

**PIANC Workshop**  
13-14th September 2011



**Part 4: Innovation**

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**Presentation Outline**

The St. Lawrence Seaway


- Overview
- History

Innovations

- Vessel self spotting
- Hands free mooring

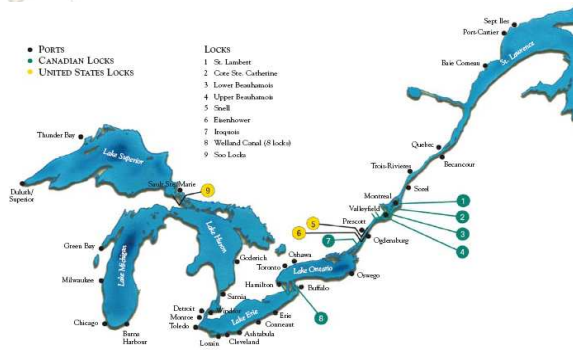


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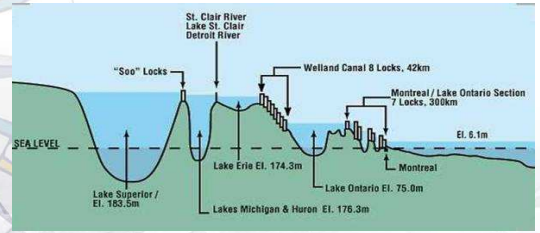
**Great Lakes St Lawrence Seaway**



**PORTS**  
 ● CANADIAN LOCKS  
 ● UNITED STATES LOCKS


**LOCKS**  
 1 St. Lambert  
 2 Corneille-Carleton  
 3 Lower Beauharnois  
 4 Upper Beauharnois  
 5 Steel  
 6 Beauharnois  
 7 Inosette  
 8 Welland Canal (8 locks)  
 9 Soo Locks

The St. Lawrence Seaway includes 13 Canadian and 2 U.S. locks



St. Clair River  
 Lake St. Clair  
 Detroit River  
 "Soo" Locks  
 Welland Canal 8 Locks, 42km  
 Montreal / Lake Ontario Section 7 Locks, 300km  
 SEA LEVEL  
 Lake Superior / El. 163.6m  
 Lakes Michigan & Huron El. 176.3m  
 Lake Erie El. 174.3m  
 Lake Ontario El. 75.0m  
 Montreal El. 6.1m

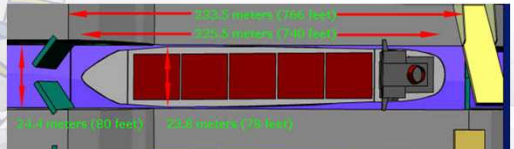
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The Seaway accepts vessels up to 30,000 tonnes

Lock Dimensions	Max Vessel Size
• Length = 233.5m	• Length = 225.5 m
• Width = 24.4m	• Beam = 23.7 m
• Depth = 9.1m	• Draft = 8.08 m



233.5 meters (768 feet)  
 225.5 meters (741 feet)  
 24.4 meters (80 feet)  
 23.7 meters (78 feet)

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**Locks in Niagara & Montreal**



Flight Locks



St. Lambert Lock

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# VESSEL SELF SPOTTING


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## Objectives of Vessel Self Spotting

- Optimize lock cycle time by having all lock personnel available for mooring operations sooner in the process.
- Set the stage for potential automation of the lockage process.

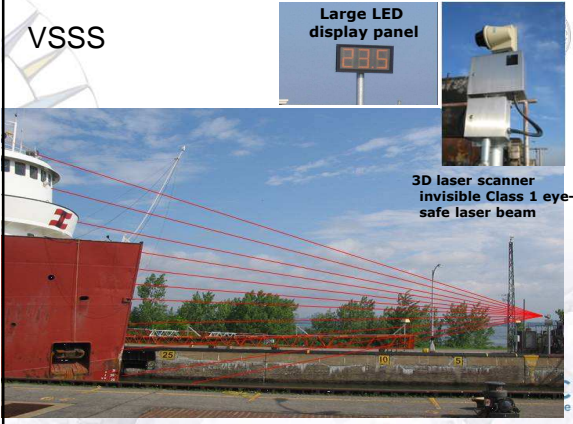
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## System Description


- The Vessel Self-Spotting System (VSSS) measures the distance from the vessel entering the lock chamber to it's final mooring position
- This distance is available to the ship master via two display panels and through an automated marine radio transmission
- The system is composed of two scanner assembly (one per direction) and two display panels

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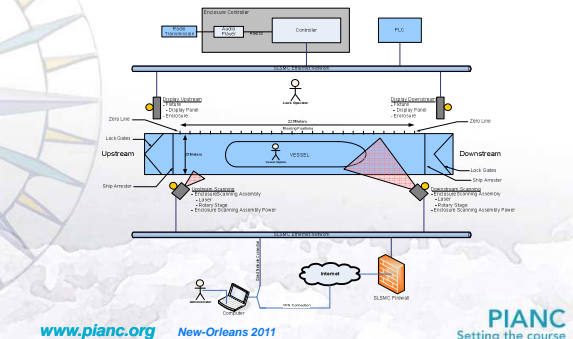


**VSSS**

**Large LED display panel**  
 239  
**3D laser scanner invisible Class 1 eye-safe laser beam**



## Schematic Layout



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## HANDS FREE MOORING

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## Objectives of Hands-Free Mooring

- Enhance operations efficiencies and reduce costs
- Remove the need to have non-standard equipment to transit the Seaway
- Enhance safety and eliminate possible mooring related injuries
- Provide customers with faster and more efficient service

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## Technologies Considered

- Mechanical
  - Rotary speed reducers
  - Robotic arm with mooring wires
- Electro-magnetic
  - Experimented by Delft University
- Vacuum Pads
  - Developed in New Zealand by MSL
    - Successful installations for ferries
    - Pilot installation in Dover, England for 7m tide

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## Why did we select vacuum mooring?

- Vacuum mooring is a proven technology
- Floating bollards are widely used in many locks around the world
- Least complicated system among the options

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## Timeline

- 2007 **Prototype #1 – Proof of Concept**  
One floatation unit installed at a “Low Head” Lock
- 2008 **Prototype #2 – Pilot Test**  
Two floatation units installed at a deep lock with 12m lift
- 2009 **Prototype #3**  
Two additional “winched” units installed at the deep lock
- 2012 **Prototype #4**

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## Prototype #1 confirmed that the concept is feasible

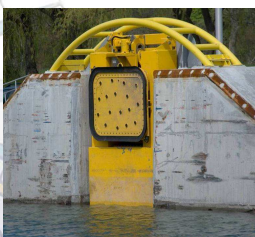


- Vacuum pad can hold 20 kN perpendicular force and 16 kN sliding force
- Rubbing bar & other obtrusions on hull can be an issue with seal
- Needs redesign of vertical travel mechanism

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## Prototype #2 showed that floatation units have limitations




- Generally work as per design
- Two units inadequate for large vessels
- Rubbing bar and obstructions continue to be an issue
- Ice build-up on floatation tank and track

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### Prototype #3 exhibited major improvement in performance

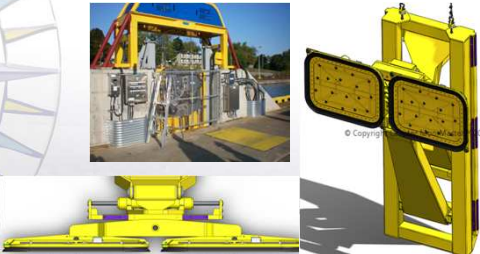


- Ability to be positioned vertically to avoid obstacles
- Can be parked at top when not in use
- More complicated operation & control system
- 4 units still inadequate for vessel induced surge forces

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### Prototype #4 will boost energy absorption capabilities



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### Challenges of technology innovations

- Lack of means to simulate real conditions
- Initial reliability not optimal
- Adaptation by vessel masters
- Impact on lock crews

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