Sediment Build-Up and Bank Erosion Along the Grass, Rapid, and Torch Rivers

Anthony Kendall

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Project Partners

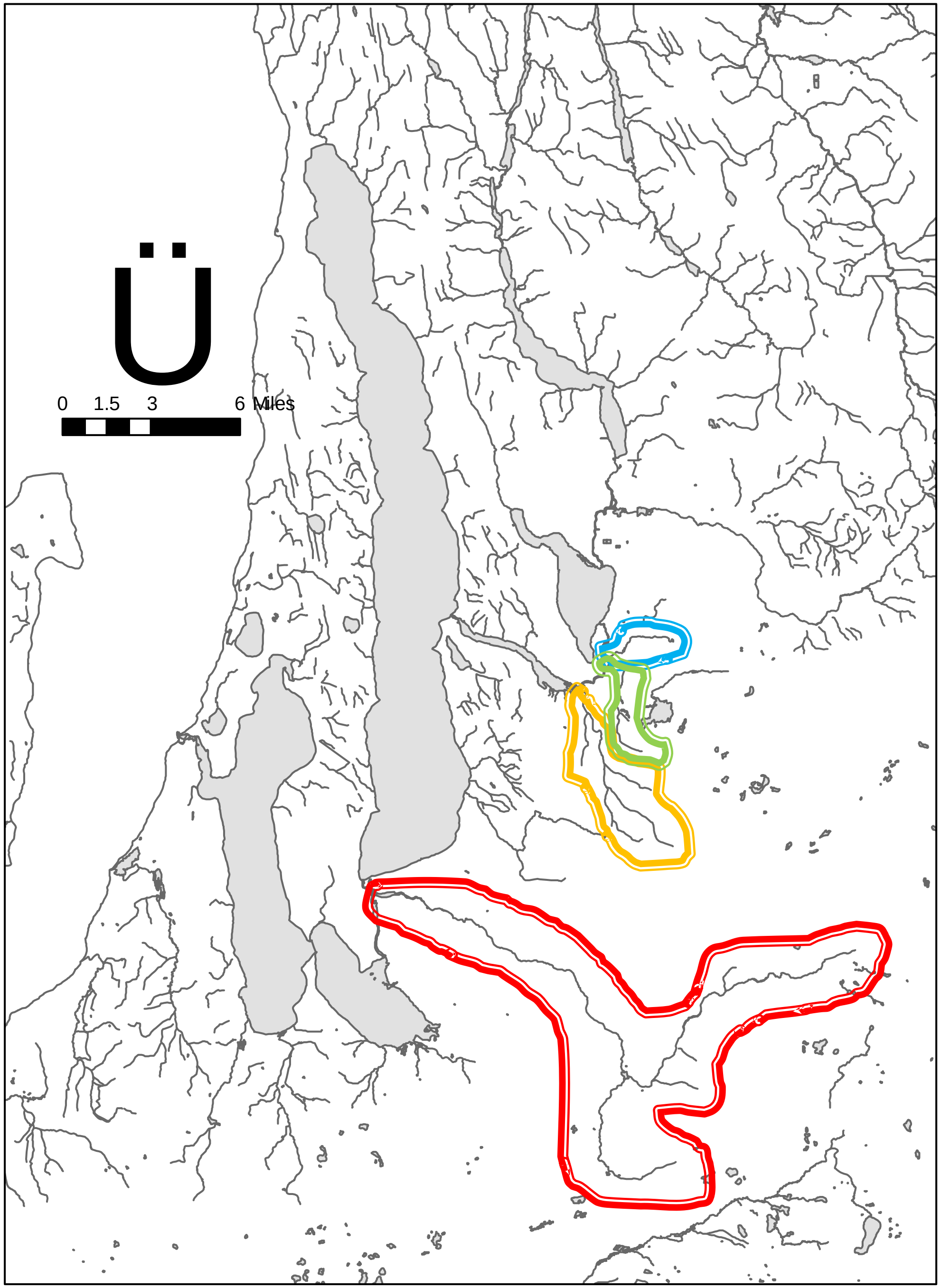
- Co-Investigators:
  - Brett Fessell and Frank Dituri
    Grand Traverse Band of Chippewa and Ottawa Indians
  - Kevin Cronk
    Tip of the Mitt Watershed Council
  - Paul Richards
    State University of New York, Brockport
- Funders:
  - Elk Skegemog Lakes Association
  - Three Lakes Association
- Field and lab associates from MSU:
  - Lon Cooper, Blaze Budd, and Jordan Hein
- Local volunteers:
  - Dean Branson, Bob Kingon, Fred Sittel

Project Elements

- Surveying historical condition with aerial imagery
- Field campaign
- Analysis and reporting
  - Make recommendations

Study Area

- Lakes:
  - Torch
  - Clam
  - Bellaire
  - Elk/Skegemog
- Rivers:
  - Grass
    - Shanty Ck
    - Cold Ck
    - Finch Ck
  - Rapid

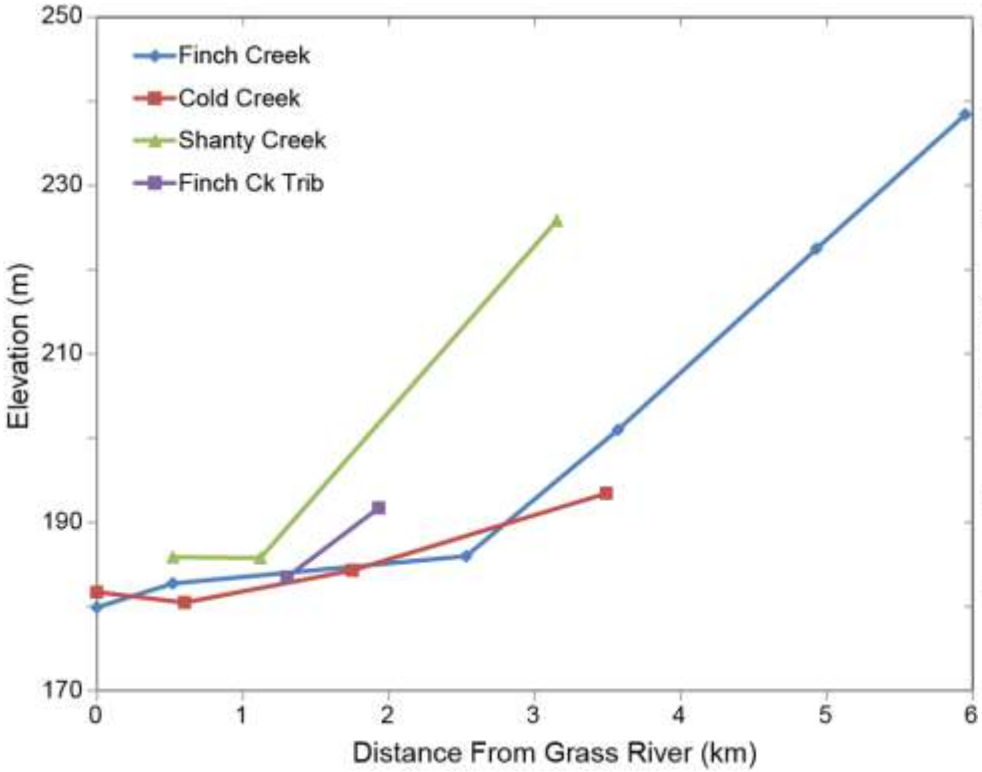


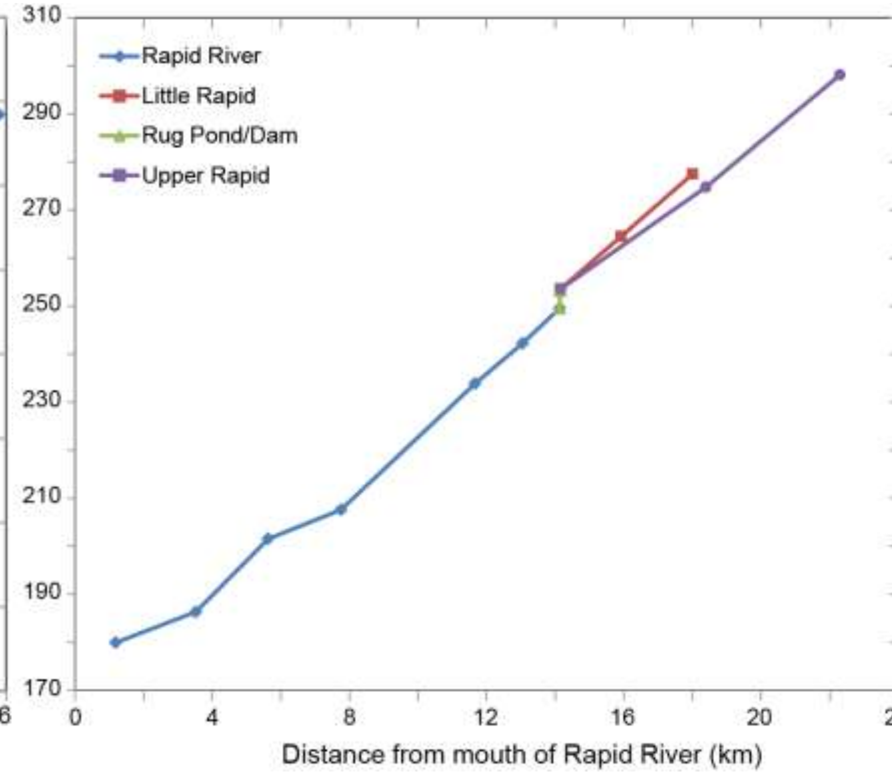
Field Activities

- GPS elevation and stream flow surveys of Grass and Rapid watersheds
- Depth (bathymetry) data collection along Torch, lower Rapid, and Grass Rivers
- GPS-tagged photographic surveys
- Survey-grade GPS benchmarking from Lake Bellaire to Clam Lake

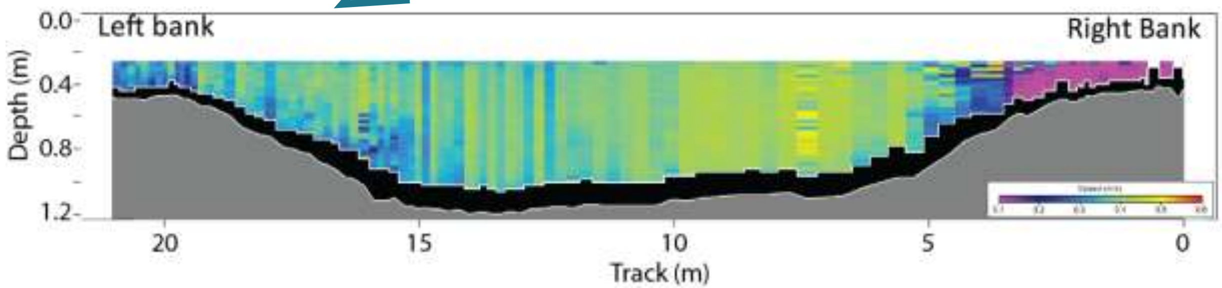
GPS Data Collection

Elevations of tributaries

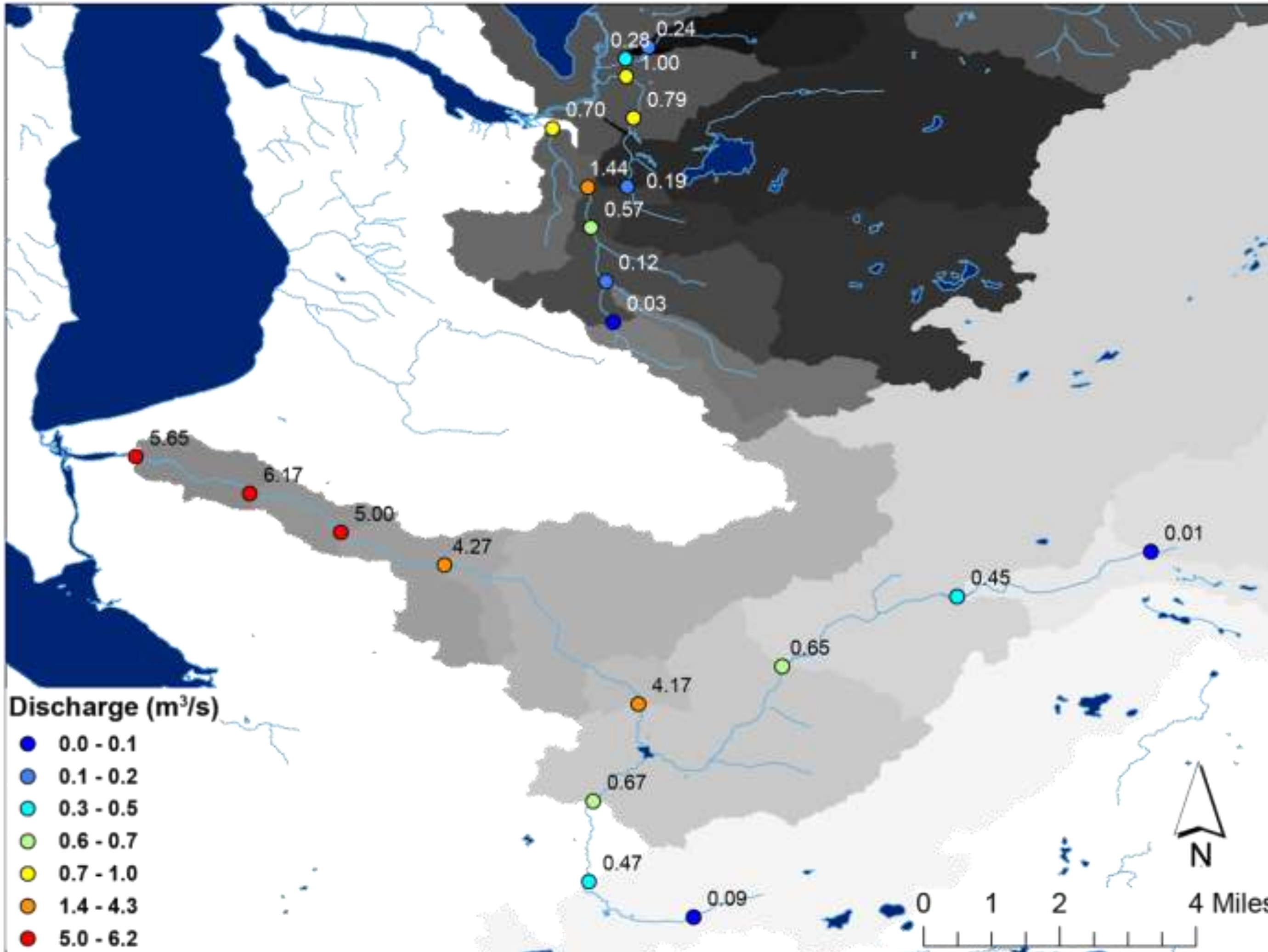




Streamflow measurements

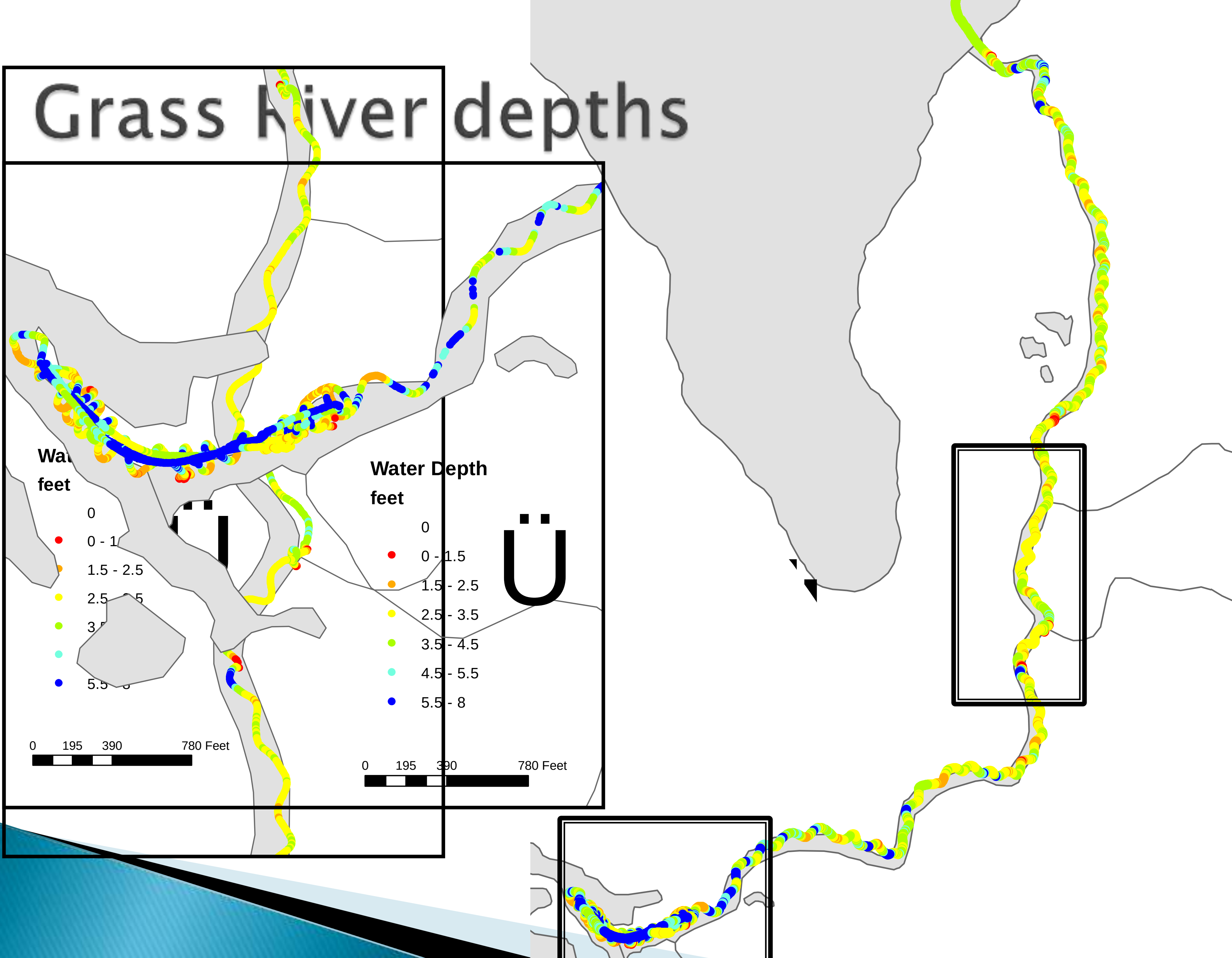


Streamflow of tributaries



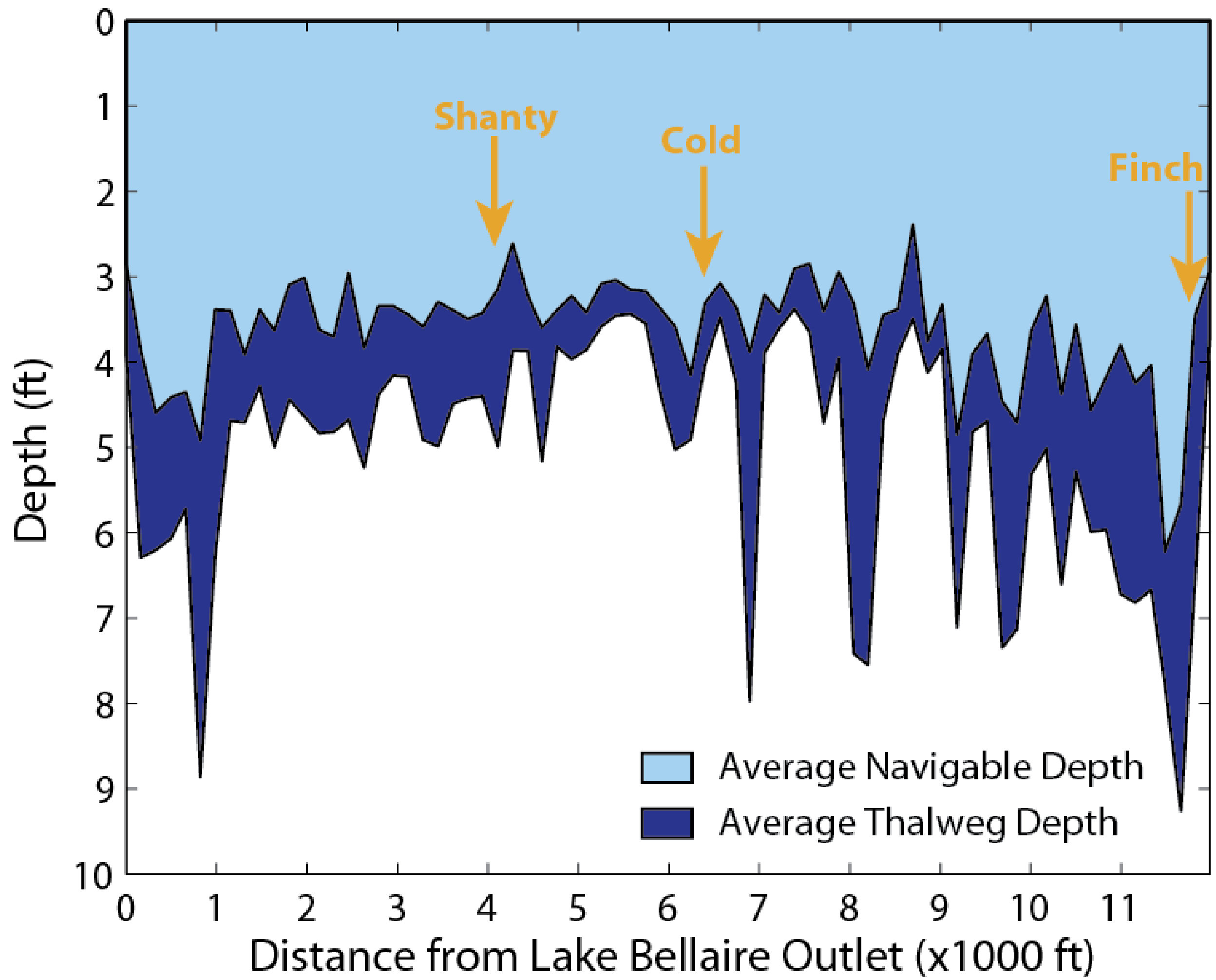
Bathymetry data

Grass River depths

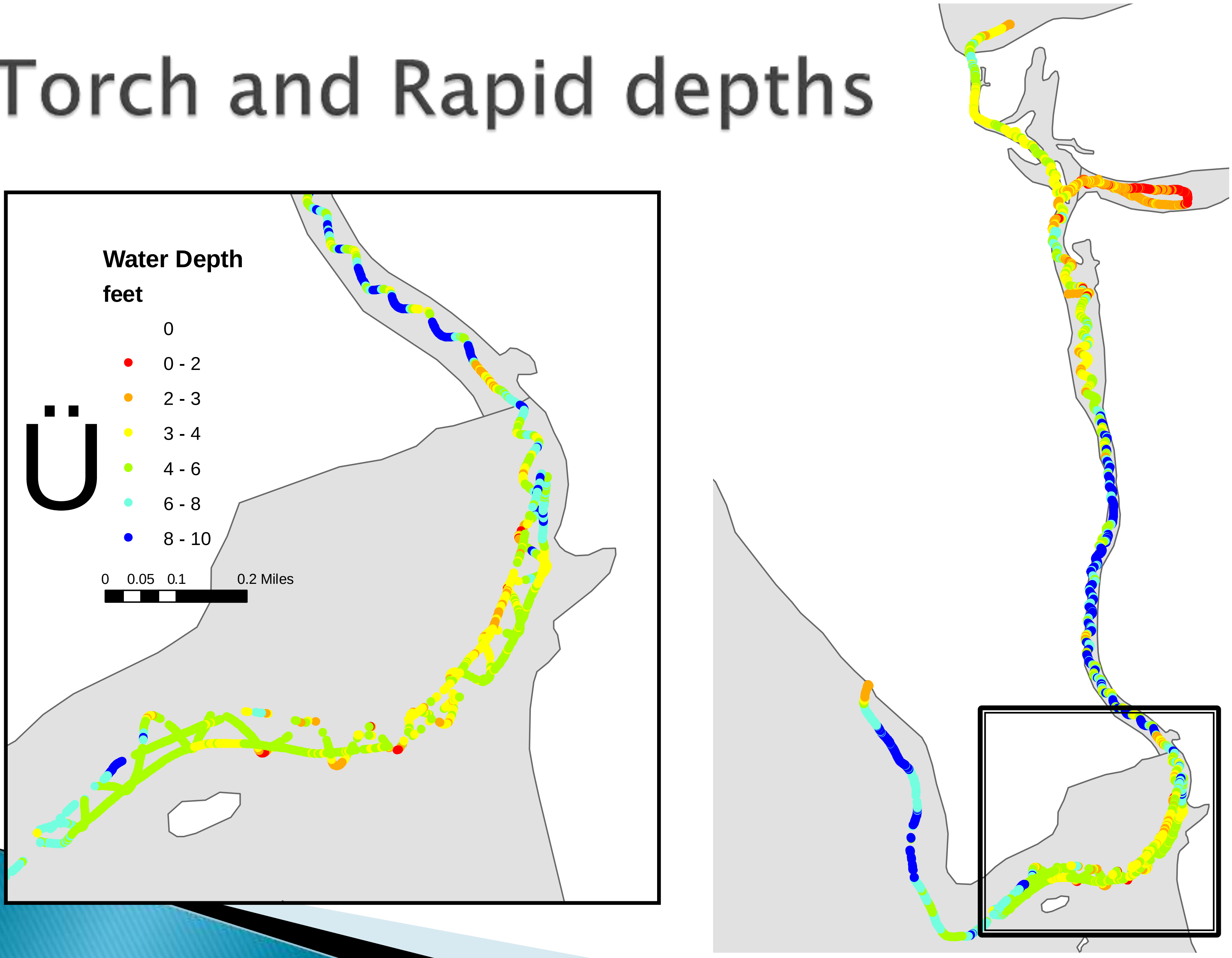


Grass River depths

- Average depth of navigable channel
  - Edges can be much shallower!
- Acute navigational issues at 3 ft

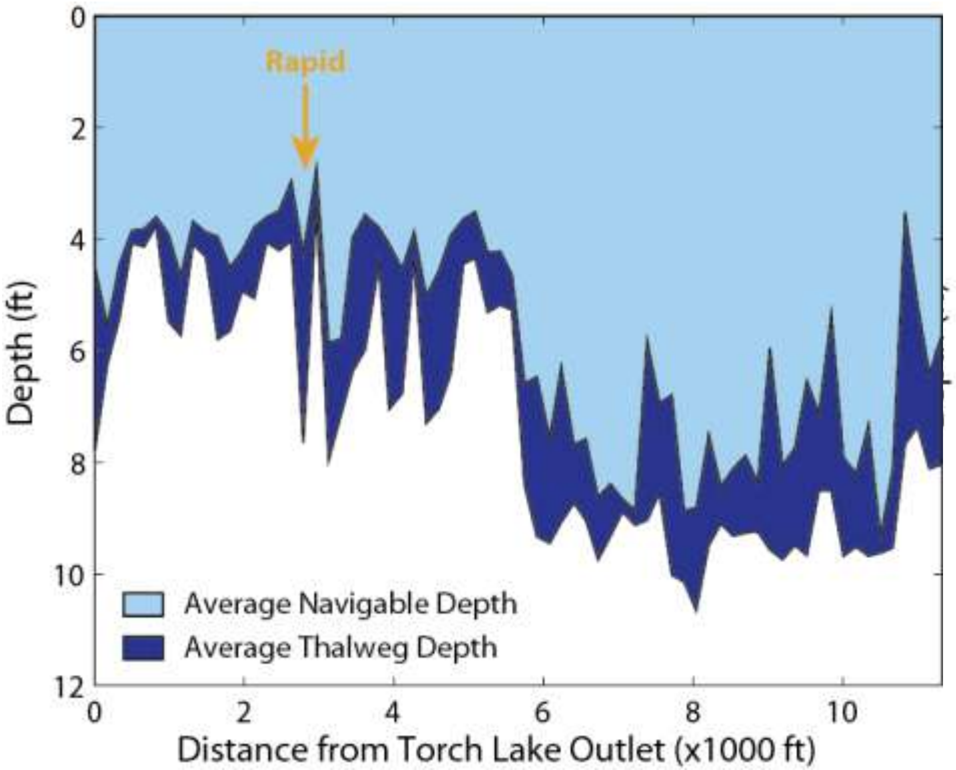


Torch and Rapid depths

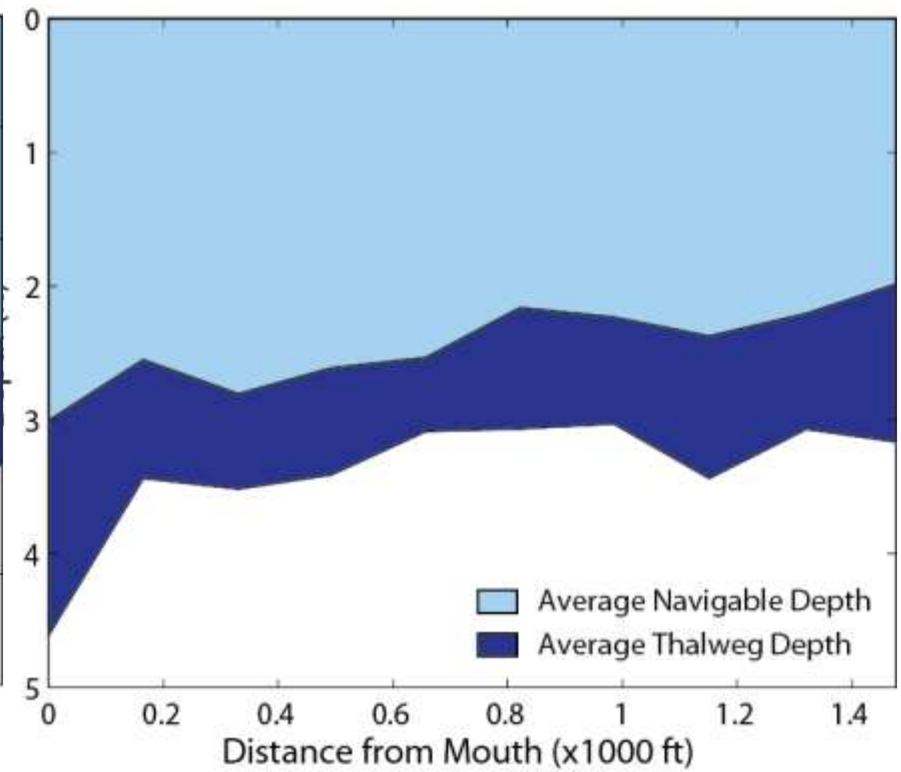


Torch and Rapid depths

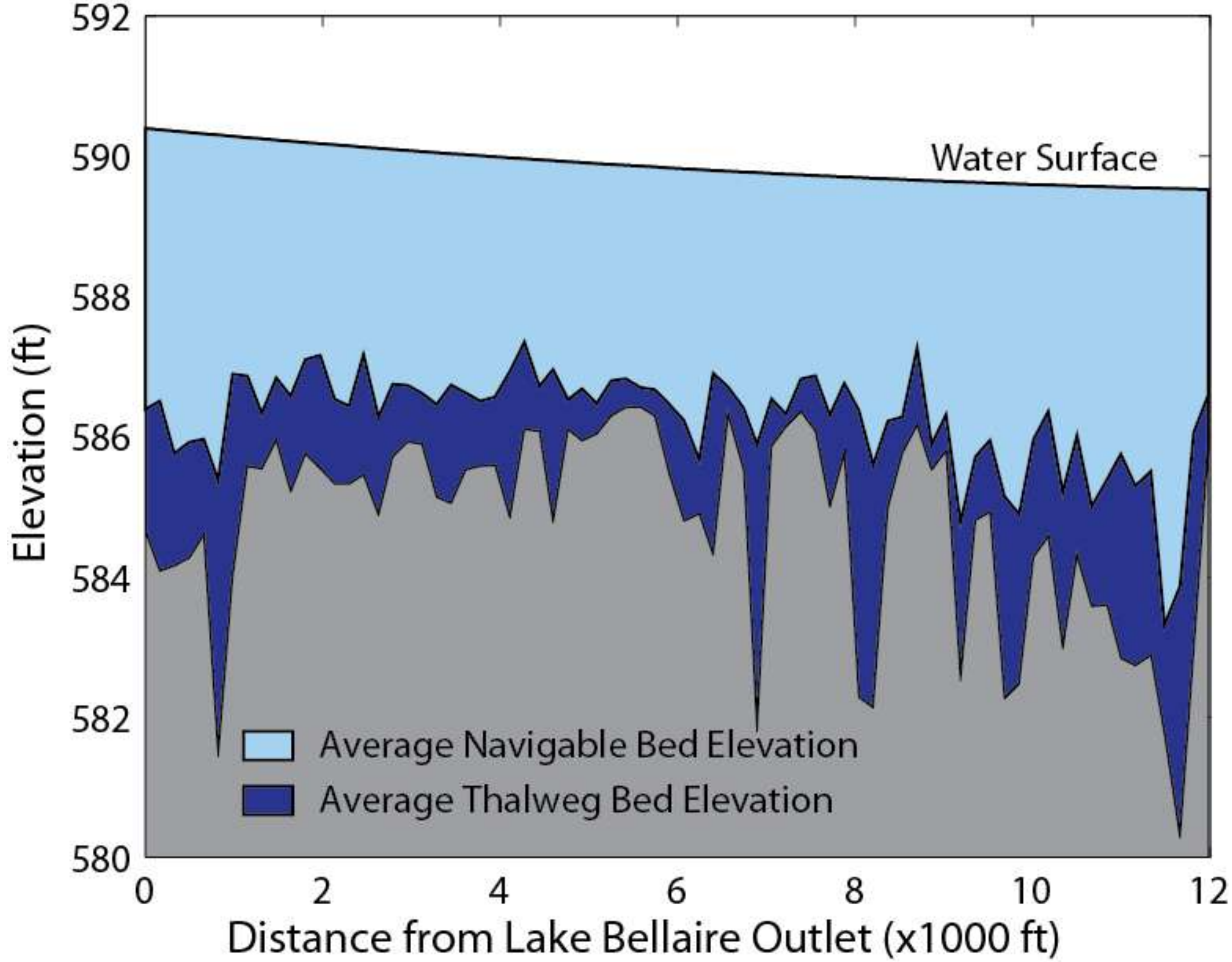
Torch River



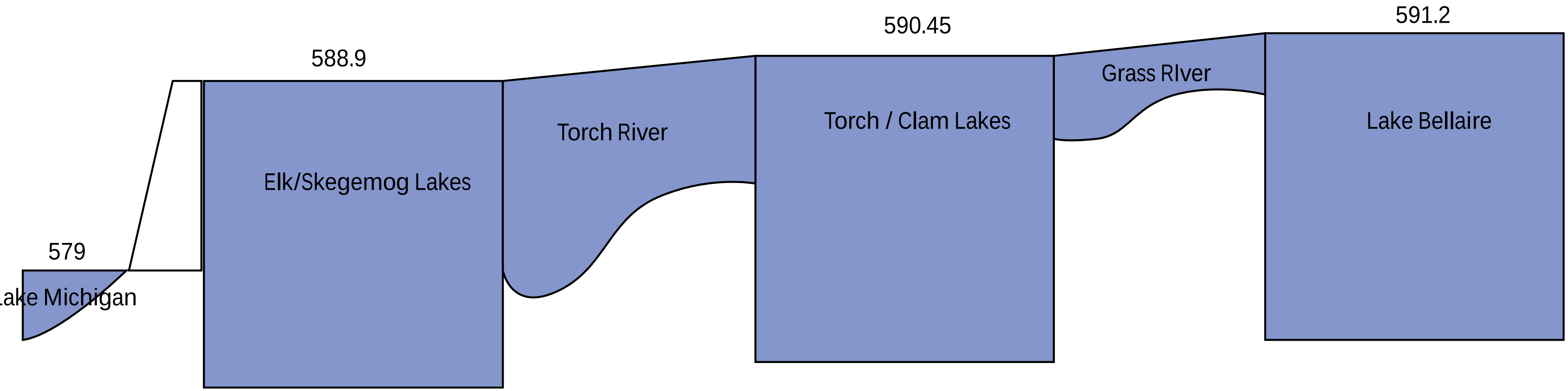
Rapid River



Grass River elevation profile

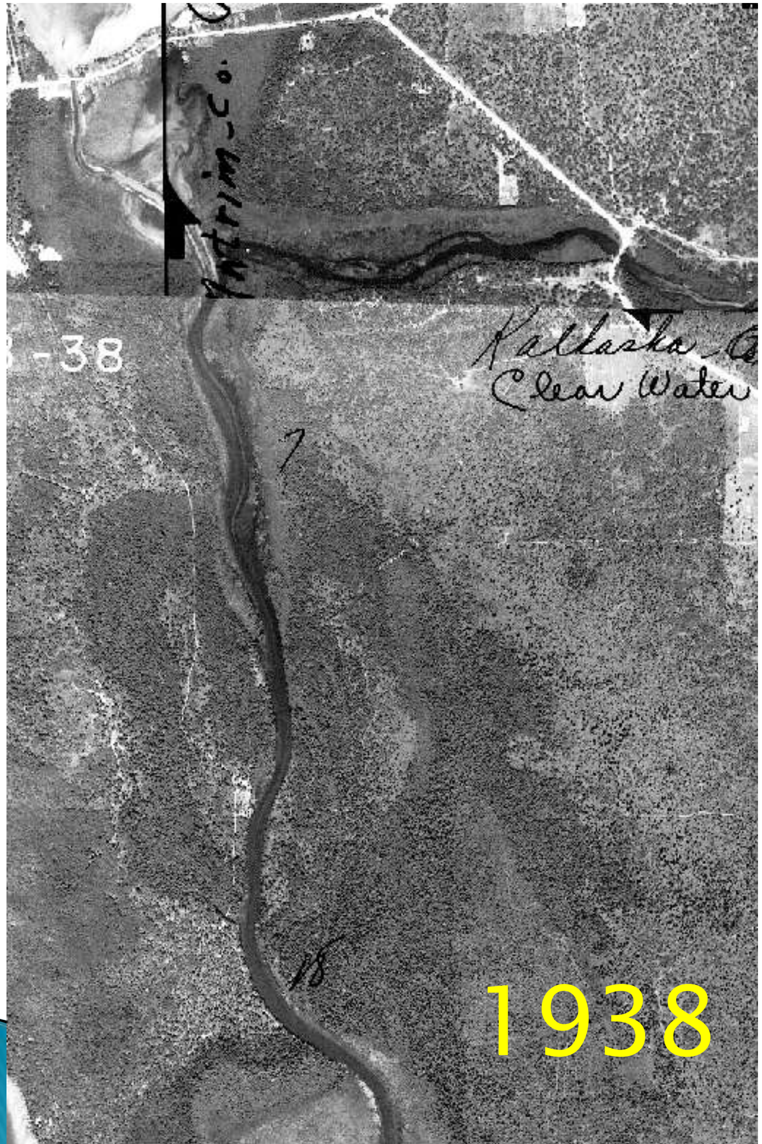


Elevations of the lower Chain



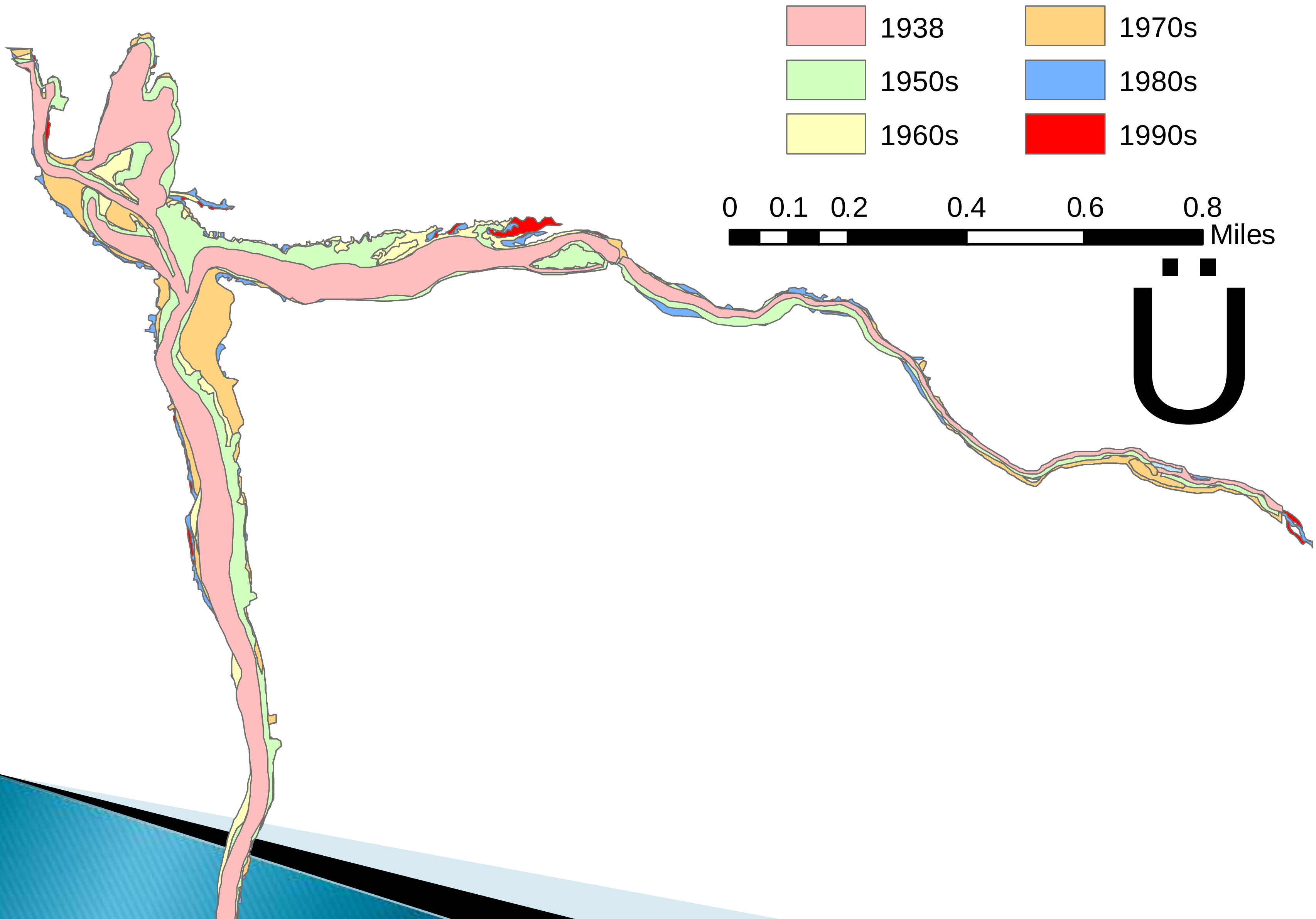
- Very small gradient along Grass and Torch Rivers, ~1 ft drop/10,000 ft of channel (0.01%)
- Rapid River and tributaries to Grass have slopes 50-150 times higher, ranging from 0.5-1.5%

Aerial Photo Analysis

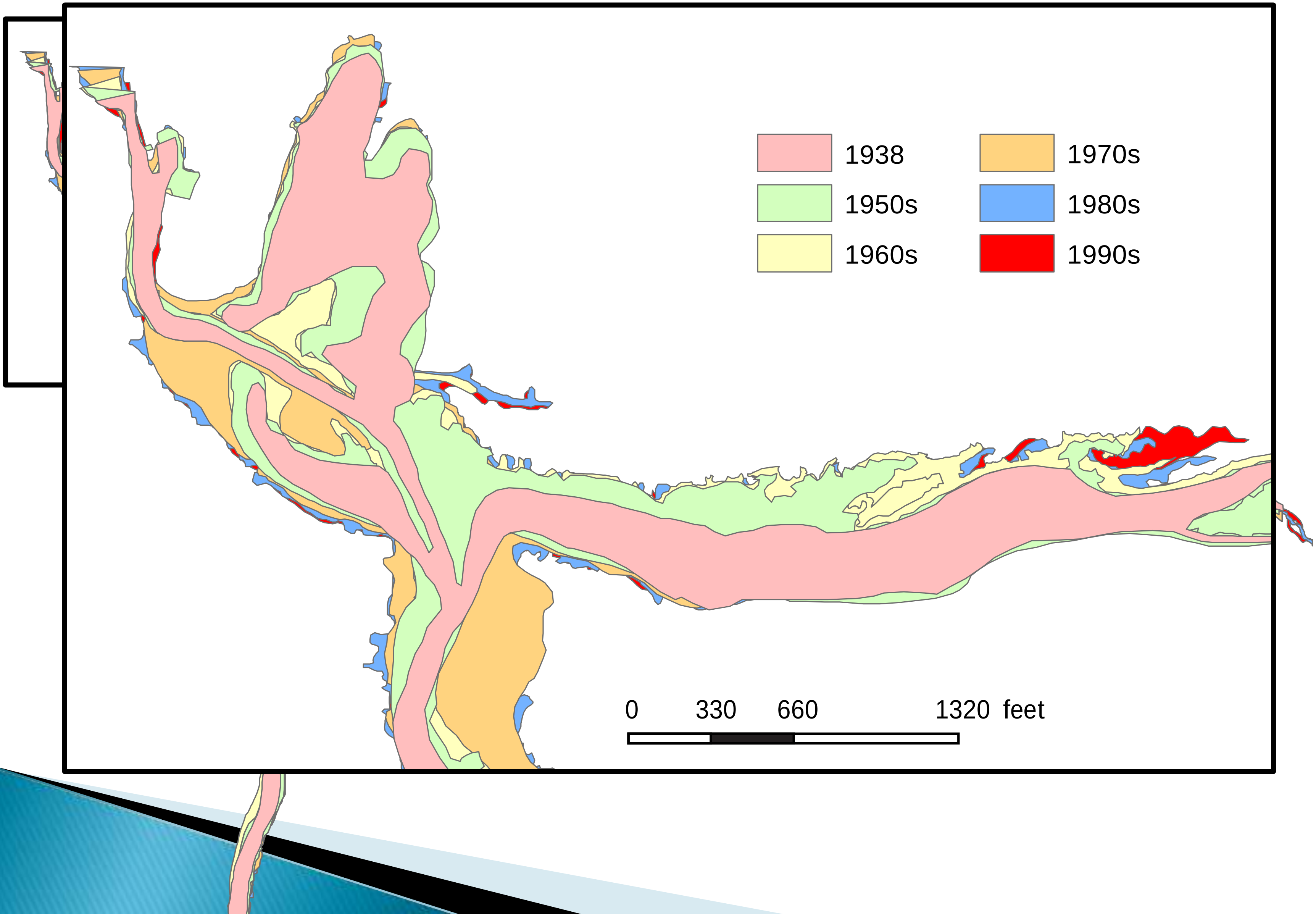


Aerial imagery mosaic

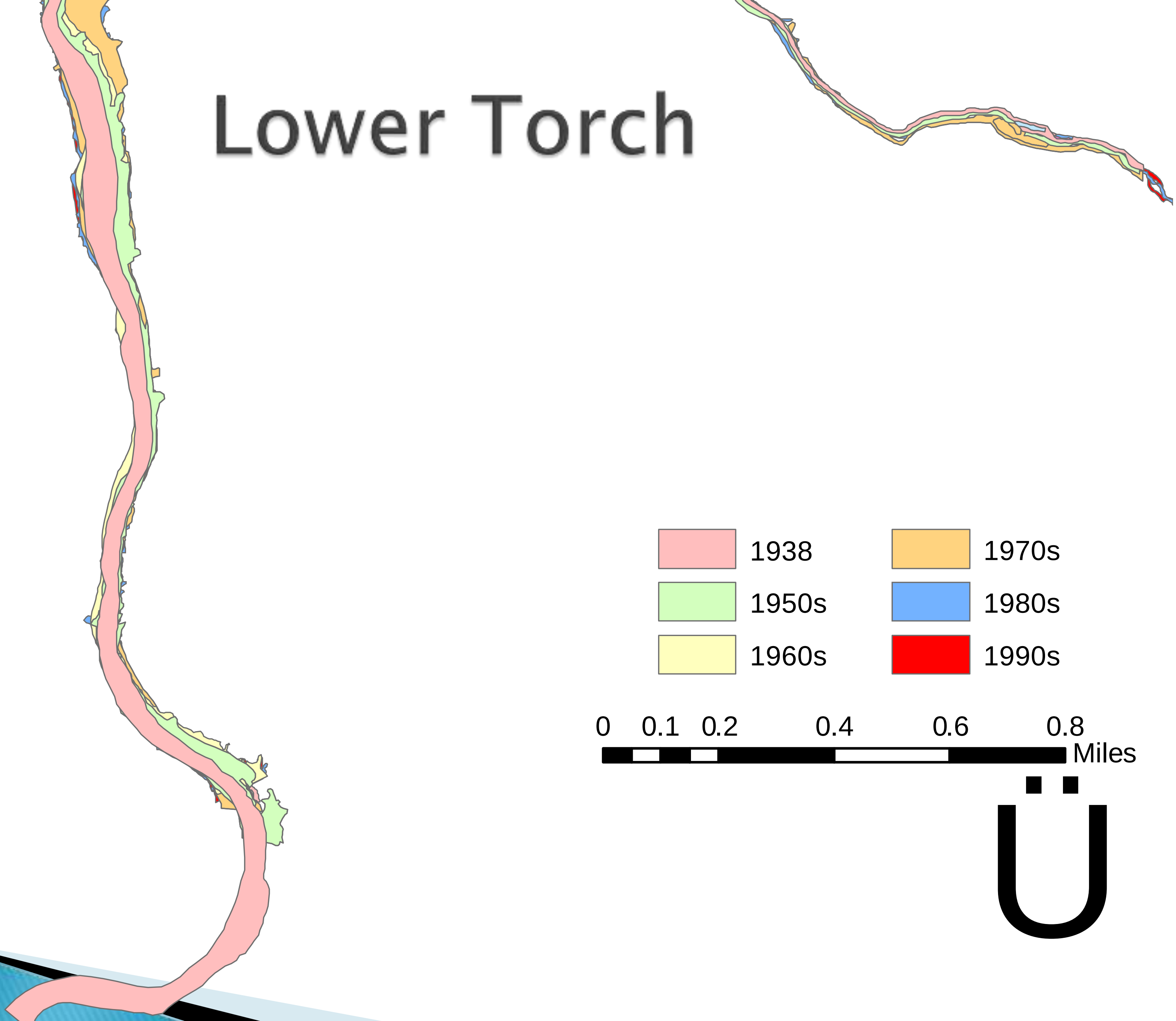
Upper Torch and Lower Rapid



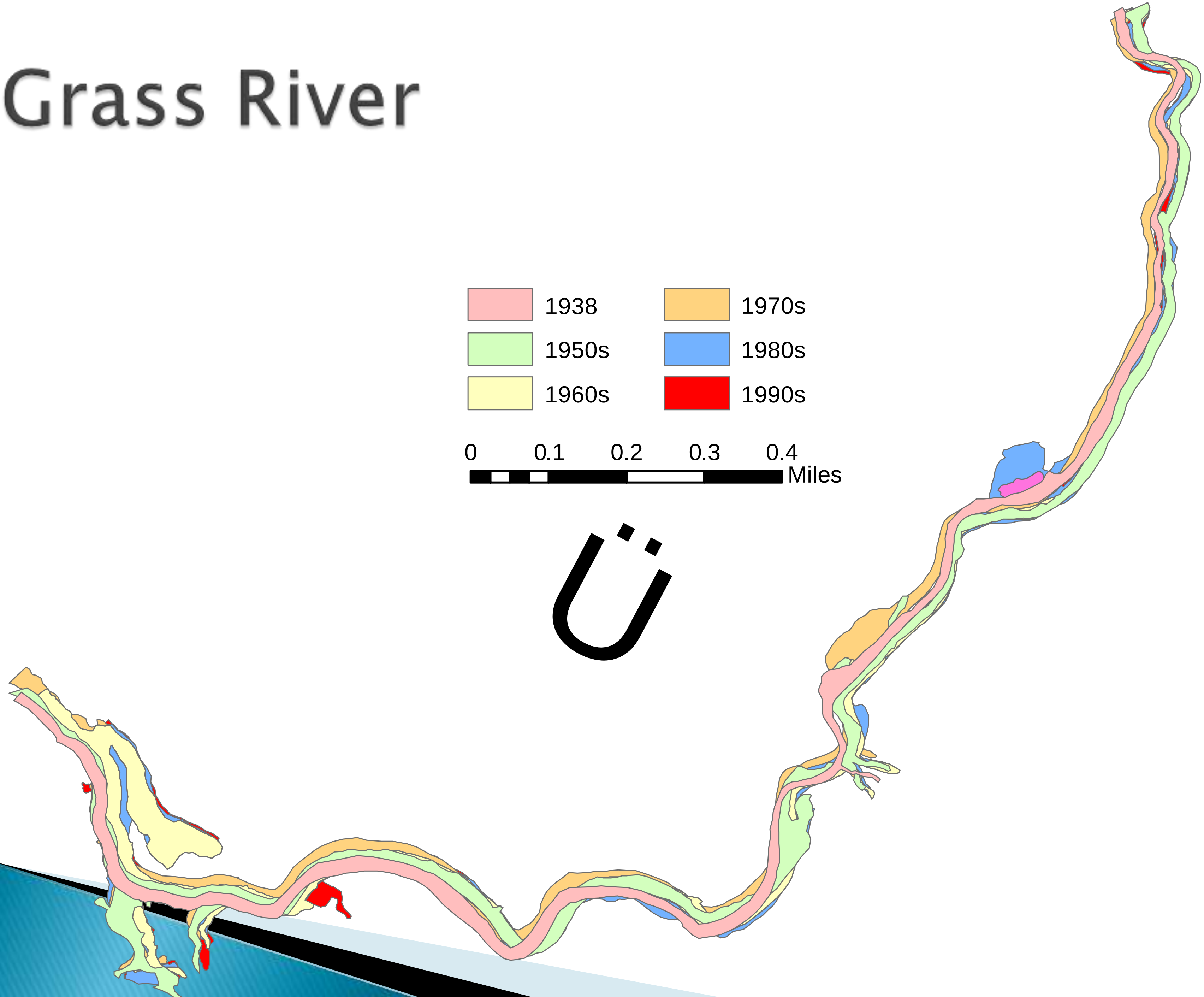
Confluence of Torch and Rapid



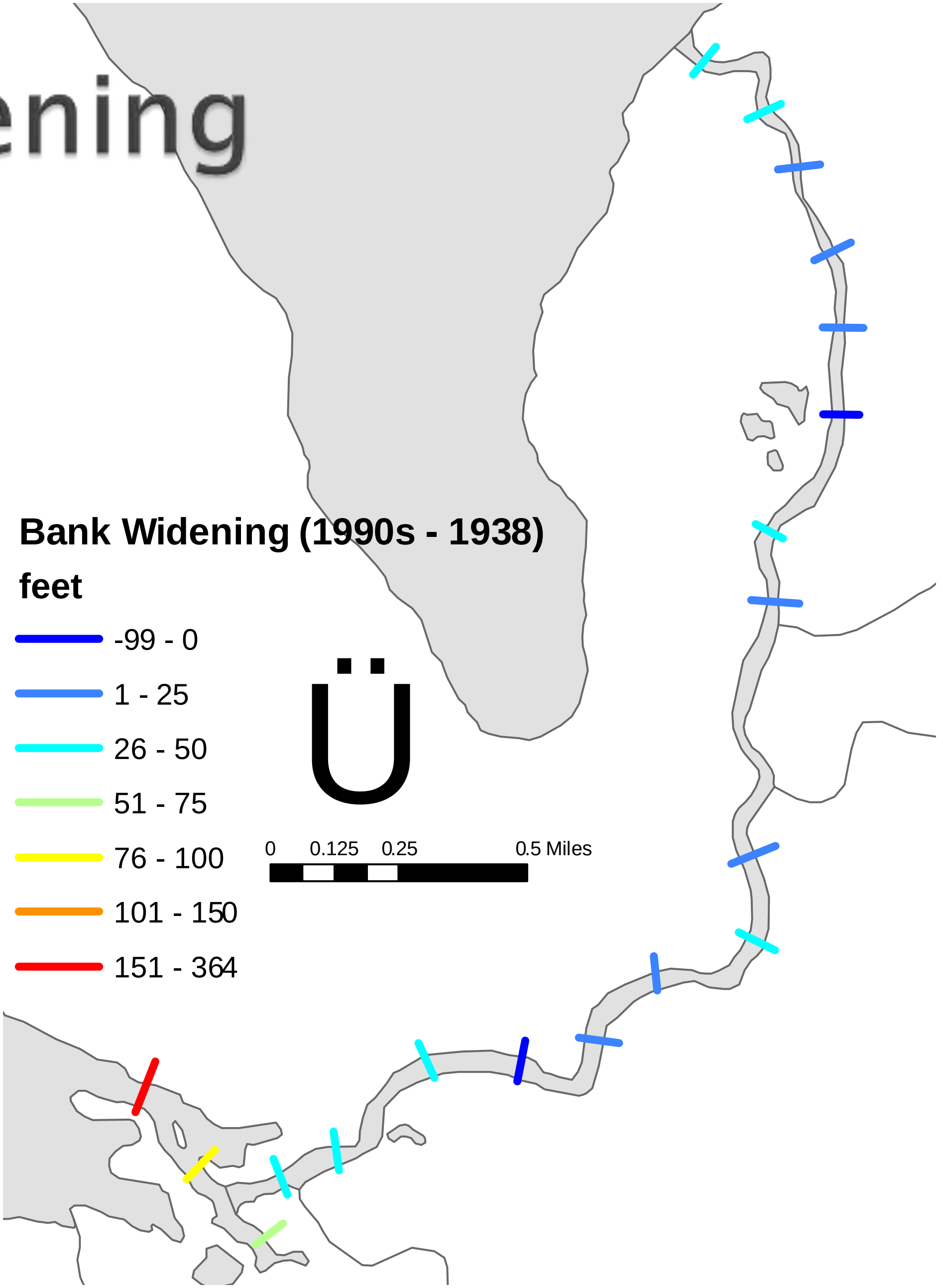
Lower Torch



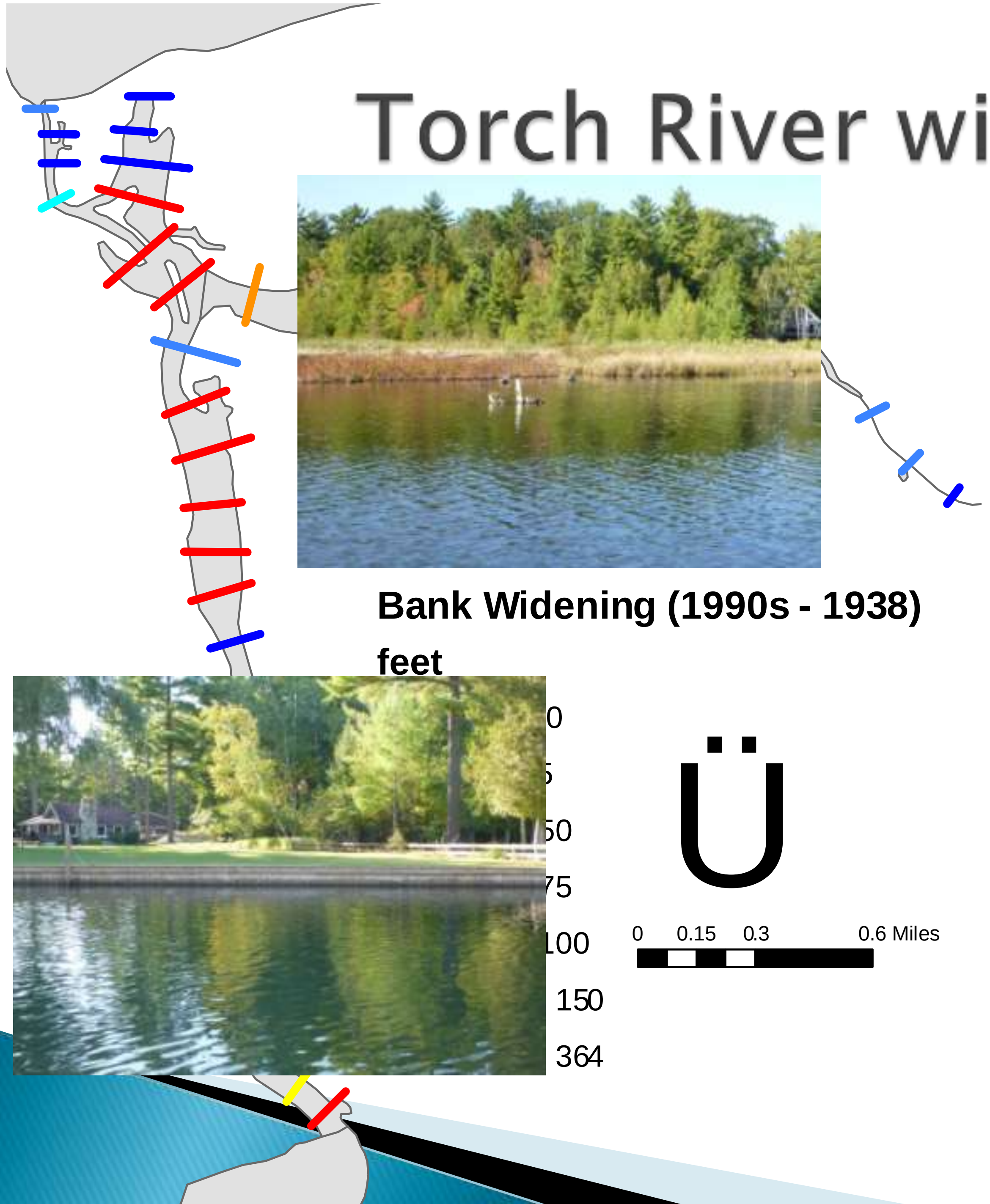
Grass River



Grass River widening



Torch River widening



Bank Widening (1990s - 1938)

feet

0

5

50

75

100

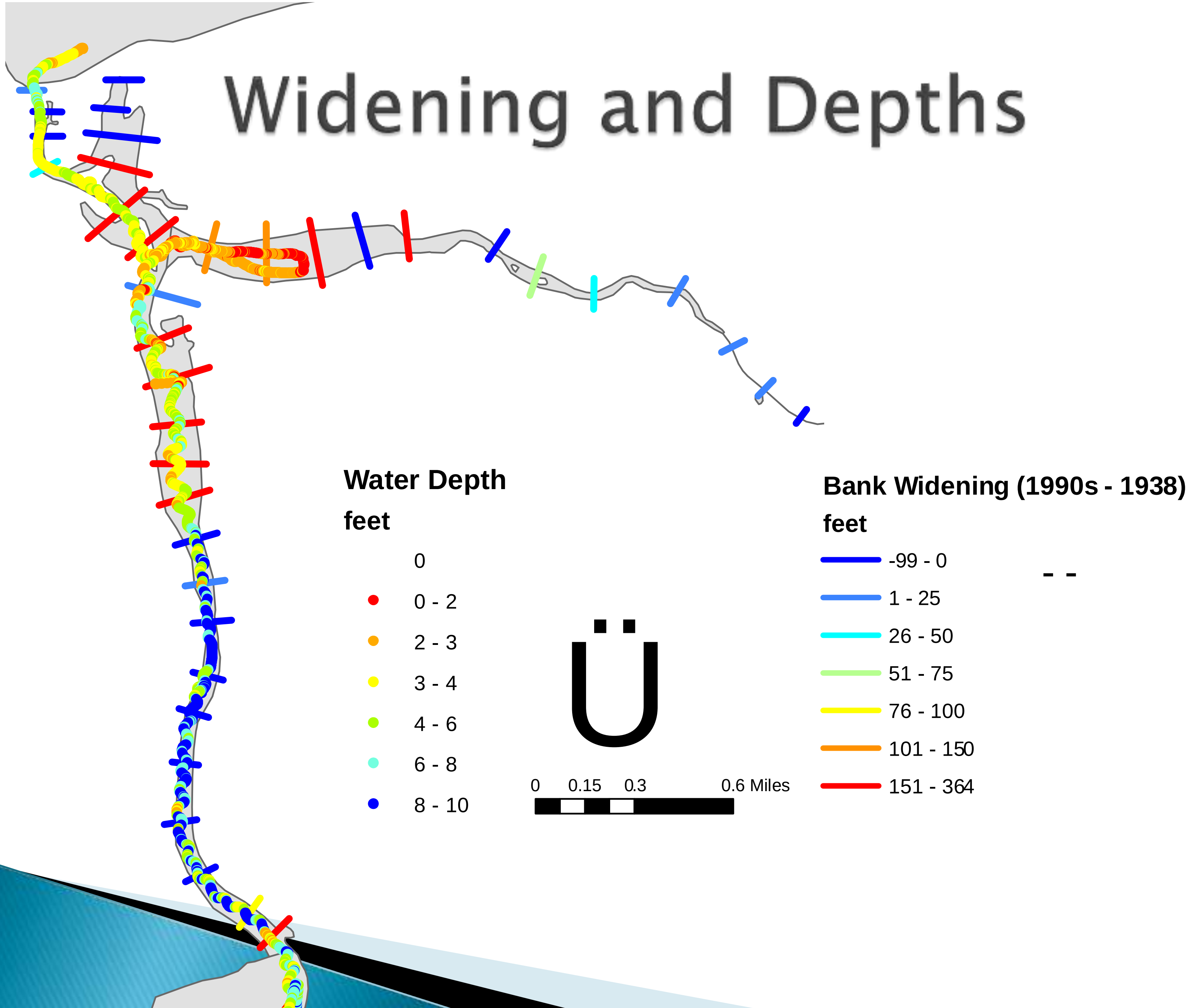
150

364

Widening photos

Widening photos

Widening and Depths



Study findings

- Acute navigational hazards to two-way boat traffic exist along the Grass River and most of the lower Rapid Rivers
  - Torch River near the confluence with the Rapid River is an area of concern
- Significant bank erosion, channel widening, and sediment build up can be observed in the historical record
- Armored sections of the banks do not exhibit significant changes from 1938 to present

Study findings (cont.)

- Rapid River and tributaries to the Grass River have significant flow and slope—and as a result naturally convey significant “bedload” sand
- Grass and Torch rivers have very low gradients, reducing their capability of moving input sediment from bank erosion or tributaries downstream

Seven recommendations

1. Establish a GIS database
2. Install preliminary large woody debris (LWD) bank armoring along the Grass River
3. Continue to improve road crossings and identify acute sediment sources in tributaries
4. Conduct a follow-on feasibility study of LWD armoring and dredging
5. Conduct a stakeholder and property owner survey to gauge support for active intervention options, includes riparian education campaign
6. Continue regular monitoring of channel bed sediment elevation; and
7. Study new management options for the Elk Lake Dam

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Bank Armoring with Large Woody Debris

Photos: US Forest Service

LWD Concept

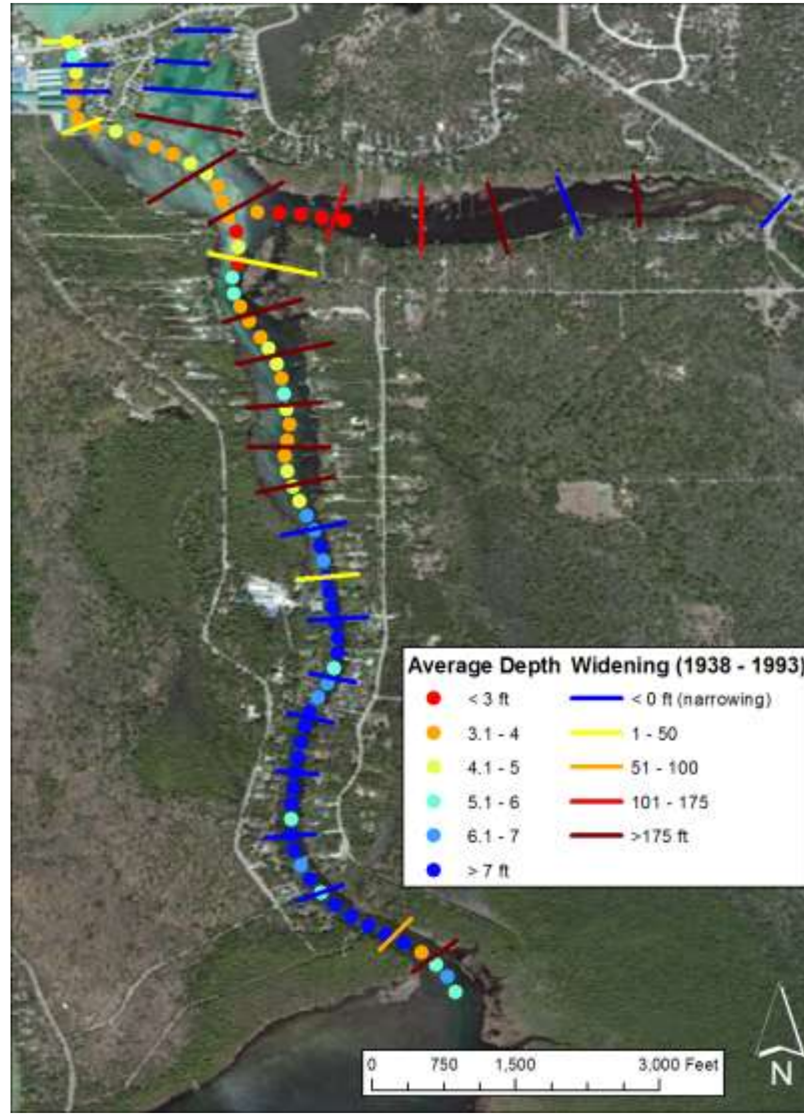
1. Reduce “effective” channel width using large trees with intact crowns
2. Increase velocity in deeper (thalweg) portion of channel
3. Sedimentation behind LWD makes channel width changes more resilient
4. Faster thalweg water velocities should cause bed scour and deepen the channel

LWD installations

- Two sites along Grass River have just received permits for 2013 installation
  - Both downstream of Cold Creek confluence
- A third site is recommended near the Shanty Creek confluence
- Also recommend:
  - Install prominent signage
  - Continue to collect feedback from public (including seasonal residents)
  - Monitor effectiveness of these installations

Study cost and feasibility of large-scale LWD and dredging

- Feasibility
  - Need to assure two-way channel navigability
  - Likelihood of success
- Assess costs
  - Expanding LWD installations along Grass, Torch, and Rapid would be a large effort
  - May need dredging in some areas to provide channel scour and sediment to reduce bank widths



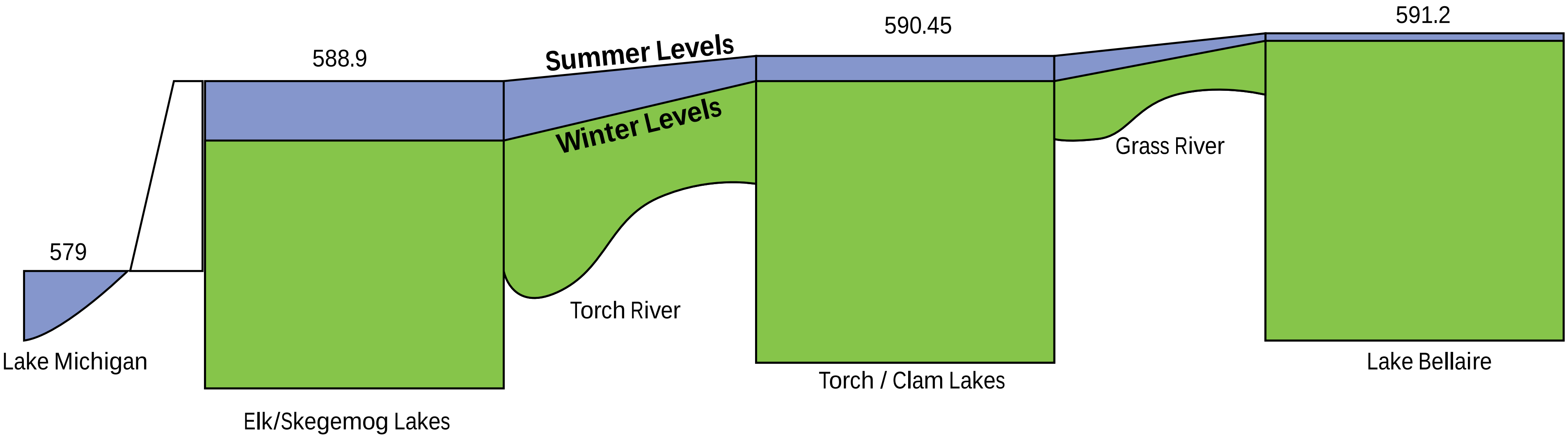
Stakeholder and riparian survey

- Determine perceptions the current state and desired end-point of the system;
- Ask opinions on the performance and appeal of initial LWD installations;
- Rank the desirability of potential remediation solutions;
- Gauge support for adaptation to changes, as opposed to active mitigation;
- Provide education about related issues;
- Be a feedback mechanism for additional suggestions; and
- Inquire about uses of the rivers

Managing the Elk Lake Dam for sediment transport

- The Elk Lake Dam is held at a nearly-constant elevation throughout the year
  - Many inland lakes have sought and received modifications to court-ordered levels allowing lower winter levels
- Lowering the winter level of Elk/Skegemog lakes may provide an increased gradient to the Torch and Grass Rivers
  - This would aid in moving sediment through increased thalweg scour
- Must consider hydrolectric function of the Dam year-round, in addition to other aesthetic, ecological, economic, and recreational concerns

Goal of the Dam Management approach



- Increase gradients along Torch and Grass Rivers to improve bank widths and channel depths
- Maintain current "summer level"
- Maintain function of other uses

Feasibility of the Dam Management approach

- Key questions:
  - Would levels of lakes respond rapidly enough to changes at the Dam to achieve both summer and winter levels?
  - Would the bridge across Torch River restrict flow out of Torch Lake, potentially limiting success of this approach to Torch River only?
  - Can sufficiently low winter levels be achieved that maintain hydroelectric function?
  - What would be the permitting processes required for such changes?
  - What might be the unintended consequences of altering dam management?
  - Where would the sediment currently in Rivers go—i.e. what would be the impacts on Clam and Skegemog Lakes?

Taking a holistic approach

- Sedimentation and bank erosion is a problem exacerbated by human activities: damming Elk Lake, land use in watersheds, engineered structures, climate change, etc.
  - But these rivers always move sand!
- It has taken over 100 years for the state of the system to reach this point
- Any action must take into account all of the users and uses of the waterways and watersheds

Questions?