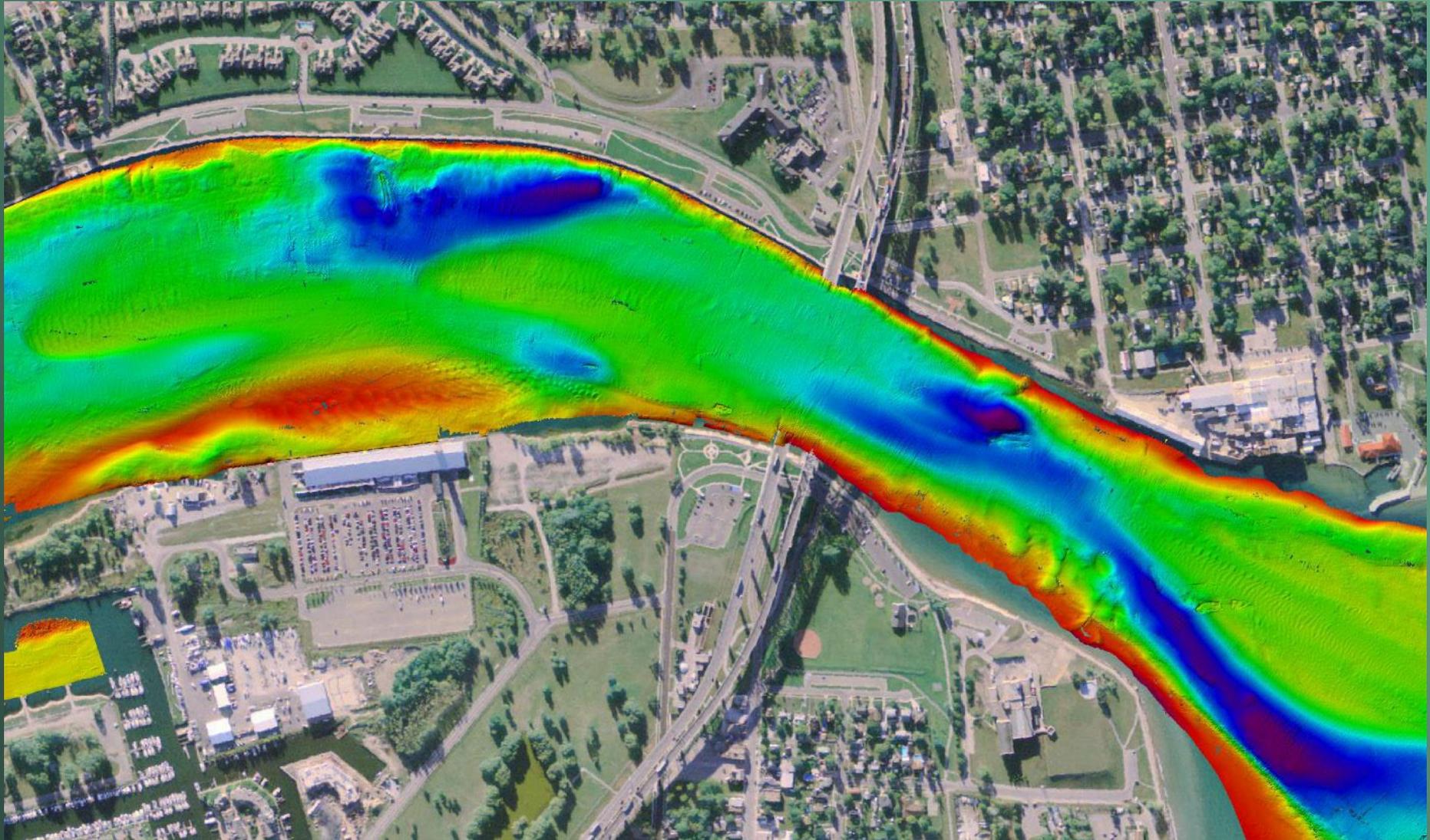


# USGS Bathymetric Survey Capabilities for Quantitative and Qualitative Assessments



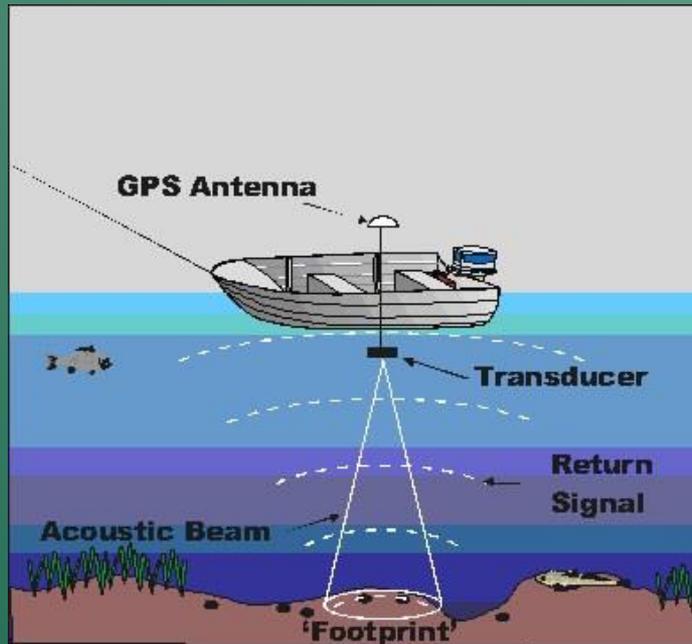
## How does the USGS collect bathymetry data?



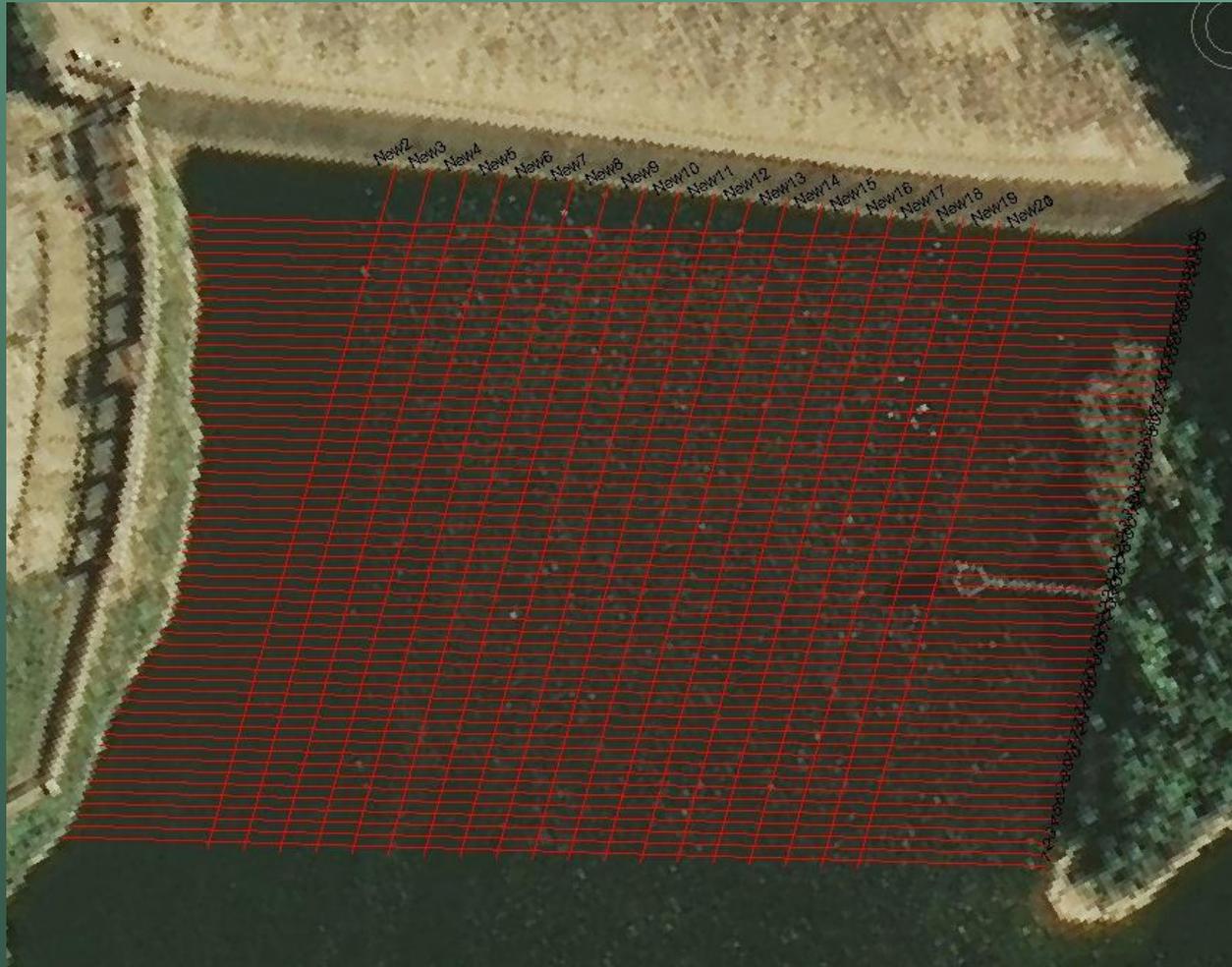
- Single Beam Bathymetry
- Multi-Beam Bathymetry
- Acoustic Doppler Current Profiler (ADCP)
- Side Scan Sonar
- Swept-frequency acoustic sub-bottom profiler



# Single Beam Surveys (manned boat)



# Predetermined Bathymetry Transects



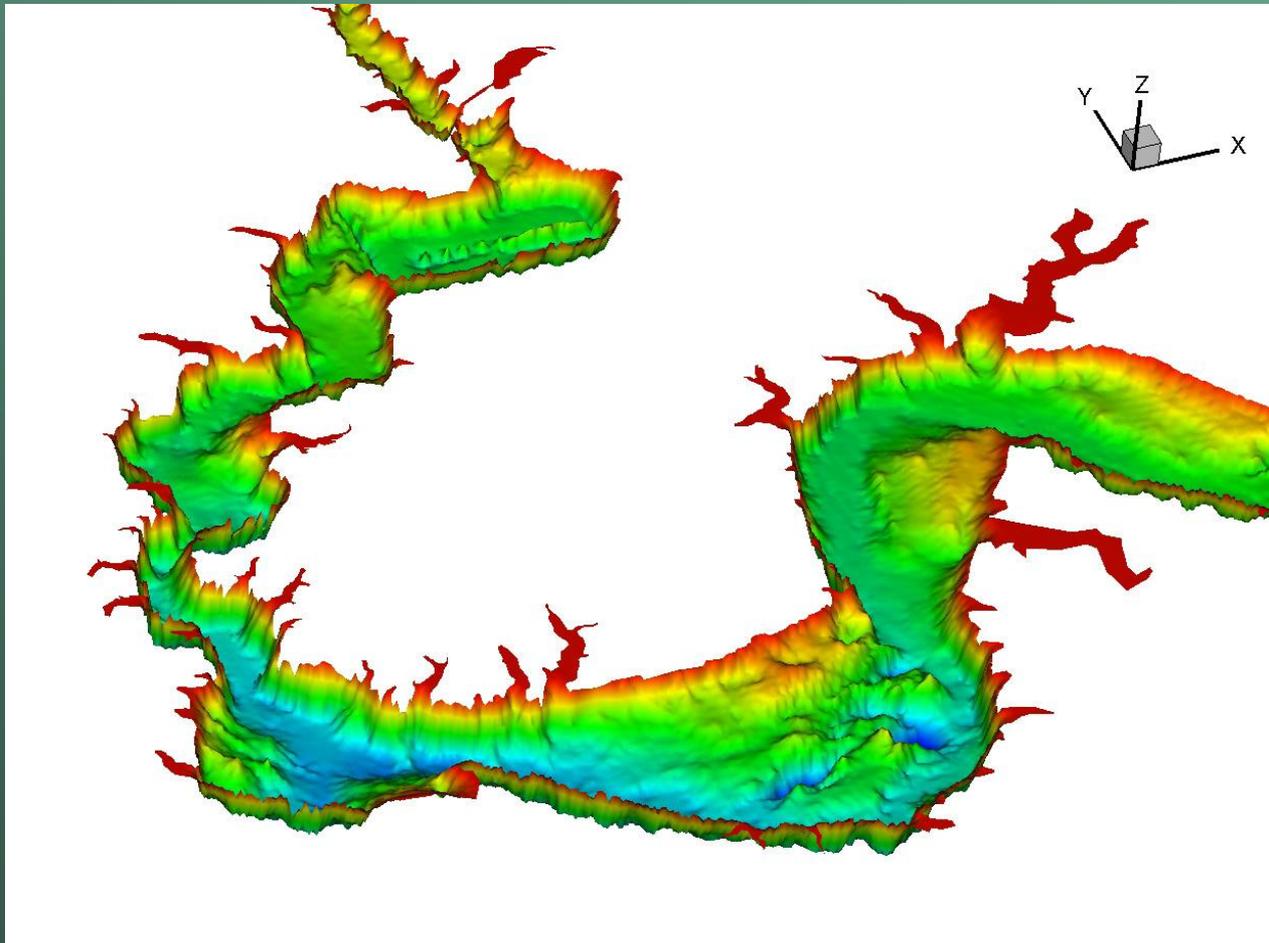
# Flood Inundation of Frankfort, Kentucky



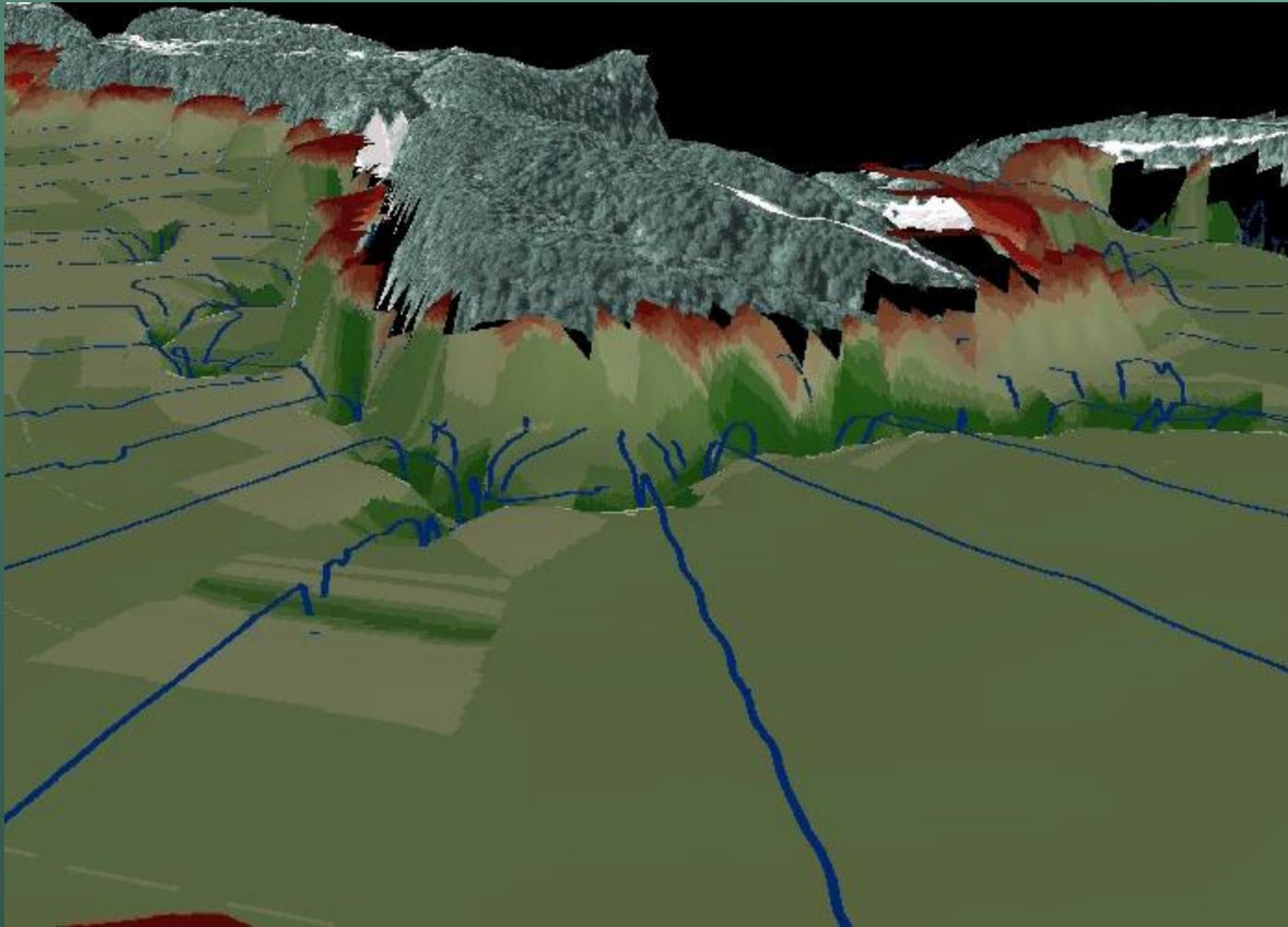
# Single Beam Surveys (autonomous mapping)



# Example Single Beam Product

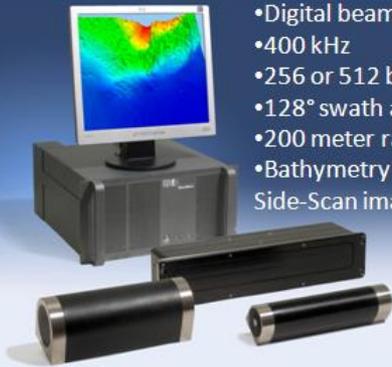


# Example Single Beam Product



# Multi-Beam Surveys

## RESON Seabat 7125 Multibeam Echosounder System



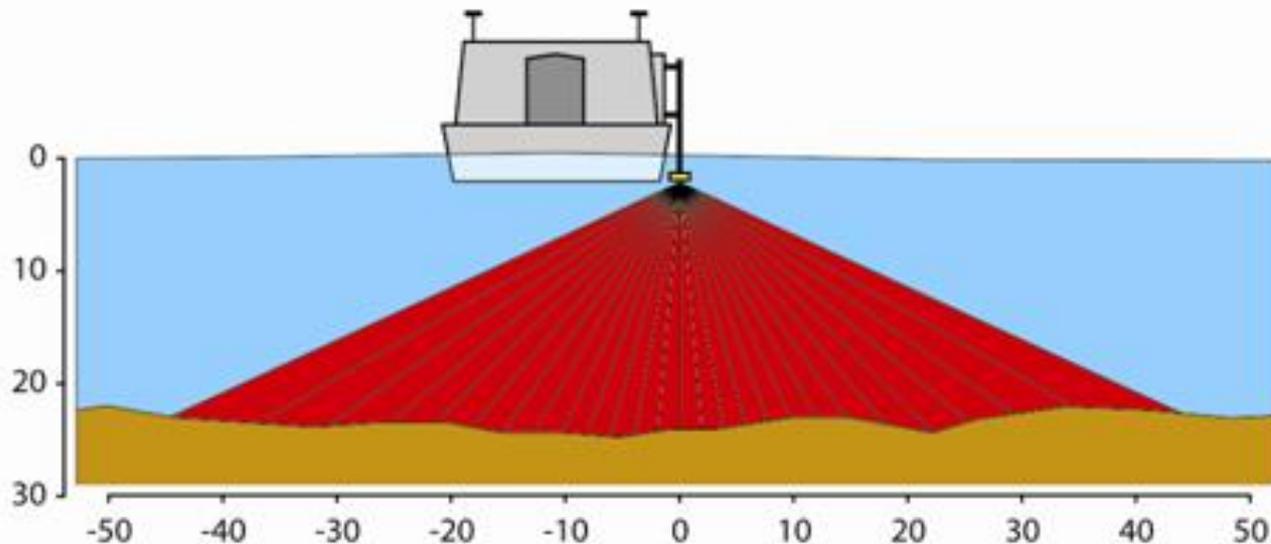
- Digital beam-former
- 400 kHz
- 256 or 512 beams
- 128° swath angle
- 200 meter range
- Bathymetry data and Side-Scan imagery



# Multi-Beam Surveys

## Multibeam Hydrographic Surveying

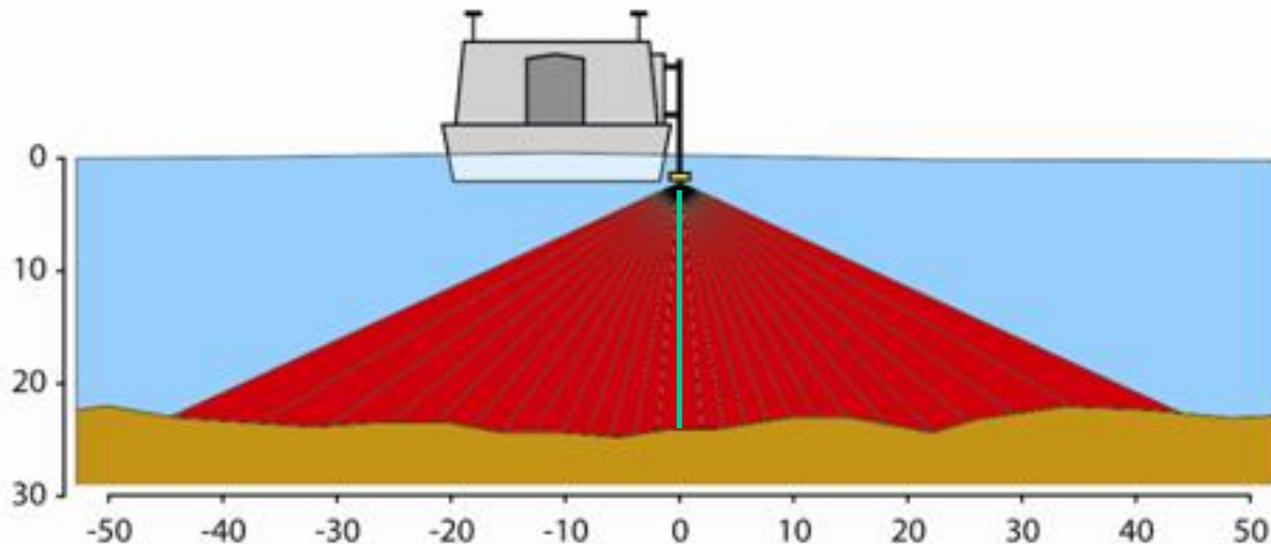
- Wide yet narrow swath perpendicular to the boat direction
- Multiple beams in just one ping
- ***SURVEYS the ENTIRE RIVER or LAKE BED***



# Multi-Beam Surveys

## Multibeam Hydrographic Surveying

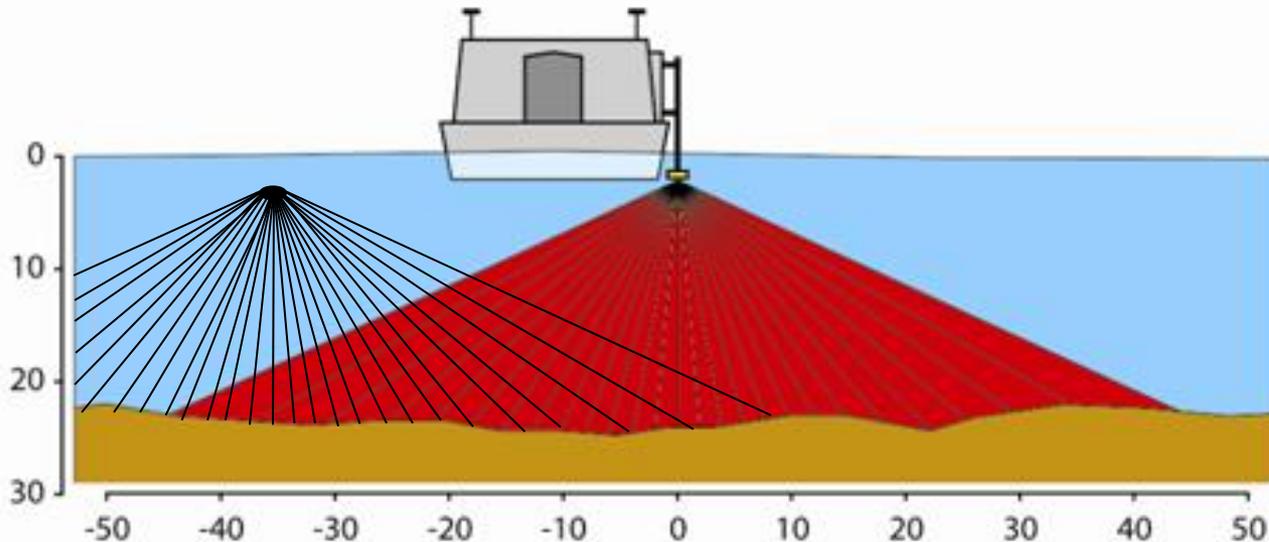
- Wide yet narrow swath perpendicular to the boat direction
- Multiple beams in just one ping
- ***SURVEYS the ENTIRE RIVER or LAKE BED***



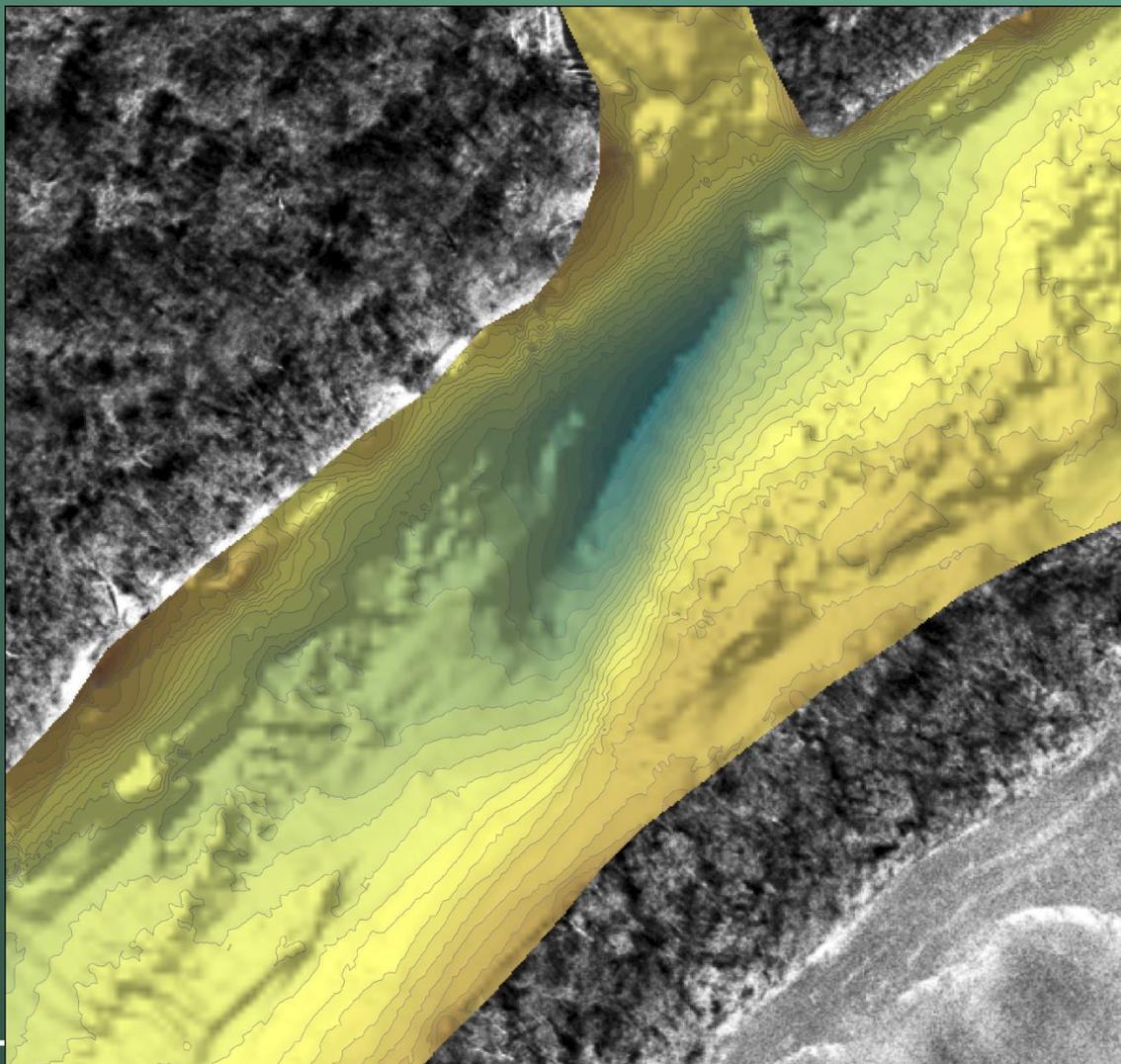
# Multi-Beam Surveys

## Multibeam Hydrographic Surveying

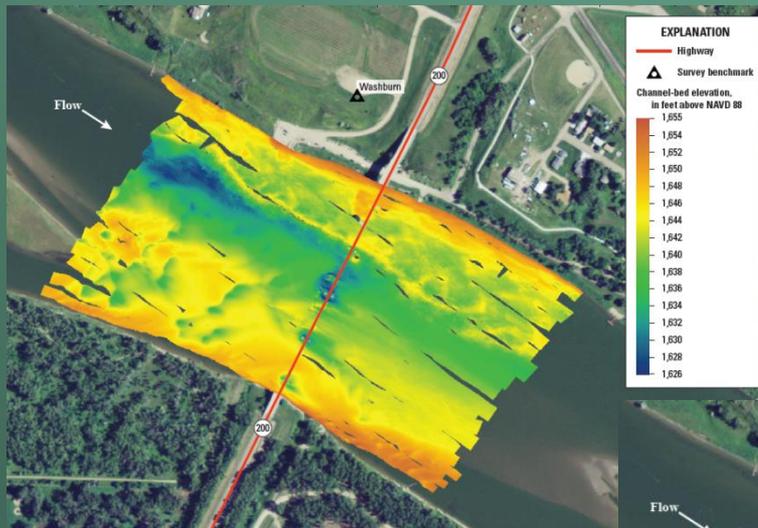
- Wide yet narrow swath perpendicular to the boat direction
- Multiple beams in just one ping
- ***SURVEYS the ENTIRE RIVER or LAKE BED***



# Example Multi-Beam Low Resolution Product

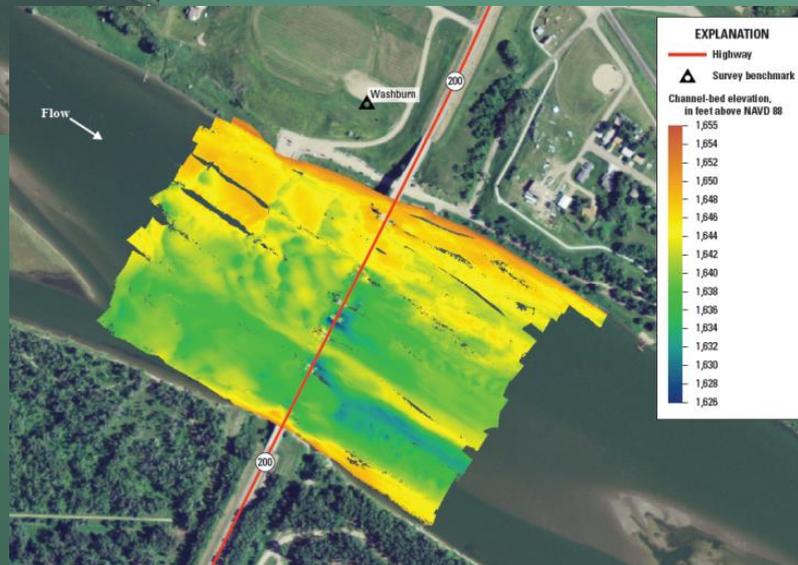


# Example Multi-Beam Low Resolution Product

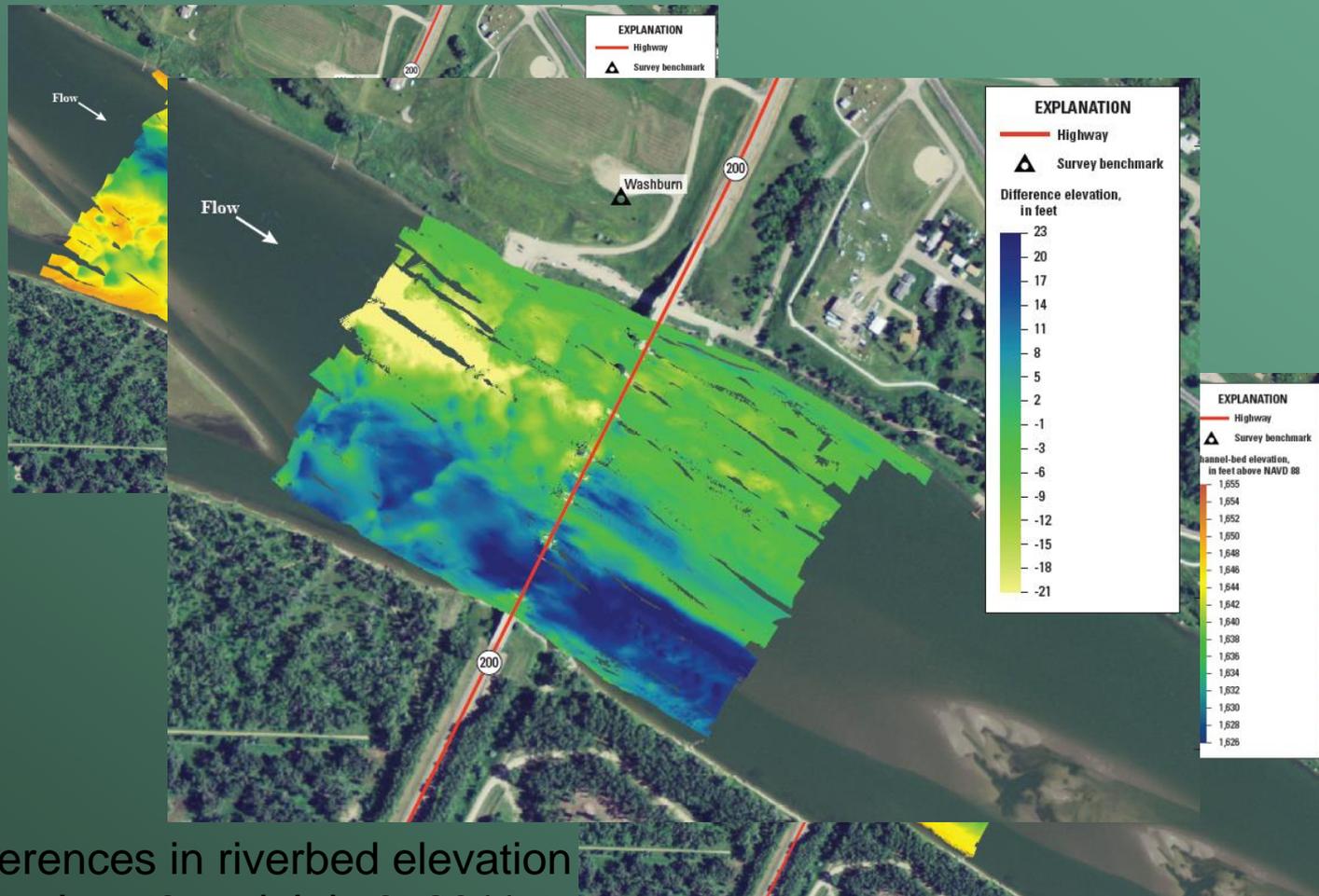


Map results on June 9, 2011  
← before an event

Map results on July 9, 2011  
after an event →

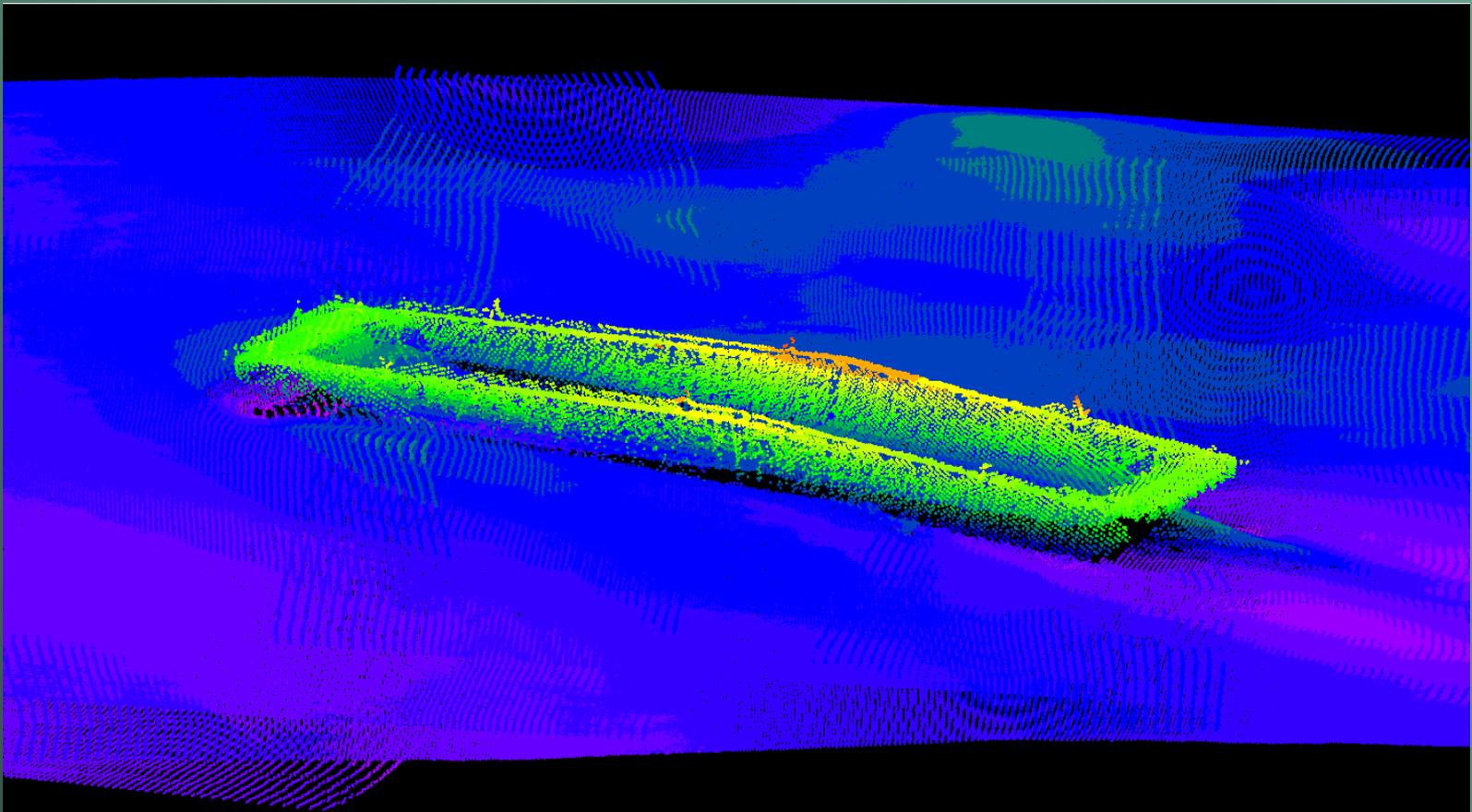


# Example Multi-Beam Low Resolution Product



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

# Example Multi-Beam Low Resolution Product

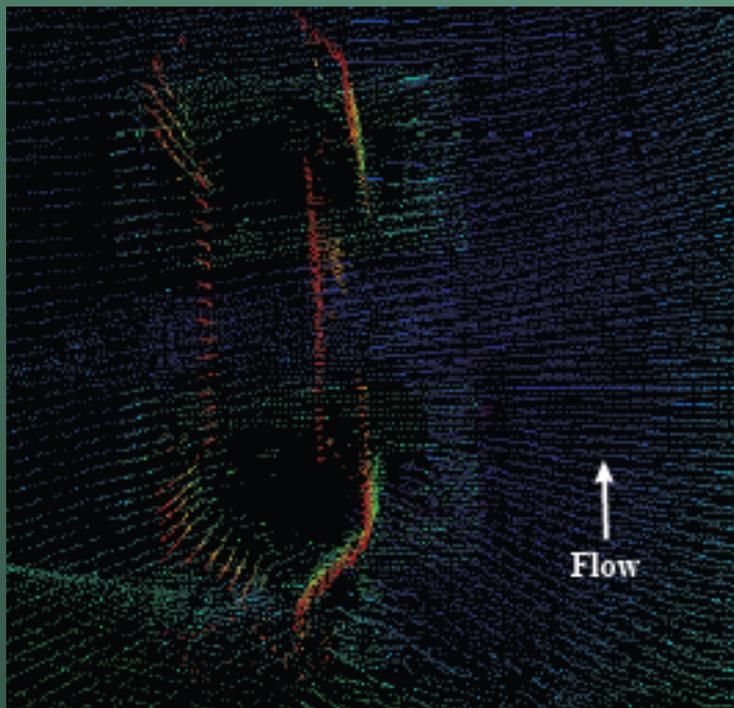


Sunken Barge in the Ohio River near Louisville Water intakes found 8/24/2012

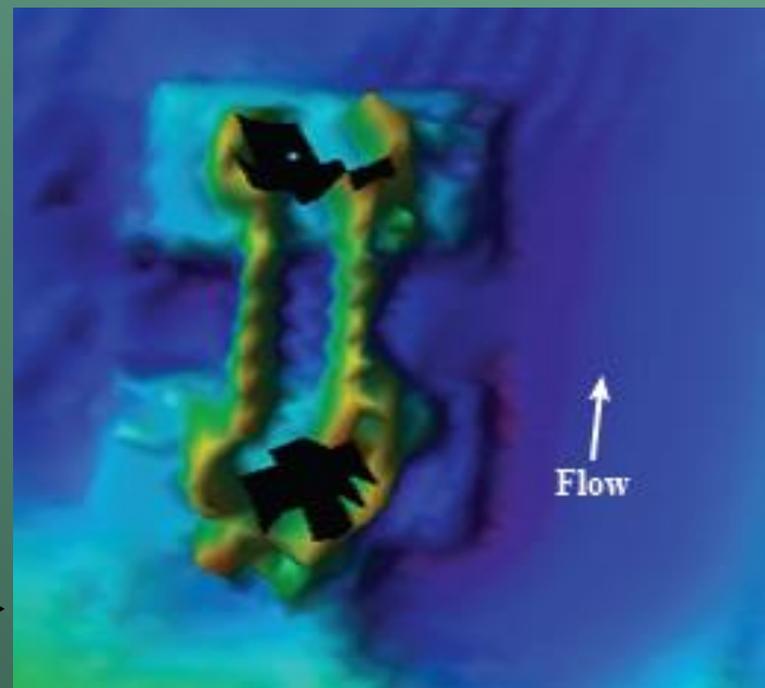
# Example Multi-Beam High Resolution Product



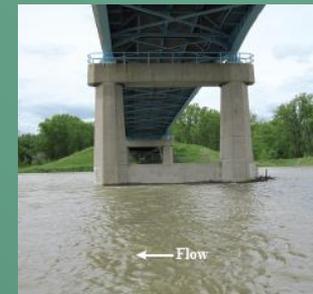
Raw multi-beam data



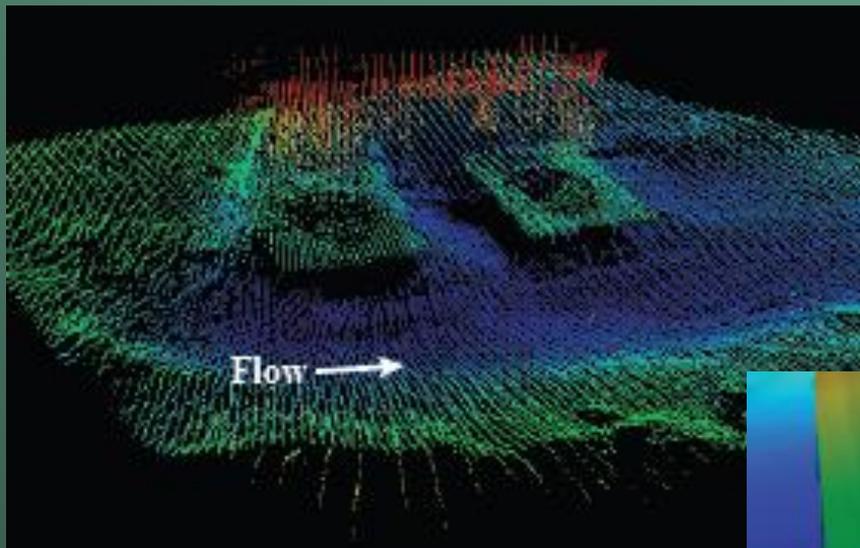
TIN- rendered surface



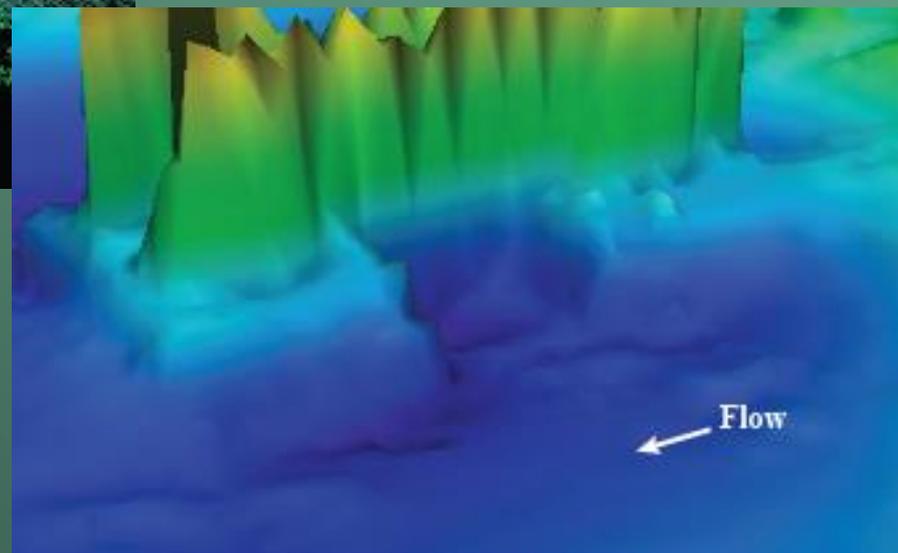
# Example Multi-Beam High Resolution Product



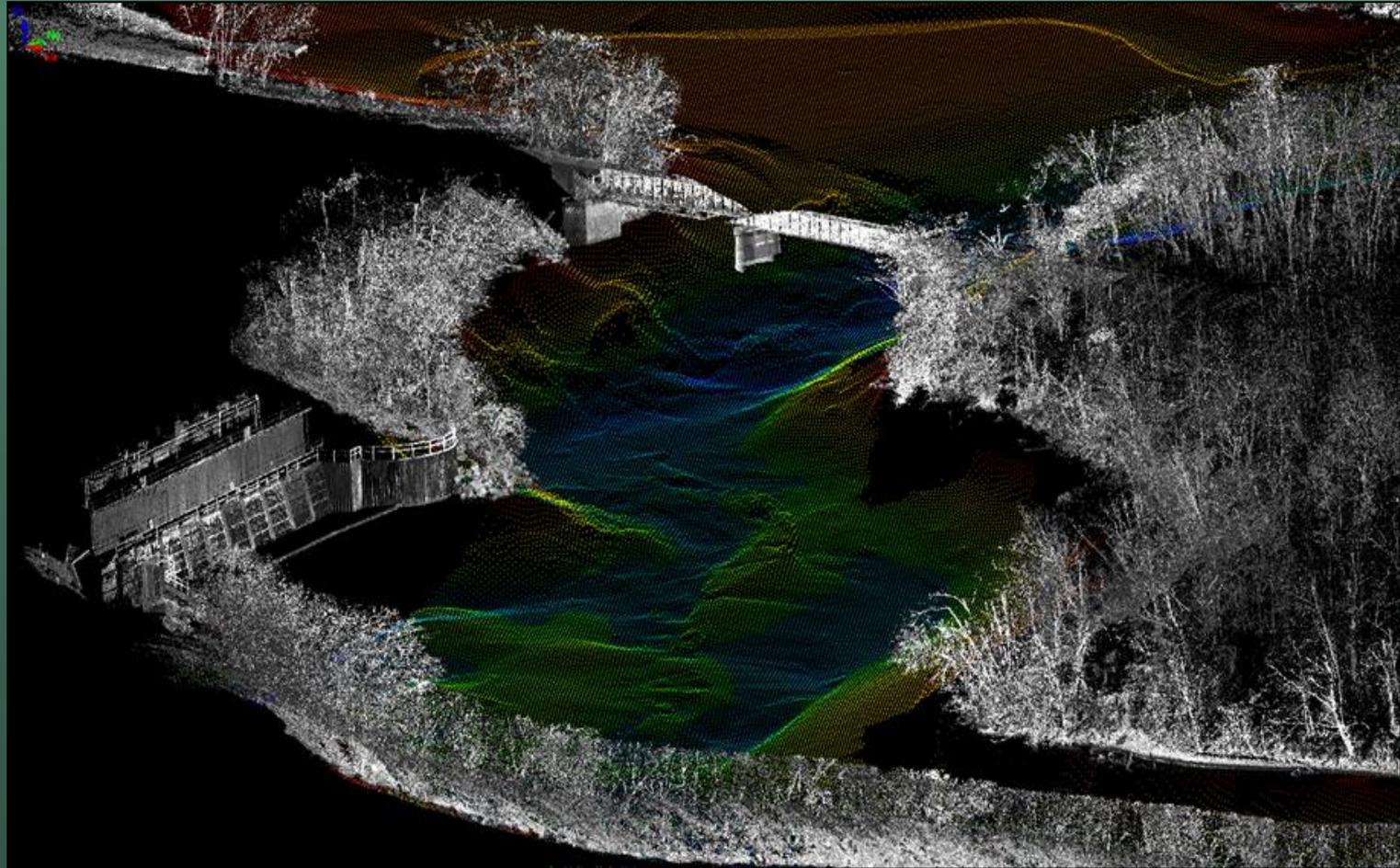
Raw multi-beam data



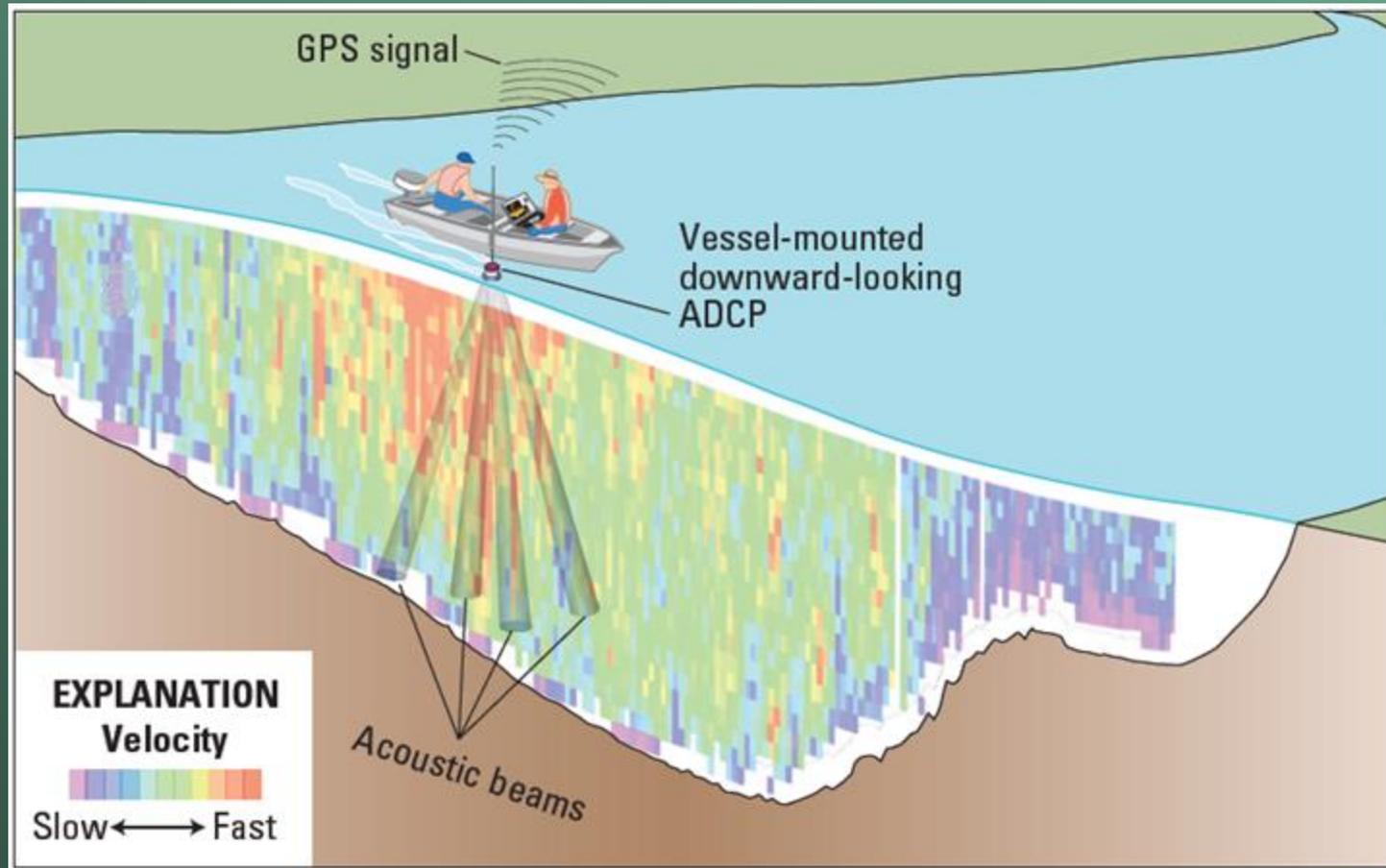
TIN- rendered surface



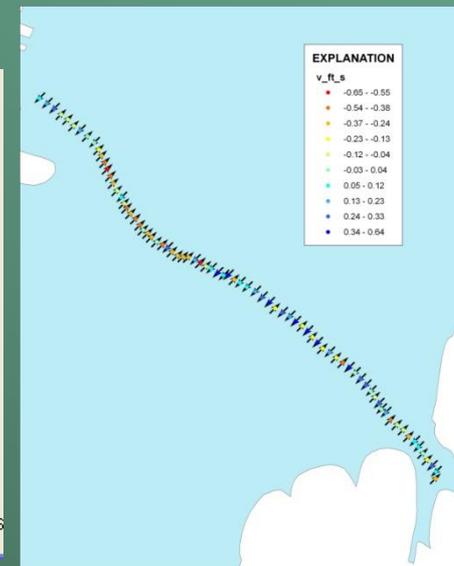
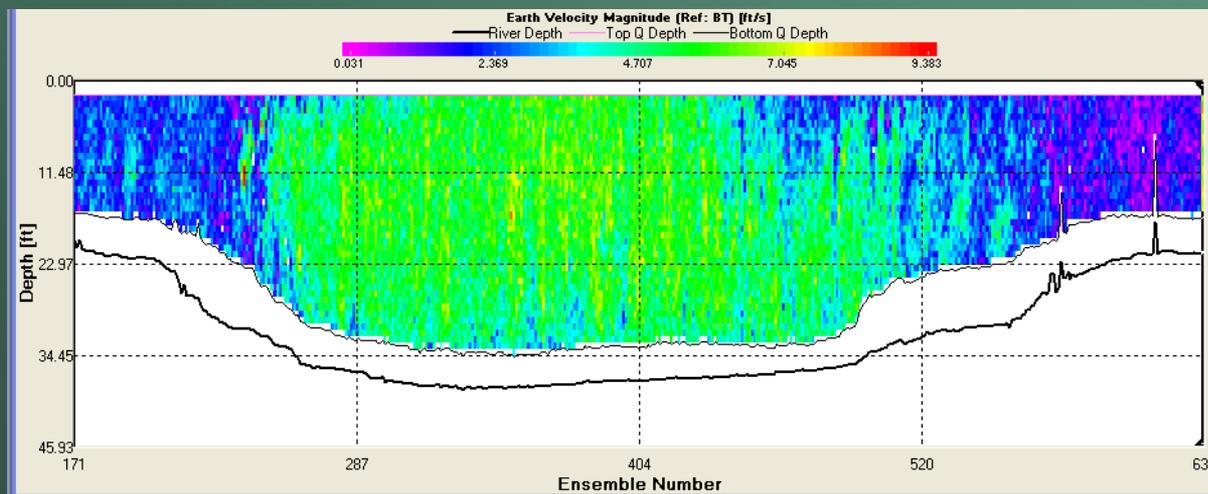
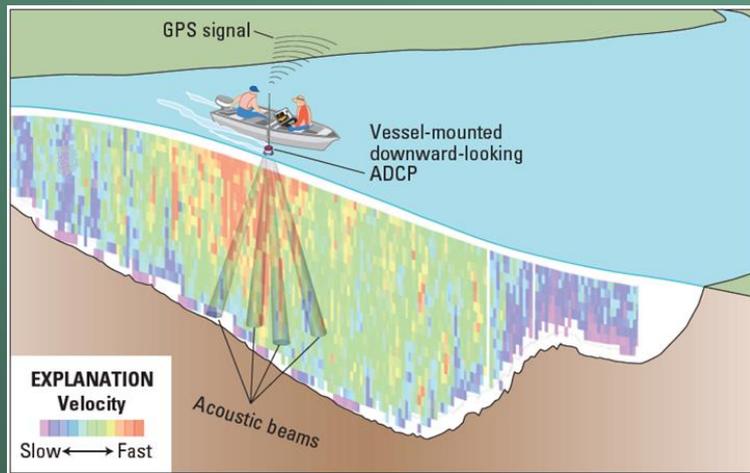
# Example Multi-Beam High Resolution with Compensated T-LIDAR Product



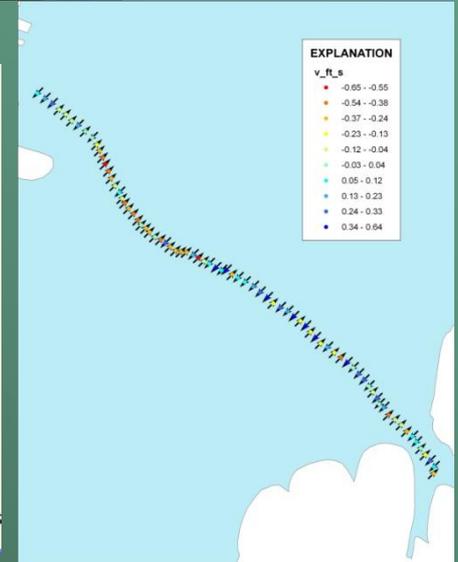
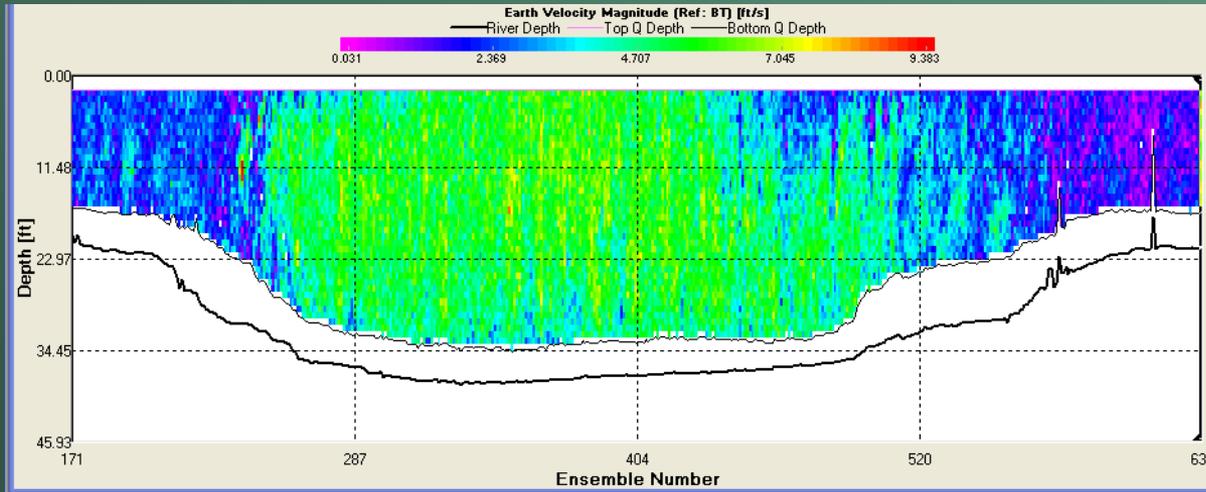
# ADCP

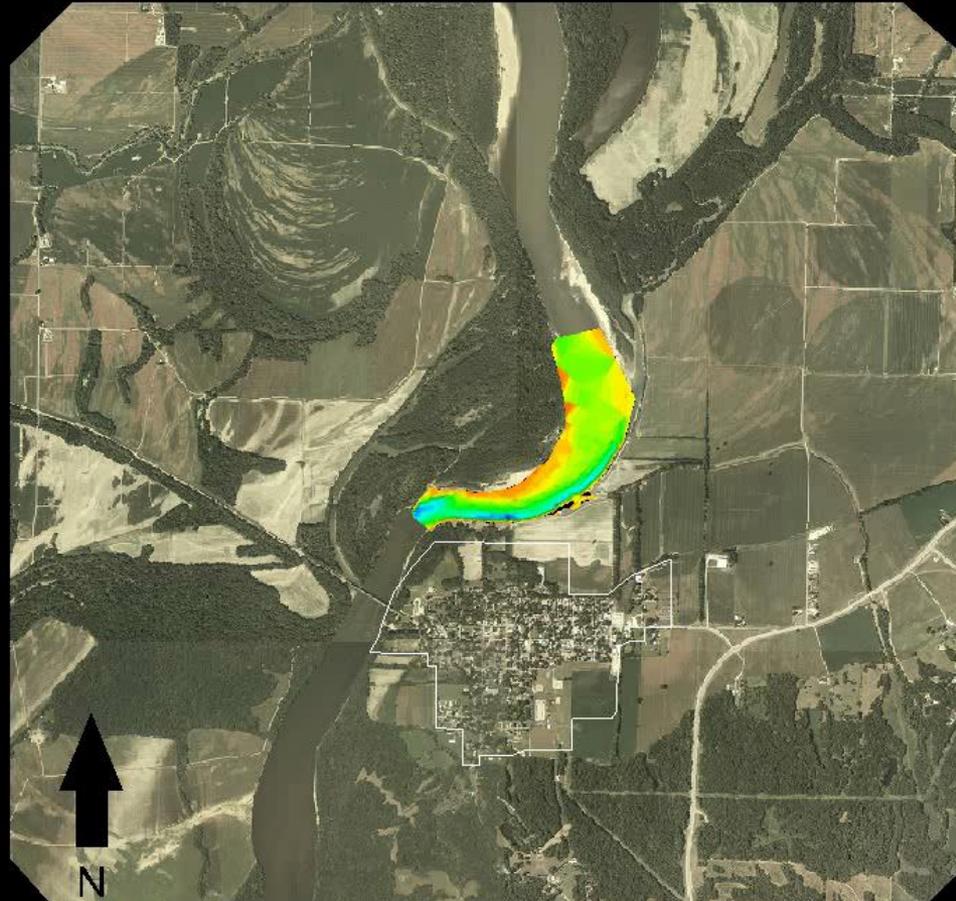


# Acoustic Doppler Current Profiler (ADCP)



# ADCP





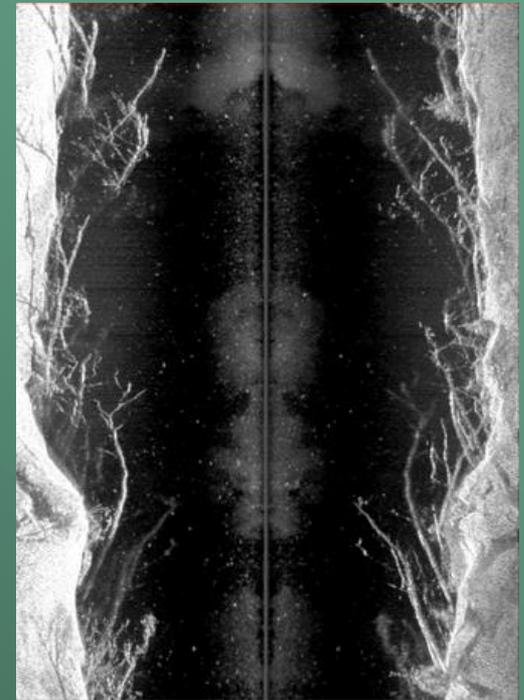
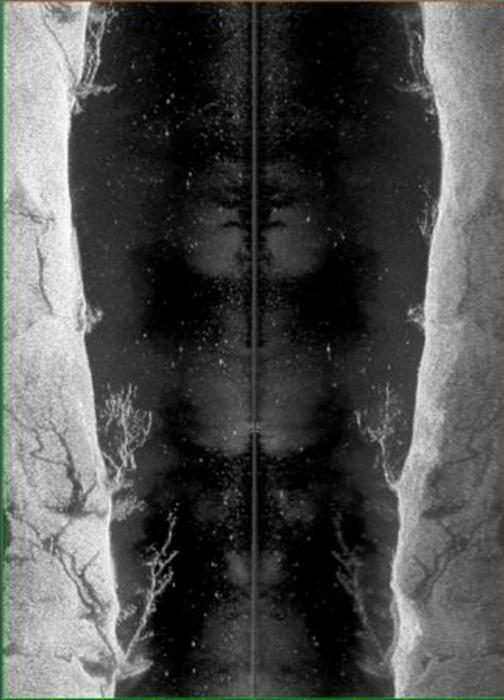
**Bathymetric and Velocity survey of the Wabash River  
near New Harmony, Indiana**

# Side Scan Sonar

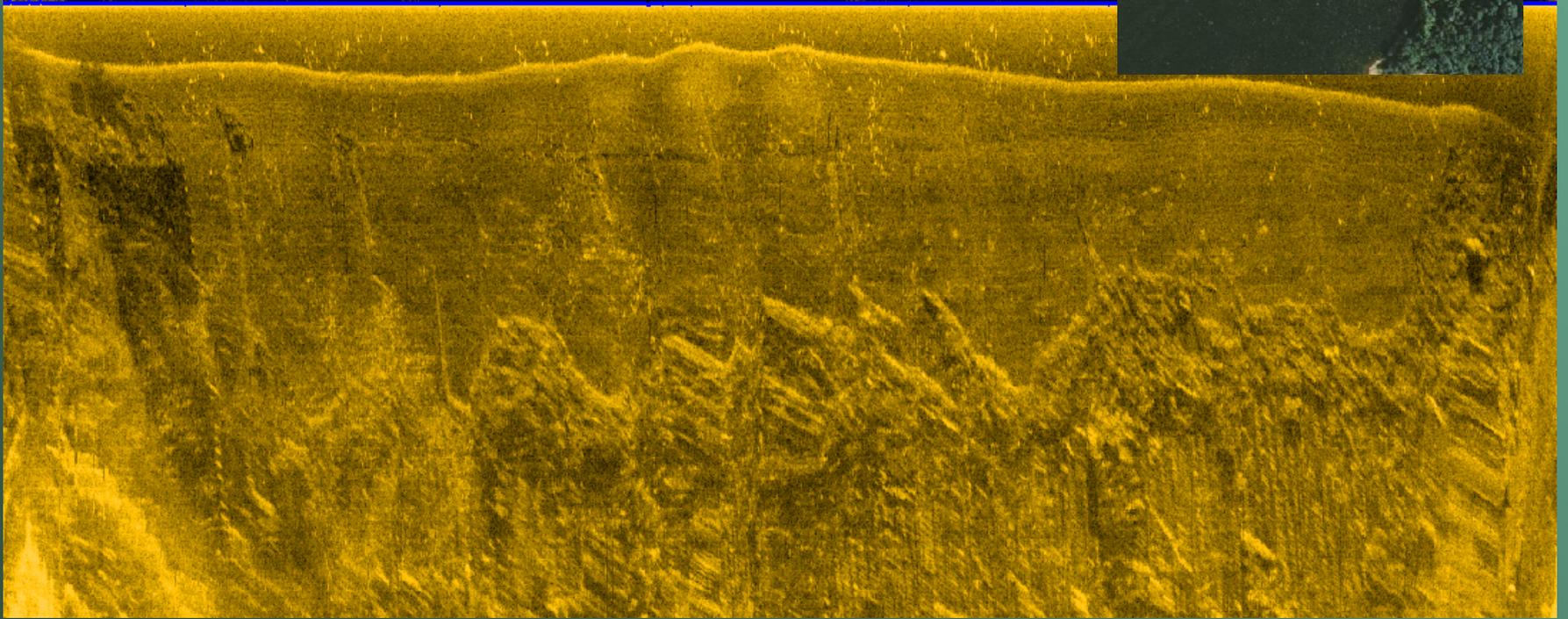


# Side Scan Sonar

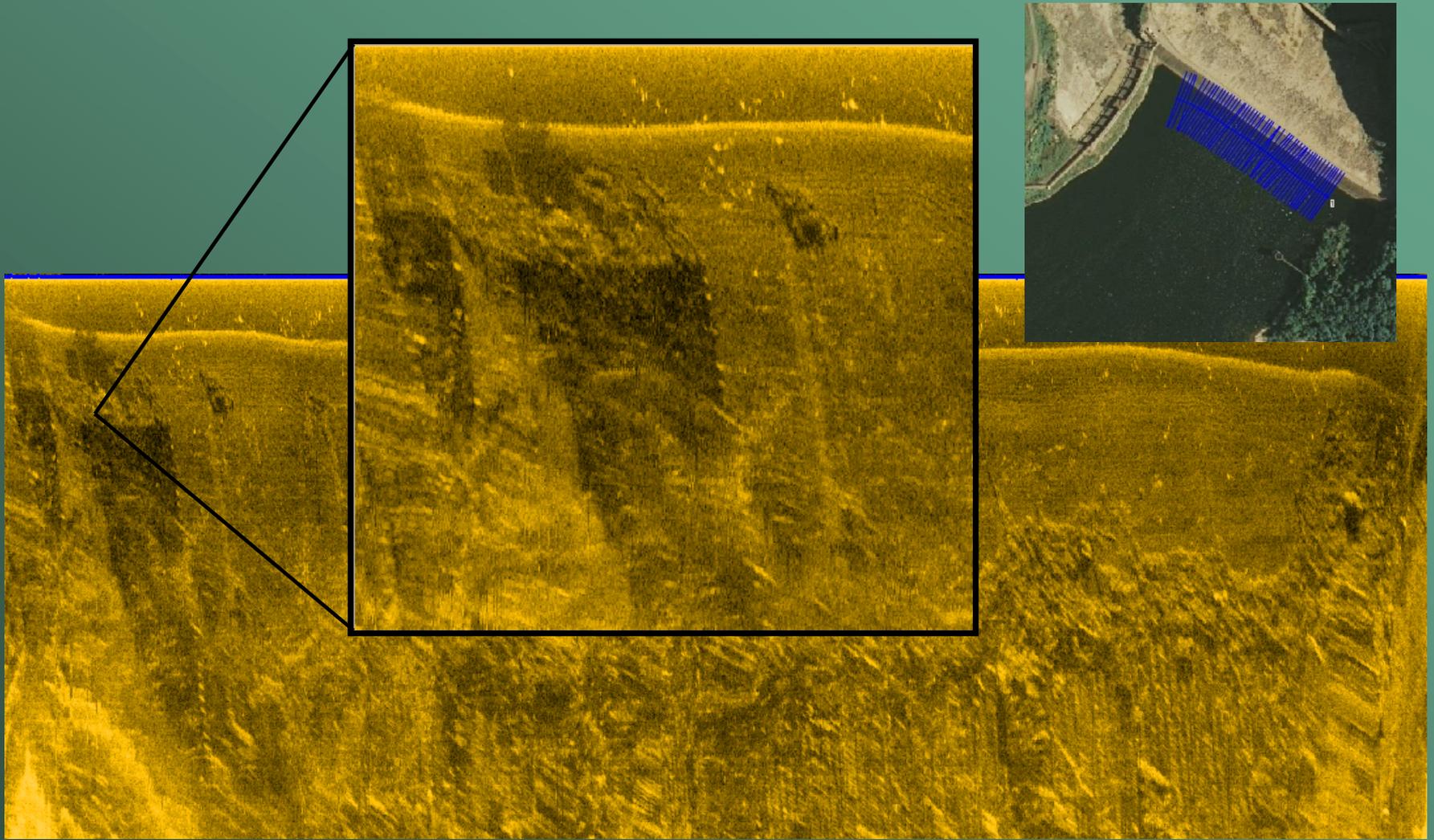
Submerged trees at Wabash River



# Side Scan Sonar



# Side Scan Sonar



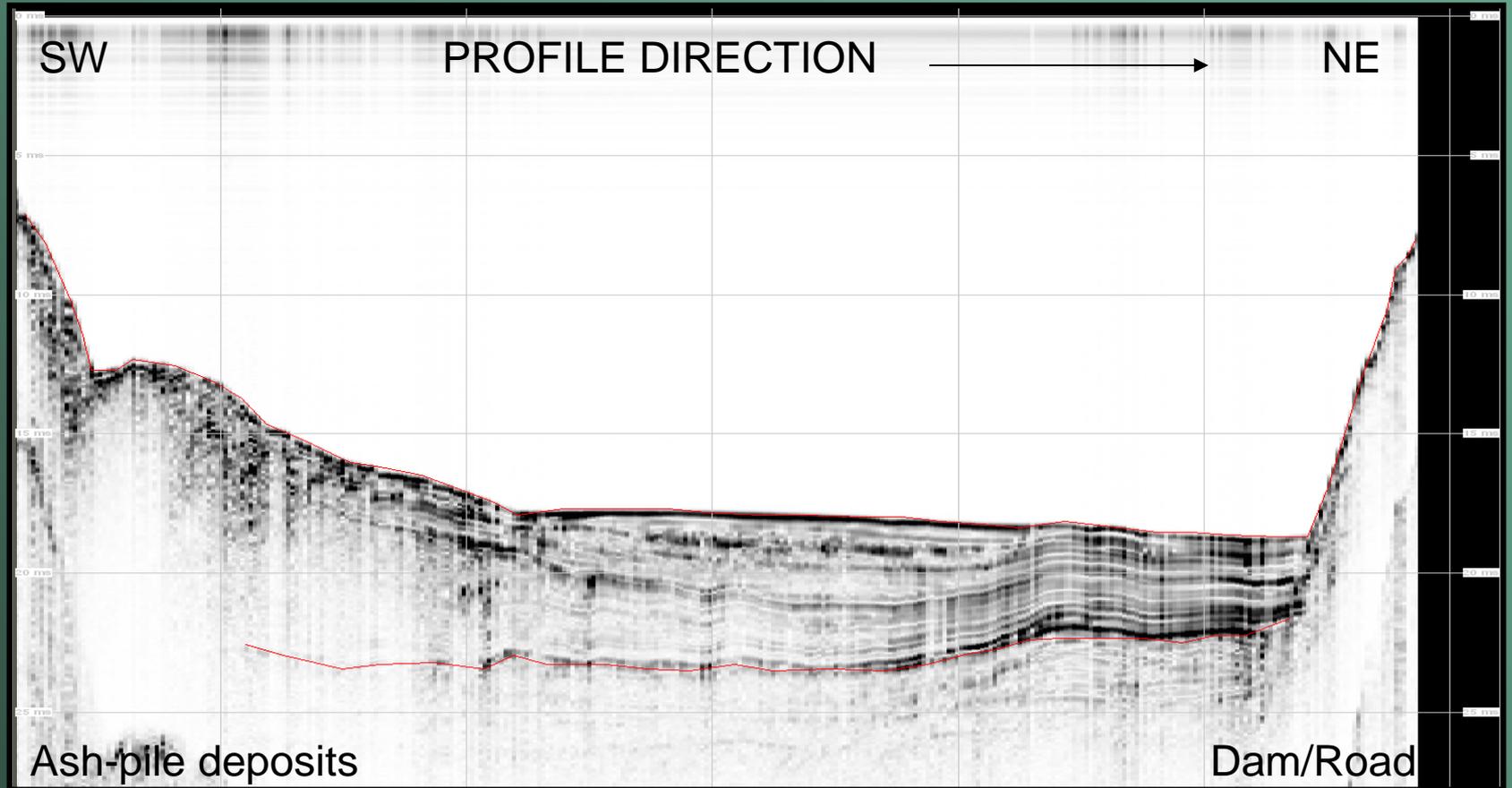
# Swept-frequency acoustic sub-bottom profiler



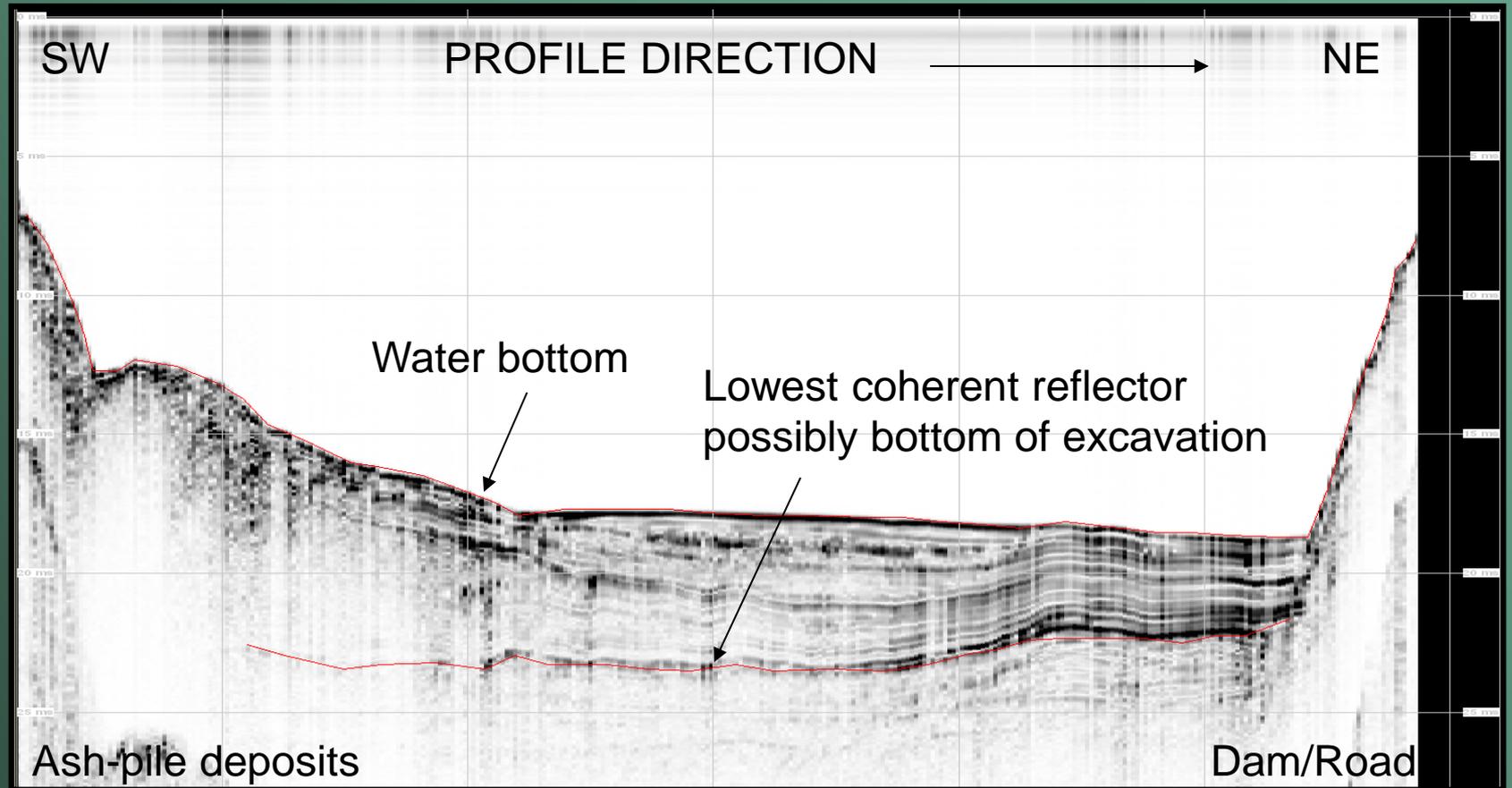
# Swept-frequency acoustic sub-bottom profiler



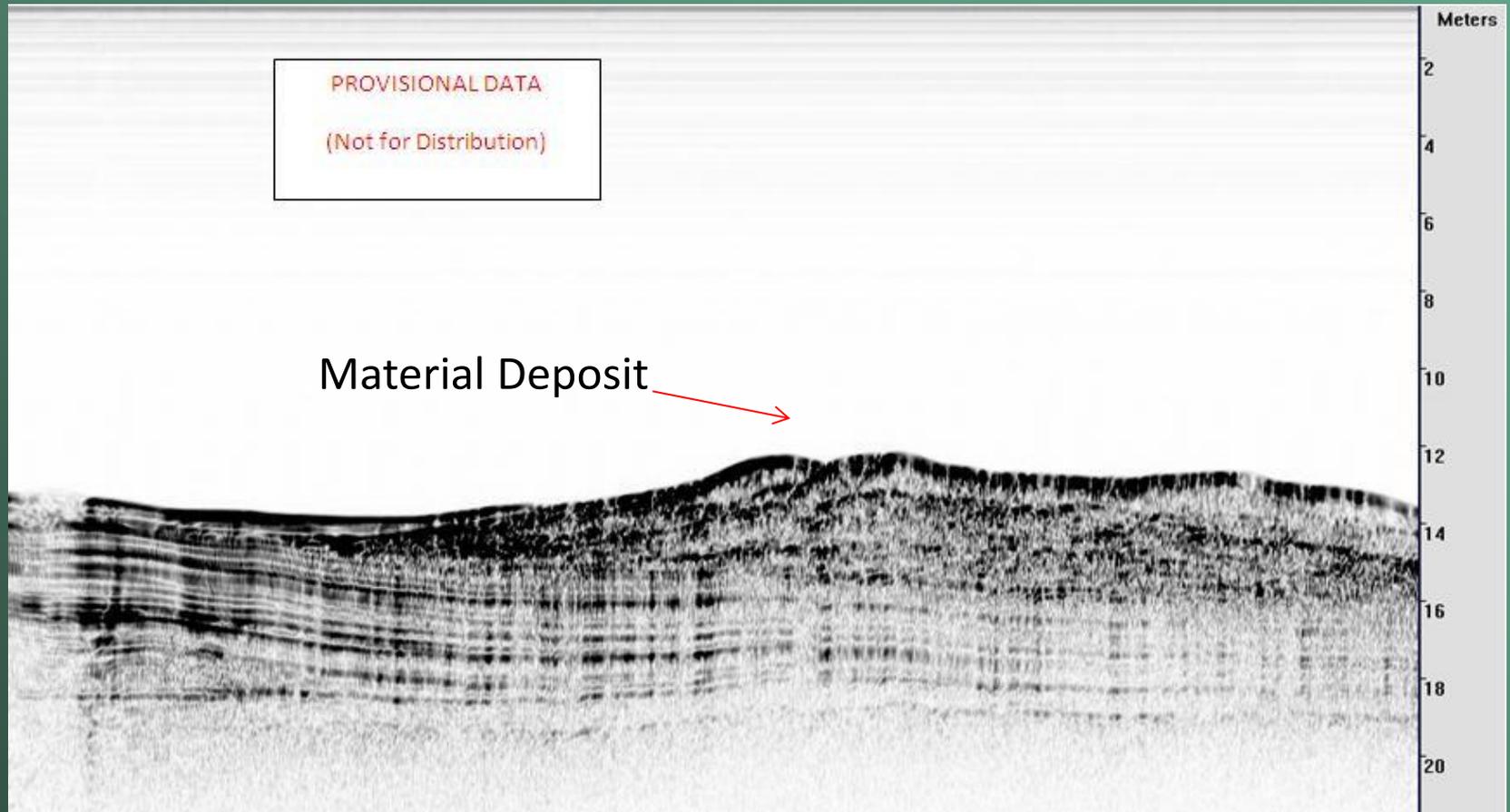
# Swept-frequency acoustic sub-bottom profiler



# Swept-frequency acoustic sub-bottom profiler



# Swept-frequency acoustic sub-bottom profiler



# 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 Arsenal of Tools

- **Combined for offices in surrounding area**
  - 2 Multibeam 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)

# QUESTIONS ?



**USGS**  
U.S. Department of the Interior

**Methods for Noninvasive Bathymetric and Velocity Surveys for Impoundment Safety—A Case Study of Harrington Lake at Dix Dam near Burgin, Kentucky**

**Abstract**  
This report describes the methods used to collect bathymetric and velocity data for the purpose of assessing the structural integrity of the Dix Dam near Burgin, Kentucky. The data were collected using a variety of noninvasive techniques, including side-scan sonar, single-beam bathymetry, and velocity profiling. The results of the surveys are presented in a series of maps and charts, and the methods used to collect the data are described in detail.

**Introduction**  
The Dix Dam near Burgin, Kentucky, is a concrete gravity dam that was constructed in 1934. The dam is currently in good condition, but it is subject to periodic inspections to ensure its structural integrity. One of the most important aspects of these inspections is the collection of bathymetric and velocity data. This report describes the methods used to collect this data for the purpose of assessing the structural integrity of the dam.

**Methods**  
The bathymetric data were collected using a side-scan sonar system. The sonar system was mounted on a boat and was used to scan the lake bed. The velocity data were collected using a single-beam bathymetry system and a velocity profiling system. The single-beam bathymetry system was used to collect depth data, and the velocity profiling system was used to collect velocity data.

**Results**  
The bathymetric data show that the lake bed is relatively flat, with a maximum depth of approximately 10 feet. The velocity data show that the water velocity is generally low, with a maximum velocity of approximately 1 foot per second.

**Conclusions**  
The results of the surveys indicate that the Dix Dam is in good condition and that there is no significant risk of failure. However, the data do indicate that there is a need for continued monitoring of the dam to ensure its structural integrity.

**References**  
1. US Army Corps of Engineers, "Dam Safety Inspection Manual," 1998.  
2. US Army Corps of Engineers, "Dam Safety Inspection Manual," 1998.  
3. US Army Corps of Engineers, "Dam Safety Inspection Manual," 1998.

**Appendix A**  
Side-scan sonar image of the lake bed.

**Appendix B**  
Single-beam bathymetry data.

**Appendix C**  
Velocity profiling data.

**Appendix D**  
Bathymetric map of the lake.

**Appendix E**  
Velocity map of the lake.

**Methods for Noninvasive Bathymetric and Velocity Surveys for Impoundment Safety—A Case Study of Harrington Lake at Dix Dam near Burgin, Kentucky**  
A. Thomas Ruby III  
2012

**USGS** Development of Methodology for the Assessment of Coal-Ash Impoundments, Slurry Ponds, Reservoirs, and Other Structures **e-on | US**  
science for a changing world

In the 2010 and April 2012, USGS partnered with multiple academic centers in cooperation with the American Gas and Electric Council (AGEC) to develop a methodology for the assessment of coal-ash impoundments. The methodology was developed to assess the structural integrity of coal-ash impoundments, slurry ponds, reservoirs, and other structures. The methodology was developed to assess the structural integrity of these structures and to provide data and information to assist in the decision-making process.

**Assessment Tools**

- Swept-Frequency Acoustic**  
This tool is used to collect bathymetric data and to assess the structural integrity of the structures. It provides a high-resolution image of the lake bed and can be used to identify areas of concern.
- Ground-Penetrating Radar**  
This tool is used to collect data on the subsurface structure of the structures. It can be used to identify areas of concern and to provide data on the structural integrity of the structures.
- Multi-Channel Analysis of Surface Waves (MASW)**  
This tool is used to collect data on the surface waves of the structures. It can be used to identify areas of concern and to provide data on the structural integrity of the structures.
- Single-Beam Bathymetry**  
This tool is used to collect depth data and to assess the structural integrity of the structures. It provides a high-resolution image of the lake bed and can be used to identify areas of concern.
- Velocity Profiling**  
This tool is used to collect velocity data and to assess the structural integrity of the structures. It provides a high-resolution image of the water velocity and can be used to identify areas of concern.
- Side-Scan Sonar**  
This tool is used to collect bathymetric data and to assess the structural integrity of the structures. It provides a high-resolution image of the lake bed and can be used to identify areas of concern.
- 2D Resistivity**  
This tool is used to collect data on the resistivity of the structures. It can be used to identify areas of concern and to provide data on the structural integrity of the structures.
- Thermal Imaging**  
This tool is used to collect data on the thermal properties of the structures. It can be used to identify areas of concern and to provide data on the structural integrity of the structures.

**Key Information Contact:**  
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USGS KY Water Science Center  
INKY Commonwealth