Hydrology and Sediment Transport of the Jordan River

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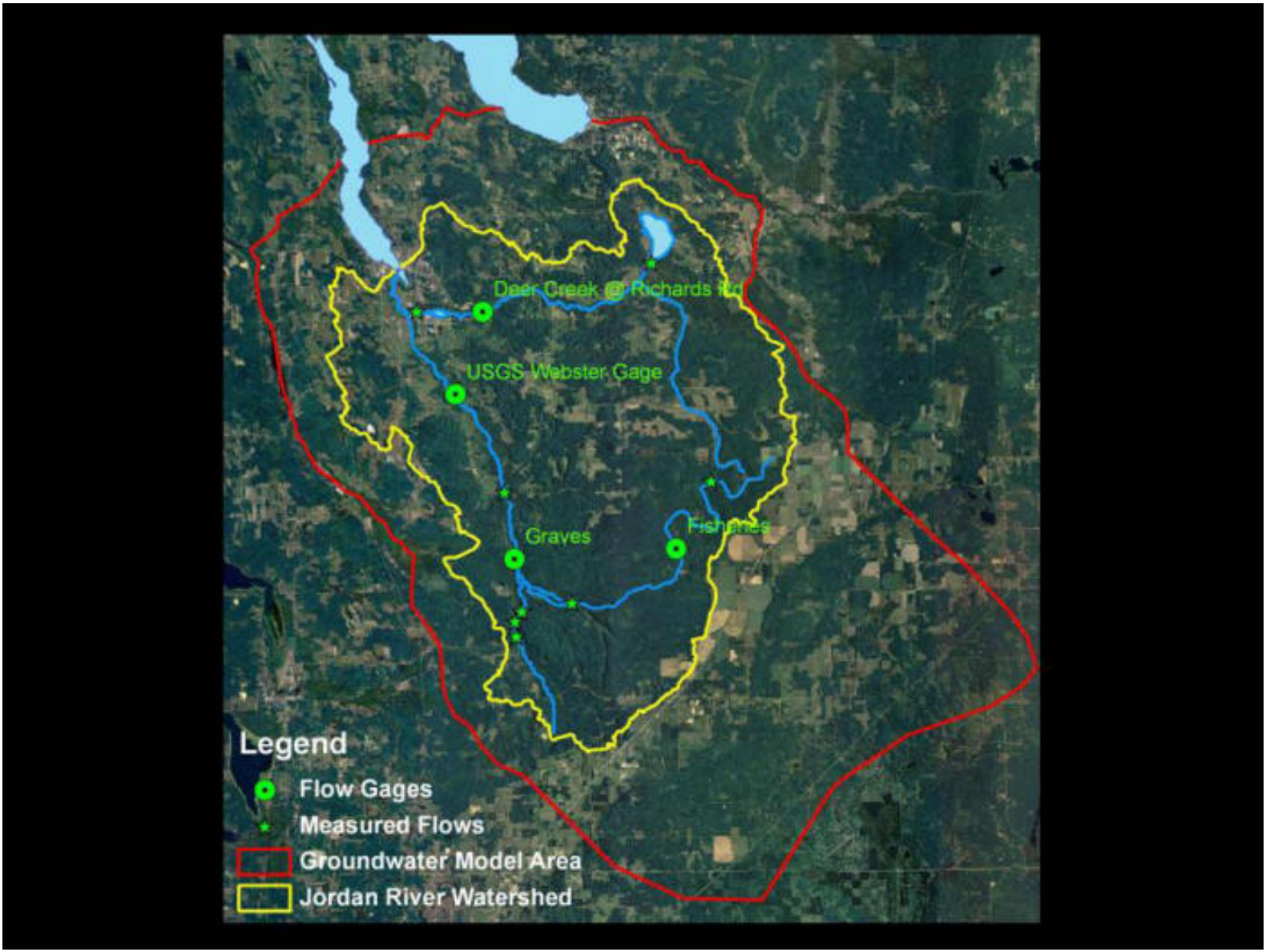
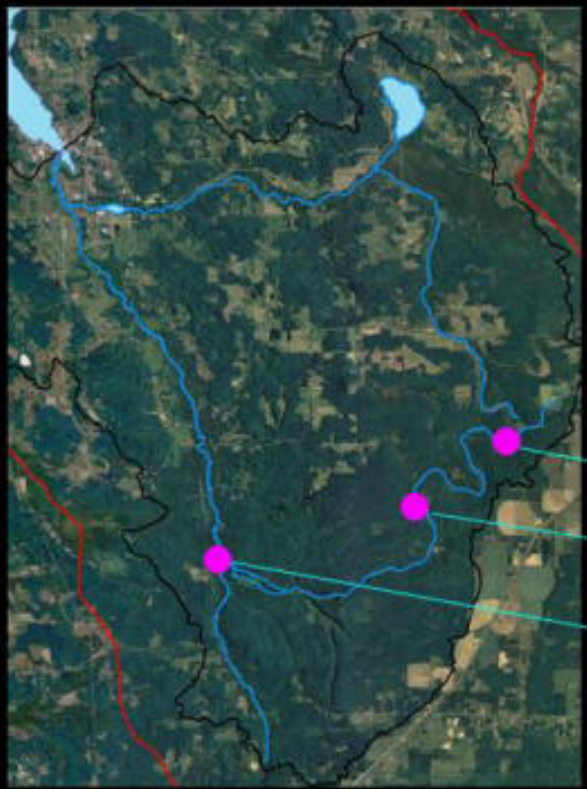
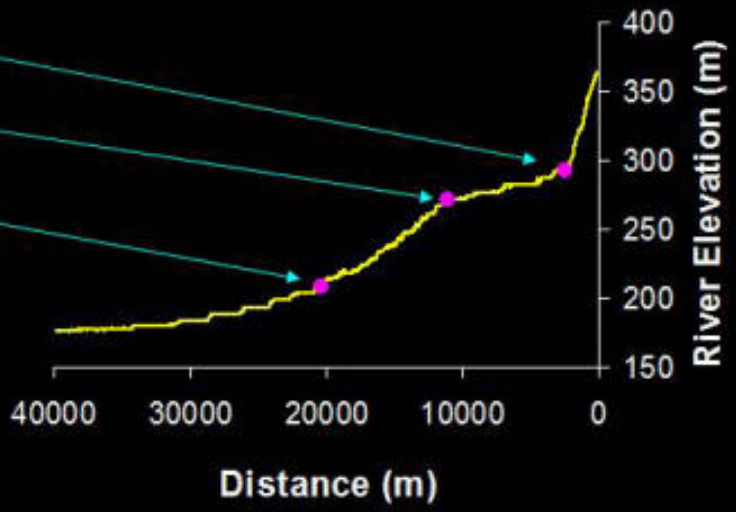

Deer Creek @ Richards Rd
USGS Webster Gage
Graves
Fishermes
Legend
Flow Gages
Measured Flows
Groundwater Model Area
Jordan River Watershed

Overview

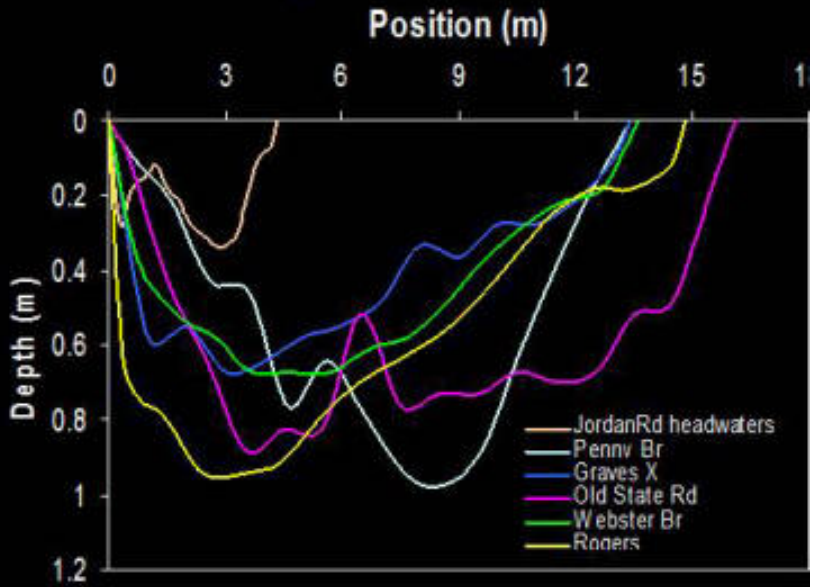
- Stream elevations and geometry
  - Downgradient profile
  - Temporal changes in cross-channel geometry
- Streamflows
  - Stage-Discharge relationships for 3 stream gages
- Groundwater modeling
- GPR characterization of delta

Why is the stream out of equilibrium?



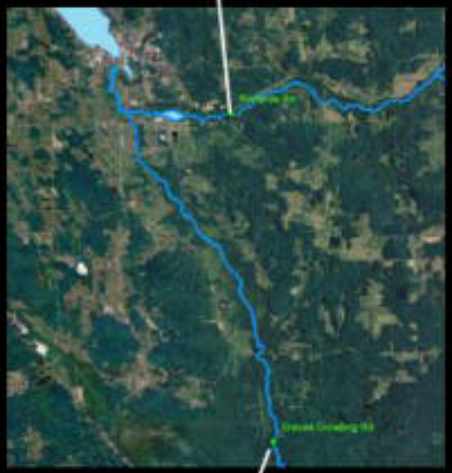


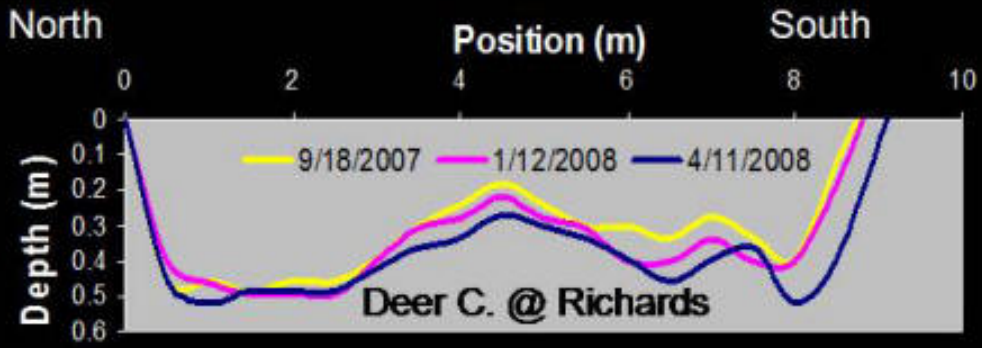
Channel Geometry



- Similar Depths and Widths below Penny Bridge
- Very different character in headwaters

Channel Change



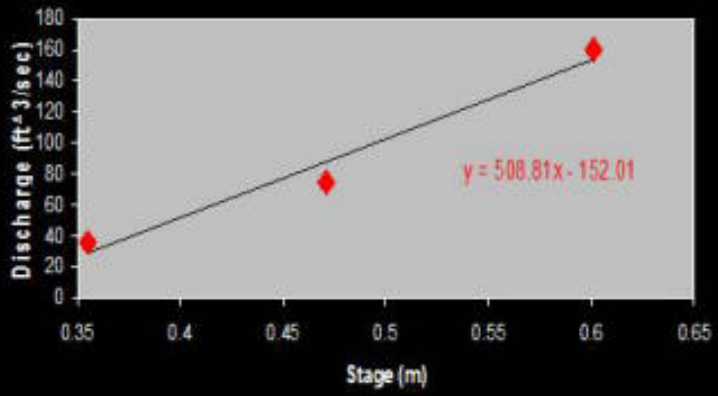


- Erosion on Deer Creek at Richards Rd
- Some erosion on West side Jordan R. @ Graves

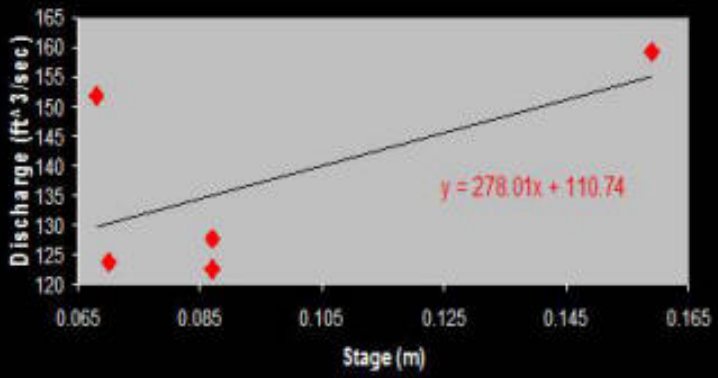
Gage Locations

Preliminary Stage Discharge Relationships

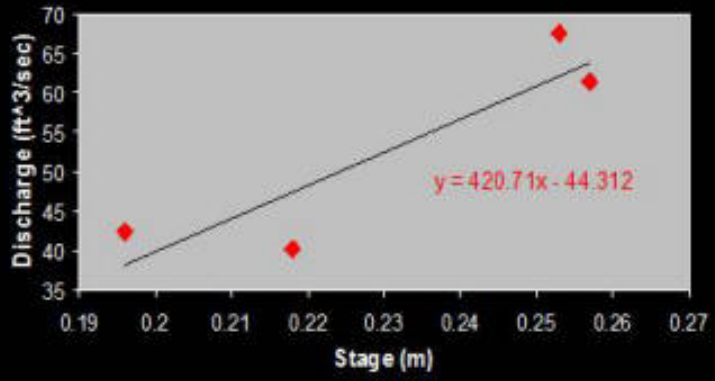
Deer Creek at Richards Rd



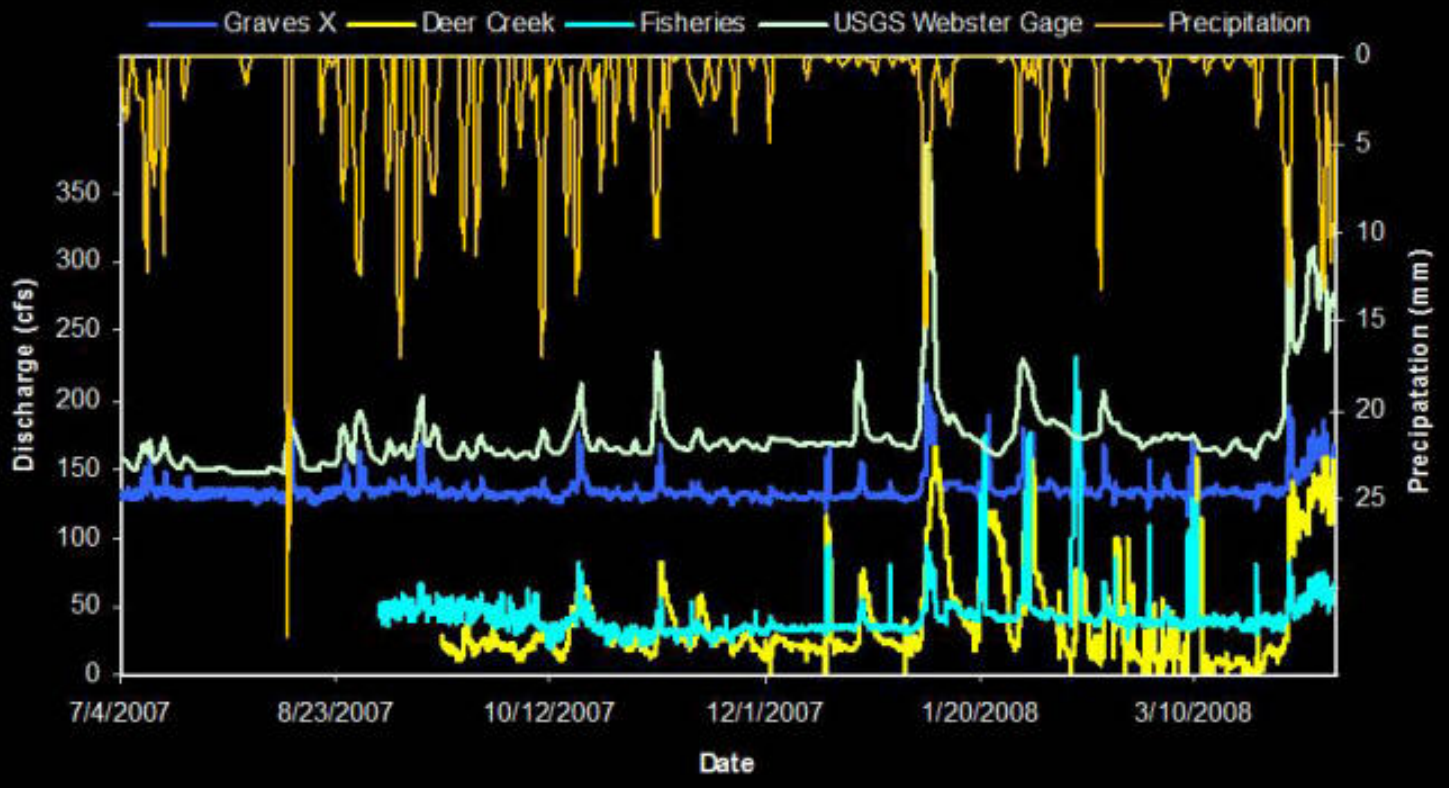
Graves



Fisheries

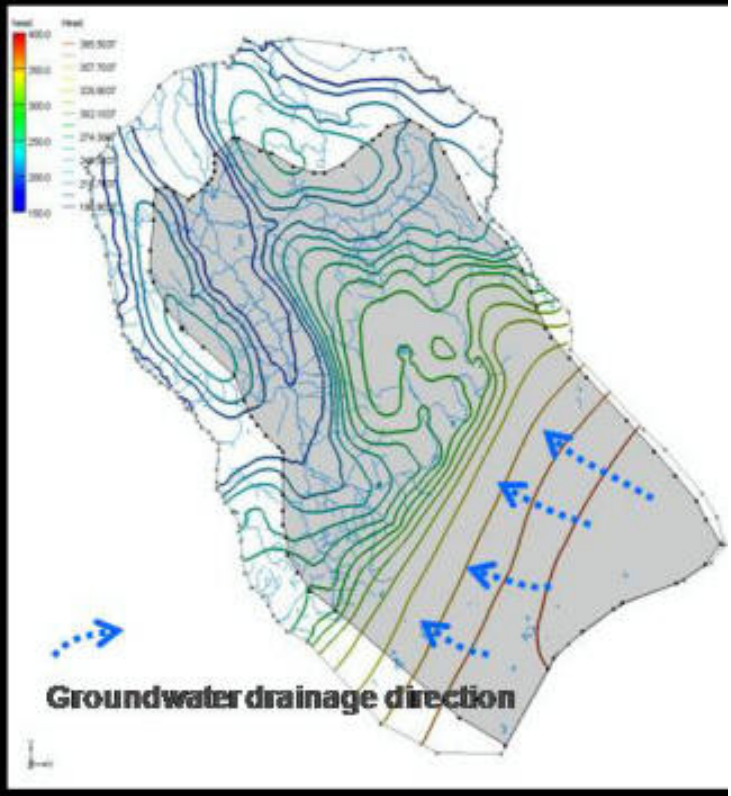


Discharge and Precipitation



Groundwater Model

- Explore influence of climate and landscape changes on fluxes of water and sediment.
- ILHM will simulate overland flow, evapotranspiration and recharge
- MODFLOW simulates groundwater flow based on recharge from ILHM
- Overland flow + groundwater discharge to surface water = streamflow.

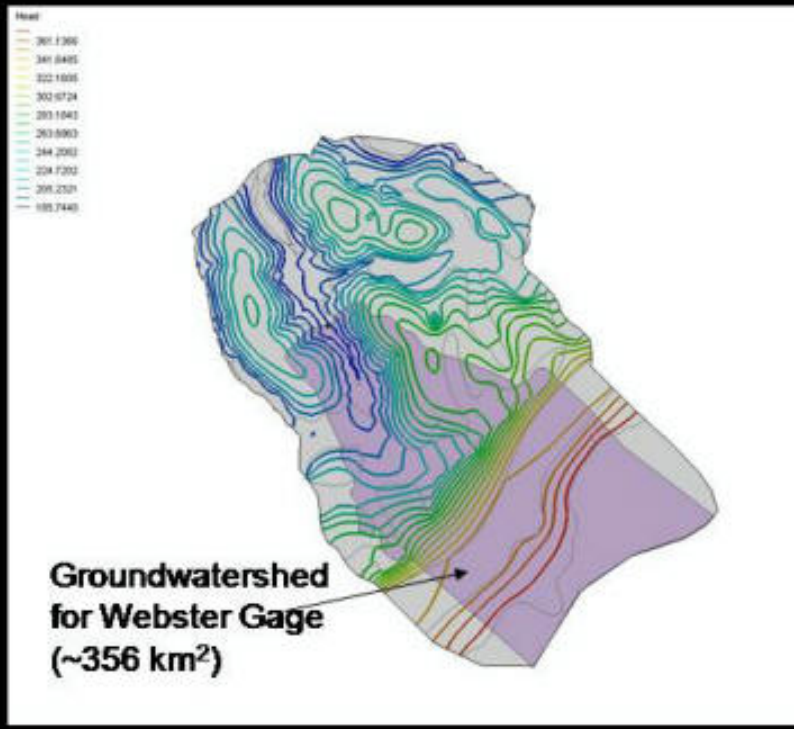


Estimated Recharge to the Near Surface Aquifer Based on USGS Gage Flow

- Recharge was initially estimated as:

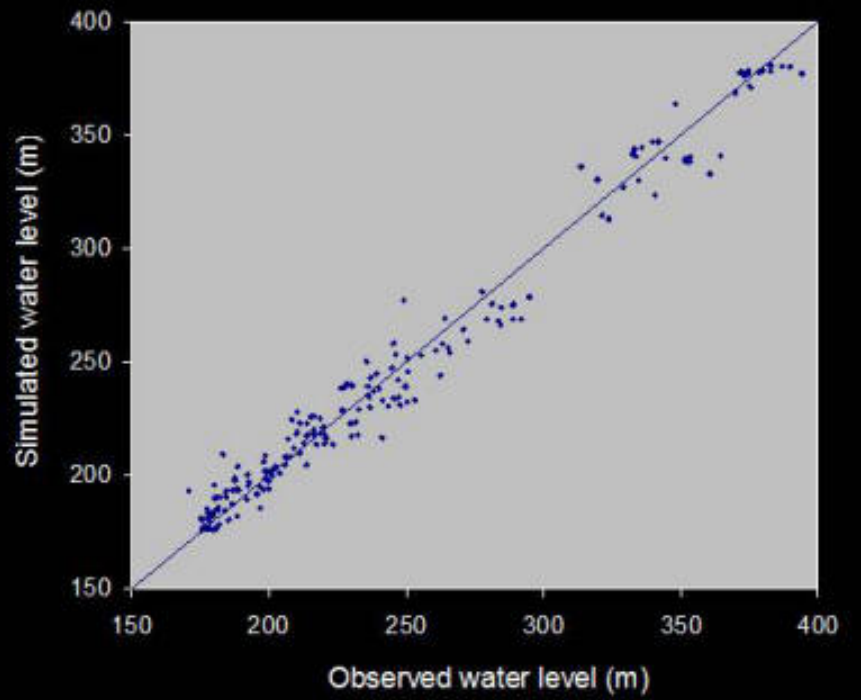
$$\frac{\textit{Baseflow @ gage}}{\textit{Area}}$$

= 16 inches/yr



Simulation of Groundwater Levels

Reasonable prediction of observed levels across the watershed.



Future Modeling Work

1. Calibrate transient groundwater flow model to improve simulations of seasonal streamflow variations

2. Build ILHM model of the Jordan River Watershed to predict streamflows over last 20 to 30 years

3. Simulate the influence of:
   - climate change over the last century on streamflows and sediment transport
   - land use change from presettlement → deforested → current on streamflows.

4. Examine likely changes in sediment transport due to predicted changes in streamflow

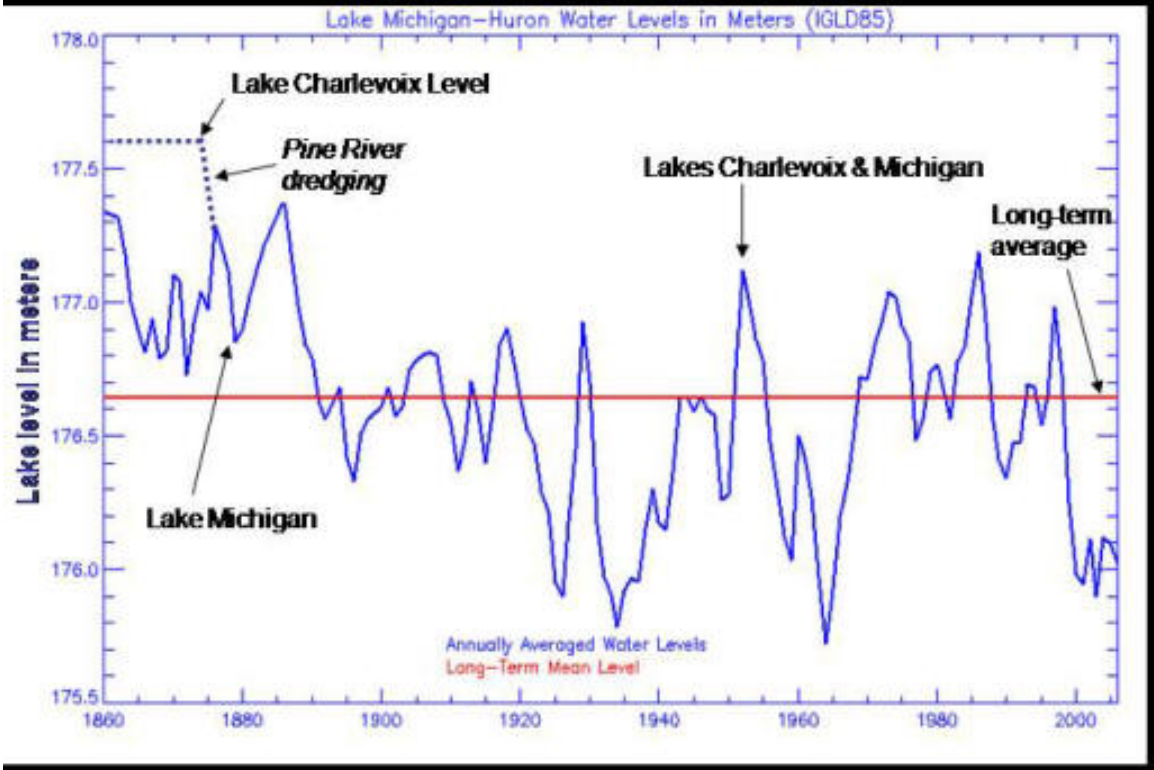
Delta Characterization

Objectives:

- Characterize depositional units
- Quantify volume and age of sediment

Tasks:

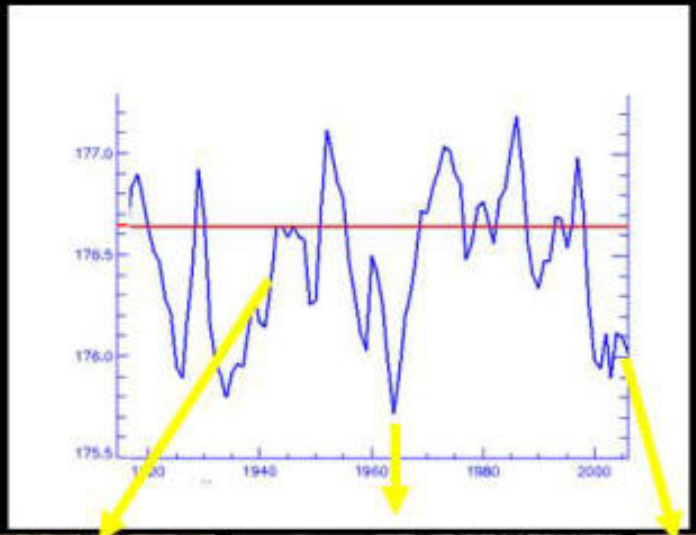
- Survey the Delta
- Characterize recent changes using air photos
- Use GPR data for subsurface imaging
- Core and age-date key samples



(modified *from NOAA*)

- Pre-dredging, Lake Charlevoix levels were relatively stable
- After dredging in 1870's levels fluctuated with Lake Michigan
- Significant change in base level altered the Jordan River delta

Low Lake Levels

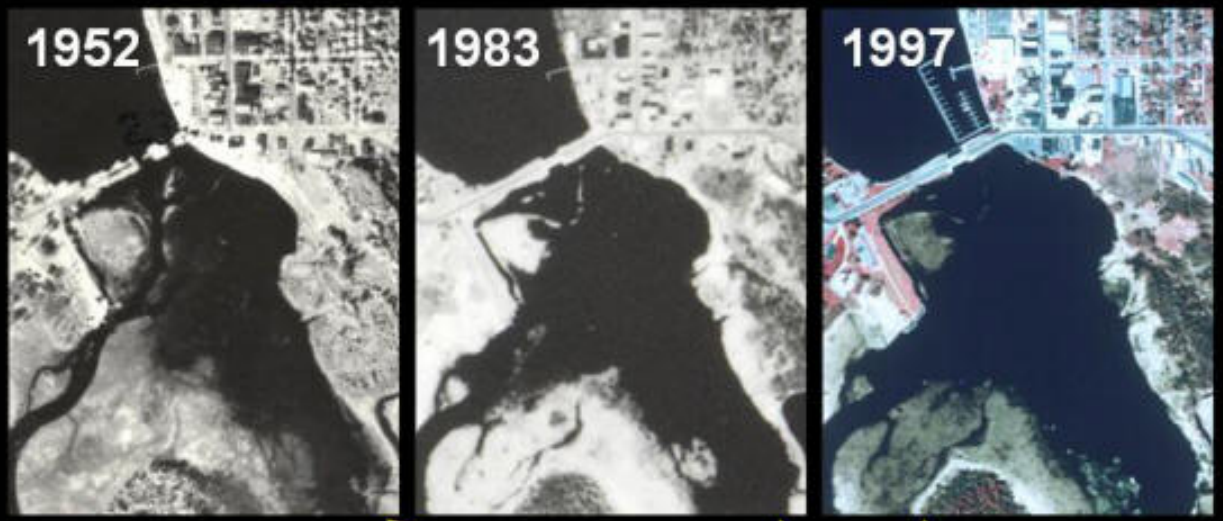


During periods of low lake level:

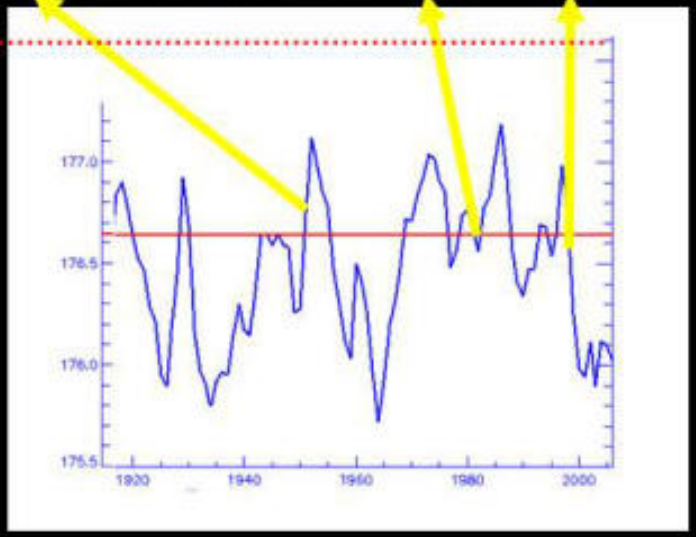
- Delta area is exposed
- Natural harbor is inaccessible

- Documented in 1945, 1965, 2005
- Likely also in 1925, 1934

High Lake Levels



Lake Charlevoix level prior to dredging in 1870's

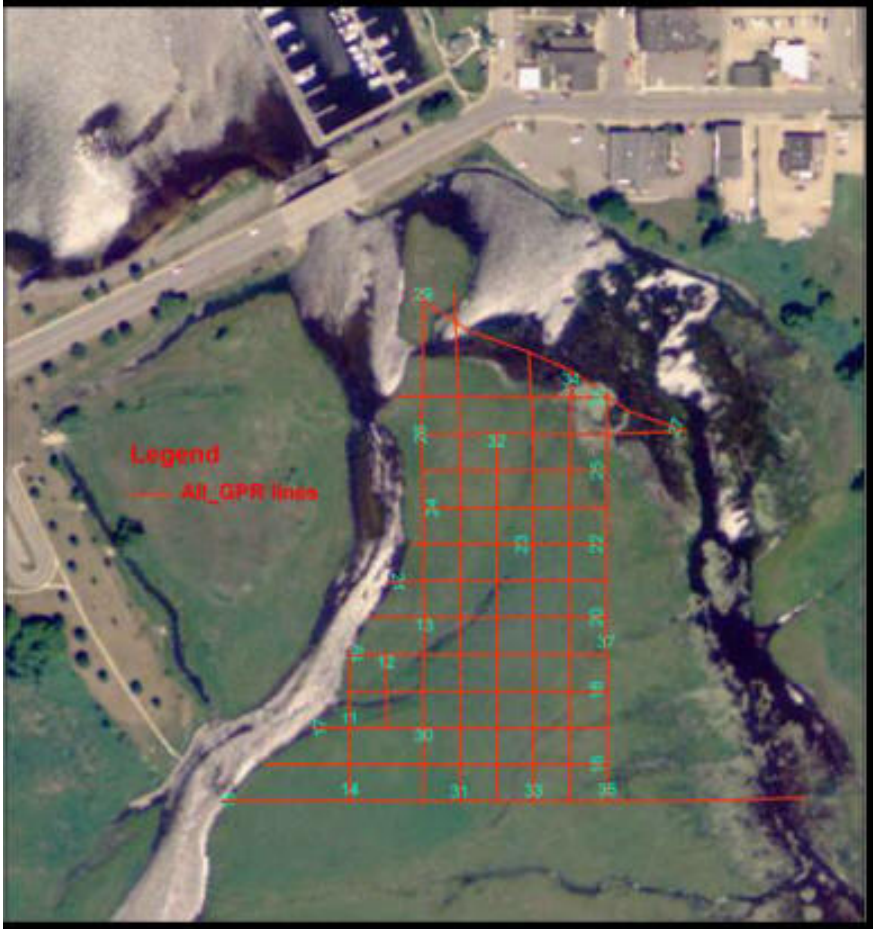


During periods of high lake level:

- Delta inundated
- Distinct natural harbor

- Documented in 1952, 1983, 1997
- Pre-dredging?

GPR Grid

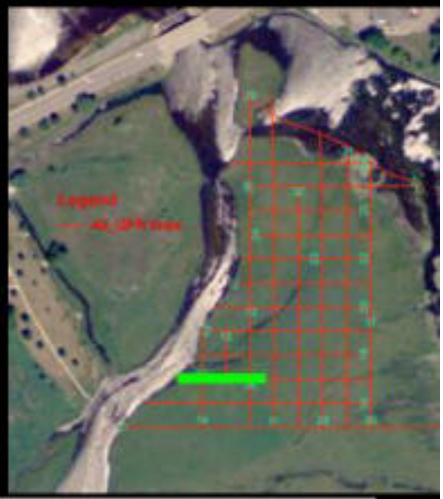


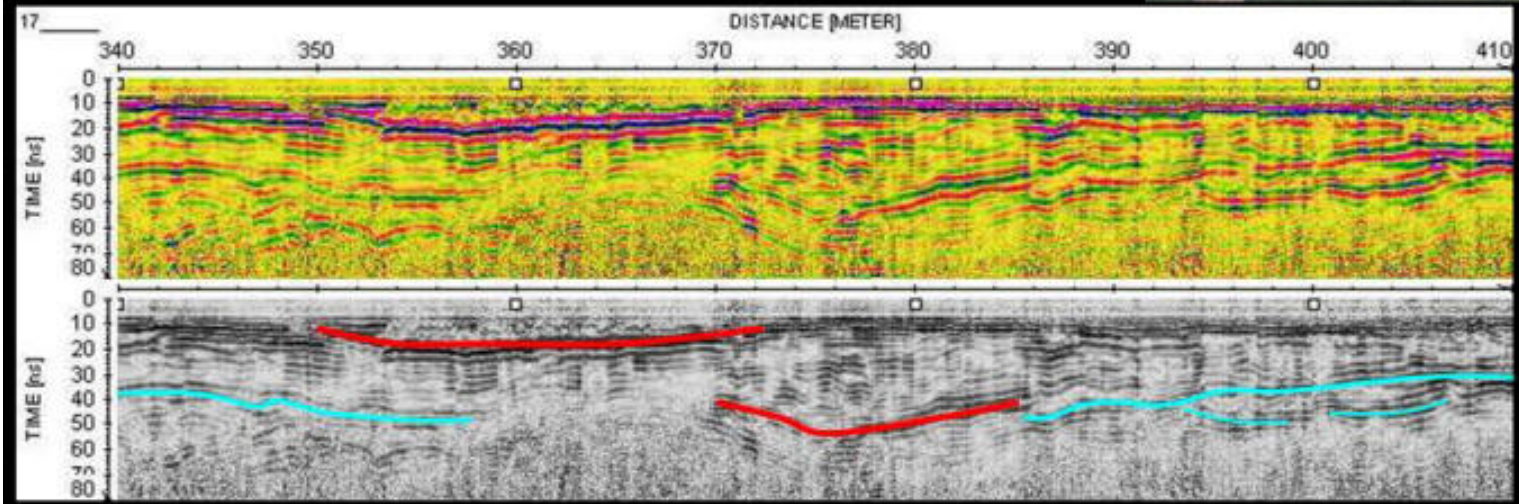
- Dipping features often indicate deposition by flowing water
  - Paleochannels
- Flat-lying reflectors often from low-energy deposition
  - e.g., lake bottom
- Drilling is needed to 'ground-truth' our data

Line 17 (West-East)

Observations:

- Concave features indicative of channels
- Dipping features suggest channel migration

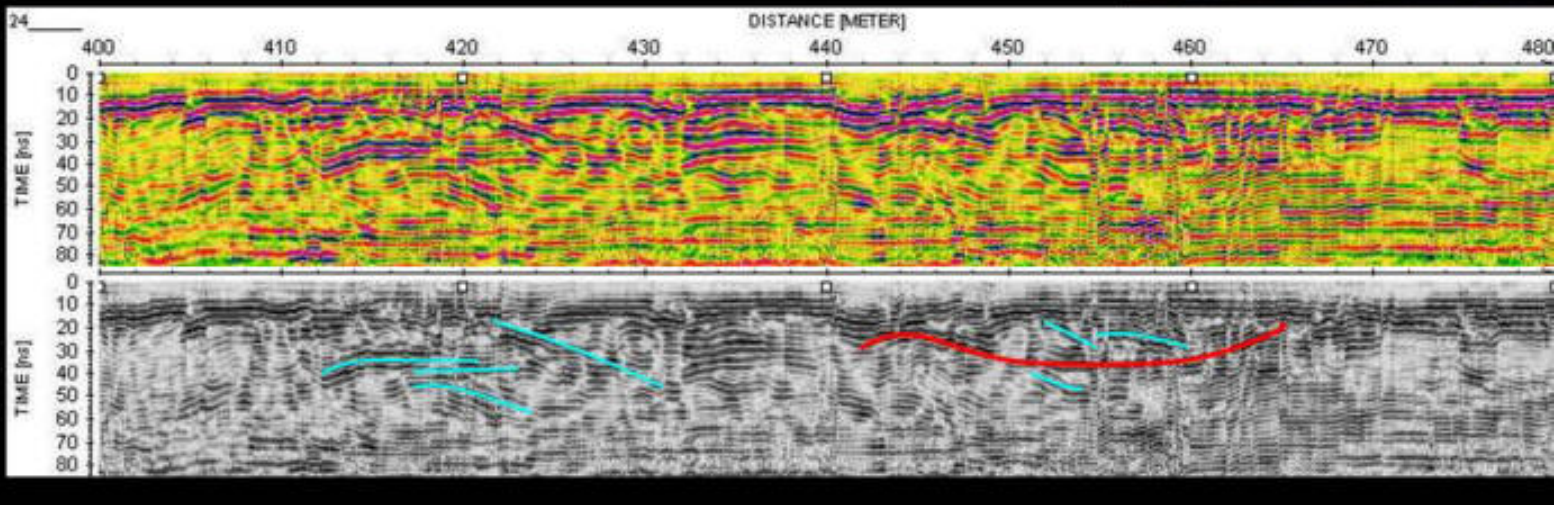




Line 24 (West-East)

Observations:

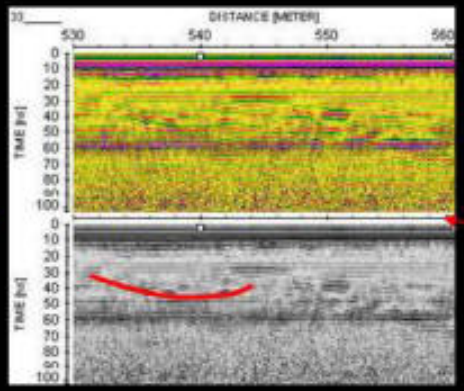
- Concave and dipping reflections indicative of channels
- Dipping features suggest sedimentary deposits

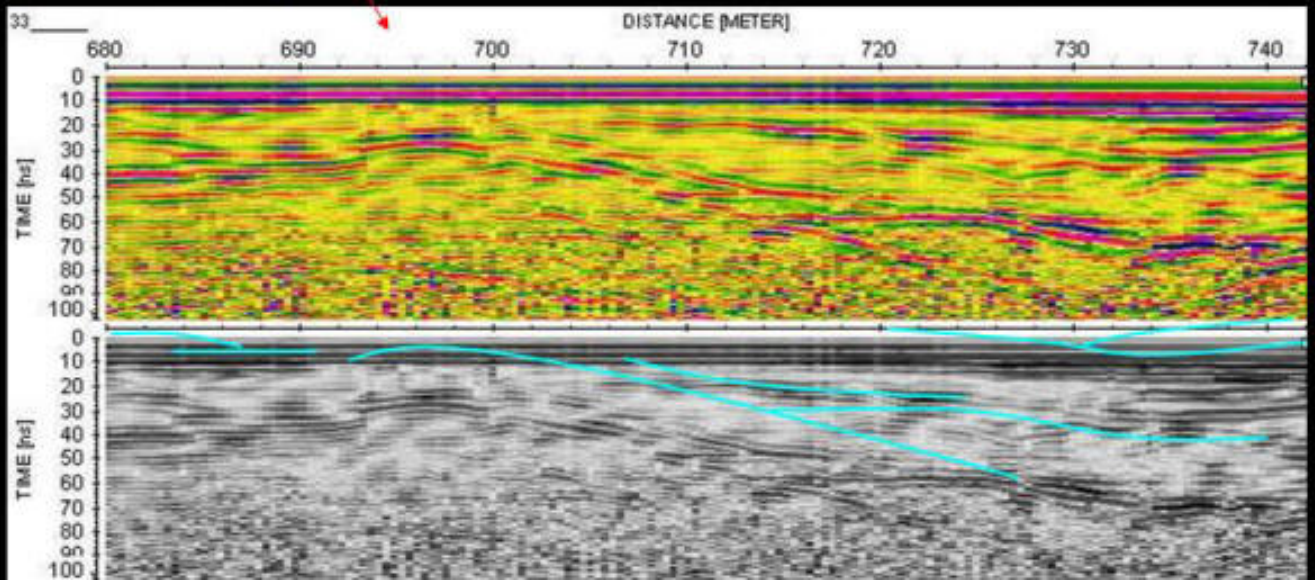


Line 33 (South-North)

Observations:

- Channel feature coincides with paleo channel location
- Strong dipping reflections in northern part may be related to channel deposition





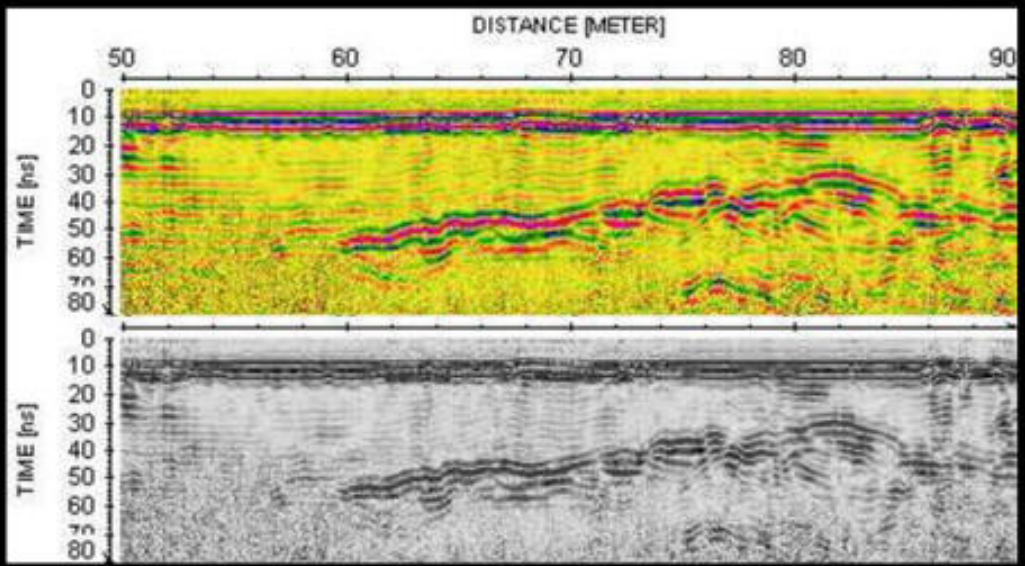
Line 27 (ESE-WNW)

Observations:

- Prominent reflector at 1 - 1.5m depth
- Natural feature, or old harbor?
- Drilling needed.

ESE

WNW



Future Delta Work

1. Age-dating the sediments in the delta area (sand / organics / shells)

2. Analyze stratigraphic information from GPR and drilling campaigns

3. Combine archival records and high-resolution topographic surveys
   Goal: locate pre-dredging (Pine River) outflow location

4. Locate the sand from Jordan River:
   … in the current delta area? (current drilling campaign)
   … location of pre-dredging outflow location? (future drilling campaign)
   … In Lake Charlevoix? (future marine seismic survey; Abby Norton)