deployed after high waters recede**
- **It is proposed that the Lake MH crisis levels, and crisis alarm levels defined during the 1993 Level Reference Study be adopted**



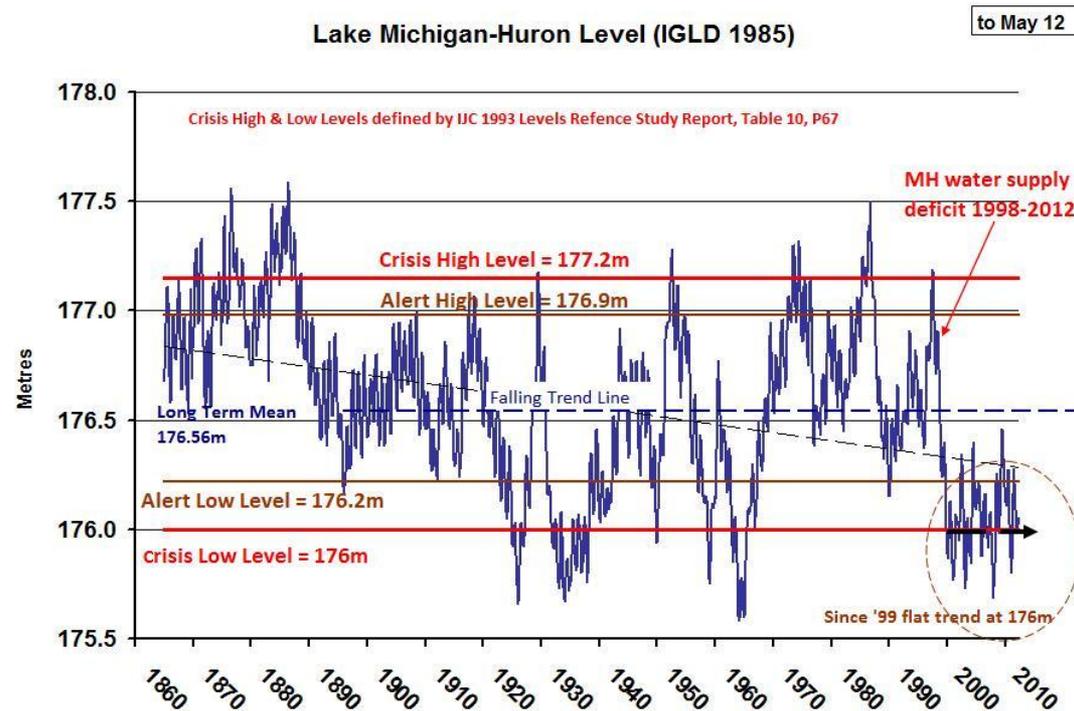
# MH Restoration operation

- **1993 LRS MH crisis levels:**

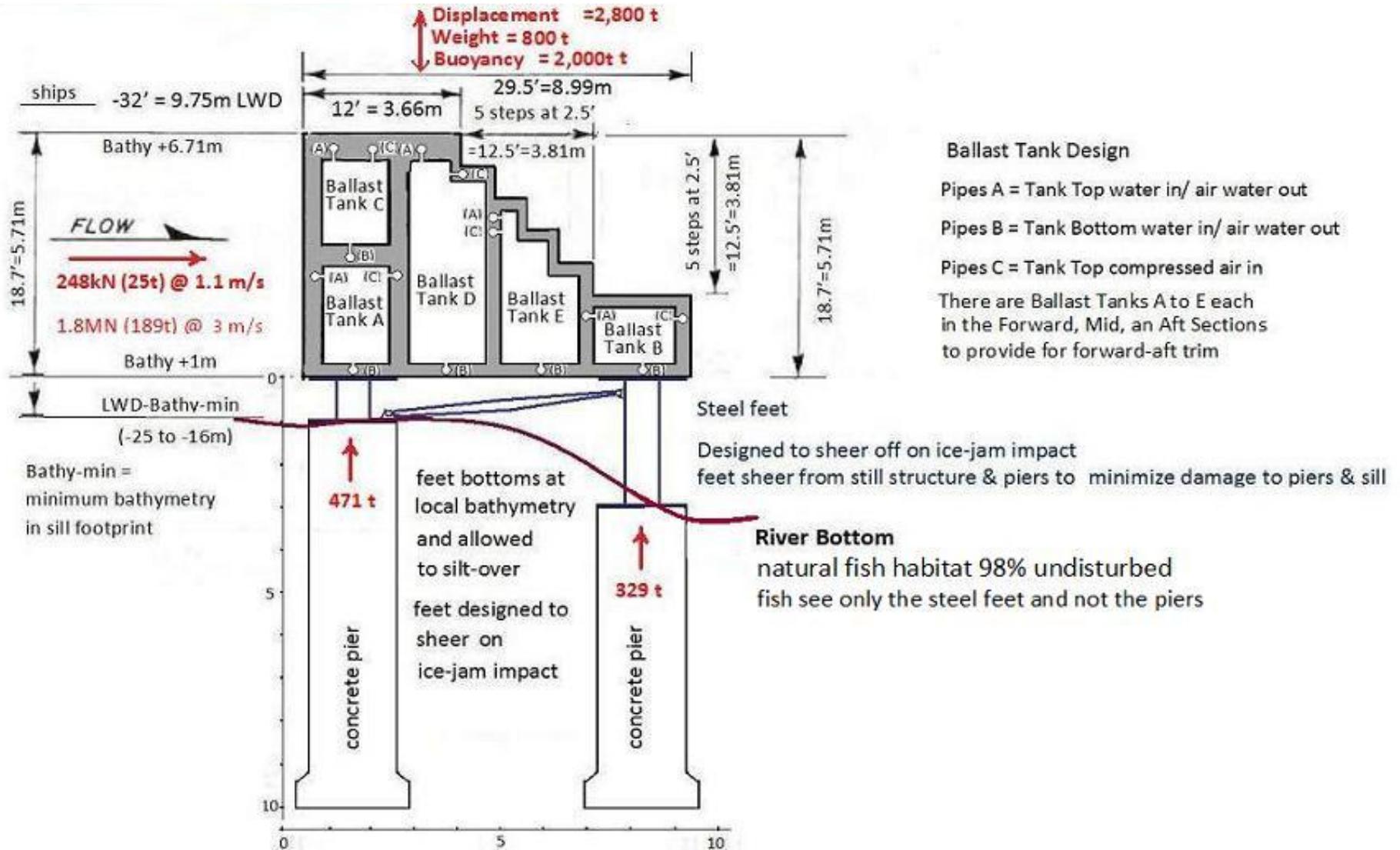
- Crisis low= 176.0m
- Alert low =176.2m
- Alert high= 176.9m
- Crisis high=177.2m

- **Suggested sill operation**

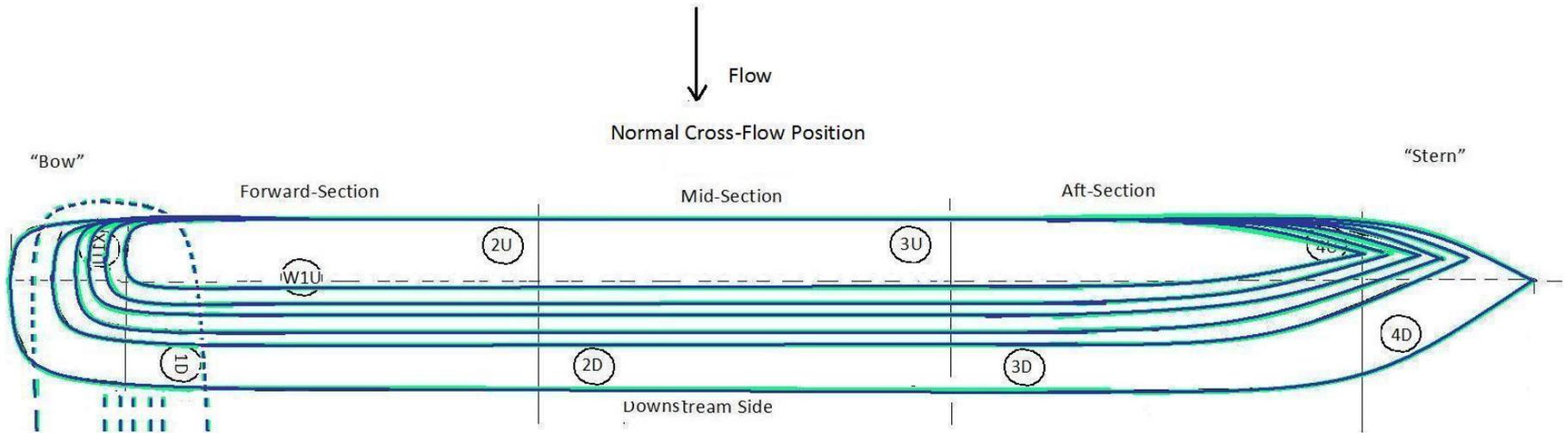
- At 176.2m all sills in facing flow
- At 176.5+m & level rising fast , at the discretion of the GL-SLRL Advisory Board rotation of some sills can start
- At 176.9m all sills rotated
- At 176.9+ sill removal starts
- At 177.2m all sills out
- At 176.9m level falling, sill installation can resume
- At 176.5-m level falling, all sills reinstalled, although some may be rotated
- At 176.2 all sills in facing flow



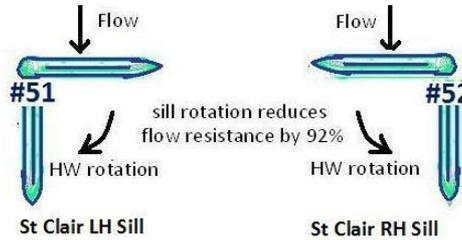
# St. Clair Sills – Design Cross Section



# St. Clair Sills– Design Plan View



Shown is a St. Clair LH Sill with clockwise rotation  
 St. Clair RH Sill with counter clockwise is mirror image

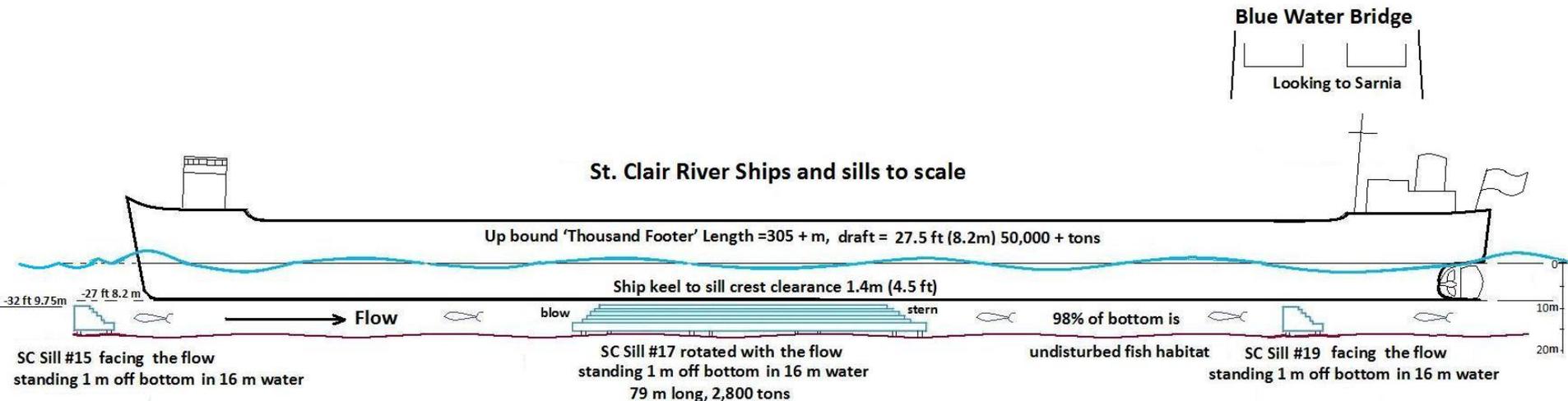


St Clair sills need a minimum depth of 16 m  
 and provide 9.75 m (32 ft) clearance for shipping

Sill in rotated position

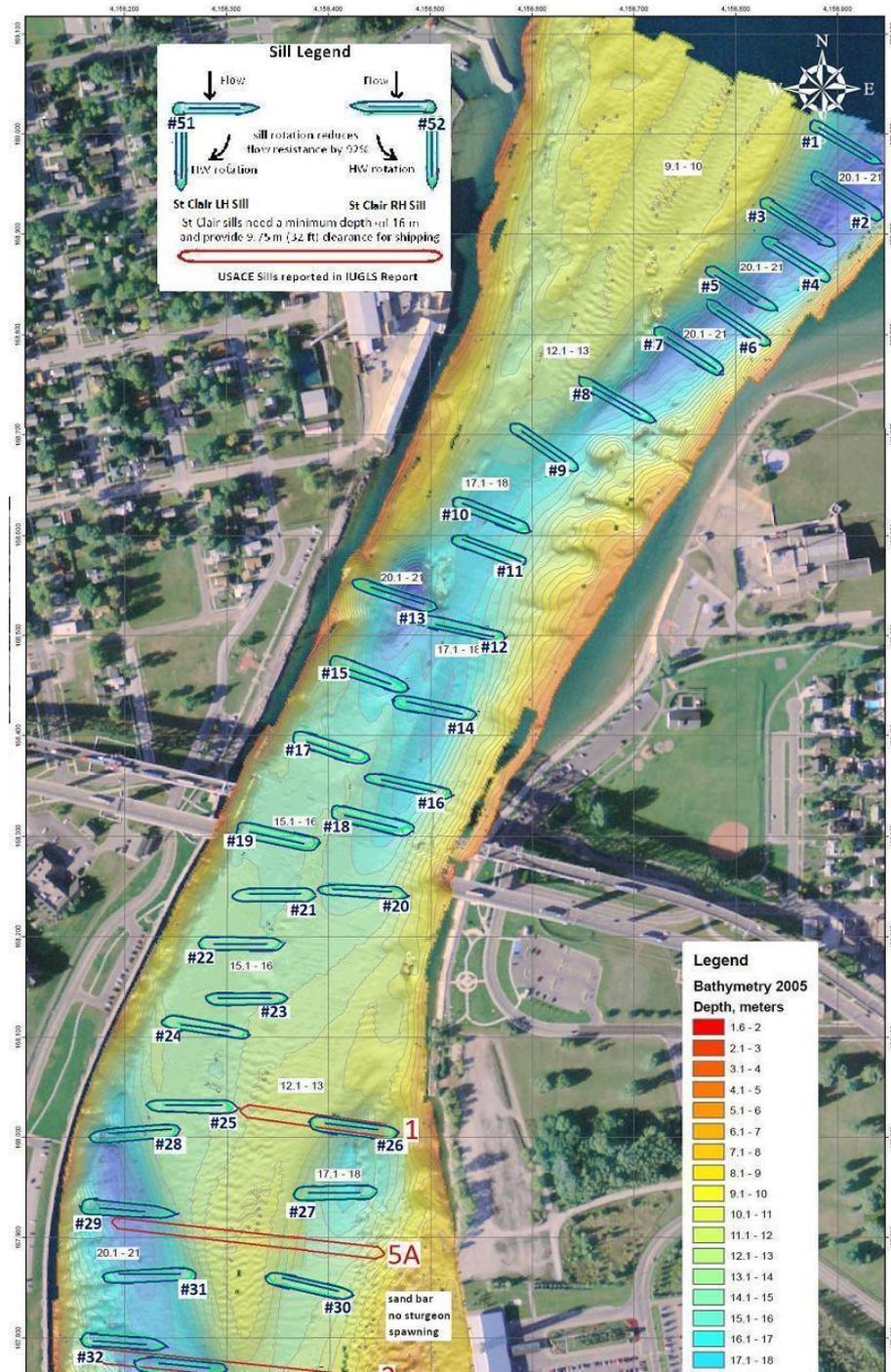
# St. Clair Sills – Ship passing

- The channel is dredged for a design depth of 27.5 feet (8.2m)
- The SC sills are designed to sit 1m off the bottom with sill crests at depth of 32 feet (9.75m)
- The keel-to-sill clearance is 1.5m (4.5 ft)



# SC Sills – in Upper SCR near Blue Water Bridge

- USACE sills are shown in red, and SC sills in blue/green
- The SC Sills have a height of 5.7m (19 ft) and are off the bottom by 1 m. Hence they require a minimum depth of 16 m
- This chart shows SC Sills installed in typical locations in depths of 16m+ and illustrates areas shallower than 16m need to be avoided
- Given that sturgeon spawning habitat covers an area of only 16 ha, it may be a simple matter of laying SC sill directly on the bottom in 15m of water in non-sturgeon areas



# Where Should Levels be now?

- In 2004, The Baird Report discussed modeling methods based on capturing the essences of the many 'cycles present in typical water level graphs
- The is 'math' based on Fourier transforms that decomposes variability into cycles.
- Baird used the 150 years of level data, as well as 4000 years of beach ridge data
- Just recently, Baird announced that they had extended this method to all of the upper lakes, and sent their results as part of their submission to the IJC

# Baird analysis of long and shorter term cycles

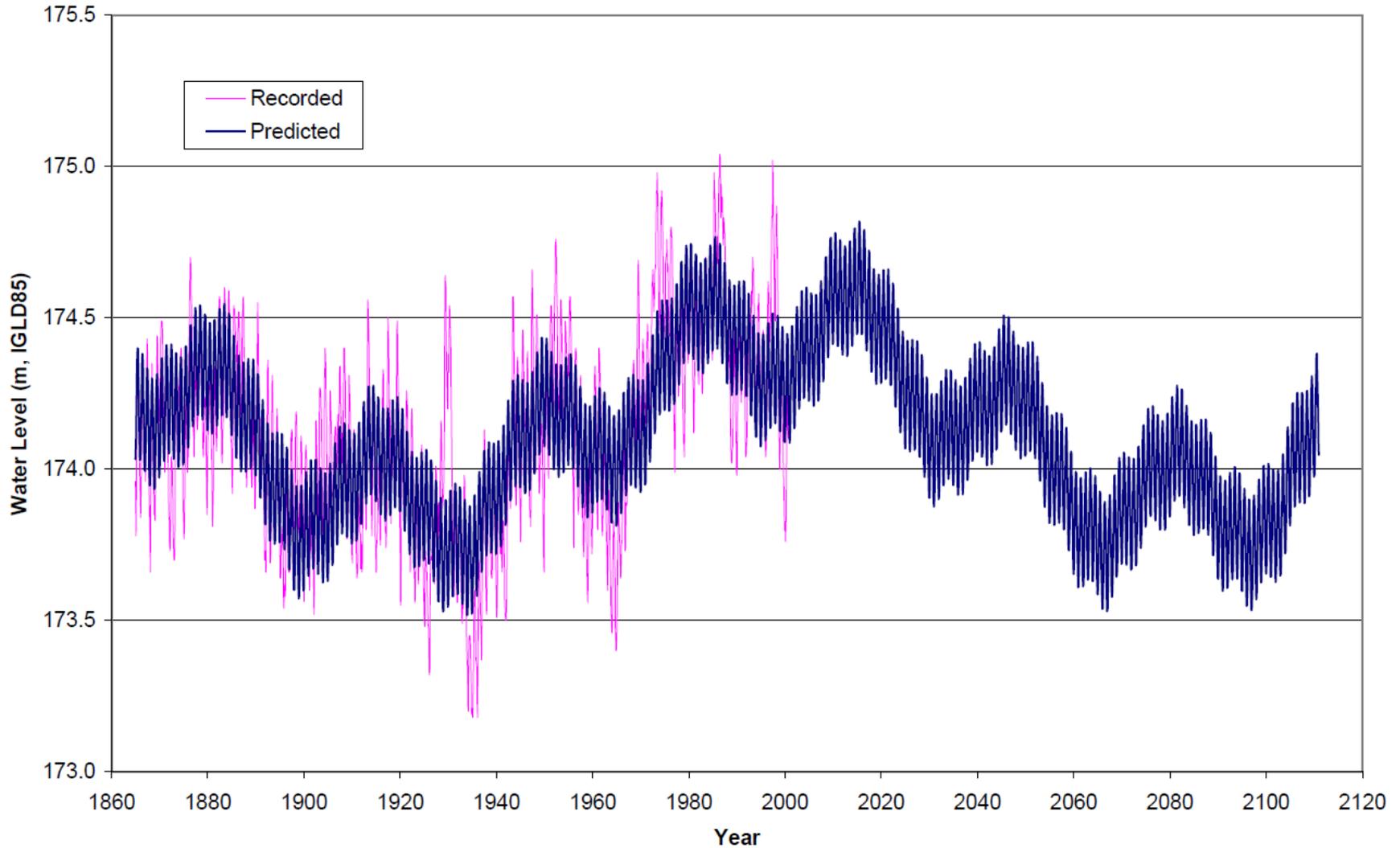


Figure 2.6 Lake Erie Annual Mean Water Levels Showing 160 and 33 Year Cycles

# Baird analysis of Lake ON cycles 2012

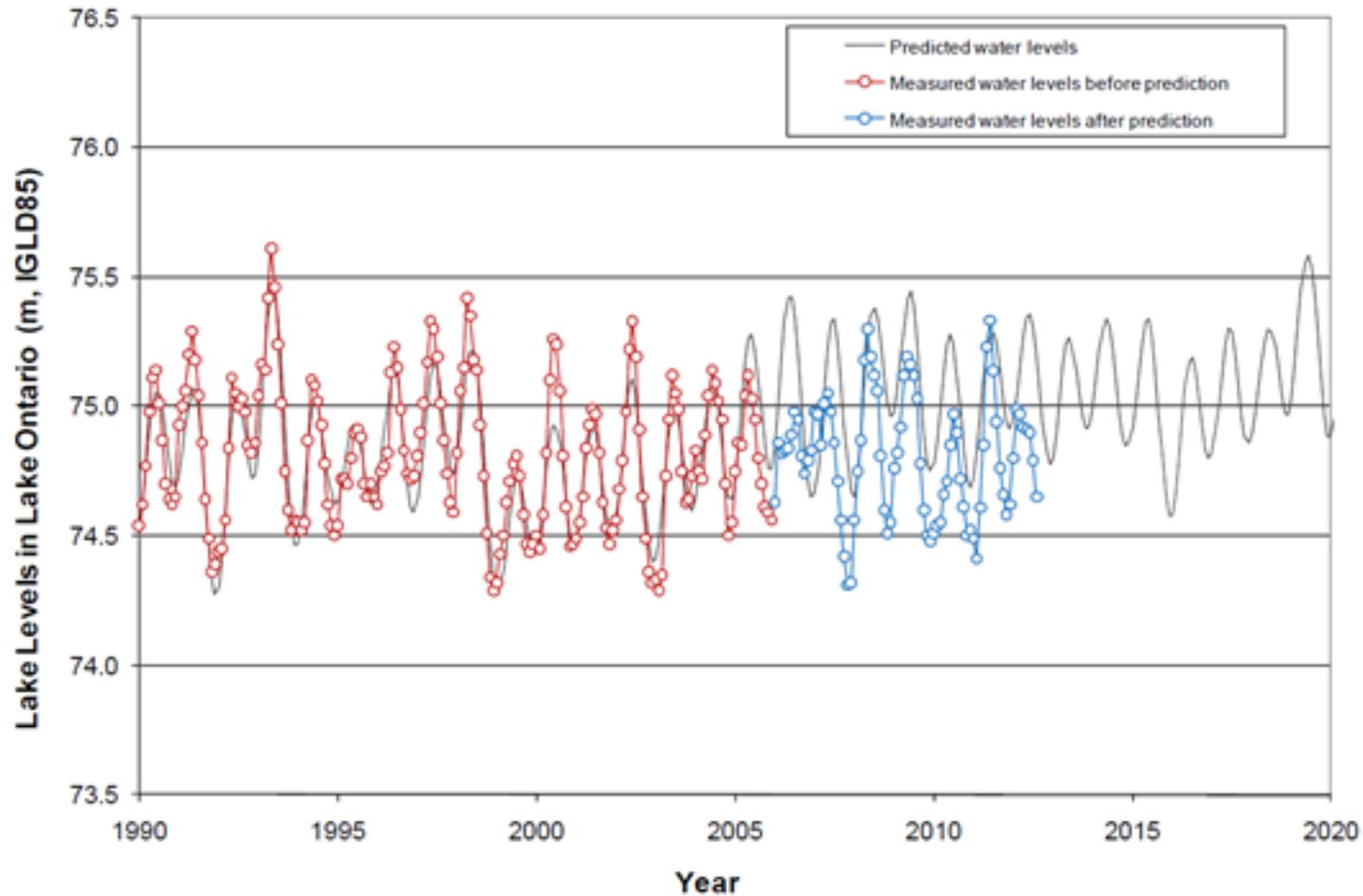


Figure 1 Comparison of predicted water levels with the measurements for Lake Ontario

# Baird analysis of Lake ER cycles 2012

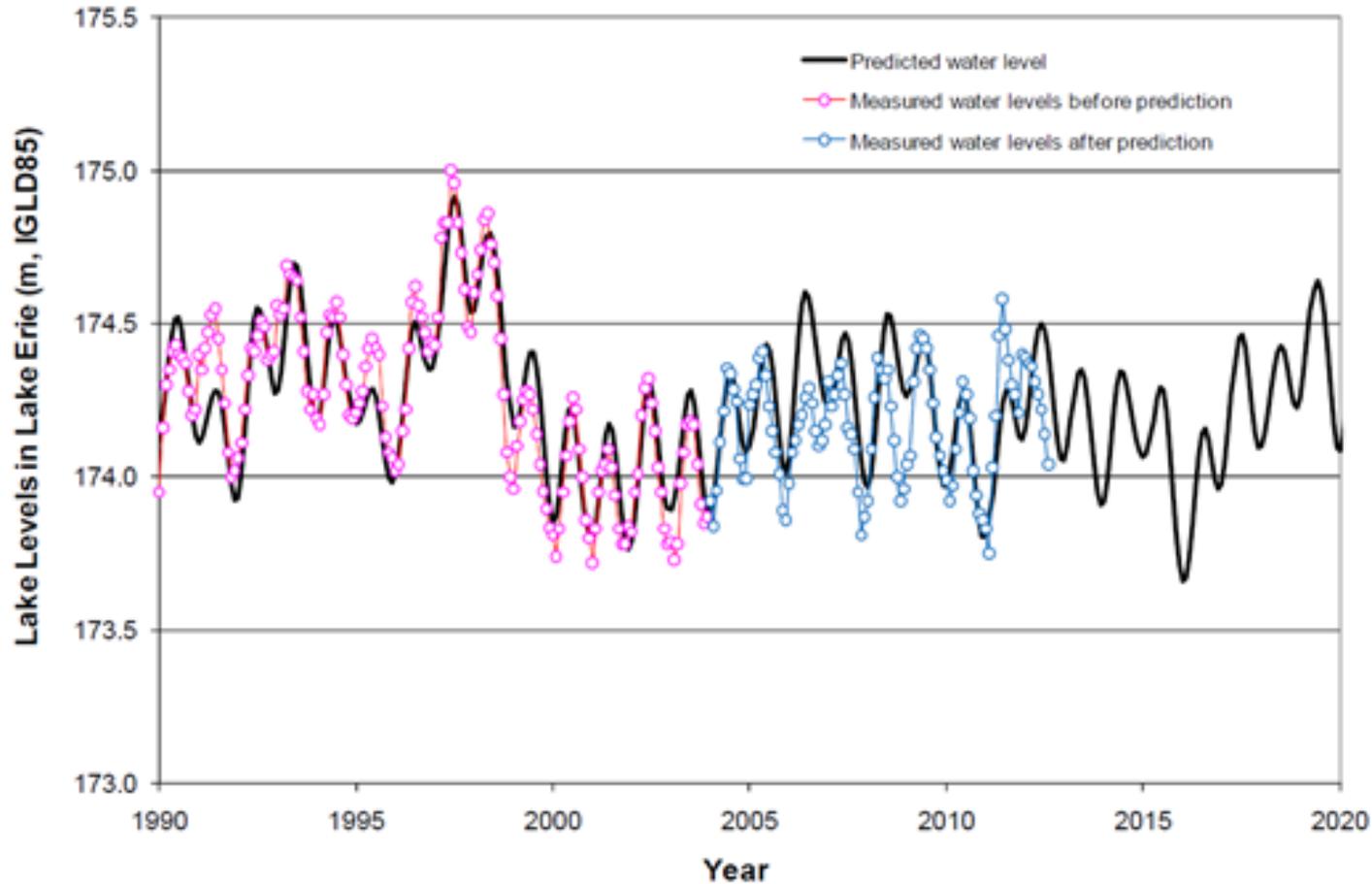


Figure 2 Comparison of predicted water levels with the measurements for Lake Erie

# Baird analysis of Lake MH cycles 2012

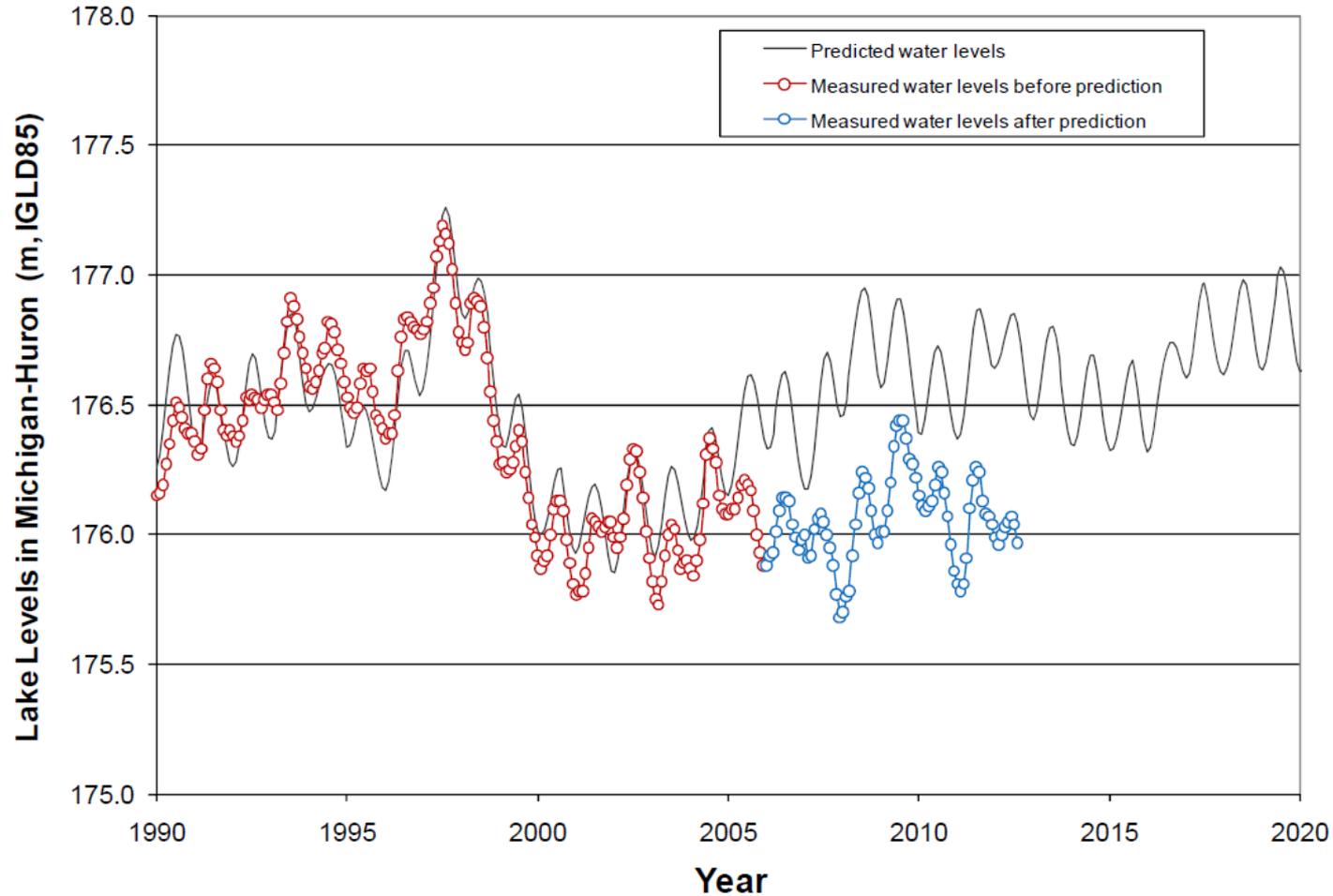


Figure 3 Comparison of predicted water levels with the measurements for Lake Huron/Michigan

# Baird analysis of Lake SU cycles 2012

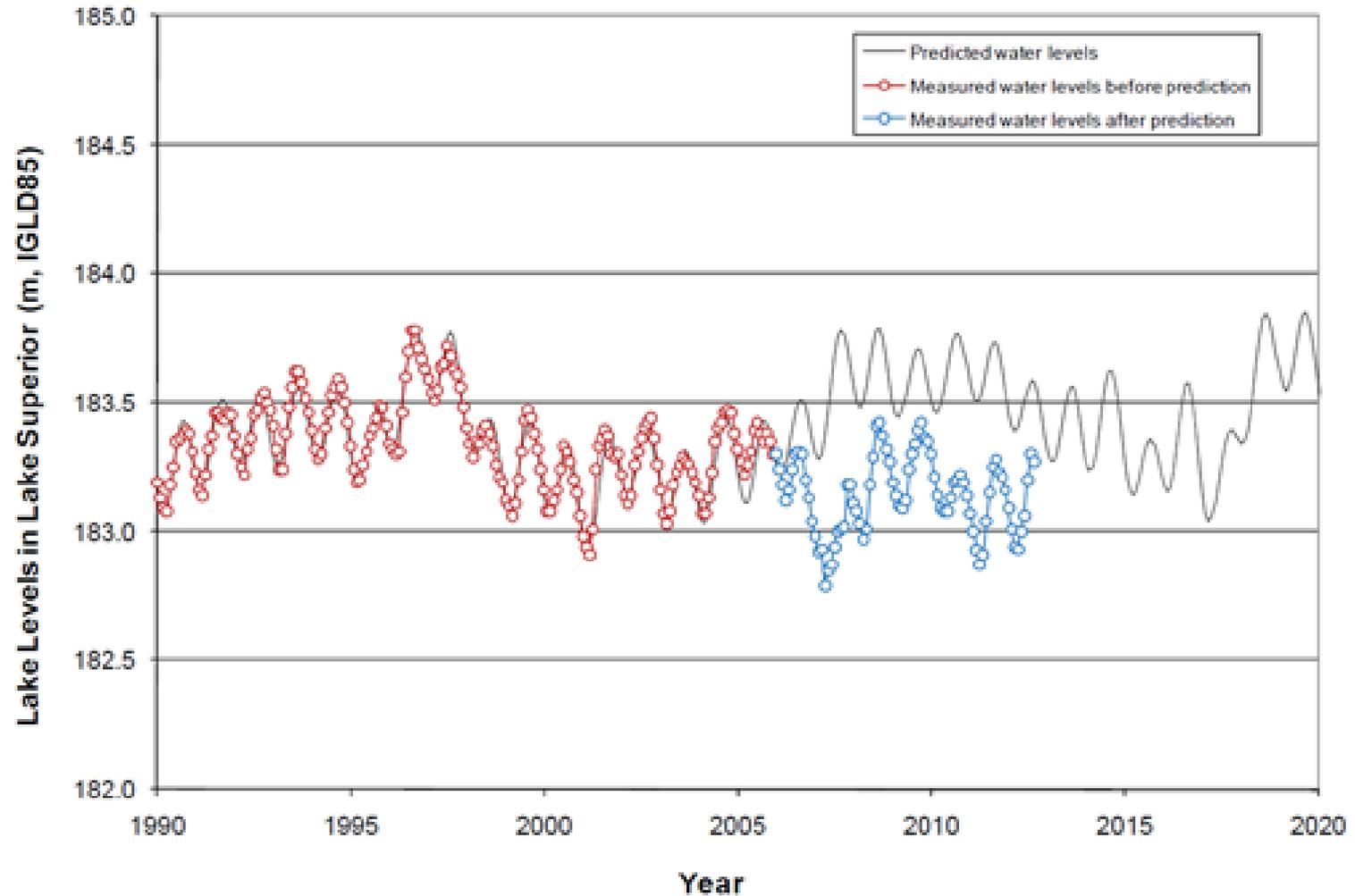


Figure 4 Comparison of predicted water levels with the measurements for Lake Superior

# Where Should Levels be now?

Based on this analysis

- Lakes ER and ON are where they were expected to be
- Lake MH is 50 cm lower than expected (we can assume due to SCR erosion, and weather)
- Lake SU is 50 cm lower than expected due to Plan 1977A drawing SU down to save MH



**What is Sierra Club doing?  
Moving the campaign to the US**

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Image NOAA  
Image © 2012 TerraMetrics  
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45°29'53.77" N 84°50'37.42" W elev 192 m



# What is Sierra Club doing?

## Our US connections and goals

- Will continue to support and fund McMaster's research – IJC Commissioners told us that having the science to support our concerns gives credibility
- Our engineers will continue to monitor lake levels and report as needed including media interviews
- Continue to consult with W.F. Baird and Assoc.
- All 9 Sierra Club Chapters have agreed by consensus to restoring Michigan/Huron/Georgian Bay levels by 25cm
- All the other large Great Lakes engos onside with restoration NB US organizations **do not** want Control Boards – fear political interference will trump the environment
- Other US groups now also supporting restoration; shoreline property owners, US Lake Carriers
- Meeting planned early December in US with groups and newly elected House and Senate leaders
- One group contacting Brookings Institute to assess economic impact of doing nothing

# What can you do to help?

- Meet and write to political leaders at all levels that you want Georgian Bay water levels restored and funding for the IJC to install submerged weirs following a full EIS
- Donate to Sierra Club or FoTTSA to help get this message to Washington

Thank you and please keep in touch