



Implementation of Autonomous Surface Vessels for Dredge Spoil Containment Cell Surveys

ERDC Dredging Operations Technical Support Program (DOTS)

U.S. ARMY CORPS OF ENGINEERS

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Response Summary:

The USACE Norfolk District (NAP) Craney Island site is a large dredge spoil containment site that covers nine square miles and is comprised of three large containment cells of equal size (Figure 1). These cells need to be regularly surveyed for three main reasons: 1) To determine the amount of sediment free water that can be pumped from the cell 2) To determine depth of flocculated/unsettled sediment layers present within the cell 3) To determine the depth of the hard mud bottom of cell. Once these three parameters can be measured, an accurate volume of available space within the cell can be determined and used to inform dredging operations.

The containment cells are difficult to survey with traditional methods due to location, water depth, water access, extremely fine and suspended sediment (making wading operations hazardous), and local vegetation obstructions. There is no boat access, water depth varies from a few meters to a few centimeters and vegetation causes obstructions throughout the survey area. Fine sediments can cause problems with cooling systems on vessels and different sounder frequencies will be needed to define all sediment layers within the containment cells.

ERDC-CHL-COAB implemented two different, single person portable, autonomous survey vessels (ASVs) with different frequency sonars to attempt to identify both the soft sediment top layer and the hard bottom layer underneath. The ASVs were able to navigate the shallow water, avoid obstructions, and survey the containment cells. In our efforts, new bottom finding algorithms were needed to be developed as the manufacturer's algorithms were not sufficient for this type of environment (Figure 2). The sounders used (115khz and 500 khz) were best able to identify the soft mud layer at the surface and were unable to produce a second return at the deeper hard bottom layer. From this information, the available sediment free water volume can be calculated from these data to help quantify volumes of water to be discharged from cells.

In FY24 the team did not have low-frequency sonar available for this application, but at the end of the FY, the team was able to acquire a multi-frequency sonar (on another project) that could work for this application. If funding was available in FY25, the team would be eager to try the new sounder that has 15khz and 200 khz frequencies to identify the sub bottom and soft mud layer location.

Period of Performance:

Start of work: August 2024 End of Work: September 2024

Benefits of the Response to the USACE Dredging/Navigation Program:

ERDC-CHL-COAB has provided platform that can autonomously survey dredge spoil containment areas that have limited access due to navigational hazards, no access to navigable waters, and fine sediments. Preliminary surveys of the site were able to define water depths to the top of the fluid mud. Using these autonomous survey platforms to make high resolution surveys with 500khz sonar can define a volume of sediment free water present in the cell. This data can be used to inform pumping operations within the containment cells, ensuring water pumped out of cells contains acceptable amounts sediment. This ensures that the USACE dredging programs are able to continue the mission while maintaining effective compliance with environmental standards.

Deliverable:

Bathymetric plots and depth charts showing top of fluid mud layer in the southern containment cell were produced from ASV Surveys at the Norfolk District Craney Island Site (Figure 3 and Figure 4). Along with a PowerPoint explaining the process, and an xyz file with elevations in NAVD88 ft. This information was delivered to Norfolk District Craney Island Site along with plans for future work with different platforms and multifrequency sounders. Survey data produced with ASVs provided to Norfolk District Craney Island Site.

Providing environmental and engineering technical support to the U.S. Army Corps of Engineers
Operations and Maintenance navigation and dredging missions



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Figure 1. Craney Island Dredge spoil containment cells



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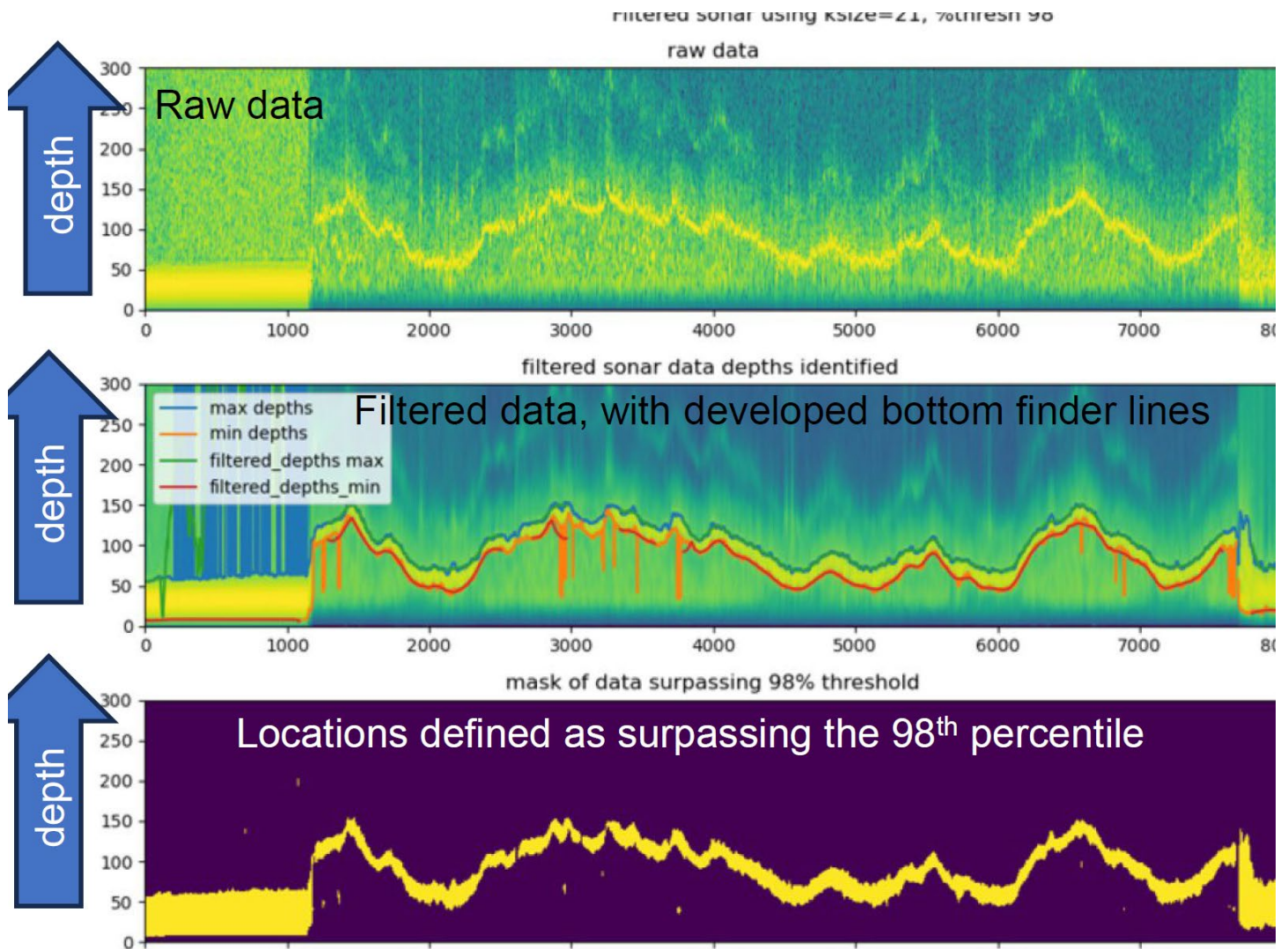


Figure 2. Sonar backscatter plots produced from Craney Island survey.



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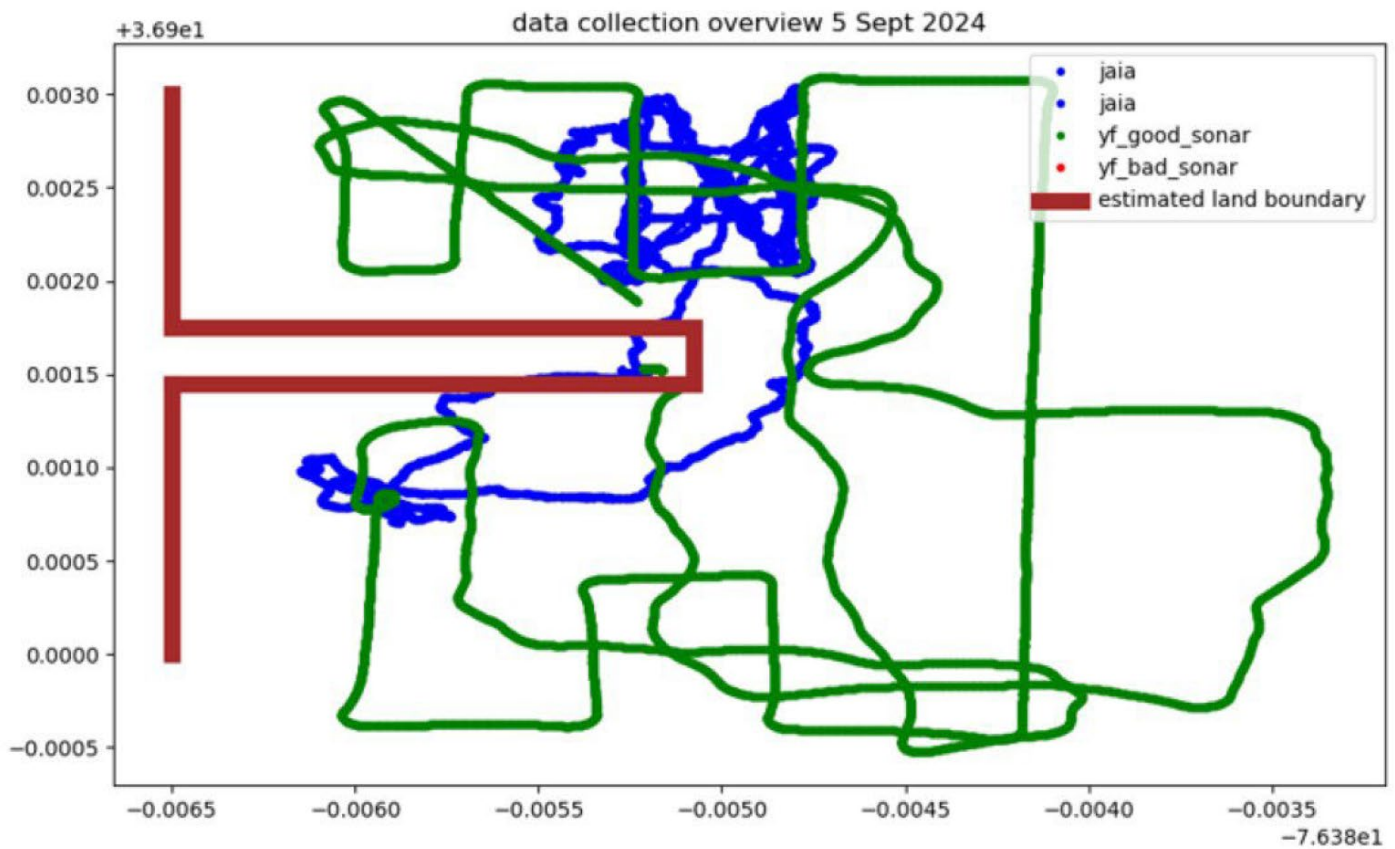


Figure 3. GPS track of Yellowfin and Jaiabot ASVs.



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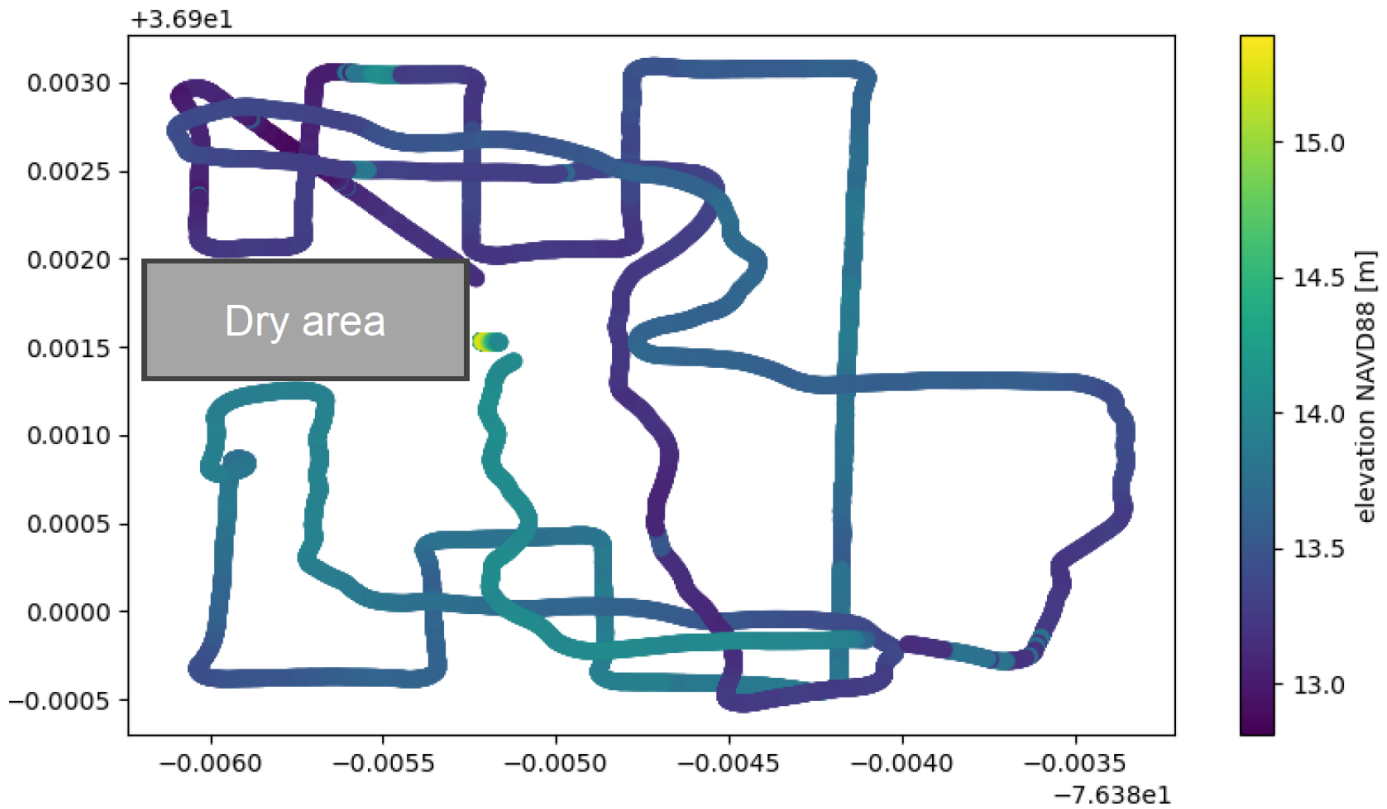


Figure 4. Surveyed depth plotted along GPS track.



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