SLIDES ONLY

NO SCRIPT PROVIDED

DERP WEBINAR

Underwater Munitions Response Technology

Kelly Dreyer, Office of the Deputy Assistant Secretary of War for Environmental Management and Restoration

John Jackson, U.S. Army Corps of Engineers

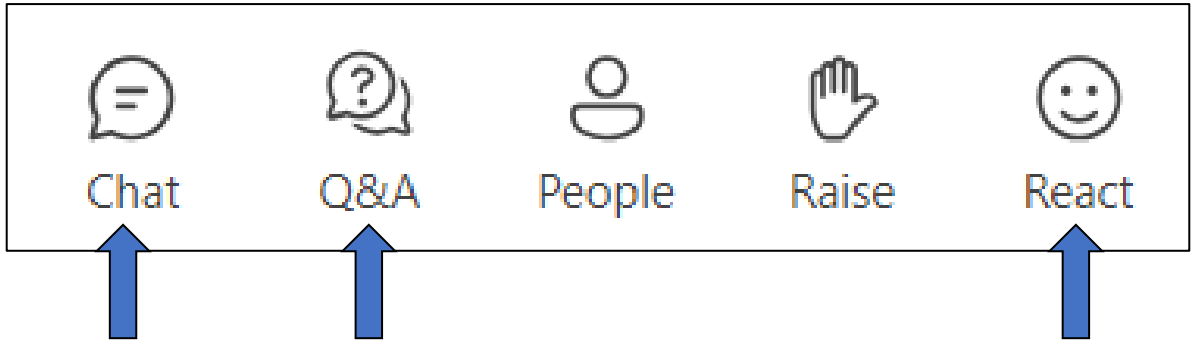
Kelly Enriquez, U.S. Army Corps of Engineers

Austin Geiser, Naval Facilities Engineering Systems Command and Expeditionary Warfare Center

Kyle Newman, Virginia Department of Environmental Quality

Webinar Rules

- Please use the **chat** function for general discussion.
- Please use the **Q&A** function if you have a content-related question during the webinar that you would like answered.
- Please use the **react** function to engage during the webinar.
- If you experience technical difficulties, please reach out to DoWWebinarSupport@bah.com



Agenda

- **Underwater Munitions Response Technology (UWMRT): Goals and Objectives** - John Jackson
- **Conceptual Site Models (CSMs)** - Kelly Enriquez and Austin Geiser
- **UWMRT: Types and Deployment** - John Jackson
- **Interstate Technology and Regulatory Council (ITRC) Underwater Munitions Response (MR) Team** - Kyle Newman
- **Wrap-up and Q&A** – All Presenters

Goals and Objectives of Underwater Munitions Response Teams

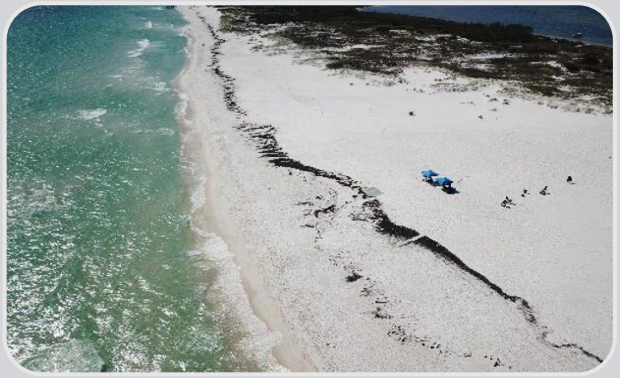
John Jackson

MR Program Manager

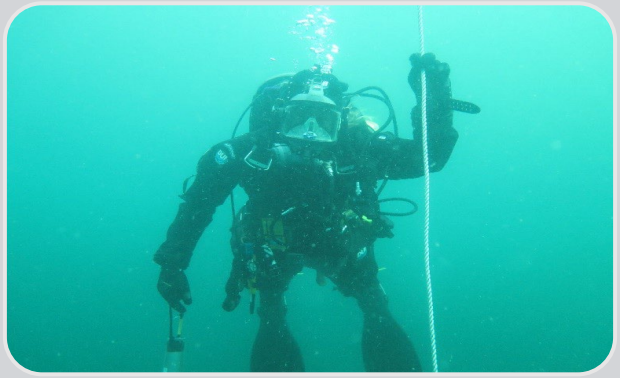
Strategic Environmental Research and Development Program and

Environmental Security Technology Certification Program (SERDP/ESTCP)

Challenge of an Underwater Environment



UXO remediation at underwater sites presents unique challenges for DoW compared to land-based sites.



The underwater environment restricts access and impacts the performance of established and emerging detection, classification, and localization (DCL) technologies.

Dynamic nature of sea conditions results in mobility of munitions and repeated burial.

DoW Goals and Objectives

DoW/ESTCP

- How do we transition underwater MR technology?
- How do we develop processes and quality control (read: Quality Assurance Project Plan) for underwater?

Services

- How do we contract underwater work?
- What are appropriate production assumptions?
- What technologies are ready for prime time?
- How do we manage uncertainty?

Stakeholders

- What's going on with our site?
- Standard Remedial Investigation (RI) concerns- nature, extent, risk?
- How can we minimize impact of investigation work to site users and receptors?
- How do we manage uncertainty?

Environmental Data Quality Workgroup (EDQW)/DoW Advanced Geophysical Classification Accreditation Program (DAGCAP)

- Is there a place for DAGCAP underwater?
- How do we accredit and validate in the underwater arena?
- What does "100%" mean?

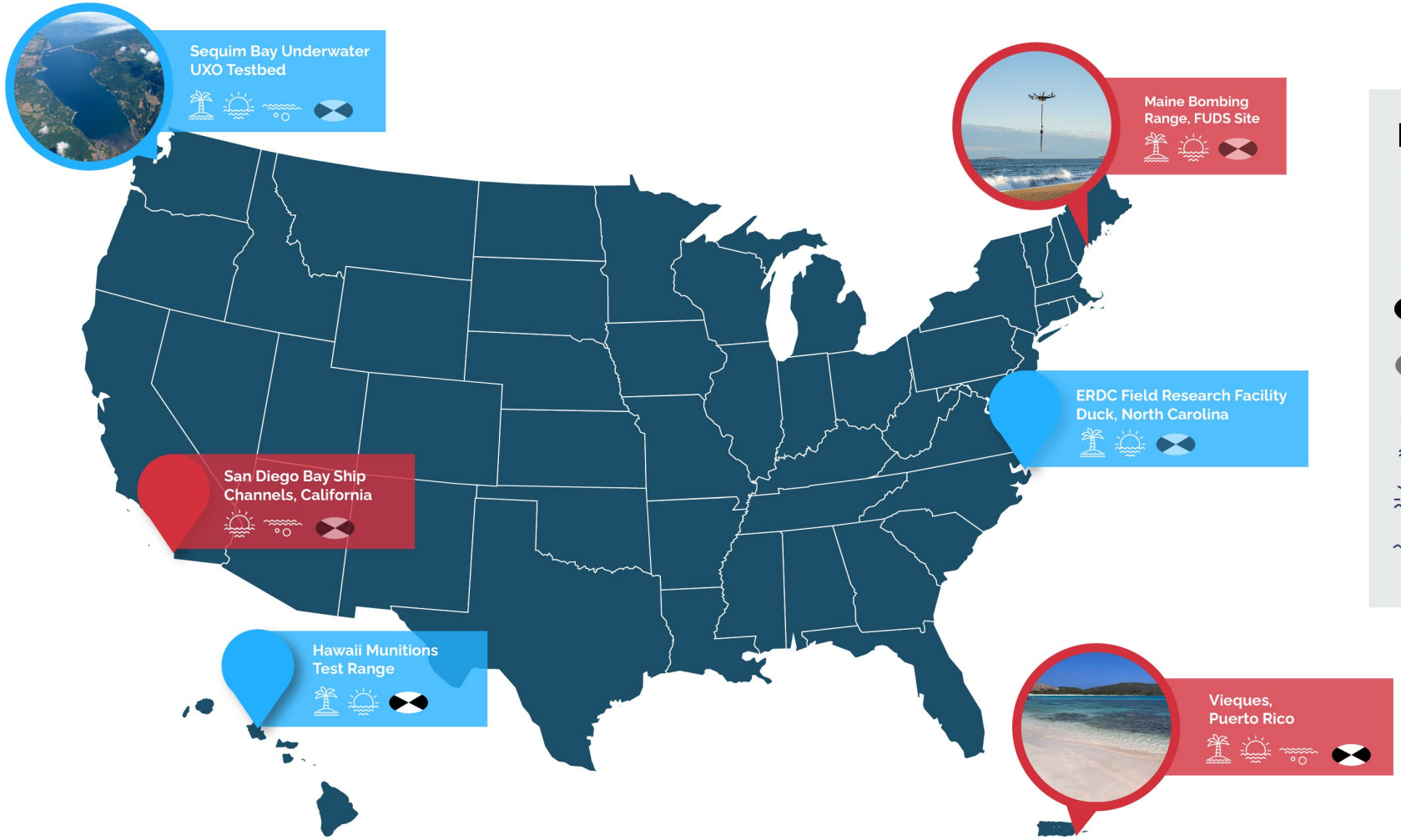
How is SERDP/ESTCP Managing this Objective?

- Bulk of MR program shifted to primarily ESTCP efforts
- ESTCP will focus on live site demonstrations and test bed projects with an emphasis on mature technologies nearing ready for commercial transition
- DoW Policy → Underwater MR Workgroup → ITRC Team
- Coordination with EDQW and DAGCAP

Planned Live Site Demonstrations

Maine Bombing Area	San Diego Bay	Vieques, Puerto Rico	Potential 4th Site
• Field work complete March 2026 • Formerly Used Defense Site; practice rocket range and potential burial • Surf zone; Typical sandy beach and dunes->~15 feet water depth • Mirroring process for RI • Nature and extent • Preliminary Characterization followed by Detailed Characterization	• Navy site with busy harbor and significant boat traffic; dredging channel • Mirroring process for Remedial Action (RA) • Size estimation primary component for classification • Information being collected to better inform dredging operations	• Navy site with multiple targets • Elements of both RI and RA • Information to inform cost estimates in Feasibility Study (FS) • Testing limits of technology	• Inland/freshwater (river?)

ESTCP MUNITIONS RESPONSE DEMONSTRATION AND LIVE SITES



LEGEND

- Demo Sites
- Live Sites
- High Water Clarity
- Slightly Turbid
- Nearshore
- Shallow Water
- Deep Water

Testbed Opportunities

- Sequim Bay, Washington (PNNL)
- Duck, North Carolina (ERDC)
- Hawai'i Test Bed (UH)

ITRC Underwater Munitions Group

- January 2025 – Group formed
- Subgroups:
  - Introduction
  - Planning/CSM
  - Quality
  - Technology
- October 2025 - Draft internal document
- November 2025 – Comment Resolution Meeting
- Originally planned completion at end of 2026. Extended team a year to include more SERDP/ESTCP lessons learned/case studies
  - Interim deliverables Fall of 2026
- **More later!**

Elements of an Underwater Conceptual Site Model

Kelly Enriquez

U.S. Army Corps of Engineers

What's Different from Land?

- **Dynamic Environment**
  - Waves / Currents / Tides
  - Burial / Mobility
  - Defining a Beach
- **Lack of Visibility**
  - Obstacles
  - Changing bathymetry
  - Vegetation
- **Positioning**
- **High Costs**

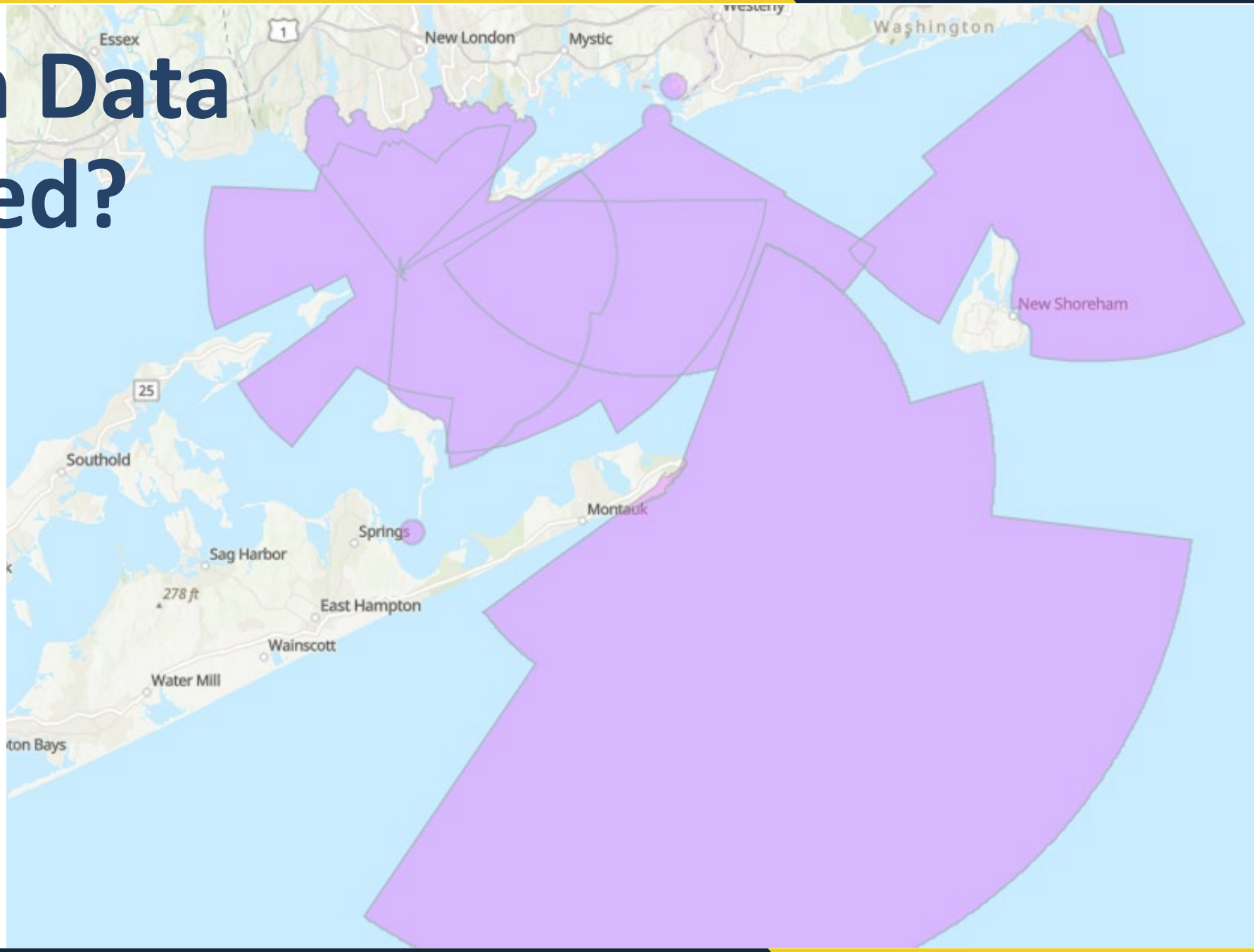
How Much Data Do We Need?

Site Inspection (SI) Phase

- Limitations on visual-only surveys
- Optical Sensors / Remotely Operated Vehicles
- Acoustic Sensors / Collect Detection / Classification Data?

RI Phase

- Due to high costs, potentially focus investigations based on land use
- Acoustic sensors can provide wider coverage



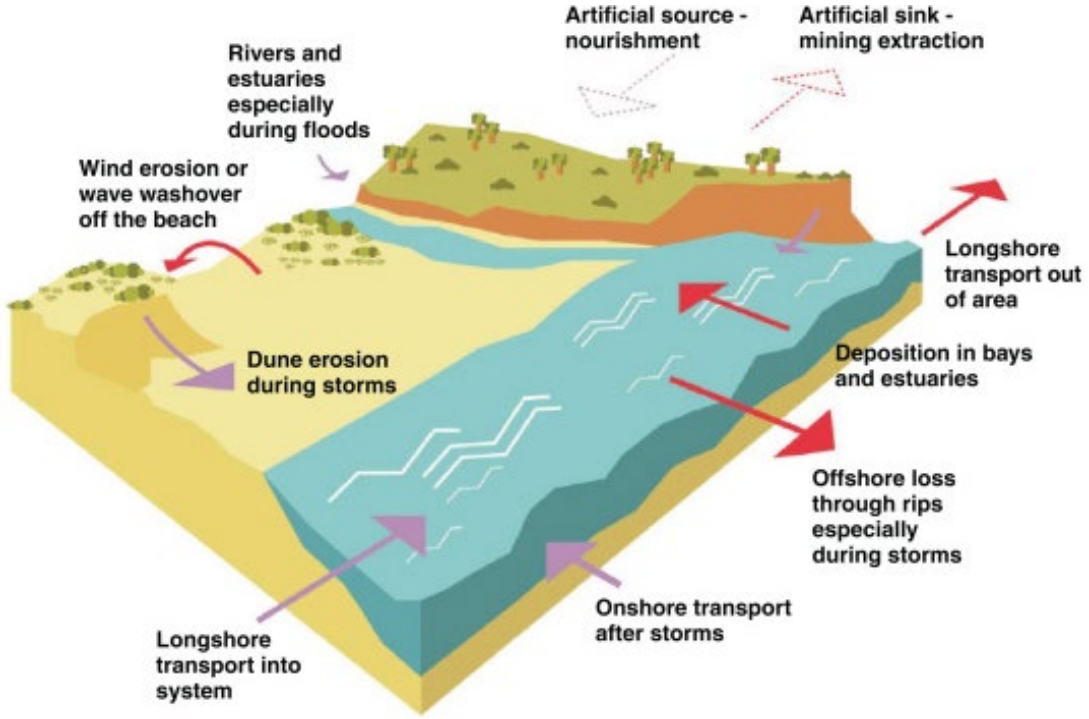
How Much Data Do We Need? (cont.)

RA Phase

- Do we need to do a physical removal?
- Do we need 100% coverage?
- Can we achieve 100% coverage?
- Can we manage in place?

Challenges Underwater

- Planning / Operating in Various Conditions
- Collecting Preliminary Information
  - Multi-Beam Bathymetry
  - Side-scan Sonar / Obstacles
  - Critical Habitats / Threatened and Endangered (T&E) Species
- Detection / Classification Data
  - Proximity to the water bottom
  - Positioning



Critical Data Needs

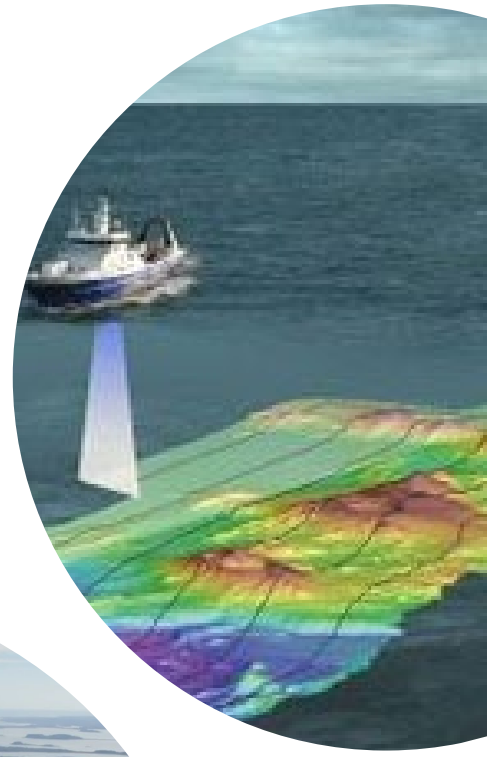
What kind of data do we need for a well-developed CSM?

What type of underwater site is it?

- Ocean, lake, river, canal, port/harbor, etc…
- Industrial area, recreational area

Preliminary site characterization

- Underwater bottom types
- Bathymetry
- Obstacles
- Visibility
- Waves / Currents / Tides
- Sensitive Habitats / T&E Species
- Nautical Charts



Critical Data Needs (cont.)

History of Military Use

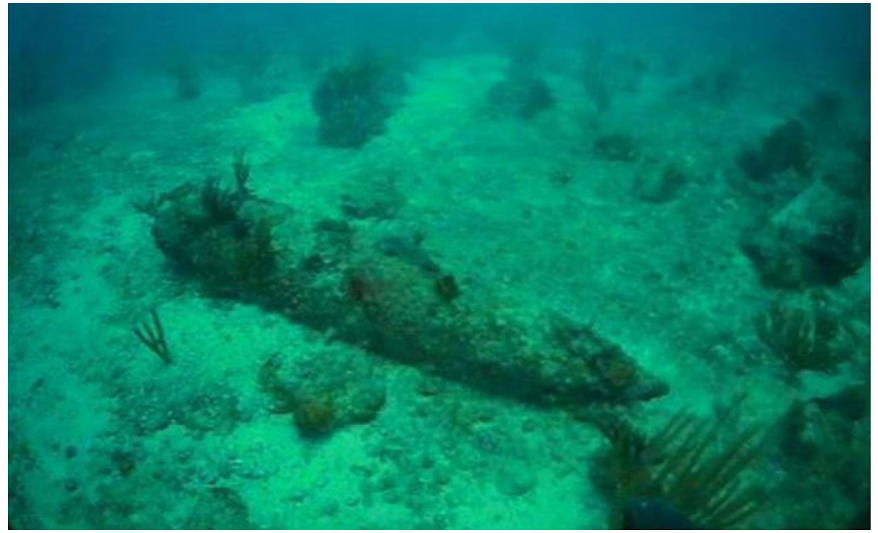
- Water Range
- Overshoots/Undershoots to Land Targets
- Dump Site

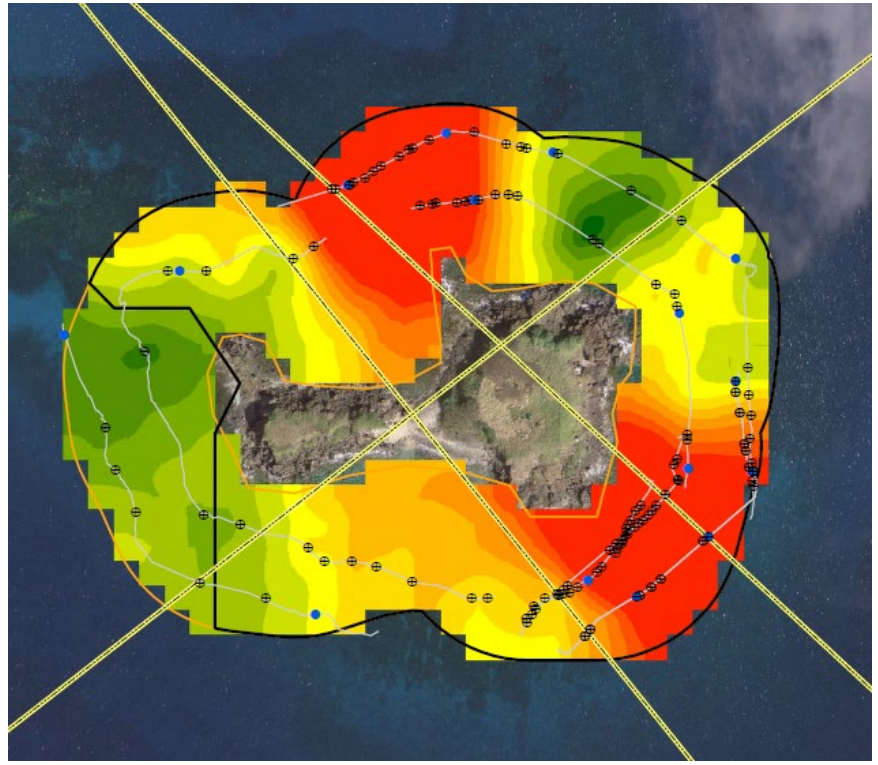
Munitions Detection / Classification

- Density
- Distribution
- Mobility / Burial

Investigation Results

- Munitions Types
- Sensitivity
- Depths





Land Use Data

Receptors

- Recreational
- Commercial / Maintenance / Construction
- Resource Management

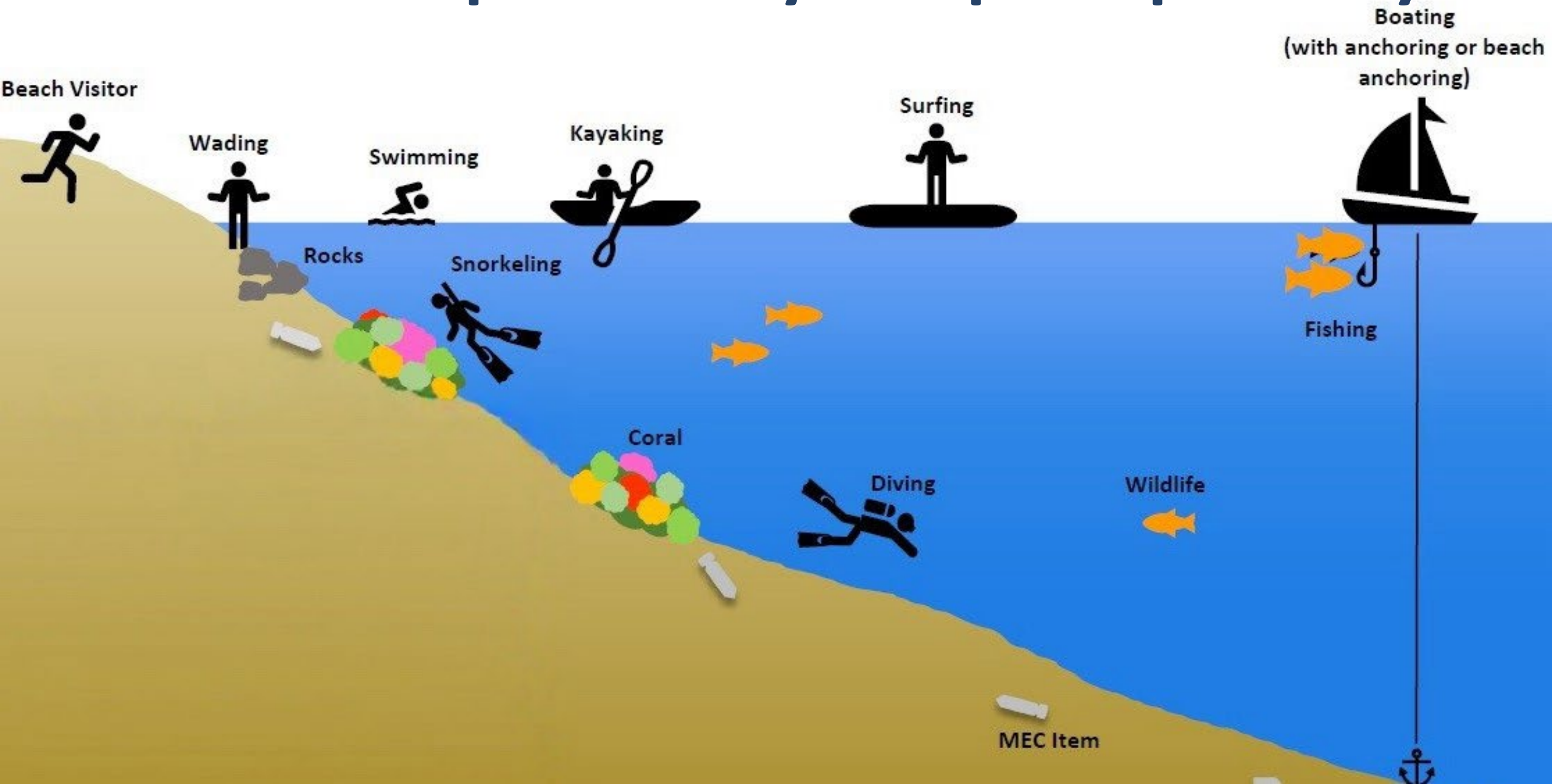
Activities

- Wading
- SCUBA/Snorkeling
- Anchoring
- Dredging
- Treasure Hunting
- Clamming / Fishing

Location

- Horizontal boundary
- Water Depth
- Subsurface Depth

Where is the potentially complete pathway?



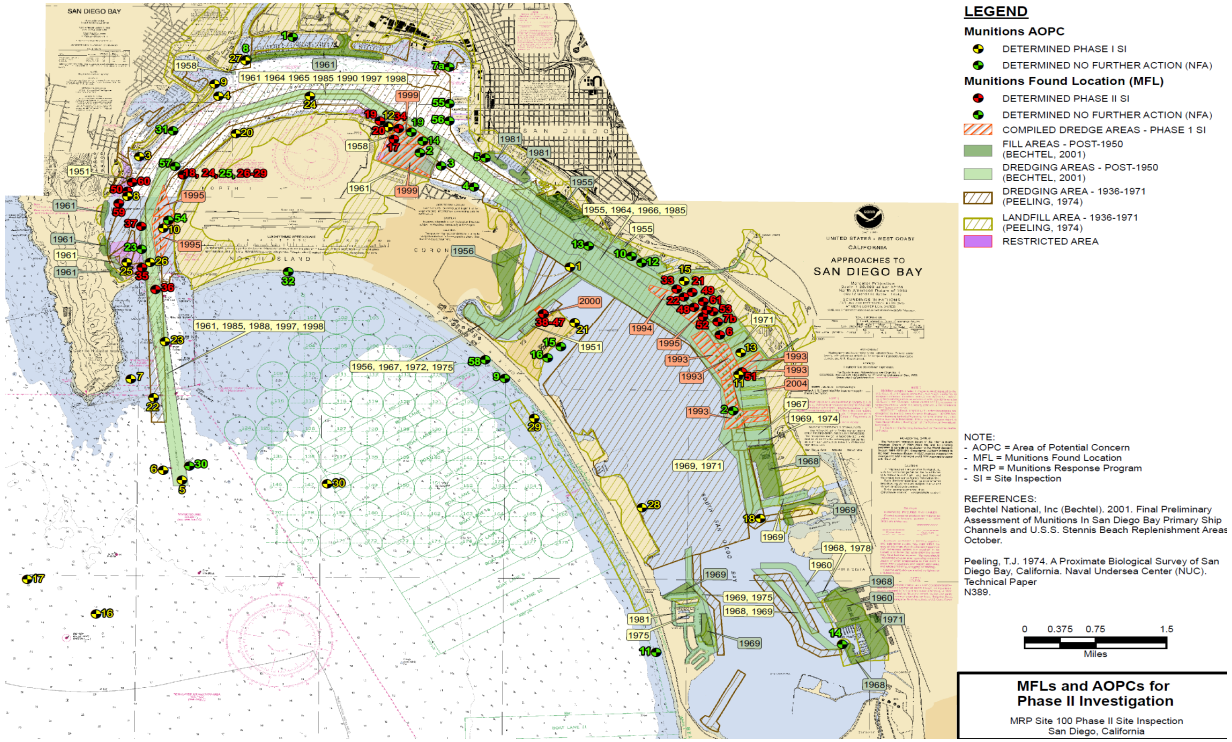
Summary

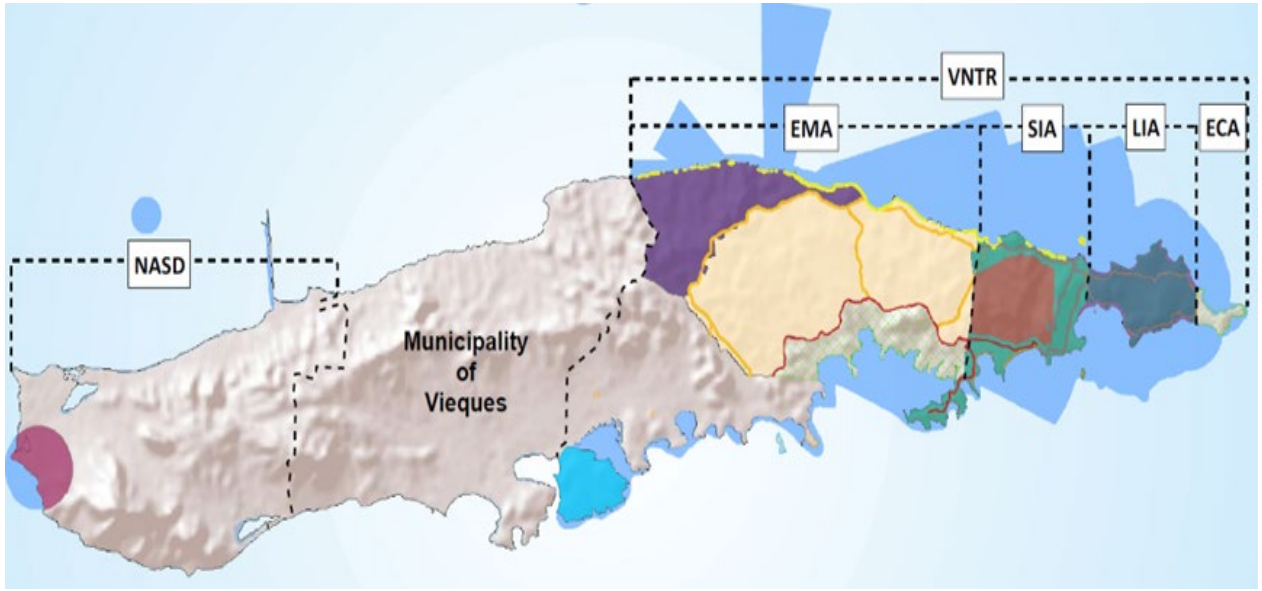
- What challenges does the underwater site present?
- Identify additional data needs
- Plan appropriately
- Is land use information detailed enough?
- Is 100% coverage viable / necessary?

Kelly.D.Enriquez@usace.army.mil

CSM Case Studies

- Vieques, Puerto Rico / VNTR
- San Diego Bay / Site 100



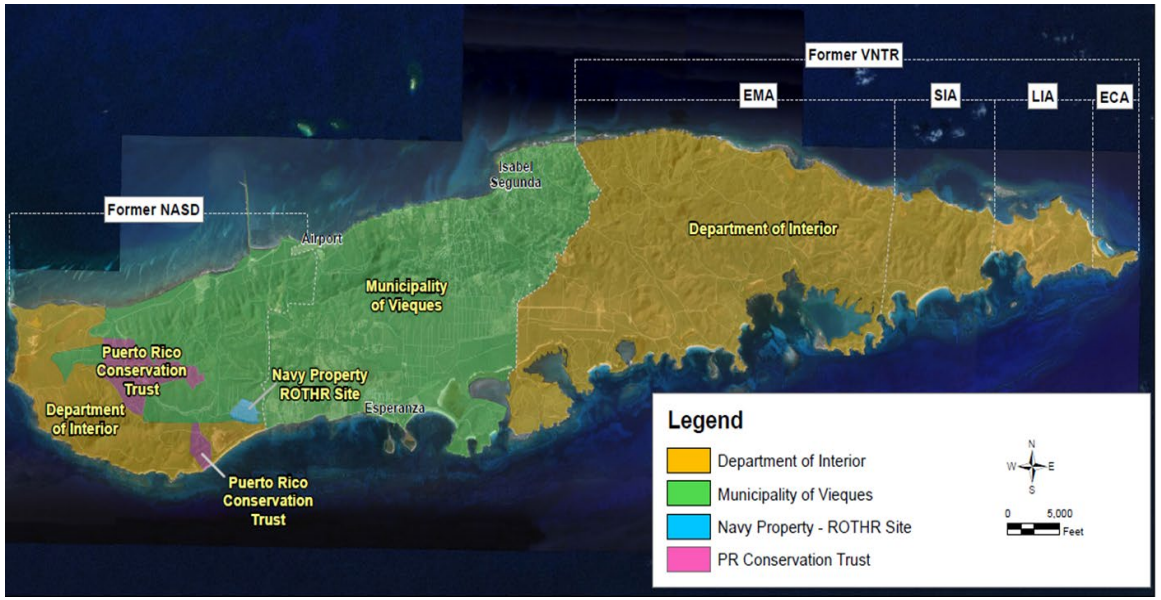


Austin Geiser NAVFAC/EXWC
austin.s.geiser.civ@us.navy.mil

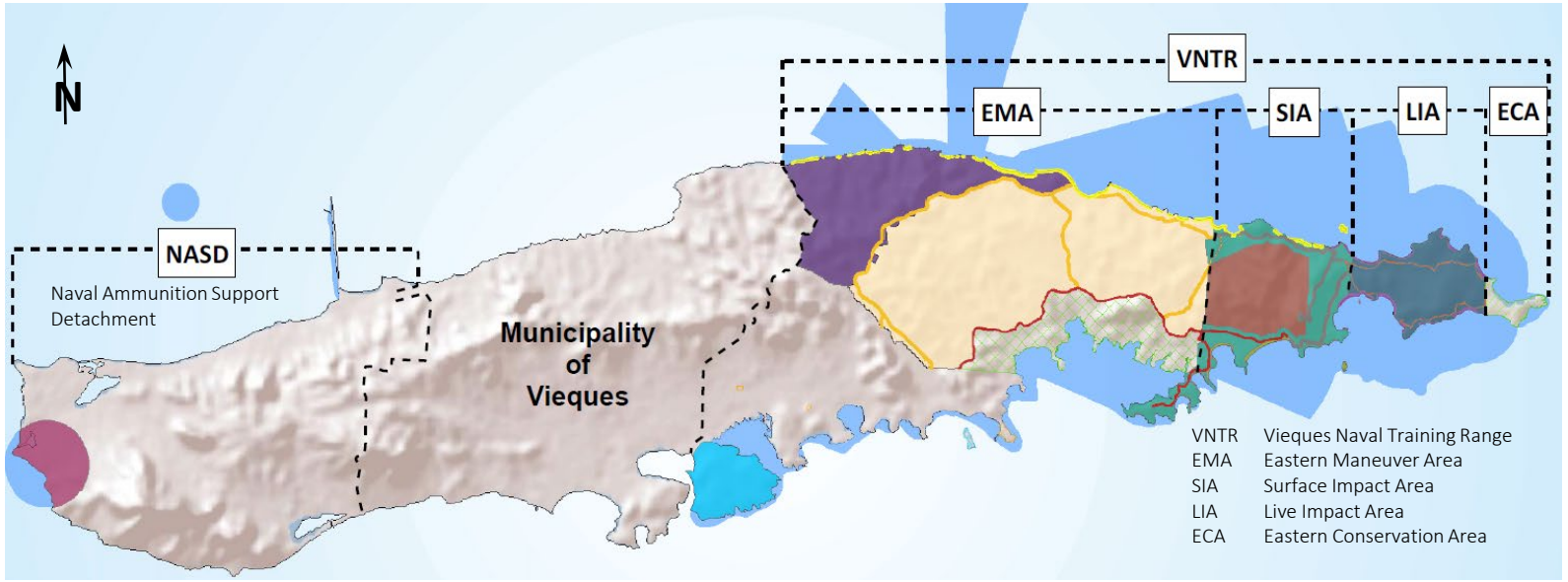
Former Vieques Naval Training Range and Ammunition Support Detachment

Background

- 1945-1999:
  - Multi-purpose live-fire training - Vieques Naval Training Range (East Vieques)
  - Ammunition support – Naval Ammunition Support Detachment (West Vieques)
- 2001: Live-fire training on Vieques ceased, West Vieques transferred to the following entities:
  - Municipality of Vieques (4,249 acres)
  - U.S. Department of Interior (DOI), to be managed by Fish and Wildlife Service (FWS) (3,058 acres)
  - Puerto Rico Conservation Trust (800 acres)



Background (cont.)



- 2001 and 2003: Former Navy lands transferred to Municipality of Vieques, Puerto Rico Conservation Trust, and DOI
- 2003: East Vieques (14,600 acres) transferred to DOI for FWS management
  - Live Impact Area (LIA) established as Wilderness Area with no public access
  - FWS manages DOI lands as the **Vieques National Wildlife Refuge**
  - Underwater areas and small islands belong to the Commonwealth and are managed by the PR Department of Natural and Environmental Resources
  - Due to explosives safety concerns, federal law designated the LIA as a Wilderness Area and required DOI to "…deny public access to the area"
- 2005: Vieques placed on National Priorities List
  - Cleanup by the Comprehensive Environmental Response, Compensation, & Liabilities Act (**CERCLA**)

Interagency Collaboration

Vieques Cleanup Team

- Participants from Vieques, Puerto Rico, and mainland United States
  - Senior management, project managers, technical experts
  - Decisions made by consensus of all team members
- CERCLA process ensures all points of view are considered
  - Public meetings
  - Public comment

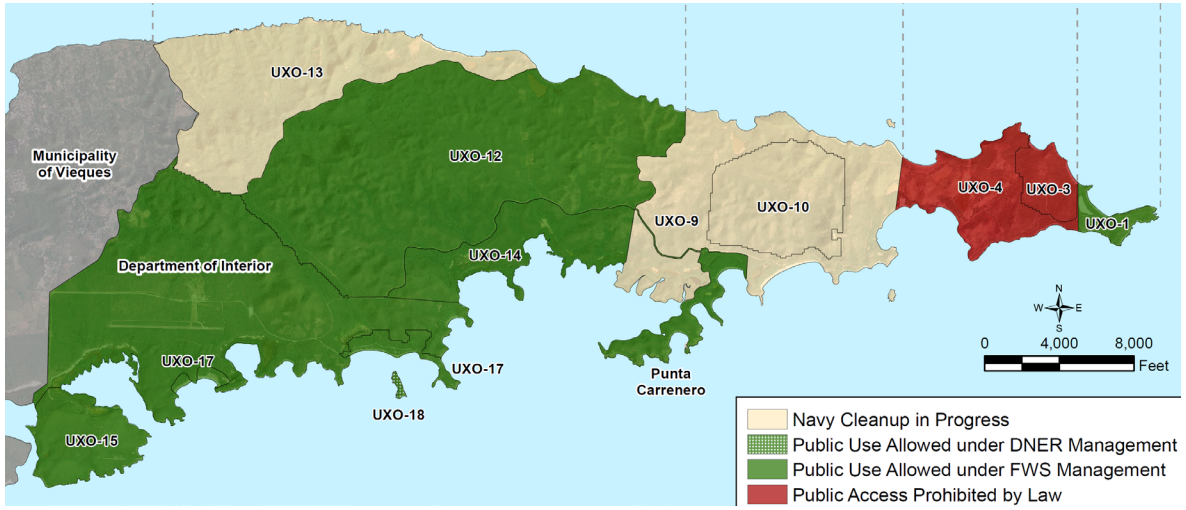
1. **FWS, EPA Region 2**
   Vieques, Puerto Rico
2. **Puerto Rico Stakeholders:**
   EQB , DNER
   SHPO
   RAB
   Univ. of Puerto Rico
   Municipality of Vieques
   General Public
   Local Businesses
3. **Fish & Wildlife Service**
   Atlanta, GA
4. **CFFC/NAVFAC Atlantic (PAO)**
   Norfolk, VA
   Vieques Core Project Team
   Norfolk, VA
5. **ASN/CNO/NAVFAC**
   Washington, D.C.
   NOAA, DoD, EPA Headquarters, DDESB, EQB Support Contractor
   Washington, D.C.
6. **NOSSA & Tech Div.**
   Indian Head, MD
7. **FWS**
   Annapolis, MD
8. **EPA Region 2, NOAA**
   New York, NY
9. **EQB Support Contractor**
   Boston, MA

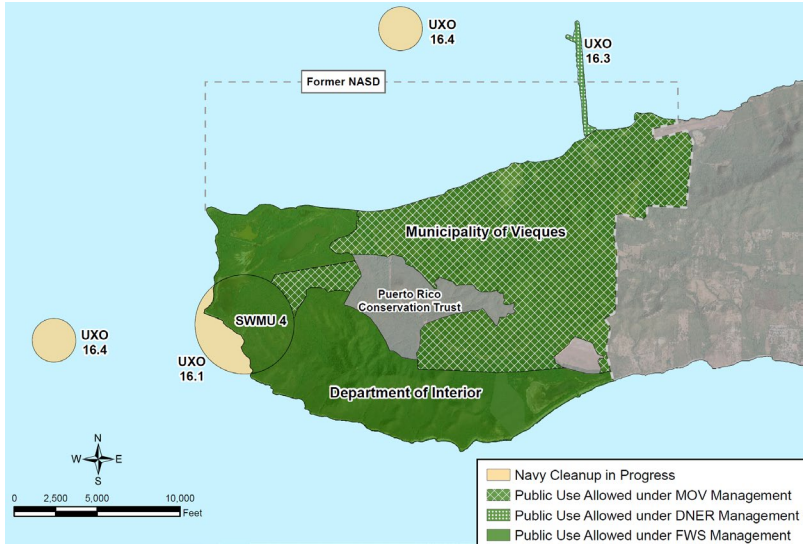
Cleanup Status

- Surface clearance
  - 97% complete
  - 4,651 acres cleared of munitions
- Sub-surface clearance
  - 89% complete
  - 19 miles of roads, 12 miles of beaches
- Overall removal
  - 138,000 munitions items
  - 8.8 million pieces of material potentially presenting an explosive hazard
  - 17.8 million pounds scrap metal recycled

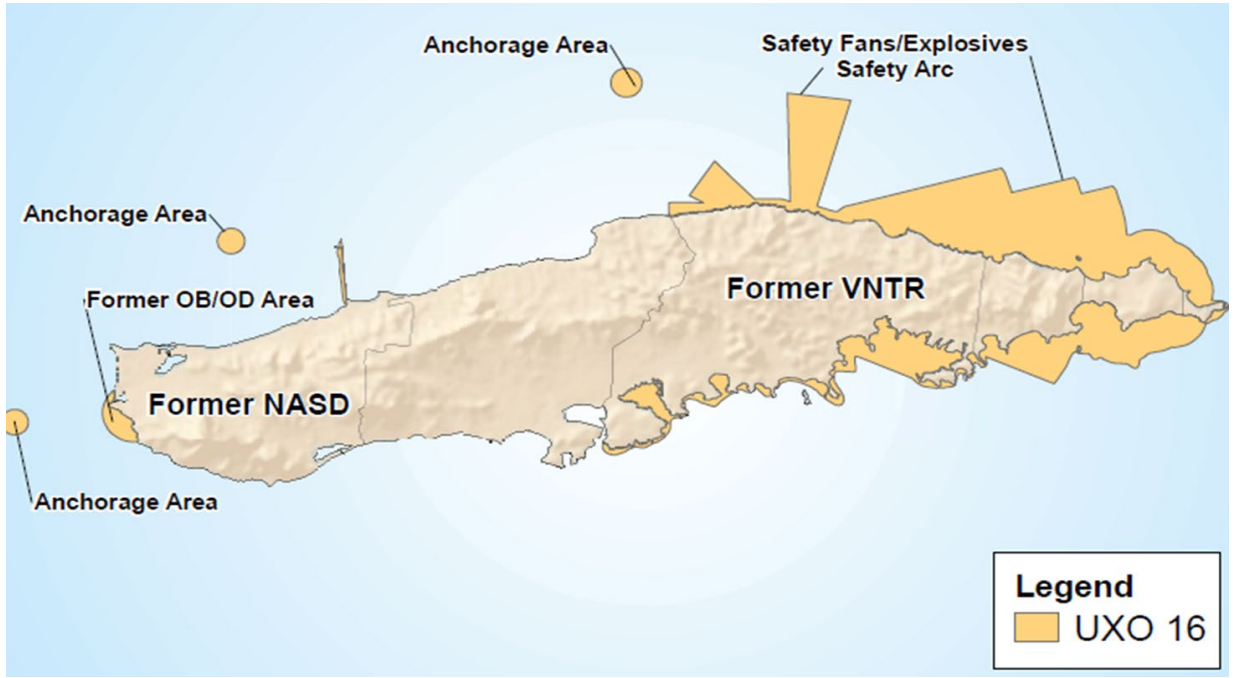
Cleanup Schedule

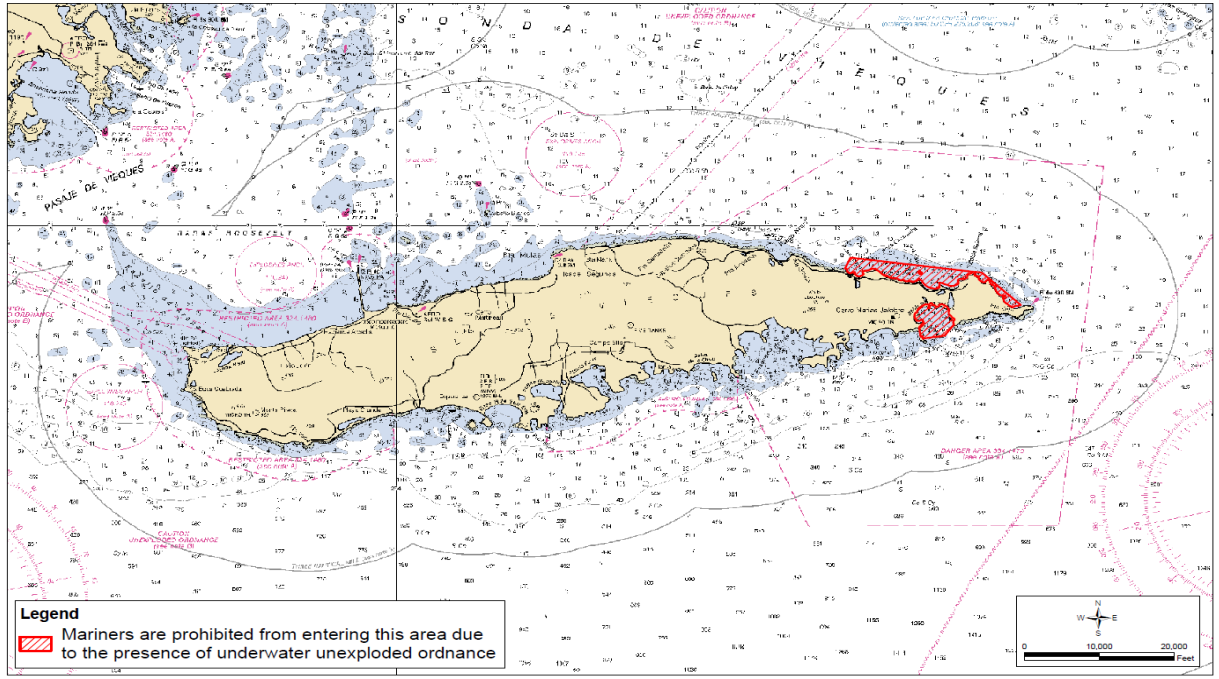
- **CERCLA Munitions Cleanup Actions**
  - Within two years, the Navy expects to complete UXO 9 and UXO 10.
  - Within five years, the former training ranges at UXO 13, additional beaches, and nearshore underwater areas will be completed.
  - CERCLA Response Complete is expected for the land munitions sites by 2033, and by 2035 for the underwater munitions site.
  - The Navy will perform Long Term Management to ensure safety.
- **Highest Navy Priority**
  - Since 2005, the Vieques cleanup has been the highest priority and the most heavily funded project in the Navy's Munitions Response Program (MRP).





UXO 16 Underwater Areas





Land Use Overview

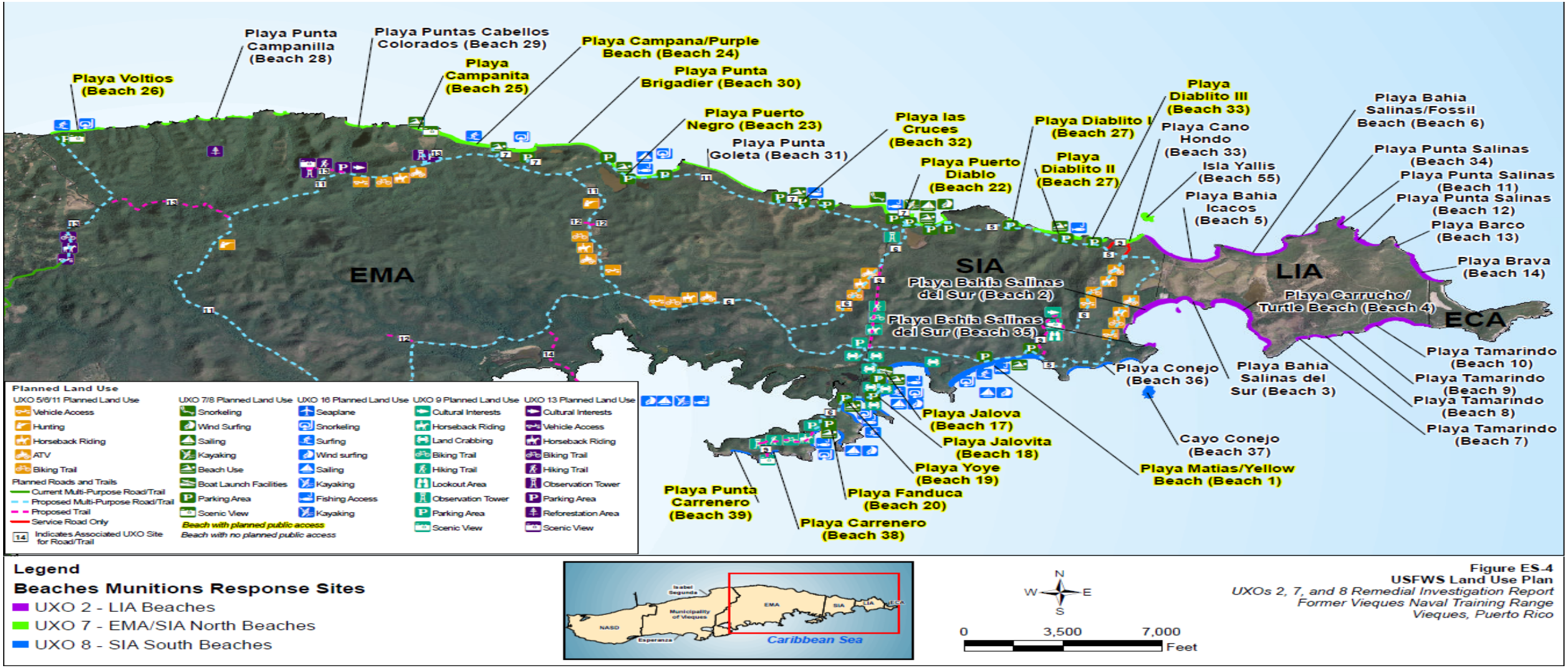
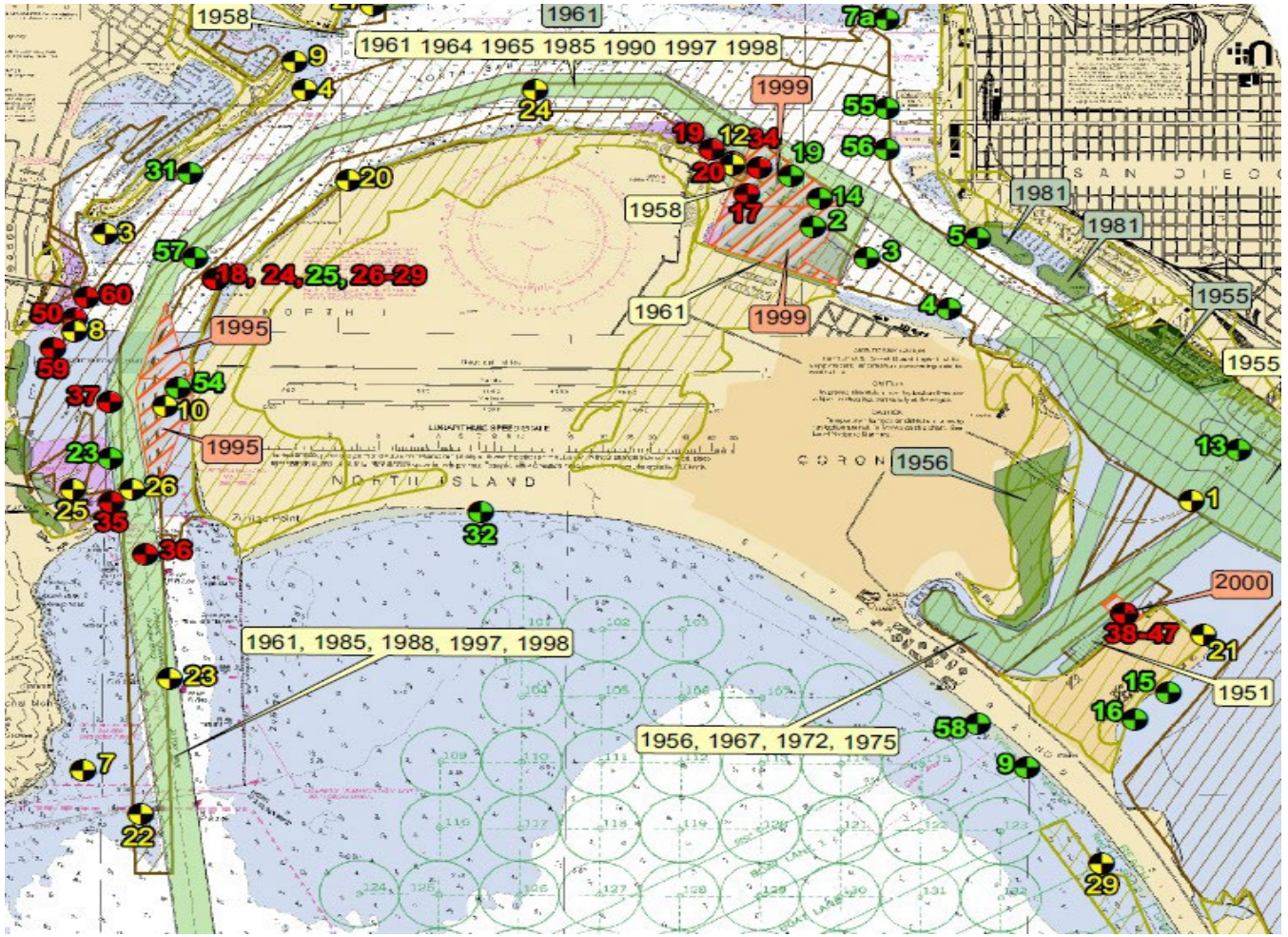


Figure ES-4
USFWS Land Use Plan
UXOs 2, 7, and 8 Remedial Investigation Report
Former Vieques Naval Training Range
Vieques, Puerto Rico

Navy Goals Vieques Demo

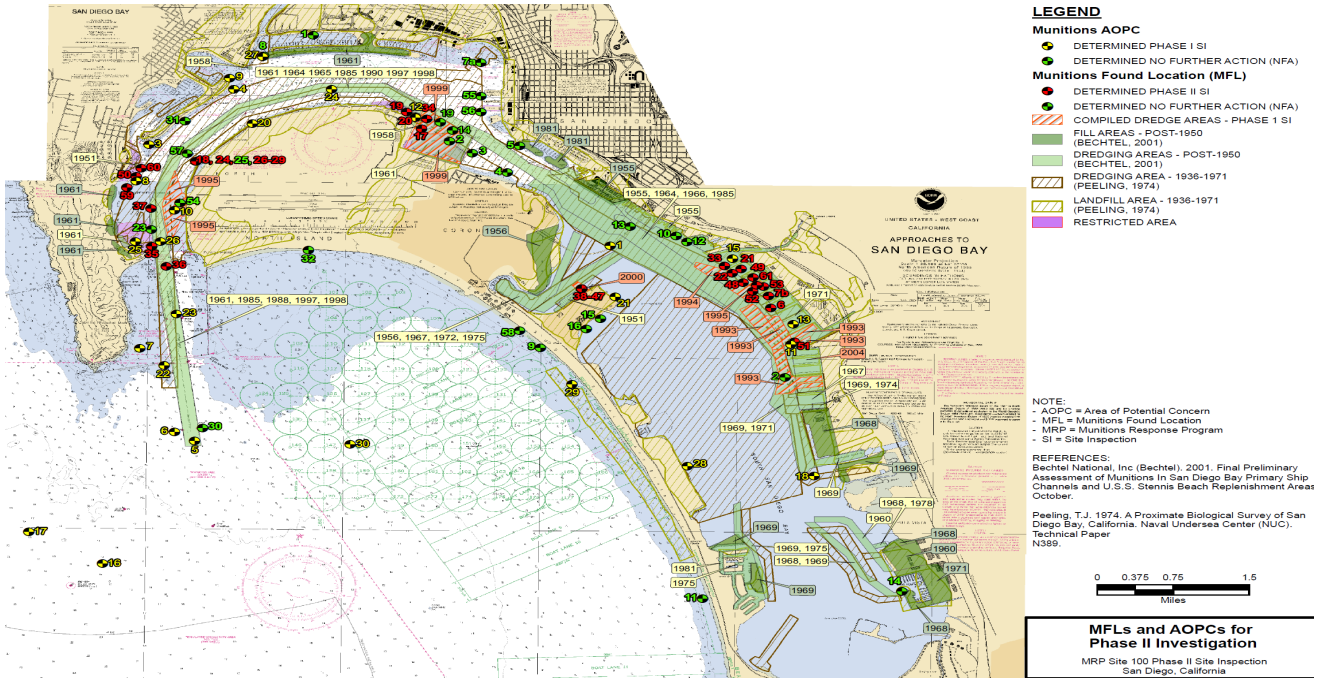
- **Navy Goals**
  - The technologies used during the live site demos may prove useful in determining the extent of UXO contamination in the deep water at the outer edges of UXO 16.
  - Encounters with underwater UXO only occur when someone or something contacts the seafloor. Therefore, the Navy strategy is to focus on the shallow areas where contact with the seafloor is most frequent and encounters with UXO are most likely. These shallow areas include the surf zone, the wading zone (0-4-foot water depth), and the swimming zone (0–10-foot water depth)."
  - Technologies demonstrated for the shallow water sites (primarily the surf zone) may help with focused remedial actions in UXO 16.

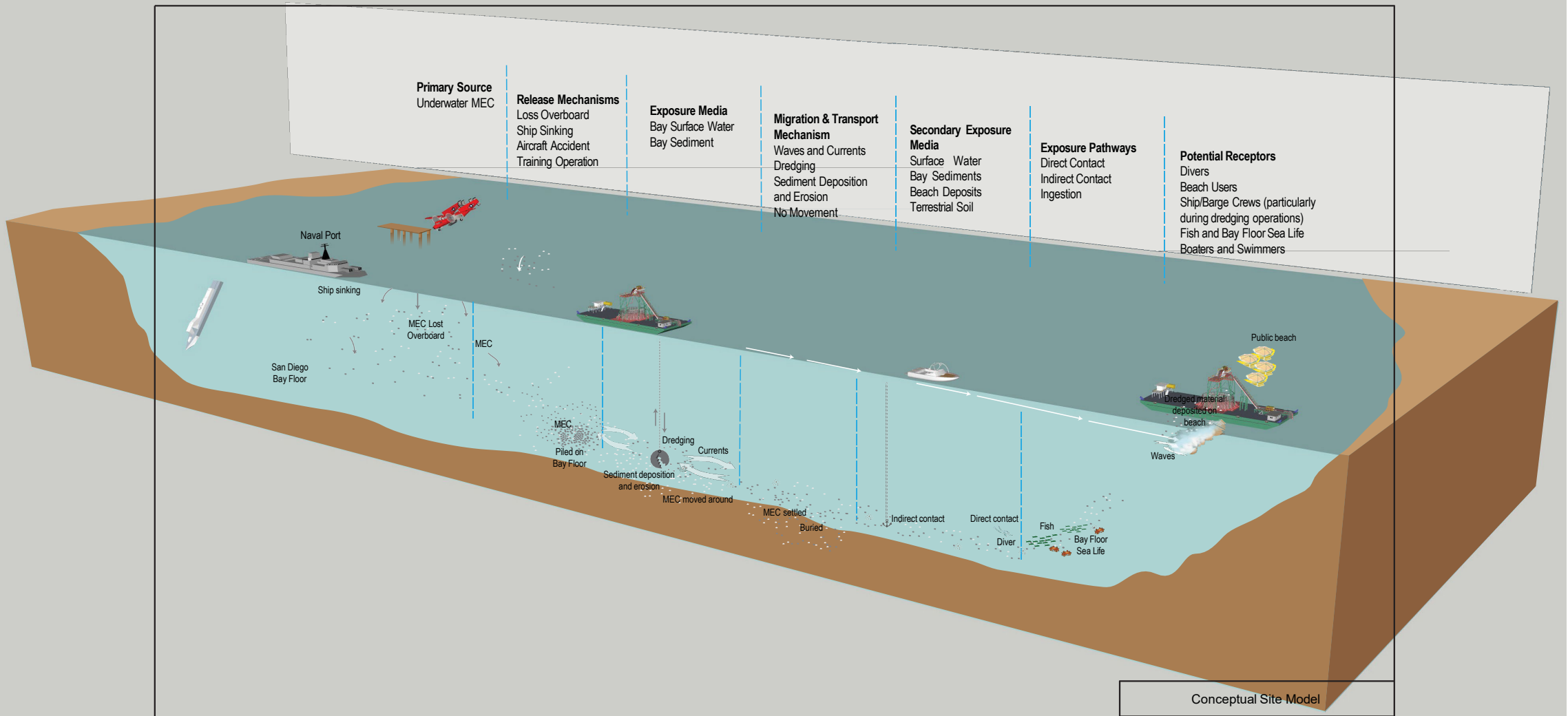
Naval Base San Diego Bay Primary Shipping Channel, UXO Site 100



Background

- In September 1997, the Navy discovered munitions on an Oceanside, California, beach that was receiving dredge material as part of a sand-replenishment effort. The source of the sand was a Navy dredging operation in the San Diego Bay Primary Ship Channels.
- The munitions found were determined to be military and ranged from small-caliber munitions to 81-millimeter (mm) rounds.
- The Navy responded by initiating a Preliminary Assessment/SI (PA/SI) of the San Diego Bay Primary Ship Channels under its Environmental Restoration Program.





Legend

MEC = Munitions and Explosives of Concern

Conceptual Site Model

MRP Site 100 - San Diego Bay
Primary Ship Channels

Date: March 5, 2014
File No.

FIGURE:
55

ES082009002SCO387900.SI.WP.DR SDBay_conceptual_v6.ai 3/14

Background (cont.)

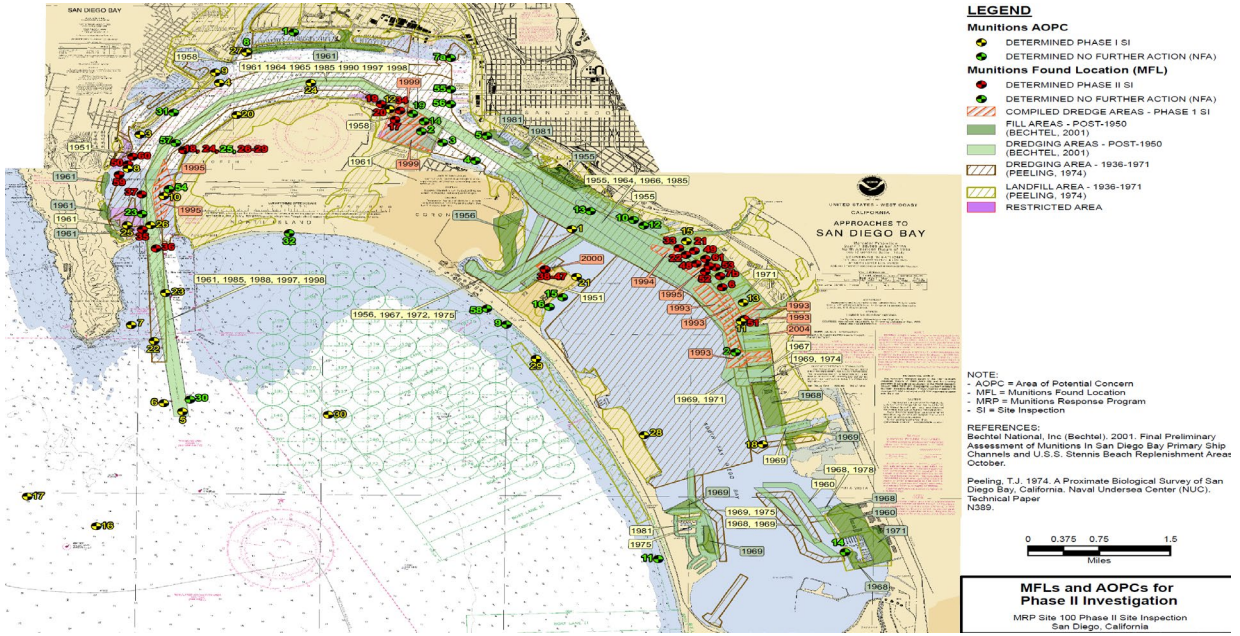
Dec-99	(98) 5 1/4 in casing (7 with primers), (7) 3-inch rounds, Found in dredged material from near Pier 3, Naval Station San Diego (5) Mark IX AA rounds, (4) 2 1/4-inch rounds, (46) 40-mm rounds, (8) 30-mm rounds, (171) 20-mm rounds, (4) 5.62-mm rounds, (113) .50-caliber rounds, (47) .243-caliber rounds, (16) .30-caliber rounds, (16) .223-caliber rounds, and (1) 12-gauge shotgun round	Found in dredged material from near Pier 3, Naval Station San Diego

Historical Finds

24	14-Apr-97	(1) 20-mm HEI round, (1) .30-cal. round, (1) AN/M8 smoke grenade, (8) .50-cal. slugs, (2) .30-cal. slugs, (1) 1.1-inch slug	Found while dredging
25	14-Apr-97	(1) Sonar buoy*	Found while dredging
26	17-Apr-97	(1) 20-mm M99 with an M21A1 practice cartridge, (1) Mk 3 practice bomb	Found while dredging
27	22-Apr-97	(20) .30-cal. rounds, (1) 20-mm round, (1) .50-cal. round	Found while dredging
28	25-Apr-97	(27) .50-cal. slugs, (3) .30-cal. slugs, (1) .45-cal. slug, (1) 20-mm cartridge case	Found while dredging
29	5-May-97	(1) .50-cal. round	Found while dredging
30	28-May-97	(1) Sonar buoy*	Found floating
31	21-Jun-97	(1) Mk 6 training mine	Found floating
32	29-Aug-97	(1) Mk 1 100-pound practice bomb	Found washed up on shore
33	11-Sep-97	(1) 3-inch ceremonial round	Found by civilian divers doing hull cleaning
34	10-Oct-97	(1) Mk 13 practice torpedo	Found while dredging
35	18-Nov-97	(1) 20-mm round	Found while dredging
36	18-Nov-97	(13) .50-cal. blank rounds, (4) Mk 3 20-mm rounds	Found while dredging
37	17-Dec-97	(4) Mk 3 20-mm rounds, (4) .50-cal. blanks, (2) 5.56-mm blanks, (1) 7.63-mm round, (1) Mk 2 40-mm cartridge	Found while dredging

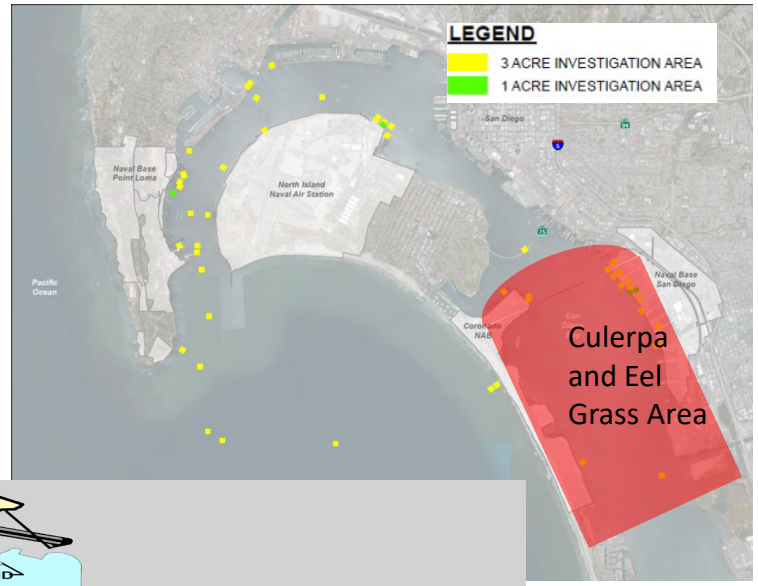
Background (cont.)

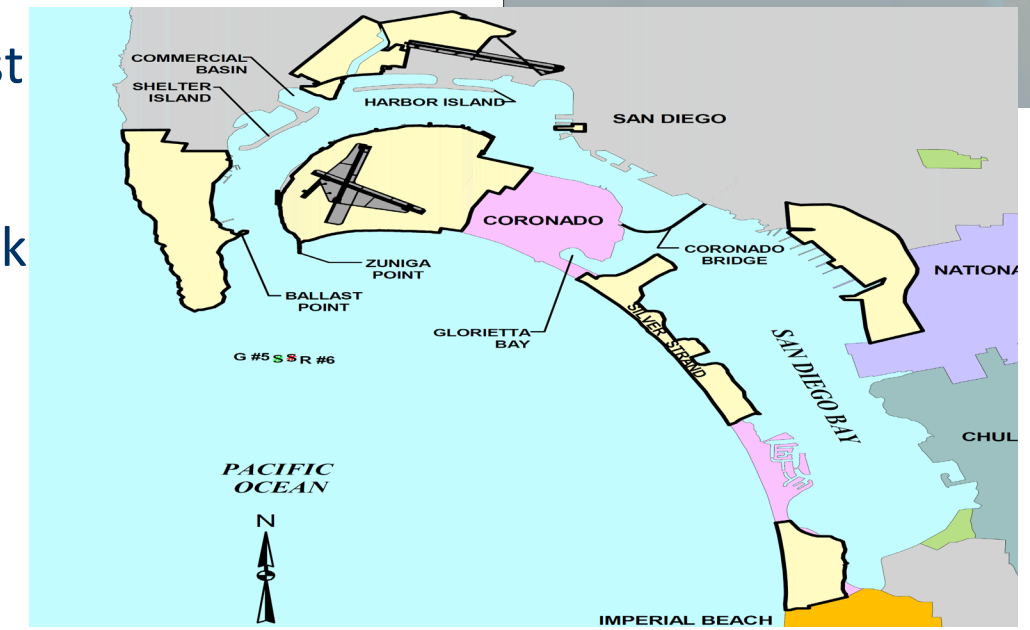
- PA finalized in 2001.
  - PA identified **61 Munitions Found Locations.**
  - PA identified **30 Areas of Potential Concern.**
- SI commenced in 2009/2014 under MRP.
  - **SI Objective:** Confirm or exclude the presence of Munitions and Explosives of Concern (MEC) in the San Diego Bay as identified in the PA.
  - **SI Boundaries:** Vicinity of 91 total locations identified in the PA
  - **Key component:** SI involves collaboration with various Navy entities during the course of this work, including SPAWAR/NIWC.
- 50 Areas moving forward into RI/FS phase ~144 acres.



Logistical Considerations and Challenges

- Offshore contractor with vessel support and diving/underwater support
- Scope of dive support provided by the Navy needs to be defined.
- Options include anomaly excavation, placement of seed items at a site location using anomaly avoidance, installation of test bed/IVS. One of the A&Es or RAC type contractors would be best suited with subcontracting as needed.
- An ESS will be required as well as the vetting of contractors/subcontractors to perform the work
- Existing Navy contracts capacity and ordering authority must be determined
- **No Impact to operational Navy**
- **No disturbance to Eel grass or Culerpa**

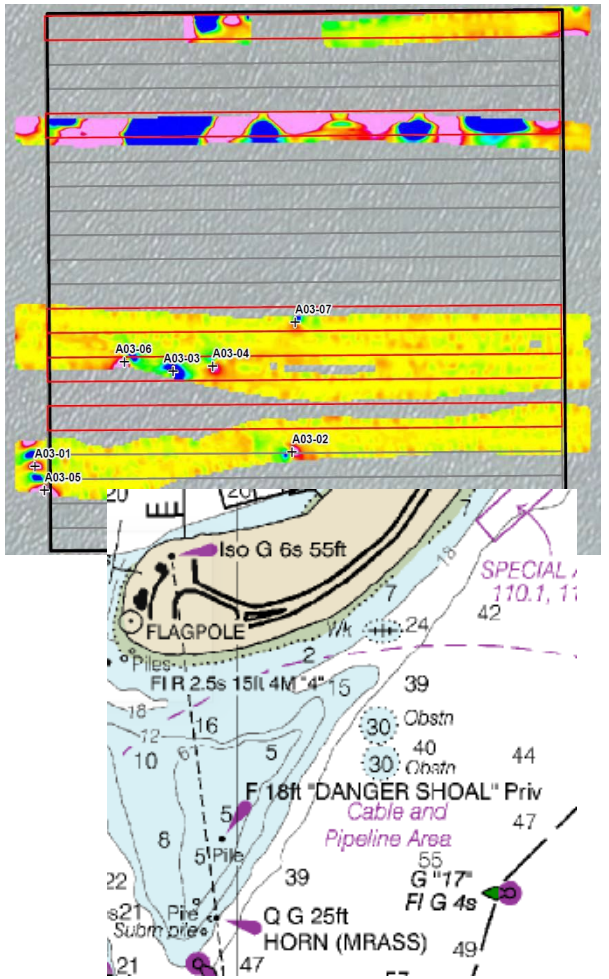




Navy Goals San Diego Demo

Navy Goals

- Gain an understanding of how well the current technology can detect and classify MEC in a highly cluttered environment with varying bathometry with a logistically challenging high vessel traffic harbor with a large Navy presence.
- If the detection technology is successful, it will be useful to reduce and/or eliminate Explosive Safety Quantity Distances associated with dredging and waterfront Military Construction projects thereby minimizing operational impacts both on water and ashore.
- The Navy needs underwater DCL to improve before the site can move to RI. Data from the demo may provide a justification for lifting the deferment to the RI or at least move us a little further in the green on that effort.



Thank You!

Austin Geiser NAVFAC/EXWC
austin.s.geiser.civ@us.navy.mil

Technology Overview

John Jackson

MR Program Manager

SERDP/ESTCP

Towed Electromagnetic Induction (EMI)

UltraTEM System

- Twelve receivers and four transmitters
- Tested at Sequim Bay, WA site (2021 Blind Test)

ESTCP MR19-5073, TPOC: Steve Billings, Black Tusk Geophysics

Marine Towed Array (MTA)

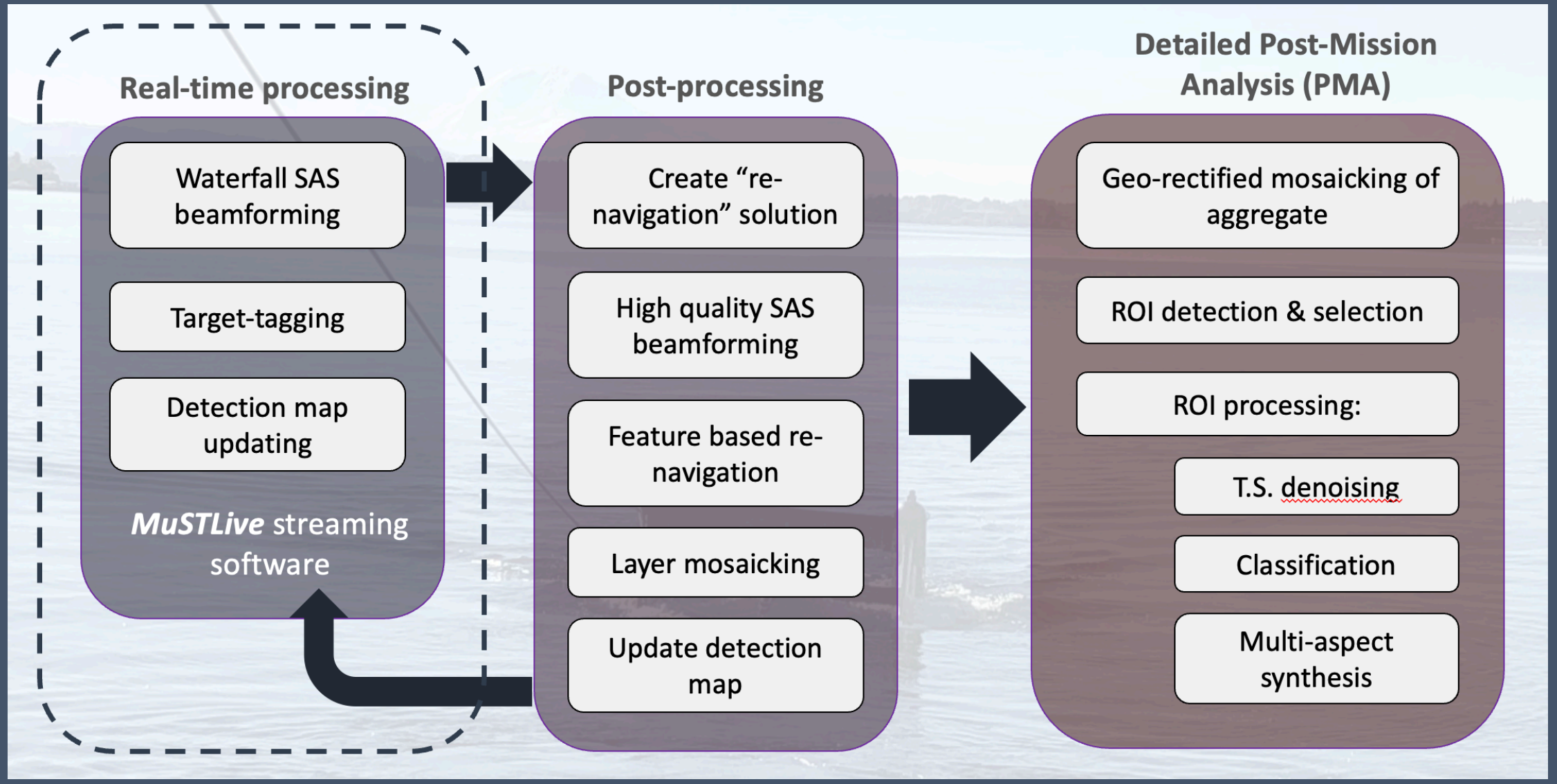
- 4.6 m wide; strong magnetomotive force (2.3xUltraTEM)
- Tested at multiple marine venues for UXO

ESTCP MR21-5066, TPOC: Dan Steinhurst, Nova Research

SONAR: Multi Sensor Towbody (MuST)

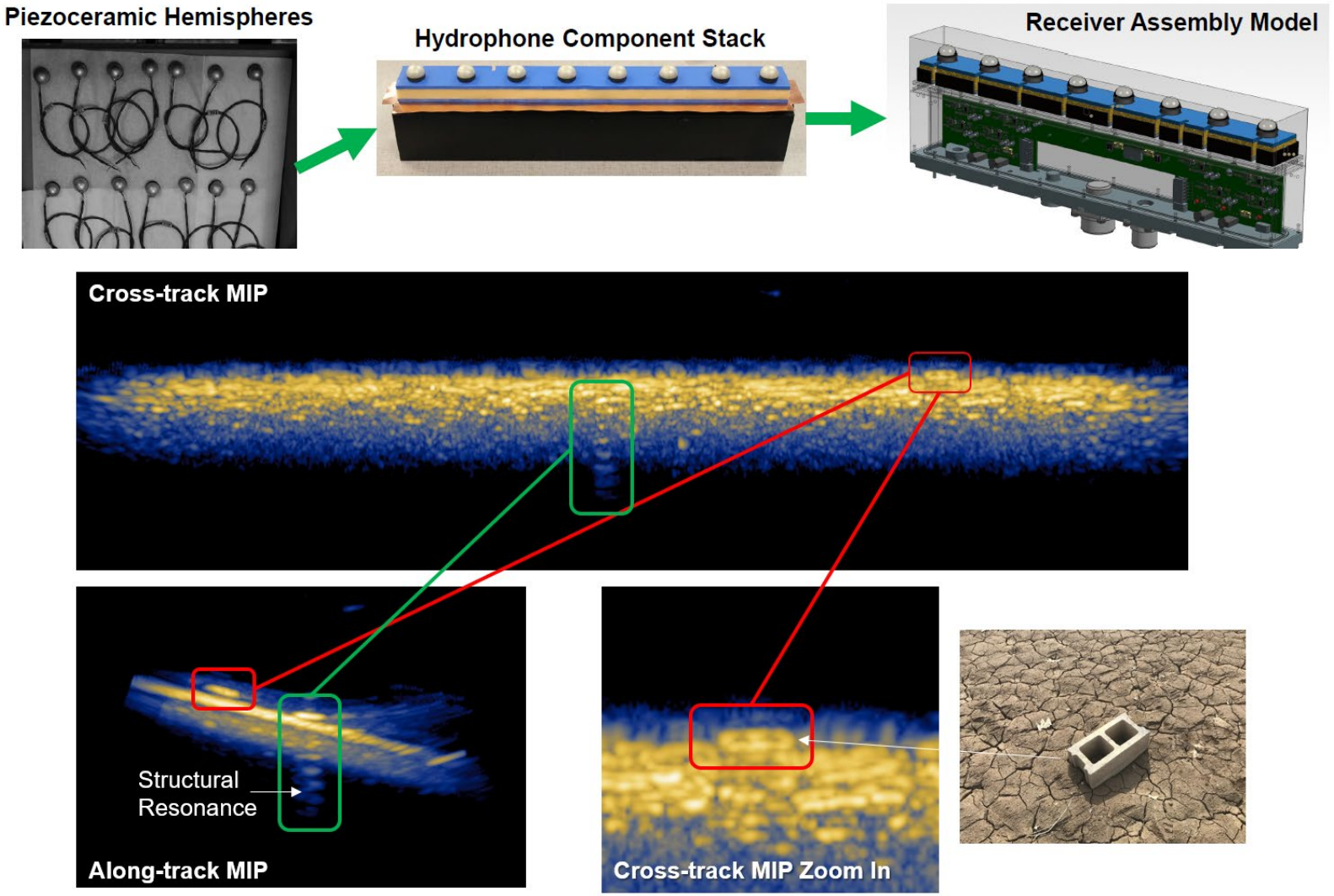
ESTCP MR23-7596, TPOC: Kevin Williams, UW APL

MuST Data Analysis Overview



SONAR: Sediment Volume Search Sonar (SVSS)

ESTCP MR23-8364, TPOC: Dan Brown, Penn State



NRL Structural Acoustic SONAR

High-Level Processing Flow Diagram

Raw Sonar Data
- Sonar & Platform Configuration
- Acoustic Echoes
- Navigation Data
- Calibrated Source & Receiver Lookup

Spectral Processing
- Reference Deconvolution
- Three-Dimensional Beamforming
- Aspect Dependent Calibration

Waterfall

Target Detection
- Synthetic Aperture Processing
- Generate 3D Detection Map
- Localize Energetic Detections

Detection Surface

Target Identification
- Extract Signatures From Detections
- Acoustic Focusing Refinement
- Multi-Feature Bayesian Classifier

Time Freq Phase

Quality Control (Performance) Map

Provides Contextual Feedback To The End User

(Assessment of Target SNR)
- Compute Background Reverberation Levels
- Estimate Target Signal-to-Noise Ratio (SNR)
- Label Regions Where (Signal-to-Noise < 0)

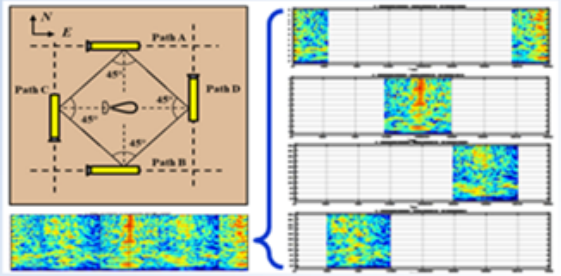
Reverberation Map

(Assessment of Object Density)
- Generate Map Of All Energetic Detections
- Generate Object Density Map Of Region

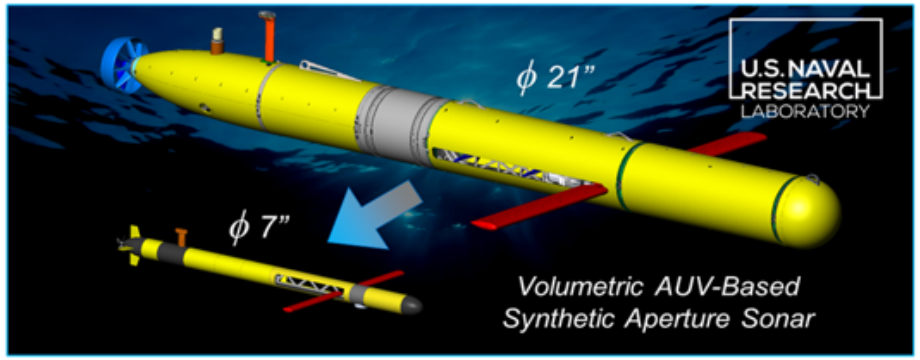
Object Density Map

Multi-Pass Processing

Synthesize High Quality 360° Acoustic Color Responses From Multiple Linear Surveys



AUV Based Structural Acoustic Sonar

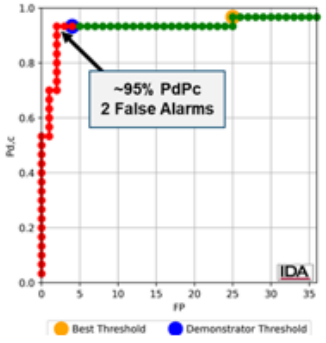


Sequim 2023 Blind Test Results

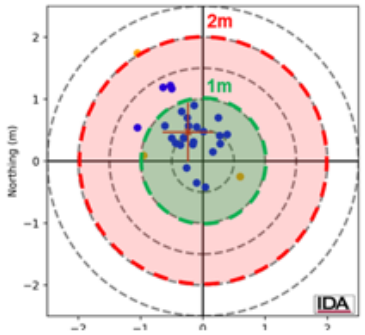
(Independently Assessed By IDA)

NRL Found UXO That Went Missing During Sequim 2023

Classification



Localization



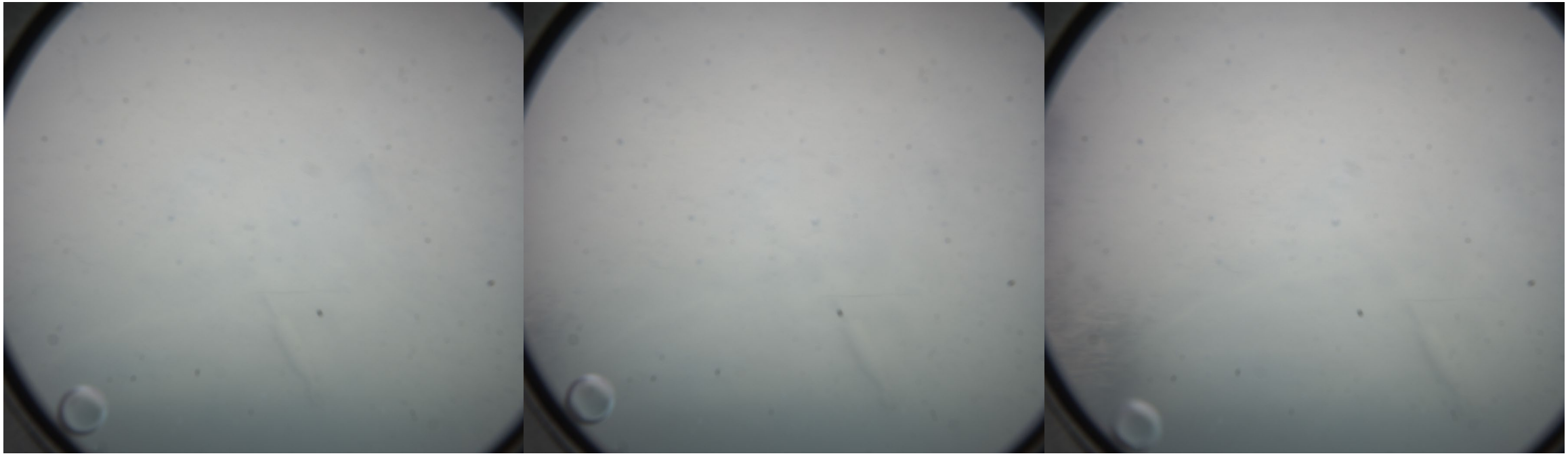
ESTCP MR23-7753, TPOC: Zach Waters, NRL

Optical Systems

MR23-9001 (Creare)

MR22-7964 (Orion)

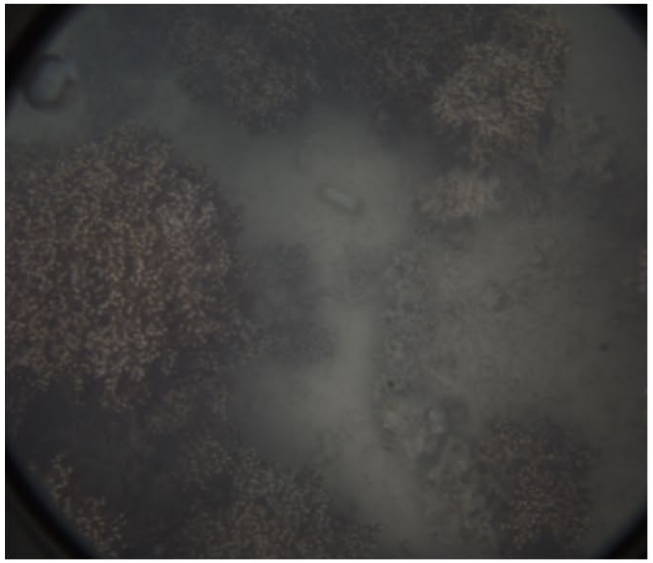
Creare- Preliminary Results



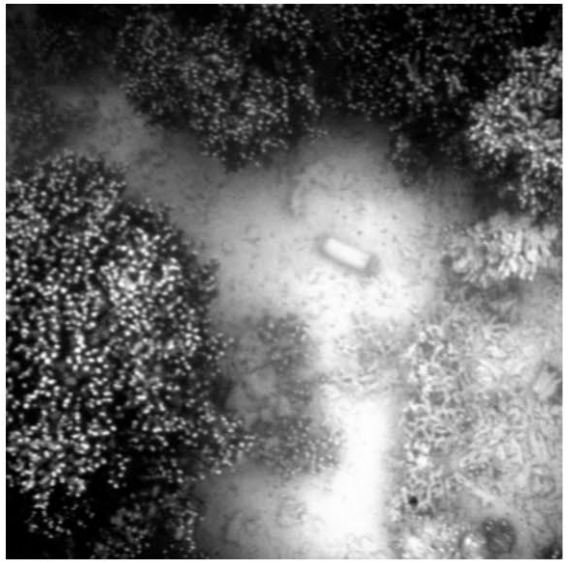
47

Creare- Preliminary Results

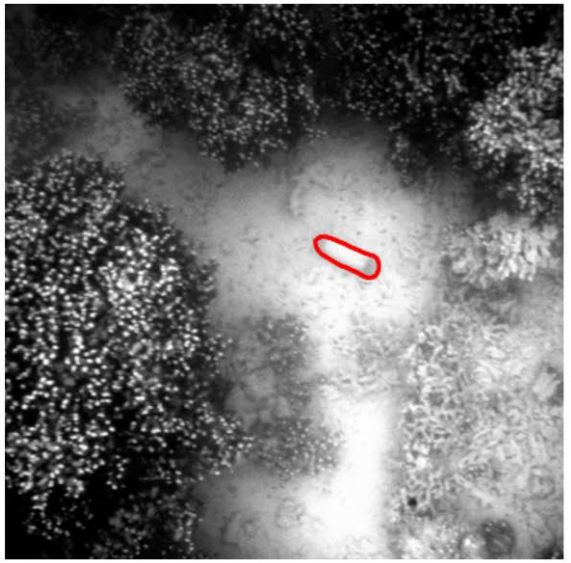
HQ Color Image



Processed Image



Munition Identification



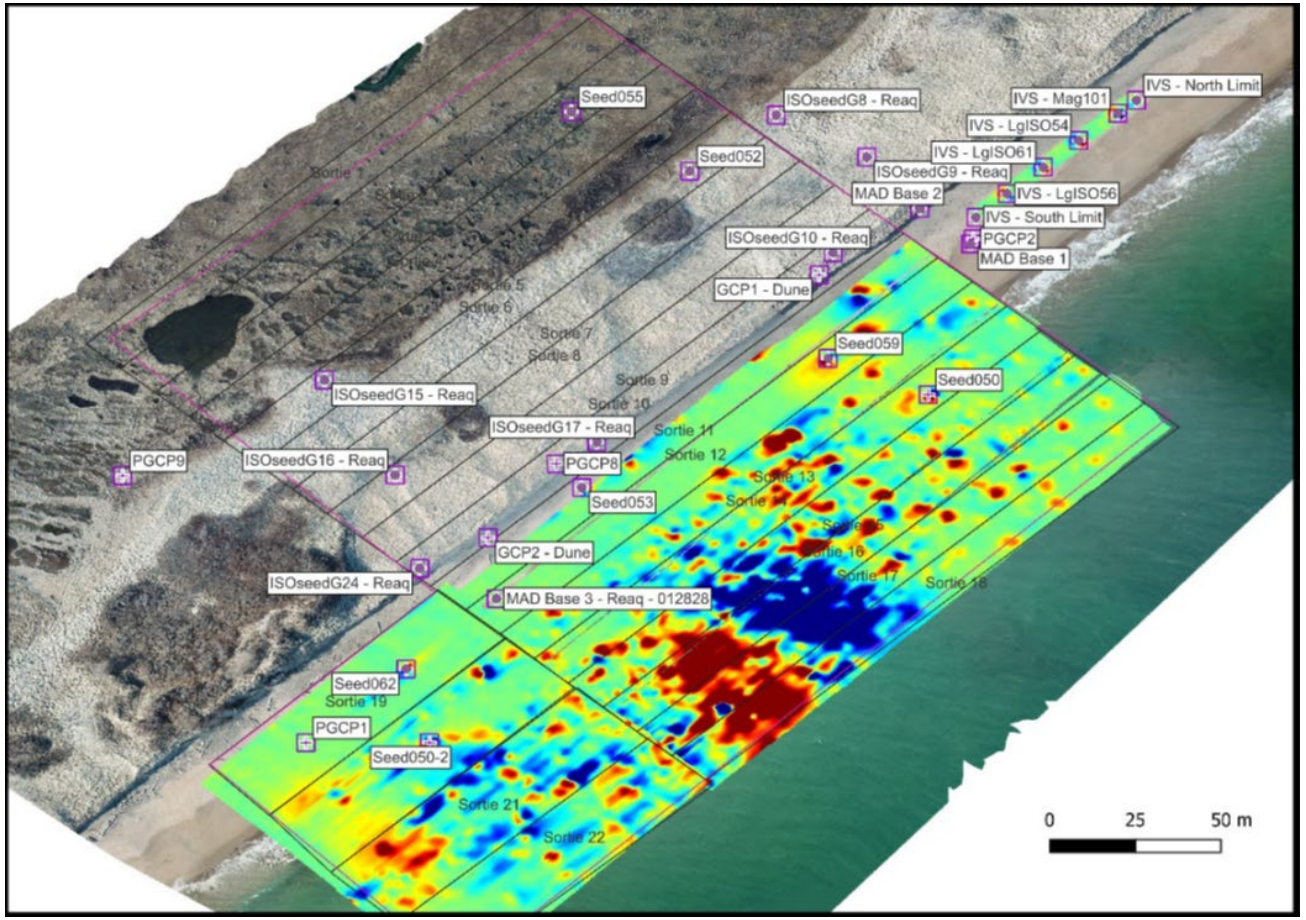
Final Result

48

Mobility, Burial, and Other

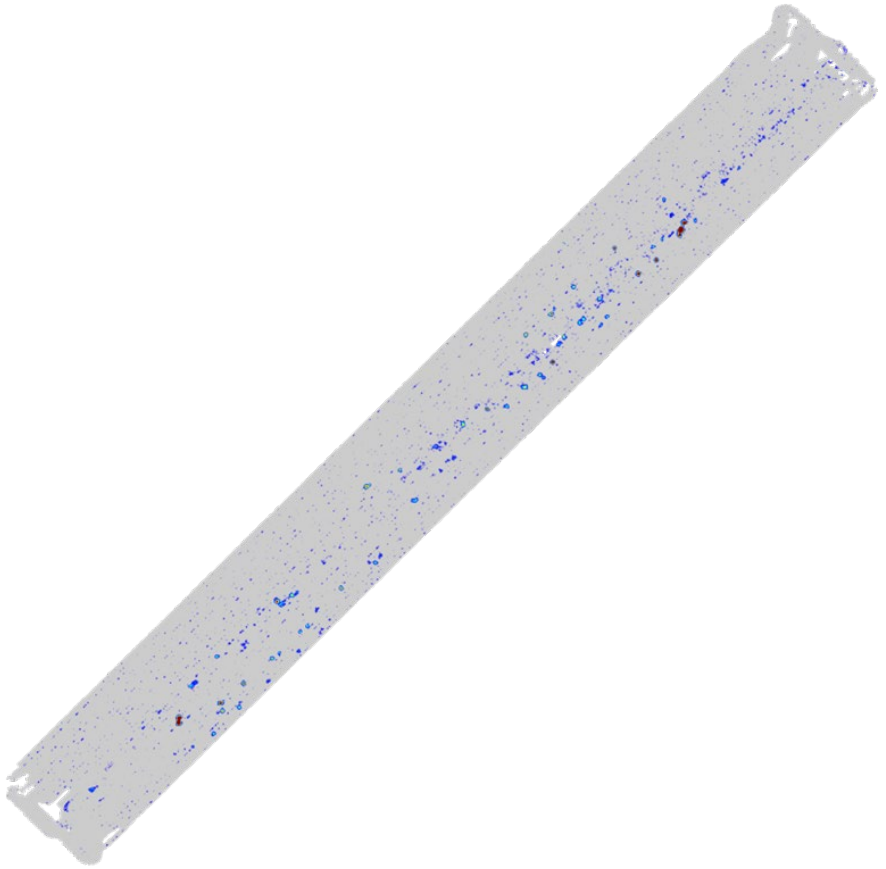
- UnMES (many projects, currently NRL) and UXOMOB (MR21-1081, TPOC: Peter Menzel, Corvus Works)
  - Burial and Mobility modeling tools to help manage MR sites
  - Both forecasting and hindsight model capabilities
- Robust Prediction of Ordnance Depth of Burial (MR19-1277, TPOC: Stephan Bless, NYU)
- VIPER (MR23-7687, TPOC: Ed Braithwaite, NRL)
  - “Vibrocoring” approach to placing seeds
  - Minimize location errors due to placement
  - Minimize costs
- Mobility Measurement Units (MMU- TPOC: Carter Duval, NRL)
  - Acoustic pingers for “real-time” tracking of seed location

Maine Bombing Area-Drone Mag



50

Maine Bombing Area- Crawler with AGC



51

Known Gaps/Looking forward

- Saturated response areas
- Assessments and validation of various platforms
- Recovery and disposition of munitions
- Understanding and communication of limitations
  - Looking at you, ITRC!

ITRC Underwater Munitions Team

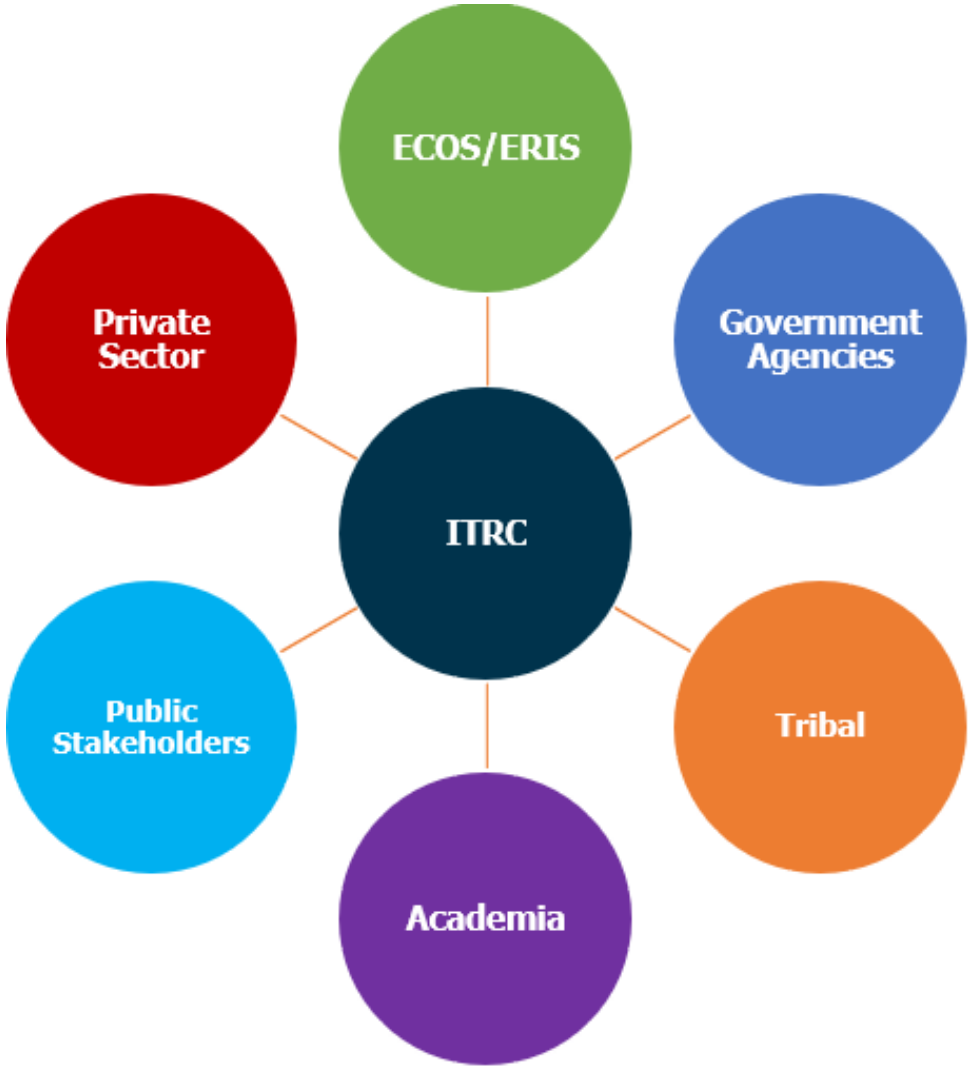
Kyle Newman

VA Department of Environmental Quality

ITRC Underwater Munitions Co-Lead

Who We Are

- National coalition created in 1995
- Program of the Environmental Research Institute of the States, a 501(c)3 education and research nonprofit affiliated with the Environmental Council of the States
- **Volunteer members** from state, federal and local government, Tribal stakeholders, private sector, academia, and public stakeholders



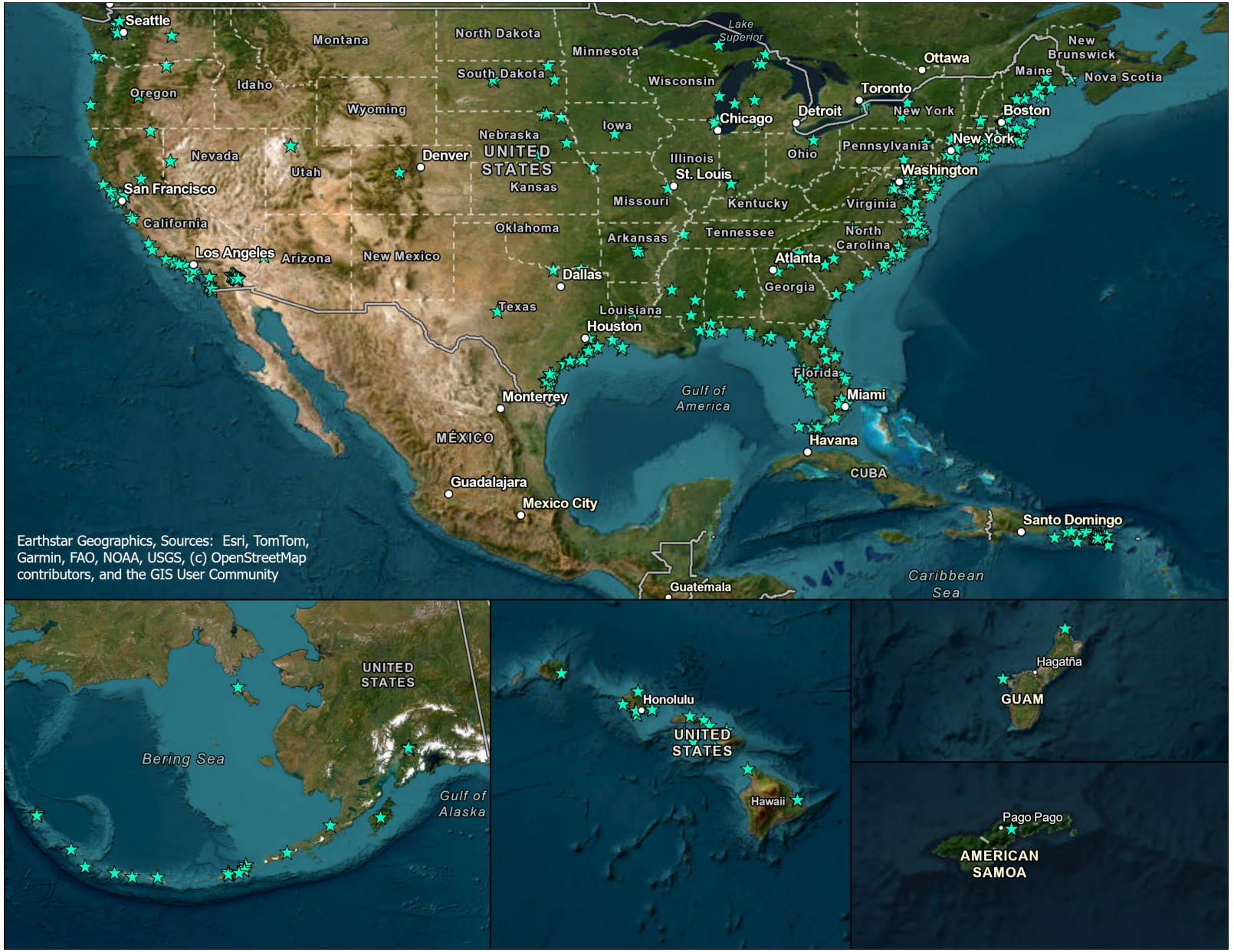
https://itrcweb.org/who-we-are/

ITRC

- Brings teams of regulators, industry, and other stakeholders together to develop technical guidance
- Utilizes a consensus-based approach
- Offers training on guidance and research topics
- Always accepting new members!
- www.itrcweb.org

Underwater Munitions Team

- Developing guidance for performing munitions investigations in various underwater environments
- Integrating data from ongoing SERDP/ESTCP technology demonstrations
- Identifying limitations around the environment, sensor technologies, and platforms
- **NOT** developing guidance to evaluate risks at underwater munitions sites


Seattle
Montana
North Dakota
Lake Superior
Minnesota
Ottawa
New Brunswick
Maine
Nova Scotia
South Dakota
Wisconsin
Toronto
Oregon
Idaho
Wyoming
Chicago
Detroit
New York
Boston
Nebraska
Iowa
Denver
UNITED STATES
Ohio
Pennsylvania
New York
Nevada
Utah
Illinois
St. Louis
Washington
San Francisco
Kansas
Missouri
Kentucky
Virginia
California
Oklahoma
Arkansas
Tennessee
North Carolina
Los Angeles
Arizona
New Mexico
Atlanta
Dallas
Georgia
Texas
Louisiana
Houston
Florida
Gulf of America
Monterrey
Miami
MÉXICO
Havana
CUBA
Guadalajara
Mexico City
Santo Domingo
Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
Guatemala
Caribbean Sea
UNITED STATES
Bering Sea
Gulf of Alaska
Honolulu
UNITED STATES
Hawaii
Hagatña
GUAM
Pago Pago
AMERICAN SAMOA

Public Exposures-

Real and more common than you think

Existing Frameworks for New Challenges

- Data Quality Objective (DQO) Process
  - What study questions need to be answered
  - How good do the data need to be to answer them?
  - How to address inherent uncertainties from both measurements and the environment?
  - The underwater environment requires particular consideration of the above

- MR QAPP
  - Plan to collect quality data specific to study questions
  - Spells out decision points and how the data are to be used
  - Incorporates DQOs and associated data quality requirements for the project

Products and Timelines

Appetizer Products (Release date: end of 2026)

- Underwater Munitions 101 Fact Sheet
  - Why we care
  - Challenges of the Underwater Environment
- Underwater Munitions 102 Fact Sheet
  - Overview of technologies and how they function

Main Course (Release date: end of 2027)

- Primary Guidance Document
  - Full technical guidance for planning and implementing investigations
  - Summary of current technology capabilities and limitations
  - Guidance for performing Quality Assurance/Quality Control with new technologies

Wrap-up and Q&A

Thank you!

Please fill out a brief survey here: https://forms.osi.office365.us/r/SYcZd38rbd