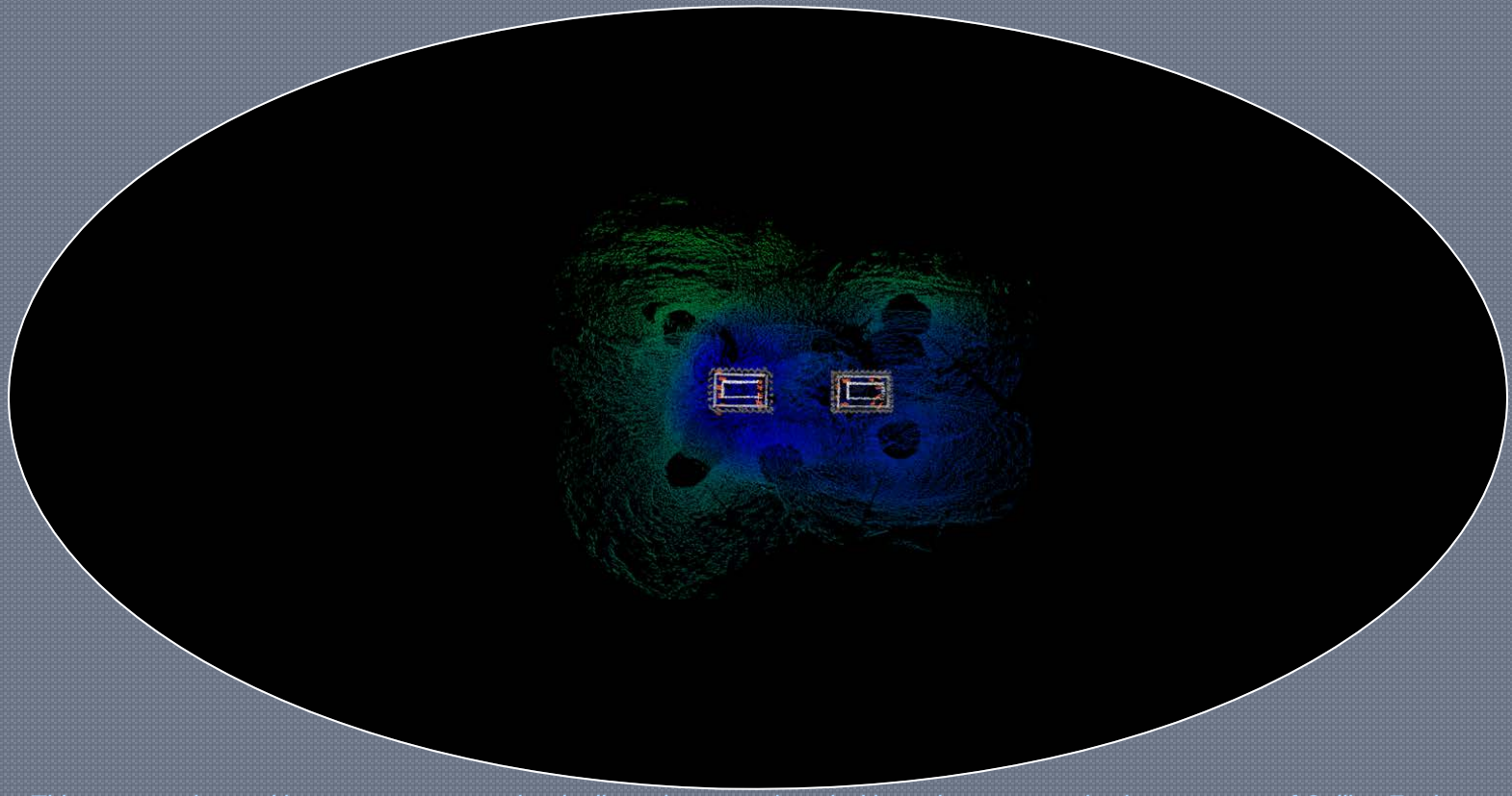
Underwater Acoustic Imaging for Scour Monitoring

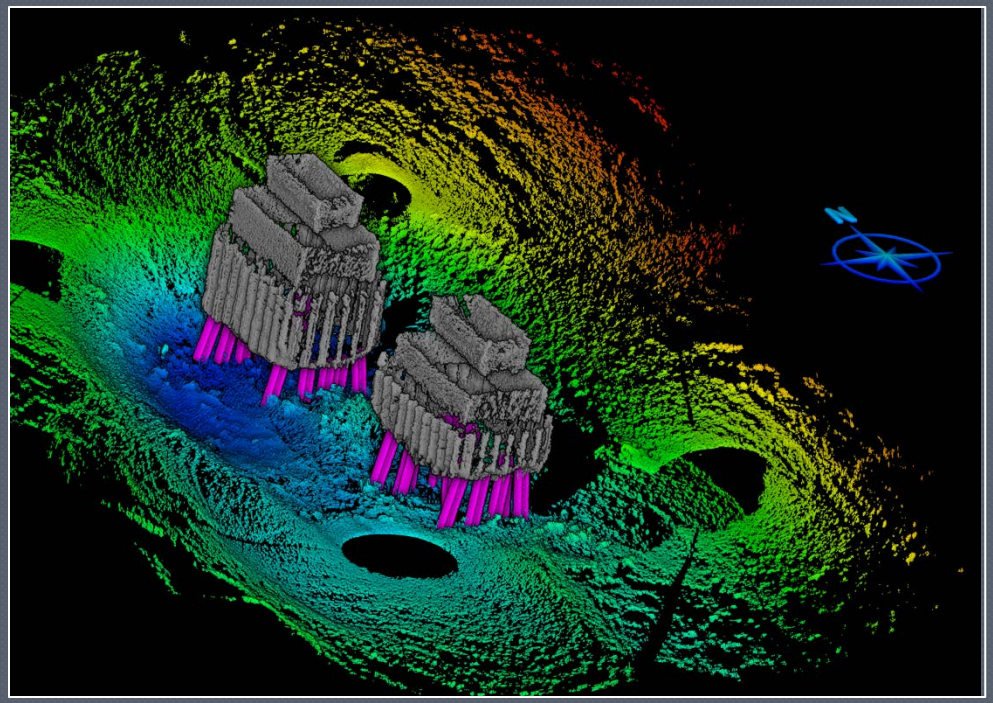
COLLINS ENGINEERS INC.

Presented by:
Greg Heringhaus
Roy Forsyth, P.E.
Mike Todsen, P.E.



Presentation Overview

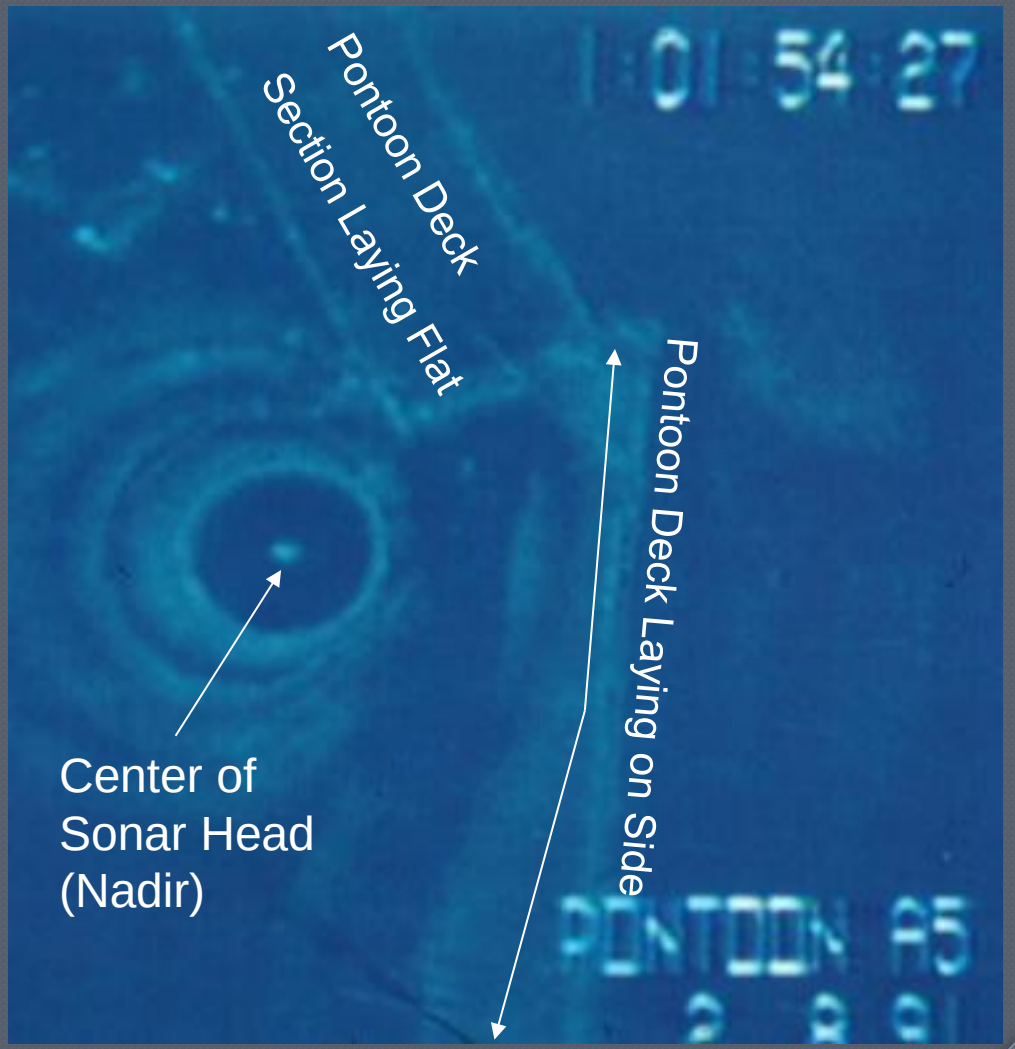
- Introduction
- What is Acoustic Imaging
- Example Projects
- Conclusions



Info About Collins

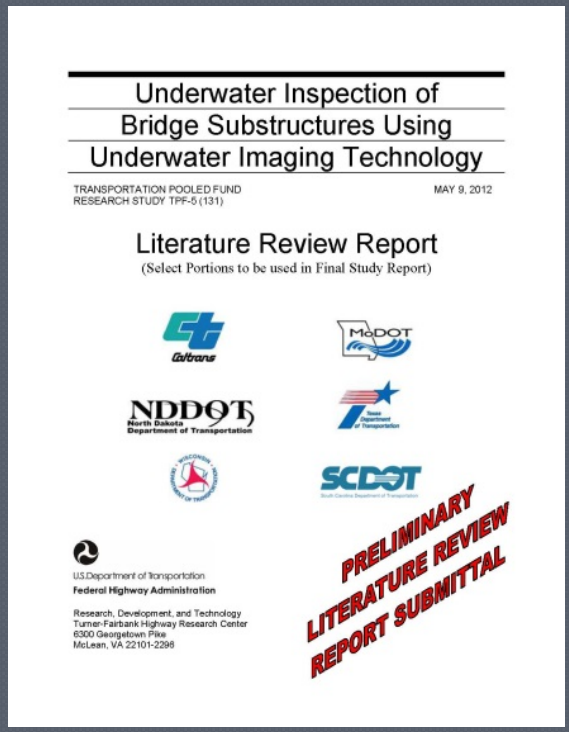
- Established 1979 in Chicago
- Predominantly an Asset Management & Structural Engineering Firm
- Provide Services to Clients Nationally and Internationally
- Responsive Service Including 24 Hour Emergency Hotline

I-90 Bridge Failure
November 25, 1990



Info About Collins

- Conducted FHWA Underwater Imaging Study
  TPF-5 (131)
- Evaluated Usefulness of Various Acoustic Imaging Devices at Bridge Sites

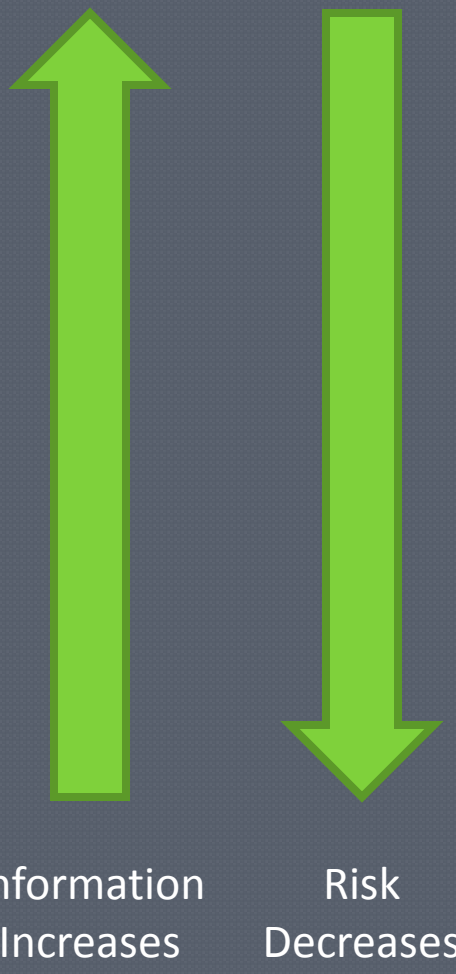


Every site presents unique challenges…

…and we typically want to know what lies below the surface.

Inspection Risk can be Managed with Information

- Traditional information sources
  - Contract documents
  - Diver inspections
  - Single beam sonar survey data
- Modern information sources
  - Underwater acoustic imaging
    - 2-D images
    - 3-D point cloud models

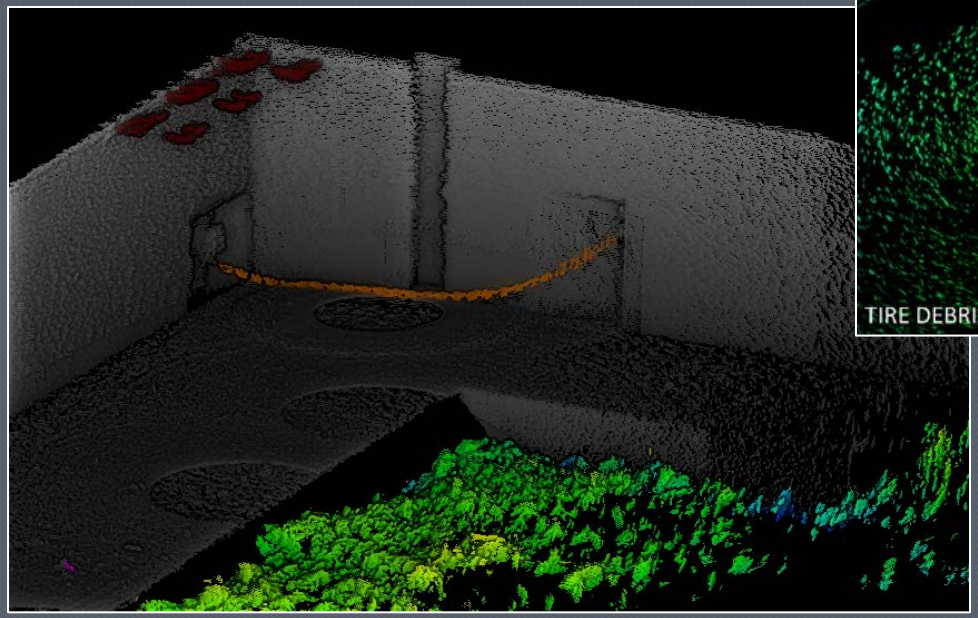


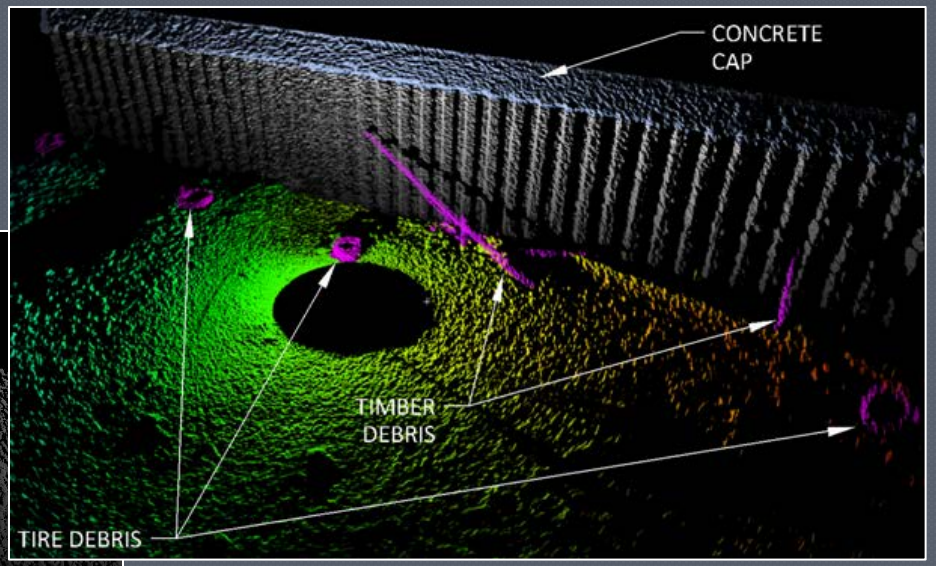
Why is SONAR Useful to Underwater Inspectors

- **Common uses include:**
  - Volume calculations (riprap and dredge quantities)
  - Bridge scour monitoring (replace sounding plan)
  - Hydraulic analysis for design
  - Assessment of underwater conditions (structural investigation)
  - Underwater archeological documentation (shipwrecks)
  - Assist or direct divers (especially in hazardous conditions)
  - Assess existing or changed conditions
  - Detect and identify submerged objects
  - Verification documentation (quality, quantities, safety, etc.)
  - As-built documentation

Presentation Agenda

- Introduction
- What is Acoustic Imaging
- Example Projects
- Conclusions





Key Advantages of Acoustic Imaging

- Ability to deploy from multiple points of view
- Easily adaptable to vertical and horizontal surfaces
- Compact for deployment in remote locations
- Not dependent on GPS
- Optimize resolution by reducing range from target

Most Useful When Standard Practices Have Shortcomings

- For divers/inspectors:
  - Low/No visibility (obtain big picture)
  - Difficult geometry (if a picture is worth 1,000 words – a 3-D model is worth much more)
  - Dangerous diving conditions
    - Extreme depth
    - Heavy pollution
    - Flooding (strong currents)

Most Useful When Standard Practices Have Shortcomings

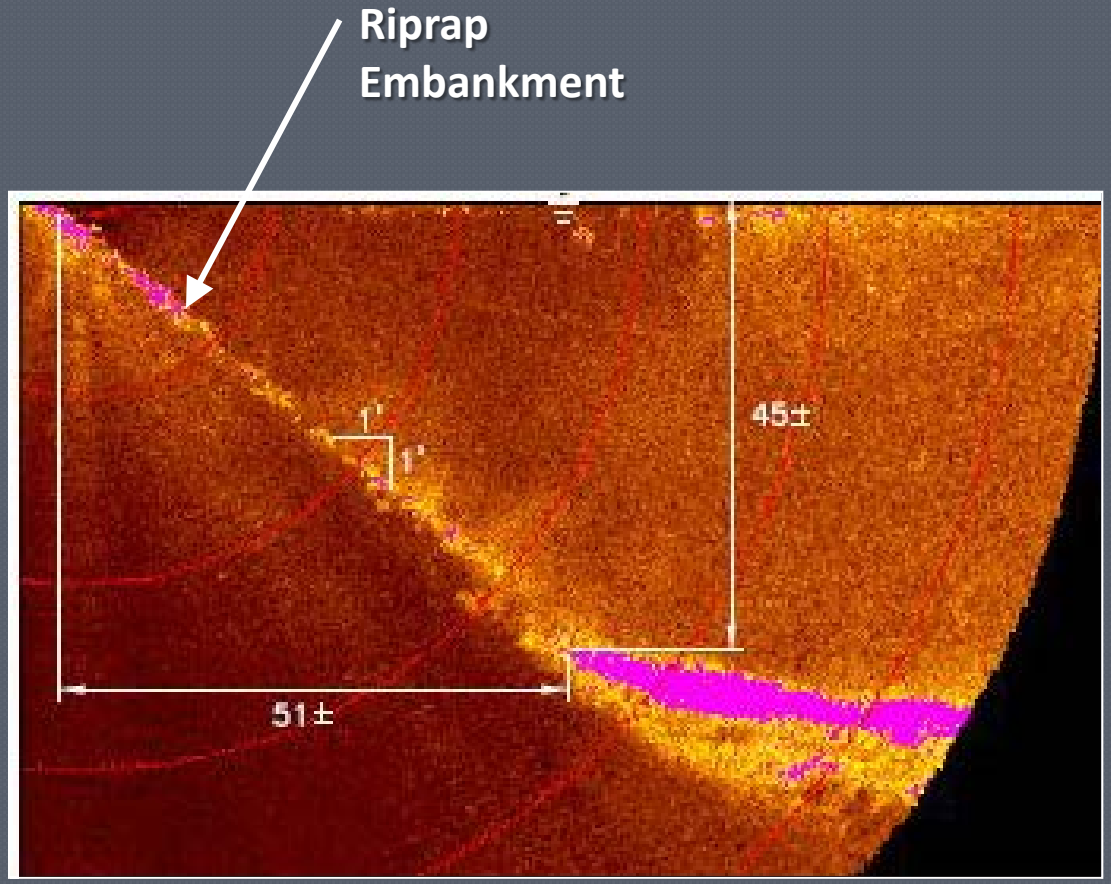
- For hydrographic surveyors:
  - Obtain data under heavy canopy (within enclosed structures/caverns, under large shipping piers, even below the ice)
  - Reduce range/Enhance resolution at extreme depth
  - Provide data in shallow or heavily obstructed areas
  - Supplement to missing or low resolution traditional multi-beam data (cloud to cloud registration)

Presentation Agenda

- Introduction
- What is Acoustic Imaging?
- Example Projects
- Conclusions

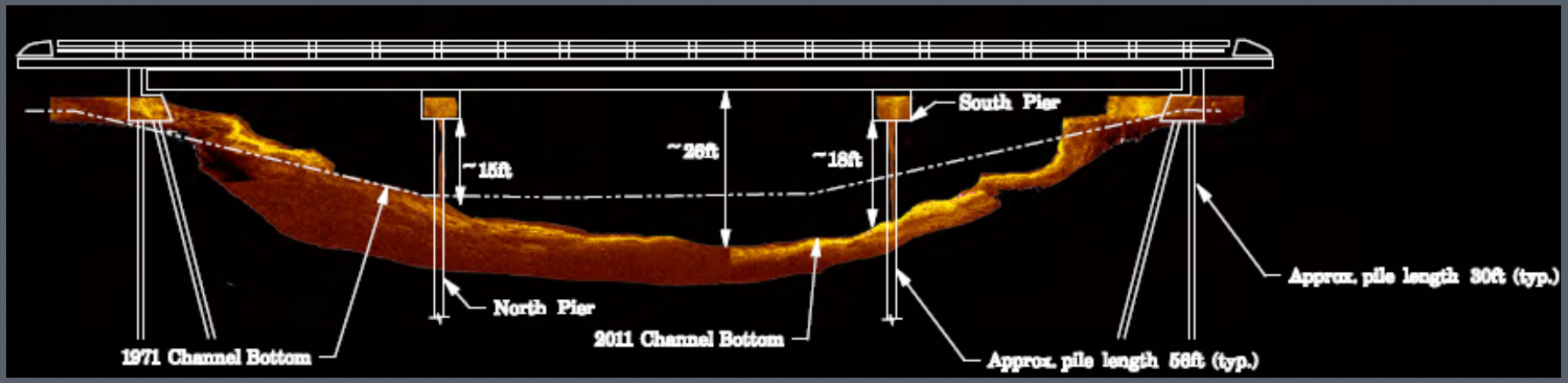
Example 1A: Imaging During Flood Events

Iowa DOT: 2011 Floods at Hwy 175 near Onawa, IA



Example 1B: Imaging During Flood Events

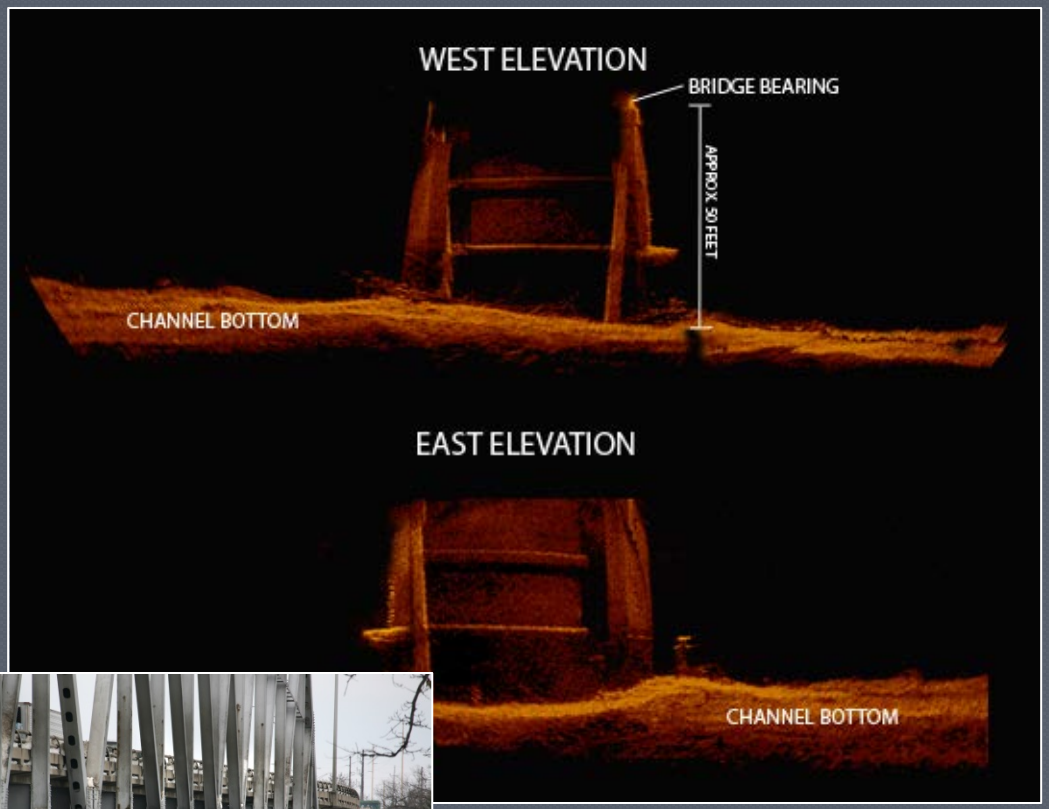
Iowa DOT: 2011 floods investigation of 4 bridges on I-29

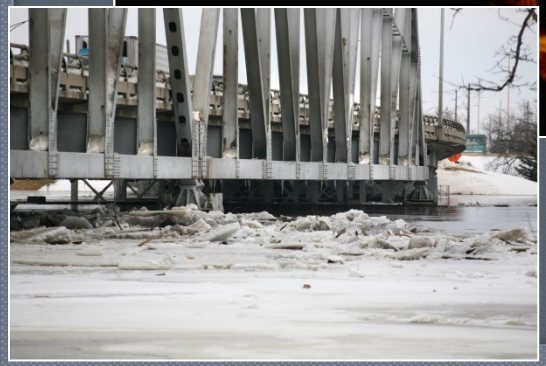


Overlay of as-built and historic channel info for comparison

Example 1B: Imaging During Flood Events

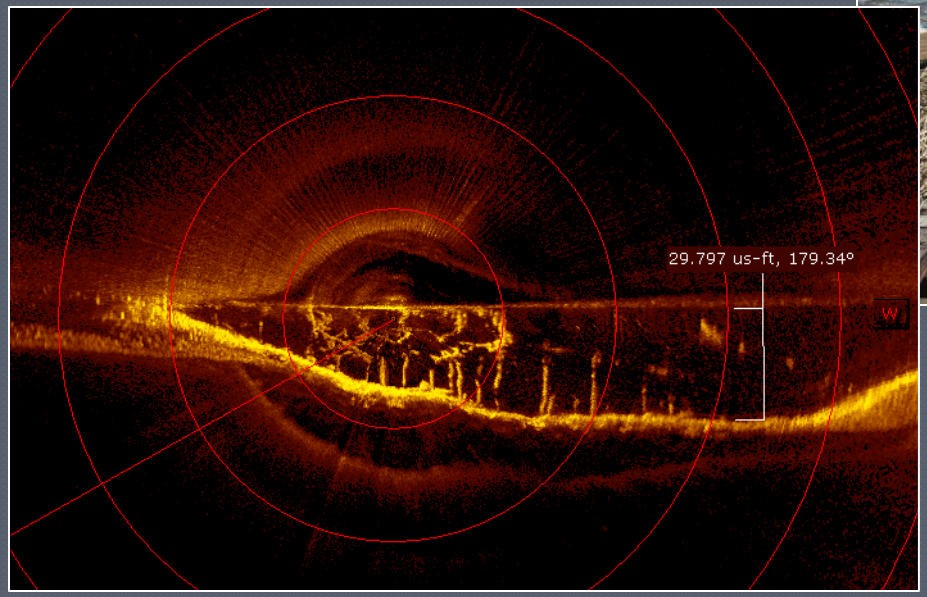
NDDOT: 2009 Floods at Grand Forks, ND



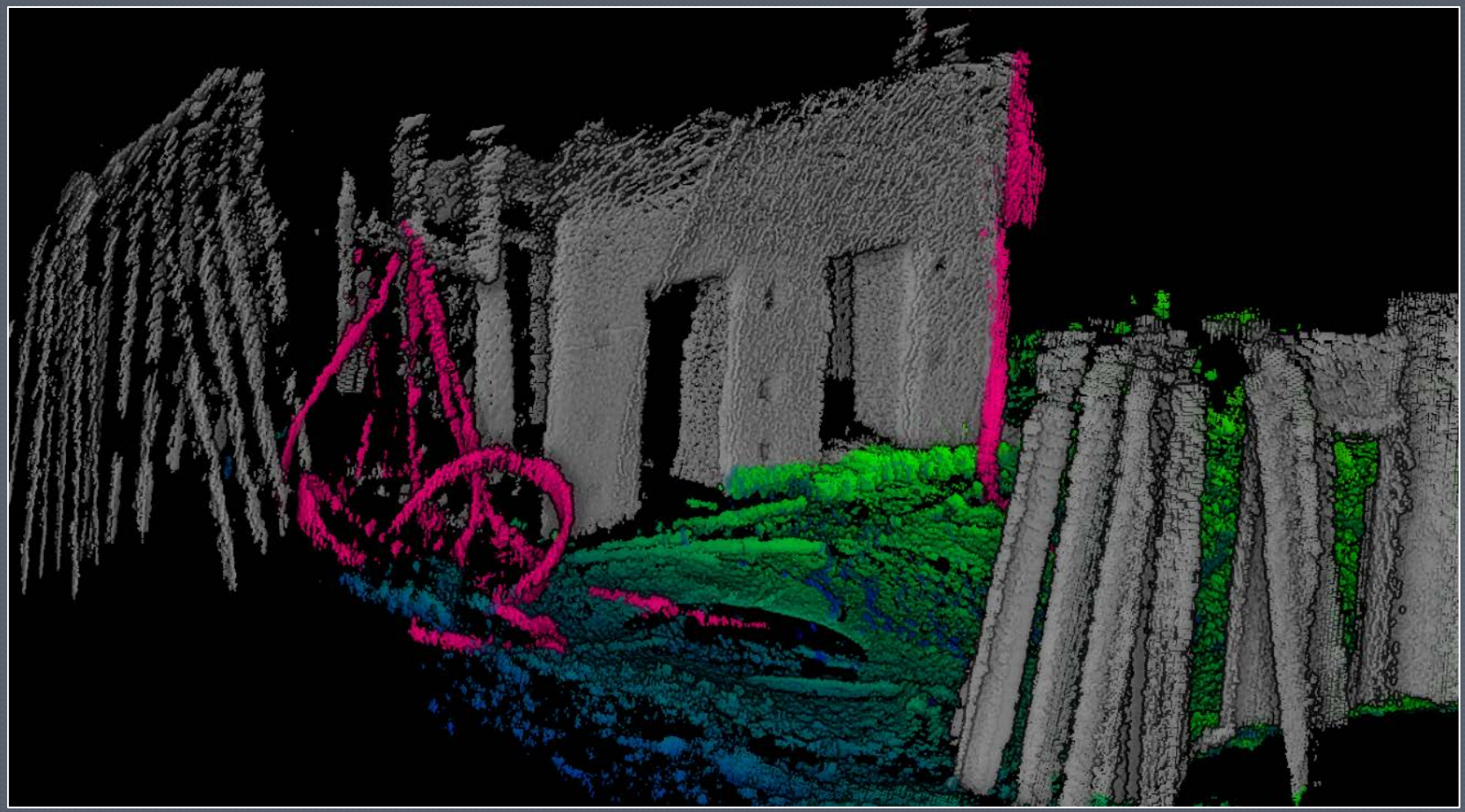


Example 1C: Imaging During Flood Events

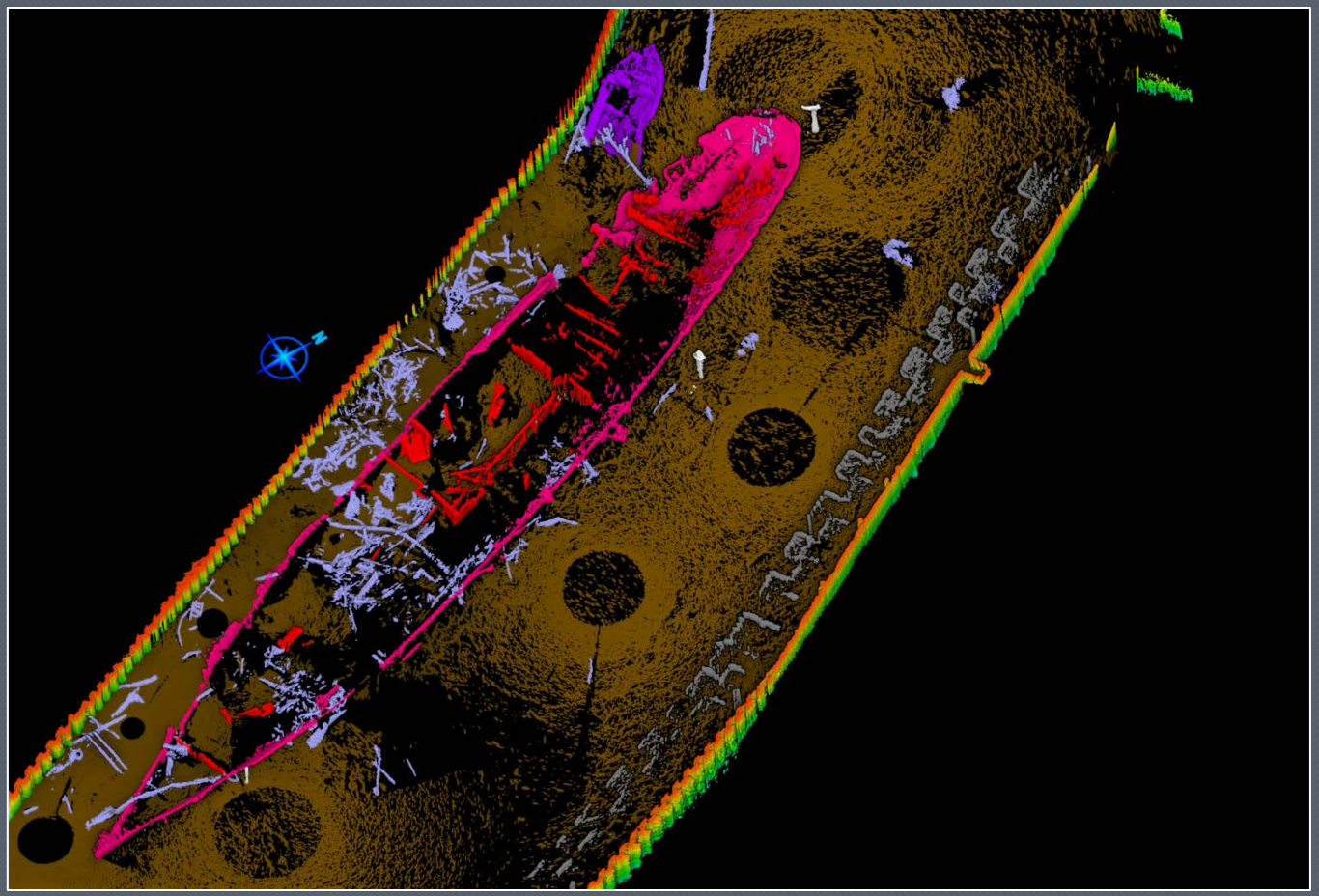
Northern Plains Railroad: 2011 Floods near Bottineau, ND



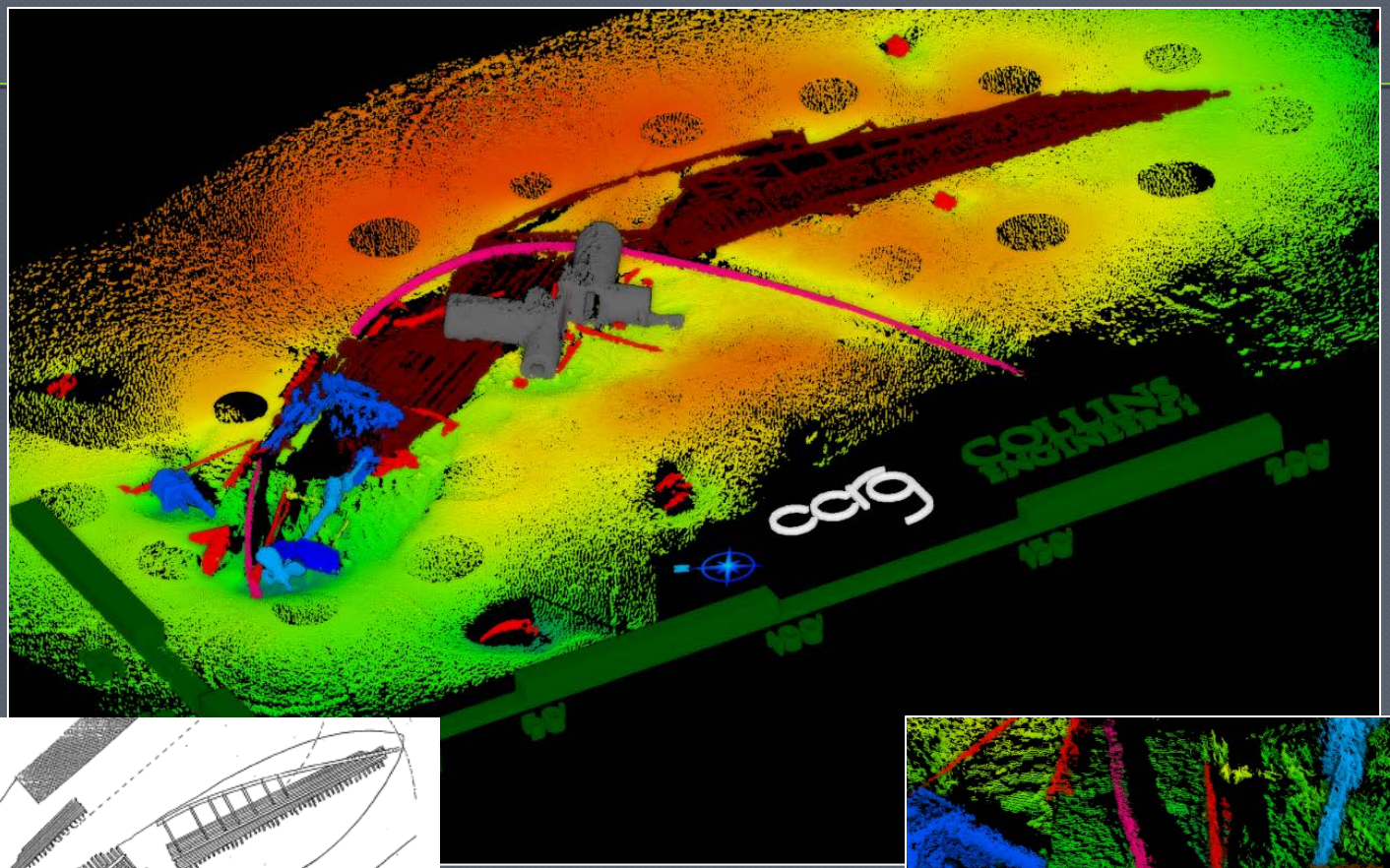
Example 2 – Diver Safety

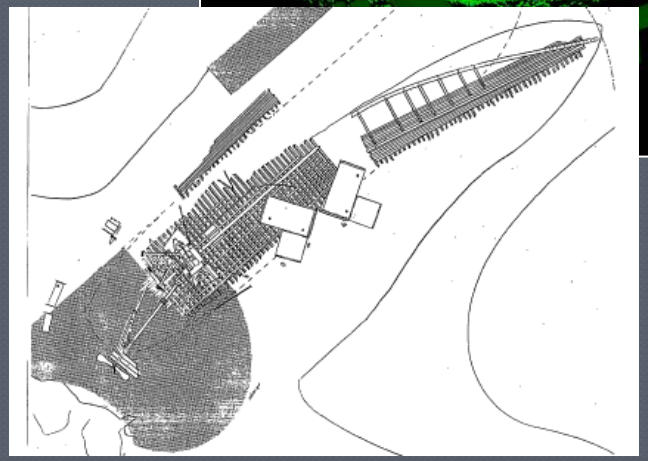


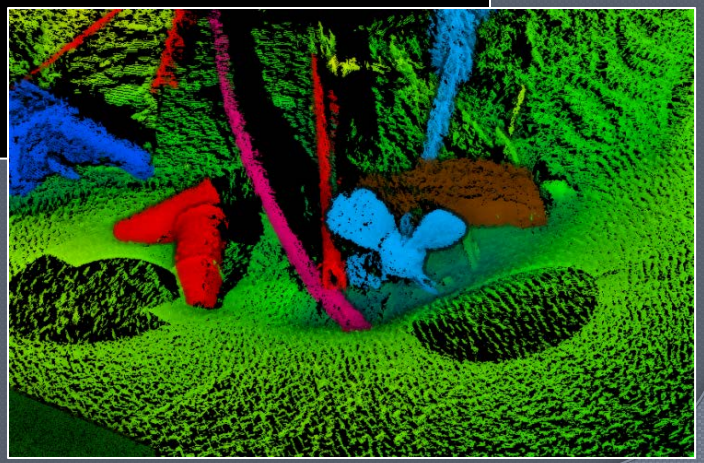
Example 3– Obtain Data Over Shallow Obstructions



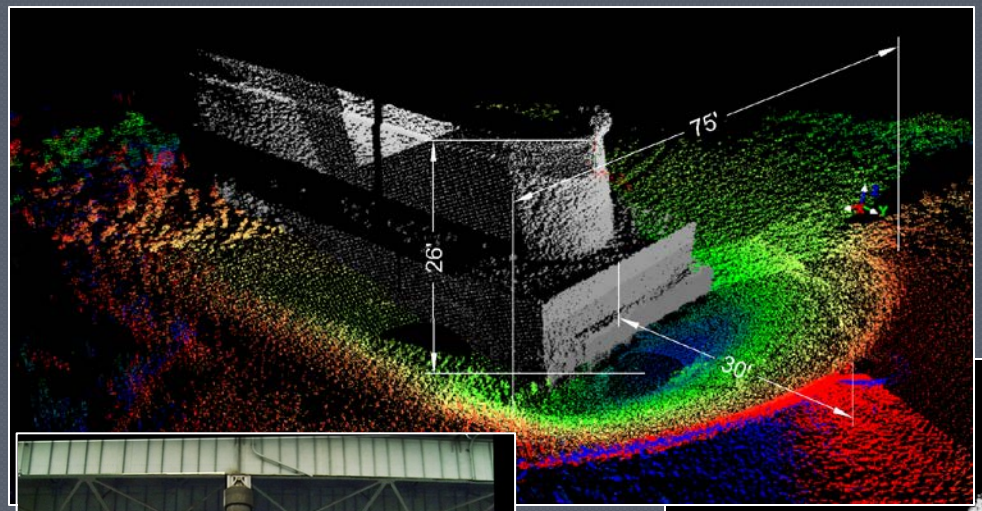
Example 5 – Archeological Documentation

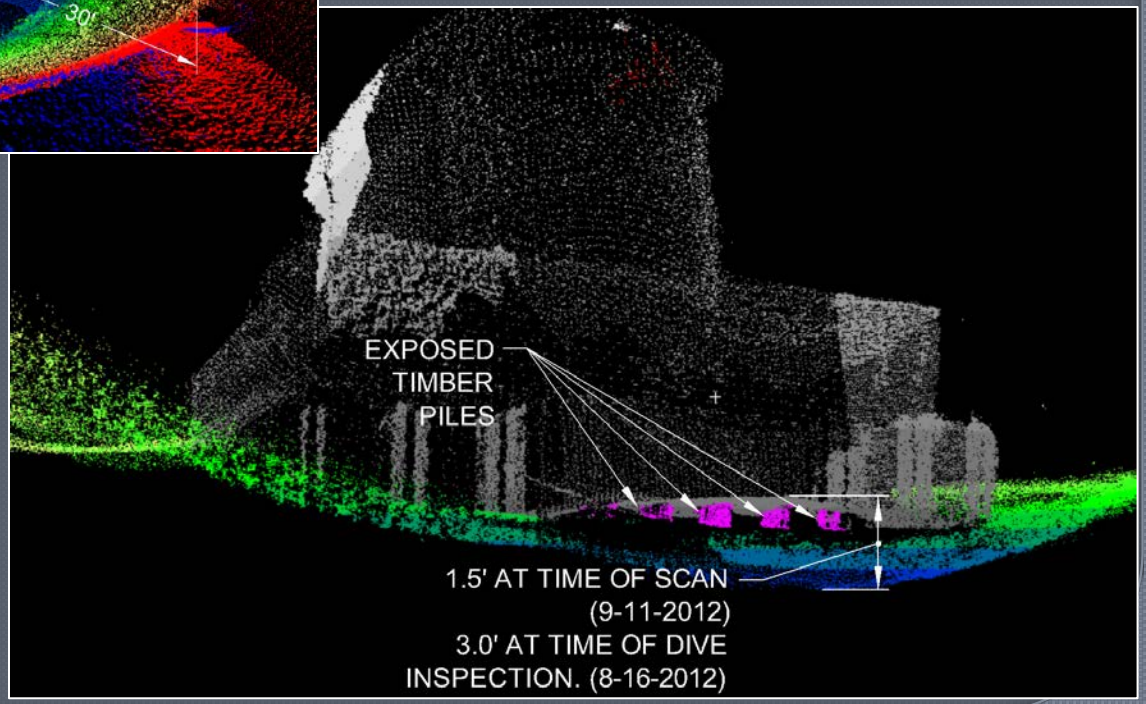




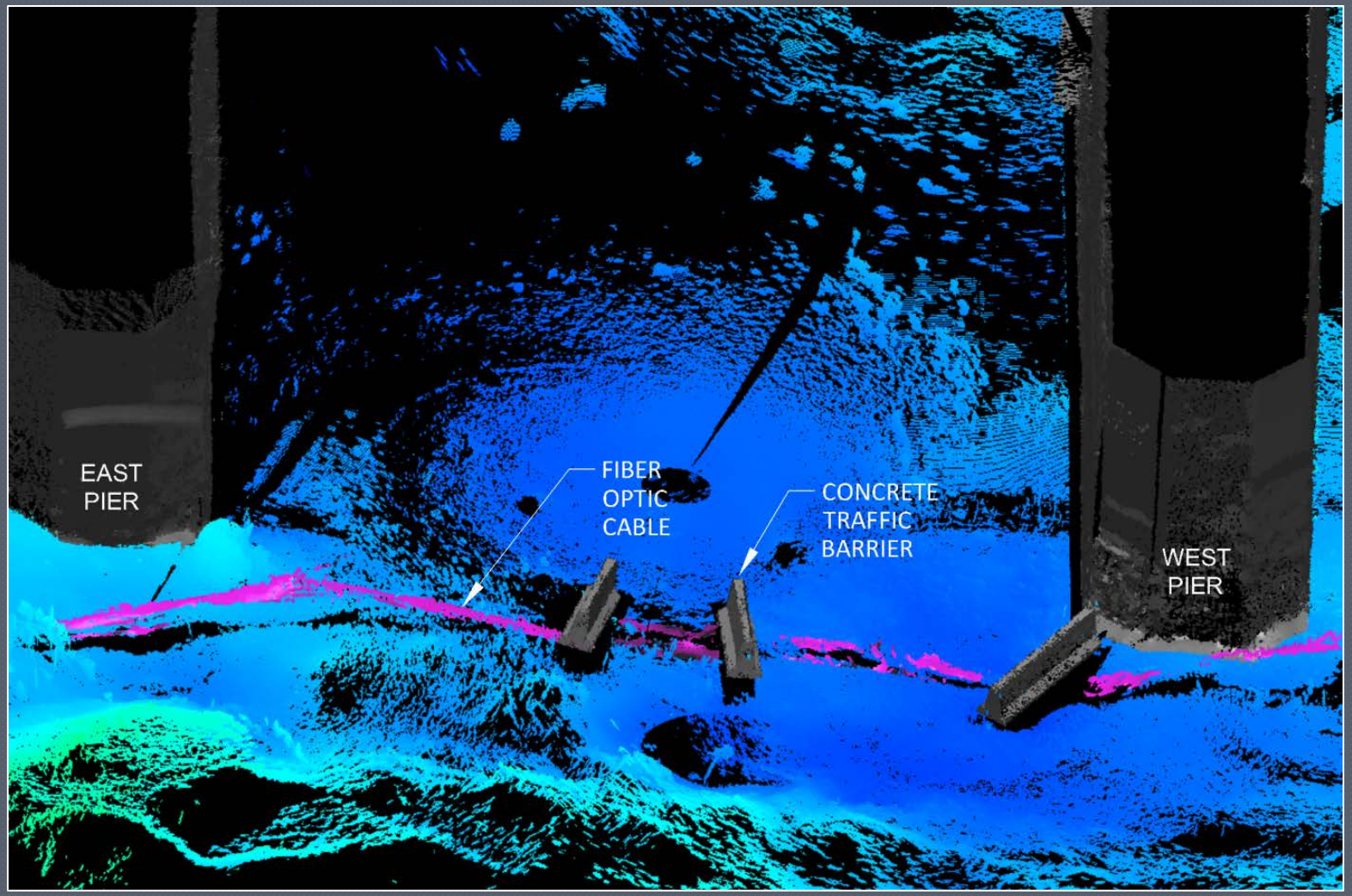


Example 6 –Areas Inaccessible to Traditional Surveys



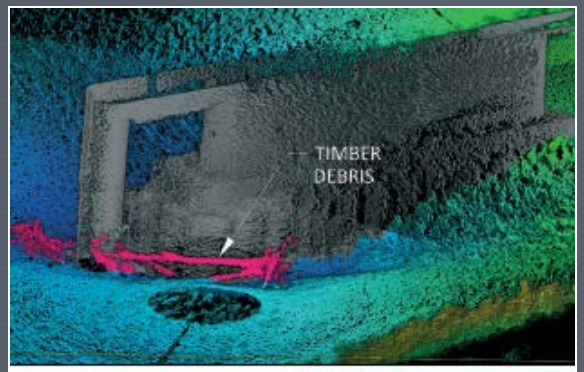


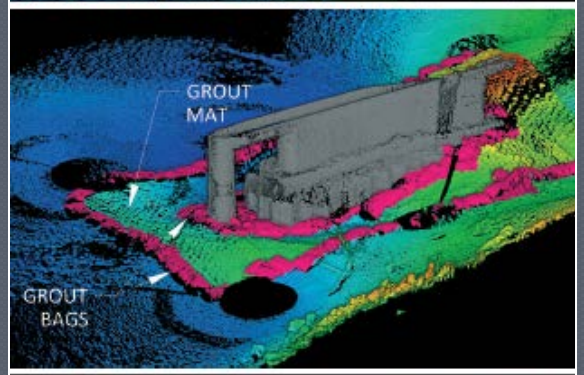
Example 7 – An Image is Worth a Thousand Words… And it might be worth even more in a claim.

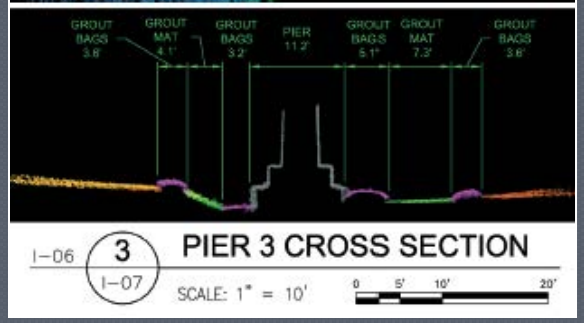


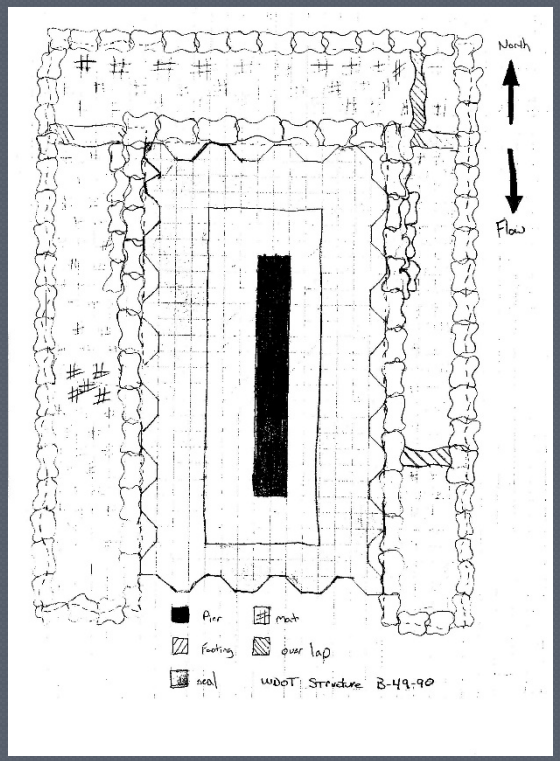
Example 8- Underwater Construction Inspection

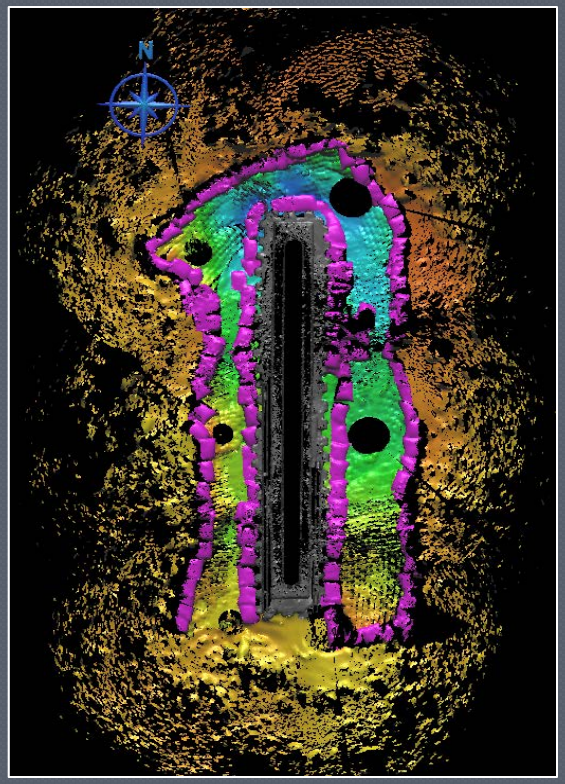
Reduce Claims & Create As-Built Drawings







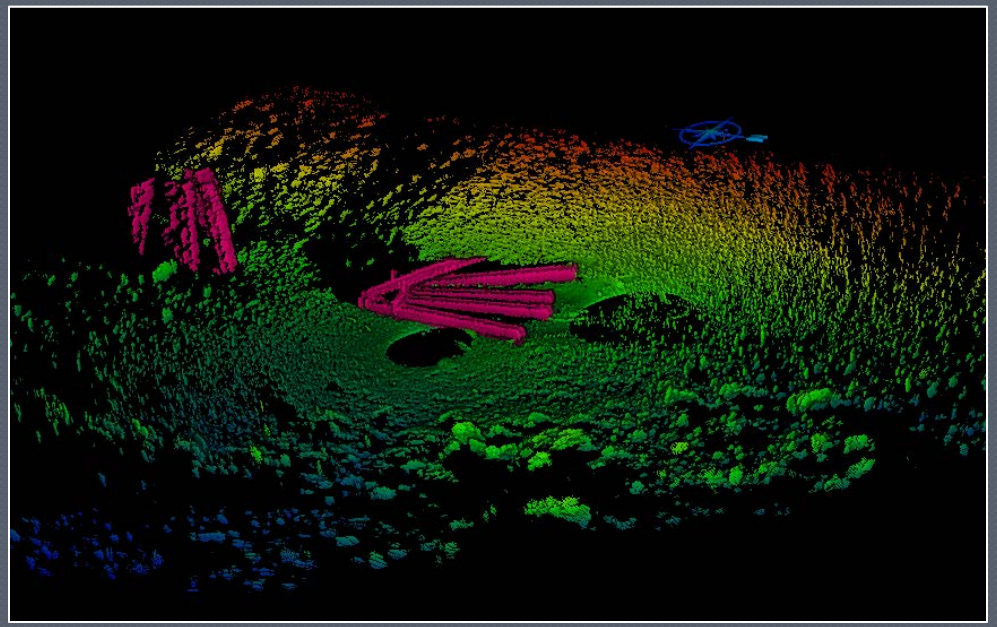




"The BlueView data that Collins Provided was extremely useful to us. It reduced the risks for everyone involved."– Tom Hardinger, Bridge Maintenance Engineer for WisDOT

Presentation Agenda

- Introduction
- What Is Acoustic Imaging
- Example Projects
- Conclusions



Conclusions

Current Technology allows safe and cost effective underwater investigation during hazardous conditions, flood peak levels, and frozen surfaces.

- Acoustic imaging can:
  - provide useful information when traditional methods are difficult or unsafe.
  - increase equipment and diver safety.
  - increase quality.
  - decrease risk.

Questions

Contact:

Greg Heringhaus
(312) 704-9300

gheringhaus@collinsengr.com

COLLINS ENGINEERS INC.

877-FIND-CEI (24-hr Emergency)
www.collinsengr.com