Navigability from Bathymetry Data

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Abstract: Navigability Score for River Reach

Given a point-cloud of bathymetric data for a reach of a river, and gauge levels when the bathymetry survey was done, come up with some kind of value to describe the navigation accessibility of that reach given future gauge levels.

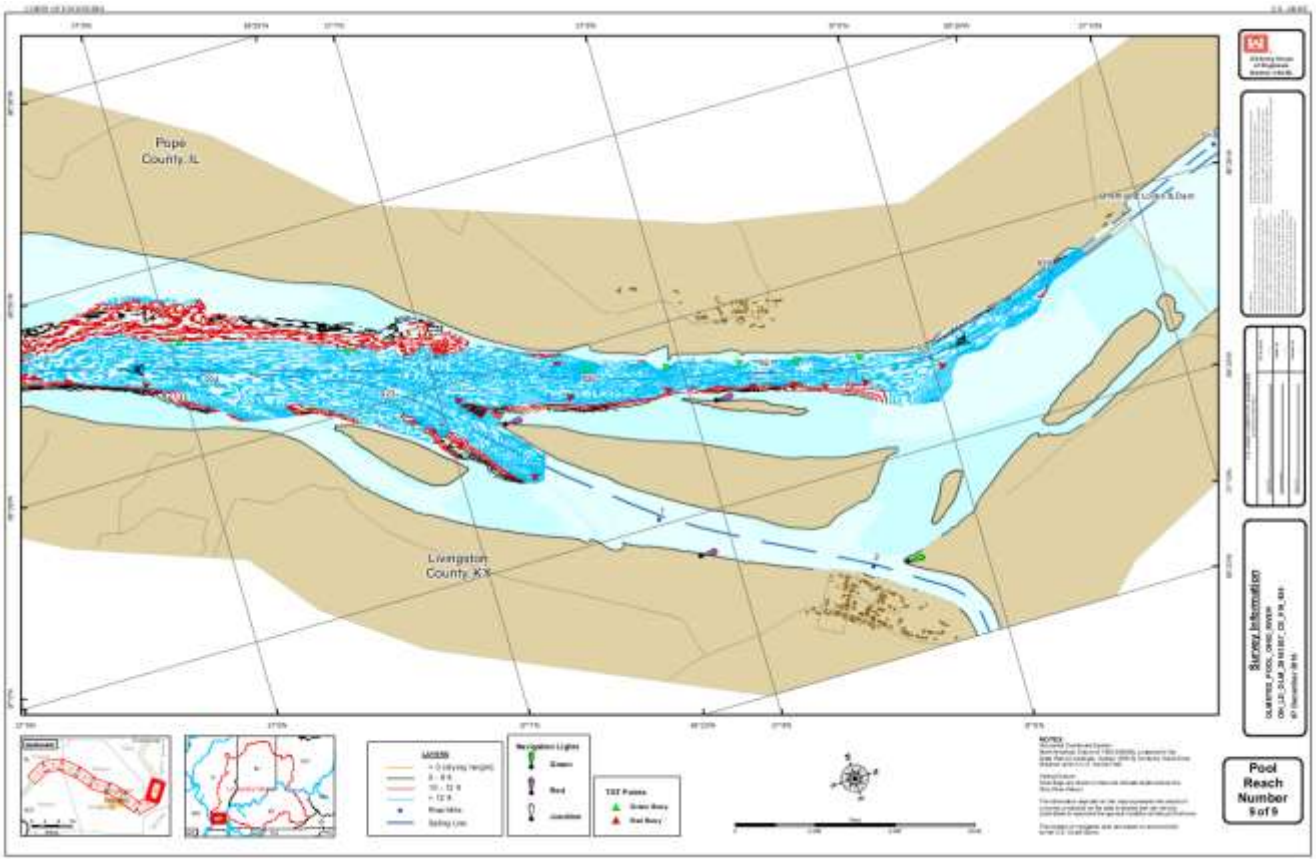
For example if we can find a course through that reach that is at all points 300 feet wide and 9 feet deep, it would be considered "fully navigable" or "100%". But if the navigation path gets choked to 200 feet wide at some point, the *navigability score* would be lower.
This analysis could be used to help with the placement of navigation buoys as well as providing "current condition alerts" as the gauge levels change.

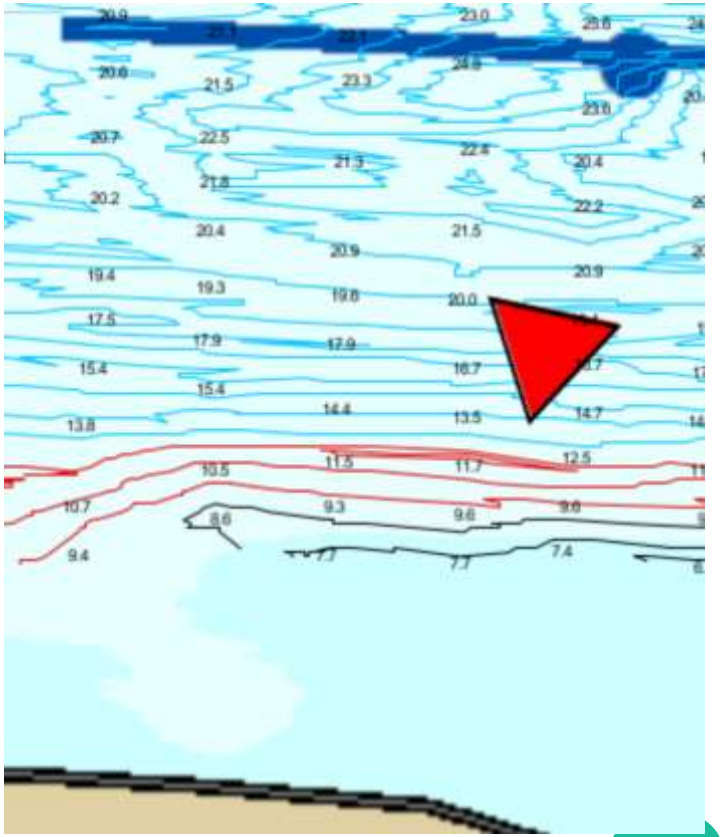
While the Corps of Engineers has done like this for coastal regions, in those places the navigation channel is fairly static and only the bottom conditions need to be evaluated. This effort needs to both identify the navigation channel (possibly given a “sailing line”) as well as evaluate the depth to determine navigability.

Some Context

Source: https://www.youtube.com/watch?v=YWUDqw51F60

Bathymetry data from the Ohio River





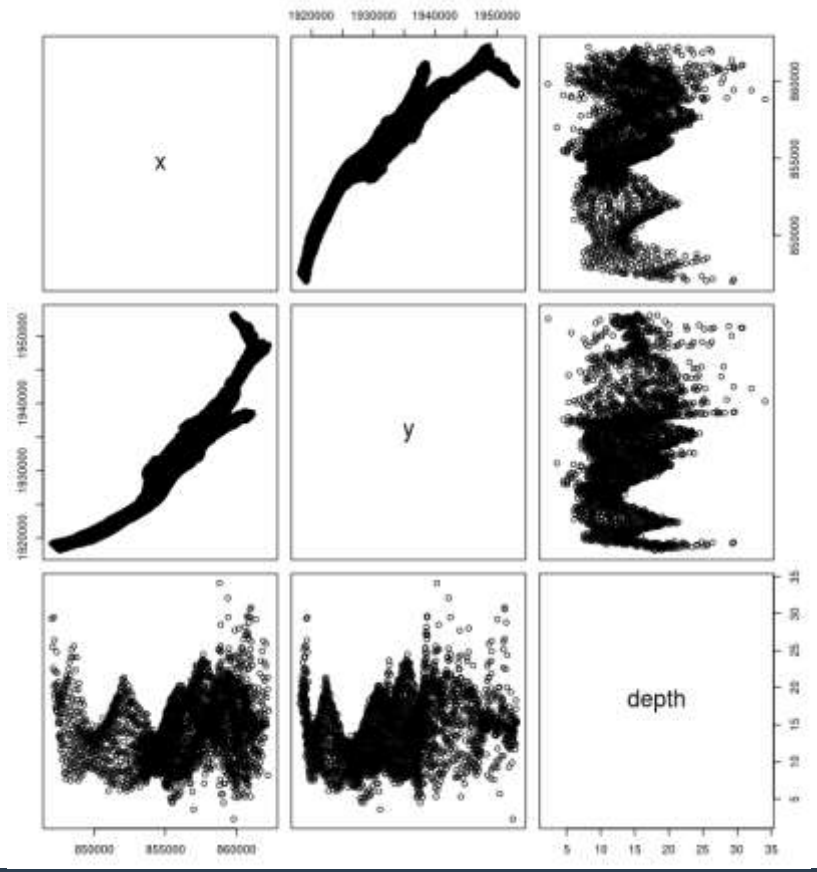
Source: https://www.lrl.usace.army.mil/Missions/Civil-Works/Navigation/Survey-Data/

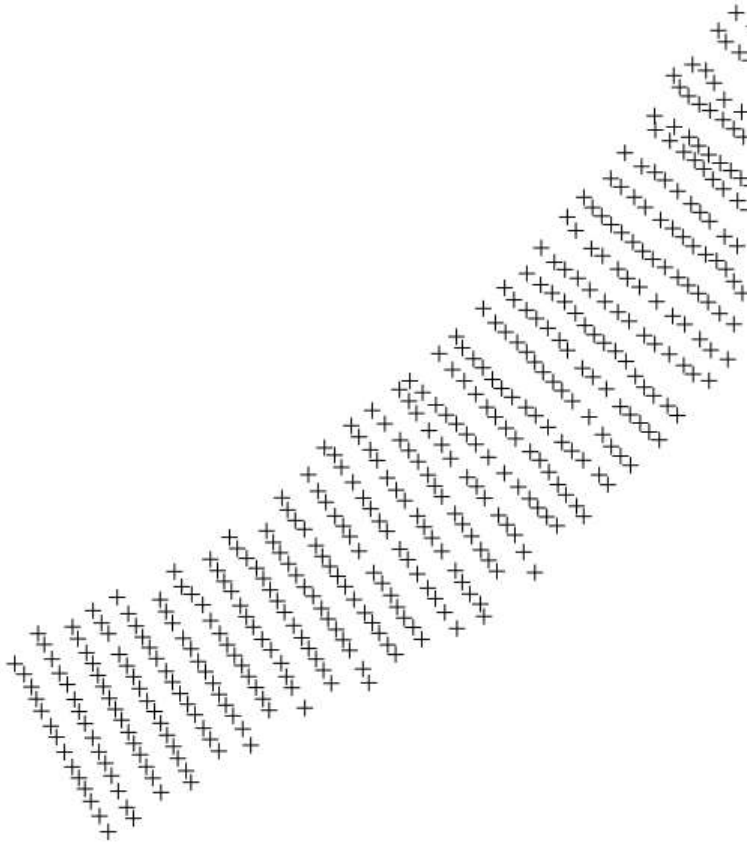
Goal: Find Widest Swath Along River

- Fully navigable = 9’ deep x 300’ wide along reach
- Current “fishbone method” can end up with discontinuities – paths vessels can’t actually use
- Also want to re-evaluate using same data but at different gauge heights (e.g. if we lower the river by 1’, then 2’, etc. how navigable is it?)
- Written in Python or R

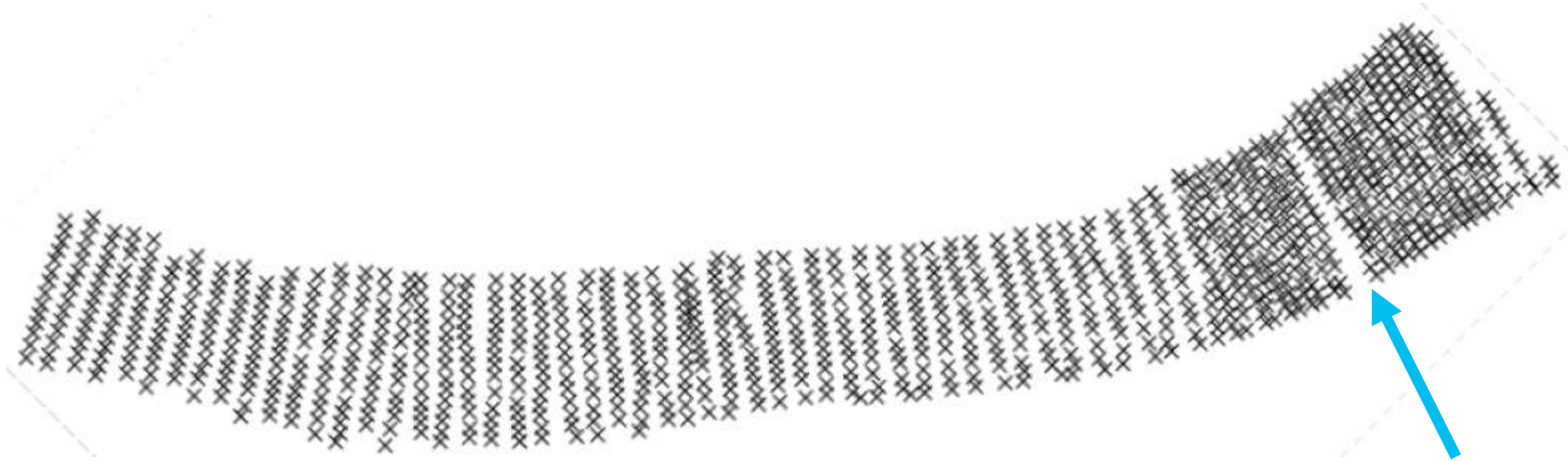
A Look at the Data

x	y	depth
847266.2	1918715	17.5
847232.2	1918782	18.5
847174.8	1918874	19.2
847143.7	1918947	20.2
847284.6	1919103	20.5
847238.2	1919189	22.2
847113.7	1919021	22.6
847069.4	1919098	25.5
847192.2	1919278	26.4
847012.6	1919160	29.3
847154.4	1919344	29.5
847647.8	1919218	11.6
847581.9	1919344	13.1
847550.0	1919023	13.3
847518.1	1919091	13.5
847587.4	1918951	13.8
847438.8	1918797	15.2
847624.2	1918885	15.2
847486.4	1918711	15.4
847540.1	1919409	16.0
847524.5	1918626	16.4
847635.5	1919565	16.4

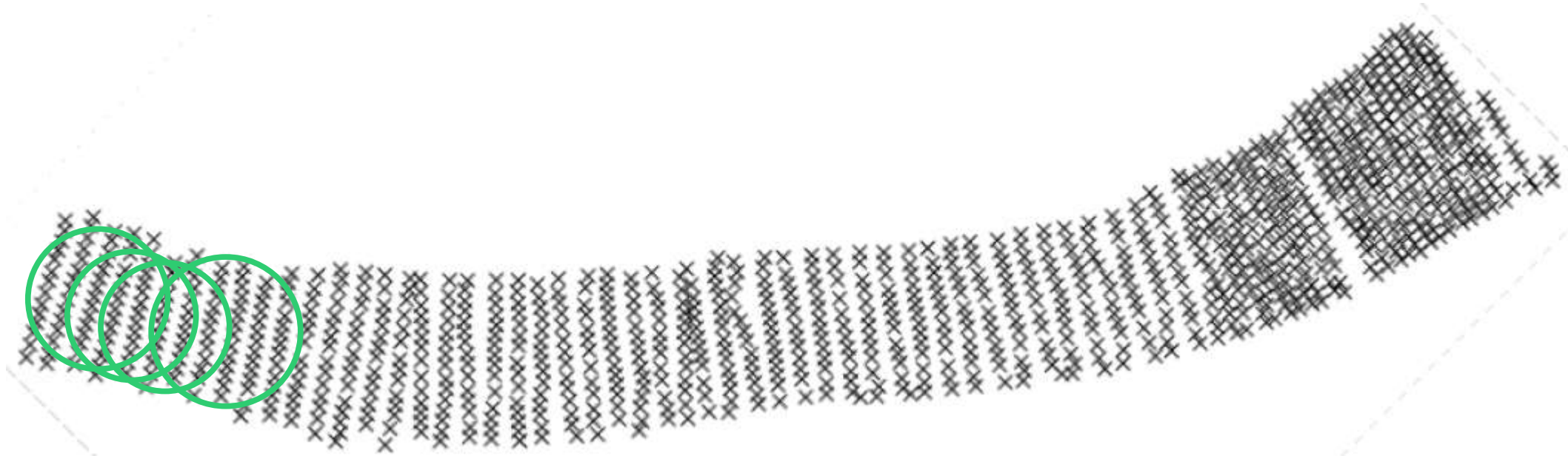




First Challenge: Convert to Grid/Mesh



Plan: Find Swath With Overlapping Circles



Challenges

- **Finding Optimal Grid Size to avoid gaps in data**
- **Could a “largest circle” algorithm work within a TIN?**
- **How to come up with a Navigability score:**
  - Some kind of singe number “percent navigable”?
  - Single choke point:
  - Long constrained width 

Questions?