Agenda for WRM: Jan. 17

Reminders

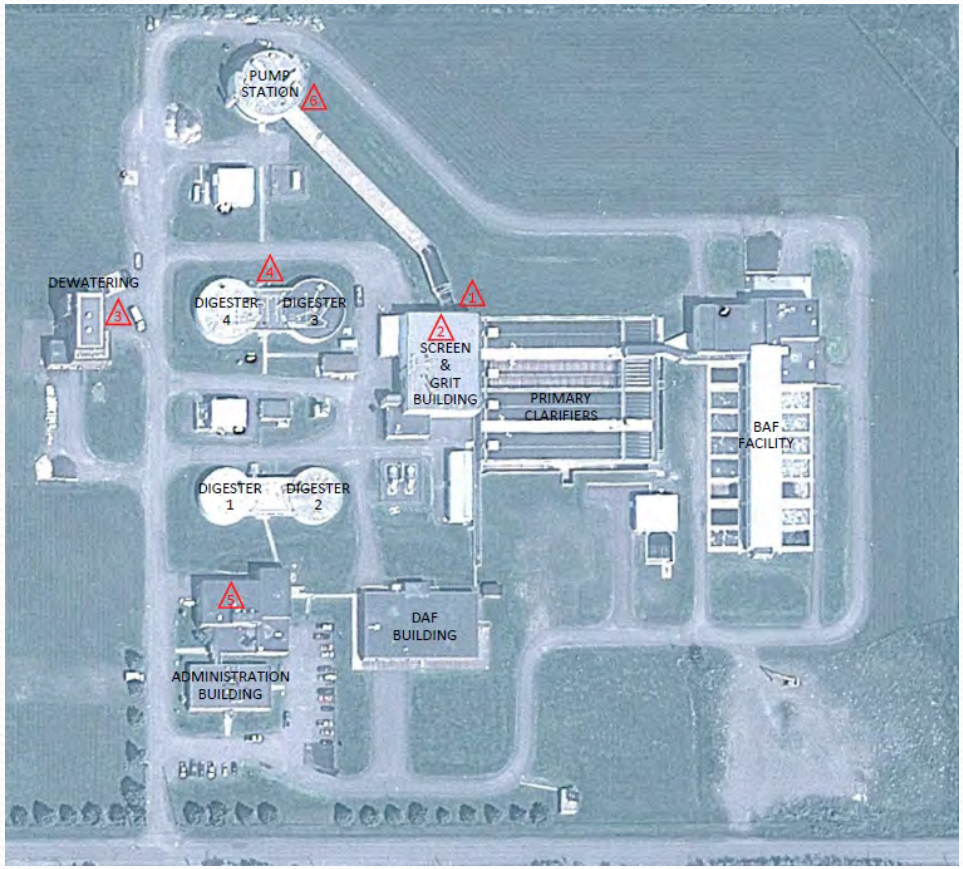
- Assignment 1: David Schindler
- Independent Research Project
  - Topic
  - Proposal Report Seminar
- Field trip

Lecture 2

Field Trip: January 26

Atlantic Avenue Water Pollution Control Plant (WPCP) on January 26, 2017

- Leave LU at 11:20 am
- Return approx. 1315



Lecture 2: Great Lakes

- History of agreements
- Seaway
- Concerns re climate change
- Great Lakes Compact signed in 2008
- Current Great lakes issues

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)
- 2008 - Great Lakes–St. Lawrence River Basin Water Resources Compact
- 2012 - Great Lakes Water Quality Agreement **(amendments)**

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.
- Signed in 1972, recent amendments in 2012
- 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.

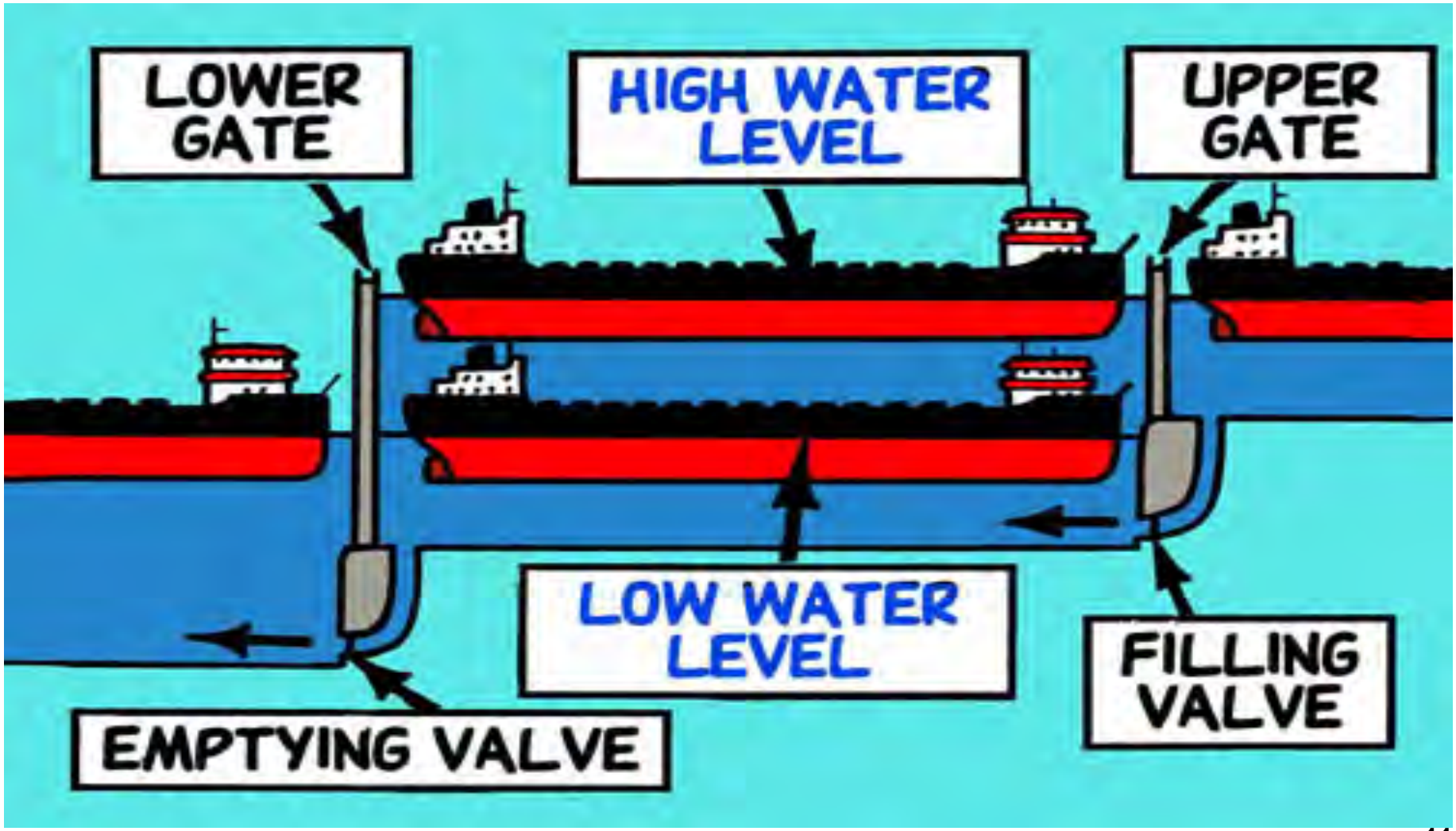
- **1979**

  The gross tonnage of ships passing through the Seaway reaches 80 million tonnes.

- **1996**

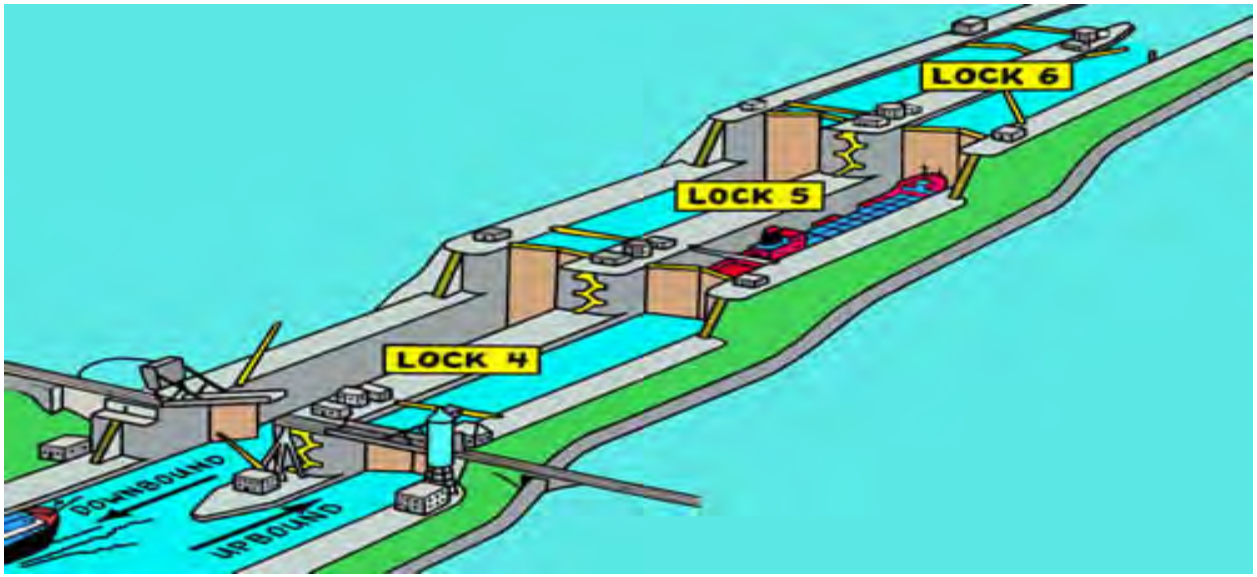
  Total of two billion tonnes of cargo, valued at more than $300 billion.

Example of a lock



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.



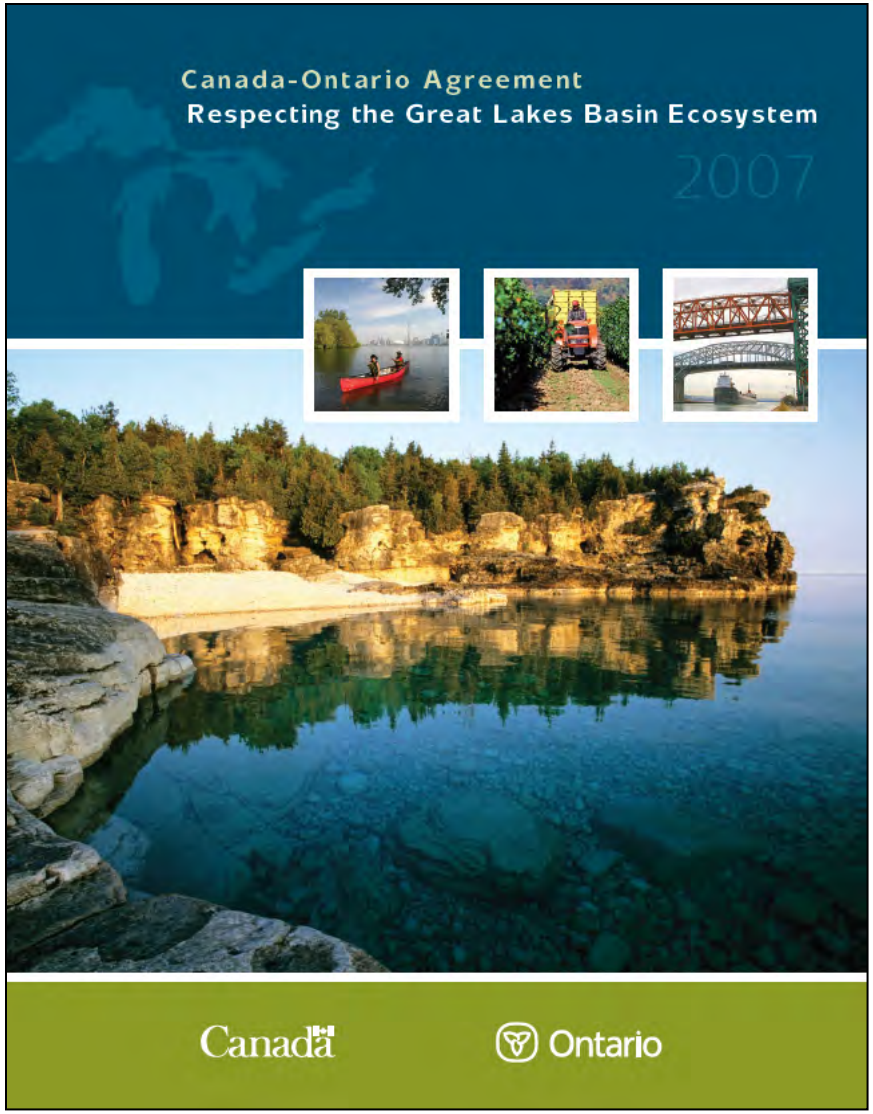
Discussion

- **1993**
  The Seaway's draft is increased from 7.87 m to 7.95, enabling ships to carry more cargo per voyage
- **2004**
  - The Seaway's draft is increased 8.03m (26.5 feet) enabling ships to carry up to 300 tonnes of additional cargo per voyage.

In-class discussion/consideration

Canada-Ontario Agreement

Respecting the Great Lakes Basin Ecosystem



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 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

Recovery of about 50 cm

The present level is 183.46 m above MSL

Annual cycle:

Long Term Average: 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

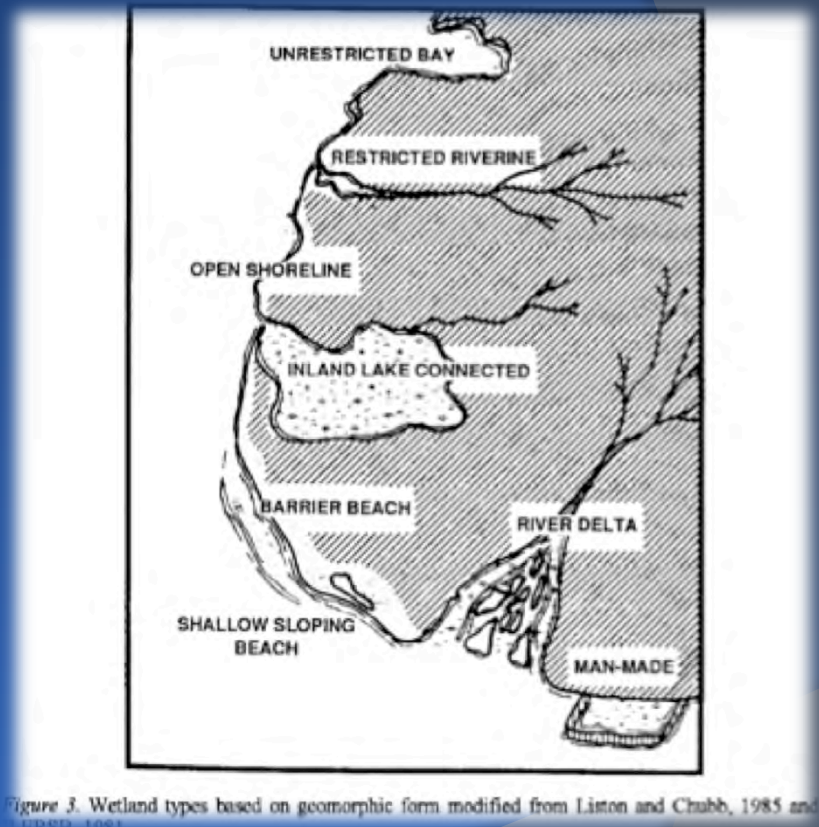
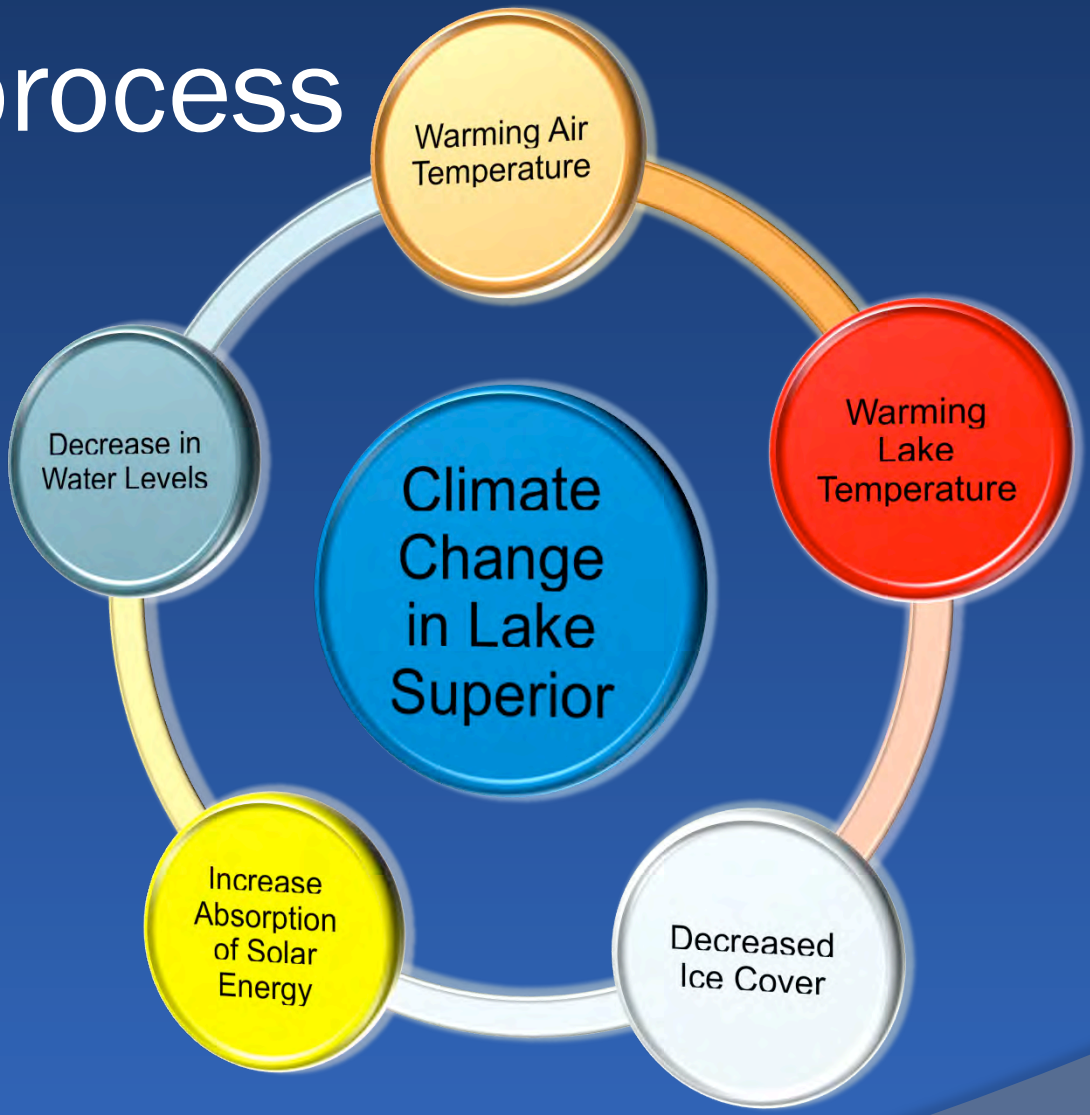
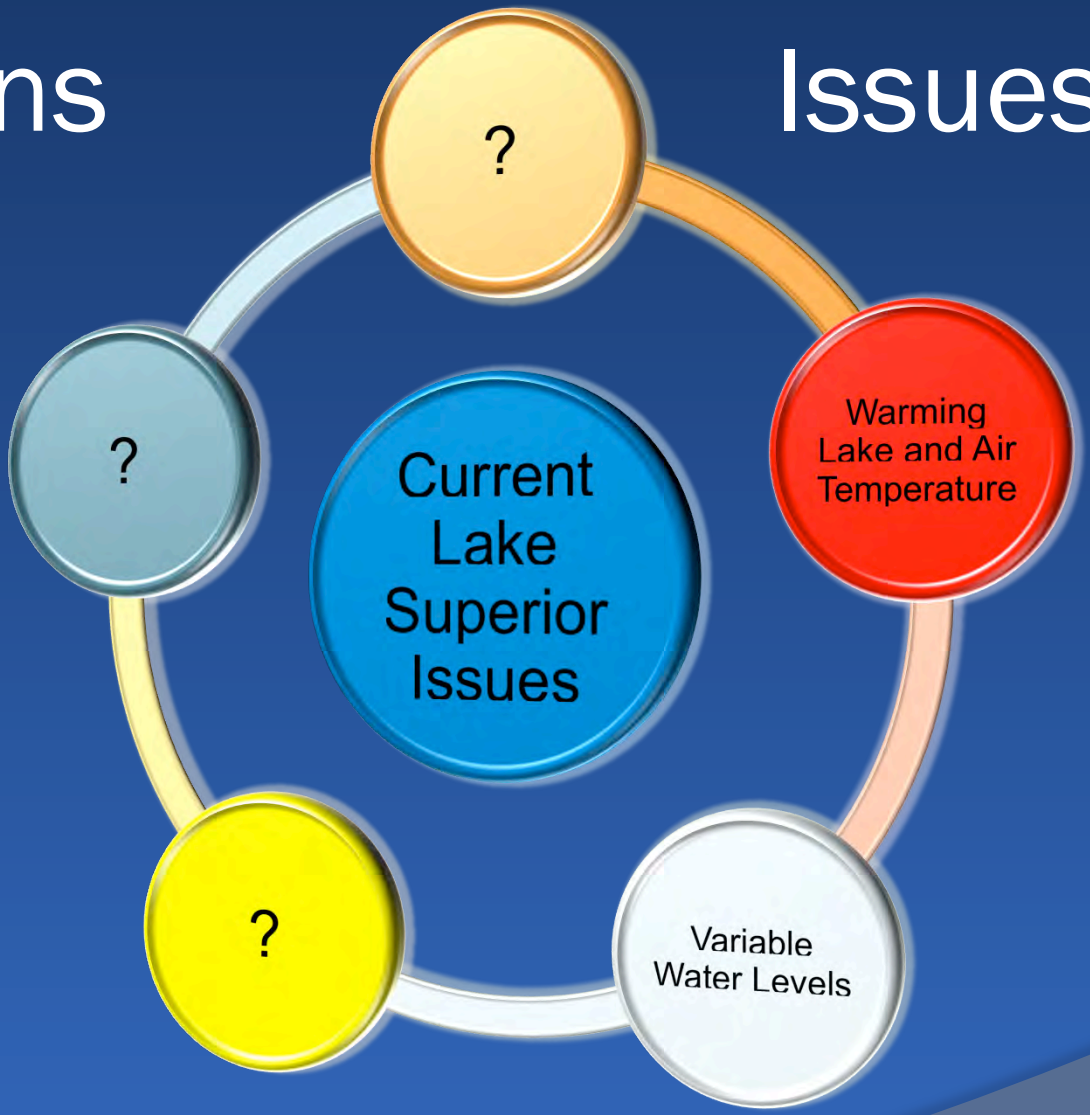


Figure 3. Wetland types based on geomorphic form modified from Linton and Chubb, 1985 and

Likely process



Concerns Issues



Oil pressure builds in the Great Lakes

The following slides contain ideas and discussion of Dan Egan, journalist and author of "**The Death and Life of the Great Lakes**"

Construction on the Dakota Access Pipeline was halted late in 2016

- Hundreds of protesters put their bodies on the line to stop the $3.7 US billion project
- Native Americans: Risk the oil line poses to the river - source of drinking water
- Support by environmentalists re climate change, military veterans and the "Hollywood tribe" to draw attention to both global warming and centuries of injustices suffered by Native Americans. In 2016 President Barack Obama – cancelled project.

Confrontation – Police and Occupiers

Obama rejected the proposed Keystone XL pipeline that would have carried Alberta tar sands oil to the Gulf of Mexico and other markets in the US in 2015. Part of this decision was to protect theOgallala aquifer, a rapidly depleting underground freshwater reserve.

Egan details history/expansion of pipelines with capacity to carry three times the volume proposed for TransCanada's Keystone XL. This pipe infrastructure already exists - operated by Enbridge in western Canada and the U.S.

Murphy Oil (Enbridge): Superior, Wisconsin

Capacity of holding tanks next to lake Superior is 13 million barrels (60% of daily U.S. consumption).

Daily flow in is 2.6 million barrels (bpd)

Planned capacity is 3 million bpd

45,000 bpd refined on site.

Enbridge Pipelines: Superior to Sarnia

From Superior, Wisconsin

Line 5 - 500,000 barrels a day, mainly petroleum from the Bakken shale oil in North Dakota, can flow in a pipeline via Michigan's Upper Peninsula, Straits of Mackinac, southern Michigan – to Sarnia.

Line 6A

Most bitumen oil runs in three pipelines south to Illinois. Much flows to regional refineries (gasoline, diesel and other petroleum products).

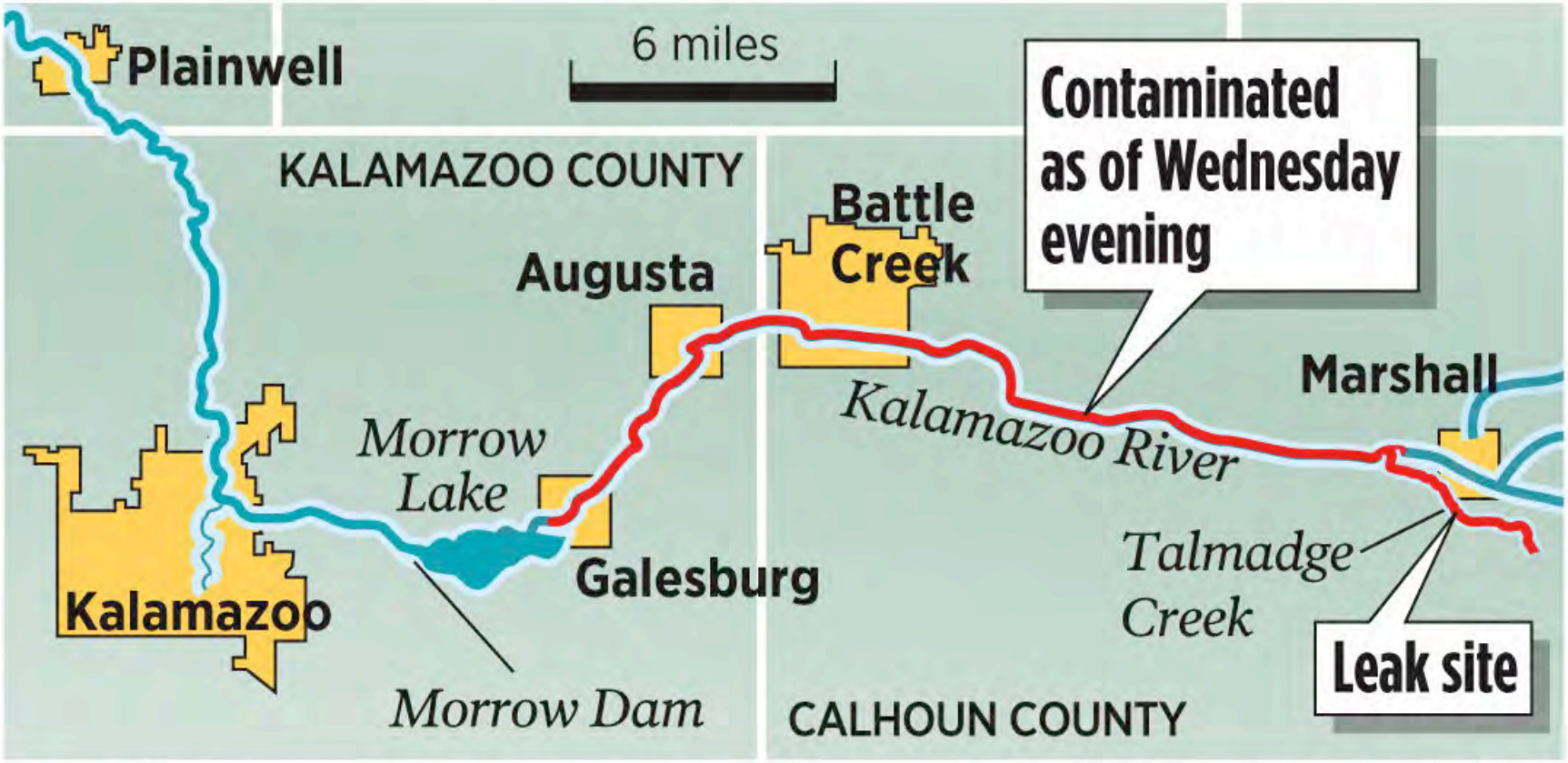
Some of it moves to Indiana, lower Michigan and Sarnia. Some oil now also flows in an Enbridge pipe east from Sarnia to Montreal, onto tankers and shipped around the globe.

Line 6A in Wisconsin, opened in 1968 with a capacity of 300,000 bpd. Now it has a capacity of nearly 700,000 bpd. The line itself never got larger. The increase was achieved largely by increasing pressure on steel tube that is today nearly 50 years old.

Line 6B ran from the Chicago area through southern Michigan and terminated in Sarnia. Enbridge identified six "crack-like" defects in Line 6B in 2005. These ranged from 24 cm to more than a metre and were left unrepaired. On July 25, 2010, alarms went off at Enbridge's headquarters in Edmonton, Alberta, signaling something was amiss near Kalamazoo, Michigan.

Operators in Edmonton tried increased pressure to pump more heavy crude into the line. They tried this twice for a total of about 90 minutes.

July 25, 2010, at about 5:58 p.m. EDT



Source: Kalamazoo Couty Sheriff's Department

GAZETTE GRAPHIC/**KRIS KINKADE**

Line 6B,, burst in Michigan on July 25, 2010

- Spilled nearly 4 million litres of tar sands bitumen
- 60 km of creek and Kalamazoo River directly affected
- Largest on-land oil spill in North American history
- Clean up costs about $1US billion to date
- Enbridge fined $3.7US million dollars because of 22 probable violations
- Environmental Protection Agency (EPA) had not been informed by Enbridge that “Dilbit” initially floats in water but sinks, which compounds problems with clean up.

- Enbridge decided that the existing line (began operation in 1968) was too deteriorated to salvage.
- Opened a new version of the line in 2014
- This slightly larger replacement doubled the old line’s operating capacity to 500,000 bpd.

Pipeline Technology

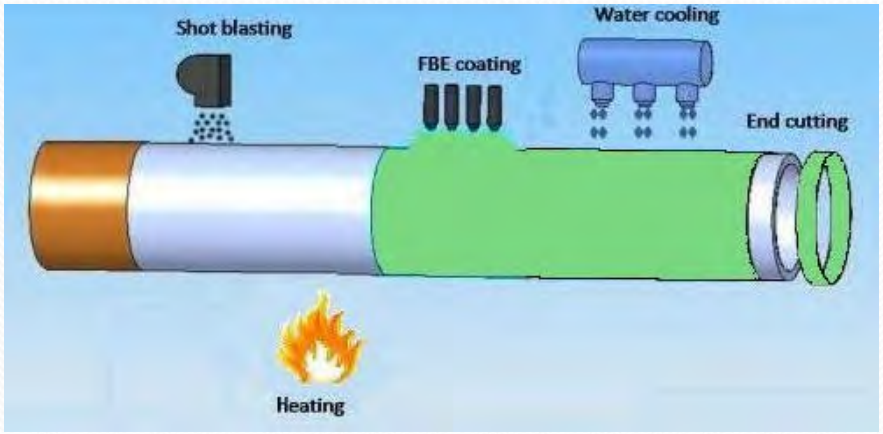
Steel pipe protected by coating

Examples:

Polystyrene tape wrap

Bitumen enamel (better)

Fusion bonded epoxy (FBE) coating (best)



No coating system is perfect

Once coating is broken, it admits corrosive agents from the soil

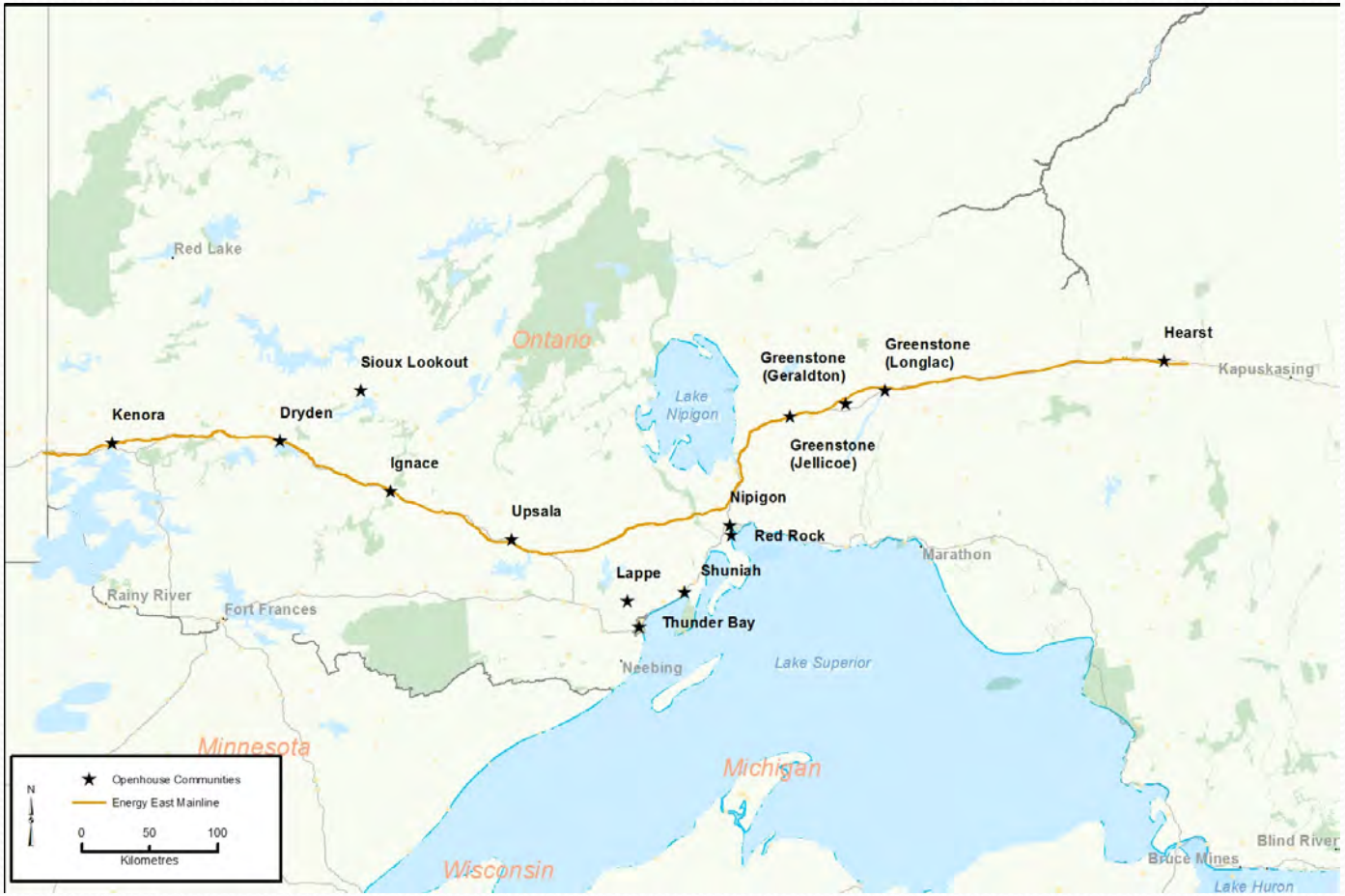
Corrosion is slowed by a cathodic protection system which applies an electrical current.

Significant water crossings

Energy East

- TransCanada (TCP) has been lumped together with Enbridge for their poor safety records
- Old converted pipeline and using the same technologies as Enbridge for leak detection
- At a minimum, we should use the Talmadge Creek/ Kalamazoo River spill 60 km figure as a benchmark
- **Small Leaks a Bigger Threat?** TCP Leak detection system can't detect leaks under 1.5% of the pipeline flow
- TCP's highly questionable figures, with over 1000 km of old pipe stretching across northwestern Ontario - expect a failure about every 2.3 years.

Trans-Canada Pipeline: Energy East proposal



Likely locations of pipeline conflicts

Energy East

Mackinac

Line 5 is 90 cm (30 inches) in diameter, except when crossing the Straits of Mackinac
Two 20-inch pipes that lie about 1,000 feet apart.
Construction was completed in 1953, and the twin pipelines under the Straits now carry approximately 540,000 barrels of oil and natural gas liquids per day.

Photo Credit: University of Michigan