Presentation to the Building and Operating Committee
Meeting of August 21, 2025
Agenda Item No. 5

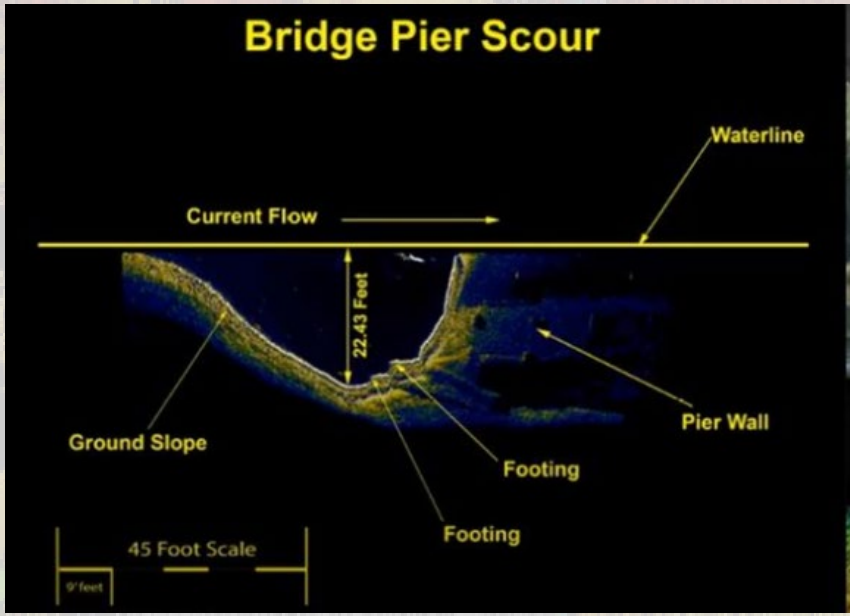
Golden Gate Bridge Underwater Inspection

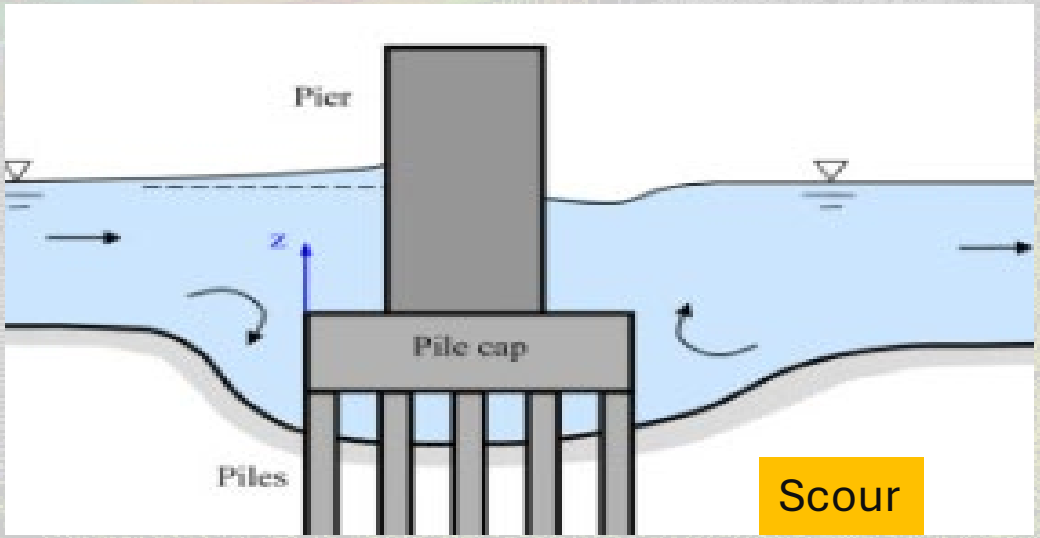
UW Inspection Requirements

- National Bridge Inspection Standards (NBIS) was revised in 1988 to include underwater inspection requirements. This was in response to the Schoharie Creek Bridge's collapse in 1987.
- More than 80 percent of the approximately 628,000 US highway bridges cross some type of waterway.
- Scour or undermining is one of the main causes of bridge failure or collapse.
- Scour is not observed at the Golden Gate Bridge.

Scour and Undermining

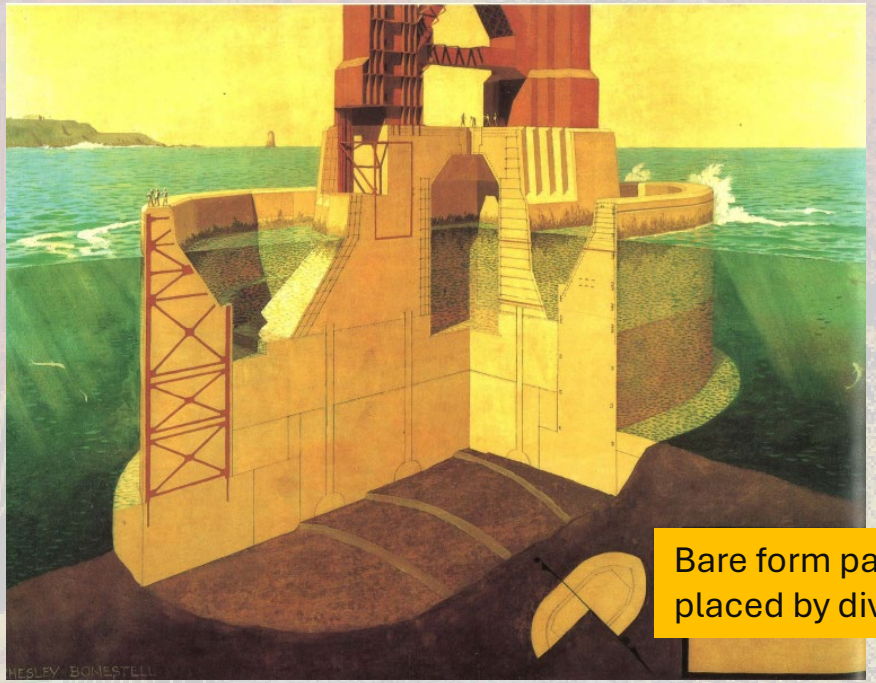
Schoharie Creek Bridge in NY



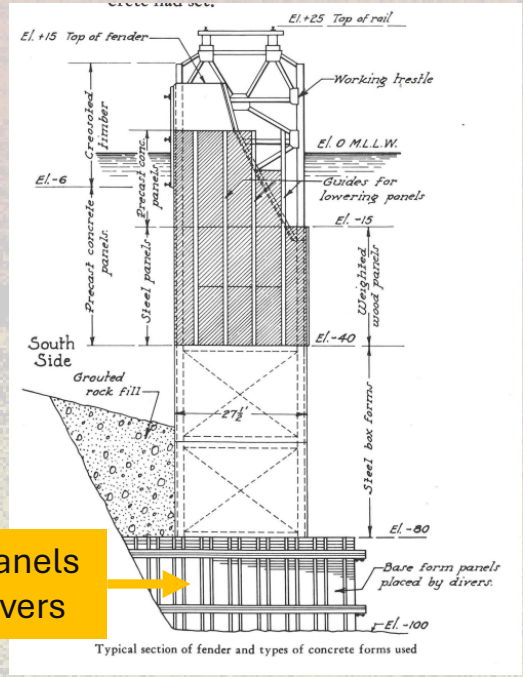


Scour

GGB South Tower Pier and Fender

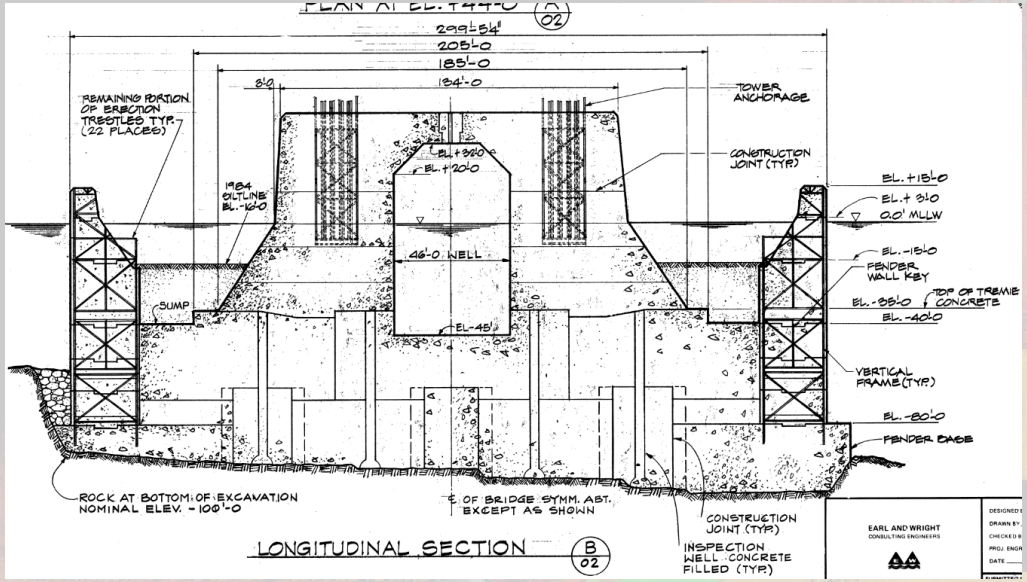


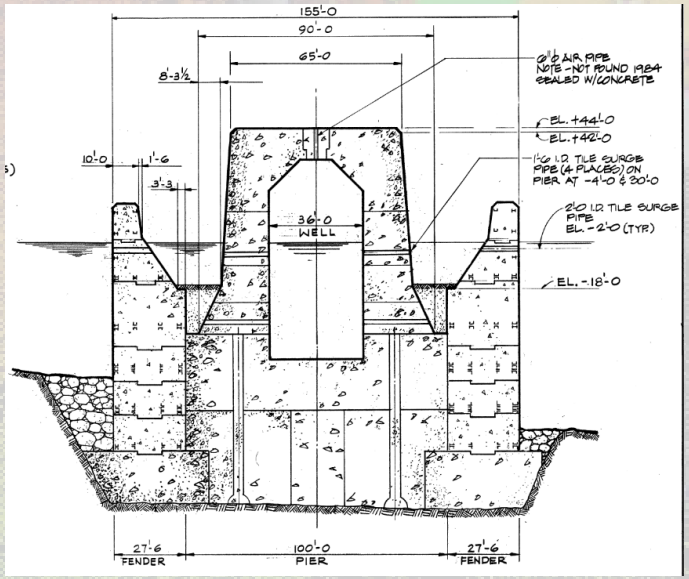
Bare form panels placed by divers



Typical section of fender and types of concrete forms used

GGB South Tower Pier and Fender

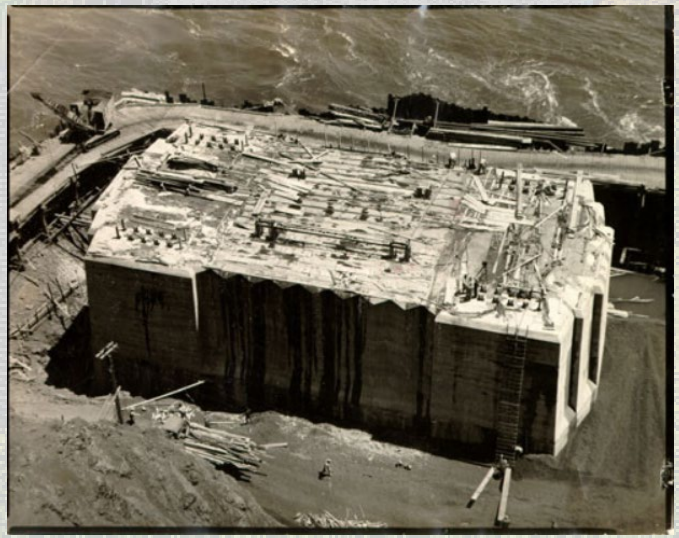


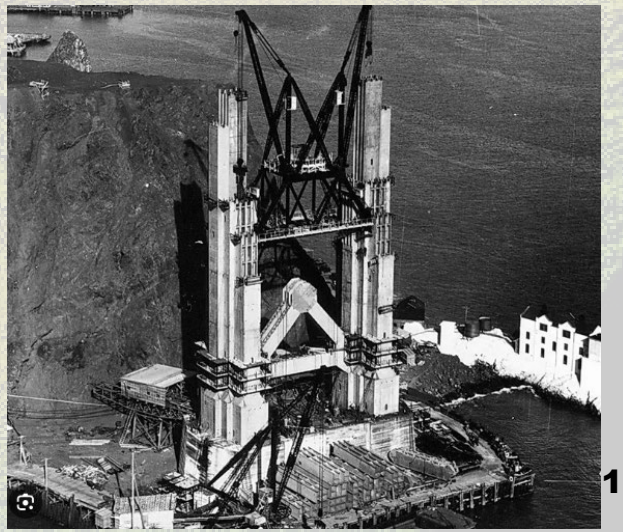


- Fender Details
  - ✓ Encloses football field sized area
  - ✓ Over 120ft maximum height in 75ft average water depth
  - ✓ 40ft maximum wall thickness
  - ✓ Over 105,000 cubic yards of concrete
- Tower Pier Details
  - ✓ Constructed within dewatered fender
  - ✓ 140ft long by 66ft wide
  - ✓ Foundation keyed into bedrock at 110ft below sea level
  - ✓ 23,500 cubic yards of concrete

GGB North Tower Pier

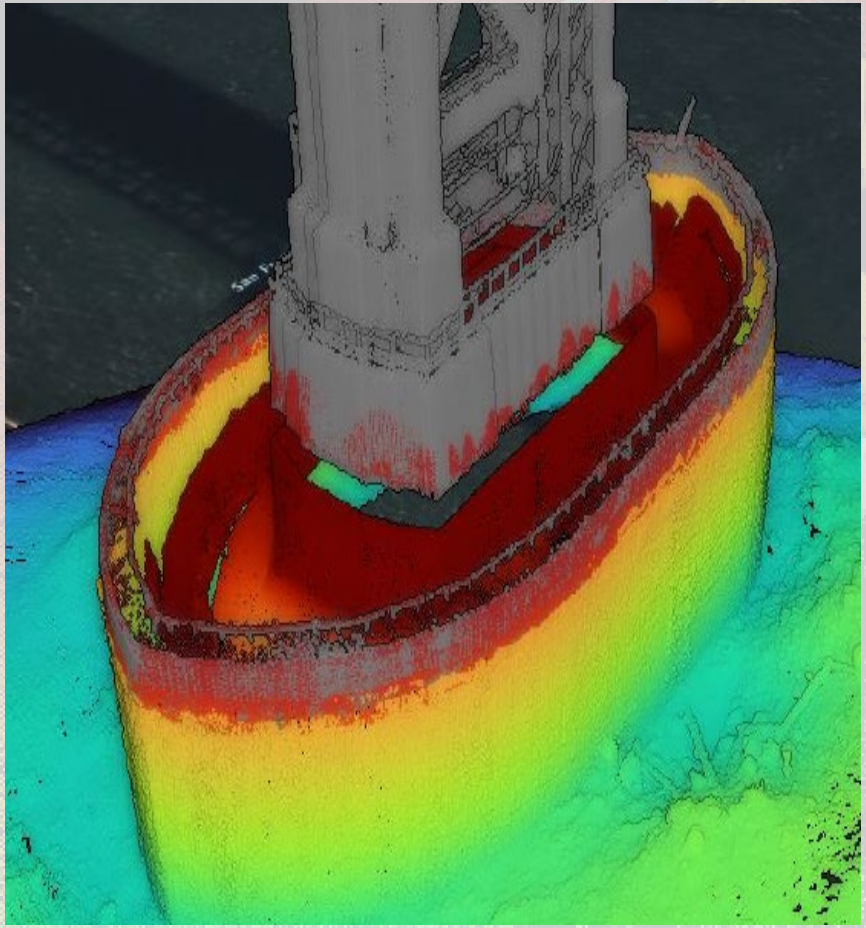
- North Tower Pier Details
  - ✓ Constructed within dewatered cofferdam
  - ✓ Same size as South Tower Pier, 140ft long by 66ft wide
  - ✓ Keyed into bedrock with 160ft by 80ft base dimension
  - ✓ 23,500 cubic yards of concrete





UW Inspection Scope of Work

Step 1: Sonar scanning and imaging



Step 2: Visual & tactile examination

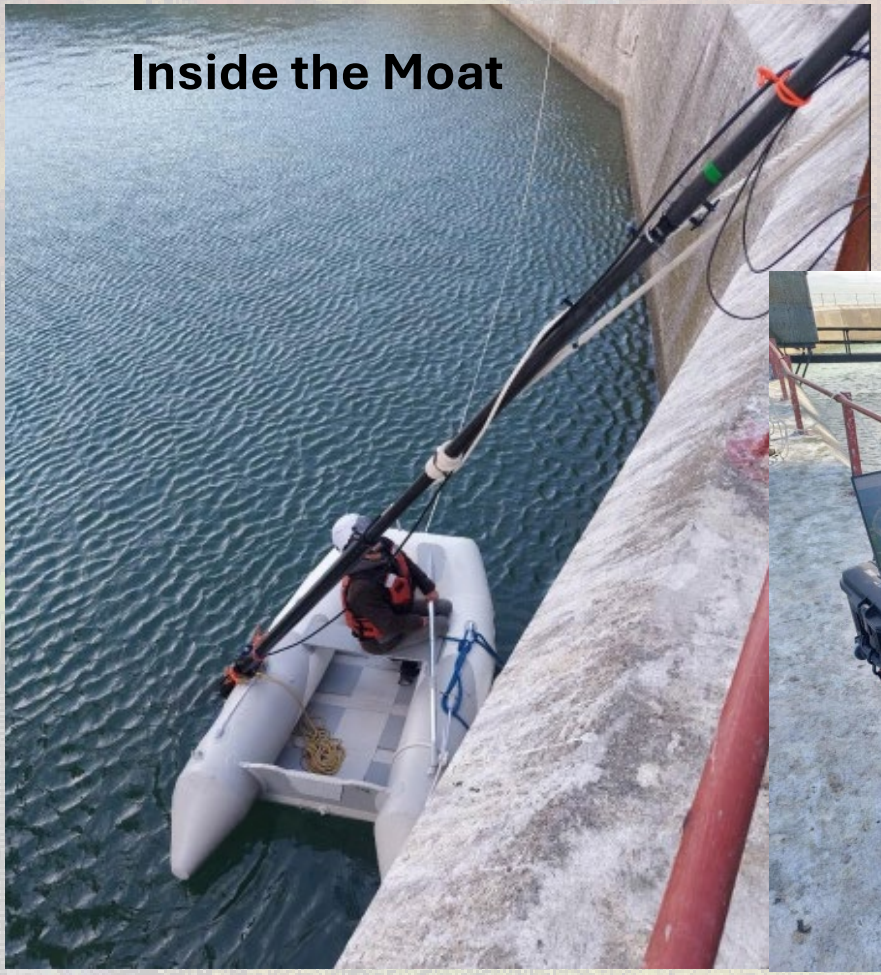
Step 3: Cleaning & In-depth inspection

Sonar Scanning

- To obtain bathometry as well as identify areas of interest or concern prior to diving inspections
- High-resolution sonar survey with the combined use of multibeam(1) and mobile LiDAR (2)
- Limits of works:
  - ✓Concrete faces of the South and North Tower Piers
  - ✓ Interior and Exterior faces of the South Tower Fender
  - ✓ Seafloor (bathymetric map of the areas extending a minimum horizontal distance of 100 feet from the South Tower fender and North Tower pier)

Note 1: Multibeam uses sound waves to map the seafloor suitable for deep water survey, e.g. bathymetry between towers.
Note 2: LiDAR uses lasers to measure distances and create detailed 3D models of surfaces, ideal for shallow water survey, e.g. moat and piers.

Sonar Scanning – March 2025



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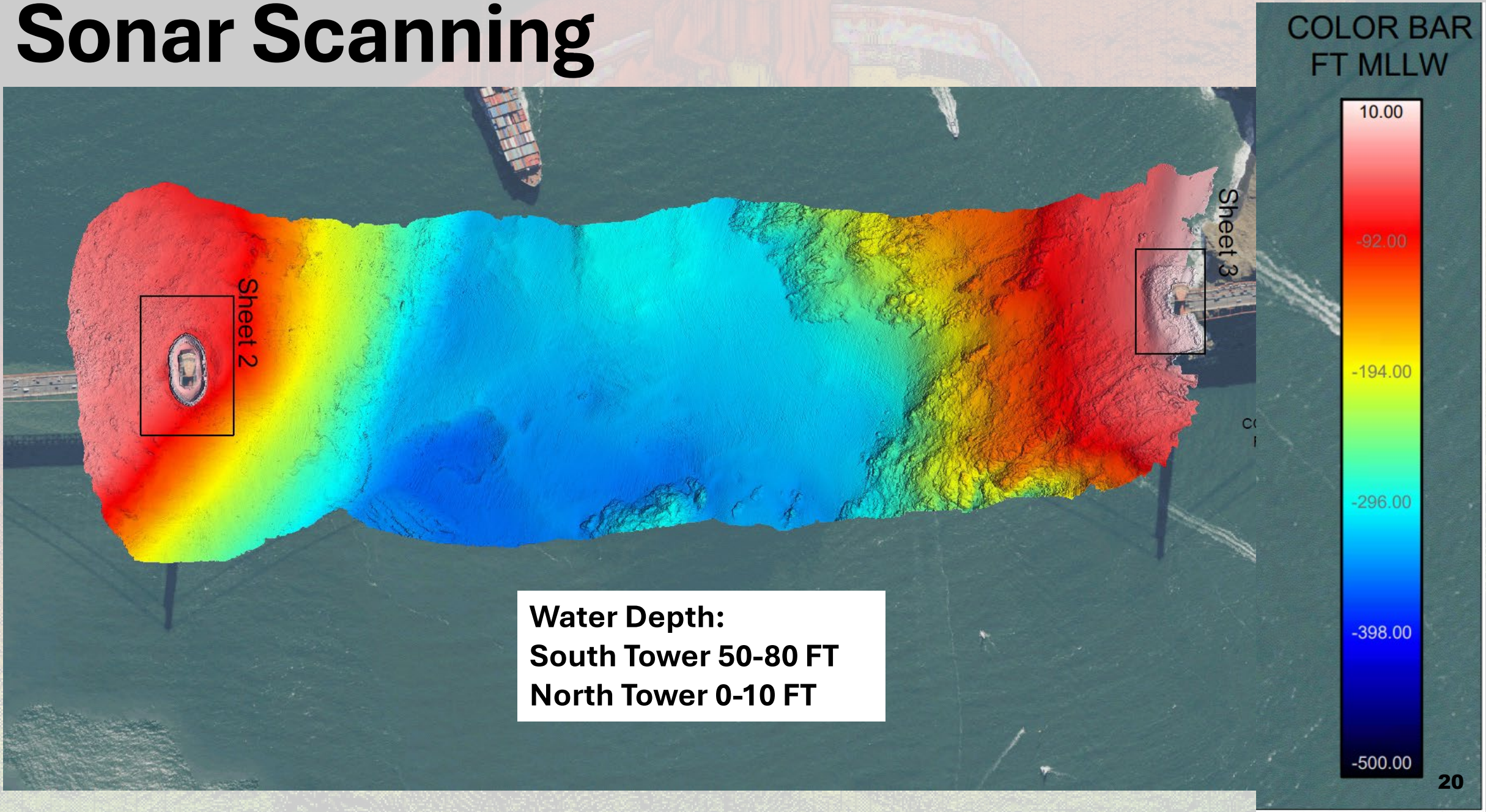
Sonar Scanning



Sonar Scanning

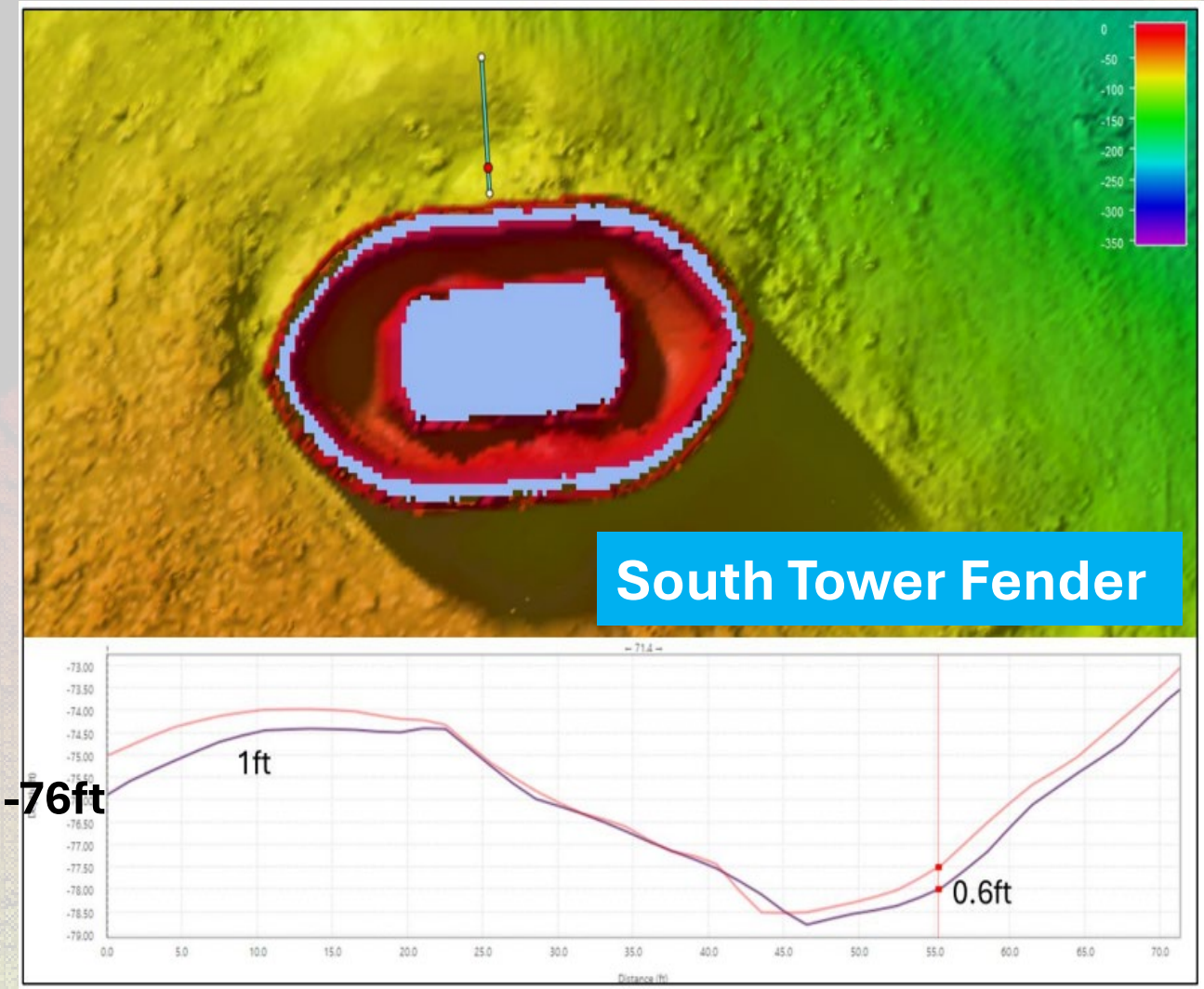
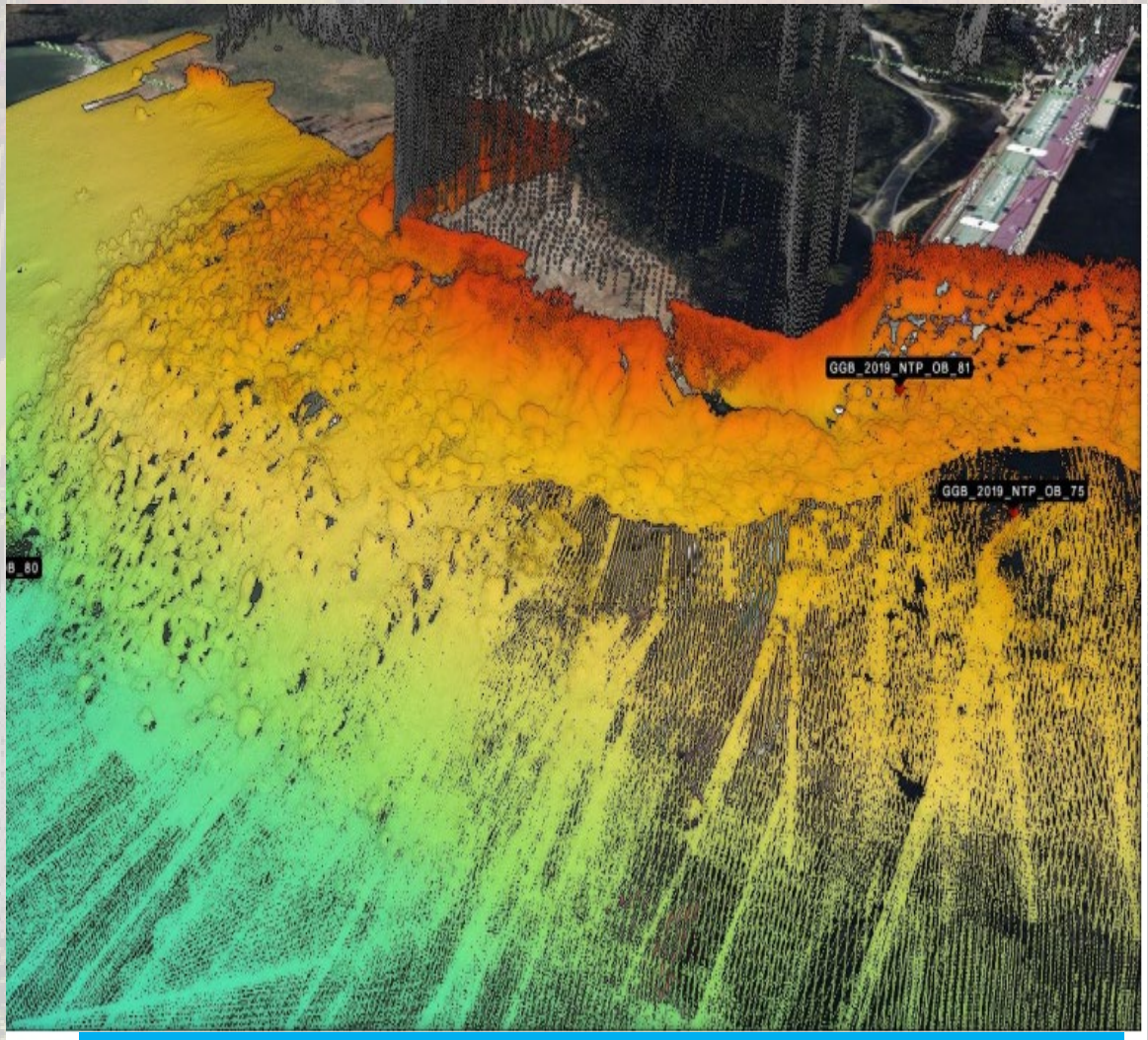
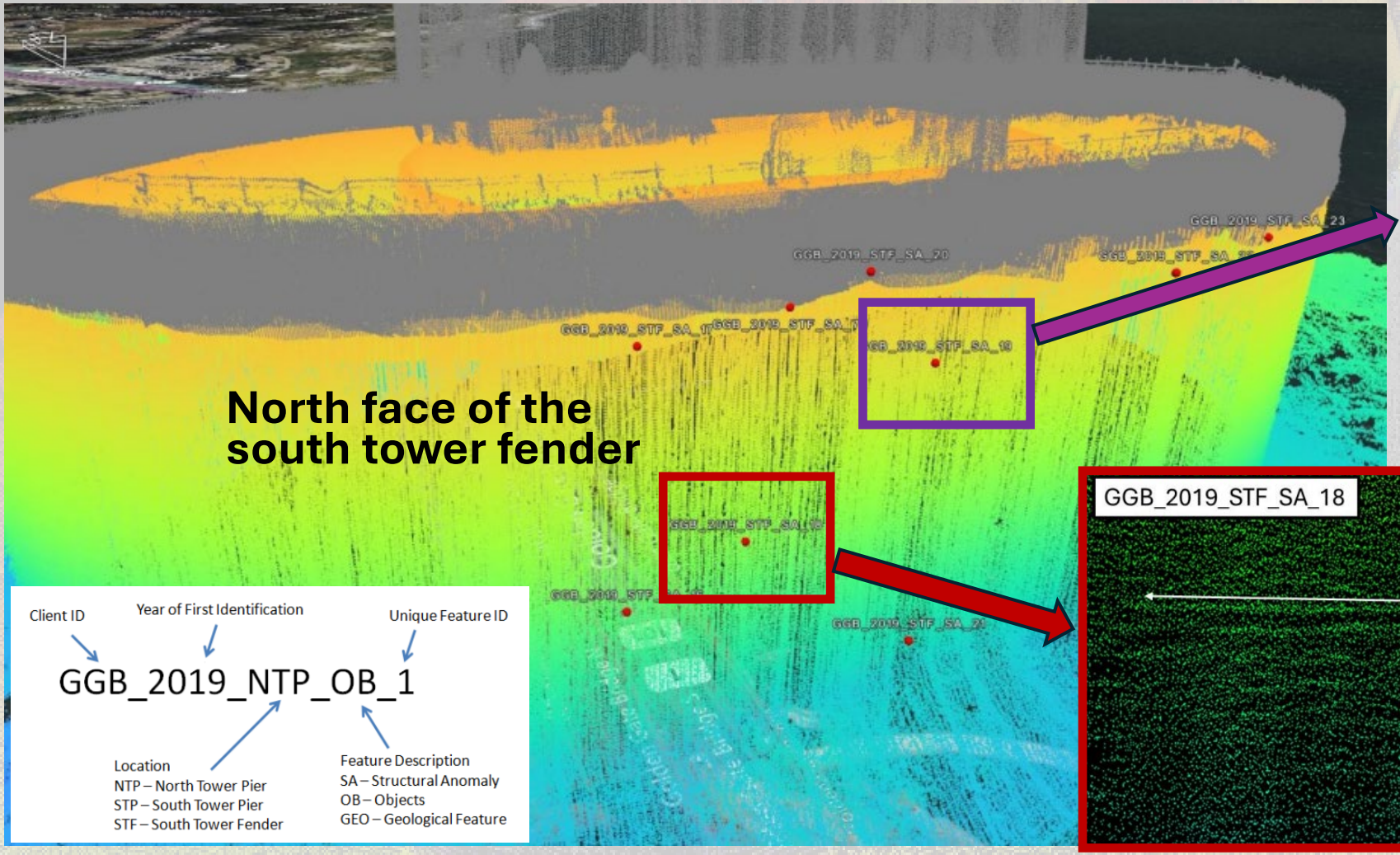


Figure 5-107 – South Tower Bathymetric Surface Change 2019 (red line) – 2025 (purple line)

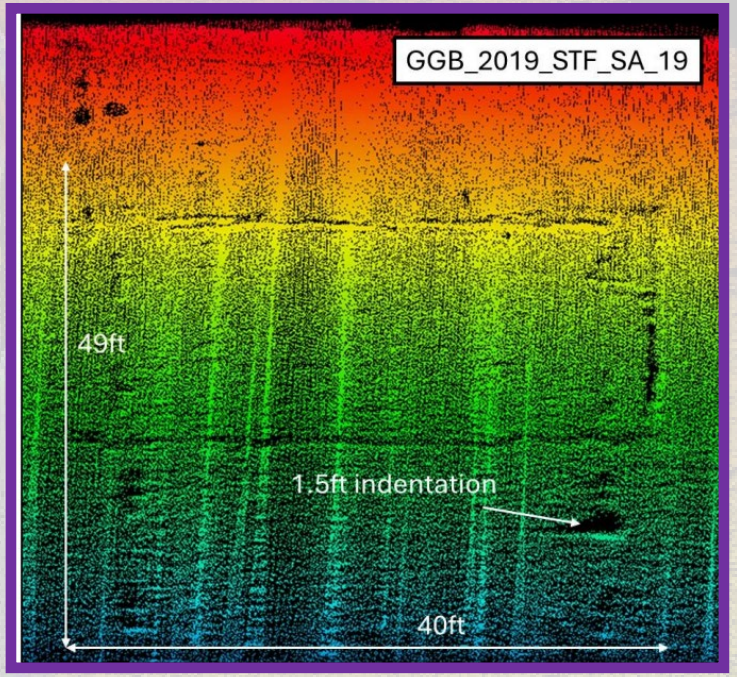


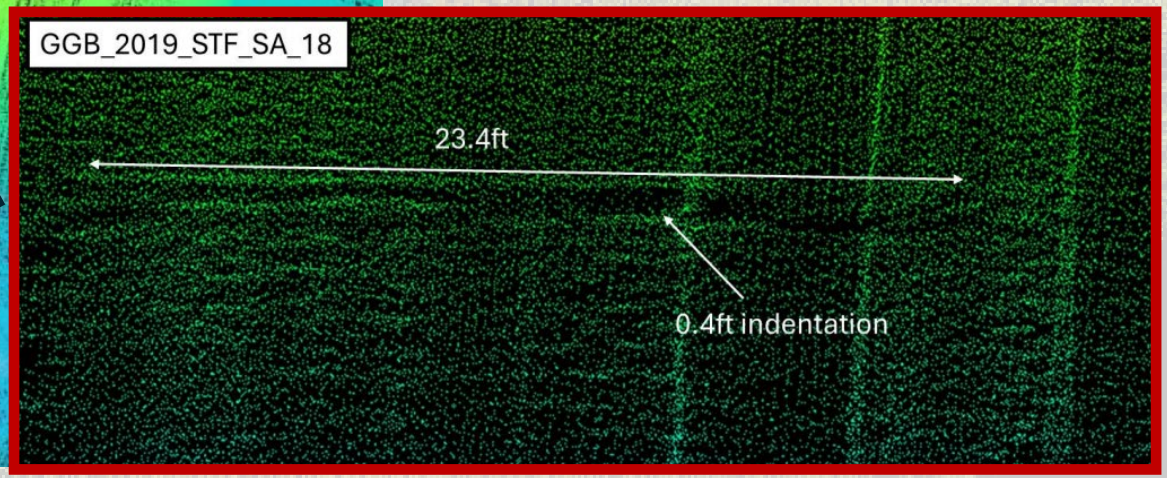
North Tower Pier Bathymetry Features

Sonar Scanning



North face of the south tower fender





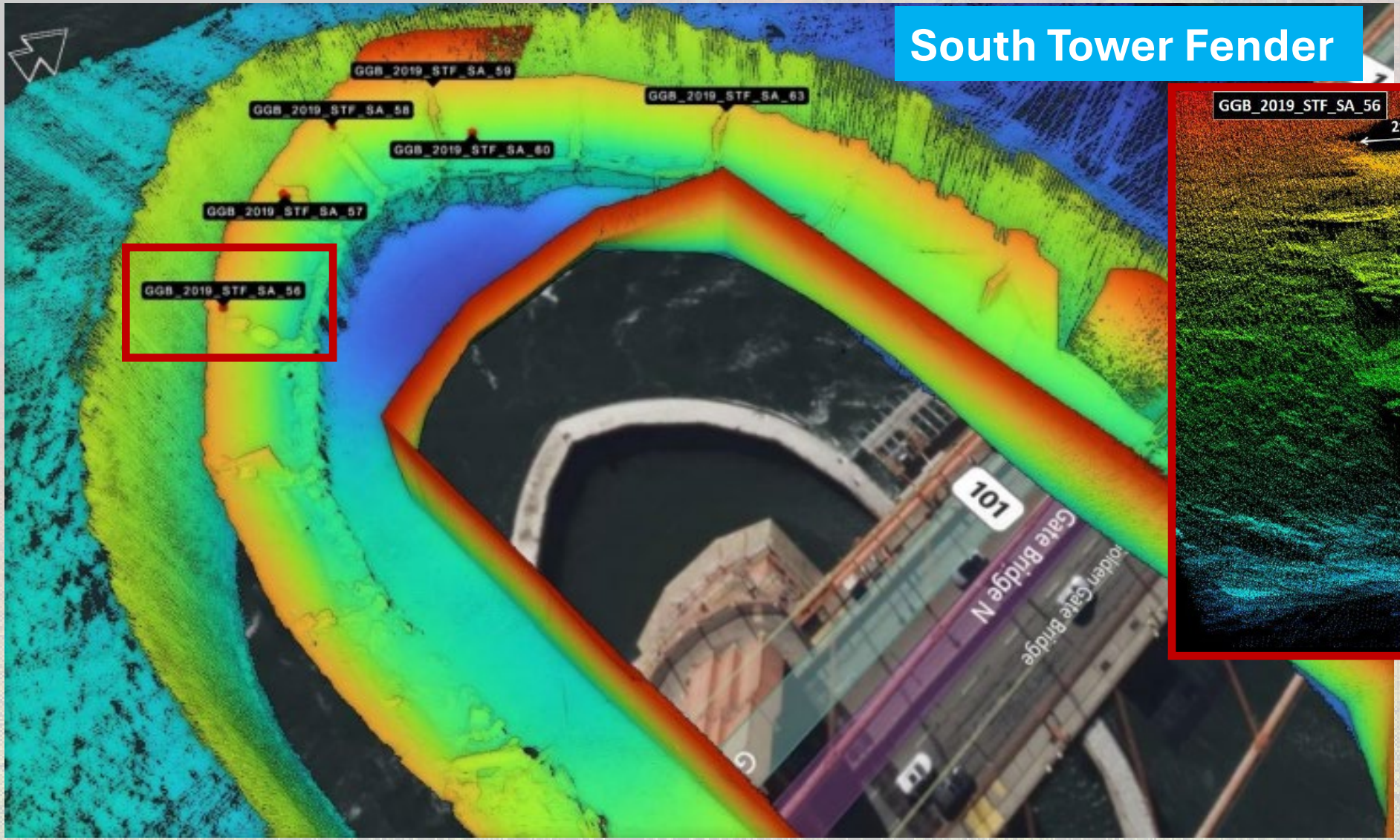
Client ID — Year of First Identification — Unique Feature ID

GGB_2019_NTP_OB_1

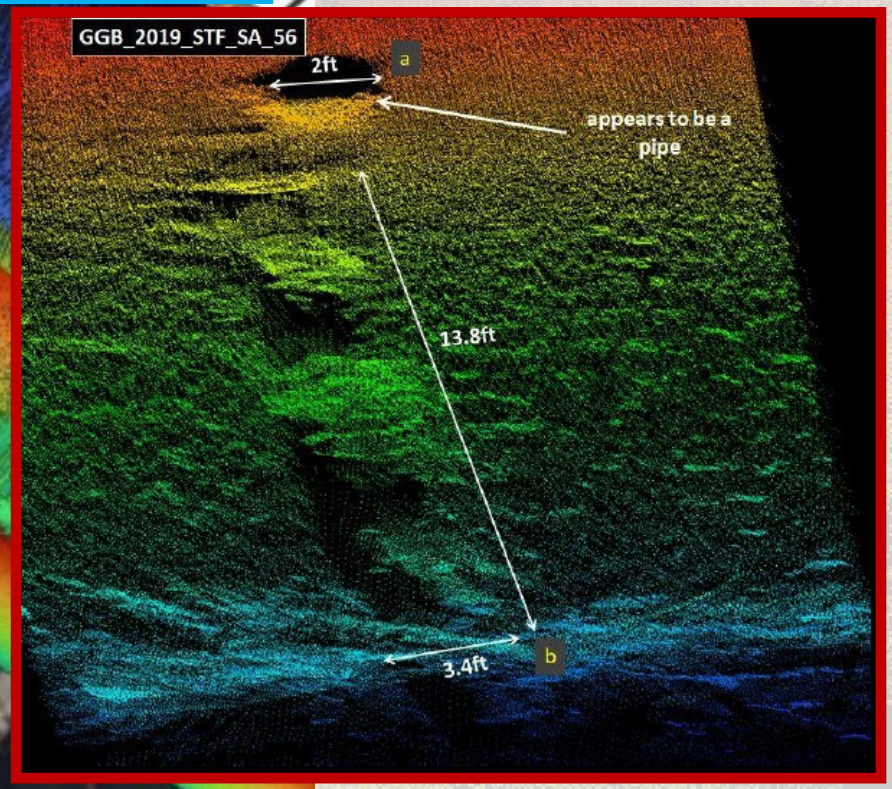
Location
NTP – North Tower Pier
STP – South Tower Pier
STF – South Tower Fender

Feature Description
SA – Structural Anomaly
OB – Objects
GEO – Geological Feature

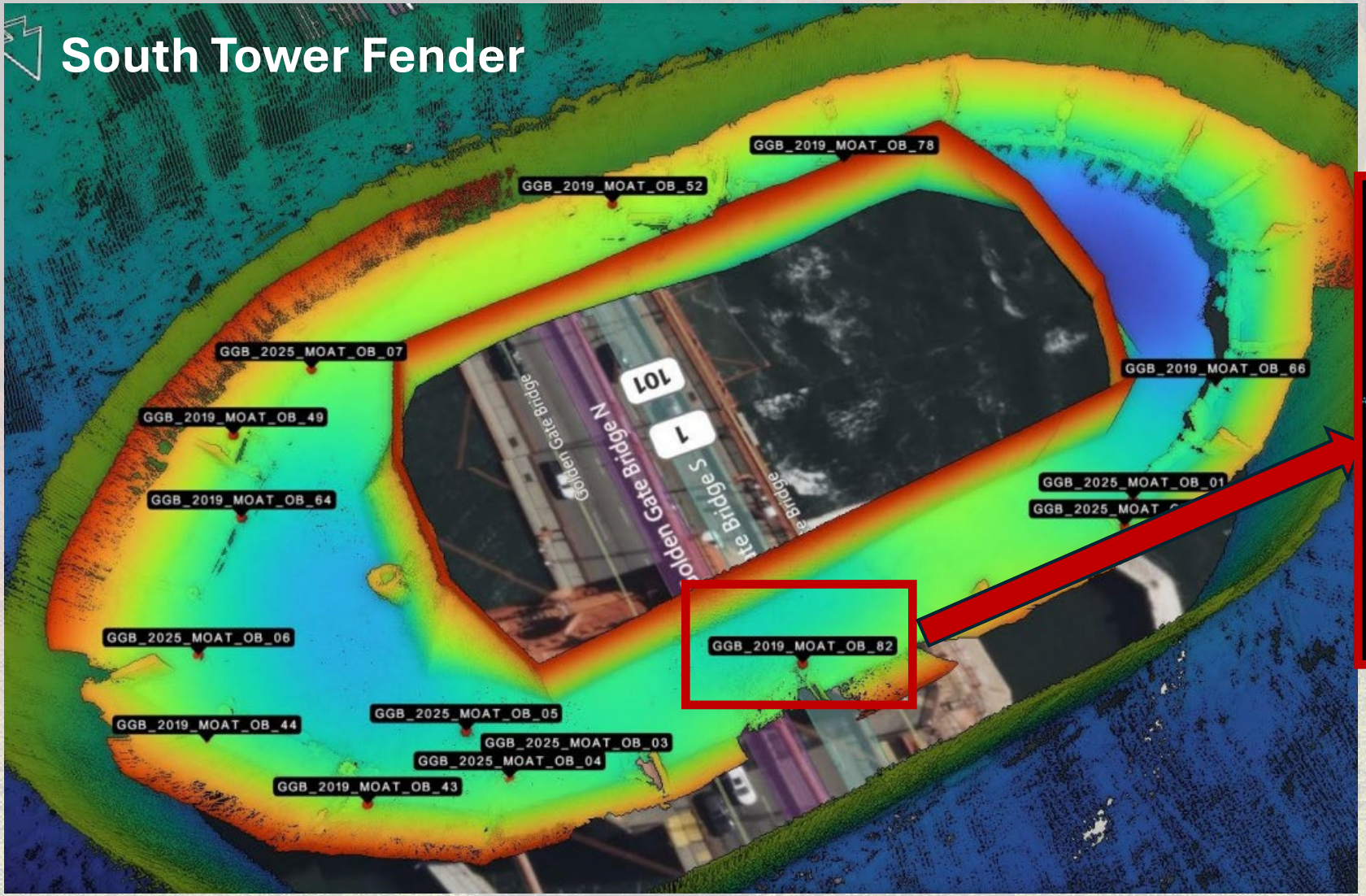
Sonar Scanning

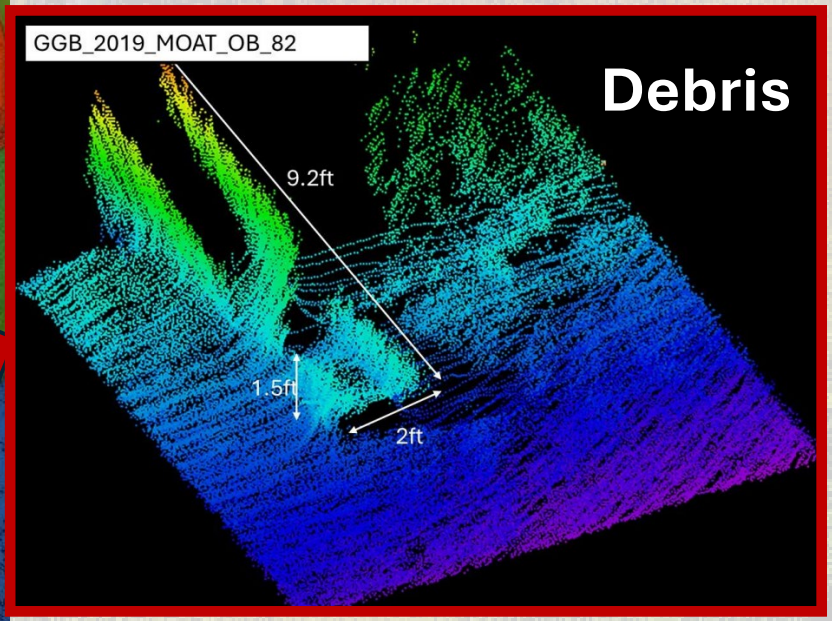


South Tower Fender



Sonar Scanning

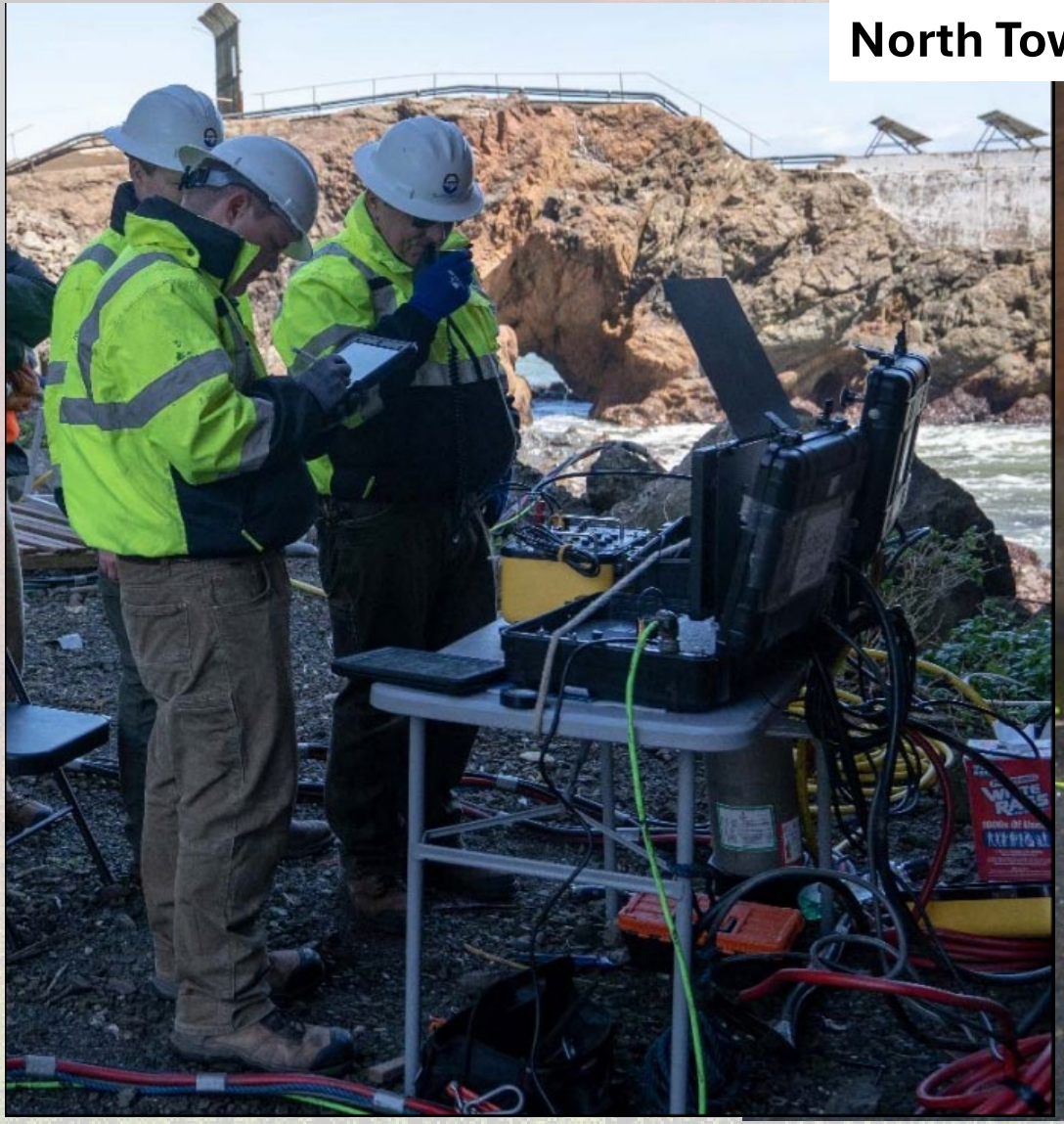




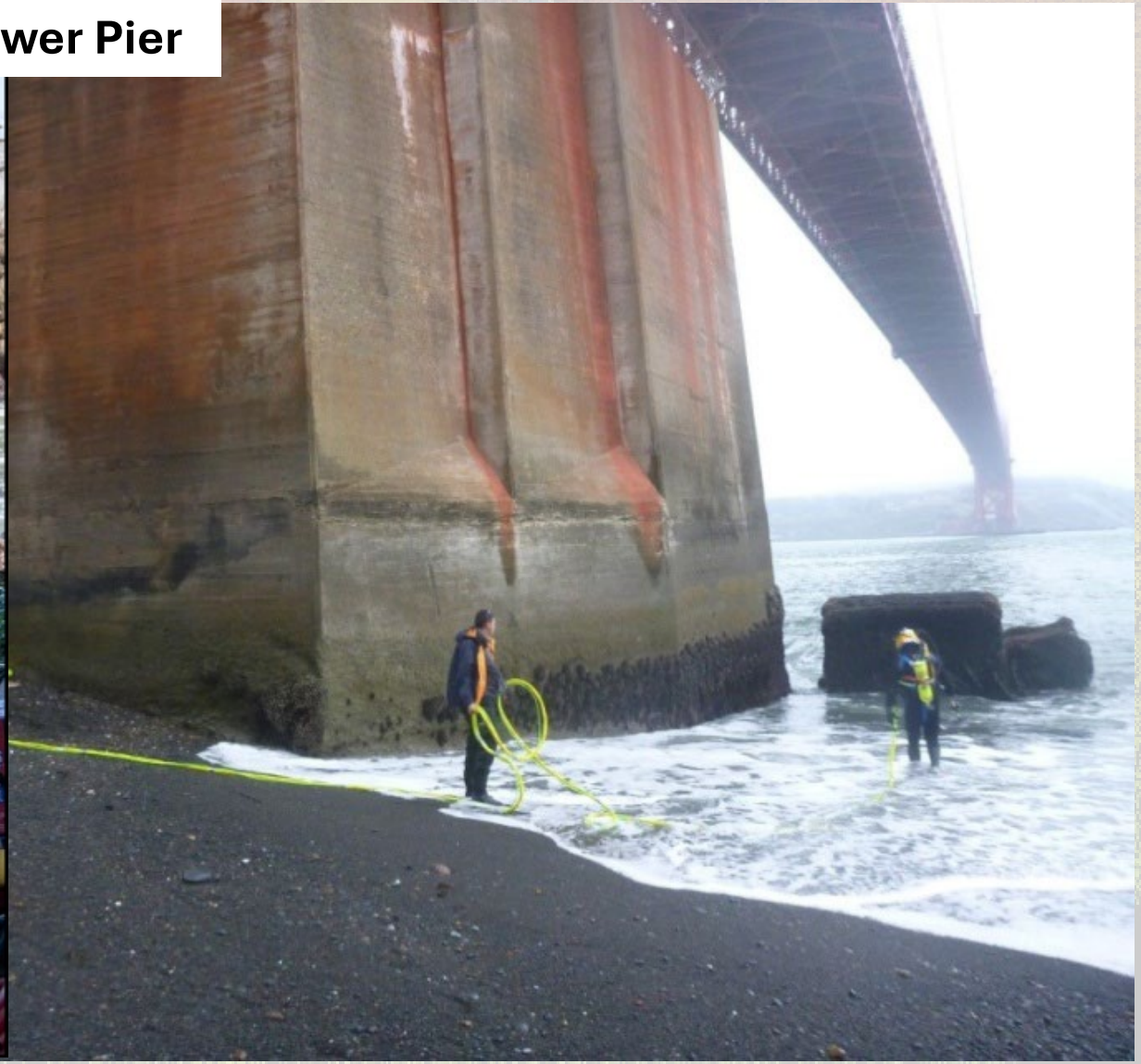
Level I and II Dive Inspections

South Tower Pier and Fender

Level I and II Dive Inspections



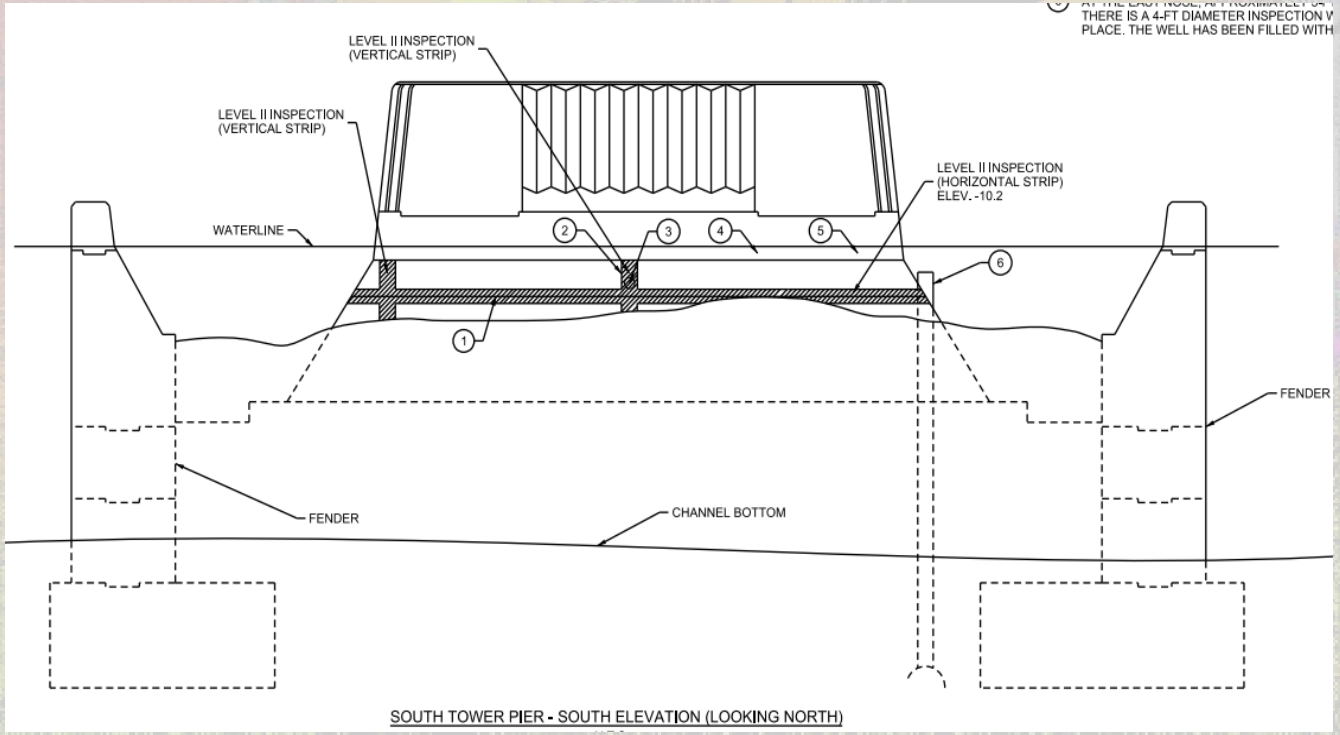
North Tower Pier

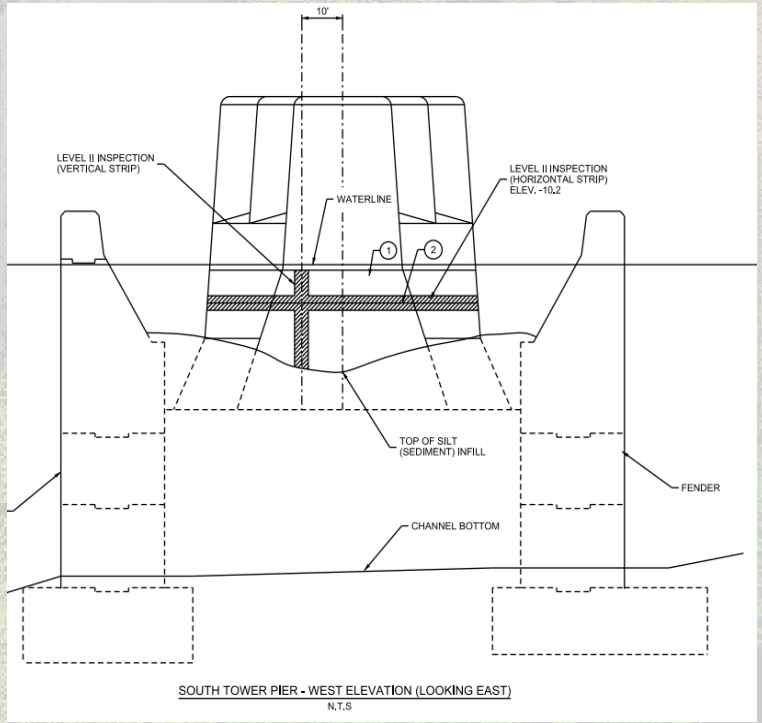


UW Inspection Scope of Work

Level II Inspection consists of cleaning & in-depth inspections:

- ✓ 6 Vertical and one horizontal strips cleaned for Level II inspection
- ✓ Approximately 1,000 sq.ft of marine growth cleaning was performed for Level II inspection





Level I and II Dive Inspections

Level I and II Dive Inspections

- South Tower and Fender: Satisfactory Condition
  - ✓ Cold joint at Elevation – 10.2
  - ✓ Hairline width vertical cracking in the splash zone.
  - ✓ Isolated 1/8-in wide vertical cracks, with edge spalling and isolated areas of light efflorescence in the splash zone.

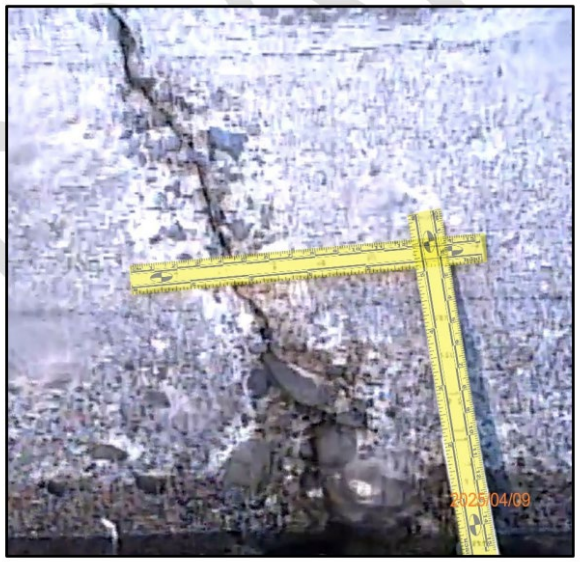


Photo 12 – South Pier, West Face, 1/8-in wide Crack with Spalling

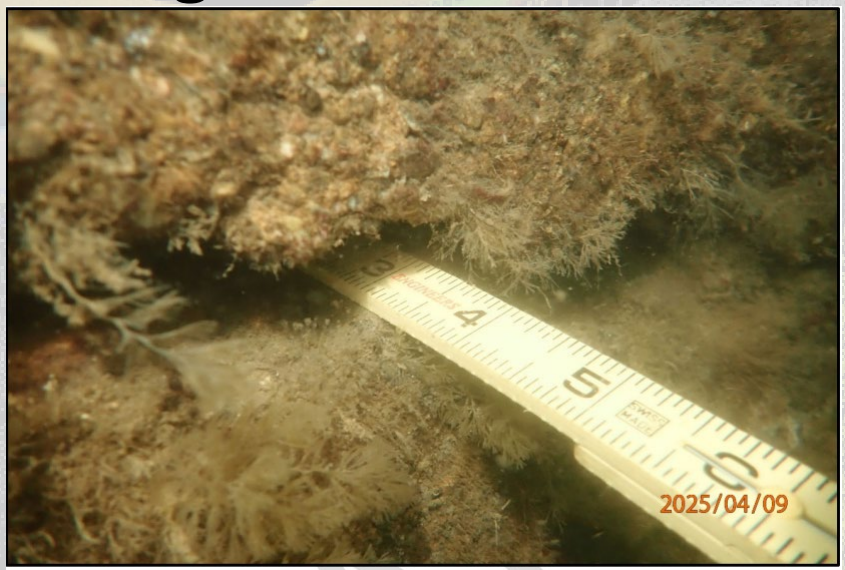


Photo 19 – South Tower Pier, Voiding at Cold Joint at ELEV. -10.2

Photo 23 – South Tower Pier Fender, South Face, Spalling with Exposed Reinforcing

Level I and II Dive Inspections

- North Tower Pier: Satisfactory Condition
  - ✓ The west end of the pier has abrasion, up to 6-in penetration, with one exposed reinforcing steel bar at the northwest corner.

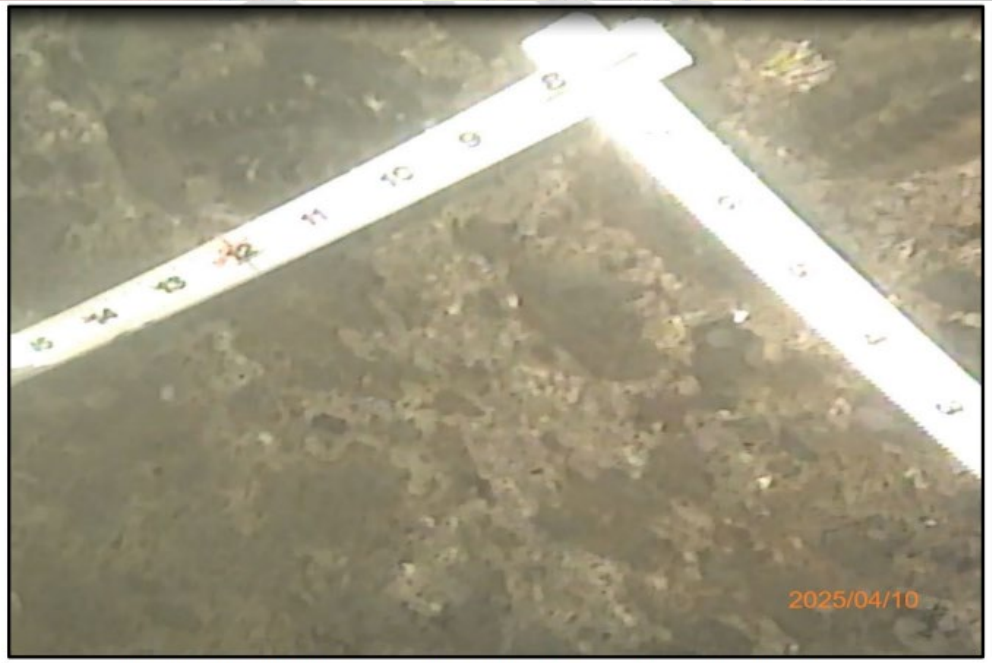


Photo 28 – North Tower Pier, West Face, Abrasion, 3-in deep

Photo 26 – North Tower Pier, South Face, Rock Outcropping to Left (West Face) and In Foreground (South Face), Spalling with Exposed Reinforcing Above MHHW

Underwater Inspection - 2025

- No critical or major issues were observed.
- Overall rating is Satisfactory Condition:
  - ✓ Widespread minor or isolated moderate defects
  - ✓ Condition is the same as that found during the previous underwater inspection performed in 2019
- In full compliance with federal and state regulations.

Level I and II Dive Inspections

- Work Recommendations
  - ✓ South Tower Pier: Clean and seal cracks that are 1/16-in wide and larger with an epoxy suitable for marine applications
  - ✓ South Tower Fender: Remove unsound concrete and patch areas of spalling that have exposed reinforcing steel
  - ✓ North Tower Pier: Remove unsound concrete and patch the area of abrasion damage and spalling

Thank you