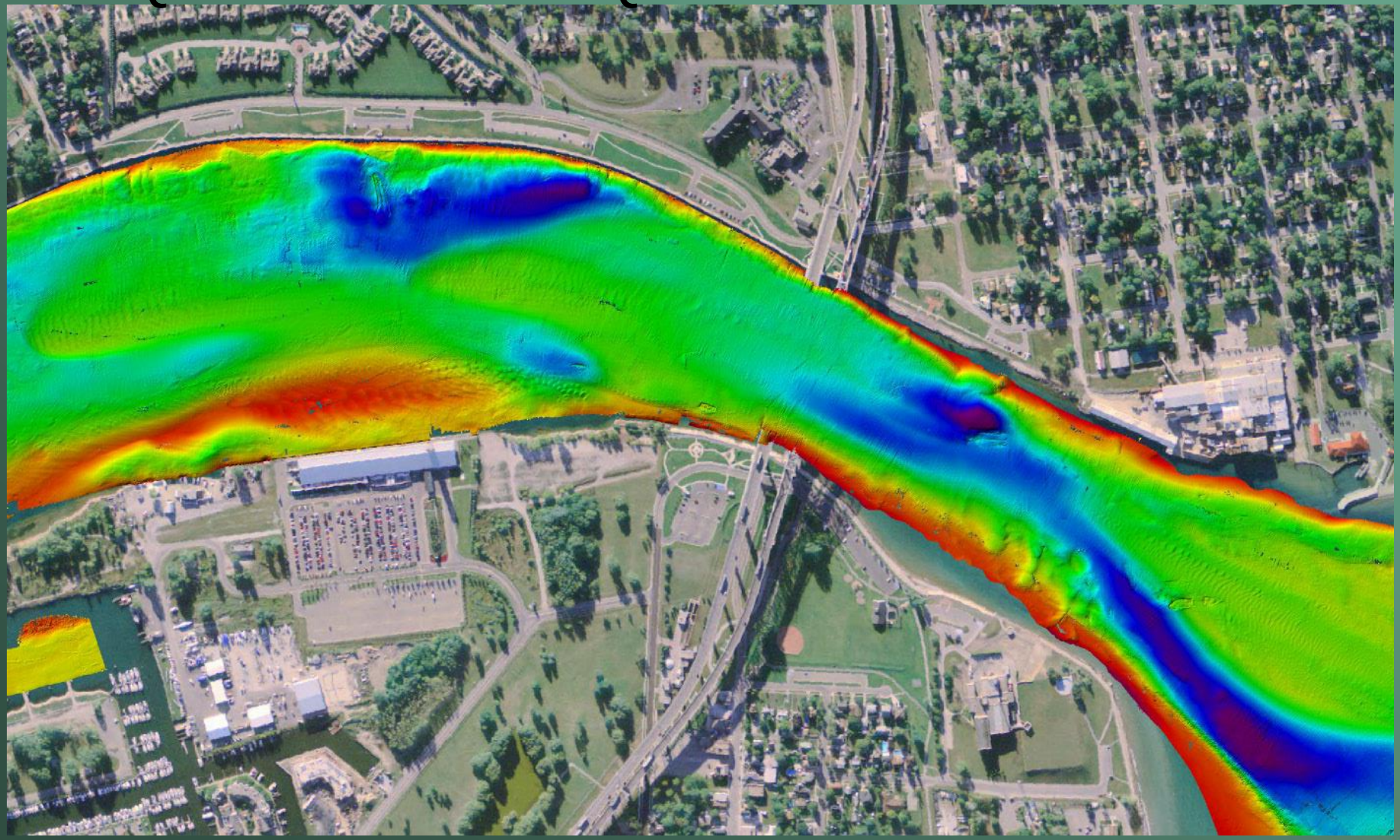
USGS Bathymetric Survey Capabilities for Quantitative and Qualitative Assessments



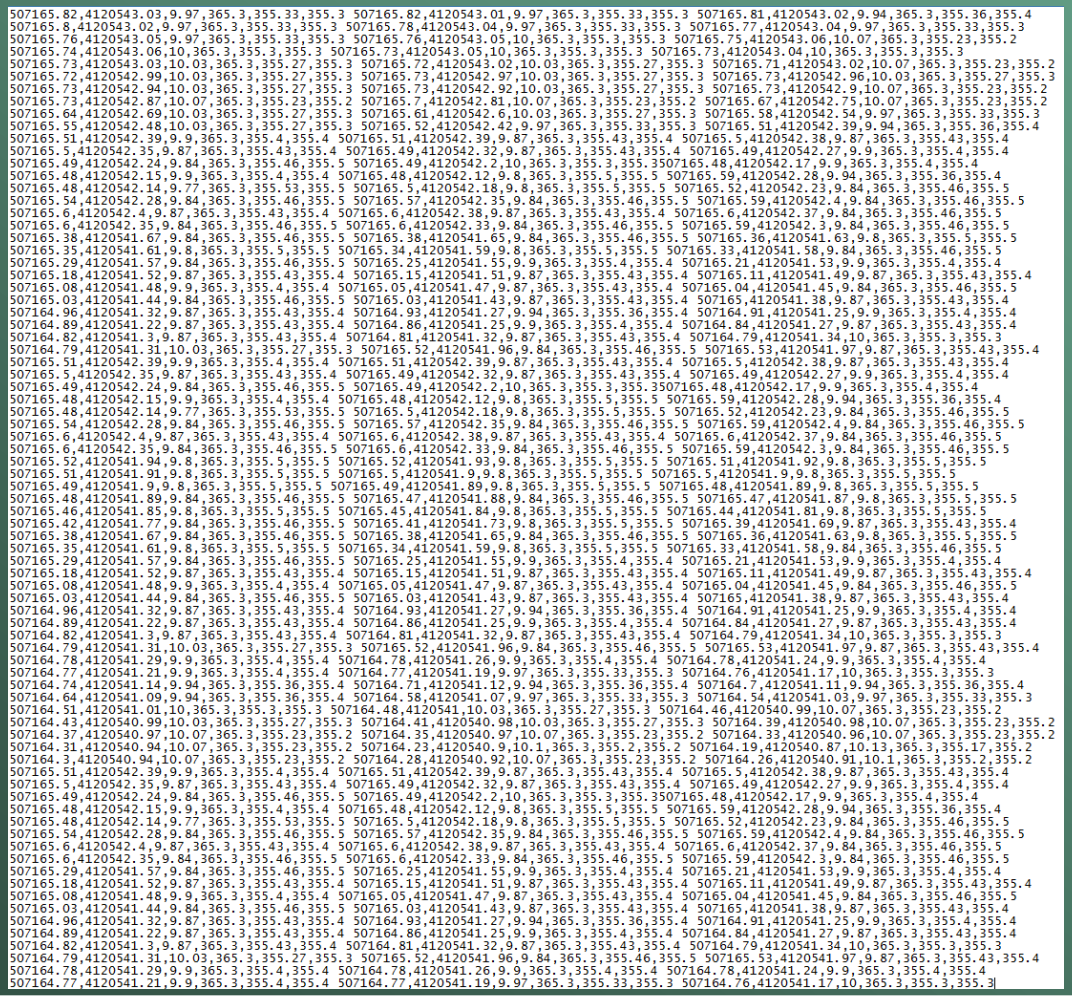
How does the USGS collect bathymetry data?

"Now! *That* should clear up a few things around here!"

Single Beam Bathymetry
Multi-Beam Bathymetry
Acoustic Doppler Current Profiler (ADCP)
Side Scan Sonar
Swept-frequency acoustic sub-bottom profiler

USGS

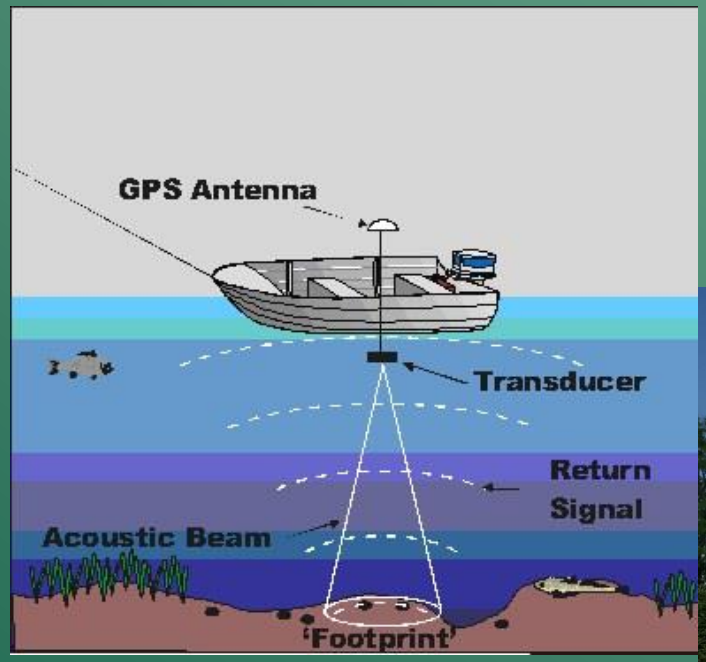
So this is bathymetry,



Don’t worry only half of my 100 slides are like this

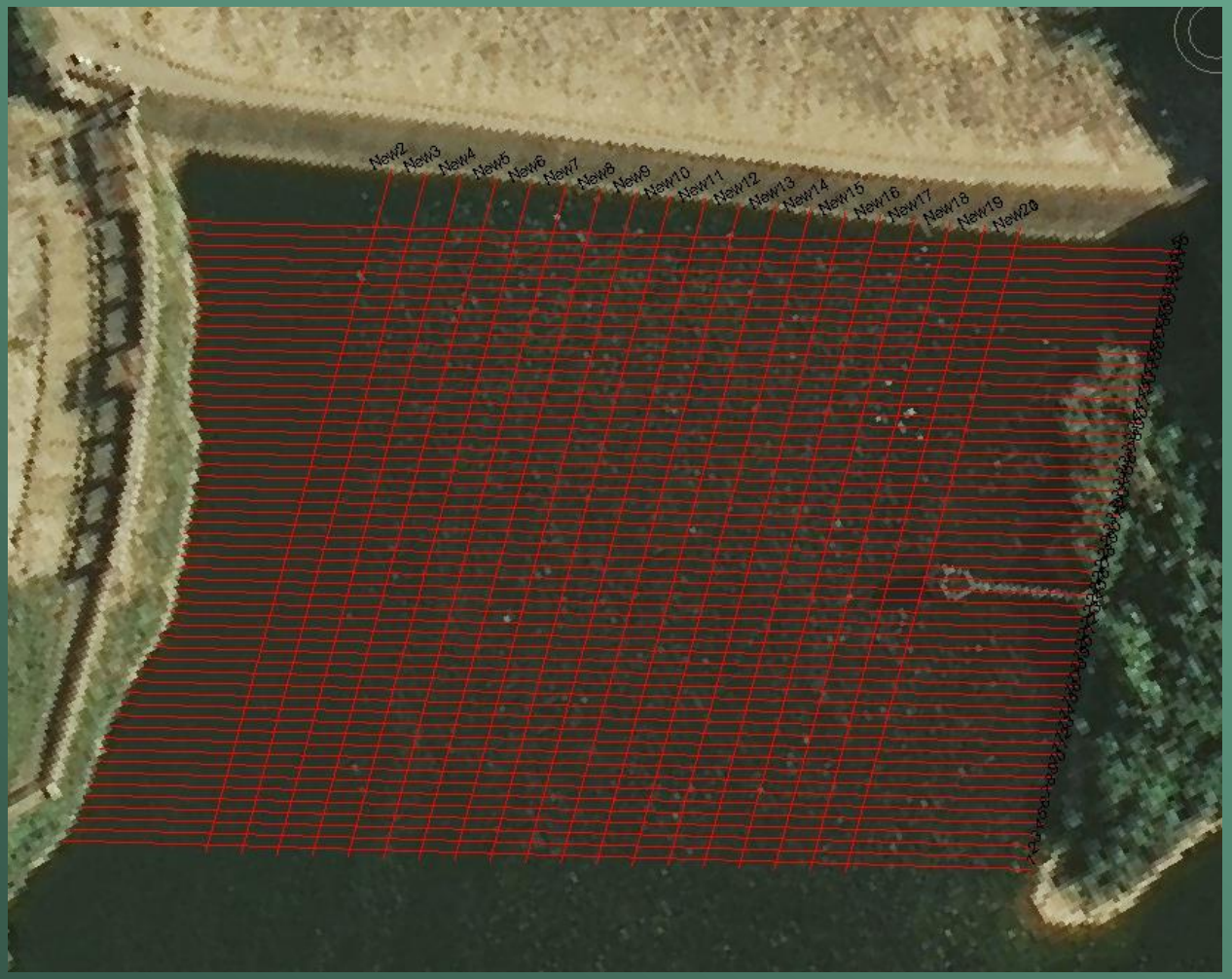
USGS

Single Beam Surveys (manned boat)



USGS

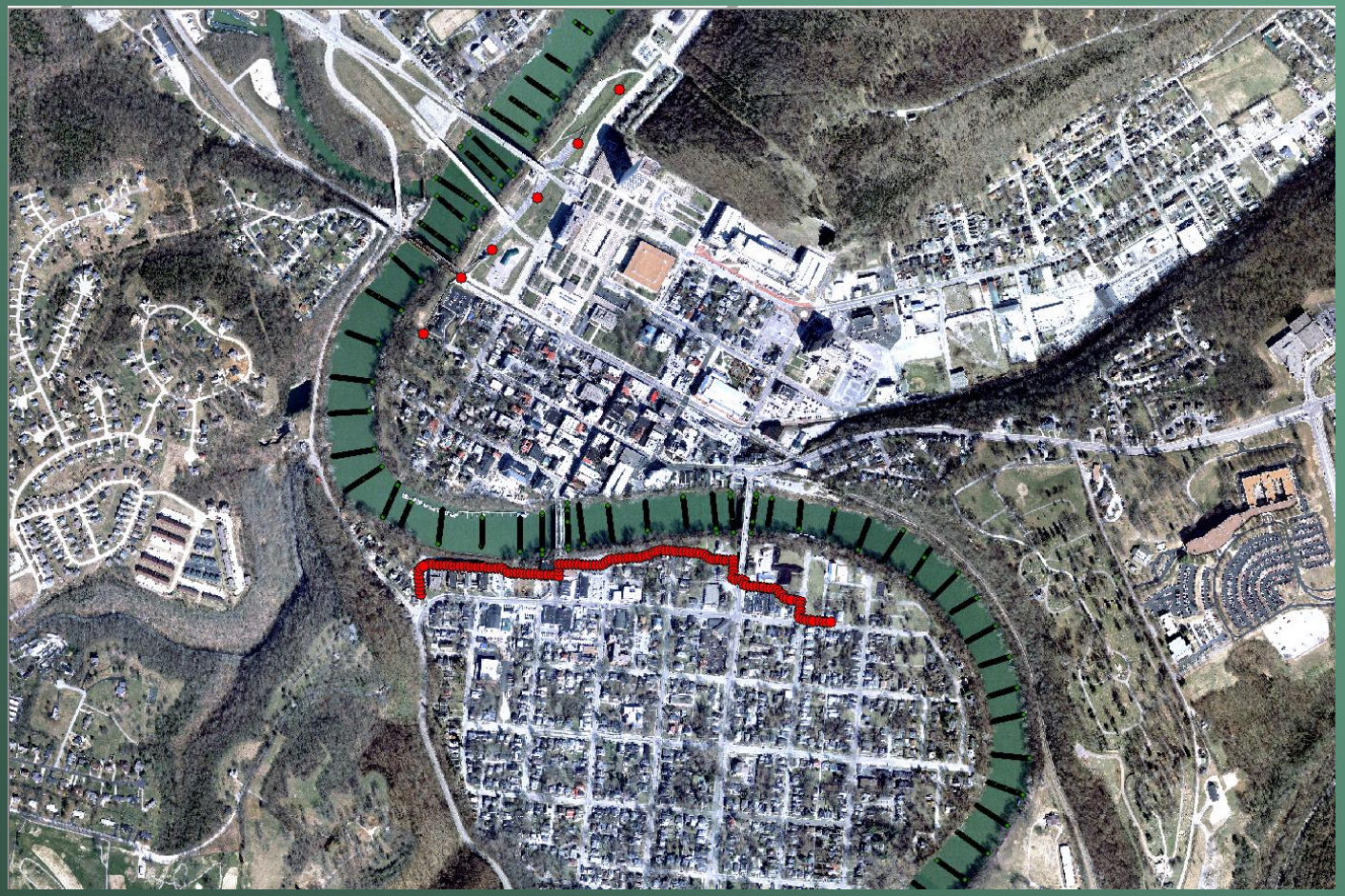
Predetermined Bathymetry Transects



USGS

Herrington Lake, KY

Flood Inundation of Frankfort, Kentucky

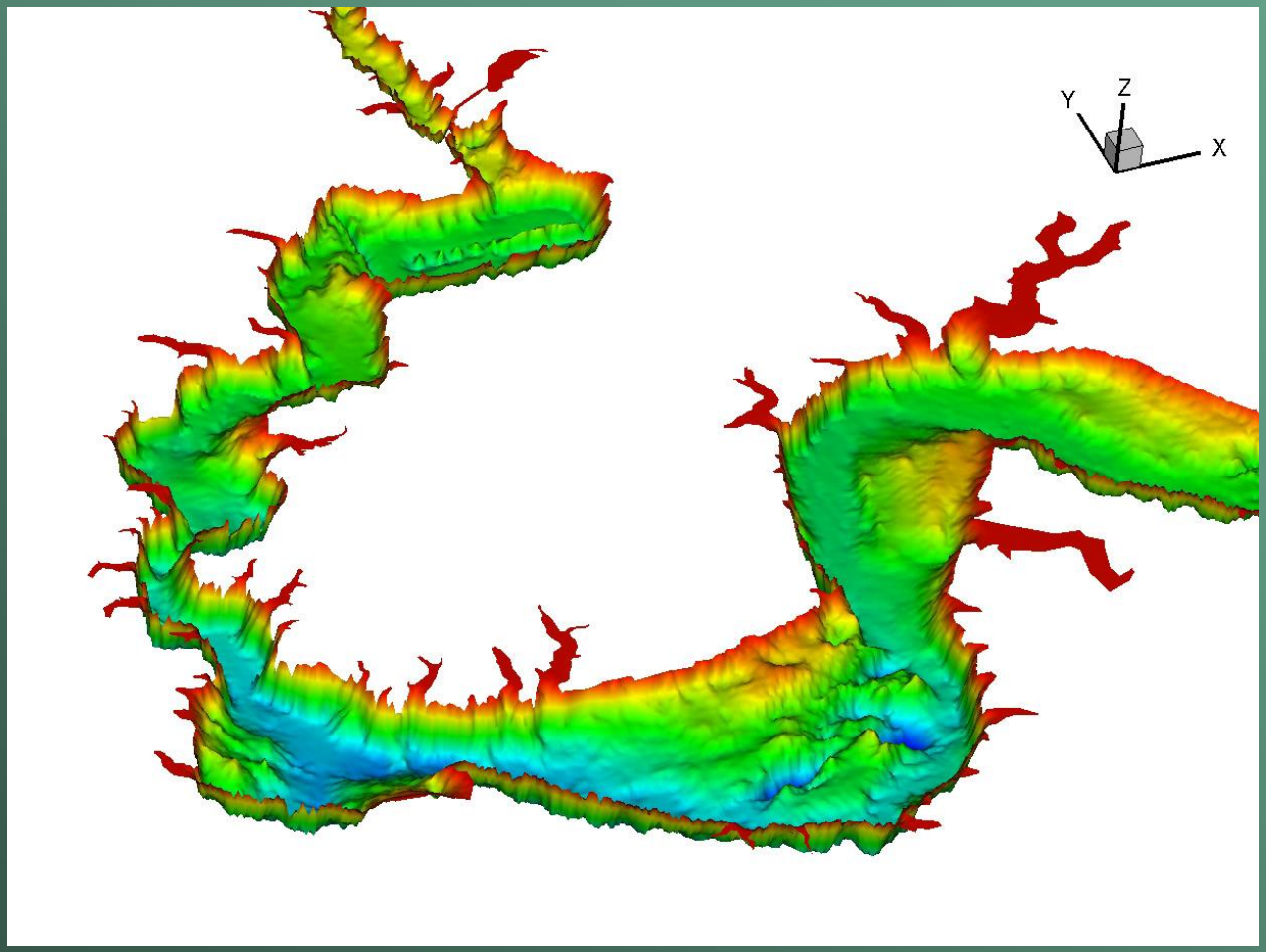


USGS

Single Beam Surveys (autonomous mapping)

USGS

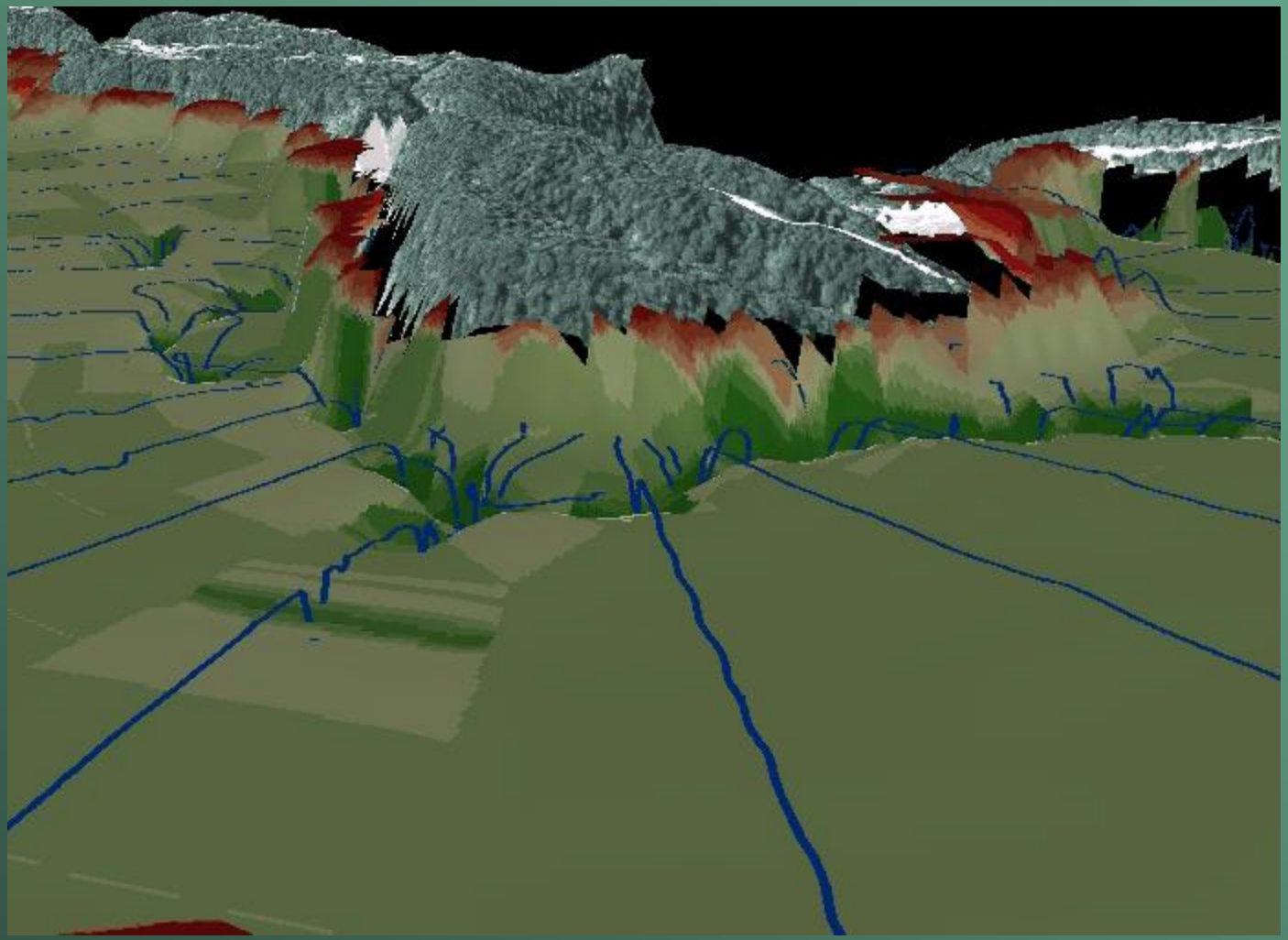
Example Single Beam Product



USGS

Cooling Reservoir, IL

Example Single Beam Product

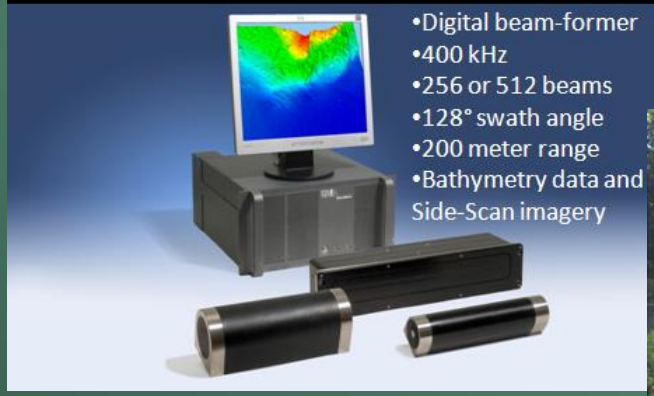


USGS

Lake Monroe, IN

Multi-Beam Surveys

RESON Seabat 7125
Multibeam Echosounder System



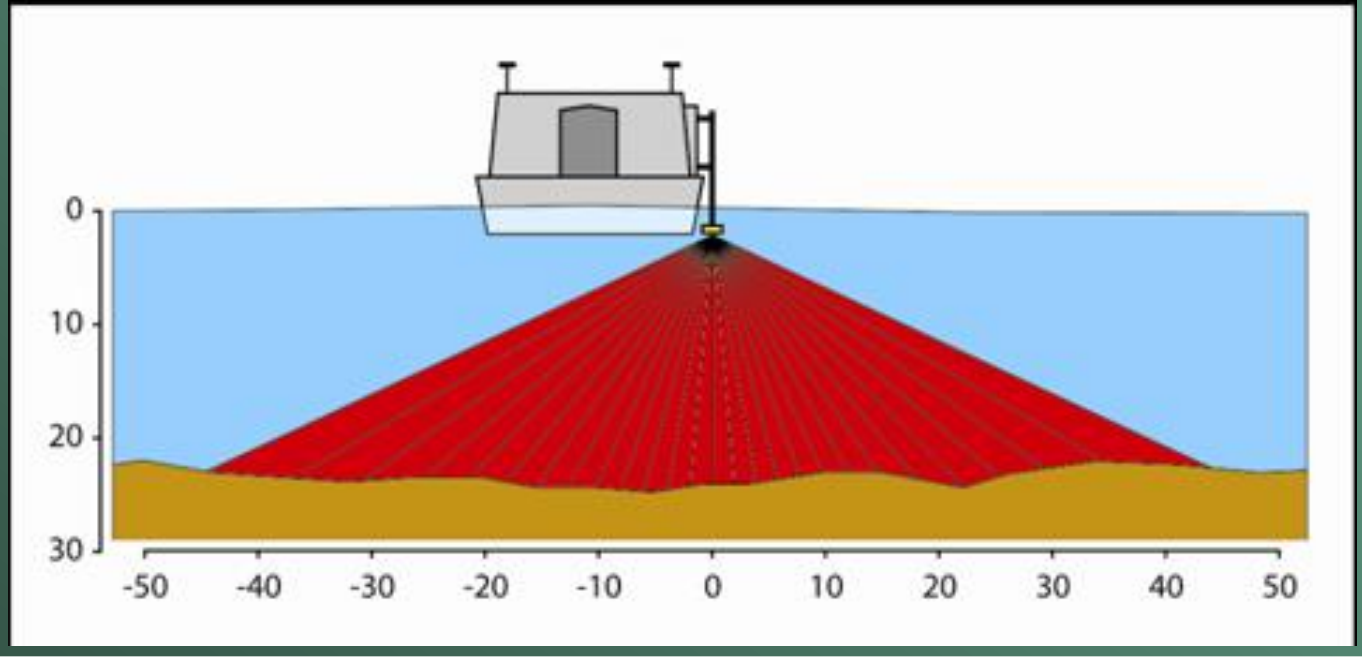
- Digital beam-former
- 400 kHz
- 256 or 512 beams
- 128° swath angle
- 200 meter range
- Bathymetry data and Side-Scan imagery

USGS

Multi-Beam Surveys

Multibeam Hydrographic Surveying

- Wide yet narrow swath perpendicular to the boat direction
- Multiple beams in just one ping
- *SURVEYS the ENTIRE RIVER or LAKE BED*



USGS

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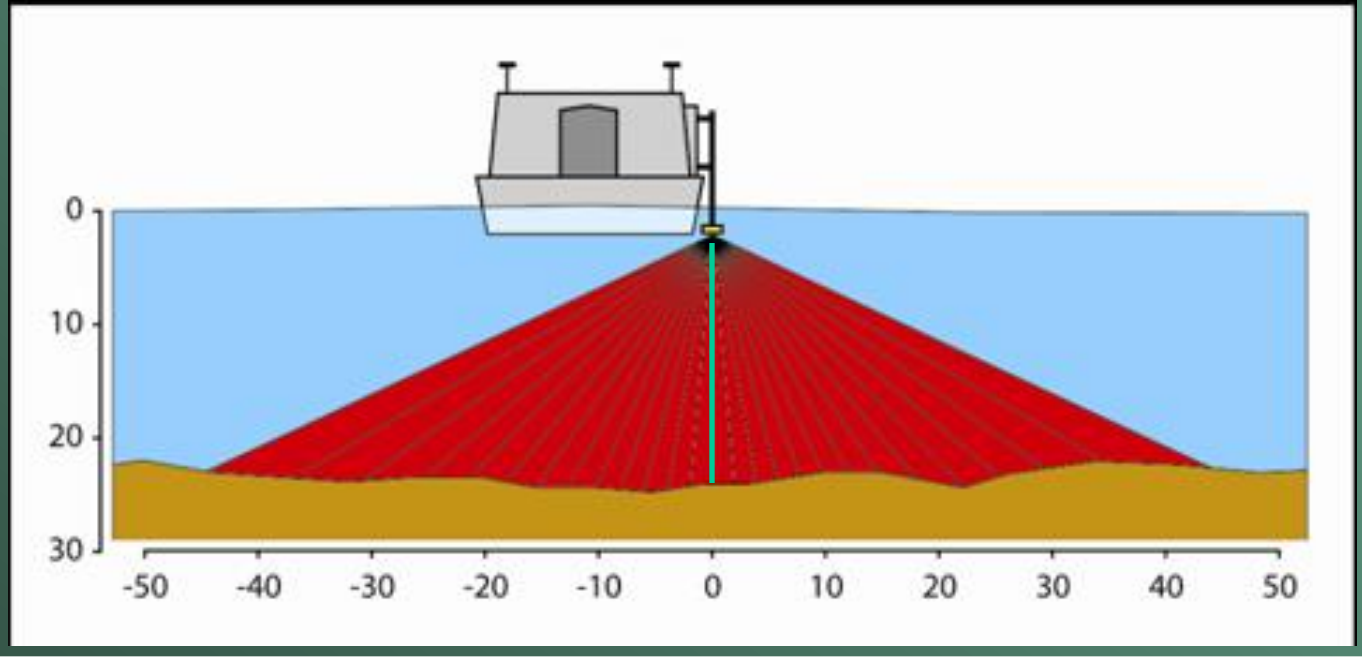

USGS

Multi-Beam Surveys

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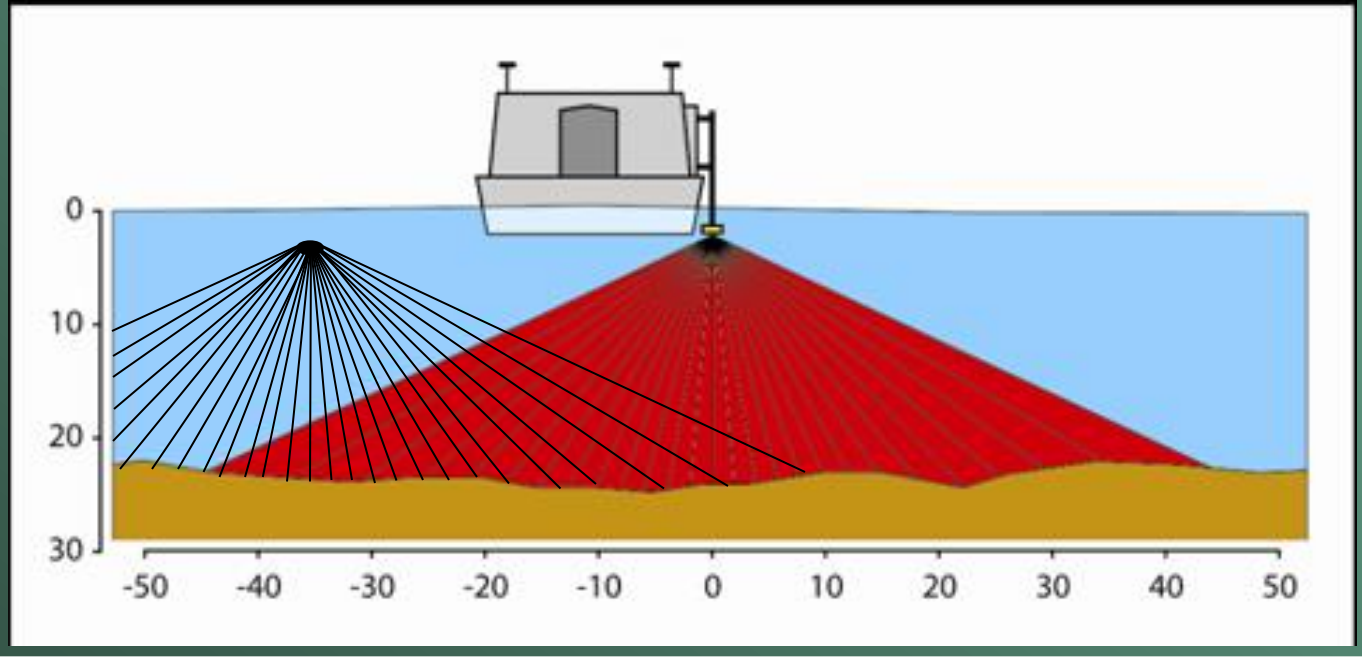
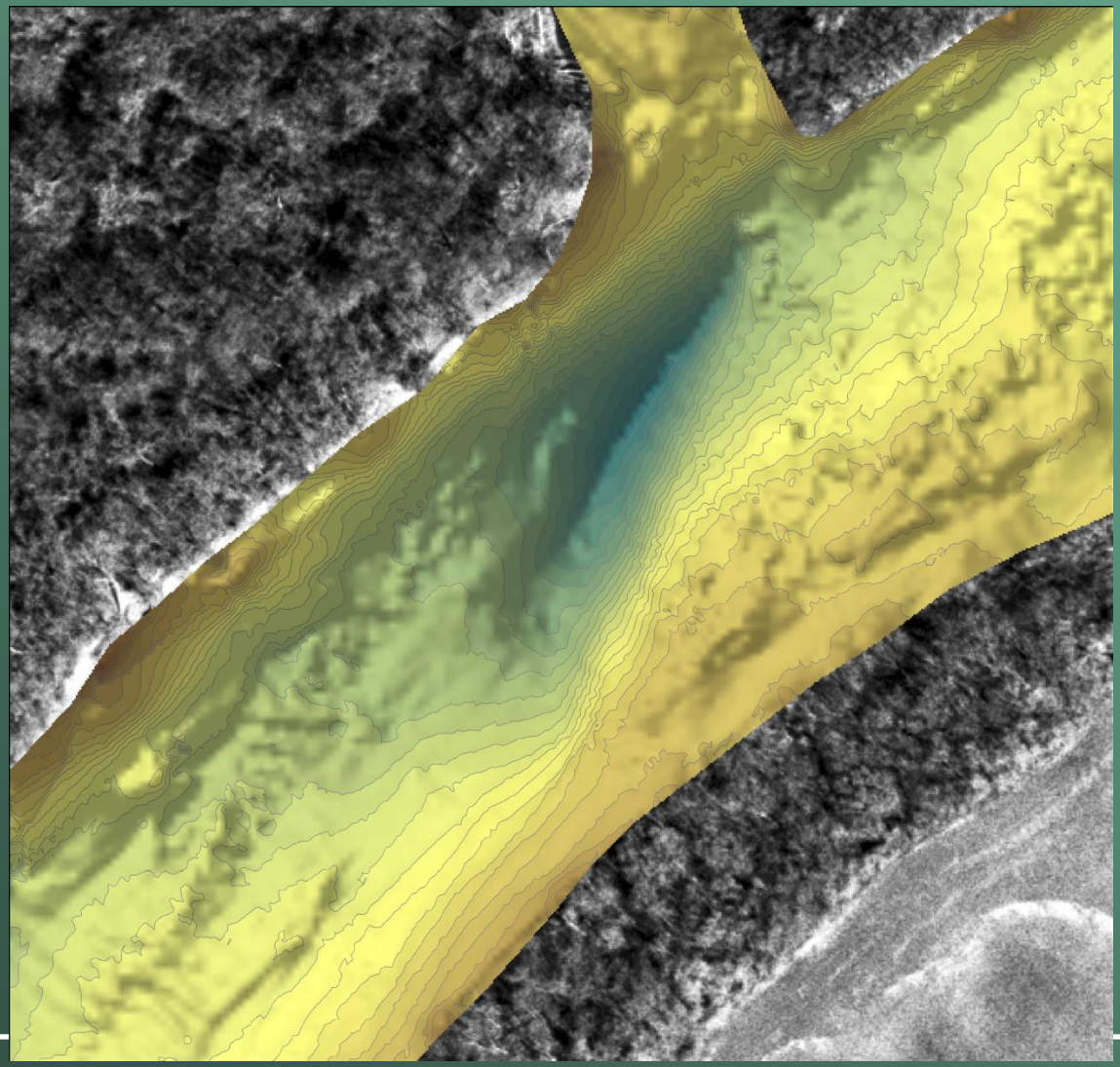


USGS

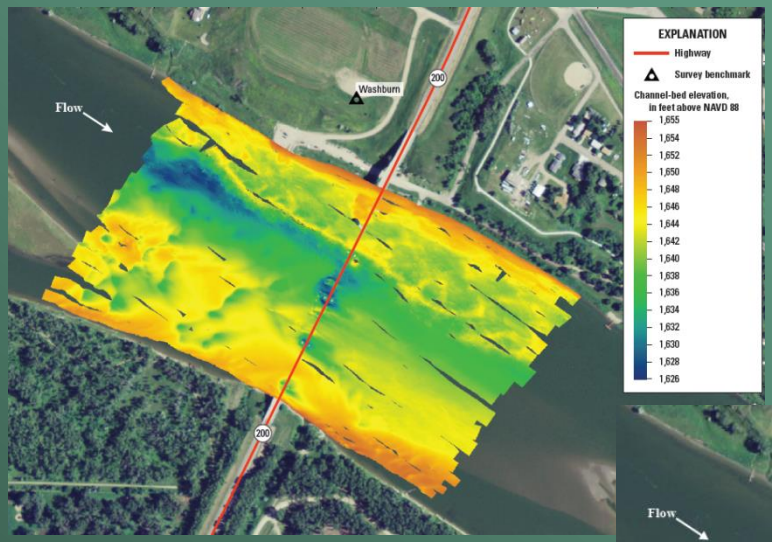
Example Multi-Beam Low Resolution Product



USGS

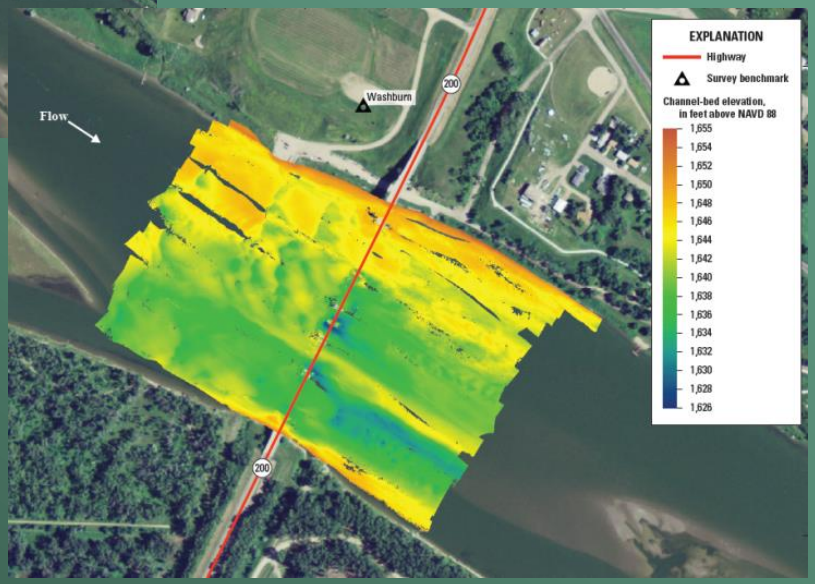
Wabash River, IL

Example Multi-Beam Low Resolution Product



Map results on June 9, 2011 before an event

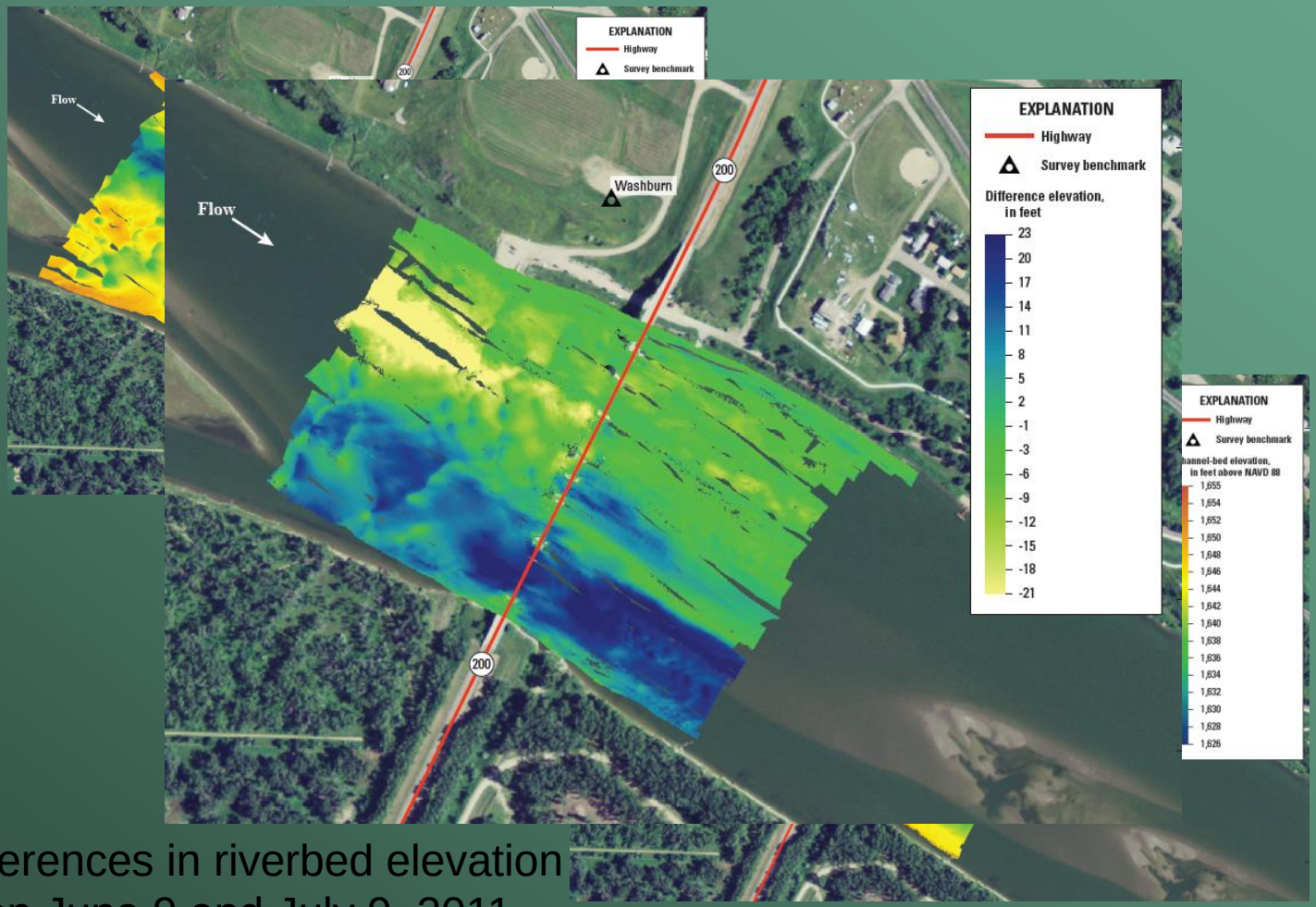
Map results on July 9, 2011 after an event



USGS

Missouri River, MO

Example Multi-Beam Low Resolution Product

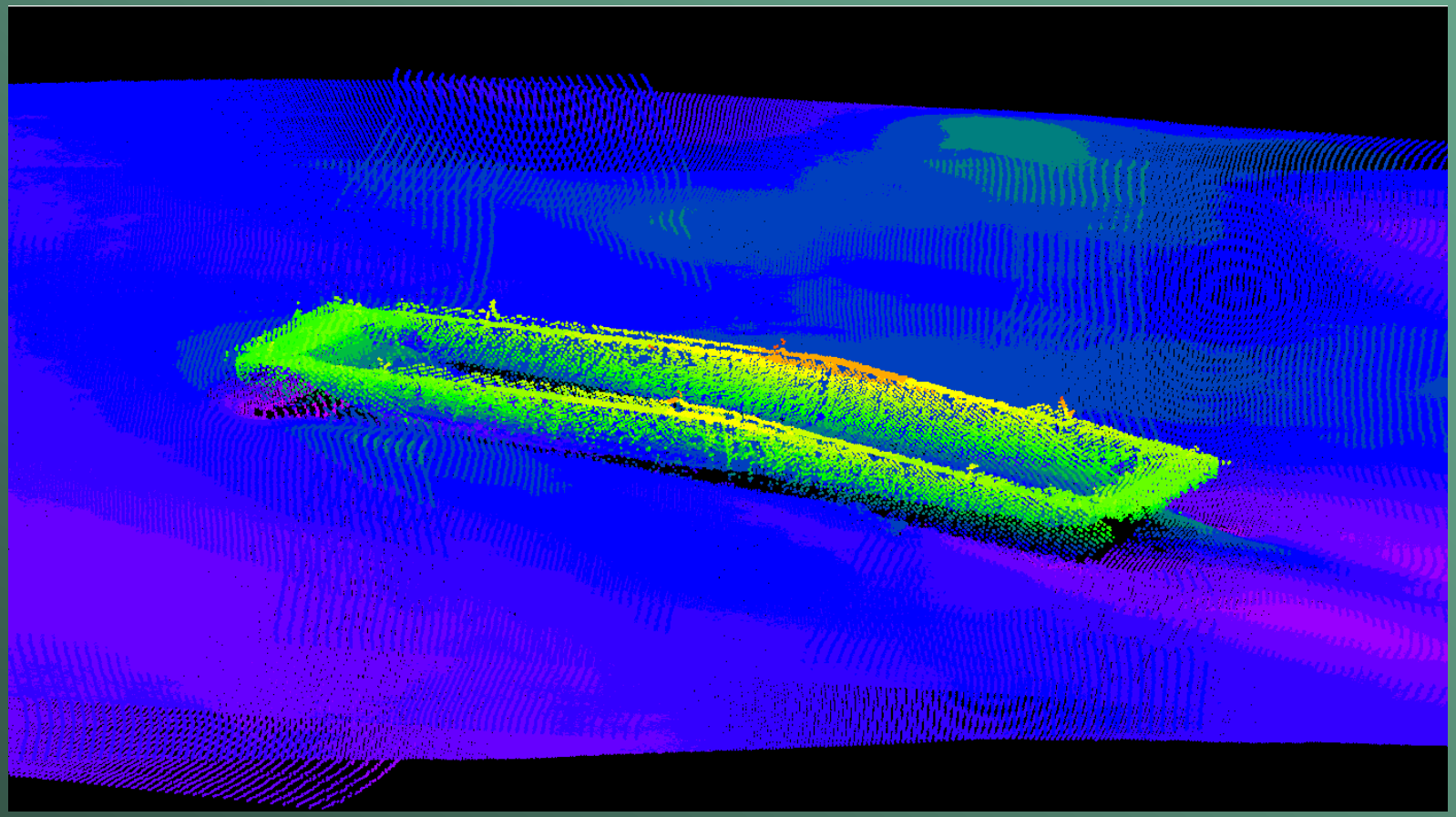


Differences in riverbed elevation on June 9 and July 9, 2011

USGS

Missouri River, MO

Example Multi-Beam Low Resolution Product

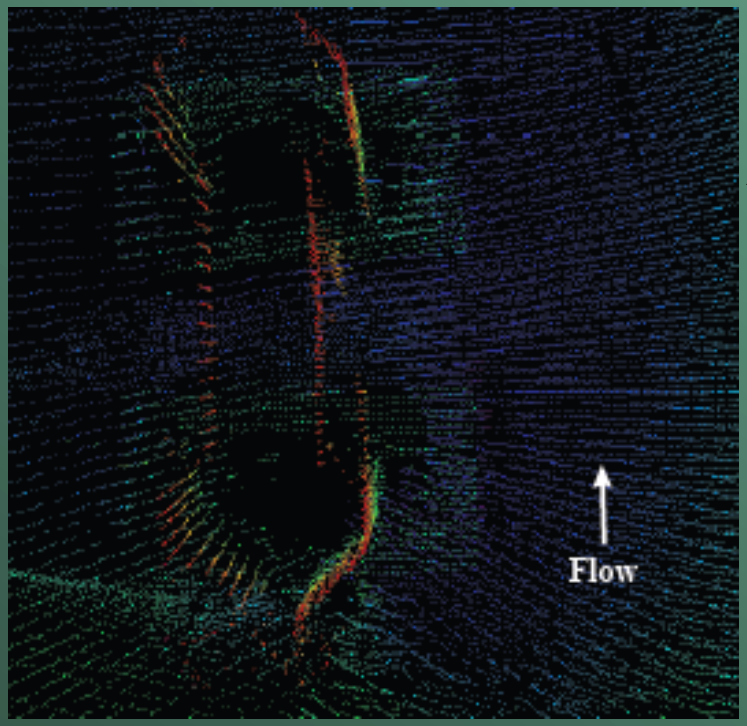


Sunken Barge in the Ohio River near Louisville Water intakes found 8/24/2012

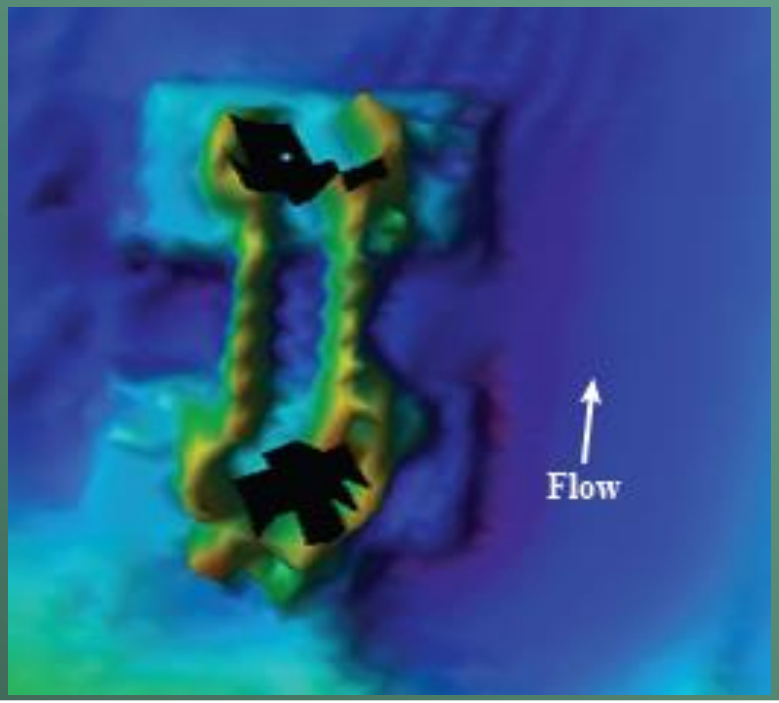
USGS

Example Multi-Beam High Resolution Product

Raw multi-beam data

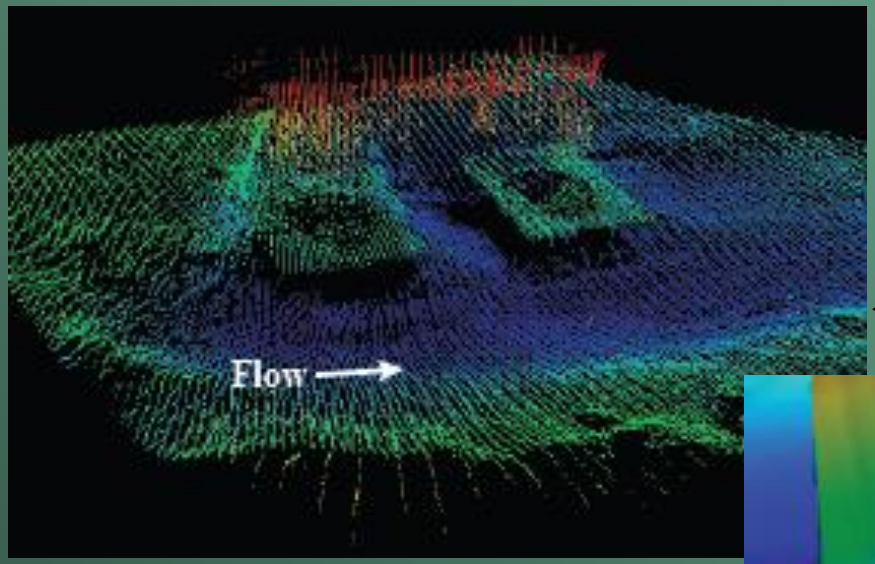


TIN- rendered surface



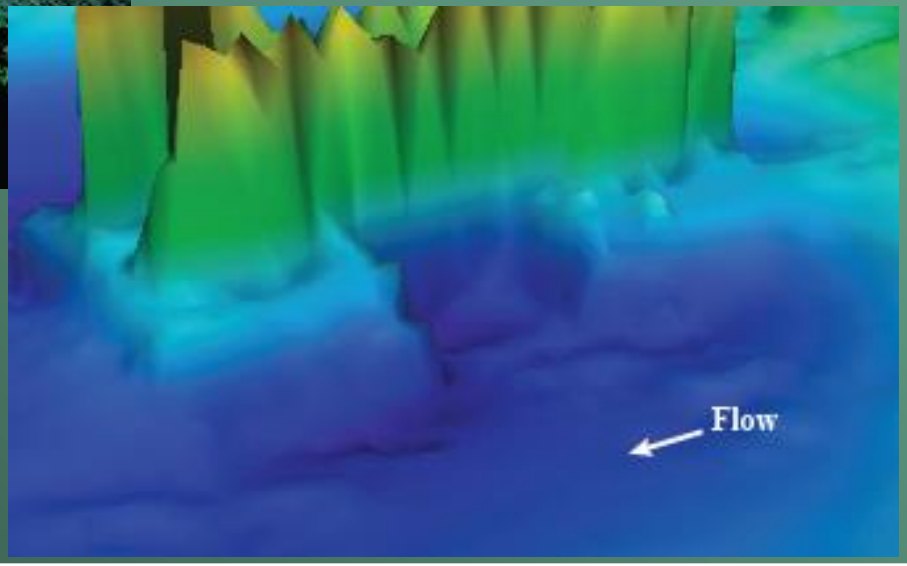
USGS

Example Multi-Beam High Resolution Product



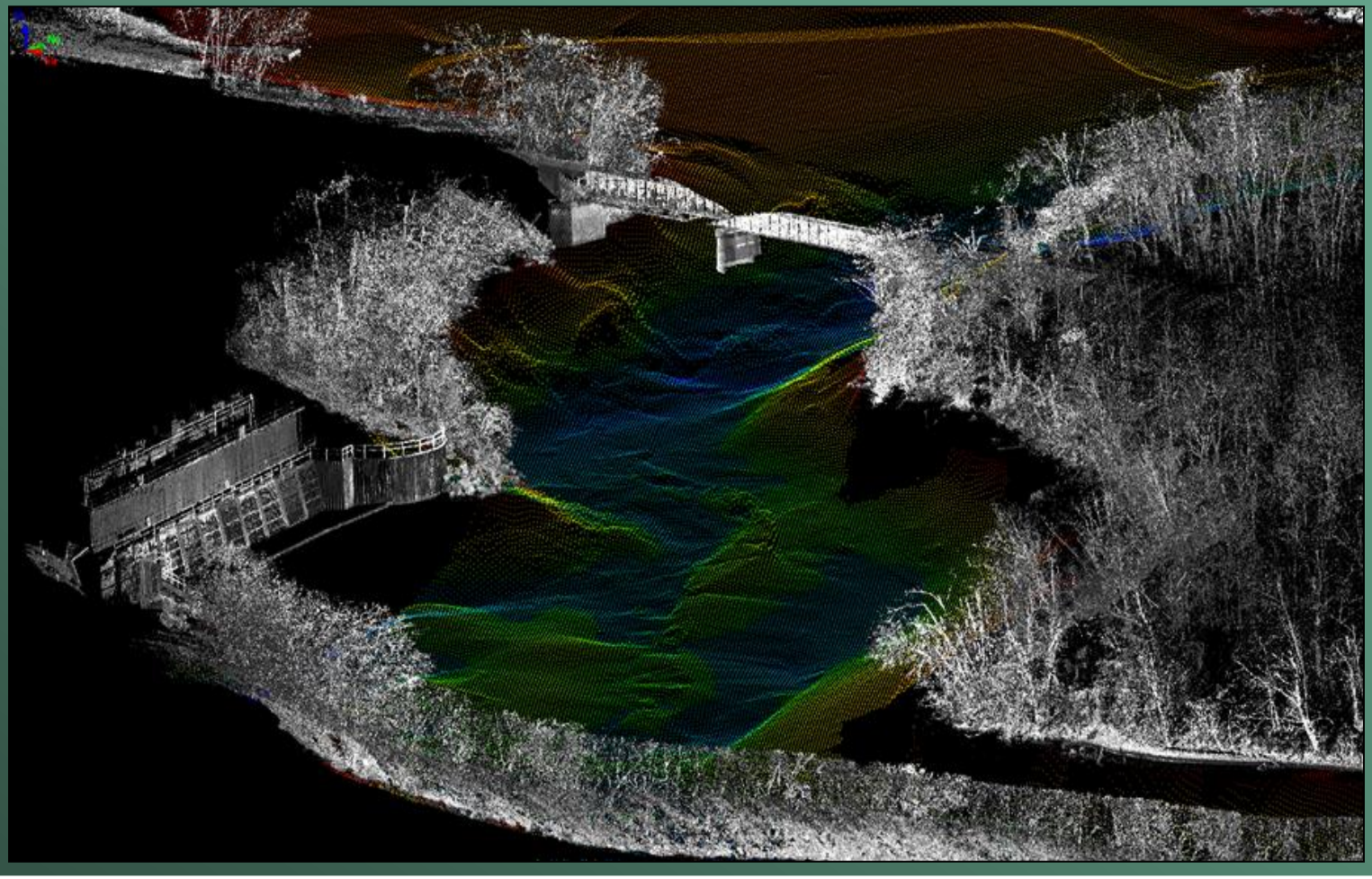
Raw multi-beam data

TIN- rendered surface



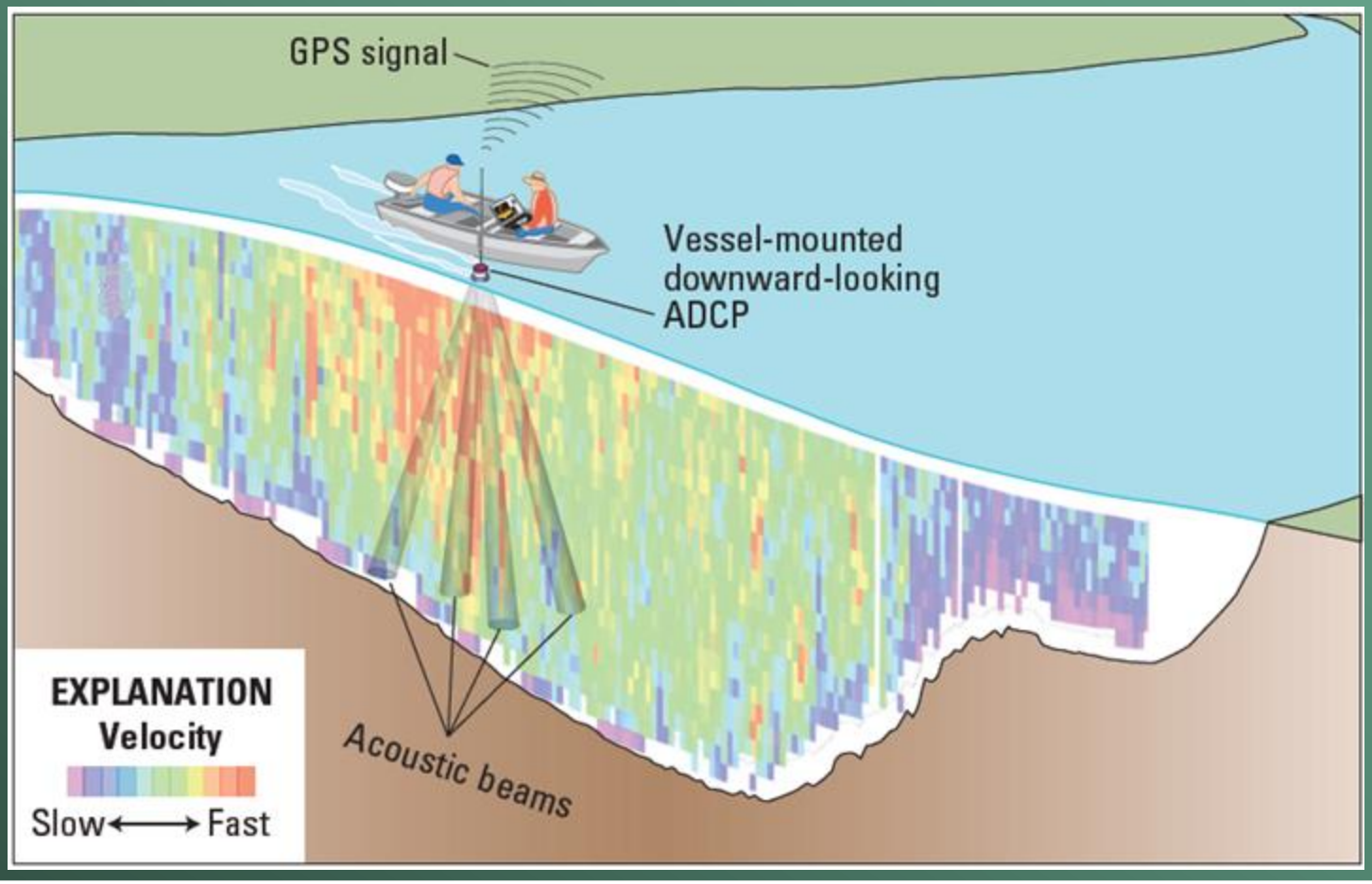
USGS

Example Multi-Beam High Resolution with Compensated T-LIDAR Product



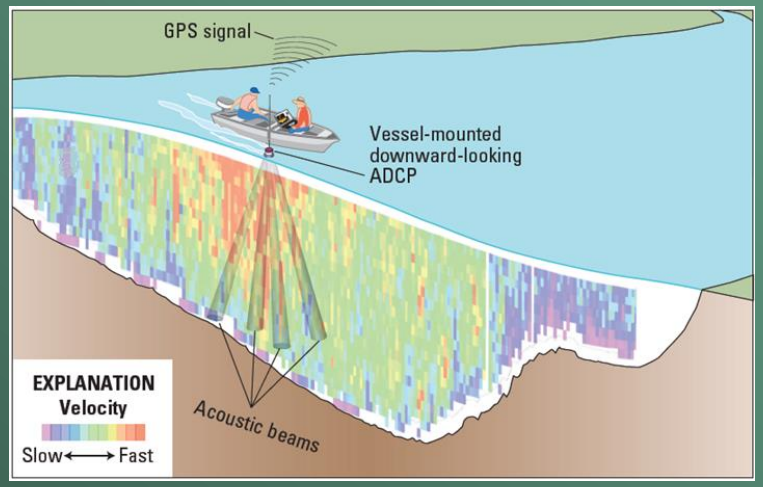
USGS

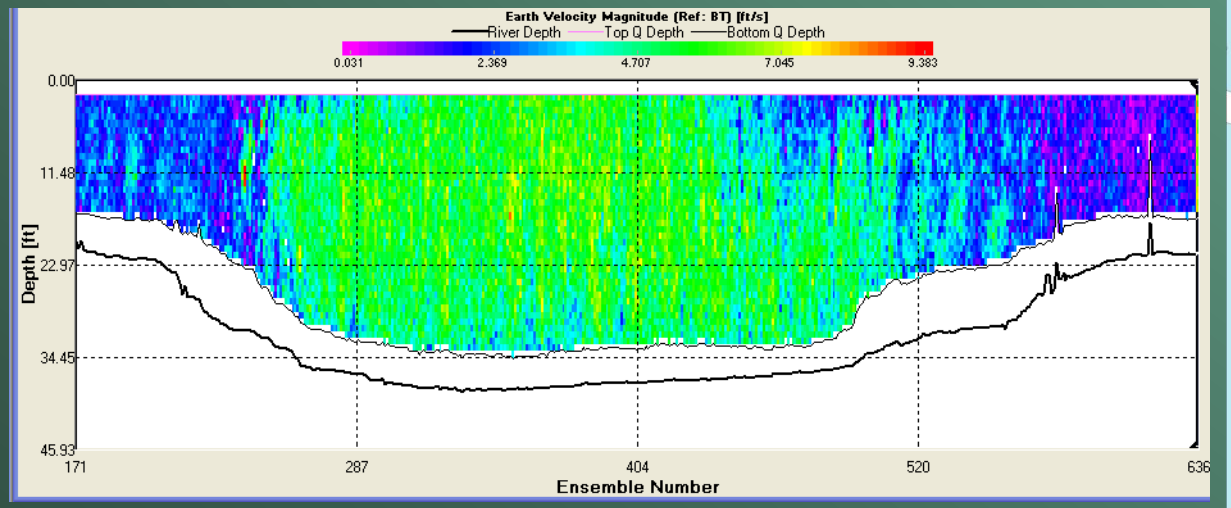
ADCP

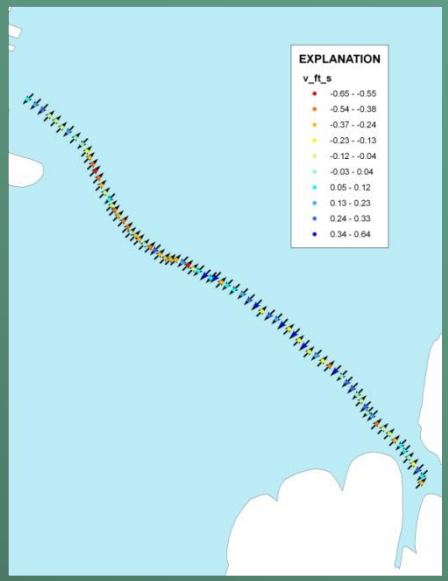

GPS signal
Vessel-mounted
downward-looking
ADCP
EXPLANATION
Velocity
Slow ⟷ Fast
Acoustic beams

USGS

Acoustic Doppler Current Profiler (ADCP)





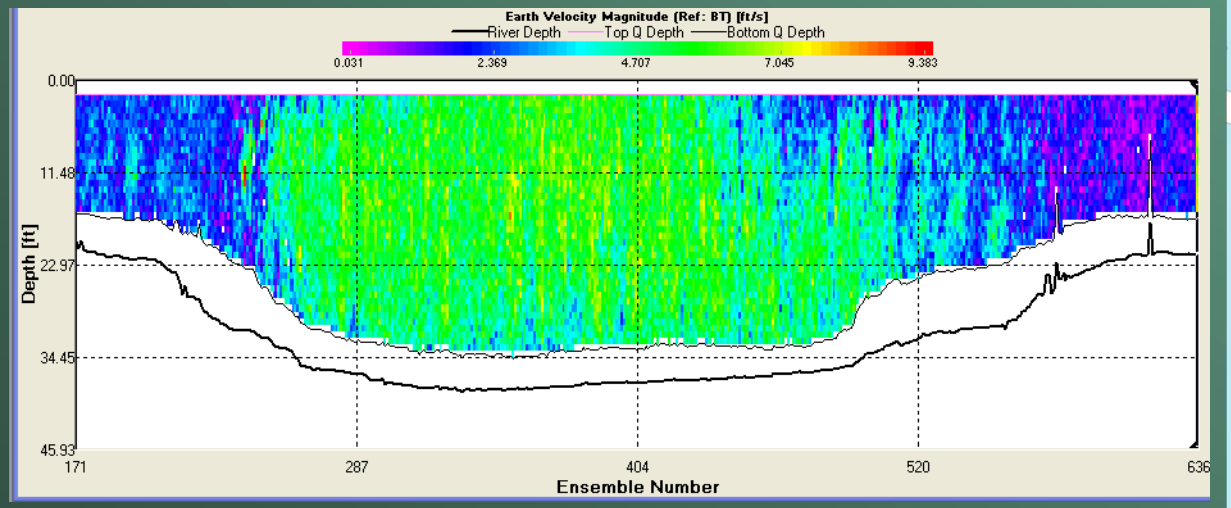


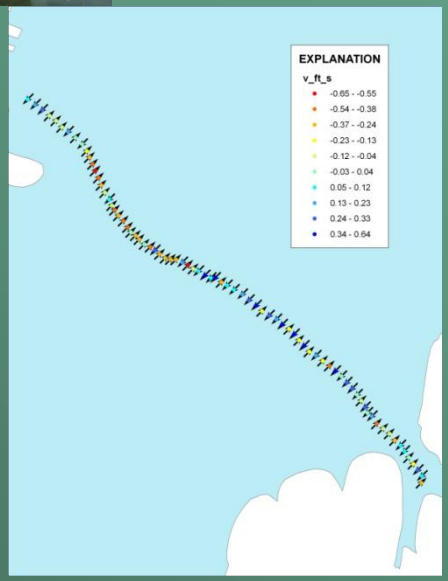
USGS

ADCP

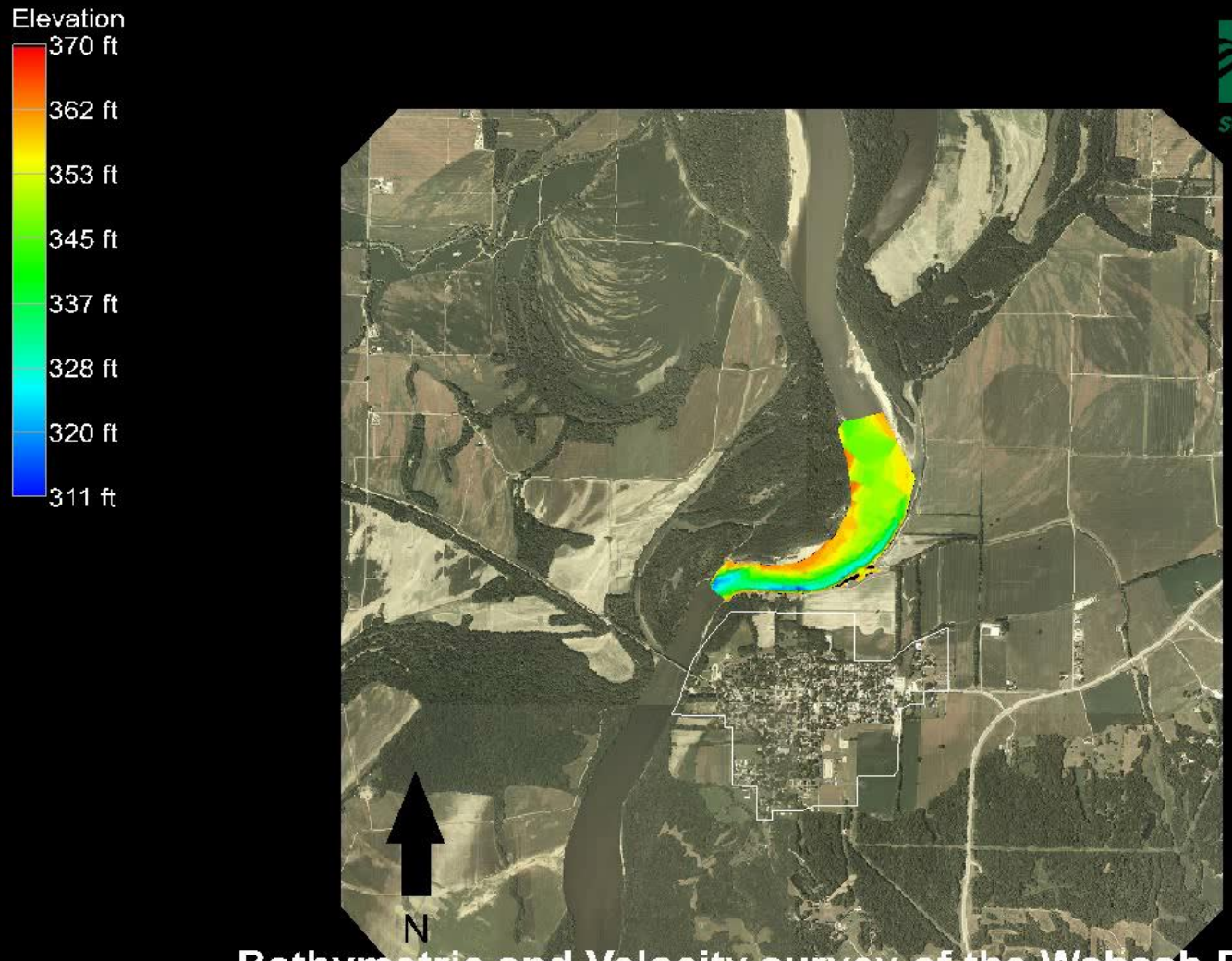

USGS
MERCURY


USGS


Earth Velocity Magnitude (Ref: BT) [ft/s]
River Depth
Top Q Depth
Bottom Q Depth
0.031
2.369
4.707
7.045
9.383
0.00
11.48
22.97
34.45
45.93
Depth [ft]
171
287
404
520
636
Ensemble Number


EXPLANATION
v_ft_s
-0.65 - -0.55
-0.54 - -0.38
-0.37 - -0.24
-0.23 - -0.13
-0.12 - -0.04
-0.03 - 0.04
0.05 - 0.12
0.13 - 0.23
0.24 - 0.33
0.34 - 0.64

USGS

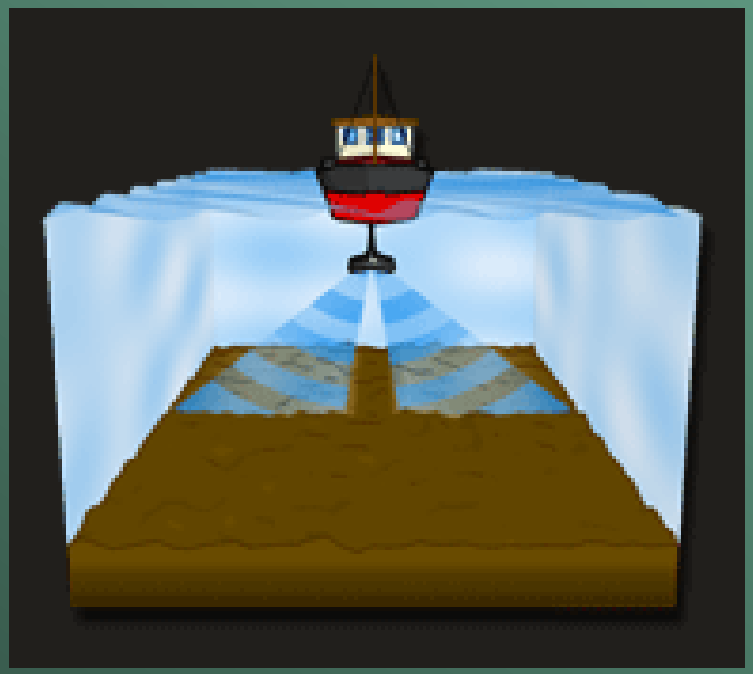


USGS
science for a changing world

Bathymetric and Velocity survey of the Wabash River near New Harmony, Indiana

USGS

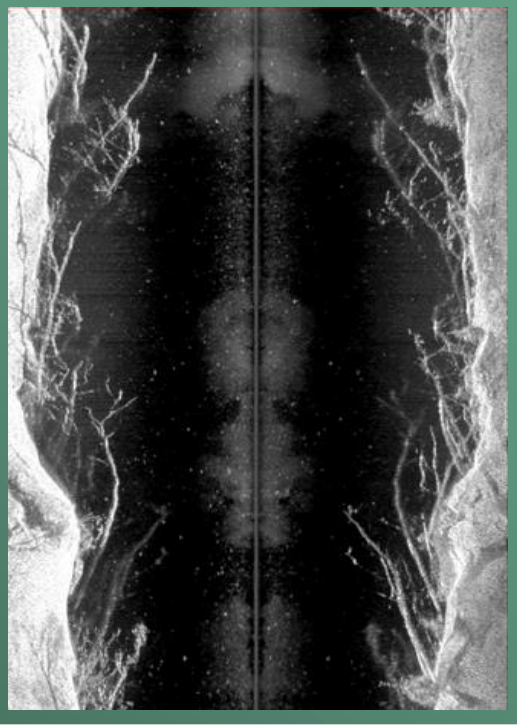
Side Scan Sonar



USGS

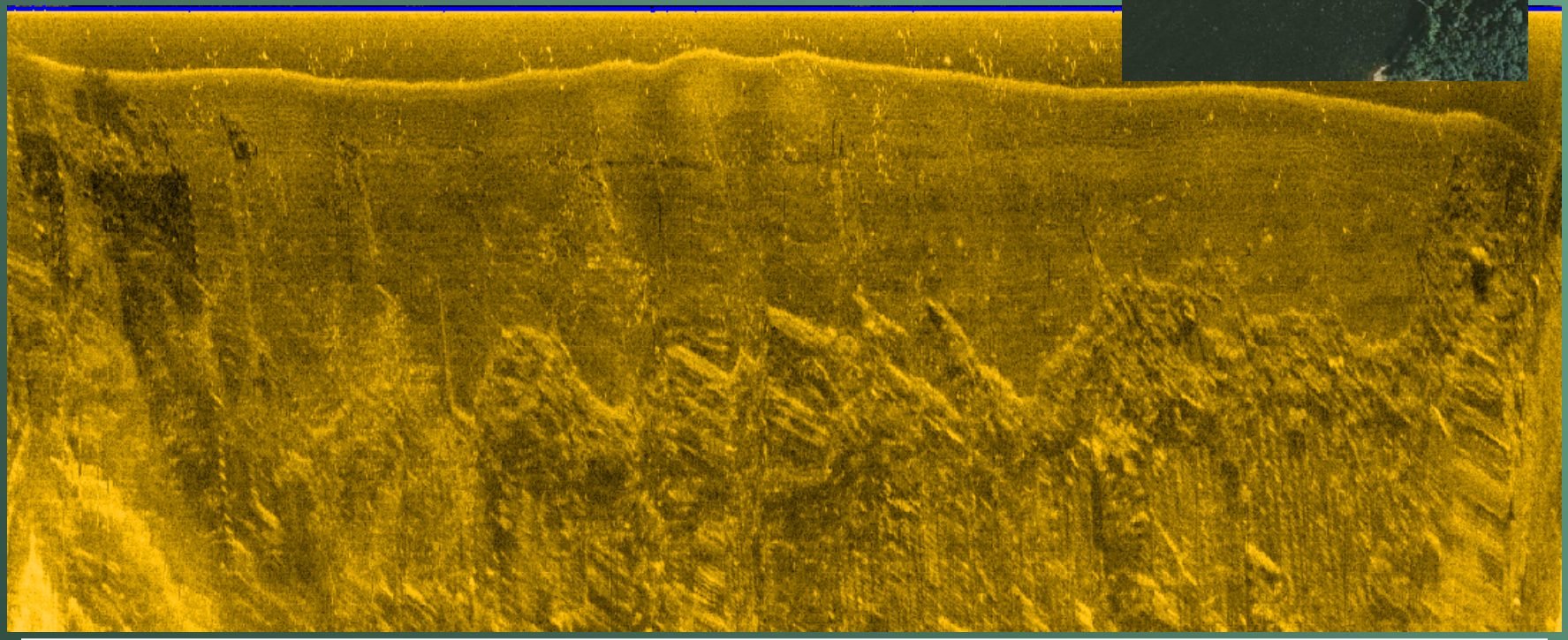
Side Scan Sonar

Submerged trees at Wabash River



USGS

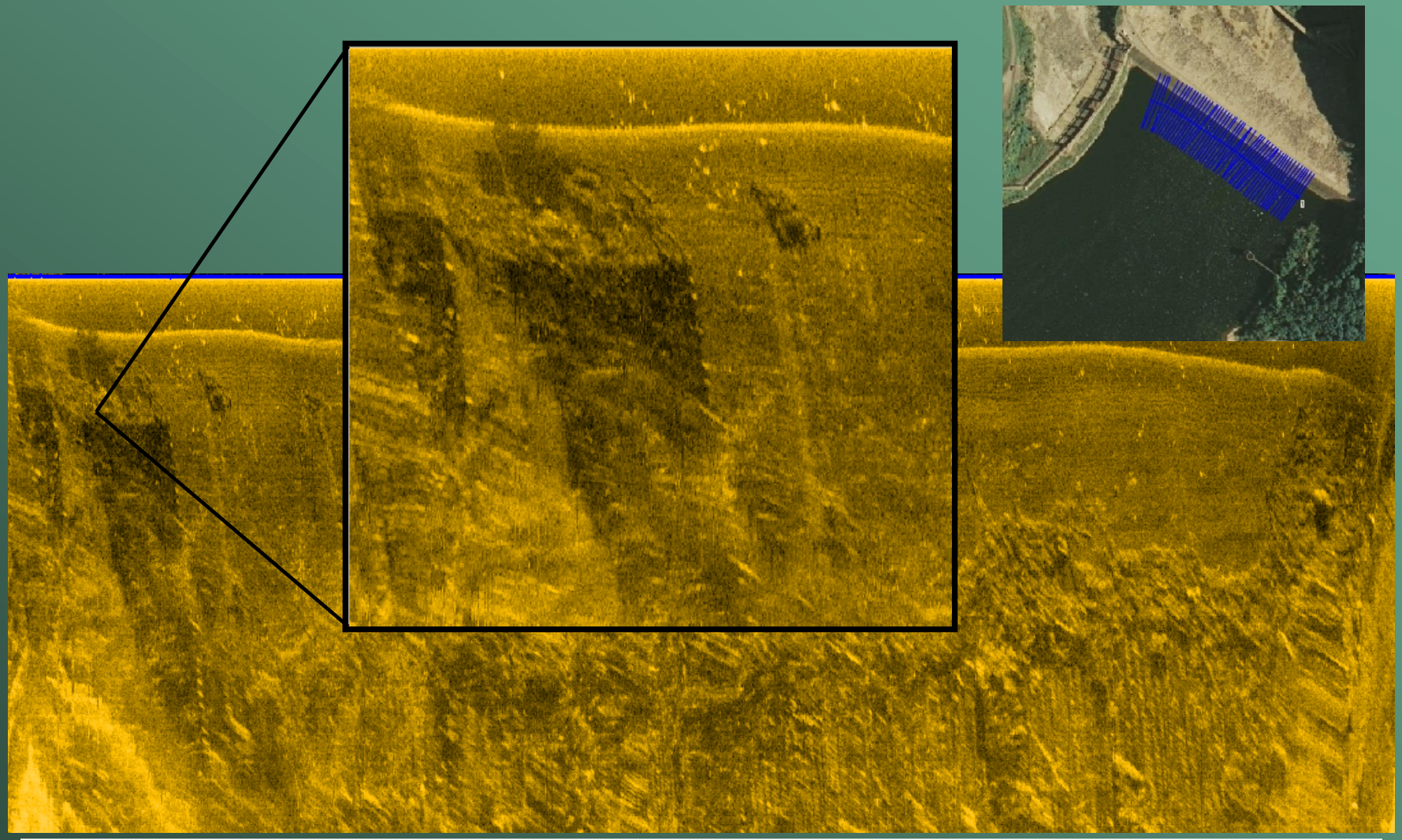
Side Scan Sonar



USGS

Herrington Lake, KY

Side Scan Sonar



Herrington Lake, KY

USGS

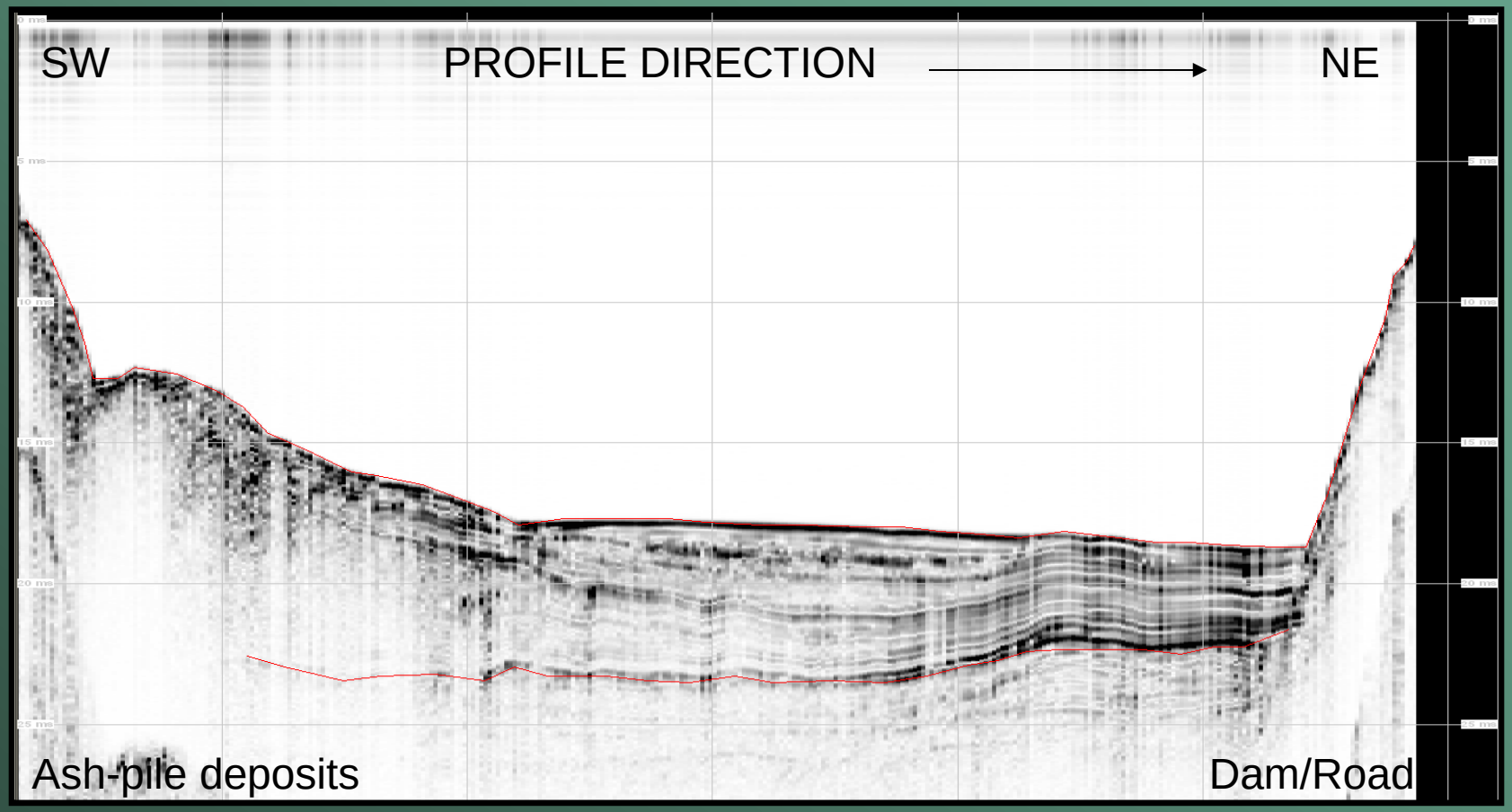
Swept-frequency acoustic sub-bottom profiler

USGS

Swept-frequency acoustic sub-bottom profiler

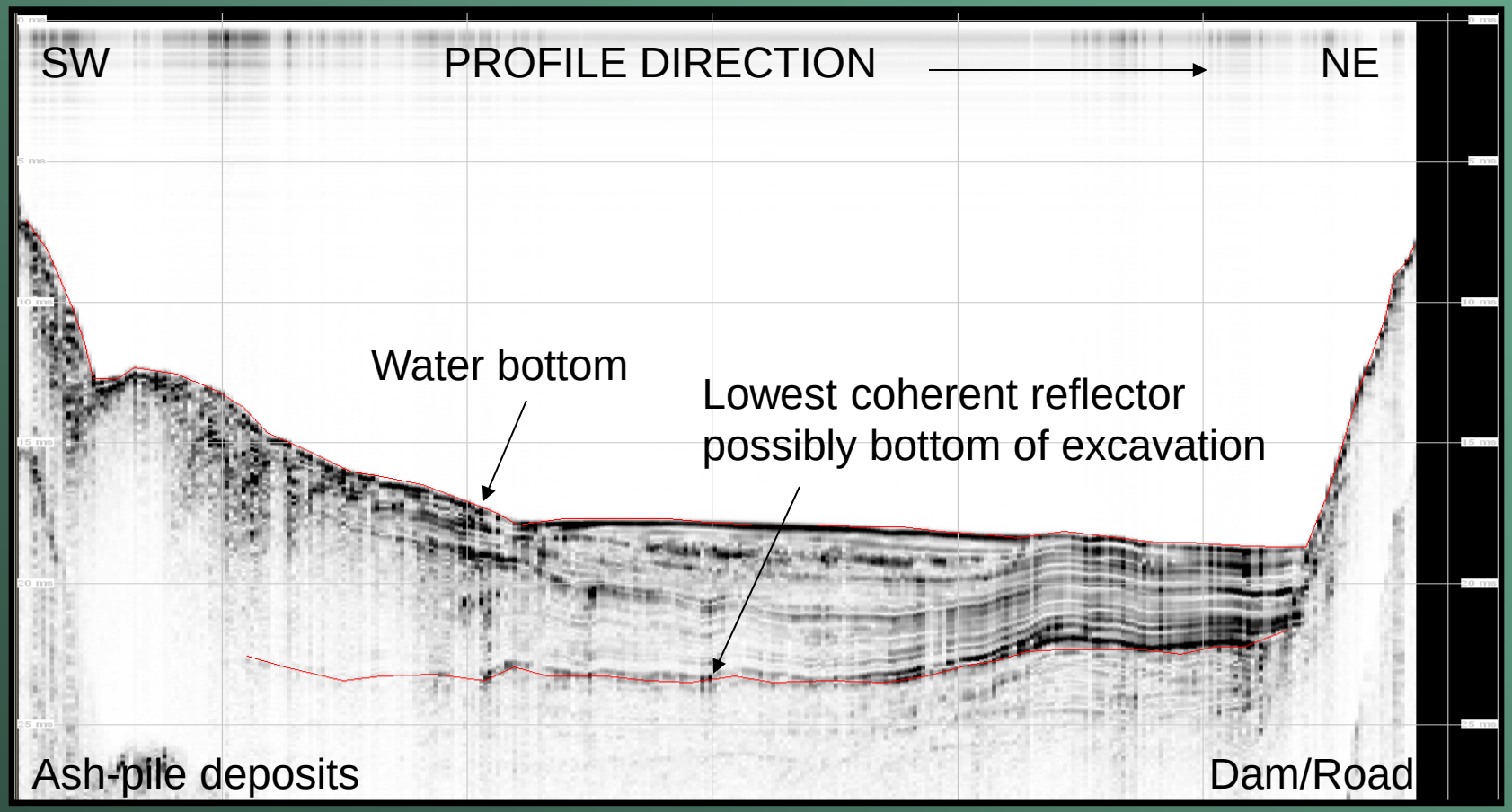
USGS

Swept-frequency acoustic sub-bottom profiler



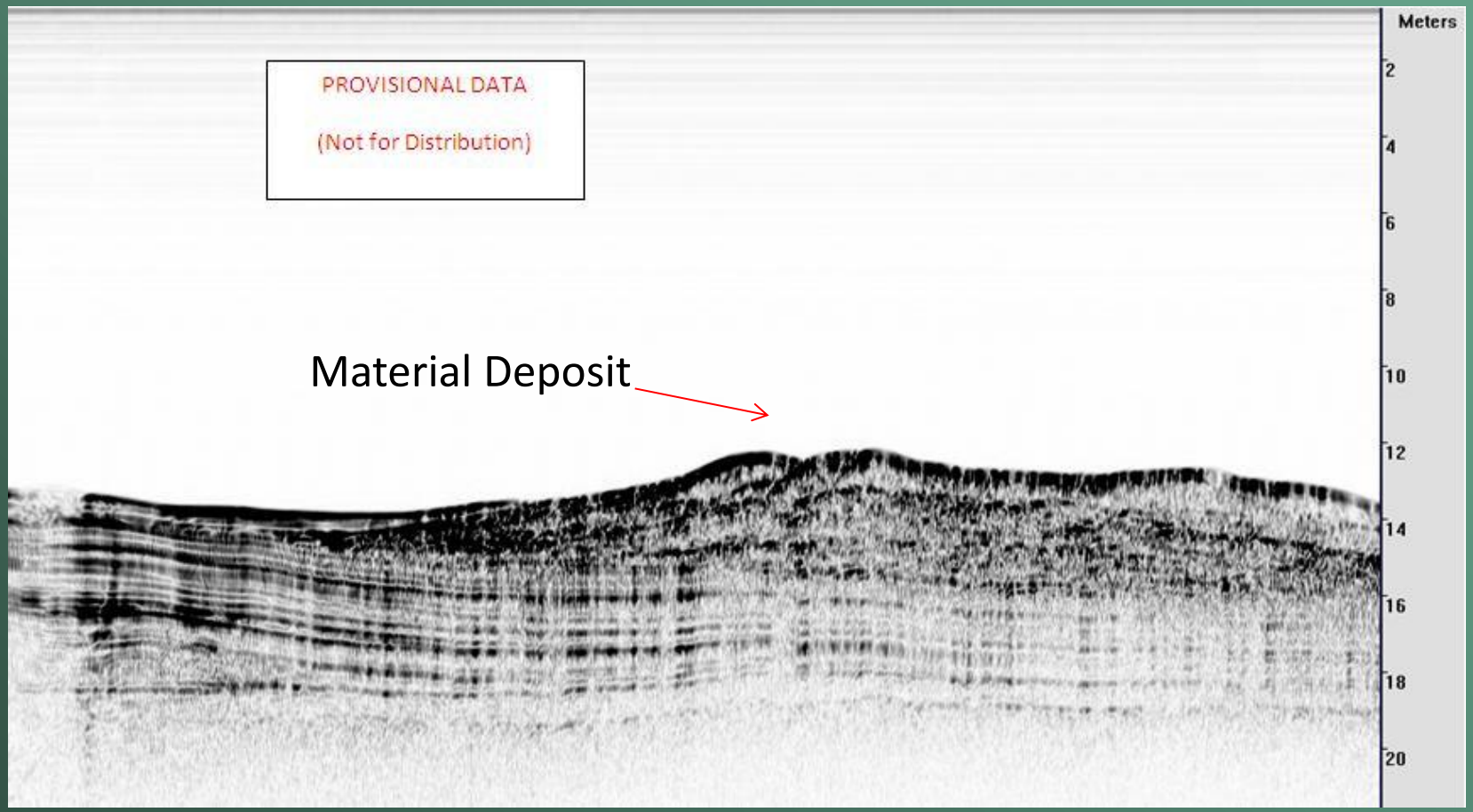
USGS

Swept-frequency acoustic sub-bottom profiler



USGS

Swept-frequency acoustic sub-bottom profiler



USGS

Project Capabilities for Bathymetry

- Flood Inundation
- Contour Mapping (streams and reservoirs)
- Leakage Studies
- Scour and Stabilization Studies
- Water Quality Issues
- Dam Removal
- Biological and Spill Studies
- Storage and Fill in Ponds and Reservoirs
- Plus More

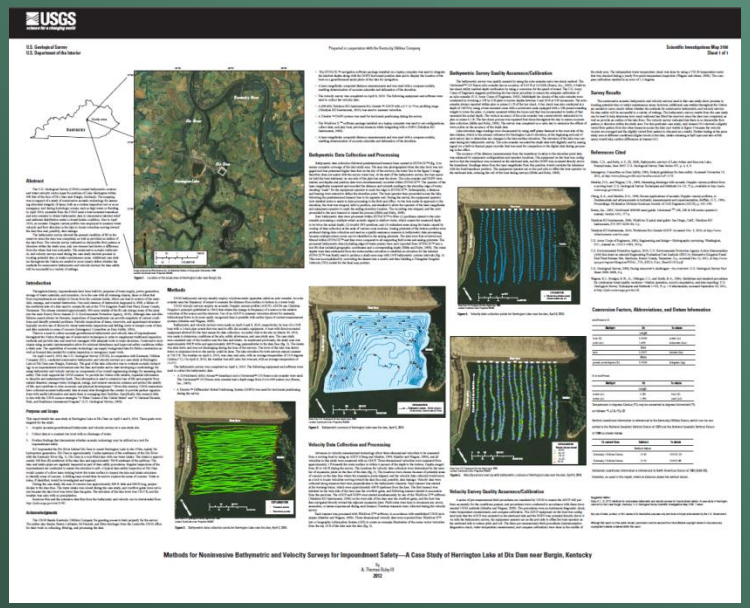
USGS

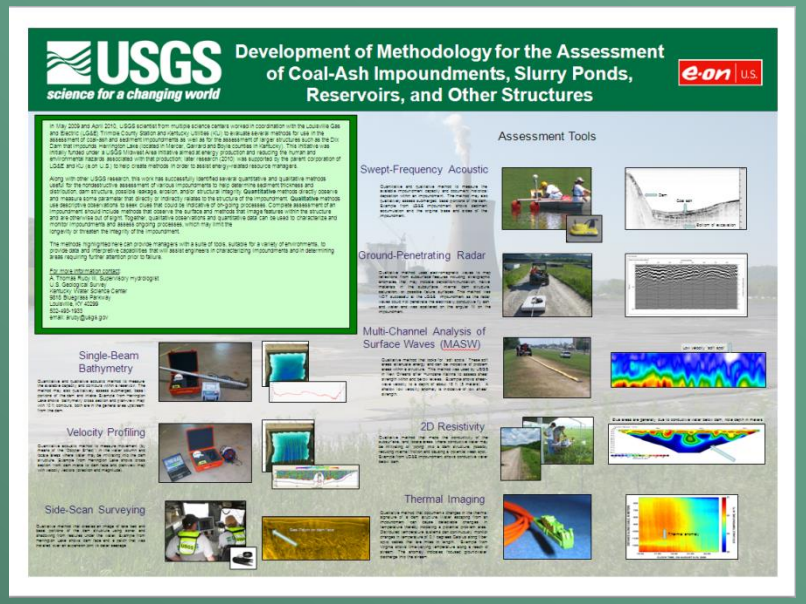
USGS Arsenal of Tools

- Combined for offices in surrounding area
  - 2 Mulit-beam echosounders
  - 6 single beam echosounders
  - 1 single beam autonomous echosounder
  - > 50 ADCPs
  - > 10 RTK GPSs
  - Plus more high end equipment is housed and available for use at the USGS main offices
    - Office of Surface Water (HydroAcoustics)
    - Office of Groundwater (Branch of Geophysics)

USGS

QUESTIONS ?





A. Thomas Ruby III
aruby@usgs.gov

USGS KY Water Science Center
INKY Commonwealth

USGS