

# Water Resource Management: Geography/Environmental Studies 4411

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# Graham Saunders

- Australian Weather Bureau
- Environment Canada
- Ministry of Natural Resources
- M.Sc. in Forestry and Climatology
- Teaching at LU since 1995
  - **Designed, proposed, teach Lake Superior course**
  - Climate Change Research – boreal forest
  - Severe Weather adaptation
  - Pricing carbon
- Decades of writing about weather, climate, Lake Superior and related policy issues.







# Assignment 1: public lecture by David Schindler

Bio of David Schindler: research and expertise in fish, mercury, various aquatic issues

Public lecture by David Schindler (recorded on June 18, 2014) in Waterloo, Ontario. The lecture was titled *Canada's Freshwater in the 21st Century* and is about 61 minutes in duration.

[David Schindler Lecture Video](#)

# Lecture 1:

## A Global Water Crisis?

- Water resources
- Security
- Freshwater Supply
- Modification
- Future Stressors
- Resource Management



# Global Water Security



**Control of Water Resources** : where water supplies or access to water is at the root of tensions.

**Military Tool** : where water resources, or water systems themselves, are used by a nation or state as a weapon during a military action.

**Political Tool**: where water resources, or water systems themselves, are used by a nation, state, or non-state actor for a political goal.

**Terrorism** (non-state actors): where water resources, or water systems, are either targets or tools of violence or coercion by non-state actors.

**Military Target**: where water resource systems are targets of military actions by nations or states.

**Development Disputes** (state and non-state actors): where water resources or water systems are a major source of contention and dispute in the context of economic and social development.

<http://www.worldwater.org/conflictchronology.html>



# Modification of Water Resources

Global demand in the 20th and 21st century

- Population growth
- Industrialization
- Expansion of irrigated agriculture

Change in rivers, lakes, reservoirs

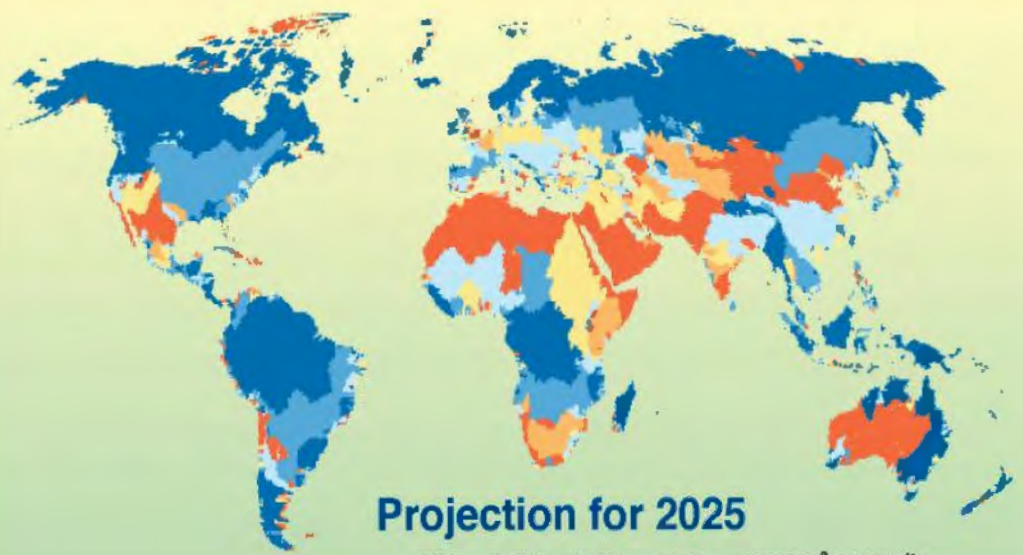
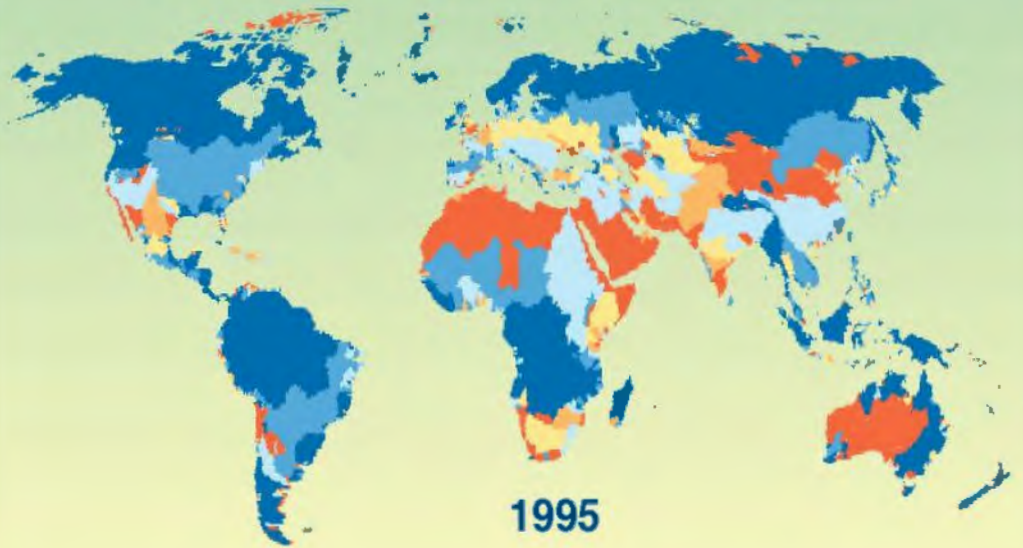
- Altering waterways
  - draining wetlands
  - constructing dams and irrigation channels
  - Connecting water basins with canals, pipelines, water transfer)





# The World's Freshwater Supplies

## Annual Renewable Supplies per Capita per River Basin



# The Great Lakes Basin



- A shared resource between Canada and the U.S.
- 20% of the world's surface fresh water
- Drinking water - more than 45M people
- Rich biodiversity
- Vital role in supporting central Canada's economics





# Political Stakeholders



# History of Great Lakes Environmental Programs



- 1909 - Boundary Waters Treaty established the International Joint Commission (IJC)
- 1970 - National environmental agencies:
  - Environment Canada (EC)
  - U.S. Environmental Protection Agency (U.S. EPA)
- 1972 – Ontario Ministry of the Environment
- 1972 - The Great Lakes Water Quality Agreement (GLWQA)





# History of Great Lakes



Past historical disputes and agreements of water flowing along or across the boundary, notably for navigation:

- Europe
- Mexico and United States
- Canada – US Disputes included:
  - St. Mary and Milk Rivers in the west
  - Rainy River
  - the Chicago Diversion of Lake Michigan (which lowered lake levels by 15 cm)
  - St. Mary's River at Sault Ste. Marie and the Niagara River



# Goals of the Great Lakes Water Quality Agreement



- The Great Lakes Water Quality Agreement is an Executive Agreement between Canada and the United States. It is not a Treaty.
- The Agreement commits the two countries to *restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem*.
- The Agreement is a relatively successful model of Canada-United States binational cooperation.





# Great Lakes – St. Lawrence Seaway



St. Lawrence River, St. Lawrence Seaway and the Great Lakes, sometimes termed Hwy H2O, is a 3,700-kilometre (2,300 mile) marine highway that runs between Canada and the United States.

## Some history

### ➤ 1895

The first joint Commission is formed to study the feasibility of a Seaway. This is followed by the International Joint Commission in 1909, but no further action on Seaway proposal.



# Seaway history (the opening)



- **1954** Completion of the Seaway navigation project links the Great Lakes to global markets.

On April 25, the icebreaker "D'Iberville" begins the first through transit of the St. Lawrence Seaway. Gross shipping weight for this first navigation season amounts to 22 million tonnes.

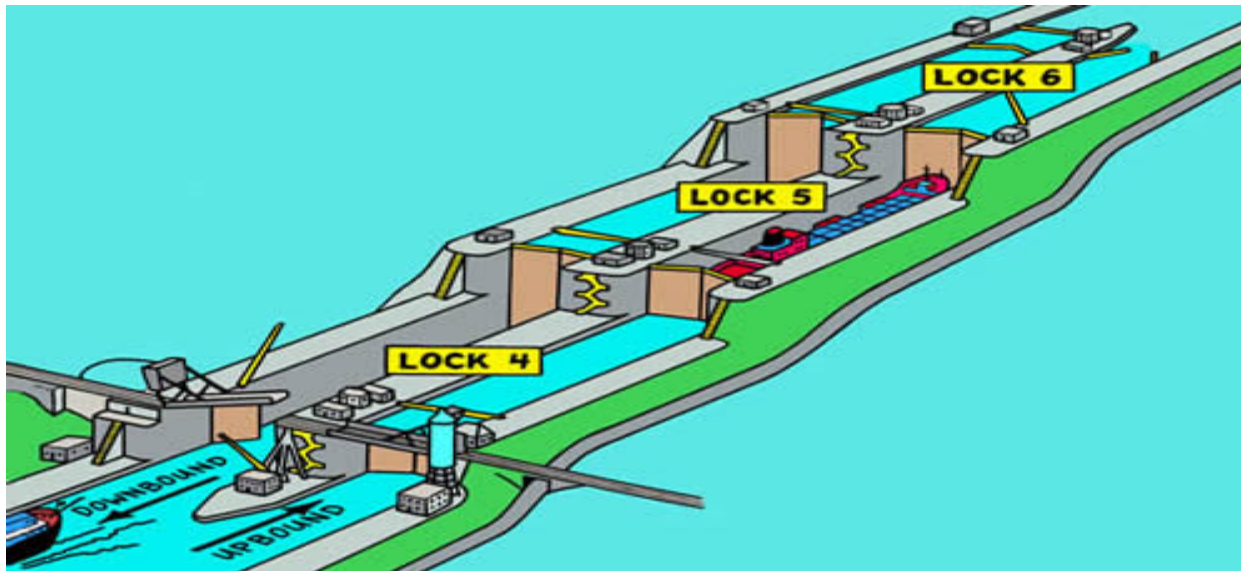


- **1979**  
The gross tonnage of ships passing through the Seaway reaches 80 million tonnes.
- **1996**  
Total of two billion tonnes of cargo, valued at more than \$300 billion.

# Seaway Locks



This lift system and accommodate ships to 225.5 metres in length (740 feet) and 23.8 metres (78 feet) in the beam. Ships can be twice as long and half as wide as a football field and carry cargoes the equivalent of 25,000 metric tonnes. Passage through a lock takes about 45 minutes.





# Canada-Ontario Agreement

## Respecting the Great Lakes Basin Ecosystem



Canada-Ontario Agreement  
Respecting the Great Lakes Basin Ecosystem

2007



## Agreement between the Government of Canada and Ontario

### ■ Six Federal Department Signatories

8 Federal Agencies/Departments:  
Agriculture and Agri-Food;  
Environment; Fisheries and Oceans;  
Health; Parks Canada Agency; Natural  
Resources; Public Works and  
Government Services; and Transport  
(and Infrastructure Canada)

### ■ Three Provincial Signatories

3 Provincial ministries: Environment;  
Natural Resources and Agriculture,  
Food and Rural Affairs

■ There have been seven COA's since  
1971.

Canada

Ontario

# Canada-Ontario Agreement (COA)



- Coordinates the governments of Canada and Ontario's efforts to achieve the vision of a healthy, prosperous and sustainable Basin Ecosystem for present and future generations.
- Key mechanism to engage the broader Great Lakes community and collaborate with other implementers to protect the Great Lakes
- Contributes to meeting Canada's commitments under the Canada-U.S. Great Lakes Water Quality Agreement
- Present – 2014 agreement  
<http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=46027E23-1>
  - GLWQA revisions
  - Align Federal/Provincial Great Lakes funding



# Water Levels (Lake Superior)

- Lake Superior regulation determined by Plan 1977
  - Plan 1977 designed to balance the levels of Lake Superior and Michigan-Huron (*Hartmann, 1990*)
- Difference: Lake Superior 183.2
  - Lake Huron 176.2



# Water Levels

- Shorter duration of ice cover will increase evaporation in winter
- Warmer air temperatures will increase evapotranspiration
- Summers with decreased soil moisture



Lake Superior, the world's largest freshwater lake, has made a major recovery. The period 1998 to 2013 featured well below levels. Its lowest level in 81 years was set in 2007 at 182.98 average and records set in some months.

Decrease of 48 cm from 1998 to 2007

The present level is 183.58 m above MSL

Long Term Avg: 183.32 m

Minimum: 182.83 (1926)

Maximum: 183.70 (1986)



# Wetlands (Lake Superior)

- Formation of wetlands: necessity of excess precipitation, flat terrain or depression in landscape, and little permeability.
- Types of wetlands affected by climate change:
  - Confined wetlands
  - Shoreline Wetlands

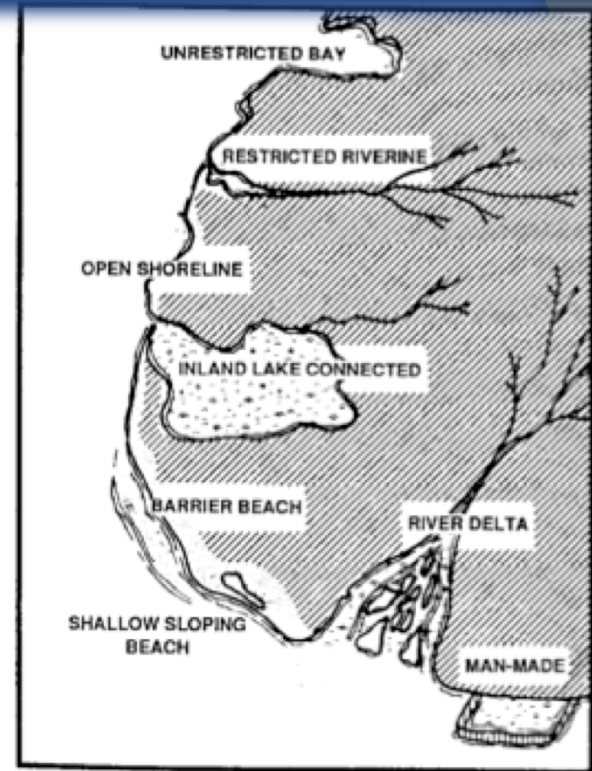


Figure 3. Wetland types based on geomorphic form modified from Liston and Chubb, 1985 and ERDC 1981

# Likely process

