

ACOUSTIC DATA ACQUISITION FOR SEAFLOOR MAPPING IN LONG ISLAND SOUND

Final Report

Submitted by:

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1.0 INTRODUCTION

In 2004, a settlement fund (Long Island Sound Cable Fund, LISCf) resulting from issues surrounding cable infrastructure in Long Island Sound (LIS) was created to support a benthic mapping effort. To date, the LISCf has supported three research teams to conduct comprehensive seafloor mapping in three identified priority areas in the Sound (Figure 1-1). The outcomes of the Phase I and Phase II efforts have been completed, reviewed and published online (see: www.lismap.uconn.edu), while Phase III is currently underway.

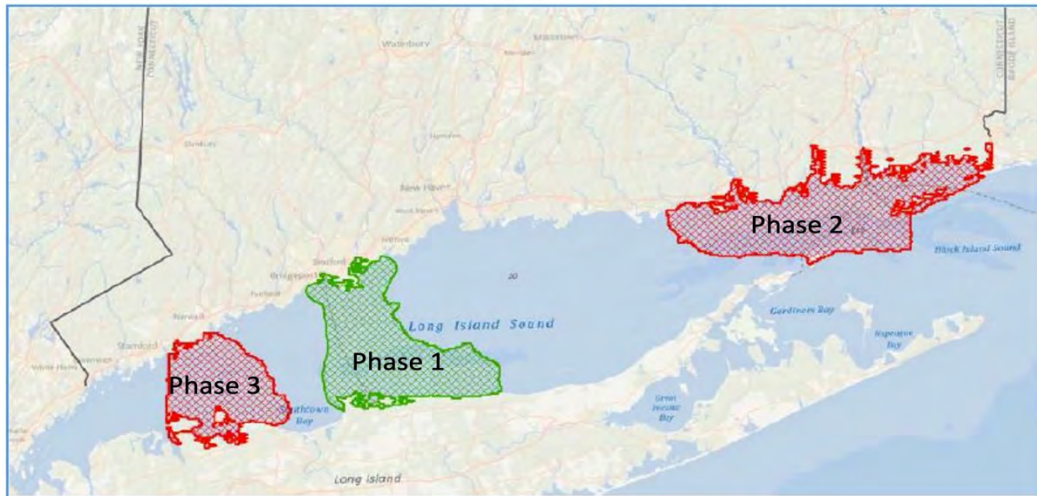


Figure 1-1 The three priority areas identified in Long Island Sound for seafloor habitat mapping.

Additional funds were made available by the Long Island Sound Study (LISS) CCMP Enhancement Grant program, allowing the LISCf Steering Committee and its mapping research teams to expand the seafloor mapping effort to collect and analyze data consistent with the previous efforts in other parts of the LIS basin. The next highest priority area identified was within the central basin, where no other recent acoustic surveys have been made, depicted as the region outlined in purple in Figure 1-2 and designated as the Phase IV of the overall mapping effort. It was decided that the acquisition of new acoustic data should be the focus of this Phase IV effort, based upon lessons learned from the Phase I and Phase II efforts regarding the timing and phasing of the multiple data collection themes identified by the LISCf. In addition, the acoustic data acquisition of this 99.5 square-mile area within the central LIS basin supports the implementation of the 2015 CCMP by improving the scientific knowledge base essential to making informed decisions to protect and restore the health of LIS.

Two research teams were identified to conduct the acoustic data acquisition, deemed Phase IVA due to the separation of this preliminary data collection from the subsequent comprehensive geological, ecological and physical characterizations carried out in the Phase I and II areas and planned as a Phase IVB. The lead organization was Stony Brook University (SBU), headed by Dr. Roger Flood, who has extensive experience with underwater mapping. The University of Connecticut originally proposed to only provide

technicians to assist with the data acquisition efforts, however, scheduling and logistical challenges mandated modifications to the original scope of work. The project scope and timeframe were both modified to accommodate these changes and augment the overarching effort in the Phase IV area with the UConn tasks summarized below and detailed in Appendix One: LISMaRC 4A Project Tasks.

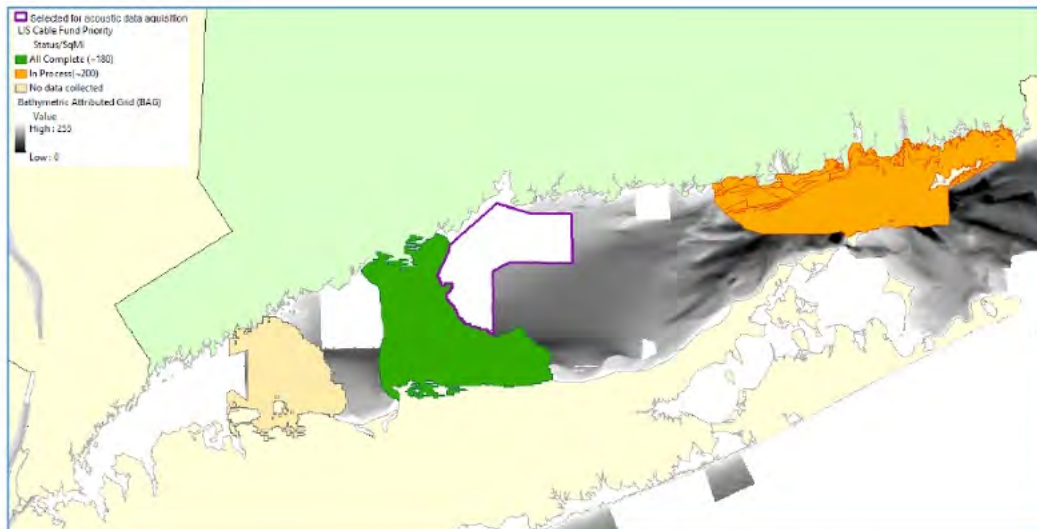


Figure 1-2 Map of Long Island Sound, indicating the original three areas identified for seafloor mapping and the Phase IV area (outlined in purple) proposed for additional acoustic data acquisition.

Table 1-1 Elements of the UConn Scope of Work for the Phase IVA project.

Task #	Task Description
3	QAPP Review
6	Review revised QAPP
15	Sonar Technician participates in Year 1 mapping cruise
22	Sonar Technician participates in Year 2 mapping cruise
24	Data Mining of Ancillary Data to Support Acoustic Data Characterization (review/interpretations of existing & new data)
25	Integrate the acoustic results with existing data, including identifying any sample station data that exists in the literature, online databases and include review and discussions of any unpublished data from other projects or investigators. Includes review and inclusion of new imagery from the Phase IVB project.
27	Draft & submit Final Project Report
32	Revise & Submit Final Project Report based on SC recommendations

2.0 NEW ACOUSTIC DATA ACQUISITION

2.1 Year One Activities (Tasks 3,6 and 15)

For Year One, a primary goal of the LISS Enhancement Grant proposal was the purchase of a new multibeam sonar system (MBS) since coordination of leasing such gear with vessel availability had proven challenging in previous phases of the Long Island Sound Seafloor Mapping initiative. The proposed system was a Kongsberg EM2040c MkII with dual heads with motion sensor, and logging computer plus software. The MBS equipment was proposed as a system that could operate from SBU's Research Vessel (RV) *Seawolf* and UConn's RV *Connecticut*, when appropriate, to serve as a regional resource for seafloor mapping in LIS.

Therefore, the main component of UConn's SOW was to have UConn-DMS' Acoustic Mapping Technician, Dennis Arbige supported to travel to and attend the installation and training of this new MBS on Stony Brook University's RV *Seawolf*. Since the MBS equipment was also proposed as a system to be installed on the RV *Connecticut*, a vessel technician was also included in the training on the new system.

Contract implementation delays and production delays pushed the delivery of this system back several months, with delivery finally being made in January, 2022. This had implications for completing the scope of work as proposed, as it delayed and compressed the training and field-testing program until March, 2022. However, finding time on the RV *Seawolf*'s schedule to conduct this element became challenging, which unfortunately resulted in SBU only being able to inform UConn with very short notice of upcoming installation/testing activities, which as it turned out conflicted with both Dennis Arbige and the RV *Connecticut* technician's schedules and therefore this element wasn't carried out.

Since the project was being supported by the LISS with funds from the U.S. Environmental Protection Agency (EPA), a Quality Assurance Program Plan (QAPP) was required prior to any data collection. This effort was led by the CT DEEP Project Manager, DeAva Lambert, and a draft version of the QAPP was sent to the two team leads (SBU and UConn) for review and edit during the first and second quarters and completed in the third quarter of year one (Appendix Two).

2.0 Year Two Activities (Task 22)

2.1 New MBS Installation and First Data Acquisition Cruises on the RV Connecticut

The second major goal of the project for Year One was to begin mapping the designated area with the new MBS installed on the RV *Seawolf* with two 5-day surveys. However, the challenges in scheduling the RV *Seawolf* continued, and it was decided to

conduct this first of these mapping surveys using the RV *Connecticut*. After much deliberation, the time period from August 9-23, 2022 was identified on the RV *Connecticut's* schedule to conduct the installation and mobilization of the system, a training day followed by two survey legs. The first leg (August 12-16) was as proposed in the UConn SOW, the second leg (August 17-22) was the first of the survey legs to be supported by SBU funding. August 23 was the demobilization day. Dennis Arbige participated on these two survey missions as part of the data acquisition team. However, the RV *Connecticut* technician gave her two weeks notice of resignation in May, and was not available to participate in these cruises. Table 2-1 provides a breakdown of the schedule and costs associated with this initial mapping effort.

Table 2 1 Summary of activities, rates and division of costs associated with the initial acoustic acquisition cruises conducted from the RV Connecticut.

Dates	Activity	# Days	Rate	UConn Budget	SBU Budget
Aug 10	SBU personnel travel to UConn	0.5	\$208/hr	\$832	
Aug 10	Mobe w/ diver install of MBS	1	\$208/hr	\$1,664	
Aug 11	Training day	1	\$208/hr	\$1,664	
Aug 12-16	UConn Mapping Operations	5	\$10003/day	\$50,015	
Aug 17-22	SBU Mapping Operations	6	\$10003/day		\$60,018
Aug 23	Demobe w diver	1	\$208/hr	\$1,664	
	Fuel Surcharge - UConn & SBU days	5/6 days	\$1,440	\$7,200	\$8,640
Subtotals				\$63,039	\$68,658

The SBU team worked with the RV *Connecticut* management to construct a mounting plate for the new sonar transducer head that could be mounted to the hull of the vessel below its moon pool. This plate had to be slightly modified by UConn's machine shop to allow for proper installation of the unit (Figure 2-1). Since the system had to be installed from below, UConn Marine Science Department divers were required to bolt the system to the hull at the dock (Figure 2-2). The data acquisition system was rack mounted and installed in the dry laboratory of the vessel. Two additional antennas, one for GPS, and the other for improved directionality were also installed. Half a day was spent developing all of the offsets between the transducer head location, including depth, and these two antennae as part of the required installation procedures. A Kongsberg technician was also part of the mobilization team who assisted with the fine-tuning of the system install and providing training on the nuances of the system's operation (Figure 2-3).



Figure 2-1 The acoustic transducer (bottom), mounting plate and motion reference unit (cylinder on top of plate) on the deck of the RV Connecticut.

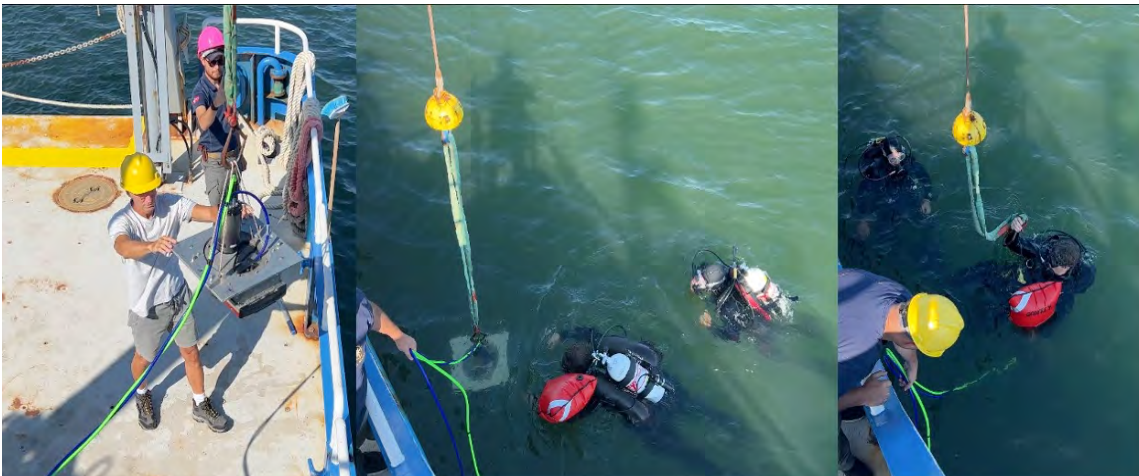


Figure 2-2 Deploying the transducer over the side, divers attaching a lift bag to hold the weight of the unit.

The second day of the mobilization (August 12) was devoted to at-sea calibration of the system. A nearby location was chosen that, based upon previous data acquisition from the LIS Cable Fund Phase II project (Figure 2-4), provided the necessary seafloor topography to conduct the system calibration (roll, pitch and direction axes). Additional noise measurements were made of the system at speeds of 5, 7, 8 and 9 knots, with the installation showing consistent low (~58 dB) noise levels at each of these speeds for the 200 kHz frequency (Figure 2-5). This provided confidence that the system could acquire good data without interference from bubbles or other factors that could produce

extraneous noise into the acoustic acquisition. Conductivity, temperature and depth (CTD) measurements were made every two hours to provide data to develop the sound velocity profiles needed as part of the data acquisition protocols (Figure 2-6).



Figure 2-3 Installing the data acquisition system in the dry lab (from left to right - Jason, SBU graduate student; Mohammed, SBU Post-doc; Dan, Kongsberg technician; Roger, Chief Scientist; Dennis, UConn/LISMaRC technician).

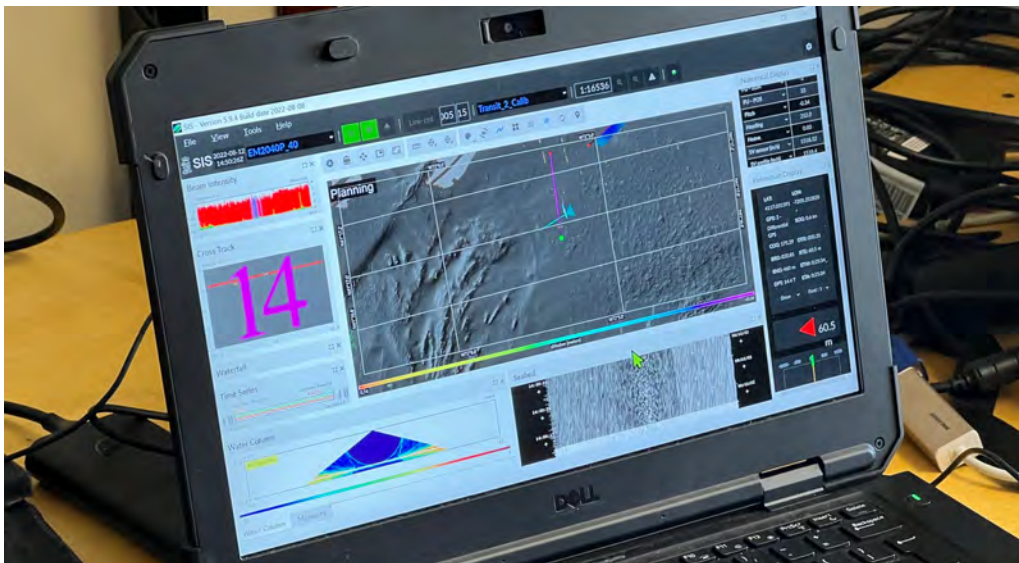


Figure 2-4 Computer with the Phase II data imported to provide seafloor topography imagery needed to conduct the at-sea system calibration of the new MBS system.

The RV *Connecticut* departed for the LISS Phase IV area on the evening of August 12, with Ivar Babb and the Kongsberg technician, Dan, getting off the vessel since they were not part of the field data acquisition team. Three updates were received to date, one from Roger Flood and another from Dennis Arbige on Friday, August 19th reporting that all was operating smoothly, with the team of four getting the job done, albeit with the comment that a team of six would have been better. A third update was received from the RV *Connecticut* vessel manager, Turner Cabaniss, reporting that the vessel had a mechanical issue Friday PM and returned to Avery Point. The issue was resolved early Saturday and the vessel was back on station before noon. About 20 hours of survey time was lost so Turner arranged for Roger Flood to make that up with ship arriving back by 0600 on August 24. The preliminary results of the backscatter data acquired on these first two legs of acoustic mapping can be seen in Figure 2-7.

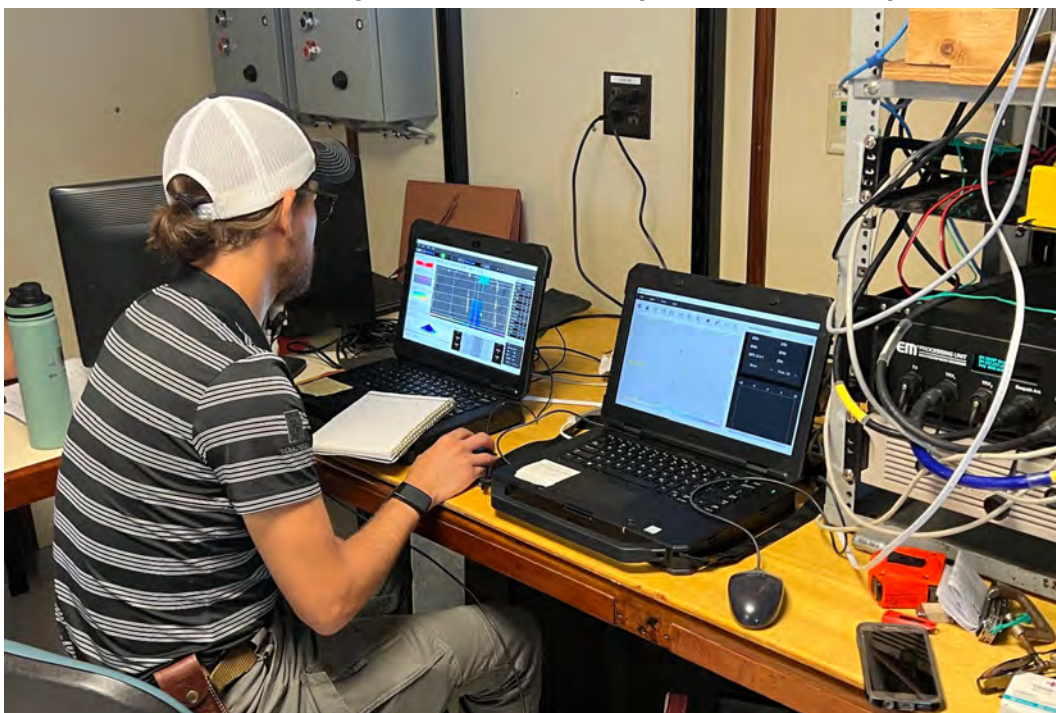


Figure 2-5 Kongsberg technician Dan conducting the noise tests.



Figure 2-6 Dennis Arbige recovering the CTD used for sound velocity profile measurements.

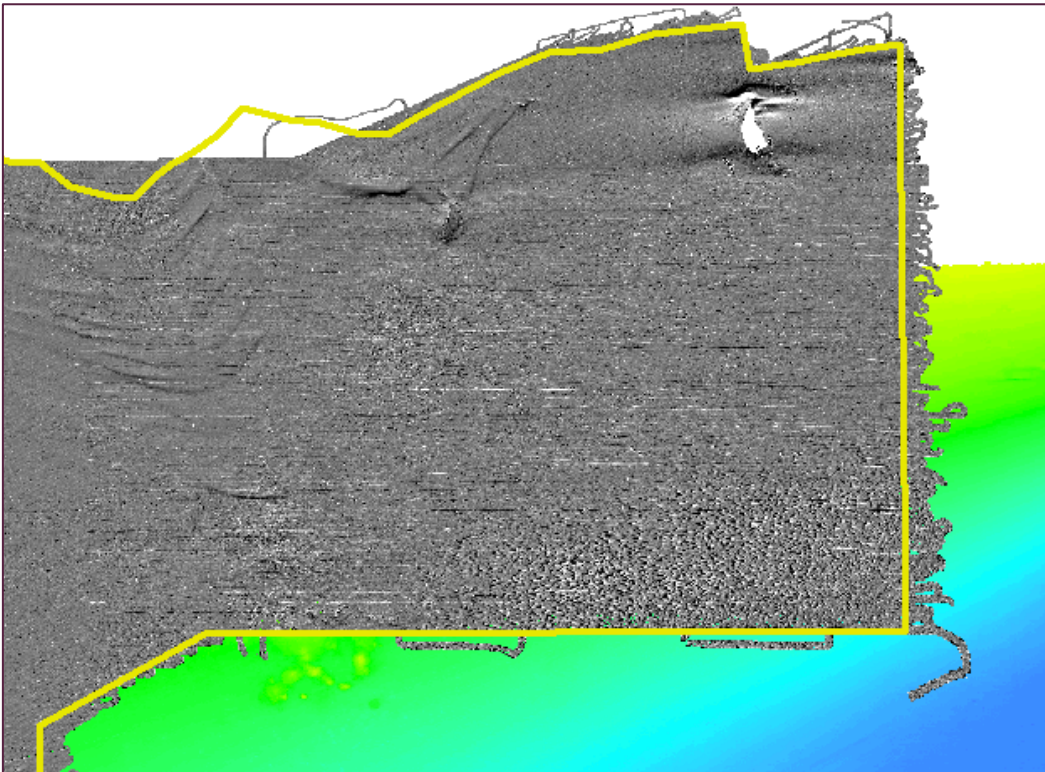


Figure 2-7 Early draft of the backscatter data acquired in August from the RV Connecticut.

2.2 Second Acoustic Data Acquisition Cruise on the RV Seawolf

The next phase of the project focused on acquisition of new acoustic data on the RV *Seawolf* in September 2022. However, for the first leg on the RV *Seawolf*, neither UConn technician was able to participate, as they were already scheduled for other projects on the RV *Connecticut* and at UConn. These scheduling challenges have been one of the main reasons that all subsequent acoustic acquisition (e.g. LISC Phase IIIA) is being led by a single team (i.e., Dr. Roger Flood from SBU), as trying to match moving ships' schedules with moving personnel schedules has proven challenging. Dr. Flood and the SBU team were able to add an area roughly equivalent to the first mapping effort from the RV *Connecticut* during this leg (Figure 2-8). Of note from this image is that the RV *Seawolf* acquired data (left side) appears to be smoother and more dense than that acquired by the RV *Connecticut* (right side). The reason(s) for this apparent difference is unknown, but Dr. Flood has been emailed for a possible explanation.

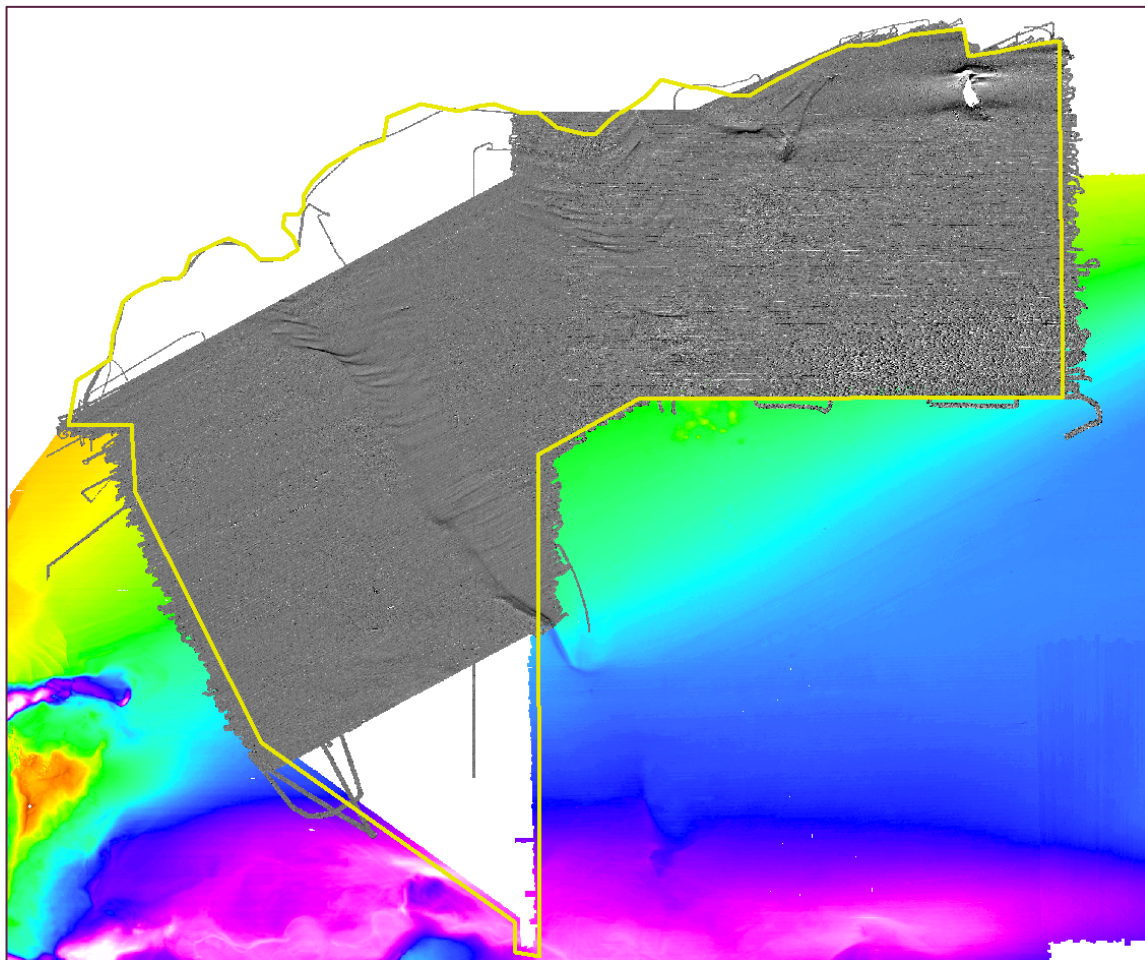


Figure 2-8 Preliminary results of new acoustic data acquisition (backscatter) merging the RV Connecticut data (right) with the RV Seawolf data (left).

2.3 Third Acoustic Data Acquisition Cruise on the RV Seawolf

For the final two legs of the project, two UConn technicians, Dennis Arbige and Wendy Woods, were able to arrange their schedules to participate on the RV *Seawolf* legs (Wendy Woods: November 28 – December 6 and Dennis Arbige: December 7 – 12). This represents nine and six days respectively, totaling the 15 days estimated by project lead, Dr. Roger Flood to complete the mapping of the Phase IV area. The data acquisition was completed during these time frames without any weather-related issues or technical problems. Figure 2-9 shows the preliminary compiled backscatter data from all of three of the sampling legs, while Figure 2-10 shows the compiled bathymetry data. Details of the data processing will be provided in the Final Report submitted by Roger Flood.



Figure 2-9 1 Compiled preliminary backscatter of the newly acquired acoustic data for the Phase IV area (outlined in yellow).

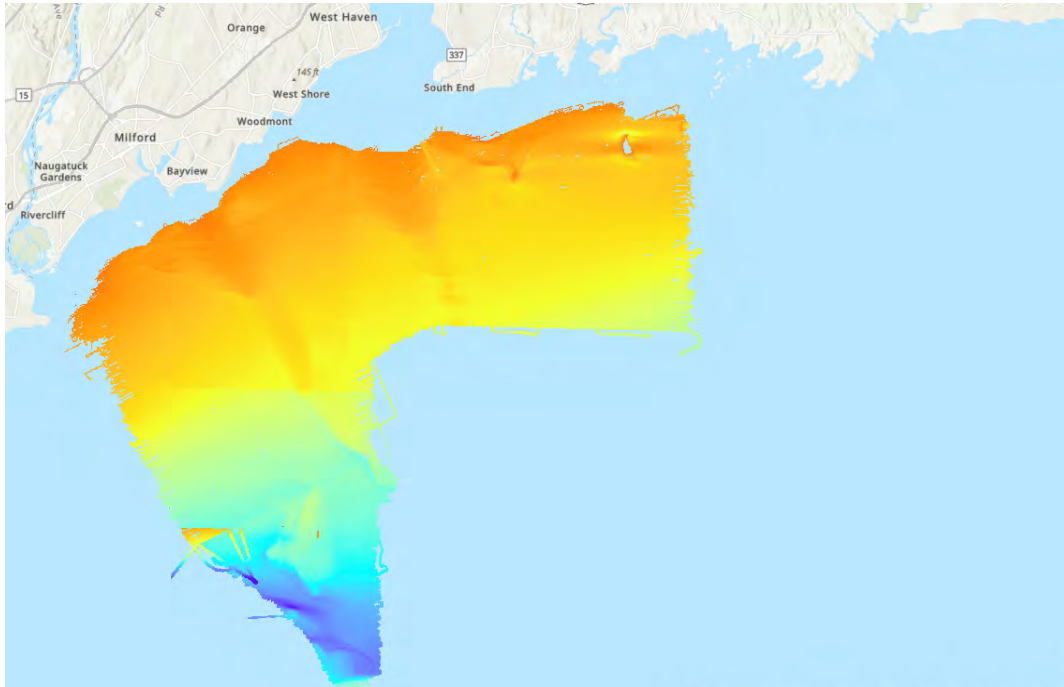


Figure 2-10 Compiled preliminary bathymetry map of the newly acquired data for the Phase IV area.

3.0 PHASE IVA DATA MINING TO SUPPORT ACOUSTIC INTERPRETATION

3.1 Background (Tasks 24 and 25)

This project was made possible by funding from the EPA through its Long Island Sound Study Enhancement Grant program. From the outset the project was designed as a partnership between the University of Connecticut Department of Marine Sciences and the Stony Brook University School of Marine and Atmospheric Sciences, utilizing both existing infrastructure (research vessels) and expertise (Principal Investigators, Technicians) combined with new technology (multibeam sonar acquisition by SBU) and training of technicians and students on the use of this new system to acquire the new acoustic data in the Phase IVA study area. As such this project supports one of the goals of the recent National Academy of Sciences report (NASEM, 2023) regarding EPA science, that states the agency should: “create and maintain an innovation network that embodies both hardware and software advancements, management system improvements, systems thinking, and multi-institutional collaboration for research and development of scientific tools for direct application to newly emerging health and environmental priorities.”

The data acquisition was completed through the multi-institutional partnership between UConn and SBU as reported above. Also, much of the initial data processing was completed while on board the research vessel. Final data processing and interpretation is being completed by SBU. One additional component of the overarching project that remained, however, was to integrate the survey results with existing sample, photo, etc. data, including identifying any sample station data that exists in the literature, online databases (e.g. McMullen et al. 2014) or elsewhere to improve the interpretation of the both the bathymetry and especially the backscatter mosaics.

As described above, the proposed initial training and field-testing elements of the UConn Scope of Work (SOW) were not completed due to contract and new MBS delivery delays and vessel scheduling challenges on the RV Seawolf. As a result, there were funds remaining in the Personnel category, and under the aegis of the SBU-UConn partnership, a request was made to apply these funds to support UConn to assist with the data archive mining, and to extend the period of performance to allow for this work to be completed. It was deemed that this effort should be led by UConn Principal Investigator, Ivar Babb, based upon his recent leadership role in the LIS Mapping effort and institutional memory of working at UConn for 30 years versus an acoustic technician.

3.2 Review of Existing Data and Applicability to Acoustic Data Interpretation

A range of existing data sets exists for the Phase IV area of Long Island Sound of various vintage, quality, accuracy and completeness. These data encompass a range of data access techniques and technologies that have been collected by federal, state and academic institutions over the course of over thirty years. Some of these data have been published in the literature, while others are online. There are surely other data that exist in unpublished “shoeboxes” of researchers that have not been encountered through this investigation.

The following are the types of data that were deemed to be most useful in the interpretation/understanding of the newly acquired acoustic data collected in the Phase IVA area. A short description, year collected, citation and Digital Object Identifier or other link to the data are provided in Appendix Two. The purpose of the Appendix is to provide the SBU team with easy access to all of the existing data found through this data mining effort to assist their better interpreting their newly acquired acoustic data.

3.2.1 Existing Acoustic Data

Three different types of acoustically collected data were found for the Phase IV area: single beam, multibeam and side scan sonar data sets and sub-bottom profile records. There are several previous acoustic surveys that have been conducted in this area by NOAA over the course of several decades using these technologies. Information and source data (when available) for these surveys can be found at: <https://www.ncei.noaa.gov/maps/bathymetry/>. Figure 3-1 illustrates the location and coverage of these surveys in and around the Phase IV area (inset) from the NOAA NCEI (National Center for Environmental Information) website. Appendix Two contains links to these surveys to provide a larger regional context for the SBU team, should they yet to have accessed these data resources.

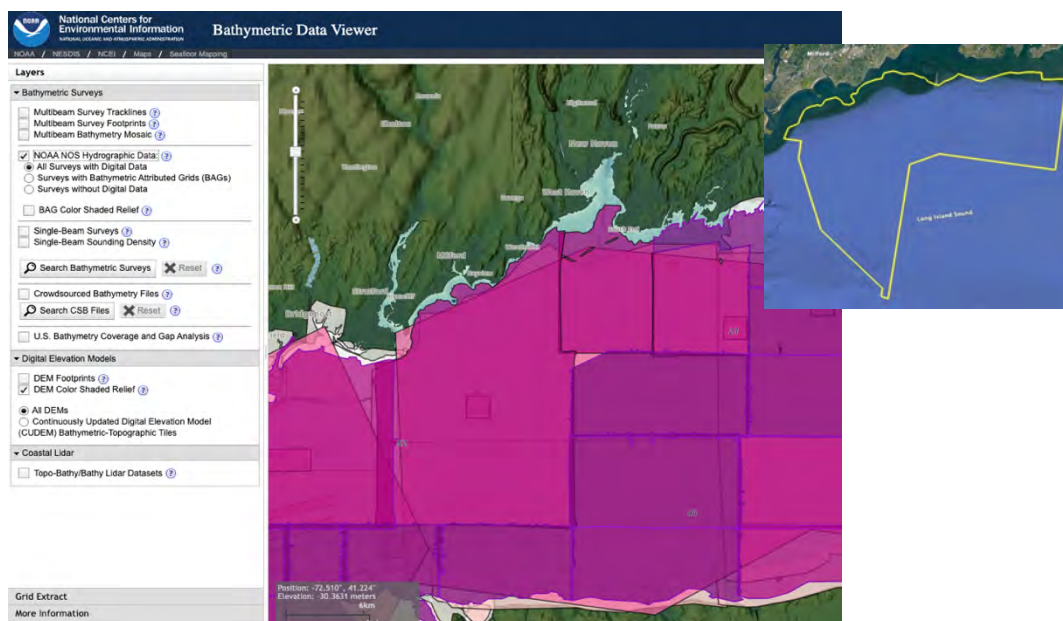


Figure 3- 1 Screen capture of NOAA’s NCEI data holdings in the Phase IV area (inset).

The various boxes outlined in Figure 3-1 represent the areas of the previous NOAA multibeam surveys for this vicinity. Table 3-1 is cut from the Appendix Two and lists all of the acoustic data sources identified for the Phase IV area, including a link to the online data, where available. This data spans from 1968 to 2013, with the earliest data being listed as not available on the NCEI web portal. Multibeam sonar data from 2004 on is presented as a Bathymetric Attributed Grid (BAG). The NOAA NCEI defines a BAG as: “The BAG format is a gridded, multi-dimensional bathymetric data file (see [Open Navigation Surface](#)). Readable with various applications such as the free [CARIS Easy View](#), [ESRI ArcGIS](#) or open source [GDAL](#). The BAGXYZ files are ascii representations of the BAG data in XYZ format, but do not include uncertainty.” The more recent data files also include a “project sketch” file, representing a thumbnail image of the area of the survey. Figure 3-2 provides a project sketch for NOAA multibeam survey H12481 conducted in 2012 from the NOAA Ship Thomas Jefferson overlain on the larger area depicted in Figure 3-1, providing a geographical context.

Table 3 3 Existing acoustic data sources located in and around the Phase IV area.

Data Source	Title/Description	Date	DOI or Online Link
a. Multibeam			
H11011	Approaches to New Haven Harbor, NOAA Ship Rude, Bathymetry, Side Scan Sonar, 8 bottom grabs	2000	https://www.ngdc.noaa.gov/nos/H10001-H12000/H11011.html
H11043	3 Nautical Miles South of Brandford Harbor, Long Island Sound	2001	https://www.ngdc.noaa.gov/nos/H10001-H12000/H11043.html
H11044	Oyster Point to Stratford Shoal Middle Ground, NOAA Ship Rude, MBES, SSS, 18 bottom samples	2001	https://www.ngdc.noaa.gov/nos/H10001-H12000/H11044.html
H11255	4 Nautical Miles North of Roanoke Point Shoal, NOAA Ship Thomas Jefferson, MBES BAG	2004	https://www.ngdc.noaa.gov/nos/H10001-H12000/H11255.html
H12438	4 Nautical Miles North of Herod Point Shoal, NOAA Ship Thomas Jefferson, MBES BAG	2012	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12438.html
H12479	4 Nautical Miles South of Guilford, PT, NOAA Ship Thomas Jefferson, MBES BAG	2012	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12479.html

H12480	4 Nautical Miles South of Faulkner Island, NOAA Ship Thomas Jefferson, MBES BAG	2012	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12480.html
H12481	Offshore Approaches to New Haven, CT, NOAA Ship Thomas Jefferson, MBES BAG	2012	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12481.html
H12485	Joshua Cove to Mansfield Pt, NOAA Ship Thomas Jefferson, Bathymetric Attributed Grid (BAG), 14 bottom samples	2013	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12485.html
b. Side Scan			
New Haven Harbor Survey	The distribution of surficial sediments in New Haven Harbor, Connecticut, and the New Haven Dumping Grounds, north-central Long Island Sound	1998	https://doi.org/10.3133/ofr98217
c. Sub-bottom			
	Maps Showing the Stratigraphic Framework and Quaternary Geologic History of Eastern Long Island Sound	1987	https://doi.org/10.3133/mf1939A
d. NOAA/NOS Hydrographic Surveys			
H08967	Stratford Shoal Middle Ground to Herod Point, USC&GS Ship Whiting, Single Beam Sonar, Source Data Not Available	1968	https://www.ngdc.noaa.gov/nos/H08001-H10000/H08967.html
H09008	Stratford Point to Branford Reef, NOAA Launch 1257, Single Beam Sonar, Source Data not available	1968	https://www.ngdc.noaa.gov/nos/H08001-H10000/H09008.html
D00102	Basic Hydrographic Surve, Ship: Heck, Source Data not available	1989	https://www.ngdc.noaa.gov/nos/D0001-D02000/D00102.html

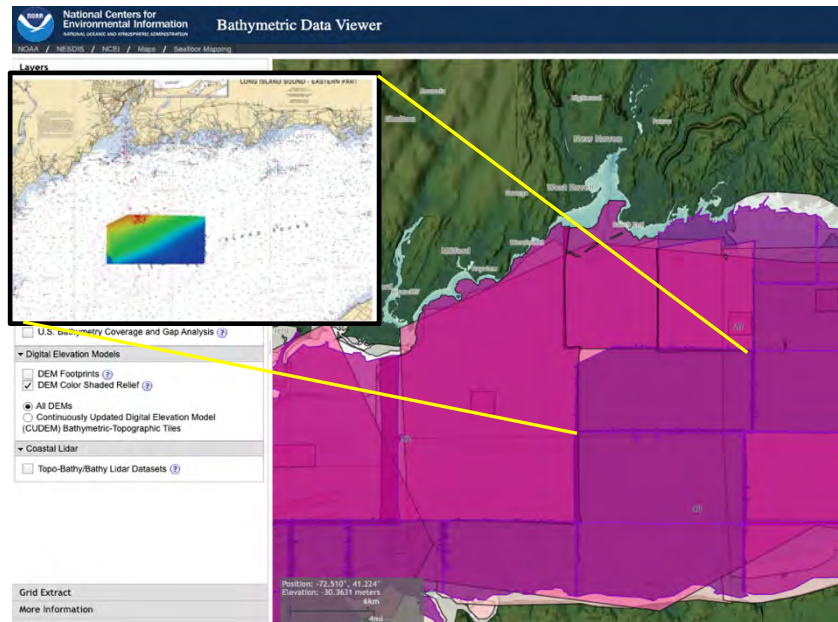


Figure 3- 2 Image of the Phase IV area with existing NOAA acoustic surveys with the 2012 H12481 project sketch.

3.2.2 Existing Sedimentary Environments Data

The second class of data deemed useful for interpretation of the newly acquired acoustic data from the Phase IV area was sediment environments and sediment grain size data. Sedimentary environments are typically determined using a low frequency acoustic sub-bottom profiling system that is able to penetrate into the seafloor. The sound is reflected as it encounters features beneath the surface, providing an image of the layers that comprise the seafloor. Similar to the surface mapping sonars, harder layers return a stronger signal, while the sound penetrates further in softer bottoms. This technology is critical to measuring the sedimentary environments found in Long Island Sound and provides an historical record of the physical processes affecting the seafloor. Areas impacted by strong currents will feature harder, more reflective bottoms, while areas with lesser currents will be characterized by softer, muddier sediments that settle and are deposited on the seafloor.

Two early studies, published in a U.S. Geological Survey Open File Report, “Georeferenced Sea-Floor Mapping and Bottom Photography in Long Island Sound” (Paskevich and Poppe, Open File 00-304), provide a comprehensive collection of assessments of various aspects of the sedimentary environments of the Sound. Links to these studies are provided in Appendix Two. In addition, the USGS released a fact sheet in 1998: “Sedimentary Environments in Long Island Sound: A Guide to Sea-Floor Management in a Large Urbanized Estuary” that provided a useful introduction to the role and importance of sedimentary environments to management, a link is provided in Appendix Two.

The first, the work of DiGiacomo-Cohen and Lewis (2000), “Maps Showing the Shape of the Marine Transgressive Surface and the Thickness of Postglacial Sediments in Long Island Sound”, was the result of a 20-year collaboration between the U.S. Geological

Survey and the Connecticut Geological and Natural History Survey. The data set was derived from over 3500 km of high-resolution seismic reflection profiles, and presents the thickness of the surficial sediments of the Sound that range from 0 to 45 meters (Figure 3-3). As can be seen in Figure 3-4, the sediment thickness in the Phase IV area is quite variable and ranges from 1-20 meters.

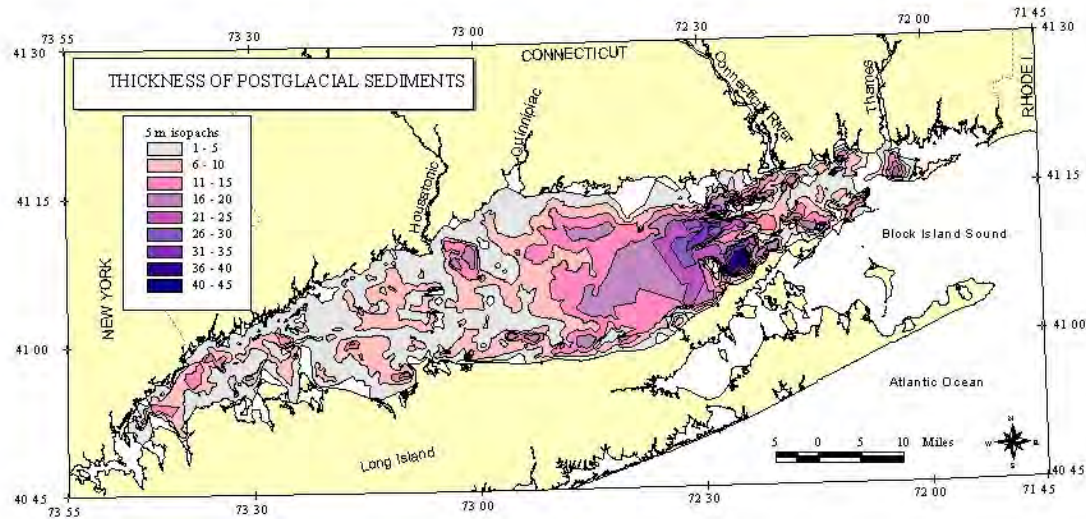


Figure 3- 3 Map of sediment thickness in Long Island Sound from DiGiacomo-Cohen and Lewis, 2000.

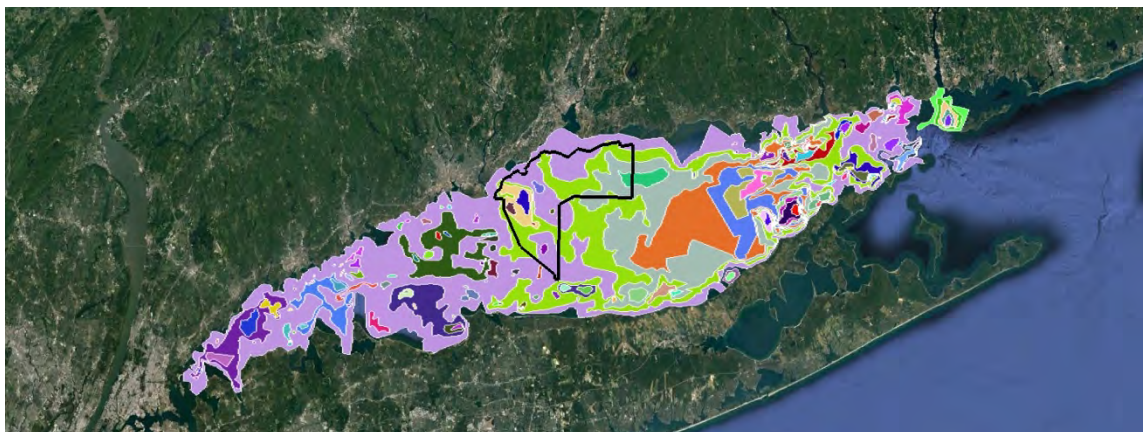


Figure 3-4 Map of sediment thickness in Long Island Sound from DiGiacomo-Cohen and Lewis, 2000 with the Phase IV area superimposed.

The second major study that addressed the sedimentary environments of Long Island Sound was the work of Knebel, Poppe and Cross, "Regional Distribution of Sea-Floor Sedimentary Environments in Long Island Sound" (In: Open-File Report 00-304, 2000). The authors: "outline the general characteristics and locations of the following four categories of bottom sedimentary environments present in Long Island Sound: (1) erosion or nondeposition; (2) coarse-grained bedload transport; (3) sediment sorting and reworking; and (4) fine-grained deposition...noting that these environments reflect the effects of dominant, long-term processes." Figure 3-5 is the map developed by Knebel et al, while Figure 3-6 provides an overlay of the Phase IV area to provide the geographical context. As can be seen, the majority of the Phase IV area is

characterized as “Fine-Grained Deposition” with some as “Sediment Sorting and Reworking” and a small portion near the Connecticut coast as “Erosion or Nondepositional.”

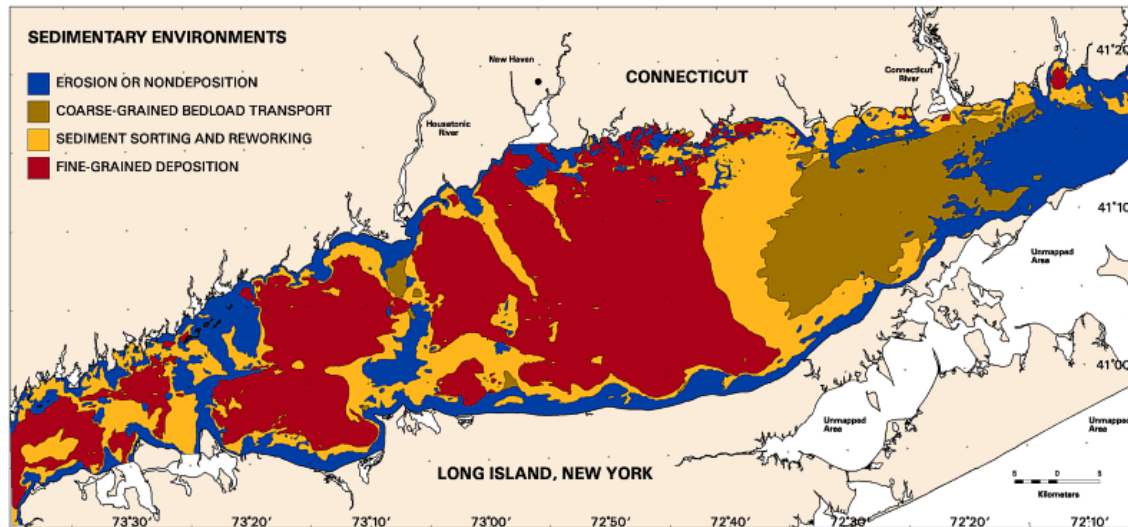


Figure 3-5 Map of the sedimentary environments of Long Island Sound (Knebel et al. 2000).

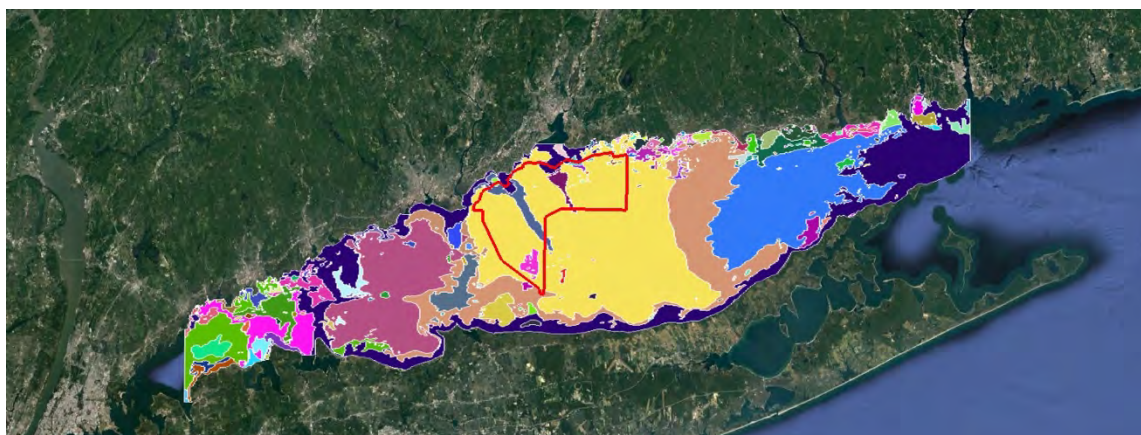


Figure 3-6 Map of the sedimentary environments of Long Island Sound (Knebel et al. 2000) with the Phase IV area overlain.

3.2.3 Existing Sediment Grain Size Data

Four historical compilations of sediment grain size data were reviewed and links to these data are provided in Appendix Two. These reports were all developed by the U.S. Geological Survey’s Woods Hole Coastal and Marine Science Center and range in date from 2000 to 2014. Many of these data sets have overlapping records, however, when all are simultaneously mapped, each one provides additional sampling points so all are included in this report.

The first study, “Map Showing the Distribution of Surficial Sediments in Long Island Sound” by Poppe et al. 2000 presents the results from numerous previous studies in Long Island Sound. This report is also included in the “Georeferenced Sea-Floor Mapping and Bottom Photography in Long Island Sound” (Paskevich and Poppe, Open File 00-304, Chapter 4). Most records are simple bottom descriptions. However, a

subset represent data from USGS surveys conducted between 1992 and 1998. The surface sediments, defined as between 0-2 centimeters, were sampled using a Van Veen grab and/or photographed at 1643 locations. The sediment samples were analyzed for coarse and fine fractions. The distribution of the data points within the Phase IV area can be seen in Figure 3-7. These data were then combined with over 12,900 published sediment texture analyses and descriptions to develop the interpreted map seen in Figure 3-8. As can be seen, the preponderance of the surficial sediments in the Phase IV area was interpreted to be “Sand Silt, Clayey Silt or Silt” with smaller pockets of “Silty Sand” and “Sand.” Also of note is the very small portion of the Phase IV area that was classified as “Gravel or Bedrock.”

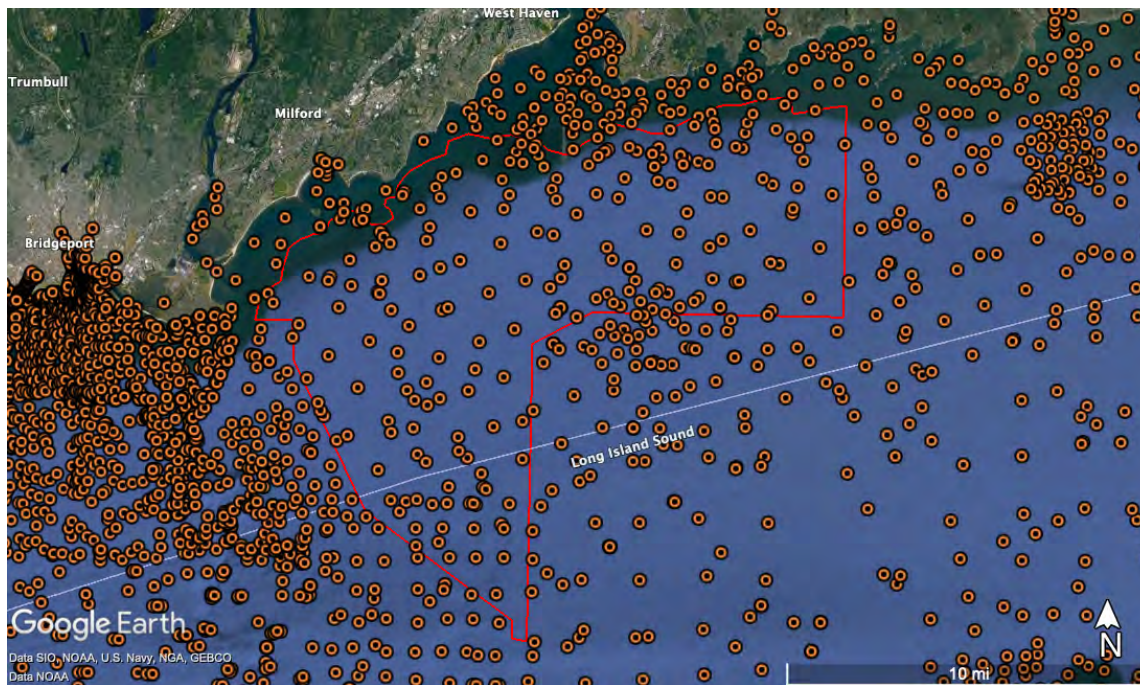


Figure 3.7 Map of the Phase IV area showing the distribution of sediment grain size from the Poppe et al listex data set.

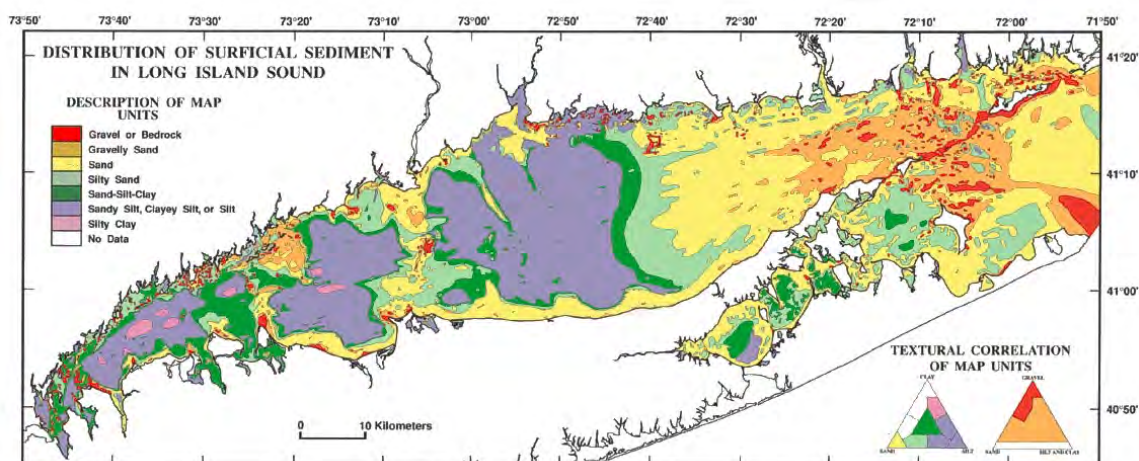


Figure 3-8 Interpreted map of the distribution of surficial sediments in Long Island Sound (Poppe et al. 2000).

The second report, “Long Island Sound Surficial Sediment Data (LISSEDATA, Poppe and Paskevich, 2004) is focused entirely on the Long Island Sound region. This Open-File Report provides data going back to 1931 through 1998 and provides qualitative observations of the sediment type from previous surveys (e.g. Pelligrino and Hubbard, 1993) as well as quantitative data of phi values from sediment grab sample analyses. Figure 3-9 shows the level of effort/data provided in this report subsampled within the Phase IVA area, with an insert showing the extent of the entire dataset in Long Island Sound. Figure 3-10 provides an example of the quantitative data provided for some of the points in the dataset.

The third report, “usSEABED: Atlantic Coast Offshore Surficial Sediment Data Release, version 1.0” (Reid et al. 2005) is complex data set that uses a number of sources and applies the dbSEABED processing software to generate a number of derived data sets from the sources, specifically: “It uses the dbSEABED data mining and processing software to extend the coverage of information in areas where data coverage is more descriptive than quantitative.” As such the derived datasets include: _EXT extracted numeric and lab-based data, _PRS parsed, word-based data, _CLC calculated variables data, _CMP components, content and features, and _FAC facies, components only. This data does add points within the Phase IV area beyond the previous LISSEDATA base, see Figure 3-11 that provides a map of the Phase IV area that includes both the LISSEDATA and usSEABED data points. It is felt that providing this greater data density is valuable, although the utility of the data for acoustic data interpretation may not be as useful, given the qualitative nature of the derived data. Figure 3-12 provides an example of the data available within the usSEABED data, showing the higher level information for that point.

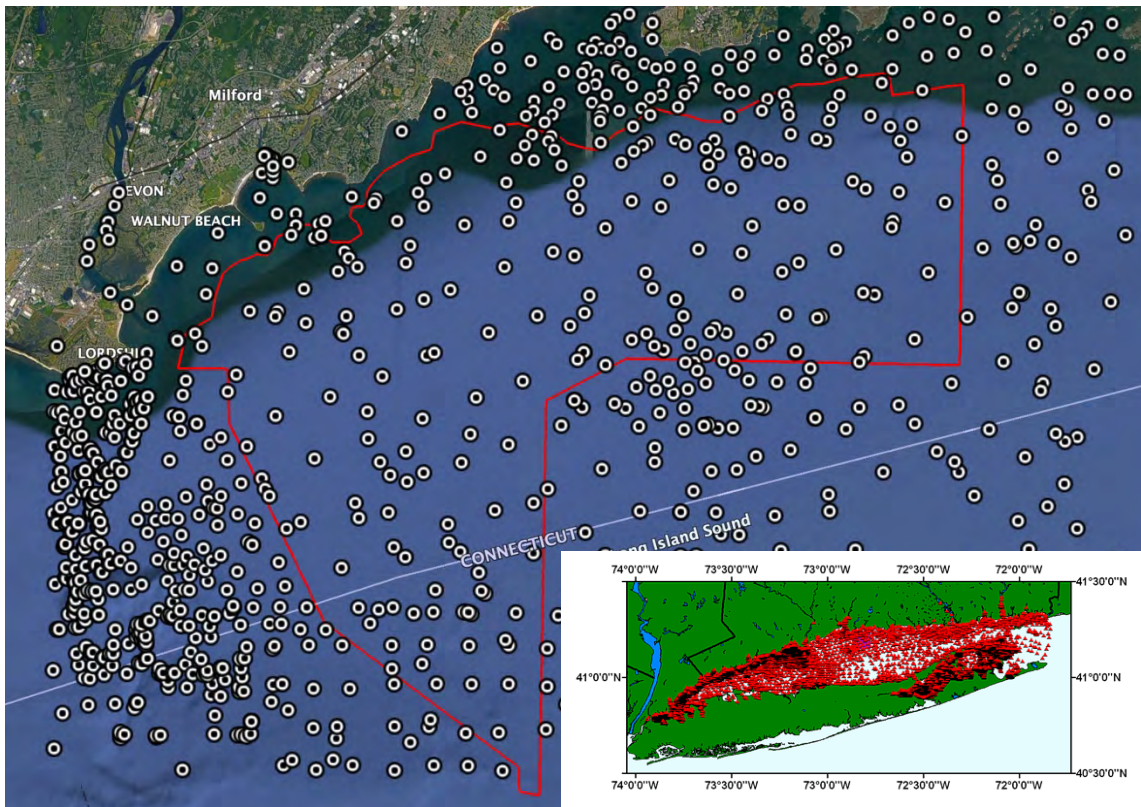


Figure 3-9 Map of the Phase IVA area showing the distribution of data from the LISSDATA data set with insert showing entire data distribution in the Sound.

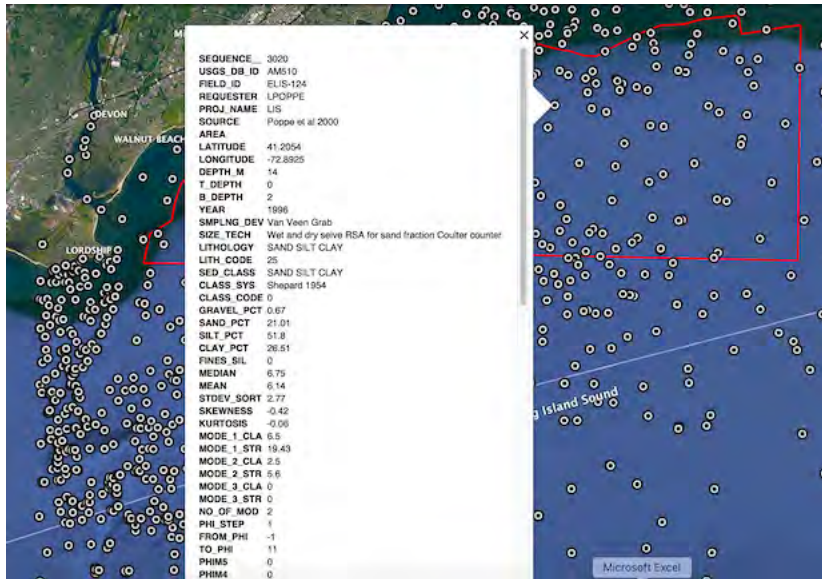


Figure 3-10 Map of the Phase IVA area showing available quantitative sediment grain size data available in some points.

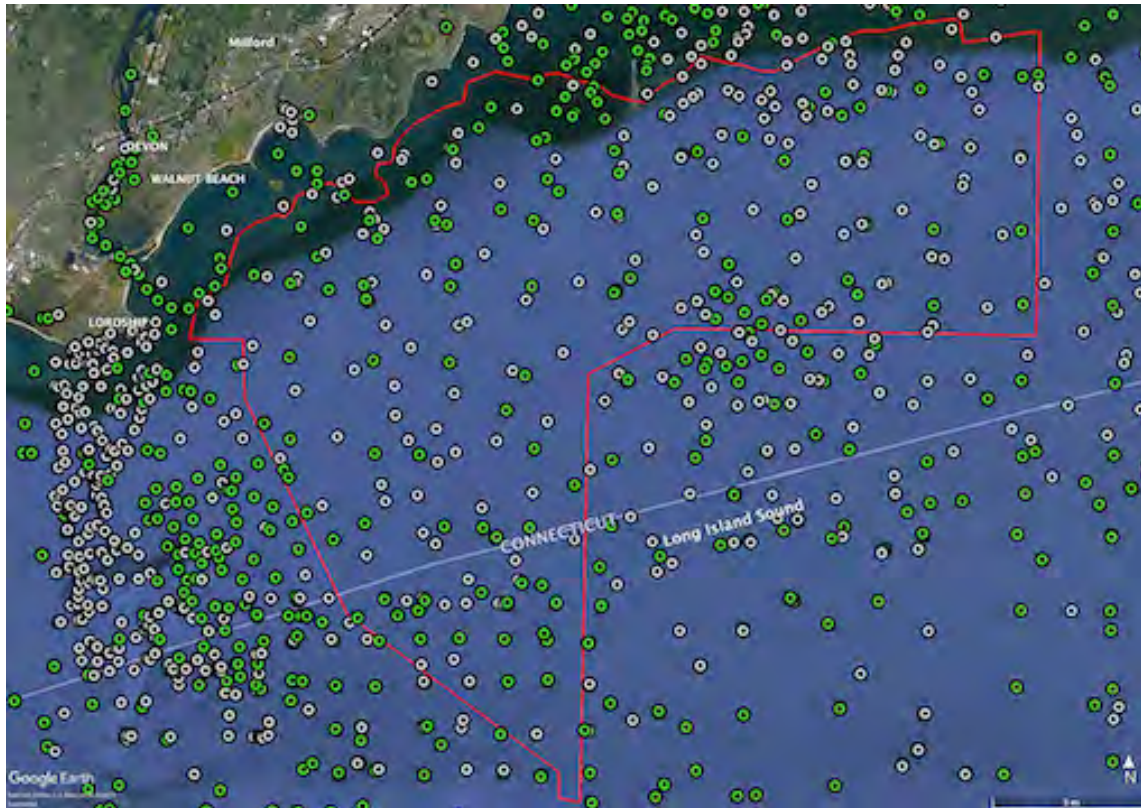


Figure 3-11 Map of the Phase IVA area showing the distribution of the LISSEDATA points (white) and the usSEABED data points (green).

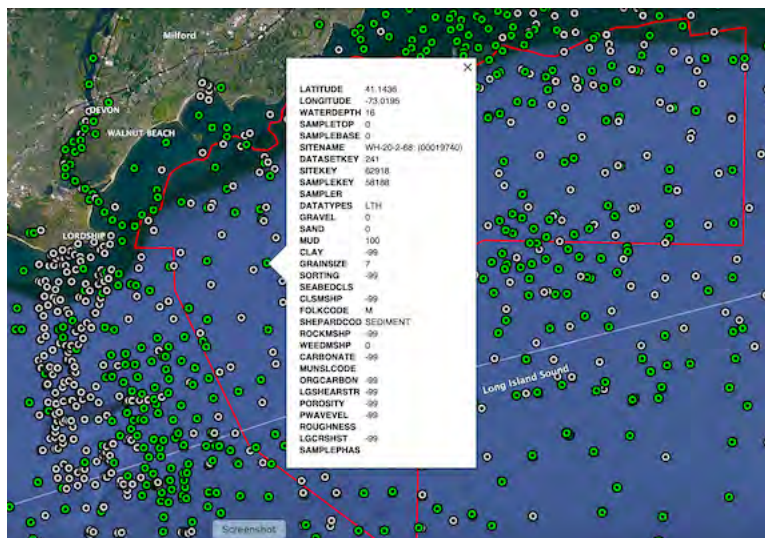


Figure 3-12 Map of the Phase IVA area showing the nature of the data for one point available within the usSEABED data set.

The fourth historical database that was reviewed that addressed sediment grain size was the “USGS East-Coast Sediment Analysis: Procedures, Database and GIS Data” effort (Version 3.0, McMullen, K.Y et al. 2014). As described in the metadata: “This sediment database contains location, description, and texture of samples taken by numerous marine sampling programs. Most of the samples are from the Atlantic

Continental Margin of the United States, but some are from as diverse locations as Lake Baikal, Russia, the Hawaiian Islands region, Puerto Rico, the Gulf of Mexico, and Lake Michigan. The database presently contains data for over 27,000 samples, which includes texture data for approximately 3800 samples taken or analyzed by the Atlantic Continental Margin Program (ACMP), a joint U.S. Geological Survey/Woods Hole Oceanographic Institution project conducted from 1962 to 1970. As part of the ACMP, some historical data from samples collected between 1955 and 1962 were also incorporated into the dataset.” The review of this data set, however, showed very few additional points within the Phase IVA area (Figure 3-13). Of note, however, is that this latest version (3.0), does include the sediment grain size data from the LIS Cable Fund Phase I Pilot area, as can be seen by the density of points to the west of the Phase IVA area.

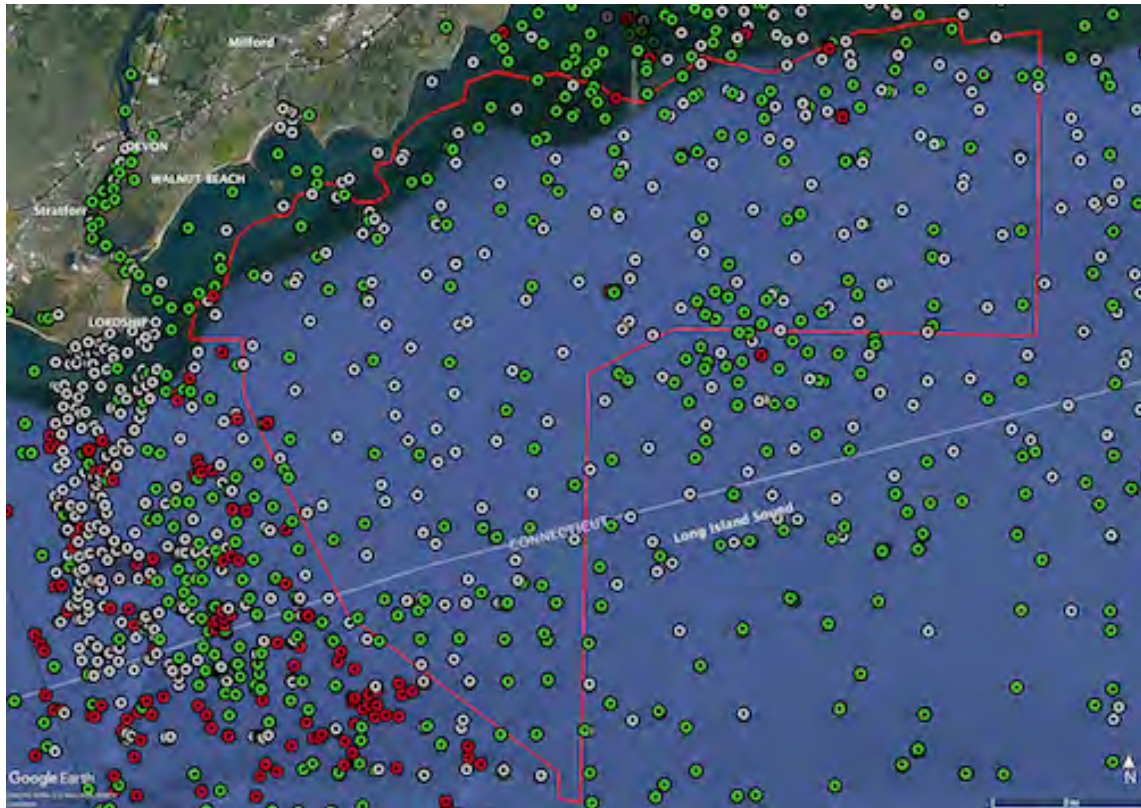


Figure 3-13 Map of the Phase IVA area showing the additional few points added (red) by the East Coast Sediment Texture Database V 3.0.

The combination of all of these sediment grain size databases provides a good resource to assist with the interpretation of the acoustic data collected in the Phase IV area (Figure 3-14). While these data represent a combination of qualitative and quantitative data points there should be useful information that can be matched up with the spatially corresponding acoustic pixel data in the area.

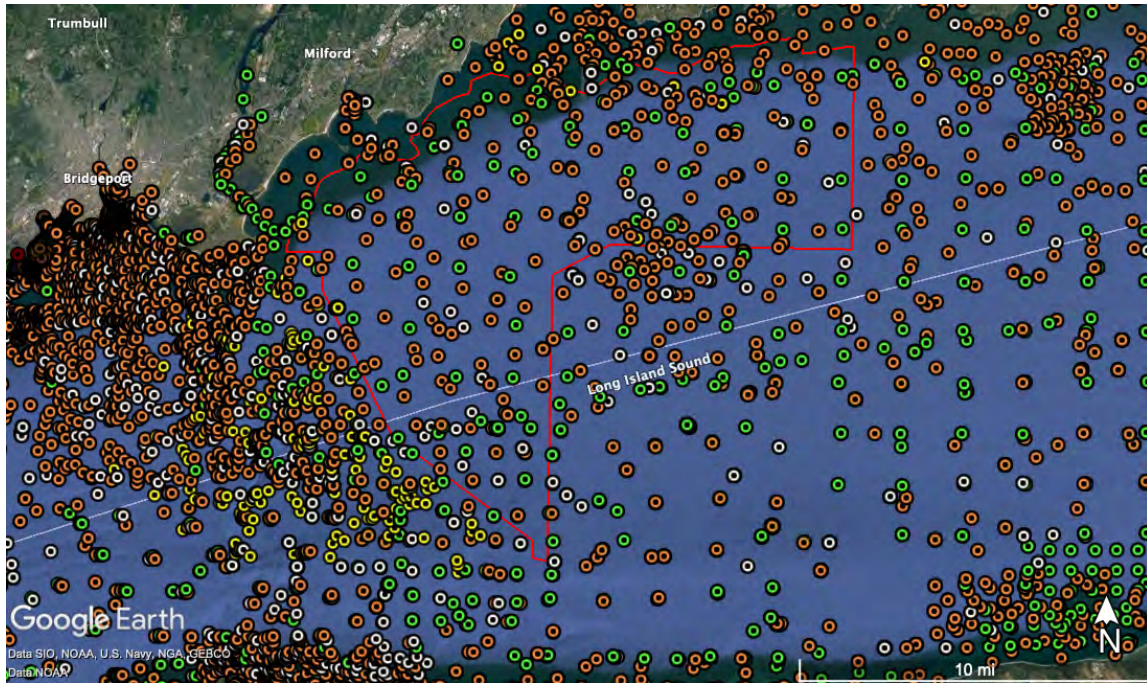


Figure 3-14 Map of the Phase IV area showing all four sediment grain size data sets: listex (orange), lissedata (white), east coast (yellow) and usSEABED (green)

3.2.4 Long Island Sound Environmental Studies Report

Of note during the review of historical data of Long Island Sound that could assist with the interpretation of the newly acquired acoustic data by Roger Flood et al. in the Phase IV area, is the compilation of several useful datasets within the “Long Island Sound Environmental Studies” (Poppe and Polloni, 1998) distributed by the USGS on CD-ROM. The link to the complete report is provided in Appendix Two. Below are the chapter titles (with links), providing an overview of the nature of the available data:

Table 3 4 Chapters from Poppe and Polloni, 1998.

<p>CHAPTER 1 -</p>	<p>Maps And Illustrations Showing The Acoustic And Textural Characteristics And The Distribution Of Bottom Sedimentary Environments, Long Island Sound, Connecticut-New York. by Harley J. Knebel, Richard P. Signell, Richard R. Rendigs, Lawrence J. Poppe, and Jeffery H. List.</p>
<p>CHAPTER 2</p>	<p>Detailed Surveys (within the Phase IV area: Survey Number 8 -- Sidescan Sonar Images, Surficial Geologic Interpretations, And Bathymetry Of New Haven Harbor, Connecticut, And The New Haven Dumping Ground, North-Central Long Island Sound. by Lawrence J. Poppe, Ralph S. Lewis, Harley J. Knebel, Eric A. Haase, Kenneth F. Parolski, and Mary L. DiGiacomo-Cohen.</p>
<p>CHAPTER 3 -</p>	<p>Surficial Sediment Database by Lawrence J. Poppe, Mary E. Hastings, Mary L. DiGiacomo-Cohen, Frank T. Manheim, and Zofia J. Mlodzinska.</p>
<p>CHAPTER 4 -</p>	<p>A Review Of Research On Benthic Communities Conducted In Long Island Sound And An Assessment Of Structure And Dynamics. by Roman N. Zajac.</p>

CHAPTER 5 -	Contaminant Distribution And Accumulation In Sediments Of Long Island Sound: Field Work And Initial Results by M. R. Buchholtz ten Brink and E. L. Mecray.
CHAPTER 6 -	Bathymetry And Current Modeling by Richard P. Signell Number 1 .--Fly-Over Of Long Island Sound by John G. Evans and Richard P. Signell Number 2 .--Long Island Sound Topographic Grid by R.P. Signell and Amy Farris Number 3 .--Digital Bathymetric Contours From Noaa Charts As Organized For The Liss Gis Library by M.L. DiGiacomo-Cohen, Mark Tedesco, and Chris Polloni Number 4 .--Physical Processes Affecting Sedimentary Environments In Long Island Sound. by Richard P. Signell, Harley J. Knebel, Jeffery H. List, and Any S. Ferris
CHAPTER 7 -	Long Island Sound Bibliographic Database by Ralph S. Lewis, Alexander C. Robinson, Nancy McHone, Mary L. DiGiacomo-Cohen, Catherine Coffin, Lawrence J. Poppe and Chris Polloni.

3.2.5 Georeferenced Sea-Floor Mapping and Bottom Photography in Long Island Sound

A second significant compendium of data relating to Long Island Sound that provides several links to datasets useful for acoustic data interpretation was the “Georeferenced Sea-Floor Mapping and Bottom Photography in Long Island Sound” (Paskevich and Poppe, 2000, Open-File Report 00-304). There are twelve chapters in this report that was also published on CD-ROM, six of which are, perhaps, the most useful to aid in the understanding of the newly acquired acoustic data. These are:

Table 3 5 Chapters from Paskevich and Poppe, 2000.

Chapter 1	Maps Showing the Shape of the Marine Transgressive Surface and the Thickness of Postglacial Sediments in Long Island Sound
Chapter 3	Regional Distribution of Sea-Floor Sedimentary Environments in Long Island Sound
Chapter 4	Map Showing the Distribution of Surficial Sediments in Long Island Sound
Chapter 10	A Benthic Community Geographical Information System (Gis) for Long Island Sound
Chapter 11	Megafaunal Interactions with Sedimentary and Biological Habitats in the Nearshore Areas of Southern New England: A Pictorial Survey

3.2.6 Seafloor Imagery and Ecosystem Data

The final historical data type that was reviewed to contribute to the interpretation of the new acoustic data was any seafloor imagery existing within the Phase IV area that could provide additional, qualitative insights into the nature of the seafloor. Unfortunately the search within the USGS archives for any existing data within the area found none.

3.2.6.1 USGS Sea-Floor Imagery and Ecosystem Data

The only available seafloor images in the Sound from USGS found were found in Chapters 11 and 12 from the above-mentioned compendium by Paskevich and Poppe, 2000. Chapter 11 (Auster and DeGoursey) provided representative images of the megafauna typically associated with the various seafloor habitat types in the Sound. Chapter 12 (Poppe, Knebel and Blackwood) provided images from Niantic Bay to the east of the Phase IV area. Links to these chapters are provided in Appendix Two. These Chapters are included as the images do provide great examples of the nature of the taxa typically found in the different seafloor types (sedimentary environments) of the Sound. In addition, however, Chapter 10 “A Benthic Community Geographical Information System (GIS) For Long Island Sound” (Zajac et al. 2000) provides links to numerous previous ecological studies including Pellegrino and Hubbard (1983), Reid et al. (1979), and Sanders (1956).

3.2.6.2 NURTEC Video and Still Image Archive

The other major source of seafloor imagery examined was from the video archive of the Northeast Underwater Research, Technology and Education Center (NURTEC, formerly the National Undersea Research Center, NURC). The Center was administratively established at the University of Connecticut in 1983 and began supporting undersea operations in 1984. The Center supported primarily academic researchers by providing them access to a variety of underwater technologies including submersibles, remotely operated vehicles, mixed-gas and air SCUBA. The Center’s records for operations supported in Long Island Sound date back to 1985. For the first years of dive support the Center would provide the underwater video to the Principal Investigator of the project. The media formats varied, depending upon the type of underwater technology used, and evolved over the years with improving media formats. In 1991 the Center adopted the policy of duplicating every video tape to store in its archive for most supported dives, the notable exception being the wet diving operations.

The Center has conducted over 200 dives and deployments in the Sound from the period of 1985 to 2018 (Figure 3-15). The dives have been conducted with a human occupied submersible (*Delta*) and several ROV systems (*MiniRover MKII*, *Phantom III*, *Hela*, and the *Kraken2*), while the deployments refer to launches of drop-video imaging and/or sampling system such as NURTEC’s In Situ Imaging System (*ISIS*) or the U.S. Geological Survey’s Seabed Observation and Sampling System (*SEABOSS*). The Center maintains a project metadata base that provides information on the year the

project was conducted, the PI, the dive system and support ship used, the date, location (general and lat/lon), depth and significantly, the bottom type (Figure 3-16).

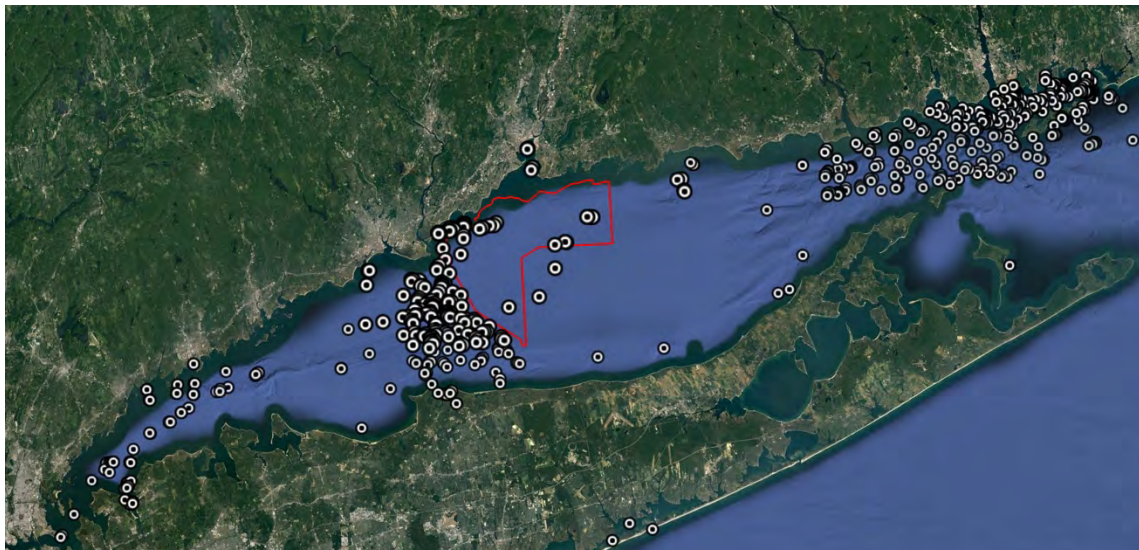


Figure 3-15 Map of Long Island Sound showing the distribution of NURTEC dives and deployments.

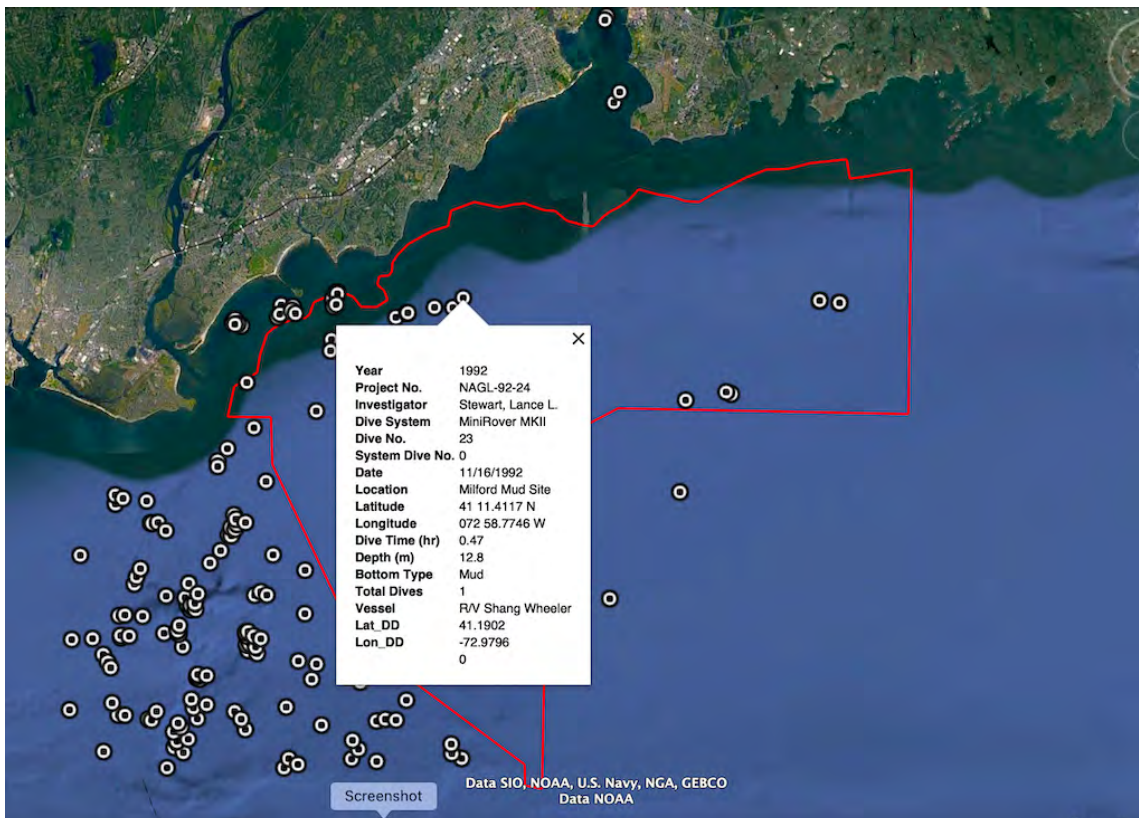


Figure 3-16 Map of the Phase IV area with NURTEC dives showing associated metadata.

The investigators associated with the LISMaRC (Auster, Babb, Zajac) have conducted several projects that have collected seafloor imagery and have provided access to this historical data (video and stills) for this current review. The NURTEC dive database has been integrated into a Google Earth Pro .kmz file that is provided in Appendix Two.

A total of six projects were conducted in the Phase IV area from the years 1988 to 2010 and a spreadsheet of relevant project metadata derived from the NURTEC archive is provided in Appendix Three A. Of these projects, however, only three were located in the archive or the possession of LISMaRC scientists, with the remainder having been provided to the Principle Investigator and not available after the decades that have ensued since collected. Of the projects located most of the original videotapes (VHS and 8 mm formats) had been encoded onto DVD's as part of NURTEC's efforts to sustain its video archive against the ravages of time, since the original videotapes are known to degrade overtime, specifically the oxides become brittle and flake off impacting the ability to synchronize the video and degrading overall quality. The three projects conducted a total of 18 dives within the Phase IV area in the years 1988, 1991 and 1992. The project metadata listed bottom type, however, seven listed no data, with the others ranging from mud, sandy/mud, sand/shell, sand, shell to hard; illustrating a significant amount of variability in the nature of the seafloor.

The extant DVDs were reviewed and unfortunately the combination of the lower original video quality (low resolution standard definition cameras combined with lower quality media, VHS), combined with the above-mentioned degradation and lastly, the very poor water visibility in the primarily muddy Phase IV area made the effort of obtaining useful images to determine the nature of the seafloor essentially useless. It was determined that with the availability of significant new imagery from the Phase IVB project (reported below) that providing these historical poor-quality images would be a waste of time for the Flood et al. team to review.

4.0 PHASE IVB DATA REVIEW

4.1 Phase IVB Data Review and Collection to Support Acoustic Data Interpretation (Task 25)

The goal of the Phase IVA project, funded by the Long Island Sound Study (LISS), was to acquire and analyze new acoustic data that was missing in the area that was deemed to be of high priority by the Long Island Sound Cable Fund Steering Committee. To ensure data consistency and interoperability with the previous (Phase I and Phase II) and on-going (Phase IIIA) projects supported by the Long Island Sound Cable Fund (LISCF), the LISCF Steering Committee elected to support a similar, comprehensive site characterization of the Phase IV area. This project (Phase IVB), “Developing Dynamic Habitat-Based Ecological Decision Support Tools and Data to Characterize Deep-water Habitats “ expanded the scope of work by including a much-needed assessment of the data and map products developed by the previous LIS Cable Fund sponsored projects. It did include the collection of the same set of data variables (sediment grain size, sedimentary environments, infaunal and epifaunal ecological characterization and physical oceanography) as collected in the previous Phases.

Selection of the sampling sites for the campaign were again based upon the review and analysis of the preliminary acoustic mosaics (bathymetry and backscatter) from the newly acquired data from Roger Flood’s team. As in previous Phases, the site selection was based upon ensuring an adequate representation of all the bottom types as well as capturing transition zones from one bottom type to another. The individual site selection was based primarily on the backscatter mosaic with both sample “Sites” and “Blocks” selected. A consecutive numbering scheme from the previous phases was used to provide data collection continuity. The “Site” assessment was identified with a NB (no-block) prefix, (n=79) that entailed collecting imagery (digital stills and video) along a transect followed by taking one sediment grab sample at the end. The “Block” assessment identified with the SB (sample block) prefix, (n=16) involved taking multiple (two or three) grab samples within a square kilometer, each with a few representative images, followed by conducting an imaging transect at the end. The data were logged by Julian day for the period of the survey, July 6-13, JD 187 to 194.

Figure 4-1 shows the selected sites superimposed over the backscatter data that shows the variability in the bottom types based upon the acoustic reflectance, with the softer sediments absorbing much of the sound showing up as darker tones while the harder substrates reflecting much of the sound and therefore appearing as lighter tones.

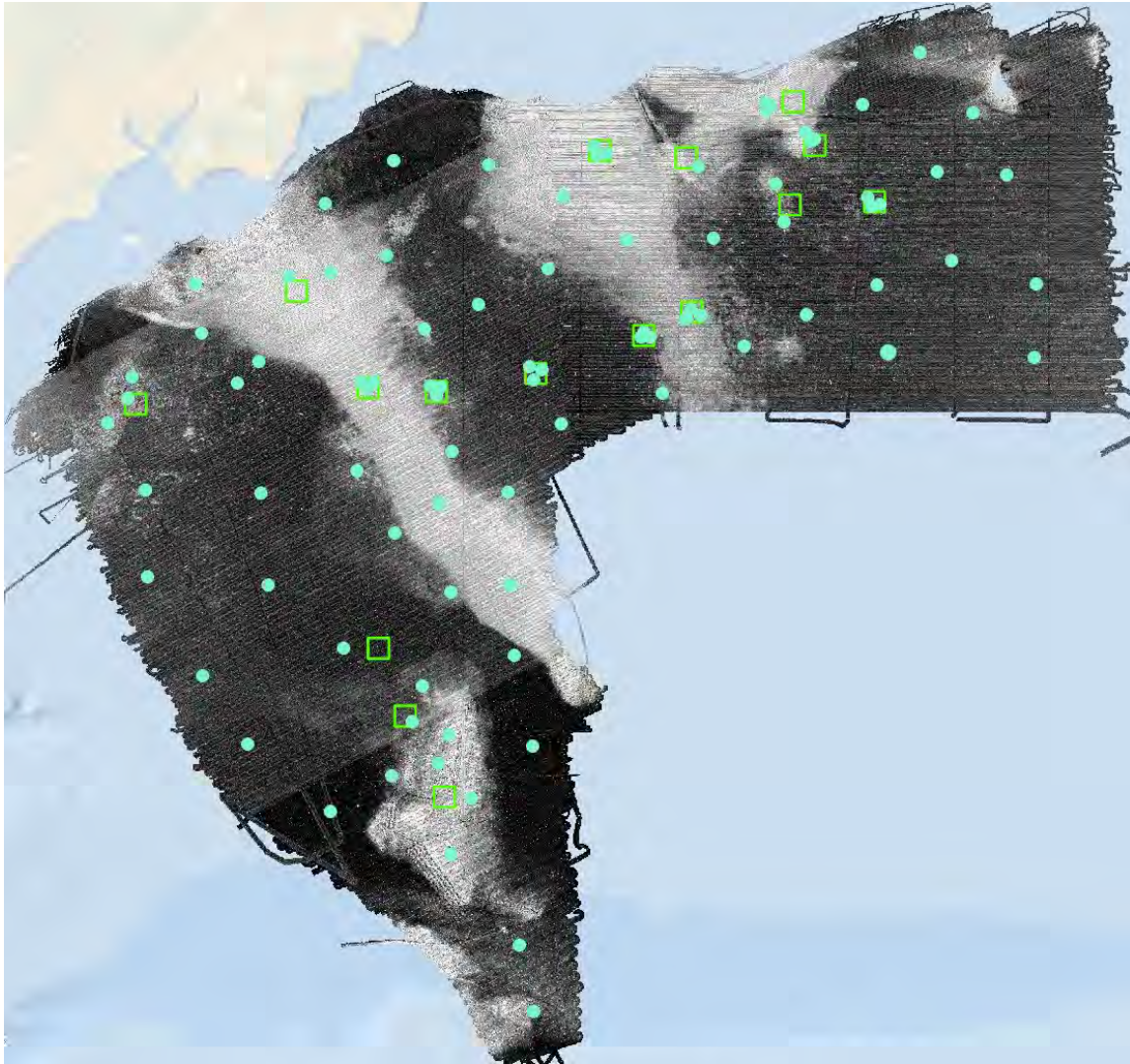


Figure 4 1 Backscatter mosaic from the Phase IV area with the sample blocks (rectangles) and sample sites (circles) superimposed.

The comprehensive data collection protocols utilized for the Phase IVB resulted in a rich data set comprised of physical sediment samples, digital still and video files and physical oceanographic data. Much of these data are currently being analyzed to provide the same level of site characterization as was developed for the previous Phases. There were, however, two primary data types that were immediately available for review and collection/compilation that were deemed useful for acoustic data interpretation: 1) images from the top of the sediment grab after recovery and prior to sample processing and 2) representative images of the seafloor taken by the Forward Looking Infrared (FLIR) and/or GoPro cameras.

4.2 Images of the Top of the Sediment Grabs Taken by the SEABOSS

The first dataset was the collection of images taken of both sides of the top of the Van Veen grab that provided an immediate indication of the nature of the seafloor (Figure 4-2). The University of New Haven graduate students lead this data collection effort that included putting a site label within the image frame. These image files were then

reconciled with the log and navigation files that provided the time and location of when the grab was taken and integrated into a spreadsheet to provide a means to review what the seafloor looked like at the time the grab was taken. In addition, the video from each deployment was reviewed to note exactly when the grab was taken, clearly visible from the sediment cloud that formed upon sampling. The timecode (UTC) value at this time was noted and aligned with that value from the log file(s) to record the exact latitude and longitude of the sample. A total of 171 images were reviewed and included in the image log spreadsheet and the twin images of the top of the grab were bundled by Julian Day (the method used by the USGS for data logging) and sent to the Roger Flood team via WeTransfer application. In addition, a rough visual assessment of the nature of the sediment was recorded in the spreadsheet. The Sediment Grab Image Log spreadsheet is provided in Appendix Three C.

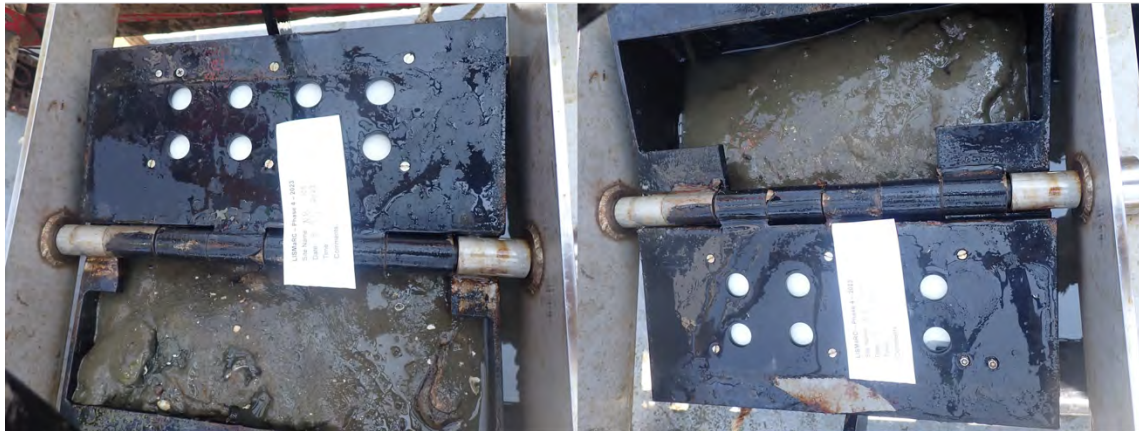


Figure 4 2 Images of the top of the sediment grab taken upon recovery, example from NB105.

4.3 Seafloor Images from the Phase IVB SEABOSS Sampling

The process for reviewing the still images entailed opening the images for each day from each deployment and reviewing the quality of the images as representative of the nature of the seafloor. There were real-time navigation files that recorded the approximate location of the SEABOSS by using a GPS antenna mounted on the stern of the RV *Connecticut* at the point of deployment. As the SEABOSS weighed about 200 pounds it was assumed that the sampler was pretty much directly below the stern of the vessel in all but the highest of current areas that could have deviated the position somewhat. A digital log (spreadsheet) was also recorded at the control station for the SEABOSS recording the time of deployment, on bottom time, time of grab sample and other pertinent comments/observations (Appendix Three B). When a useful image was identified, the EXIF image header file was reviewed for the UTC time code and matched to the line from the navigation file to provide the latitude and longitude where the image was taken. For a NB site deployment with a transect ending in a grab, 9-12 images were identified to characterize the seafloor at that location. This was also done for the transects within the SB blocks, while the additional deployments to collect sediment samples within a SB block were of shorter duration and resulted in 3-4 images identified. In all cases the review of the images taken per deployment went all the way to the point of taking the sediment grab at the end.

The result of this image review was a compilation of images, divided by Julian day with subdirectories for each deployment (NB and SB). In some cases there were also

subdivisions for useful images from the FLIR camera supplemented by backup images from the GoPro camera. There was a spreadsheet image log for each Julian day, with tabs for each deployment along with a compilation of all deployments in one tab (Figure 4-3) with the following information provided: UTC, Lat/Lon, UNIX time, image name and comments on the image. The tabs included the site or block name along with information on the site (grab number, camera source, ie GP=GoPro). The image location logs were also saved as .csv files to allow for input into mapping applications (e.g., Google Earth Pro, ArcGIS) to allow mapping of the image locations in relation to the newly acquired acoustic data (Figure 4-4) to support a preliminary interpretation of the nature of the seafloor. An example of a seafloor image from Julian day JD188 superimposed over the Phase IV backscatter mosaic provided in Figure 4-5 illustrates this process.

The image location logs are provided in Appendix Three D. All of the images subdirectories by Julian day and subdirectory of all image location logs by Julian day were provided to the Roger Flood team via a OneDrive share to hopefully provide a valuable data set to assist with the interpretation of the data.

	A	B	C	D	E	F	G	H	I
1	NMEA Type	UTC	Latitude DM	Longitude DM	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
2	\$GPRMC	120238	4113.572534	7249.270542	-72.8211757	41.22620889	1688731358	20230707120238_000-1.tif	SEABOSS Site: 2023-008-002 Sand with shell
3	\$GPRMC	120456	4113.569581	7249.286603	-72.82144338	41.22615968	1688731496	20230707120456_000-1.tif	Sand w shell fragments
4	\$GPRMC	120651	4113.569743	7249.293518	-72.82155863	41.22616238	1688731611	20230707120651_000-1	Sand w shell fragments
5	\$GPRMC	121049	4113.603417	7249.293807	-72.82156345	41.22672362	1688731849	20230707121049_000-1.tif	Sand w shell fragments
6	\$GPRMC	121245	4113.613204	7249.32016	-72.82200267	41.22688674	1688731965	20230707121245_000-1.tif	Sand w shell fragments
7	\$GPRMC	121344	4113.618432	7249.3329	-72.822215	41.22697387	1688732024	20230707121344_000-1.tif	Sand w shell fragments
8	\$GPRMC	121443	4113.621423	7249.33655	-72.82227584	41.22702371	1688732083	20230707121443_000-1.tif	Sand w lots of shell, No grab observed in FLIR pics, GoPro not used until NB120
9									
10									

Figure 4-3 Screen capture from one of the Image Location logs (JD188) developed to provide metadata to accompany SEABOSS bottom images of the Phase IV area.

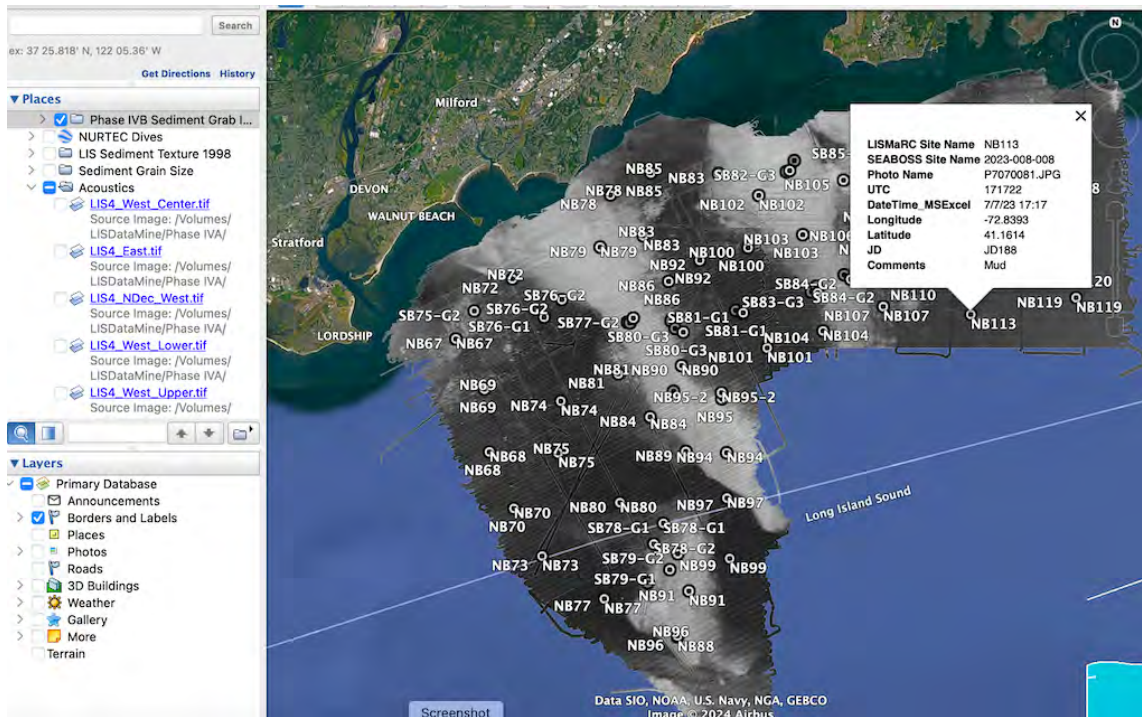


Figure 4-4 Map of the Phase IVA backscatter data with the SEABOSS sample locations overlaid.

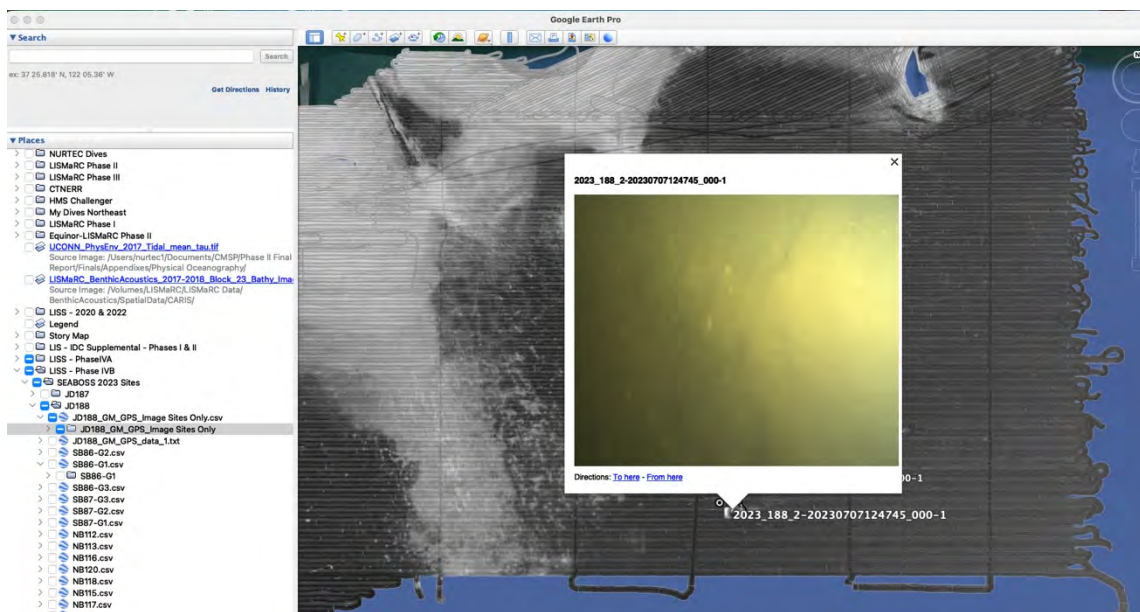


Figure 4-5 Google Earth Pro map of the Phase IV area showing the newly acquired backscatter data and an example of a SEABOSS image collected and georeferenced to mosaic.

4.4 Phase IVB Remotely Operated Vehicle Survey

The final component of data collected to characterize the Phase IV area was a one-day survey using UConn's newly acquired remotely operated vehicle (ROV), a Boxfish Alpha system (Figure 4-6), operated off the RV Connecticut on August 31, 2023 (Figure 4-7). Based upon the analysis of the new acoustic data (bathymetry and backscatter) combined with observations from the SEABOSS, it was determined that there were only 3-4 sites that were not adequately sampled and imaged by the SEABOSS that warranted follow-up with the ROV. The ROV was able to negotiate around the large boulders encountered in these areas to acquire 4K video producing high quality frame captures of the large boulders to assist with the interpretation of the acoustic data in the Phase IV area (Figure 4-8 and 4-9).



Figure 4-6 The Boxfish Alpha ROV on the deck of the RV Connecticut. Note the thin fiber optic tether (yellow) that provides control to and 4K video from the ROV.



Figure 4-7 The ROV control station set up in the dry lab of the RV Connecticut showing vehicle control station (ROV pilot, Kate Randolph) and a larger 4K monitor viewed by PI's Chris Conroy and Peter Auster and ROV technician Chris Mills.

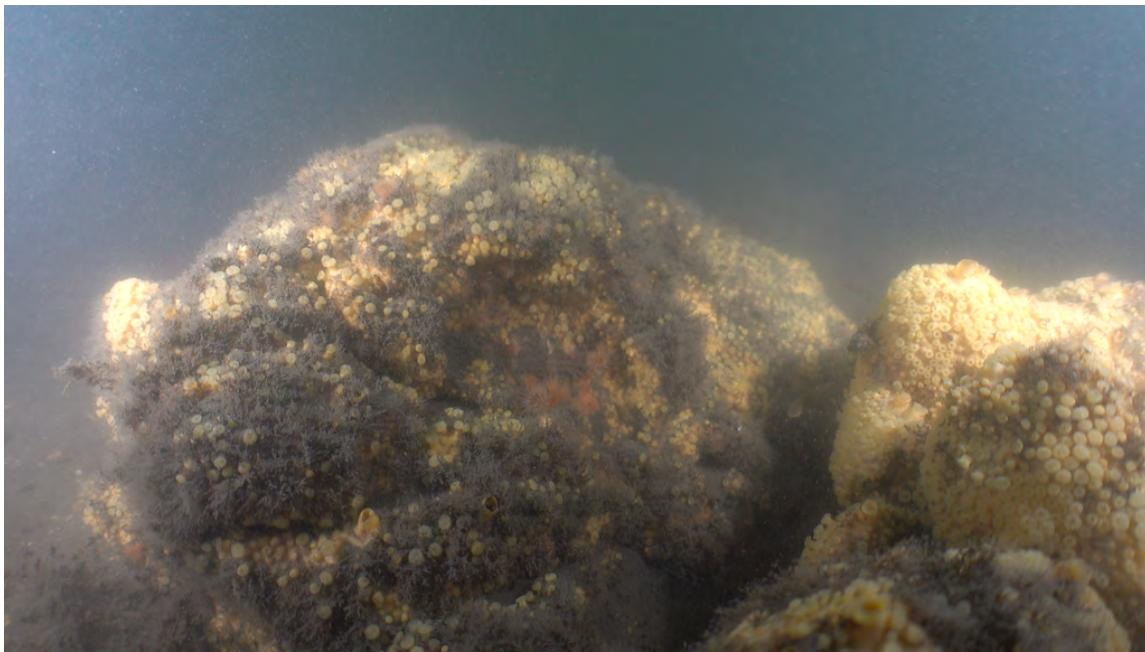


Figure 4-8 Frame capture from the ROV 4K video of the northern rocky site. Note these images are severely compressed for this report.



*Figure 4-9 Close-up frame capture of the boulders in the northern site showing a diversity of epifauna including the boring yellow sponge (*Cliona celata*) and the ghost anemone (*Diadumene leucolata*).*

5 SUMMARY

The Phase IVA scope of work for the University of Connecticut entailed two major elements as described above: 1) assistance with the installation, testing, and operation of the newly acquired multibeam sonar system and 2) a comprehensive review of the existing historical data relevant to the Phase IV area that would be useful for guiding interpretation of this newly acquired acoustic data along with a thorough review of the newly acquired data from the companion Phase IVB project.

5.1 UConn Assistance with the New Acoustic Data Acquisition

As noted above the first element was modified from the original proposed work due to several delays that altered the original role and scope of the UConn contribution to the project. The in-depth training that was proposed did not take place upon the RV Seawolf, and UConn personnel were unable to participate in a shortened acceptance and installation cruise due to schedule conflicts. The first data collection with the new system was originally proposed to take place using the RV Seawolf, however, scheduling conflicts mandated that the RV Connecticut be used for the initial data collection. The system was successfully mounted on the RV Connecticut and two data collection legs were conducted in August, 2022. UConn technician Dennis Arbige participated in these two data collection efforts. A third leg was conducted using the RV Seawolf in September, 2022, unfortunately neither UConn technician was able to participate due to scheduling conflicts. The final two data collections took place in December, 2022 using the RV Seawolf and UConn technicians Wendy Woods and Dennis Arbige participated in these final two expeditions.

The scope of work accomplished for this component was less than originally budgeted for, especially for personnel who were proposed to participate in a more comprehensive system orientation and training effort and by scheduling conflicts for the second data collection effort. The RV Connecticut was used to support the data collection effort as proposed, demonstrating that the new multibeam sonar system can, indeed, serve as a regional resource utilizing the ship infrastructure available to support seafloor mapping in Long Island Sound.

5.2 Review of Historical Data Useful for Acoustic Data Interpretation

As described above, there were unutilized funds remaining due to the reduced effort of the acoustic data acquisition, and a request was made to extend the project and utilize these funds to conduct a review of existing data that could be useful to assist with the interpretation of the newly acquired acoustic data. Several categories of data were identified, located and reviewed that could potentially serve as useful resources to aid in the Roger Flood team's interpretation efforts within the Phase IV area. These included: 1) existing acoustic data, 2) interpretations of the sedimentary environments, 3) multiple sediment grain size collections and 4) existing seafloor imagery. These data sources, along with their website URL or Digital Object Identifier (DOI) to provide access to them were provided to the SBU team and are included in Appendix Two.

5.3 Review of Newly-acquired Data from the Phase IVB Project

The final, and perhaps most valuable, source of data reviewed and provided to the Flood team was that collected by the LISMaRC team in the Phase IV area as part of the Phase IVB project. The value of this data is due to its collaborative, sequential nature; being an extension of the Phase IVA acoustic data collection effort and the larger Long Island Sound Seafloor Habitat Mapping initiative. The data set is also derivative, in that the preliminary acoustic data provided by the Flood team was used to identify the sample collection sites, and therefore provide new data that was representative of the nature of the various bottom types as judged from the backscatter reflectance data. The two sets of data that are currently available from the 2023 Phase IVB campaign deemed to be useful to interpret the nature of the seafloor were: 1) pictures taken from the top of the SEABOSS grab immediately upon recovery and 2) images of the seafloor taken by the digital still cameras mounted on the SEABOSS. These images and location metadata were provided to the Flood team via a OneDrive share. Finally, a limited ROV campaign was conducted at two locations within the Phase IV area revealing limited large boulder habitats.

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Note: Links to the above references are provided in Appendix Two – Historical Data Source Index, since many pre-date a DOI for inclusion in the reference citations.

7.0 APPENDIXES

Appendix One - LISMaRC 4A Project Tasks

Task #	Team	Task	Started	Completed	Calculated Days	% Complete	Status Summary	Issues Encountered/ Corrective Action	1st Amended Timeframe	2nd Amended Timeframe	Deliverable
3	UConn	QAPP Review	6/3/21	6/8/21	5	100%					Feedback on draft QAPP
6	UConn	Review revised QAPP	10/26/21	11/1/21	6	100%					Sign-off on QAPP
15	UConn	Sonar Technician participates in Year 1 mapping cruise	8/10/22	8/23/22	13	100%	11/2/2022 UConn technician Dennis Arbige and UConn PI Ivar Babb joined the ship for the installation and training, and Dennis Arbige participated in the R/V Connecticut mapping cruise.				Participation detailed in the quarterly report
22	UConn	Sonar Technician participates in Year 2 mapping cruise	11/28/22	12/16/22	18	100%	2/2/2022 UConn Technician Wendy Woods was replaced by UConn Technician Dennis Arbige on December 6th		1/31/23		Participation detailed in the quarterly report
24	UConn	Data Mining of Ancillary Data to Support Acoustic Data Characterization (review/interpretations of existing & new data)	4/1/23	9/20/23	172	100%			4/1/2023 - 7/30/2023	12/31/23	Summarized in quarterly reports and detailed in the final project report
25	UConn	Integrate the acoustic results with existing data, including identifying any sample station data that exists in the literature, online databases and include review and discussions of any unpublished data from other projects or investigators. Includes review and inclusion of new imagery from the Phase IVB project.	5/31/23	12/15/23	198	100%	8/31/2023 . Recent sediment grain size sampling and imagery (digital still and video) was collected in July, 2023 under the Phase 4B project that needs to be reviewed, spatially referenced and representative imagery provided to SBU as soon as possible. It		5/1/2023 - 7/30/2023	12/31/23	Summarized in quarterly reports and detailed in the final project report
27	UConn	Draft & submit Final Project Report	12/15/23	1/26/24	42	100%			5/1/2023 - 6/30/2023	12/1/2023 - 1/31/2024	UConn Final Project Report draft
32	UConn	Revise & Submit Final Project Report based on SC recommendations				0%			9/1/2023 - 9/15/2023	9/1/2024 - 9/15/2024	UConn Final Project Report amended

Appendix Two – Phase IVA Quality Assurance Program Plan

**Quality Assurance Project Plan
for
Acoustic Data Acquisition for Seafloor Mapping in Long Island Sound
Task 20-15 for Cooperative Agreement LI-00A00579-0**

**Prepared by
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**Prepared for
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Approvals Signature (required prior to project start):

_____ Date: _____
Dr. Roger D. Flood, Principal Investigator

_____ Date: _____
Ivar Babb, Principal Investigator

_____ Date: _____
DeAva Lambert, DEEP Project Manager

_____ Date: _____
Christopher Bellucci, Project QA Officer

_____ Date: _____
Leah O'Neill, EPA Project Officer

_____ Date: _____
Dr. Nora Conlon, EPA QAPP Coordinator

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1.0 PROJECT MANAGEMENT

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1.2 Table of Contents (EPA QA/R-5 A2) - See pages 2 - 3.

1.3 Distribution List (EPA QA/R-5 A3)

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1.4 Project Organization (EPA QA/R-5 A4)

Project Manager DeAva Lambert, Environmental Analyst with the Connecticut Department of Energy and Environmental Protection (DEEP) in the Land & Water Resources Division (LWRD), will be overseeing the overall project plan and budget and ensuring that the project budget is adhered to, as well as communicating with contractors on the work required to complete this project task. She will communicate with the Project Lead on the work accomplished in this plan and any problems or deviations that need to be resolved.

Project Lead Kevin O'Brien, Supervising Environmental Analyst in DEEP LWRD, will be the primary official responsible for this project task and will communicate any project needs to the Project Manager. He may also provide technical input on analytical methodologies and data review.

QA Officer Christopher Bellucci, Assistant Director in the Water Planning & Management Division with DEEP, will be responsible for reviewing and approving the QA Project Plan.

Principal Investigator Dr. Roger Flood, Research Scientist in the School of Marine and Atmospheric Sciences (SoMAS) at Stony Brook University (SBU), will be responsible for delegating appropriate personnel to complete the tasks included in this plan and assign their specific tasks and objectives. He has overall responsibility for all field activities and overseeing the data collection and analyses specified in this plan. He will coordinate with the second Principal Investigator and report to the Technical Lead and Project Lead.

Principal Investigator Ivar Babb, Research Scientist-Faculty in the Department of Marine Sciences at the University of Connecticut (UConn) will provide additional oversight, management, and reporting and delegate appropriate personnel for specific task completion. He will coordinate with the first Principal Investigator and report to the Technical Lead and Project Lead.

Field Data (Sonar) Technician Dennis Arbige, Research Operations Manager in the Department of Marine Sciences at UConn, will train and participate in data collection and analyses as specified in the plan and report to Principal Investigator, Ivar Babb, and coordinate with Principal Investigator, Roger Flood.

Project Support Staff A technician for UConn's R/V *Connecticut* will participate in equipment training and assist with data acquisition and processing. A SoMAS post-doctoral associate and a graduate student who will assist with data collection and processing will be hired to support this project. One or more SBU/SoMAS undergraduates will also be involved with working on the data. The technician, post-doctoral associate, and student staff will report to both Principal Investigators.

[See Figure 1-1. Organization Chart](#)

1.5 Problem Definition/Background (EPA QA/R-5 A5)

Benthic mapping in Long Island Sound (LIS) has long been identified as a priority need and is essential to improving science-based environmental management and mitigation decisions. High-resolution multibeam bathymetry and backscatter measurement has been recognized as an important tool in the understanding sedimentary processes and benthic habitats in a range of aquatic settings (e.g., Clarke et al., 1996; Mayer, 2006) and has been an important tool in characterizing the seabed for a range of uses in Long Island Sound (Knebel and Poppe, 2000). Sea floor landscape maps depicting habitat structure and the ecological characteristics associated with those habitats are critical pieces of information which typically integrate information from a variety of sources including acoustic bathymetry and backscatter, sedimentary, geochemical, physical, and biological data.

Plans for systematic benthic mapping in Long Island Sound were initiated following the creation of the LIS Cable Fund in 2004, which was consequent of a financial settlement resulting from issues surrounding cable infrastructure in LIS, and subsequent formation of a Steering Committee, consisting of representatives from DEEP, US EPA Regions 1 & 2, New York Department of Environmental Conservation, New York Department of State, and the SeaGrant offices of Connecticut and New York, to administer the fund. An important step in this benthic mapping initiative has been the collection and analysis of high-resolution (multibeam) bathymetric and acoustic backscatter data that shows seabed features and sediment distribution patterns.

In 2012, the LIS Seafloor Habitat Mapping Initiative identified three areas of LIS to utilize the Cable Fund to pursue a multi-phased benthic mapping effort (Figure 1-2). This initiative is currently underway to complete the mapping of those high priority areas. However, significant portions of central LIS remain lacking in the high-resolution bathymetry and backscatter data necessary to support even the initial stages of benthic mapping, and one 100 square-mile area in particular is entirely devoid of benthic data altogether (Figure 1-3).

The primary objective of this project task is to survey this 100 square-mile portion of central Long Island Sound in order to provide the high-resolution bathymetry and backscatter data needed to support the habitat mapping goals of the LIS Seafloor Habitat Mapping Initiative. Acoustic data from sidescan or multibeam sonar are typically the first pieces of any benthic mapping effort. In addition to providing important data on sea-floor depth, topography, and various sedimentary characteristics, they also serve as an important roadmap to inform efficient and relevant sampling plans for subsequent geological, ecological, and physical collections. Furthermore, acoustic data also serve as the foundation for linking together the individual thematic data the LIS Seafloor Habitat Mapping Initiative has targeted to generate final integrated habitat maps.

The acquisition of additional acoustic data within the 100 square-mile area of the LIS central basin where high-resolution multibeam bathymetric and backscatter data is not available would help improve understanding of the nature and character of the seafloor in that area. New multibeam data will also increase the extent where management decisions for LIS can be made based on the best available data and scientific analysis. Accordingly, new acoustic data acquisition in this area within the central LIS basin supports the implementation of the 2015 CCMP by improving the scientific knowledge base essential to making informed decisions to protect and restore the health of LIS.

1.6 Project/Task Description and Schedule (EPA QA/R-5 A6)

For this project task, the team will collect and process the high-resolution multibeam data needed in the 100 square mile area (259 square kilometers) of poor data coverage identified in Figure 1-3, where the

depth ranges from 8 meters (the minimum water depth to be surveyed) to about 40 meters. To conduct the acoustic data acquisition over this area, the team will purchase a high-resolution multibeam mapping system – a Kongsberg EM 2040P MKII multibeam echosounder and accompanying Kongsberg Seafloor Information Systems (“SIS”) software or comparable system and software – that is capable of collecting the needed high-resolution multibeam bathymetry and backscatter data. For this project task, this multibeam system will be installed and used on research vessels associated with SBU and UConn, ostensibly the R/V *Seawolf* and the R/V *Connecticut*, as availability necessitates and so the multibeam system is tested and utilizable between the SoMAS and UConn programs in order to take advantage of vessel availability to complete the surveying for this project as well as future projects.

The survey operations will be led primarily by Dr. Roger Flood, Research and Emeritus Professor at SBU SoMAS. Project scientists include Dr. Flood, Ivar Babb (Research Scientist Faculty, UConn Department of Marine Sciences), and Dennis Arbige (Research Operations Manager at the UConn Department of Marine Sciences), who will participate in the shipboard mapping program. Project support staff will include a vessel technician, a post-doctoral associate and a graduate student who train on the new MBES system and will assist the project scientists with data collection and processing. One or more undergraduates may also be involved with working on the data.

To cover the 100 square-mile survey area, the team will conduct up to eight 5 day cruises, mapping up to 24 hours/day, over two years. The system installation, training, acceptance trials, and 10 days of mapping are expected to occur in Year 1, and the remainder of the mapping will occur in Year 2 if vessel scheduling prevents completion of the mapping in the first year. This schedule includes additional time that is needed for station operations during the survey, for ship operations such as fueling, for transit to/from the survey area and for potential delays or slowdowns due to bad weather or other contingencies. Data processing for data collected during a project year will occur within that project year. The cruise timeline is represented in [Table 1-2. Milestones Schedule](#).

Multibeam data processing will be done using CARIS HIPS and SIPS software (for bathymetry), using QPC Fledermaus GeoCoder software (for backscatter), and using SwathEd software programs from the University of New Brunswick (for bathymetry and backscatter). Completed mapping products will be posted to the NOAA National Centers for Environmental Information (NCEI) web site (<https://www.ncei.noaa.gov/>) for archiving and to allow wide access to the mapping results. The mapping results will likely also be archived on the Marine Geoscience Data System – the data repository for the LIS Seafloor Habitat Mapping Initiative. The deliverables and product schedule are represented in [Table 1-1](#) and [Table 1-2](#).

[See Table 1-1. Deliverables](#)

[See Table 1-2. Milestones Schedule](#)

1.7 Quality Objectives and Criteria for Measurement Data (EPA QA/R-5 A7)

This study will focus on acquisition of high-resolution acoustic data covering nearly 100 square-miles in the central basin of Long Island Sound, which will enhance the knowledge of its seabed physical characteristics, particularly bottom characteristics. The bathymetry and backscatter data collected will be used to create very detailed geospatial maps of the seafloor. The information is useful for multiple purposes, including marine ecosystem protection, coastal hazard preparedness, and navigation safety. The bathymetry and backscatter data will also support further characterization of sediment facies and related bed attributes, including geomorphology, sediment chemistry, and characterization of benthic habitat.

1.7.1 Objectives and Project Decisions

The general objective of this project is to collect multibeam acoustic data in the 100 square-mile area of central LIS to produce high resolution bathymetry and backscatter images of the seafloor to improve the accuracy and quality of the benthic data available for LIS, which will be used to support enhanced science-based environmental management and mitigation decisions. This acoustic survey will provide bathymetry and backscatter data at a high resolution of 1 meter, which will help us to gain new insights into the sedimentary processes that are occurring over large areas of central Long Island Sound as well as also enable future similar studies or new research initiatives in Long Island Sound and surrounding areas.

The adequacy of a survey is the end product of the entire survey system and based on project decisions made on the processes used during its collection. How the equipment is set up, used and how it interacts with the other components in the complete survey system must all be taken into consideration. Therefore, the hydrographic survey standards identified and referenced in this QAPP will apply regardless of the method of determination.

1.7.2 Action Limits/Levels

The median depth of the 100 square-mile project area is about 11 meters beneath the survey vessel's keel, resulting in a targeted average track spacing of about 55m. The survey vessel will operate at a maximum speed of about 7.5 knots, which will be reduced as necessary to meet the ping density specifications of the multibeam system. The initial estimate of ship track spacing will be five times the water depth; although, that will be reduced as necessary to meet the ping-density specifications or if there is too much depth variability in the outer beams resulting from excessive refraction due to sound velocity variability. Therefore, conducting 560 survey hours of survey lines will be required.

The high-resolution, shallow-water multibeam system that will be utilized to conduct the acoustic mapping has several capabilities to enhance the quality of the data collection for this project. The multibeam system will operate between 200 and 400 kHz and can be used in water depths of up to about 550 m with a swath width up to 170 degrees. The beams are stabilized for vessel roll, pitch and also yaw which results in a more uniform distribution of depth and backscatter measurements on the bottom compared to systems where there is less stabilization. The system has a dual-swath capability that transmits two swaths per ping which doubles the along-track sounding density and enables operation at higher survey speeds, a key capability which will allow the work to be done using less ship time. Other system capabilities such as the ability to use continuous wave (CW) signals and also frequency modulated (FM) pulses, the ability to log multiple bottom detections and the ability to log reflections in the water-column supplement the value of this system for mapping Long Island Sound seafloor.

The project team will operate the new multibeam system at 300 kHz to collect the acoustic backscatter data, for which the quality will be somewhat prioritized over the depth data. However, the acoustic data acquisition will still follow the [NOAA Standards and Requirements for Hydrographic Surveys](#) as closely as possible to ensure the collected data can be easily integrated with other NOAA and LIS Seafloor Habitat Mapping Initiative benthic data products. These specifications are based in part on the International Hydrographic Organization's [Standards for Hydrographic Surveys, Special Publication 44](#). These specifications define standards and requirements on the action limits and levels for horizontal and vertical positioning, tides and water levels, and coverage and resolution for multibeam data. To be compliant with an S-44 Order, a survey must be compliant with ALL specifications for that order included in these Standards.

[See Table 1-3. Analytical Parameters and Target Limits](#)

1.7.3 Measurement Performance Criteria/Acceptance Criteria

1.7.3.1 Data Quality Objectives

Bathymetry and backscatter data of high resolution quality is needed to create detailed geospatial maps of the seafloor over the 100 square-mile (259 km²) survey area. The intended use of these data and maps are to support enhanced science-based environmental management and mitigation decisions surrounding the issues of marine ecosystem protection, coastal hazard preparedness, and navigation safety. The bathymetry and backscatter data and maps will also support further characterization of sediment features and attributes, as well as benthic habitat.

Acquiring high resolution bathymetry and backscatter data requires ready access to a multibeam echosounding system that can survey the minimum water depths of 8 meters as well as the maximum depth of 120 meters in LIS that is capable of a high ping rate while using a wide beam swath, which can be installed on the different research vessels working in suitable weather conditions. A multibeam system for acquiring the high resolution acoustic data also requires a precise positioning system with both heading and motion sensors, and sound velocity profilers and sensors.

For bathymetric measurements, uncertainty is introduced from a number of sources including the accuracy of the depth measurement instrument, the accuracy of the vessel positioning instrument, linking the position data with depth data, the accuracy of the water level recording instrumentation, and data processing techniques. The maximum allowable uncertainty in depth includes all inaccuracies due to residual systematic and system specific instrument uncertainties; the speed of sound in water; static vessel draft; dynamic vessel draft; heave, roll, and pitch; and any other sources of uncertainty in the actual measurement process, including those associated with Ellipsoid Referenced Survey (ERS) or water level (tide) variations (both tidal measurement and zoning errors). The approach described in NOAA's *Hydrographic Surveys Specifications and Deliverables* defines the minimum standards for uncertainty in obtaining depth soundings, which are referenced in [Table 1-3](#).

1.7.3.2 Data Quality Indicators

The high resolution needed for the survey requires the bathymetry and backscatter data to be routinely gridded at a resolution of 1 meter. We will attempt to relate the reported backscatter values and patterns to the available sediment samples or visual observations and to morphology patterns shown by the multibeam depth data for ground-truthing. For this swath-based multibeam survey, where the position of a sounding may be located some oblique distance to the vessel position, total uncertainty must account for beam forming precision of the echo-sounding system, depth of water and water column variability (speed of sound), and accuracy of motion compensation (heave, roll, pitch, heading errors and timing latency).

The position of the survey vessel needs to be accurately measured both the horizontally and vertically for acquiring precise depth data. Positions will be determined in three dimensions in real time using GPS corrections relayed through a network connection from a land-based real-time kinematic (RTK) system or a commercial satellite service. Using the commercial satellite service will ensure that GPS corrections are available on the survey vessel when cellular network connections are poor, which will improve data quality.

Synchronization of multiple sensors with the sonar system is essential for meaningful spatial analysis of the data. Seafloor Information System (SIS) software will be used to manage the mapping survey and

log the data. SIS also performs real-time gridding of water depth, backscatter data and other survey parameters that allow the real-time assessment of data quality for map digitizing.

Precise measurements are fundamental to the resulting usefulness of the survey. All measurements, however careful and scientific, are still subject to some uncertainties. Meeting the specified accuracy and resolution standards and creating a bathymetric attributed grid (BAG) that includes an accurate uncertainty layer requires an error analysis of the survey systems. Error analysis is the study and evaluation of these uncertainties with the purpose of estimating their extent and reducing them when necessary.

The validity and usefulness of the results are directly correlated to the accuracy of the individual estimates that compose the error model. CARIS marine mapping software will be used to process the multibeam data. The error model for CARIS contains uncertainties associated with the sensor and sonar, physical offsets, latency, draft, loading, sound speed and zoned water levels.

[See Table 2-4. Quality Control Requirements for Field Measurements](#)

[See Table 2-5. Quality Control Requirements for Analyses](#)

1.8 Special Training Requirements/Certification (EPA QA/R-5 A8)

A Kongsberg engineer will assist the team in installing the multibeam equipment and provide initial and follow-up training in Year 1. A minimum of two days training on operating the multibeam echosounder will occur on the primary vessel and in a classroom prior to commencing with the initial data acquisition. This assistance and training will ensure proper equipment acceptance and installation as well as proper operation of this complex system. The Principal Investigators, Sonar Technician, Vessel Technician and other Project Support Staff will attend this training. If written certifications from Kongsberg are provided to validate this training, they will be included with the corresponding quarterly report.

The technicians and project support staff will also be trained by the Principal Investigators to work with tools for the multibeam data processing, including CARIS HIPS and SIPS software (for bathymetry), QPC Fledermaus GeoCoder software (for backscatter) and SwathEd software programs from the University of New Brunswick (for bathymetry and backscatter). This training will be reflected in the completed production of the bathymetry and backscatter geospatial deliverables.

1.9 Documents and Records (EPA QA/R-5 A9)

This section specifies which documents and records are critical to the project. It disseminates the generation of project records and how the various components will be assembled to represent a concise and accurate record of all activities affecting data quality. It provides guidelines for clearly documenting software programs utilized, field operation records, and metadata guidelines. These elements will ensure that important documentation is collected, maintained, and managed so that others can properly evaluate project procedures and methods.

1.9.1 QA Project Plan Distribution

The Technical Lead will send the most current approved QAPP as an email attachment to the Principal Investigators, who will distribute it in the same manner to all Field Technicians and Project Support Staff prior to commencing any data collection. Any revision or update of the QAPP will be coordinated between the Technical Lead and Principal Investigators and will correspondingly be distributed prior to any subsequent data collection.

1.9.2 Field Documentation and Records

The system by which the geospatial data will be maintained, stored, processed, and shared is consistent with the [Data Management](#) system established for the LIS Seafloor Habitat Mapping Initiative, which reflects standards for acoustic data in Section 8 of NOAA's *Hydrographic Surveys Specifications and Deliverables (HSSD)*. Final bathymetry and backscatter mosaics including all vessel data, survey specifications, processing descriptions, and metadata will be posted to NOAA's National Centers for Environmental Information (NCEI) for archiving and to allow wide access to the mapping results. Mapping results are also anticipated to be archived on the [LIS Data Portal](#) on the Marine Geoscience Data System. These systems ensure:

- data are collected such that they can be broadly used and are consistent enough to support interoperability;
- data are sufficiently documented and stored to enable scientific discovery and facilitate management of natural resources within; and
- data are discoverable and easily accessible to a wide range of stakeholders (managers, scientists, public).

Digital data products will be in a format compatible with GIS software, referenced to NAD83(2011). UTM Zone 18N will be used for gridded data. Geospatial products will be accompanied by appropriate metadata that describes the products and depicts the collection and processing steps. Detailed metadata will specify the source, scale, resolution, accuracy, and completeness of the acoustic survey data, which is needed to provide a basis to assess its adequacy.

The hydrographer's bathymetric data format shall provide complete traceability for all positions, soundings, and correctors including sensor offsets, biases, dynamic attitude, sound speed, position, sensor position, date and time, vertical datum reducers, and sounding data from acquisition through post processing. Data quality and edit flags must be traceable. Calibration and results for horizontal and vertical datum and hydrographic positioning, including applicable nautical maps from NOAA used for referencing will also be recorded and maintained at least until the completed deliverables and final report are distributed and archived. USB disk drives and a transportable Redundant Array of Independent Disks (RAID) system will be used to back up multibeam and other data, especially during shipboard operations.

1.9.3 Laboratory Documentation and Records

All field data collected will be transferred and stored on a networked RAID system in the Principal Investigator's SoMAS Endeavour Hall office and lab (End 157 and 174), where the data reduction will primarily occur. The processed geospatial data will also be stored on this RAID system. Grids and images using all processed bathymetry and backscatter data will be generated at regular intervals and stored on the lab RAID system and made available for review via a shared drive and referenced in the quarterly reports. The provisional grids and images will be maintained at least until the final mosaicked bathymetry and backscatter geospatial products are distributed and archived.

1.9.4 Quarterly and/or Final Reports

Project progress/status reports will be prepared and submitted quarterly as prescribed in Section 11 of Appendix A. The Final Project Report and Final Financial Report will be prepared and submitted as prescribed in Sections 14 and 15 of Appendix A, respectively.

2.0 DATA GENERATION AND ACQUISITION

2.1 Experimental Design (EPA QA/R-5 B1)

This project involves conducting an acoustic survey of a 100 square-mile area in central Long Island Sound ([Figure 2-1](#)). The depth to be surveyed ranges from 8 meters to about 40 meters. The primary emphasis of the survey will be to collect high-resolution, high-quality acoustic backscatter and depth data.

While extensive studies beyond multibeam mapping are not included in this project, some limited sampling or other station activity might be possible since the mapping vessel will stop and do a sound-velocity cast at least every 4 hours.

This acoustic survey is designed based on the performance capabilities of the multibeam echosounder being purchased for this project. Using a wide multibeam swath will increase mapping efficiency by allowing the ship tracks to be placed farther apart. Additionally, the ability to ping more frequently can increase the speed at which the ship can map. The initial estimate of ship track spacing for this survey will be five times the water depth; although, that will be reduced as necessary to meet the ping-density specifications or if there is too much depth variability in the outer beams resulting from excessive refraction due to sound velocity variability. We anticipate a maximum survey speed of about 7.5 knots during this survey, but that will also be reduced as necessary to meet the ping density specifications

For complete coverage MBES surveys, lines are planned to acquire sufficient overlap to allow for a reasonable level of vessel deviation. MBES acquisition can also be planned using a real time coverage matrix and polygon areas to achieve full bottom coverage. Crosslines are acquired as an additional confidence check for bathymetry. Crosslines provide a meaningful comparison between nadir beams and outer beams of mainscheme acquisition lines in the case of multibeam, and nadir to nadir for vertical beam lines.

We estimate that 560 survey hours of mainscheme lines and crosslines will be required. However, the amount of time needed to survey this area depends on the width of the multibeam swath, the speed of the survey vessel, and the amount of time required for turns, sound-velocity profiles, time required for vessel fueling and other servicing, transiting to and from the survey area, and potential bad weather. Bad weather has the potential to affect multibeam measurements if conditions cause the pitch and roll of the vessel to continually change. Therefore, the experiment design includes several phases. Acoustic survey of the 100 mi² area will be conducted in seven separate 5-day cruises of up to 24 hours per day of mapping. An additional 5-day cruise will be conducted on a different vessel to ensure interoperability of the MBES system.

[See Figure 2-1. Site Map with Sampling Locations](#)

[See Table 2-1. Sampling Design and Rationale](#)

[See Table 2-2 Summary of Field and QC Samples To Be Collected](#)

2.2 Sampling Methods (EPA QA/R-5 B2)

For conducting the acoustic survey, a multibeam system will be purchased that can be installed on the different research vessels that work in Long Island Sound to collect high-quality bathymetry and backscatter data in shallow water depths as well as depths up to 120 m – the maximum depth in Long Island Sound. This system also needs the capability to project a wide beam swath with a high ping rate in order to increase mapping efficiency by enabling the ship tracks to be placed further apart at a higher vessel speed.

The plan is to purchase a complete, operational Kongsberg EM 2040P MKII or comparable multibeam system including a transducer, multibeam electronics, operating computer, software licenses, position sensor, heading sensor, motion sensor and sound velocity profiler along with necessary cables and sensors. This system can be operated at different frequencies between 200 kHz and 400 kHz, can record multiple detections on each beam, can record acoustic returns in the water column, and is stabilized for moderate values of roll, pitch and yaw. Other survey equipment includes a sound velocity profiler, additional GPS receivers, and shipboard network components with internet access.

Vessel position will be determined in three dimensions in real time using GPS corrections relayed through a network connection from a land-based RTK system such as the UConn Advanced Continuous Operating Reference Network (ACORN) system and the NYSDOT NYSNet system. The vertical water-level measurements measured by GPS will be supplemented by NOAA tide gauges at Bridgeport and New Haven, CT.

We will also subscribe to a precise navigation service such as Fugro, which transmits GPS differential correction messages from satellites to a specialized receiver on the ship. While similar GPS correction messages can be received over the internet, experience has shown that network connectivity is lost when the survey vessel is in the center of Long Island Sound or the weather is poor. Loss of GPS correction signals because of cellular network connection problems degrades the multibeam data quality and adds excessive time and expense to the data processing. Subscribing to this service will simplify many aspects of multibeam data reduction and improve data quality.

[See Table 2-3. Analytical Method and Time Requirements](#)

2.3 Sample Handling and Custody (EPA QA/R-5 B3)

The field technicians or project support staff will copy the survey data from the survey computer to backup computers and networked disk drive arrays at regular intervals to ensure data safety and to enable data processing to begin. Project support staff will transfer the multibeam data and other data streams from shipboard computers that monitor the GPS positions, GPS correction signals, motion sensor data streams, sound velocity, vertical profiles, and remote navigation display for ship operations to USB disk drives and back up the data to a transportable RAID array. The Principal Investigator or project support staff will transfer and store all field data collected on a networked RAID system in the Principal Investigator's lab, where the primary data processing will occur.

2.4 Analytical Methods (EPA QA/R-5 B4)

2.4.1 Field Measurements Methods

Each survey cruise will be conducted with the MBES operating with a ping density of 5 pings/bin and cross-track ping spacing of less than 1 m for water depths less than 20 m. The median depth of the survey area is about 11 m beneath the ship's keel, resulting in an average track spacing of about 55 m while operating at a frequency of 300 kHz and maintaining an average vessel speed of 6 knots. Acquisition speeds will be adjusted to balance data quality, productivity, and energy efficiency. Using these parameters, we estimate a minimum of 617 mainscheme lines and 25 crosslines will be required.

Since the MBES that will be used for the acoustic data collection can operate at frequencies between 200 kHz and 400 kHz, some areas of interest can be profiled at a range of acoustic frequencies and/or track azimuths to characterize backscatter patterns with different acoustic frequencies and azimuths. Details and results of the multibeam data interpretation studies will be provided in quarterly and annual project reports.

2.4.2 Field Analyses Methods

2.4.2.1 Screening

Many of the sensors used during multibeam mapping will be monitored or manipulated using dedicated laptop computers to ensure their proper operation. Key sensors include GPS positions, GPS correction signals, motion sensor data streams, sound velocity data streams and vertical profiles, and remote

navigation display for ship operations. The computers that monitor these data streams can also be used to process the project data.

2.4.2.2 Definitive

The acoustic backscatter patterns in the multibeam data will be analyzed and studied using software packages such as QPC Fledermaus GeoCoder and SwathEd, and the backscatter patterns correlated to available sediment samples or visual observations and to morphology patterns shown by the multibeam depth data.

2.4.3 Laboratory Analyses Methods (Off-Site)

This project does not include any off-site analyses conducted at a contracted or Tribe-owned laboratory.

[See Table 2-3. Analytical Method and Time Requirements](#)

2.5 Quality Control Requirements (EPA QA/R-5 B5)

The required QC checks for both the field sampling methods (discussed in Section 2.2) and measurements/analyses (discussed in Section 2.4) are summarized in Tables 2-4 and 2-5.

[See Table 2-4. Quality Control Requirements for Field Measurements](#)

[See Table 2-5. Quality Control Requirements for Analyses](#)

2.5.1 Field Sampling Quality Control

Kongsberg SIS software will be used to plan the survey lines and assist the helmsman in following the desired ship track. SIS also does real-time gridding of water depth, backscatter data, and other survey parameters that allow the real-time assessment of data quality. SIS is the interface for collecting and applying sound-velocity profiles which, along with real-time measurement of the surface sound velocity, allows for the continuing assessment of the sound velocity profile being used. Sound velocity profiles will be collected every 4 hours, or more frequently if the data indicates that there has been a significant change in the velocity profile.

2.5.2 Field Measurement/Analysis Quality Control

2.5.2.1 Field Measurement QC

Quality control of field measurements will be maintained by adhering to the parameters set forth in [Table 1-3](#) and [Table 2-4](#). These tables specify the acceptance criteria for each QC check, as well as the associated corrective action if the acceptance criteria are not met. Each type of QC check will be performed for each survey cruise.

During data collection, acquisition systems are continuously monitored for errors and alarms. Alarm messages are displayed when error thresholds or tolerances are exceeded. These alarms are reviewed and acknowledged on a case-by-case basis. Alarm conditions that may compromise survey data quality are corrected. Warning messages such as the temporary loss of differential GPS, excessive cross track error, or vessel speed approaching the maximum allowable survey speed are addressed and corrected before further data acquisition occurs.

2.5.2.2 Field Analysis QC (Screening and Definitive)

Quality control of field analysis will be maintained by adhering to the parameters set forth in [Table 2.5](#). This table specifies the acceptance criteria for each QC check, as well as the associated corrective action if the acceptance criteria are not met. Each type of QC check will be performed for each survey cruise.

Bathymetry and backscatter data will routinely be gridded at 1m; although, grids at higher resolution will also be created as needed. Bathymetry data will be reduced to the NAVD88 vertical datum – a vertical datum that generally marks the height of mean sea level. The NOAA software program [VDatum](#) can be used to transform water depths measured with respect to NAVD88 to tidal datums such as MLLW, which are commonly shown on navigational charts. Digital data products will be in a format compatible with GIS software, referenced to NAD83(2011) and will be accompanied by appropriate metadata that describes the products and depicts the collection and processing steps. UTM Zone 18N will be used for gridded data.

2.5.3 Laboratory Analysis Quality Control

Quality control of laboratory analysis of data will be maintained by adhering to the parameters set forth in [Table 2-5](#).

2.6 Instrument/Equipment Testing, Inspection, and Maintenance (EPA QA/R-5 B6)

[See Table 2-6. Field Equipment/Instrument Calibration, Maintenance, Testing, and Inspection](#)

2.6.1 Field Measurement Instruments/Equipment

The primary equipment that will be used are (1) a multibeam echosounder system which includes the Kongsberg EM 2040P, the Seapath 130 GPS Antenna with MRU motion and heading sensor, (2) additional sensors and computers needed for shipboard data acquisition and (3) computers, disk drives and software necessary to collect and process the multibeam bathymetry and acoustic backscatter data. Additional shipboard instruments that will be used for field measurement include a sound velocity profiler, additional GPS receivers, and shipboard network components with internet access.

All tools, gauges, test equipment, and instruments for field measurements that require periodic maintenance, testing, or inspection are identified in [Table 2-6](#). Periodic preventive and corrective maintenance of measurement or test equipment will be performed in accordance to manufacturer's instructions and documented electronically. Computers used to collect or process acoustic data will be maintained in operating order and data will be backed up at regular intervals.

2.6.2 Field Instruments/Equipment (Screening and Definitive)

Inspections and acceptance testing of acoustic measurement systems and their components will be performed in accordance with [Table 2-6](#) and documented electronically.

2.6.3 Laboratory Analysis Instruments/Equipment (Off-Site)

Computers used to transfer or process acoustic data will be maintained in operating order and data will be backed up at regular intervals. Software licenses for processing the acoustic data will be maintained through project completion.

2.7 Instrument/Equipment Calibration and Frequency (EPA QA/R-5 B7)

2.7.1 Field Measurement Instruments/Equipment

All tools, gauges, test equipment, and instruments for field measurements that need to be calibrated are identified in [Table 2-6](#). Calibration of these items will be performed in accordance with [Table 2-6](#) and documented electronically.

[See Table 2-6. Field Equipment/Instrument Calibration, Maintenance, Testing, and Inspection](#)

2.7.2 Field Instruments/Equipment (Screening and Definitive)

Calibration of acoustic measurement systems and their components will be performed in accordance with [Table 2-6](#) and documented electronically.

See [Table 2-6. Field Equipment/Instrument Calibration, Maintenance, Testing, and Inspection](#)

2.7.3 Laboratory Analysis Instruments/Equipment (Off-Site)

This project does not include any off-site analyses conducted at a contracted or Tribe-owned laboratory.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables (EPA QA/R-5 B8)

There are no relevant supplies and consumables that would affect the quality of the results or that necessitate inspection and acceptance beyond the instruments and equipment discussed in [Section 2.7](#).

2.9 Data Acquisition Requirements (Non-Direct Measurements) (EPA QA/R-5 B9)

A large part of the survey area has been imaged with uncalibrated side-scan sonar data (McMullen et al., 2008). Studies by Poppe et al. (2004), McMullen et al. (2005) and Beaulieu et al. (2005) sought to explain the side-scan sonar imagery in terms of bottom morphology and sediment characteristics which come from bottom photographs, bottom samples and seismic profiles. These studies provide ready-made ground truth data and interpretations which give a good foundation for more advanced analysis based on the multibeam depth and backscatter results in this project.

Important lines of investigation include examining the available historical survey data to determine how fast seabed features may be changing in response to bottom flow in the area (tidal, residual, and storm-generated). We will analyze and study the acoustic backscatter patterns in our new multibeam data using software packages such as QPC Fledermaus GeoCoder and SwathEd, and seek to relate the backscatter patterns to the available sediment samples or visual observations and to morphology patterns shown by the multibeam depth data.

2.10 Data Management (EPA QA/R-5 B10)

Management of the geospatial data for this project is consistent with the [Data Management](#) system established for the LIS Seafloor Habitat Mapping Initiative, which reflects standards for acoustic data in Section 8 of NOAA's [Hydrographic Surveys Specifications and Deliverables](#). Final bathymetry and backscatter mosaics including all vessel data, survey specifications, processing descriptions, and metadata will be posted to NOAA's National Centers for Environmental Information (NCEI) for archiving and to allow wide access to the mapping results. Mapping results will also be archived on the [LIS Data Portal](#) on the Marine Geoscience Data System.

Acquired sonar data will be delivered in both raw and processed formats which provide complete traceability for all positions, soundings, and correctors including sensor offsets, biases, dynamic attitude, navigation, sound velocity, date and time, and vertical datum reducers from acquisition through post-processing. The mechanism for detecting and correcting errors in data processing are described in [Table 2.5](#).

The survey will be managed using, Kongsberg SIS software. Project support staff will log the raw multibeam bathymetry data files into a specialized laptop with the Kongsberg SIS software. SIS also does real-time gridding of water depth, backscatter data and other survey parameters that allow the real-time assessment of data quality. SIS is also the interface for collecting and applying sound-velocity profiles. The raw data in SIS will be copied from the survey computer to backup computers and networked disk drive arrays at regular intervals to ensure data safety. The SIS data will then be imported into CARIS HIPS and SIPS for processing of bathymetry data by the Project Support Staff and Field Technicians.

In CARIS, data stored in each file will be checked and erroneous soundings flagged. Multibeam data processing of the backscatter data will be done using QPC Fledermaus GeoCoder Toolbox (FMGT) and using SwathEd software programs from the University of New Brunswick for both bathymetry and backscatter. The multibeam system is expected to generate well over 100-200 GB per survey week of raw data, and the data volume increases as the raw data is unpacked and manipulated. Therefore, this data will be transferred and backed up to a networked RAID system at the Principal Investigator's lab, where final bathymetry and backscatter QC will be completed.

The Data Management and Data Processing Flow Charts ([Figure 2-2](#) & [Figure 2-3](#)) illustrate the expected flow of data usage and processing. These flow charts identify the data handling equipment and procedures to process, compile, and analyze the data, including the required computer hardware and software. The process flow also identifies how data will be managed to reduce processing errors. At each interval of data collection and processing, the raw and processed data is backed up to the transferable and then to the networked RAID systems. The approach for data storage and retrieval of electronic media is discussed in [Section 1.9](#).

3.0 ASSESSMENT AND OVERSIGHT

3.1 Assessments/Oversight and Response Actions (EPA QA/R-5 C1)

The assessments to be performed during the project to ensure activities are being conducted as planned occur with each survey cruise and at each data processing interval. [Table 1-2](#) lists the approximate schedule of activities. Project support staff, field technicians, and PIs assess the data in real time for quality control and quality assurance during acquisition using the SIS software and in accordance with [Table 4-1](#). The survey and processed data are evaluated to ensure the parameters specified in [Table 1-3](#) through [Table 2-6](#) have been followed and that all acceptance criteria are met. Response actions to non-conforming conditions shall be addressed in accordance with [Table 2-4](#) through [Table 2-6](#). The assessments are reported via calibration, maintenance, and testing records from each survey cruise. PI Dr. Roger Flood confirms the assessments and evaluates the resulting data for conformance. Conformance of the assessed data is documented in the quarterly and final reports.

3.2 Reports to Management (EPA QA/R-5 C2)

Quarterly and final reports are prepared by the PIs and distributed to the Technical Lead as outlined in [Table 1-2](#) to inform management of the status of the project, results of performance evaluations and systems assessments, results of data quality evaluations, and any significant quality assurance problems and recommended solutions. The Technical Lead reviews project progress in accordance with [Table 4-1](#) and reports progress to management in quarterly planning meetings.

4.0 DATA REVIEW AND USABILITY

4.1 Data Review, Verification, and Validation Requirements (EPA QA/R-5 D1)

The criteria used to review and evaluate/validate data are specified in [Table 4-1](#).

4.2 Verification and Validation Methods (EPA QA/R-5 D2)

The methods or procedures to be used for verifying and validating data are outlined in [Table 2-5](#), which references applicable procedures in NOAA's *Hydrographic Surveys Specifications and Deliverables*. How accepted, qualified, and rejected data will be identified is described in [Table 2-5](#), which also identifies how issues will be resolved and the authorities for resolving them. The process for data verification and validation is specified in [Table 4-1](#) and depicted in [Figure 2-3](#) and documented using the

Data Evaluation/Documentation Form in [Appendix C-1](#). The Data Evaluation/Documentation Form is to be filled in for each survey cruise.

4.3 Reconciliation with User Requirements (EPA QA/R-5 D3)

After the bathymetry and backscatter data has been reviewed, verified, and validated/evaluated, the Technical Lead and Project lead review the data for alignment with the project objectives and measurement performance criteria/acceptance criteria presented in Section 1.7 and Section 2.5. The Principal Investigators will analyze the multibeam data and determine possible anomalies or limitations on the use for the intended purpose. Data anomalies will be resolved in situ during acquisition and processing, and any limitations on the use of the data will be discussed in the quarterly and final reports.

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FIGURES:

Figure 1-1. Organization Chart

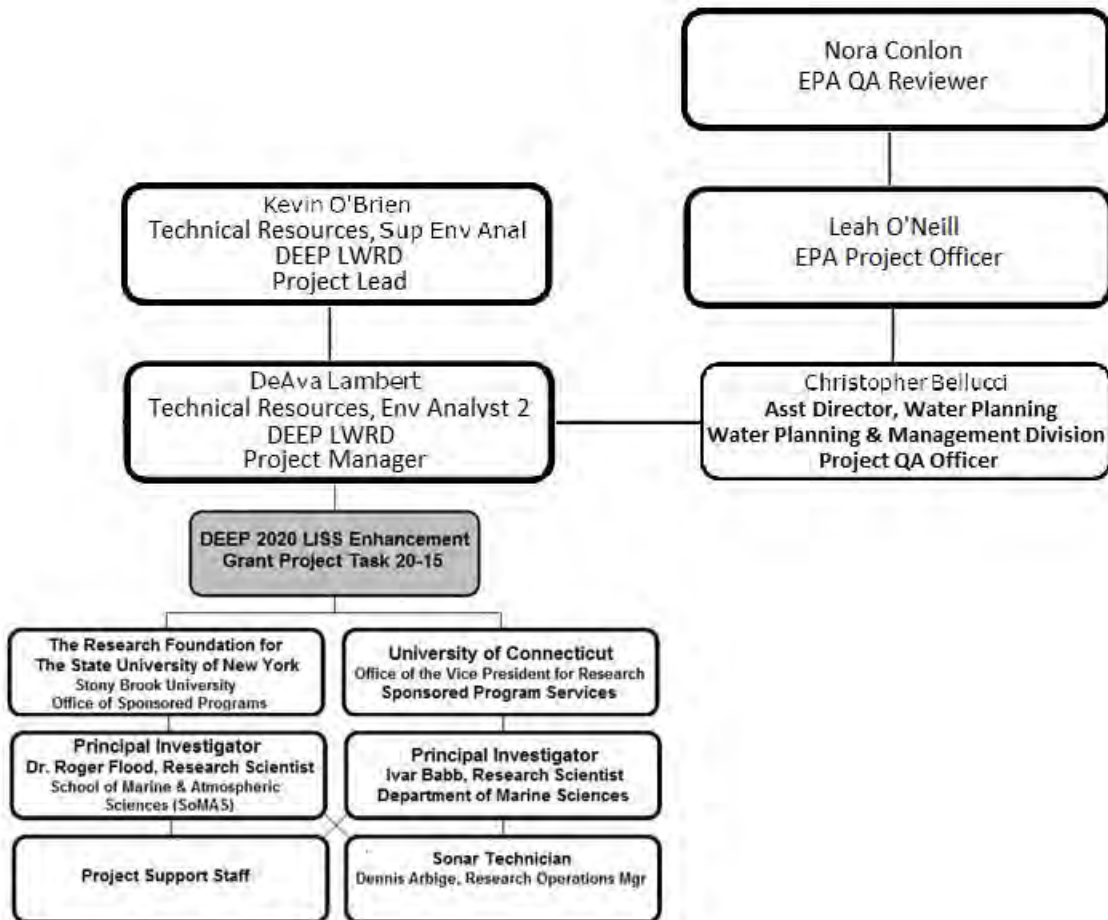


Figure 1-2. LIS Cable Fund Mapping Priority Areas

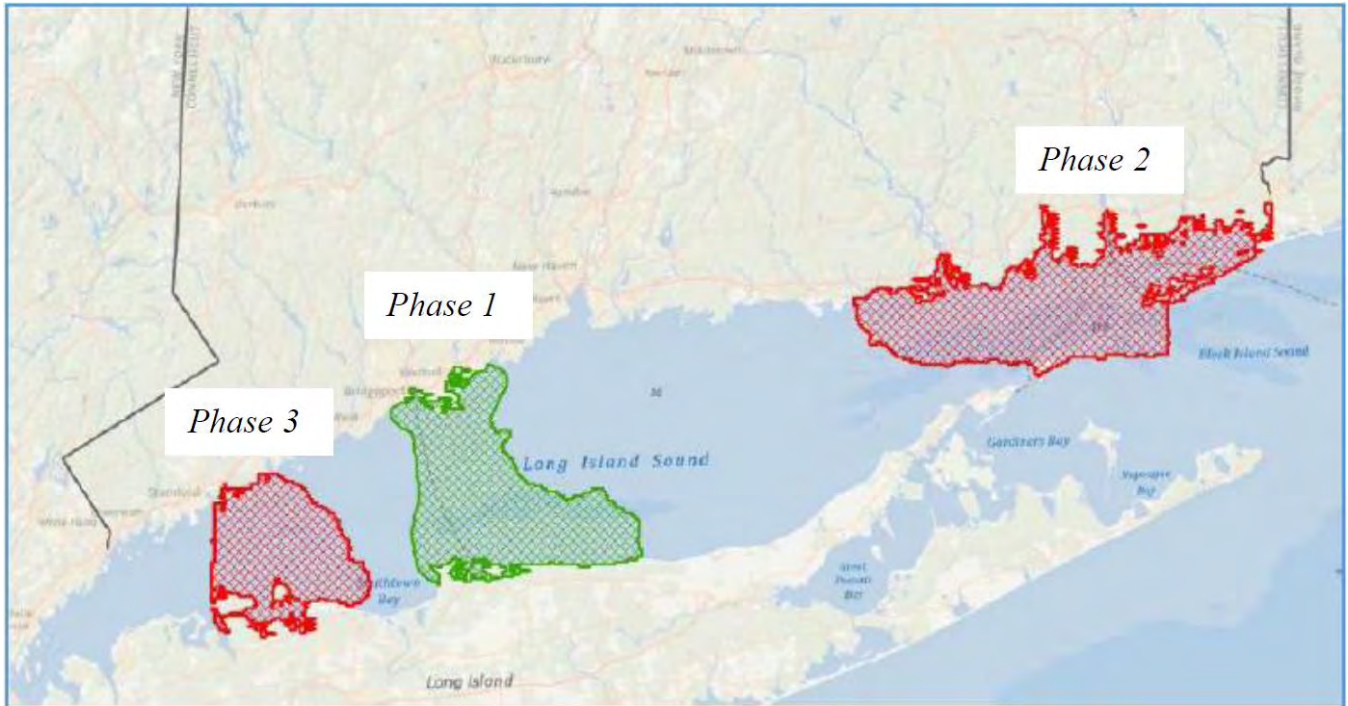


Figure 1-3. 100 square-mile area lacking benthic data

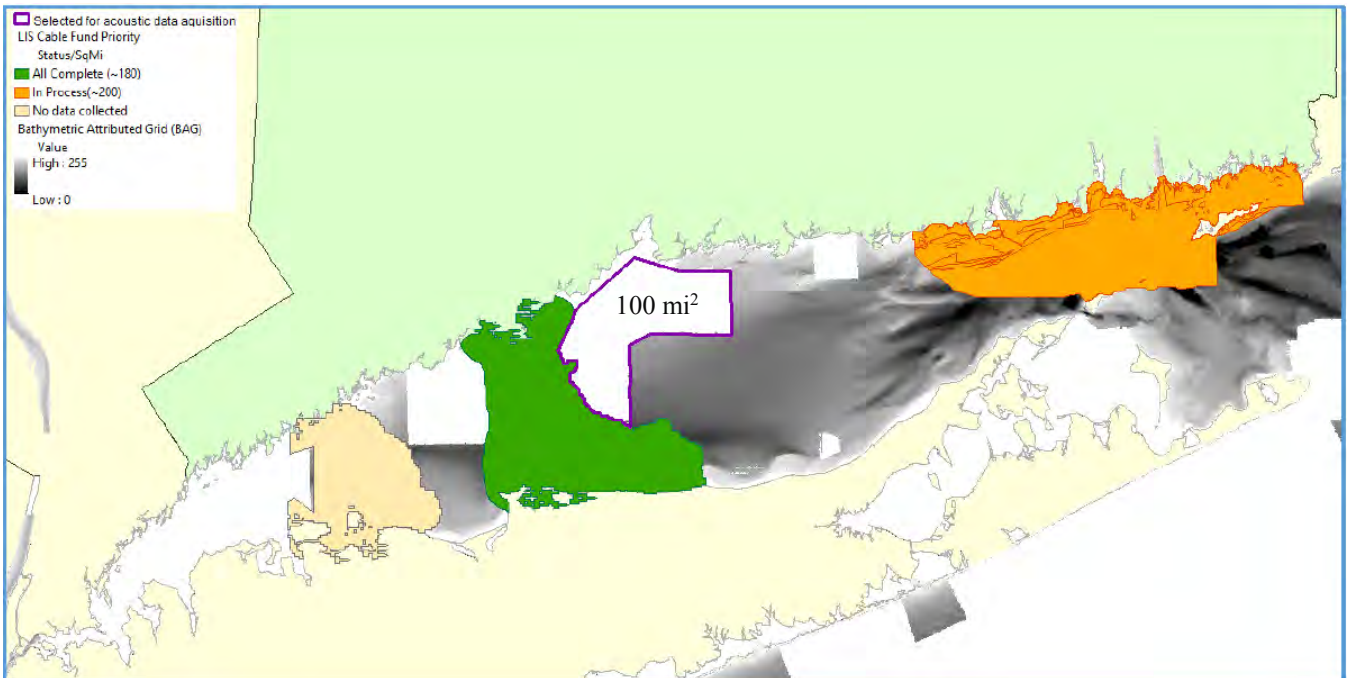
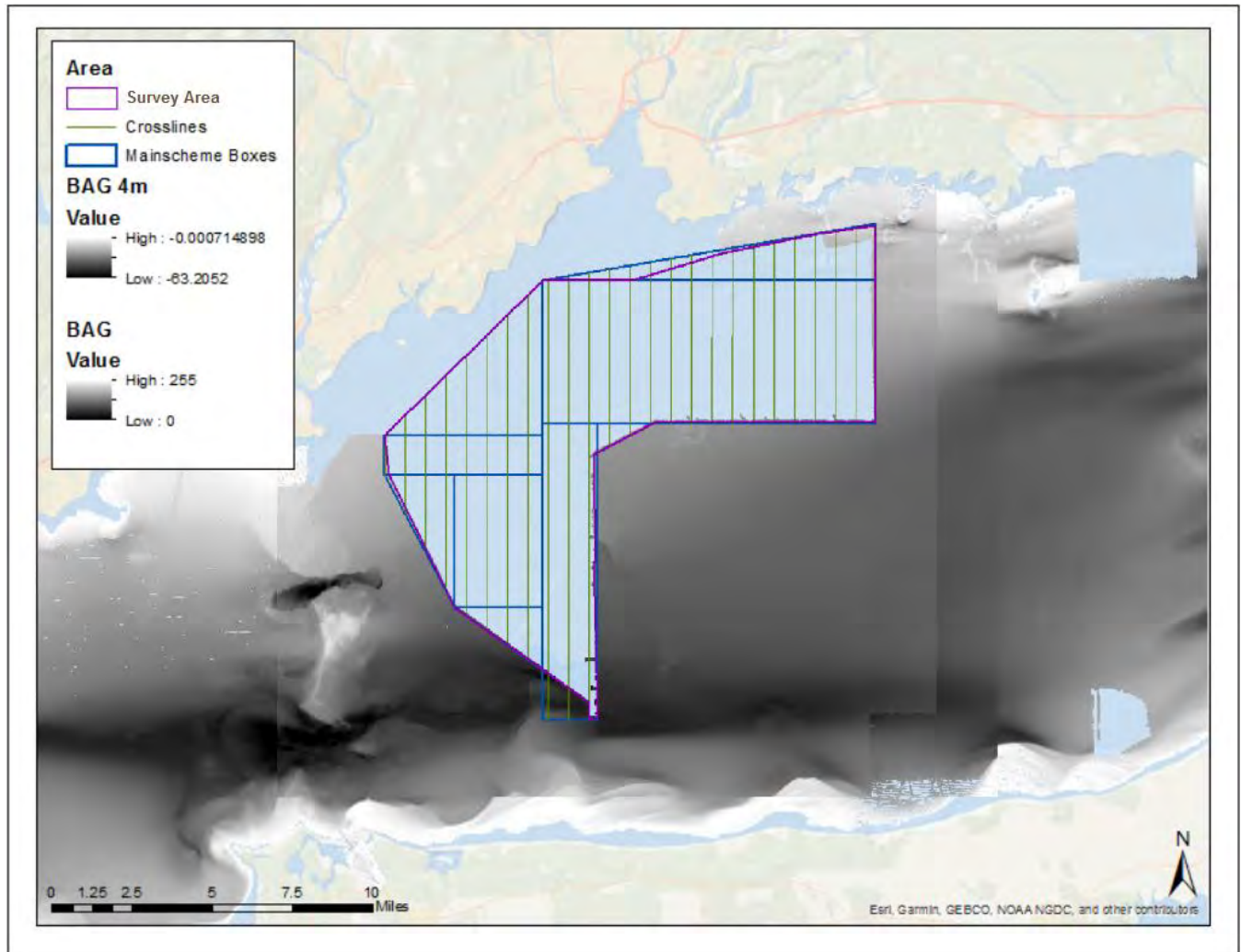
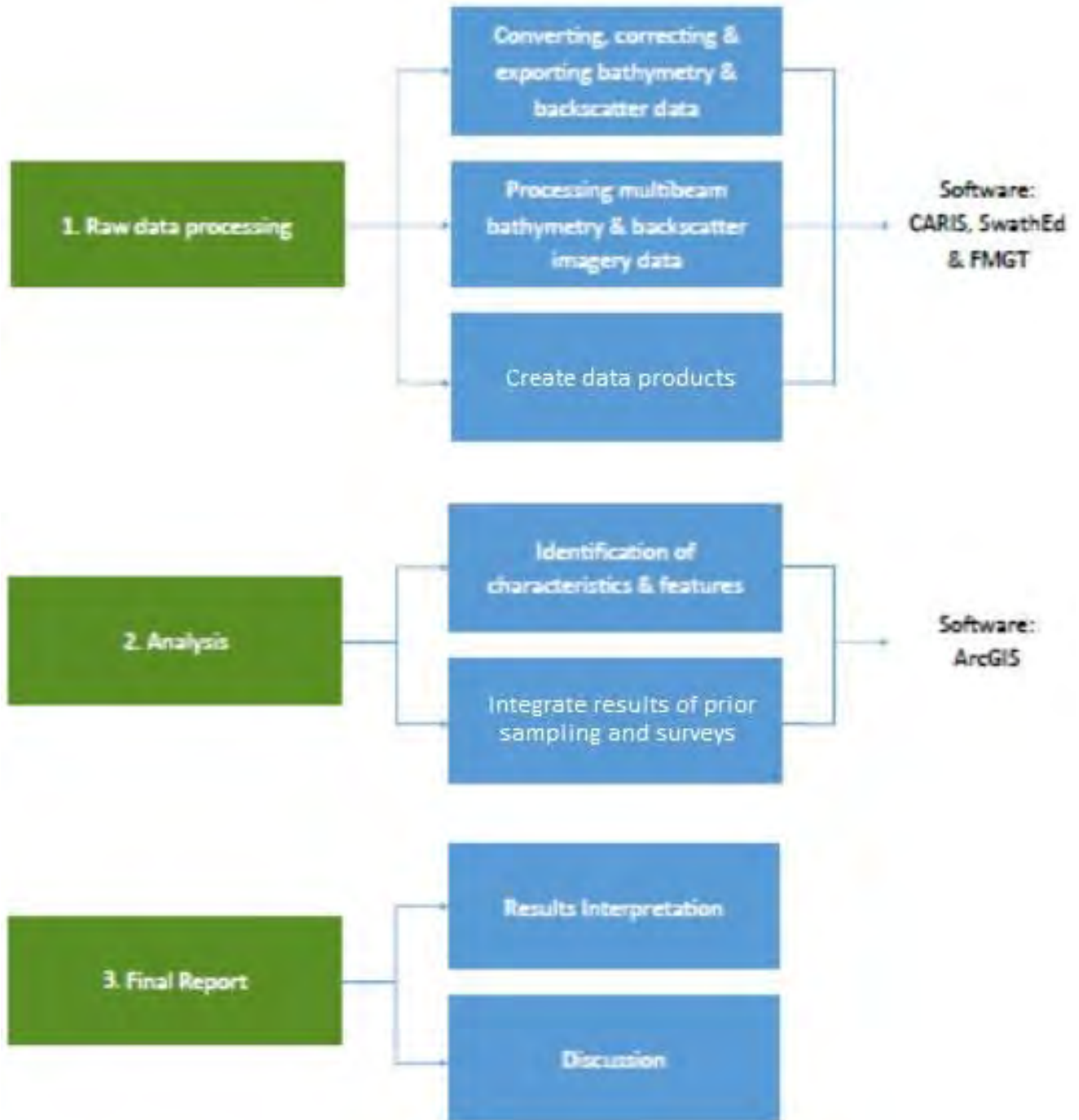


Figure 2-1. Site Map with Sampling Locations



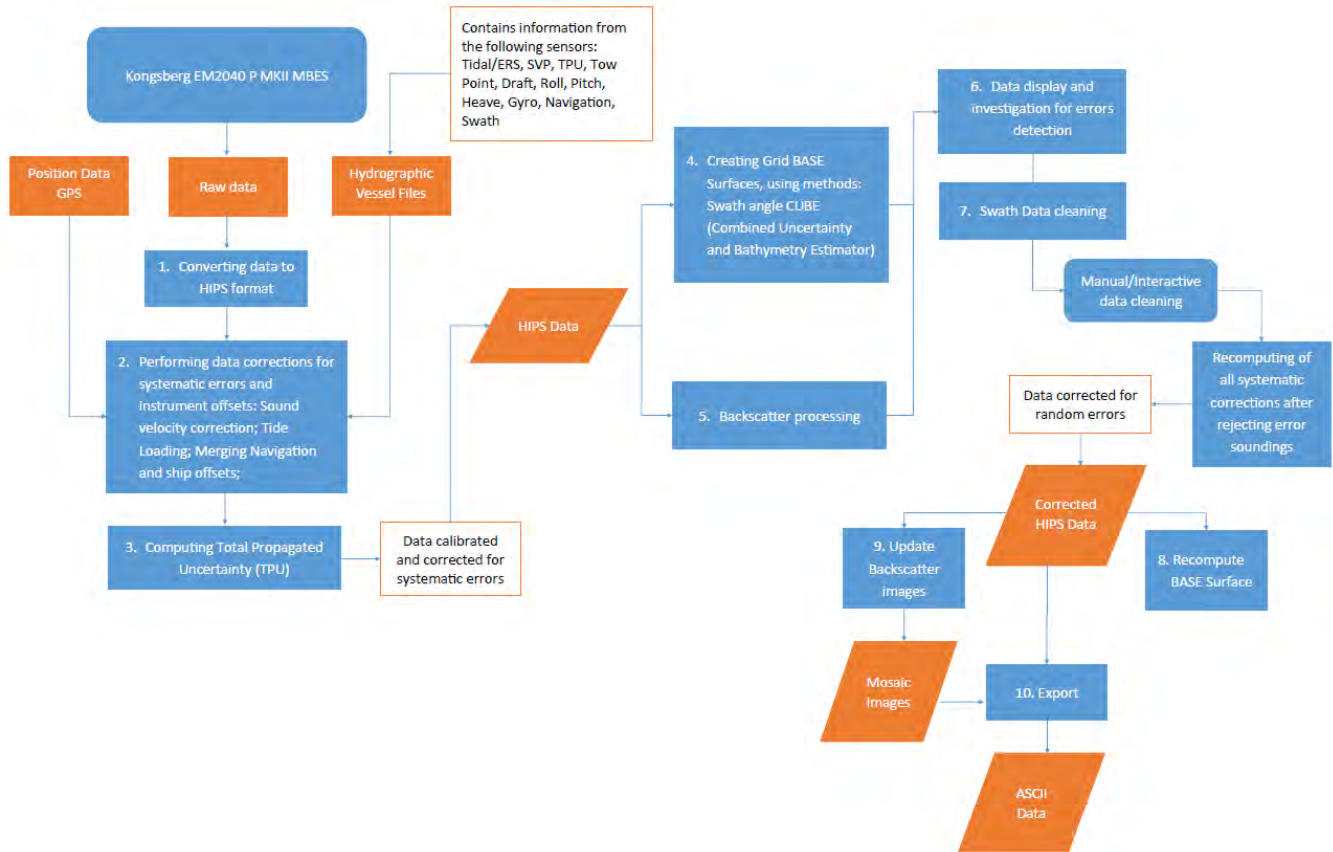
The mainscheme boxes and crosslines represent conceivable survey line orientations and are used to estimate the number of survey hours and survey lines required (See [Table 2-3](#)).

Figure 2-2. Data Management Major Components



Adapted from Banul (2014).

Figure 2-3. Multibeam Data Processing Flow



Orange boxes show the data type and information applied. Blue boxes indicate processing stage. The boxes with orange outline describe what information data file contain. Adapted from Banul (2014).

TABLES:

Table 1-1. Deliverables

Deliverable	Description	Frequency	Cumulative	Final
Multibeam Bathymetry	Depth data gridded at 1m resolution in GIS-compatible format along with appropriate metadata.	An initial grid with minimal processing will be created following each cruise and made available for review via a shared drive.	Grids using all processed data will be generated at regular intervals and made available for review via a shared drive.	The final grid will be generated at the end of project year 2 and submitted to NCEI along with appropriate metadata.
Multibeam Hillshade Bathymetry	Image of hillshade of depth data gridded at 1m resolution in GIS-compatible format along with appropriate metadata.	An initial image with minimal processing will be created following each cruise and made available for review via a shared drive.	Images using all processed data will be generated at regular intervals and made available for review via a shared drive.	The final image will be generated at the end of project year 2 and submitted to NCEI along with appropriate metadata.
Multibeam Acoustic Backscatter	Image of acoustic backscatter data gridded at 1m resolution in GIS-compatible format along with appropriate metadata.	An initial image with minimal processing will be created following each cruise and made available for review via a shared drive.	Images using all processed data will be generated at regular intervals and made available for review via a shared drive.	The final image will be generated at the end of project year 2 and submitted to NCEI along with appropriate metadata.
Final Report	a Final Report including a project-wide synthesis describing all work tasks and deliverables	Draft Final Report to be submitted at least 30 days prior to the contract end date	The Draft will be reviewed by the Technical and Project Leads for accuracy and completeness and recommended edits provided to the Principal Investigators.	Amended Final Report submitted within 30 days of the fully reviewed draft report

Table 1-2. Milestones Schedule

Milestone	Anticipated Date	Deliverable
Quality Assurance Project Plan (QAPP) Development	1/1/2022	Signed and Approved QAPP for DEEP 2020 LISS Enhancement Grant Project Task 20-15
Project start	Upon Contract Execution	
Review multibeam echosounder (MBES) selection and submit Purchase Order and Invoice	Upon Contract Execution	Completed purchase order and invoice for MBES equipment, software and incidentals
Year 1 Quarterly Project Report #1	3 months after execution date	Y1 Q1 Report
Receive multibeam and software	anticipated within 90 days of order	
Initial installation of multibeam system on research vessel	to be scheduled ASAP after MBES delivery, dependent upon ship availability	
Multibeam system installation, acceptance, calibration and training	Within 120 days of initial installation, dependent upon ship availability and other factors	
Year 1 Quarterly Project Report #2	6 months after execution date	Y1 Q2 Report
1st Year 1 multibeam mapping cruise	Within 120 days of installation, calibration, and training, dependent upon ship availability and other factors	
Provide initial 1st cruise Year 1 multibeam mapping results	with the subsequent quarterly report	An initial bathymetry grid, hillshade bathymetry image, and backscatter image with minimal processing
2nd Year 1 multibeam mapping cruise	Within 120 days of the first cruise, dependent upon ship availability and other factors	
Provide initial 2nd cruise Year 1 multibeam mapping results	with the subsequent quarterly report	An initial bathymetry grid, hillshade bathymetry image, and backscatter image with minimal processing
Year 1 Quarterly Project Report #3	9 months after execution date	Y1 Q3 Report
Provide final results of Year 1 multibeam mapping results	with the Year 1 Project Report	A combined bathymetry grid, hillshade bathymetry image, and backscatter image from cruises 1 and 2
Year 1 Project Report	12 months after execution date	Y1 Q4 Report
1st Year 2 multibeam mapping cruise	Within 120 days of the last cruise, dependent upon ship availability and other factors	
Provide initial 1st Year 2 multibeam mapping results	with the subsequent quarterly report	An initial bathymetry grid, hillshade bathymetry image, and backscatter image with minimal processing
Year 2 Quarterly Project Report #1	15 months after execution date	Y2 Q1 Report
2nd Year 2 multibeam mapping cruise	Within 120 days of the last cruise, dependent upon ship availability and other factors	
Provide initial 2nd cruise Year 2 multibeam mapping results	with the subsequent quarterly report	An initial bathymetry grid, hillshade bathymetry image, and backscatter image with minimal processing
3rd Year 2 multibeam mapping cruise	Within 120 days of the last cruise, dependent upon ship availability and other factors	

Milestone	Anticipated Date	Deliverable
Provide initial 3rd cruise Year 2 multibeam mapping results	with the subsequent quarterly report	An initial bathymetry grid, hillshade bathymetry image, and backscatter image with minimal processing
Year 2 Quarterly Project Report #2	18 months after execution date	Y2 Q2 Report
4th Year 2 multibeam mapping cruise	Within 120 days of the last cruise, dependent upon ship availability and other factors	
Provide initial 4th cruise Year 2 multibeam mapping results	with the subsequent quarterly report	An initial bathymetry grid, hillshade bathymetry image, and backscatter image with minimal processing
5th Year 2 multibeam mapping cruise	Within 120 days of the last cruise, dependent upon ship availability and other factors	
Provide initial 5th cruise Year 2 multibeam mapping results	with the subsequent quarterly report	An initial bathymetry grid, hillshade bathymetry image, and backscatter image with minimal processing
6th Year 2 multibeam mapping cruise	Within 120 days of the last cruise and at least 30 days prior to the contract end date	
Year 2 Quarterly Project Report #3	21 months after execution date	Y2 Q3 Report
Provide initial 6th cruise Year 2 multibeam mapping results	within 30 days of the cruise completion	An initial bathymetry grid, hillshade bathymetry image, and backscatter image with minimal processing
Update final Year 1 multibeam mapping as needed	with the draft Final Report	
Provide final combined Year 1 and 2 multibeam mapping results	with the draft Final Report	A seamless combined (stitched) fully processed high resolution bathymetry grid, hillshade bathymetry image, and backscatter image from all Year 1 and 2 cruises
Delivery of multibeam mapping results to NCEI	at least 30 days before the contract expiration	A seamless combined (stitched) fully processed high resolution bathymetry grid, hillshade bathymetry image, and backscatter image from all Year 1 and 2 cruises
Final Project Report draft	at least 30 days before the contract expiration	Final Project Report draft
Final Project Report (amended)	within 30 days of the reviewed draft report	Final Project Report amended

Table 1-3. Analytical Parameters and Target Limits

Analytical Parameter	Action/Limit Level	Detection Limit	Quantitation Limit	Where:	SOP Reference	
Total Horizontal Uncertainty	95% Confidence	≤ 5m + 5% of depth	5m + 5% of depth	accuracy is independent of survey scale, and values reported retain a precision of at least decimeters	HSSD § 3.2, p. 14	
Total Vertical Uncertainty	95% Confidence	$\pm\sqrt{a^2+(b*d)^2}$	maximum allowable uncertainty in depth includes all inaccuracies due to residual systematic and system specific instrument errors; the speed of sound in water; static vessel draft; dynamic vessel draft; heave, roll, and pitch; and any other sources of error	a = that portion of the uncertainty that does not vary with depth b = a coefficient which represents that portion of the uncertainty that varies with depth (b x d) = that portion of the uncertain that does vary with depth d is the depth The variables “a” and “b” are defined as: In depths less than 100 meters, a = 0.5 meters and b = 0.013 (IHO Order 1b)	HSSD § 5.1.3, p. 48	
Complete Coverage	95% of all nodes	≥ 5 soundings	The maximum propagation distance shall be no more than the grid resolution divided by $\sqrt{2}$.	<ul style="list-style-type: none"> operation detects shoals measuring 2m x 2m wide and 1m high in depths ≤ 20m operation detects and includes in the grid bathymetry features measuring ~5% of depth vertically and 2X the required grid resolution horizontally in depths > 20m all significant shoals or features found in waters less than 20m shall be developed to 1m resolution surface a holiday is defined as at least three by three nodes in the surface at the required resolution. 	HSSD § 5.2.2, p. 53	
Grid Resolution	1 m grids at all water depths	Maximum grid resolutions	Data density will be maximized at varying water depth to determine there are sufficient soundings per grid cell.	Depth Range (m)	Resolution (m)	HSSD § 5.2.2.2, p. 54
				0-20	1	
				18-40	2	
				36-80	4	
				72-160	8	
144-320	16					

Table 2-1. Sampling Design and Rationale

Sampling Location	Matrix	Depth (units)	Survey Type	Concentration Level	Analytical Parameter	Sampling SOP Reference	Sampling Location Rationale
100 square mile area in central LIS	Elevation (meters in NAVD88)	8m ≤ ≥ 120m	Multibeam	NA	Full bottom coverage with a estimated minimum of 617 track lines averaging 55m apart	Appendix D	Area where high-resolution multibeam bathymetric and backscatter data is not available and where improved understanding of the nature and character of the seafloor is needed

Table 2-2. Summary of Field and QC Samples to Be Collected

Matrix	Analytical Parameter	No. of Sampling Locations	Depth	No. of Field Duplicates	Total Number of Samples
Elevation (meters - NAVD88)	Complete multibeam coverage	Estimate 5,477 mainscheme km with 4% Crosslines based on 35 mapping days	seafloor	Average 19 track lines per 1km	Estimate 617 track lines and 25 crosslines

Table 2-3. Analytical Method and Time Requirements

Mainscheme Area	Length (km)	Width (km)	Actual Area (km ²)	Actual Area (mi ²)	55m Lines	Adjusted Length (km)	Line km
1	7.770	7.611	29.57	11.42	138	8.77	605.13
2	2.701	14.582	39.38	15.21	265	3.70	980.67
3	7.770	1.983	15.40	5.95	36	8.77	315.71
4	16.416	7.062	115.92	44.76	128	17.42	2229.20
5	16.416	2.778	22.80	8.80	51	17.42	444.10
6	4.335	6.481	28.10	10.85	118	5.33	629.50
7	3.435	6.481	11.13	4.30	118	4.43	261.66
8	4.335	3.123	6.77	2.61	57	5.33	152.04
9	2.723	1.416	1.93	0.74	26	3.72	48.40
Total	65.90	51.52	271.00	104.63	618		4574.81

Crosslines	182.99	km	25	lines	Speed					
Transit	42.78	km			1	kt =	1.150	mph	1.85	
*End Turns	1.00	km			Minimum	5	kt =	5.75	mph	9.26
						5.40	kt =	6.21	mph	10.00
						6	kt =	6.9	mph	11.11
					Maximum	7.5	kt =	8.625	mph	13.89
					Average	5.97	kt =	6.87	mph	11.07

Survey Line Time											Peripheral Travel				Cumulative		
1	2	3	4	5	6	7	8	9	Sum	Total	Crosslines	Transit					
65.35	105.90	34.09	240.73	47.96	67.98	28.26	16.42	5.23	611.92	hrs	494.04	19.76	hrs	3.08	hrs	516.88	hrs
60.51	98.07	31.57	222.92	44.41	62.95	26.17	15.20	5.23	567.03	hrs	457.48	18.30	hrs			478.86	hrs
54.46	88.25	28.41	200.61	39.97	56.65	23.55	13.68	5.23	510.81	hrs	411.70	16.47	hrs			431.25	hrs
43.57	70.60	22.73	160.49	31.97	45.32	18.84	10.95	5.23	409.69	hrs	329.36	13.17	hrs			345.61	hrs
55.97	90.71	29.20	206.19	41.08	58.23	24.20	14.06	5.23	524.86	hrs	423.15	16.93	hrs	Average		443.15	hrs

Table 2-4. Quality Control Requirements for Field Measurements

Parameter	QC Method	Frequency/Conditions	Data Quality Indicators (DQIs)	Acceptance/Measurement Performance Criteria ¹	Corrective Action	SOP Reference
Sonar Calibration	System Accuracy Test	Depths equivalent to the deepest survey depths and similar in bottom profile and composition to the survey area during relatively calm seas	Accuracy, precision, and alignment	Bias determined in order: navigation timing error, pitch, roll, heading (yaw), and uncertainty	Corrected initial alignment to compute TPU	HSSD § 5.2.4.1, p. 69
Positioning System Confidence	Ellipsoid Referenced Survey (ERS) Control	Horizontal and vertical control within THU and TVU thresholds	Tide-Corrected Hydrography Comparability to ellipsoid referenced data	Ellipsoid-to-chart datum transformation using NOAA's National VDatum transformation framework and software	3D real time GPS corrections relayed from a land-based RTK (real-time kinematic) system or a commercial system that can provide comparable 3D position corrections	HSSD § 3.4, p. 15
Crosslines	Sounding lines supplemented by a series of crosslines with ~4% of mainscheme mileage in areas surveyed and a sound-velocity cast at least every 4 hours	Acquired with same accuracy and data quality standards as required for mainscheme lines. Crosslines are useful whether collected before, during or after the main survey lines.	Accuracy and reliability/completeness of surveyed soundings and positions	Good temporal and geographic distribution with maximal nadir-to-nadir comparisons with ≥95% of depth values from the two datasets differ by no more than the maximum allowable TVU for the depth of the comparison area	Quantitative evaluation of wide survey discrepancies area by area. Note any differences found to be within the allowable maximum TVU. Any errors identified through crossline analysis and the means by which they were corrected shall be discussed.	HSSD § 5.2.4.2, p. 70

¹ Information supports the acceptance criteria/measurement performance criteria introduced in [Section 1.7.3](#).

Table 2-5. Quality Control Requirements for Analyses

Parameter	Data Quality Indicators (DQIs)	Determination Method	Conditions	Acceptance/Measurement Performance Criteria ¹	Corrective Action	Reference
Bathymetry	Precision	Analyze depth data using information on depth acquisition and computational analytical processes	full resolution representative depth range	1m bathymetric attributed grid (BAG) reflecting the state of the seafloor at the time of the survey, with resolution and attribution as described in Section 5.2	fully corrected for water levels, sound speed, vessel offsets, draft and dynamic draft made within CARIS	HSSD § 8.3.2, p. 119
	Bias	Error analysis	Evaluation of uncertainties to estimate their extent and reduce them when necessary	Determination of the estimated error (both bias and random) at the 95% Confidence Interval	the error model for CARIS contains uncertainties associated with the sensor and sonar, physical offsets, latency, draft, loading, sound speed and zoned water levels	HSSD § 5.2.3.6, p. 68
	Accuracy	Conduct an uncertainty analysis of the survey systems.	Study and evaluation of uncertainties with the purpose of estimating their extent and reducing them when necessary.	Meet the accuracy and resolution standards and create a BAG that includes an accurate uncertainty layer.	Draft corrections added to account for the depth of the echosounder transducer below the water surface. Dynamic draft corrections to correct the vertical displacement of the transducer. Speed of sound corrections to compensate for an assumed sound speed profile. Attitude corrections to correct the effect of vessel motion caused by waves and swells and the error in the vessel's heading.	HSSD § 5.2.3, p. 62

Parameter	Data Quality Indicators (DQIs)	Determination Method	Conditions	Acceptance/Measurement Performance Criteria ¹	Corrective Action	Reference
Bathymetry	Representativeness	Evaluate whether soundings are collected so the depth data reflects the seafloor condition.	Even when the appropriate resolution was selected, the grid may not portray some navigationally significant depths and features.	A review of the grid ensures that it reflects the conditions in the survey area.	File an ATON report if the survey records a shallow, potentially hazardous, depth that isn't shown on the chart.	HSSD § 1.6.2.2, p. 7
	Comparability	Compare soundings, analytical procedures, and QA protocols over entire survey	Uncertainty analysis of the survey systems	Evaluate each area of overlapping crossline and mainscheme coverage to ensure that the depth values from the two data sets do not differ more than the maximum allowable TVU for the depth	If unexplained or excessive discrepancies persist, additional crosslines shall be re-acquired to assist in resolution of the issue.	HSSD § 5.2.3, p. 62
	Completeness	Compare the resulting depth data with the quality objectives for complete coverage	Qualify the depth data to the performance criteria.	The resulting depth data meets the project DQOs.	If the survey is incomplete and/or insufficient, additional survey to qualify the data is necessary.	HSSD § 5.2.2.3, p. 57
	Sensitivity	Determine the minimum attribute that can be measured by the echosounder.	Ability to discriminate between measurement responses representing different variable levels	The depth value of the shoalest measurement is $\geq 8\text{m}$ and shoals $\leq 2\text{m} \times 2\text{m} \times 1\text{m}$ in depth $\leq 20\text{m}$ are detected.	MBES operation within complete coverage target limits	HSSD § 5.2.2.3, p. 57

Parameter	Data Quality Indicators (DQIs)	Determination Method	Conditions	Acceptance/Measurement Performance Criteria ¹	Corrective Action	Reference
Backscatter	Precision	Analyze backscatter using information on acoustic data acquisition and computational analytical processes	Backscatter samples shall be collected so as to allow for contiguous samples across the beam footprint for each seafloor detection.	The backscatter coverage shall not exceed 1.5 times the beam footprint.	The adjustment of multibeam settings should be minimized to limit the likelihood of artifacts in the resulting backscatter products. All real time acquisition parameters that are needed to conduct post processing need to be included with the digital data.	HSSD § 6.2, p. 80
	Bias	Distortion of acoustic intensity causing saturation.	Efforts shall be made to avoid multibeam receiver acoustic saturation of the backscatter data.	Raw multibeam backscatter data must contain intensity values and be capable of being successfully imported and processed into a backscatter mosaic	Failure to prevent saturation may require resurvey.	
	Accuracy	Reported backscatter accuracy shall be recorded in the form of a backscatter offset or beam pattern	A measure of the overall agreement of the acoustic measurement to a known attribute.	Verify areas of obvious or apparent bottom composition change	Indication of misreported settings versus actual used settings shall also be reported for the particular systems in use during the survey.	
	Representativeness	Evaluate whether acoustic intensity measurements are made so that the resulting backscatter data appropriately reflect the seafloor environment.	Verification to ground-truth seafloor backscatter data by evaluating available seabed samples.	Backscatter data is consistent with verification samples.	Compare mainscheme and crossline coverage to identify, evaluate, and rectify any such errors or to explain any variations if the data is found to be correct.	

Parameter	Data Quality Indicators (DQIs)	Determination Method	Conditions	Acceptance/Measurement Performance Criteria ¹	Corrective Action	Reference
Backscatter	Comparability	Compare crossline and mainscheme coverage	The comparison shall be performed at the same resolution as the final survey product	Ensure that the depth values from the two data sets do not differ more than the maximum allowable TVU	Any deviations from this standard shall be investigated, and the source of error identified and corrected if there is an instrumental error.	HSSD § 5.2.4.2, p. 70
	Completeness	Seafloor backscatter data will be evaluated for gaps in backscatter coverage	Adjacent grids shall always overlap in depth to ensure no gaps in coverage exist at the transition from one depth grid to another	The maximum propagation distance shall be no more than the grid resolution divided by $\sqrt{2}$.	The overlap between grids of different resolutions may need to be increased to prevent gaps in their junction. In these cases, the courser resolution grid should have its shoaler extent modified to prevent this coverage gap.	HSSD § 5.2.2, p. 53-56
	Sensitivity	Determine the minimum attribute that can be measured by the echosounder.	Ability to discriminate between measurement responses representing different variable levels	All significant shoals or features found in waters less than 20 m shall be developed to complete coverage standards (i.e., 1 m resolution surface in depths 0-20 m).	For variable resolution surfaces, 95% of all surface nodes shall have a resolution equal to or smaller than the coarsest allowable resolution for the node depth.	HSSD § 5.2.2.2, p. 54

¹ Information supports the acceptance criteria/measurement performance criteria introduced in [Section 1.7.3](#).

Table 2-6. Field Equipment/Instrument Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
RTK system/commercial positioning system	Verify and check all horizontal and vertical control and datum before beginning any survey.	Per manufacturer's instructions	Accuracy of position and elevation	Compare elevations with nearby tide gauge.	Before and after cruise while boat is at the dock	The commercial satellite service will ensure that GPS corrections are available on the survey vessel	Recalculate for positional accuracy	Principal Investigator, Sonar Technician, or supervised project support staff	HSSD § 3.4., p. 15
MBES	Perform patch test to determine roll, pitch, heading and navigation biases. This is done once per survey cruise	Per manufacturer's instructions	Confirm measured value aligns with known distance	Daily	Daily	Refer to Sonar Calibration in Table 2.4	Recalibrate	Principal Investigator, Sonar Technician, or Vessel Technician	HSSD § 5.2.4.1, p. 69
MBES	Grid Management	Per manufacturer's instructions	N/A	Determining latency of system	Daily	Real-time assessment of the quality of the survey parameters using seafloor information software (SIS)	Remove latency from field data	Principal Investigator, Sonar Technician, or supervised project support staff	HSSD § 5.2.1.2, p. 50
MBES	Field check of data integrity	Per manufacturer's instructions	N/A	Ensure: (1) quality digital data (i.e., no spikes or false echo from prop wash) is being recorded, and (2) ship track spacing is 5x water depth.	Real time	No data spikes or false echo from prop wash is being recorded and that ship track spacing is 5x water depth.	Adjust data collection and track spacing as required to remove deficiencies.	Principal Investigator, Sonar Technician, or supervised project support staff	HSSD § 4.1.6, p. 21

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
MBES	N/A	N/A	QC check	Provide complete traceability for all positions, soundings, and correctors including sensor offsets, biases, dynamic attitude, sound speed, position, sensor position, date and time, vertical datum reducers, and sounding data from acquisition through post-processing.	Data quality and edit flags must be traceable.	N/A	Instrument error corrections account for sources of error related to the sounding equipment itself.	Principal Investigator, Sonar Technician, or supervised project support staff	HSSD § 5.2.1.2, p. 50
Tide data	Sea surface correction to field data	Per NOAA CO-OPS	N/A	Confirm operating status of available control stations each morning prior to commencing survey operations	Real time	Inspect data stream. Tide gauges need to be installed at a surveyed elevation. All tidal datum computations and water level reductions shall be referenced to NAVD88.	Compared measured water-level elevations with elevations determined by satellite and use elevation to correct the depth data.	Supervised project support staff	HSSD § 5.2.1.2, p. 50

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Multibeam	N/A	N/A	N/A	Data acceptance	Data processing cue	Average track spacing of 55m. All multibeam data collection and post processing procedures will follow manufacturer's specifications.	Ensure depth data overlaps at the edges of the swath	Principal Investigator, Sonar Technician, or supervised project support staff	HSSD § 5.2.2, p. 53
Multibeam	N/A	N/A	N/A	Complete coverage as described in Table 1-3. This practice ensures that no data gaps caused by mound or trench shadowing occur in the survey.	Real-time	Accepted overlap	Adjust vessel position and track spacing	Principal Investigator, Sonar Technician, or supervised project support staff	HSSD § 5.2.2, p. 53
Sound Velocity Profiler (SVP)	Yearly	Calibrate probe	Compare Sound Velocity with other profiling device if available, e.g., CTD	Look for damage to sensor.	Compare with CTD each cruise if possible, inspect SVP each cast.	CTD and SVP sound-velocity values agree.	Apply offset to SVP profiles	Principal Investigator or Sonar Technician	HSSD § 5.2.3.6, p. 69

Table 4-1. Data Review and Validation

Input	Description	Responsible for Validation
Field data	Raw field data acquired during each survey cruise will be reviewed for completeness to ensure that data for vessel positioning, water depth and tidal measurements, and temperature and conductivity measurements are present for all transects or at the appropriate required intervals.	Principal Investigators (PIs)
Field data	Verify conformance of all field (survey) data to approved procedures and verify that deviations from procedures or criteria were documented.	PI
Field observations, field records	Verify conformance to procedures and criteria specified in QAPP and assess impact of deviations	PI
Field data, database output	Verify all field data are stored in electronic files and processing of data was accurate and complete.	PI/Field Technicians
Field data, processed data	Review data and processing procedures to ensure conformance with the project quality requirements. This will include review of positioning controls, survey quality controls, line files, tidal corrections, and speed-of-sound corrections.	PI/Field Technicians
Processed data	Processed data will be reviewed prior to release or reporting of results to ensure completeness.	PIs & Technical Lead
Field records, deliverables	Verify conformance to contractual specifications	PIs, Technical Lead & Project Lead
Assessments, reports	Verify that data evaluations and technical assessments were performed per the QAPP to ensure that all necessary assessments have been performed.	Technical Lead & Project Lead

APPENDICES

APPENDIX A. Scope of Work

APPENDIX B. Standard Operating Procedures

APPENDIX C. Data Evaluation

APPENDIX D. Project Proposal

APPENDIX A. Scope of Work

A-1 Stony Brook University

A-2 University of Connecticut

Appendix A-1. Stony Brook University

Referenced from the PSA between SBU/RF SUNY and DEEP executed 7/7/2021

SCOPE OF WORK

- 1. Purpose:** The purpose of this contract is to collect and process high-resolution multibeam data in an approximately 100 square mile area of poor coverage within the central basin of Long Island Sound (“LIS”) in furtherance of the LIS Cable Fund Seafloor Mapping Initiative.
- 2. Description:** The Research Foundation for The State University of New York (SUNY) (“Contractor”), Office of Sponsored Programs, in conjunction with facilities and investigators provided by Stony Brook University (“SBU”) School of Marine and Atmospheric Sciences (“SoMAS”) and the University of Connecticut Department of Marine Sciences (“UConn”), shall conduct a project entitled: **Multibeam Mapping in Long Island Sound – LISS Enhancement**, specified in Appendix D, *“Multibeam Mapping in Long Island Sound – LISS Enhancement” submitted by The Research Foundation for The SUNY Office of Sponsored Programs at Stony Brook University in Stony Brook, New York*, the contents of which are incorporated as part of this Contract.
- 3. Project Team:** Contractor staff Roger D. Flood, Research and Emeritus Professor, SoMAS is the Project Lead and comprises the Principal Project Staff. Contractor staff from SoMAS include a Post-Doctoral Associate, Graduate student, and one or more undergraduate student assistants yet to be determined, working under the Project Lead.

Contact information for the Project Lead:

Roger D. Flood

Research Scientist and Emeritus Professor

School of Marine and Atmospheric Sciences

Stony Brook University

Stony Brook, NY. 11794-5000

Email: roger.flood@stonybrook.edu

Phone: 631-632-6971

- 4. Scientific Scope of Work:** The Contractor shall conduct the work described in **Appendix D**. This work includes purchase of a high-resolution multibeam mapping system to be installed on a research vessel associated with SBU as well as on a research vessel associated with UConn, ostensibly the R/V *Seawolf* and the R/V *Connecticut*, as availability necessitates, in order to collect high-resolution multibeam bathymetry and backscatter data over approximately 100 square miles in central LIS between the Pilot and Phase II project areas of the LIS Cable Fund Seafloor Mapping Initiative. All survey cruises shall be conducted to collect data pursuant to specifications determined by equipment capabilities on the specific multibeam echosounder and software, the depth range/environmental conditions of the survey area, and otherwise in accordance with the approved Quality Assurance Project Plan (QAPP), which reflects the standards and specifications in then-current editions of “Hydrographic Surveys Specifications and Deliverables” and “Field Procedures Manual” (“NOAA Specifications”) issued by the National Oceanic and Atmospheric Administration (“NOAA”). The Contractor shall not deviate from the most recently approved QAPP in accordance with

the QAPP requirements absent the written approval of the DEEP Technical Contracting Lead, identified in Section 9, which approval shall not be unreasonably withheld.

A. Project Phases: The Contractor shall:

- 1) The Project Lead and the DEEP Technical Contracting Lead will cooperatively develop a QAPP for this project and all applicable tasks involving the collection, measurement, processing, compiling, modelling, analysis, or reporting of data in accordance with the most current National and Regional requirement documents (<http://www.epa.gov/quality/> and <https://www.epa.gov/quality/region-1-quality-systems-documents>, respectively). The QAPP must be approved by EPA prior to any data gathering work or use, except under circumstances requiring immediate action to protect human health and the environment. No later than sixty (60) days prior to the scheduled commencement of data collection and/or data generation activities, the Parties will submit a QAPP to R1QAPPs@epa.gov.
- 2) Upon disbursement of funds pursuant to this contract, purchase a Kongsberg EM 2040P MKII multibeam echosounder (“MBES”) system and accompanying Kongsberg Seafloor Information Systems (“SIS”) software, or a MBES system and software that are either comparable to or exceed the capabilities of the stated equipment.
- 3) Upon delivery of the MBES system and SIS software, but no later than one-hundred-twenty (120) days after purchase, install and calibrate the MBES system and the SIS software on an SBU or UConn research vessel. This deadline may be extended with the written approval of the DEEP Technical Contracting Lead, which approval shall not be unreasonably withheld.
- 4) Upon installation of the MBES system and SIS software, receive a minimum of two (2) days of training of all necessary project personnel on its operation not to exceed the amount budgeted as specified in **Appendix B**.
- 5) Complete two (2) 5-day survey cruises (“Year One Survey Cruises”). The first such survey shall be completed within one-hundred-twenty (120) days of the completion of training, and the second shall be completed within one-hundred-twenty (120) days of the first. All Year One Survey Cruises shall be completed no later than ten (10) months of the execution of this contract. These deadlines may be extended with the written approval of the DEEP Technical Contracting Lead, which approval shall not be unreasonably withheld.
- 6) Complete six (6) 5-day survey cruises (“Year Two Survey Cruises”). The first such survey cruise shall be completed within one-hundred-twenty days of the completion of the Year One Survey Cruises, and each subsequent Year Two Survey Cruise shall be completed within one-hundred-twenty days of the previous survey cruise. All Year Two Survey Cruises shall be completed within twenty-three (23) months of the execution of this contract. These deadlines may be extended with the written approval of the DEEP Technical Contracting Lead, which approval shall not be unreasonably withheld.
- 7) Upon completion of the “Year Two Survey Cruises” and no later than thirty (30) days before the expiration of this contract, complete the processing of the multibeam depth and backscatter data and create grids of bathymetry and backscatter data gridded at 1

meter or higher resolution with bathymetry data reduced to the NAVD88 vertical datum.

- 8) Before the expiration of this contract, provide a Final Report and a Final Financial Report in accordance with Sections 14 and 15 below.

B. Project Deliverables: The Contractor shall conduct data collection, processing, and analysis in accordance with the above-reference proposal defined in **Appendix D** and the approved QAPP, and shall provide such deliverables as described in sections b. and c. (pages 4-9) of said proposal and provided in conformance as follows:

- 1) Digital geospatial products showing bathymetry, hillshade, and acoustic backscatter from the collected and processed data in a format compatible with GIS software, referenced to NAD83(2011) and UTM Zone 18N for gridded data, and accompanied by appropriate metadata. Completed mapping products shall be posted to the NOAA National Centers for Environmental Information (NCEI) web site (<https://www.ncei.noaa.gov/>) for archiving and to allow wide access to the mapping results and also archived on the LIS Cable Fund data repository (<https://www.marine-geo.org/portals/lis/>) at least thirty (30) days prior to the contract end date.
- 2) A draft Final Report including data/statistical tables and maps and an interpretation of the multibeam data, describing the nature and character of the seafloor for the identified area of interest and relating the backscatter patterns to available sediment samples or visual observations and to morphology patterns shown by the multibeam depth data submitted to the DEEP Technical Contracting Lead within thirty (30) days of the contract end date.

Appendix A-2. University of Connecticut

Referenced from Contract # 21DEP21100AA between UConn and DEEP executed 2/19/2021

1. **Scope of Work:** The work to be performed during the period of this Agreement is referenced below and is more fully described in the proposal identified as “Acoustic data acquisition for seafloor mapping in Long Island Sound” attached herein, the content of which is incorporated as a part of this Agreement as Attachment 1. The contractor will travel to and attend the installation and training of a new multibeam sonar system to be installed and calibrated on the SBU research vessel (RV) *Seawolf* and subsequently on UConn’s RV *Connecticut*, as well as participate in up to seven 5-day acoustic data acquisition cruises on the RV *Seawolf* and at least one 5-day cruise on the RV *Connecticut* to both integrate this new mapping infrastructure onto this vessel and to finalize the acoustic data acquisition. The contractor will also assist SBU with processing of the collected data.
2. **Deliverables:**
 - a. Deliverables to be provided as described in Attachment D will include human resource development on the use of the new multibeam sonar system (Kongsberg EM 2040P MKII or similar), validated by certification from the manufacturer, if applicable, and acoustic bathymetry and backscatter data over ~100 square miles within the central basin of Long Island Sound and other products consistent with acoustic data acquisitions from previous LIS Cable Fund Seafloor Mapping Initiatives in the areas of Stratford Shoal and eastern LIS (e.g., reports, data/statistical tables, and maps.). Additionally these will be submitted for publication in peer-reviewed literature.

APPENDIX B. Standard Operating Procedures

Appendix B-1.

NOAA Standards and Requirements for Hydrographic Surveys

Appendix B-2.

Hydrographic Surveys Specifications and Deliverables (2021)

Appendix B-3.

IHO Standards for Hydrographic Surveys, Special Publication 44

Appendix B-4.

The operation manuals for all survey equipment being utilized will be included upon receipt of the purchased equipment.

APPENDIX C. Data Evaluation

Appendix C-1. Data Evaluation/Documentation Form

Survey Date:		Start Time:		End Time:	
Vessel:					
Systems Operator:					

Computer systems	Power check	Operations check	Systems updated	Software operational

Equipment (Table 2-6)	Calibration Successful	Maintenance Required	Errors Reported	Corrections Made
MBES				
GPS/RTK				
SVP				

		Comparison
Mainscheme Lines Total		
Crosslines Total		
4hr Soundings Total		

Uncertainty	TVU Confidence:		THU Confidence:	
Complete Coverage				

Data Evaluation	All Criteria Met	Corrections Made	Deletions Made
Table 1-3			
Table 2-4			
Table 2-5			
Table 4-1			

APPENDIX D. Project Proposals

D-1 [Stony Brook University](#)

D-2 [University of Connecticut](#)

Appendix D-1. SBU Proposal

A Proposal to the

Land and Water Resources Division
Bureau of Water Protection and Land Reuse
Connecticut Department of Energy & Environmental Protection
79 Elm Street, Hartford CT 60106-5127

Attn: DeAva Lambert tel: (860) 242-3207
email: DeAva.Lambert@ct.gov

Note: Please send entire package to Ms. Lambert as an email attachment.

- 1. Title:** Multibeam Mapping in Long Island Sound -- LISS Enhancement
- 2. Organization:** The Research Foundation for The SUNY
Office of Sponsored Programs
W5510 Melville Library Stony
Brook University
Stony Brook, NY 11794-3362
- 3. Project Leader:** Roger D Flood, Research Scientist and Emeritus Professor
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY. Tel:
631-632-6971, email: roger.flood@stonybrook.edu
- 4. Project Period:** October 1, 2020 - September 30, 2022
Grant Period: October 1, 2020 - September 30, 2022
- 5. Cost:** FY20: **\$647,190.51** FY21: **\$582,846.46** Total Cost: **\$1,230,036.97**
- 6. Project Summary:**

See attached Abstract

Introduction and Background

Benthic mapping in Long Island Sound (LIS) has long been identified as a priority need and is essential to improving science-based environmental management and mitigation decisions. Sea floor landscape maps depicting habitat structure and the ecological characteristics associated with those habitats are critical pieces of information which typically integrate information from a variety of sources including acoustic bathymetry and backscatter, sedimentary, geochemical, physical, and biological data.

Plans for systematic benthic mapping in Long Island Sound were initiated following the creation of the LIS Cable Fund (a settlement fund that resulted from issues surrounding cable infrastructure in LIS) in

2004. An important step in benthic mapping has been the collection and analysis of high-resolution (multibeam) bathymetric and acoustic backscatter data that shows seabed features and sediment distribution patterns. Multibeam bathymetric and backscatter data has been collected over a large portion of Long Island Sound as a result of over two decades of charting activities conducted by the National Ocean Survey, a branch of NOAA. NOAA is expected to complete their multibeam data acquisition in Long Island Sound in 2020, focusing in the far western portion of LIS. This represents a remarkable achievement by NOAA which has resulted in accurate and up-to-date charts of Long Island Sound which are helping to make vessel operations safer in Long Island Sound. The equipment used to collect multibeam bathymetric and backscatter data has continued to improve over time and we are learning that the data collected during NOAA surveys done before about 2004 does not have the spatial resolution in depth or acoustic backscatter that is needed for benthic mapping, and also that complete (100% coverage) multibeam surveys were not always done in shallower areas. The NOAA mapping data has been supplemented by multibeam mapping surveys done by SoMAS, Stony Brook University, in the two priority areas studied by the LIS Cable Fund in central ("Pilot Study" or "Phase 1") and eastern ("Phase 2") Long Island Sound. A third high-priority area will be the focus of LIS Cable Fund study "Phase 3" in western Long Island Sound starting about 2021 (Figure 1). Studies in the high priority areas include the collection and analysis of extensive sedimentary, geochemical, physical, and biological data.

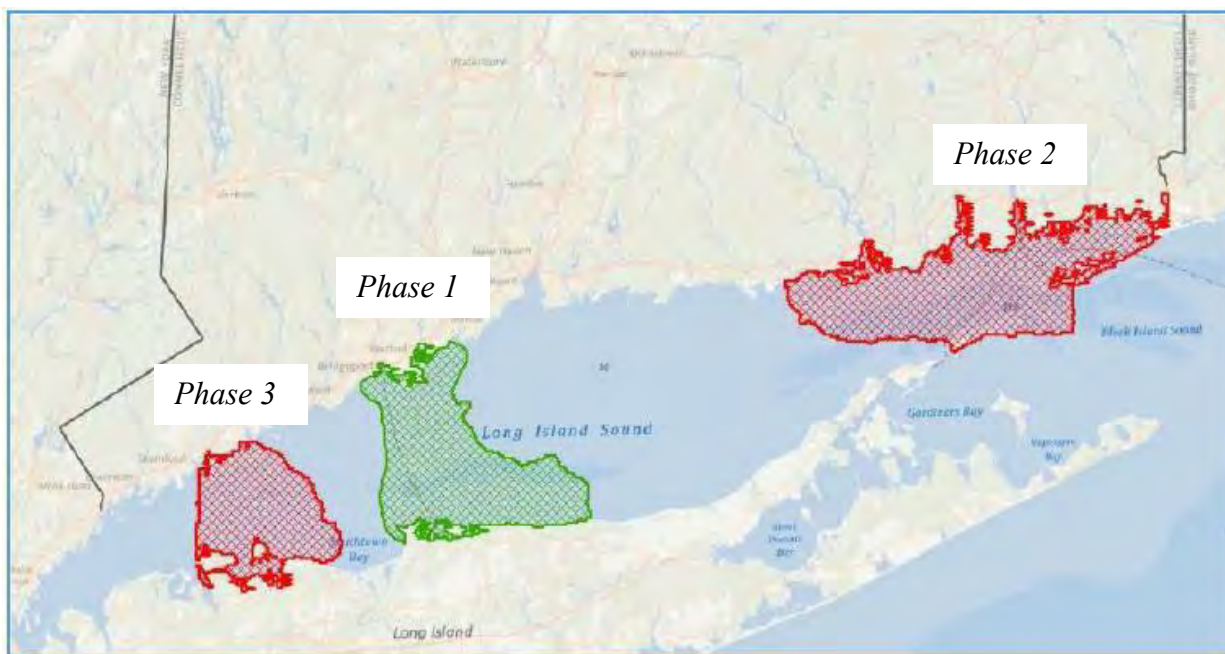


Figure 1. LIS Cable Fund Priority areas as of 2012.

Analysis of the bathymetric data collected by NOAA shows that there are two large areas in central Long Island Sound (Figure 2), about 40 and 100 square miles, which are lacking the high-resolution bathymetry and backscatter data necessary to support even the initial stages of benthic mapping which includes the characterization of habitat structure. Such high-resolution morphological data is needed in order to extrapolate the results of the three high-priority areas throughout Long Island Sound, a high priority of the LIS Cable Fund. NOAA apparently does not intend to re-survey these two areas since the existing data satisfies charting requirements.

We propose to begin an effort, including both SoMAS and UConn facilities and investigators, to collect and process the high-resolution multibeam data needed in the larger (~100 square mile) area of poor coverage to support the objectives of the LIS Cable Fund benthic mapping initiative. Our project will help us to gain new insights into the sedimentary processes that are occurring over large areas of central Long Island Sound as well as also enable future similar studies or new research initiatives in Long Island Sound and surrounding areas.

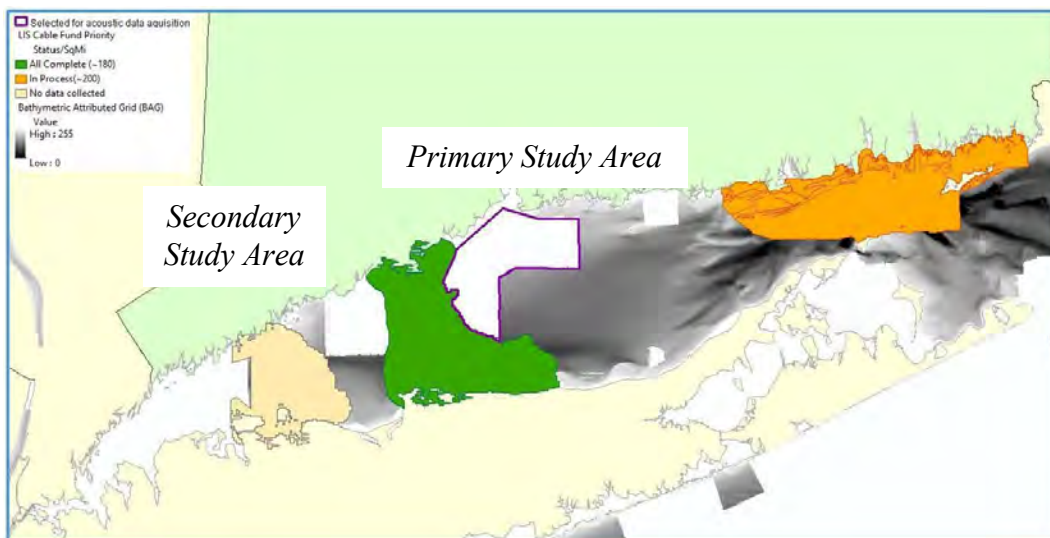


Figure 2. Map showing proposed area for acoustic data acquisition.

This project includes several phases. We will first purchase a high-resolution multibeam mapping system that is capable of collecting the needed high-resolution multibeam bathymetry and backscatter data. In several prior studies in LIS, SoMAS has used a multibeam system at SoMAS purchased in 1998 which is now obsolete. I have leased a newer high-resolution mapping system for some LIS projects, but the logistics of coordinating a system lease and a busy ship schedule have made it difficult to plan projects that require substantial ship time. By purchasing a system for this project, we substantially simplify mapping planning and logistics which makes this and other projects more feasible. This mapping system will be installed and used on the SoMAS Research Vessel R/V *Seawolf* for much of this project. We also anticipate installing the system on the UConn Research Vessel R/V *Connecticut* for part of the mapping. In addition to filling gaps in the present-day multibeam coverage, the existence of a multibeam system within the Long Island Sound community will make possible projects designed to determine how fast bottom morphology and habitat characteristics change in response to events such as seasonal anoxia and storm surge events.

Mapping will occur during a number of 5 day cruises, of up to 24 hours/day of mapping, over two years. The system installation, acceptance trials and about 10 days of mapping will occur in Year 1 and about 30 days of mapping will occur in Year 2. Data will be collected and reduced following guidelines used to collect SoMAS multibeam data during Phase 1 and Phase 2 studies, specifications which are similar to the NOAA Standards and Requirements for hydrographic surveys (<https://nauticalcharts.noaa.gov/publications/standards-and-requirements.html>), and completed mapping products will be posted to the NOAA National Centers for Environmental Information (NCEI) web site (<https://www.ncei.noaa.gov/>) for archiving and to allow wide access to the mapping results. We expect that mapping results will also be archived on the LIS Cable Fund data repository.

a. Study Objectives:

The acquisition of additional acoustic data within the portion of the LIS central basin where high-resolution multibeam bathymetric and backscatter data is not available would increase the extent where management decisions for LIS can be made based on the best available data and scientific analysis. Acoustic data from sidescan or multibeam sonar are typically the first pieces of any benthic mapping effort. In addition to providing important data on sea-floor depth, topography, and various sedimentary characteristics, they also serve as an important roadmap to inform efficient and relevant sampling plans for subsequent geological, ecological, and physical collections. Furthermore, acoustic data also serve as the foundation for linking together the individual thematic data the LIS Cable Fund has targeted to generate final integrated habitat maps. The additional acoustic data acquisition of this approximately 100 square-mile area within the central LIS basin supports the implementation of the 2015 CCMP by improving the scientific knowledge base essential to making informed decisions to protect and restore the health of LIS

b. Methodology:

1) **Multibeam System:** We need full-time access to an appropriate multibeam system to conduct this research project as well as to enable future studies in the area. The system needs to be able to work at water depths up to ~120 m (the maximum depth in Long Island Sound) as well as in shallow water, to be able to be installed on the different research vessels that work in Long Island Sound and to collect high-quality bathymetry and backscatter data. In addition, the system needs to be able to collect data with a wide swath width and to have a high ping rate. The ability to use a wide multibeam swath can increase mapping efficiency by putting ship tracks farther apart and the ability to ping more frequently can increase the speed at which the ship can map. However, there are environmental and instrumental and even contractual issues which limit swath width and ping rate. A multibeam system also needs to include a precise positioning system, heading and motion sensors, and sound velocity profilers and sensors.

The market for multibeam profilers is evolving fast and the capabilities of the shallow-water multibeam echosounders available now are significantly improved over those of the Kongsberg EM 3000D multibeam system that was operated by SoMAS, Stony Brook University, since 1998. At present, we are planning to purchase a complete, operational Kongsberg EM 2040P MKII multibeam system which includes transducer, multibeam electronics, operating computer, software licenses, position sensor, heading sensor, motion sensor and sound velocity profiler along with needed cables, sensors and shipping crates. For more details, see <https://www.kongsberg.com/globalassets/maritime/km-products/product-documents/em-2040p-mkii-multibeam-echosounder.pdf> and <https://www.kongsberg.com/globalassets/maritime/km-products/product-documents/seapath-130-series-compact-heading-attitude-and-positioning-sensor.pdf>.

This is a high-resolution, shallow-water multibeam system operates between 200 and 400 kHz and can be used in water depths of up to about 550 m with a swath width up to 170 degrees.

This system has several capabilities that will benefit our project. The beams are stabilized for vessel roll, pitch and also yaw which results in a more uniform distribution of depth and backscatter measurements on the bottom compared to systems where there is less stabilization. The wider swath

width is useful when the primary objective of a survey is backscatter mapping although a narrower swath may be better for charting. The system has a dual-swath capability that transmits two swaths per ping which doubles the along-track sounding density and enables operation at higher survey speeds, a key capability which will allow the work to be done using less ship time. Other system capabilities such as the ability to use CW or FM pulses, the ability to log multiple bottom detections and the ability to log reflections in the water-column enhance the value of this system for our Long Island Sound studies.

We have used our EM 3000D multibeam system on SoMAS vessels R/V Seawolf (80-feet) and R/V Donald W Pritchard (24-feet), and an EM 2040cD system on the R/V Donald W Pritchard and we are familiar with the survey software and data format and we have been very satisfied with the bathymetric and backscatter data and data quality. We expect that a new high-resolution EM 2040P MKII multibeam system can be installed on these vessels by modifying our existing mounts. The system will be purchased and installed in Year 1 with the assistance and training of a Kongsberg engineer. We plan to install the system on a UConn vessel in Year 2, perhaps the R/V Connecticut.

2) Survey Operations: The survey operations will be led by Roger Flood, Research and Emeritus Professor at SoMAS Stony Brook University. Project scientists will include Flood, Dennis Arbige (Research Operations Manager at the University of Connecticut Department of Marine Sciences) who will participate in the shipboard mapping program, a post-doctoral associate to be hired to support this project, and a graduate student who will assist with data collection and processing. One or more undergraduates may also be involved with working on the data.

We propose to perform an acoustic survey of an area in central Long Island Sound of about 300 square kilometers, where the ranges from 8 meters (the minimum water depth to be surveyed) to about 40 meters (Primary Study Area, Figure 2). The primary emphasis of the survey will be to collect high-resolution, high-quality acoustic backscatter and depth data. The EM 2040P MKII can operate at frequencies between 200 kHz and 400 kHz and our plan is to do the backscatter mapping at 300 kHz which is the frequency of the SoMAS EM 3000D multibeam system. Since we do not anticipate that this survey data will be used by NOAA for charting purposes, we will somewhat prioritize the backscatter data over the depth data. However, we will follow the NOAA Standards and Requirements for hydrographic surveys (<https://nauticalcharts.noaa.gov/publications/standards-and-requirements.html>) as closely as possible to ensure the data collected can be easily integrated with other NOAA and LIS Cable Fund acoustic data products.

The amount of time needed to survey this area depends on the width of the multibeam swath, the speed of the survey vessel, and the amount of time required for turns, sound-velocity profiles, time required for vessel fueling and other servicing, transiting to and from the survey area, and potential bad weather. During multibeam mapping done by SoMAS in the LIS Cable Fund Phase 2 surveys, the survey ping density specifications called for a minimum of 5 pings/bin of the depth grid and a cross-track ping spacing of less than 1 m for water depths less than 20 m.

The maximum survey speed was to be 5 kts. These survey specifications were determined based on the performance of the SoMAS EM 3000D multibeam sonar. Part-way through the Phase 2 surveys we switched to an EM 2040cD multibeam sonar which had a faster ping rate and more depths/swath and we were able to meet the ping density and cross-track spacing requirements with a somewhat wider swath although the speed was still about 5-6 kts. We expect that the proposed EM 2040P MKII multibeam echosounder will have a cross-track ping spacing about the same as the EM 2040cD but at twice the

ping rate. Therefore we anticipate a maximum survey speed of about 7.5 kts during this survey, but that will be reduced as necessary to meet the ping density specifications. Our initial estimate of ship track spacing will be 5x water depth, although that will be reduced as necessary to meet the ping-density specifications or if there is too much depth variability in the outer beams resulting from excessive refraction due to sound- velocity variability.

The median depth of the survey area is about 11 m beneath the ship's keel resulting in an average track spacing of about 55 m. We estimate that 560 survey hours of survey lines will be required. The R/V Seawolf can operate for a 24-hour day with appropriate crew and scientific party staffing, so we will require about 23 survey days. As noted above, additional time will be needed for station operations during the survey, for ship operations such as fueling, for transit to/from the survey area and for delays or slowdowns due to bad weather. Our estimate of survey time is increased to 35 days of R/V Seawolf survey time in an attempt to account for these extra variables. We plan 10 days of R/V Seawolf survey in Year 1 and 25 days of R/V Seawolf survey in Year 2. In addition to our planned R/V Seawolf operations, we plan to install the multibeam system on a UConn vessel such as the R/V Connecticut and conduct a five-day survey project using that boat.

The survey will be managed with, and the data will be logged using, Kongsberg SIS software. SIS software helps to plan the survey lines and assists the helmsman in following the desired ship track. SIS also does real-time gridding of water depth, backscatter data and other survey parameters that allow the real-time assessment of data quality. SIS also is the interface for collecting and applying sound-velocity profiles which, along with real-time measurement of the surface sound velocity, allows for the continuing assessment of the sound velocity profile being used. Sound velocity profiles will be collected every 4 hours, or more frequently if the data indicates that there has been a significant change in the velocity profile.

The position of the survey vessel needs to be accurately measured both the horizontally and vertically. Positions will be determined in three dimensions in real time using GPS corrections relayed through a network connection from a land-based RTK system such as the UConn ACORN system and the NYSDOT NYSNet system, or via satellite using a vendor such as Fugro. Using the commercial satellite service will ensure that GPS corrections are available on the survey vessel when cellular network connections are poor which will improve data quality. The vertical water-level measurements measured by GPS will be supplemented by NOAA water- level gauges at Bridgeport and New Haven, CT. Survey data will be copied from the survey computer to backup computers and networked disk drive arrays at regular intervals to ensure data safety and to enable data processing to begin.

3) **Data Processing and Reporting:** Multibeam data processing will be done using CARIS HIPS and SIPS software (for bathymetry), using QPC Fledermaus GeoCoder software (for backscatter) and using SwathEd software programs from the University of New Brunswick (for bathymetry and backscatter). Bathymetry and backscatter data will routinely be gridded at 1 m, although grids at higher resolution will also be created as needed. Bathymetry data will be reduced to the NAVD88 vertical datum, a vertical datum that generally marks the height of mean sea level. The NOAA software program VDatum (<https://vdatum.noaa.gov/>) can be used to transform water depths measured with respect to NAVD88 to tidal datums such as MLLW which are commonly shown on navigational charts. Digital data products will be in a format compatible with GIS software, referenced to NAD83(2011) and will be accompanied by appropriate metadata that describes the products and depicts the collection and

processing steps. UTM Zone 18N will be used for gridded data. Completed mapping products will be posted to the NOAA National Centers for Environmental Information (NCEI) web site (<https://www.ncei.noaa.gov/>) for archiving and to allow wide access to the mapping results. We expect that mapping results will also be archived on the LIS Cable Fund data repository.

4) **Multibeam Data Interpretation:** High-resolution multibeam bathymetry and backscatter measurement has been recognized as an important tool in the understanding sedimentary processes and benthic habitats in a range of aquatic settings (e.g., Hughes Clarke et al., 1996; Mayer, 2006) and has been an important tool in characterizing the seabed for a range of uses in Long Island Sound (Knebel and Poppe, 2000). The primary objective of the research project is to survey a portion of central Long Island Sound in order to provide the high-resolution bathymetry and backscatter data needed to support the habitat mapping goals of the LIS Cable Fund and most of our effort will go towards meeting this objective. However, we will also work to improve our understanding of this new multibeam data can help to understand the nature and character of the seafloor in the study area in support of the CT DEEP Task 20-15 Work Plan Activity 2 Environmental Outcome of creating products from seafloor bathymetry and seafloor intensity that will characterize, inventory, and map open and shallow water habitats.

Important lines of investigation include examining the available historical survey data to determine how fast seabed features may be changing in response to bottom flow in the area (tidal, residual, and storm-generated). We are also particularly interested in learning as much as possible about how acoustic backscatter is related to seafloor characteristics. In particular, there has been much progress in characterizing the angular dependence of acoustic backscatter for multibeam echosounding systems and in relating that angular dependence to sediment characteristics (Hughes Clarke, 1994; Ferrini and Flood, 2006; Fonseca and Mayer, 2007; Lurton et al, 2018). We will analyze and study the acoustic backscatter patterns in our new multibeam data using software packages such as QPC Fledermaus GeoCoder and SwathEd, and seek to relate the backscatter patterns to available sediment samples or visual observations and to morphology patterns shown by the multibeam depth data.

The area to be surveyed is a good place for detailed acoustic backscatter interpretations since a large part of the area has been imaged with uncalibrated side-scan sonar data (McMullen et al., 2008). Studies by Poppe et al. (2004), McMullen et al. (2005) and Beaulieu et al (2005) sought to explain the side-scan sonar imagery in terms of bottom morphology and sediment characteristics which come from bottom photographs, bottom samples and seismic profiles. These studies provide ready-made ground truth data and interpretations which give a good foundation for more advanced analysis based on the multibeam depth and backscatter results. While we don't envision undertaking extensive studies beyond multibeam mapping during this project, some limited sampling or other station activity might be possible since the mapping vessel will stop and do a sound-velocity cast at least every 4 hours. Also, the EM 2040P MKII can operate at frequencies between 200 kHz and 400 kHz so we can profile some areas of interest at a range of acoustic frequencies and/or track azimuths to characterize backscatter patterns with different acoustic frequencies and azimuths. Details about and results of our multibeam data interpretation studies will be reported in quarterly and annual project reports.

c. Environmental Outputs/Outcomes and Project Deliverables:

This project is Task 20-15 of the Connecticut Department of Energy & Environment Protection FY 20 Long Island Sound Study Program (Table 1), which is the Acoustic data acquisition for seafloor mapping in Long Island Sound project, in the Cooperative Agreement #LI-00A00579 between CT DEEP and EPA. Table 2 describes the deliverables of our study.

Table 1. Environmental Outputs/Outcomes and Deliverables of CT DEEP Task 20-15

LISS Program Element/Work Plan Activity	CCMP IA(s) Supported	Work Plan Activity/Deliverables	Target Date(s)	Environmental Output(s)	Environmental Outcome(s)
1. Acoustic Data Equipment purchase	SM-2: Complete seafloor mapping conducted under the Sound Cable Fund, and use results to guide additional mapping.	Acquire and install the multibeam echosounder equipment. Conduct training with manufacturer and do acceptance trials.	Oct. 2020 – Sept. 2021	Ownership of equipment necessary to collect acoustic data that will support sea floor mapping objectives;	Ability to collect data in a timely fashion without scheduling limitations or necessity of lease agreements; Ability to share equipment with other team in a manner that can provide
2. Sea Floor Mapping-Surveys	SM-2: Complete seafloor mapping conducted under the Sound Cable Fund, and use results to guide additional mapping	Complete two 5-day intervals of acoustic data survey over about 29 square miles (Year 1). Complete five 5-day intervals of acoustic data survey over about 71 square miles (Year 2). Install the system on the R/V Connecticut and conduct 5-day acoustic data survey (Year 2) Processing of the acoustic data to generate digital bathymetric and backscatter maps.	Oct. 2020 – Sept. 2021 Oct. 2021 – Sept. 2022	Acoustic survey data for approximately 100 square miles Digital bathymetric and backscatter maps for about 100 square miles	Data that will be ultimately processed into products such as seafloor bathymetry and seafloor intensity (hard/soft bottom characterizations) that will characterize, inventory, and map open and shallow water habitats to support resource management and marine spatial planning

Table 2. Description of Deliverables of Multibeam Mapping Project

Item	Description	Frequency		
		For each cruise	Cumulative	Final
Multibeam Bathymetry	Depth data gridded at 1 m resolution in GIS- compatible format along with appropriate metadata.	An initial grid with minimal processing will be created following each cruise and made available for review via a shared drive.	Grids using all processed data will be generated at regular intervals and made available for review via a shared drive.	The final grid will be generated at the end of project year 2 and submitted to NCEI along with appropriate metadata.
Multibeam Hillshade Bathymetry	Image of hillshade of depth data gridded at 1 m resolution in GIS-compatible format along with appropriate metadata.	An initial image with minimal processing will be created following each cruise and made available for review via a shared drive.	Images using all processed data will be generated at regular intervals and made available for review via a shared drive.	The final image will be generated at the end of project year 2 and submitted to NCEI along with appropriate metadata.

Multibeam Acoustic Backscatter	Image of acoustic backscatter data gridded at 1 m resolution in GIS-compatible format along with appropriate metadata.	An initial image with minimal processing will be created following each cruise and made available for review via a shared drive.	Images using all processed data will be generated at regular intervals and made available for review via a shared drive.	The final image will be generated at the end of project year 2 and submitted to NCEI along with appropriate metadata.
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Table 3. Project Schedule and Milestones

Milestone	Anticipated Date	Deliverable
Project start	TBD	
<i>Review multibeam system selection and write Purchase Order</i>		
Year 1 Quarterly Project Report #1	+3 months	*
<i>Receive multibeam system shipment</i>		
<i>Install multibeam system on R/V Seawolf</i>		
<i>Multibeam system installation, acceptance, calibration and training</i>		
1st Year 1 multibeam mapping cruise		
Year 1 Quarterly Project Report #2	+6 months	*
Provide initial 1st cruise Year 1 multibeam mapping results		*
2nd Year 1 multibeam mapping cruise		
Provide initial 2nd cruise Year 1 multibeam mapping results		*
Year 1 Quarterly Project Report #3	+9 months	*
Provide final results of Year 1 multibeam mapping results		*
Year 1 Project Report	+12 months	*
1st Year 2 multibeam mapping cruise		
Provide initial 1st Year 2 multibeam mapping results		*
1st Year 2 Quarterly Project Report #1	+15 months	*
2nd Year 2 multibeam mapping cruise		
Provide initial 2nd cruise Year 2 multibeam mapping results		*
3rd Year 2 multibeam mapping cruise		
Provide initial 3rd cruise Year 2 multibeam mapping results		*
Year 2 Quarterly Project Report #2	+18 months	*
4th Year 2 multibeam mapping cruise		
Provide initial 4th cruise Year 2 multibeam mapping results		*

5th Year 2 multibeam mapping cruise		
Provide initial 5th cruise Year 2 multibeam mapping results		*
6th Year 2 multibeam mapping cruise (R/V Connecticut?)		
Year 2 Quarterly Project Report #3	+21 months	*
Provide initial 6th cruise Year 2 multibeam mapping results		*
Update final Year 1 multibeam mapping as needed		
Provide final combined Year 1 and 2 multibeam mapping results		*
Delivery of multibeam mapping results to NCEI		*
Final Project Report	+24 months	*

Note: "multibeam mapping results" includes Bathymetry, Hillshade Bathymetry and Acoustic Backscatter deliverables in GIS-compatible format as described in Table 2.

7. Justification:

Acoustic data acquisition is critical to the completion of the LIS seafloor mapping effort, which shall assist managers in the State of Connecticut, the State of New York, Connecticut and New York Sea Grant, and the U.S. Environmental Protection (USEPA) agency with their mandates to preserve and protect coastal and estuarine environments and water quality of Long Island Sound, while balancing competing human and energy needs with protection and restoration of essential ecological function and habitats. The proposed project will be consistent the Implementation Actions (HW1, HW3, HW6, HW22, SM1, SM2, SM3, SM10 and Objectives (2-1a, 2-1b, 2-4a, 3-3a, 4-1a, 4-1b, 4-1c, 4-2a) specified in the 2015 CCMP. This project directly addresses the Implementation Action (SM2) – to complete seafloor mapping conducted under the Sound Cable Fund, and use the results to guide further mapping – for the strategy (4-1b1) – to characterize, inventory, and map open and shallow water habitats to support resource management and marine spatial planning. The acquisition of high-resolution bathymetry and backscatter data provide the stepping off point for all subsequent elements of the habitat mapping initiative. Thus, these products are fundamental components necessary to satisfy the objectives of the benthic mapping project and provide the greatest extent of data possible.

8. Resources Requested:

See attached Budget and Budget Justification

9. Other Information:

See attached Facilities, Equipment and Other Resources

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Budget Justification

The proposed budget includes personnel, equipment, travel, shiptime and other direct costs needed to conduct the proposed research program.

Personnel costs include PI Flood (Item A1, 3 months in Year 1, 7 months in Year 2) who will have overall project responsibility and will oversee the purchase, installation and operation of the multibeam system and the processing of the multibeam data to create the data products. PI Flood has been a user of multibeam mapping systems since about 1981 when Lamont Doherty Geological Observatory of Columbia University installed a deep-water multibeam system on the R/V Robert D. Conrad. In 1998 he started using a shallow-water multibeam system at Stony Brook University and since then he has conducted surveys in New York waters (including the entire tidal Hudson River, all of Jamaica Bay, all of Peconics Bay, Long Island Sound, and at every DEC Artificial Reef), in New Jersey and Connecticut waters, off Washington State, off California, off Florida and in the Black Sea. He has the experience and expertise necessary to conduct this research program. Support staff include a Post-Doctoral Associate (Item A2, TBD, 9 months Year 1 and 12 months Year 2) who will assist with shipboard data collection and also take a major role in post-cruise data processing. A Graduate Student (Item A3, TBD, 4.5 months in Year 1 and 12 months in Year 2) will assist with shipboard data collection and data reduction and one or more Undergraduate students (Item A4) will assist with data reduction. These time commitments are in line with data acquisition starting midway through Year 1 and continuing through Year 2. I expect that colleagues at UConn will provide a person who will participate in shipboard data acquisition in both study years and that they are requesting funds for that field support in a separate proposal. Fringe Benefits are budgeted at approved rates (Item B 1-4) and Tuition is budgeted for the Graduate Student (Item G13, \$2,826 for one semester in Year 1, \$5,652 for two semesters in Year 2).

In Year 1 we will purchase a complete high-resolution, shallow-water multibeam system which includes transducer, transducer mount, navigation system with antennas and sensors for position heading and motion, operating and logging computer with software, sound-velocity profiler, extra wires needed for installation and shipping cases. A quote for a system based the Kongsberg EM 2040P MK II multibeam system for \$242,027 (Item D1) which is included in the budget. The EM 2040P has a dual-swath capability that significantly increases data density and a swath width of up to about 170 degrees. This system can be operated at different frequencies between 200 kHz and 400 kHz, can record multiple detections on each beam, can record acoustic returns in the water column, and is stabilized for moderate values of roll, pitch and yaw. I have managed, operated and processed data from Kongsberg multibeam systems at Stony Brook University since 1998 and my experience makes me expect that this Kongsberg system will generate high-quality bathymetry and calibrated backscatter data that will meet the project needs.

In addition to equipment costs, we will also request that a Kongsberg engineer assist us in installing the equipment and provide initial and follow-on training in Year 1 (Item G2, \$11,930 and \$9,860). This assistance and training is necessary to ensure proper equipment acceptance and installation as well as proper operation of this complex system. Project staff as well as colleagues at UConn will attend this training. Fees and shipping costs related to the delivery of this equipment are estimated at 3% of the equipment costs in Year 1 (Item G4, \$7,760.81). We budget for local machine-shop and electronics-shop assistance during the installation (Item G6, \$6,000 in Year 1 for R/V *Seawolf*, \$2,000 in Year 2 for R/V *Connecticut*).

The computer that operates the EM 2040P is a Dell Latitude 5424 Rugged Laptop. This is a critical component of the system and we proposed to purchase a second specialized laptop with similar specifications for the exclusive use with this equipment to allow system operation to continue should there be a problem with the system computer (Item D2, \$5,000 in Year 1).

Many of the sensors used during multibeam mapping need to be monitored or manipulated using dedicated laptop computers to ensure their proper operation. Key sensors include GPS positions, GPS correction signals, motion sensor data streams, sound velocity data streams and vertical profiles, and remote navigation display for ship operations. The computers that monitor these data streams are for the exclusive, shipboard use of the research project. Some of the computers we now use for these tasks are getting obsolete, operate using Windows XP and Windows 7 and need to be replaced. These computers need to operate online and the University actively discourages the use of computers using these obsolete operating systems. We propose to purchase two new Windows 10 laptop computers in Year 1 (Item D5, \$1,200 each, total \$2,400) to meet this essential shipboard need. These computers are for the exclusive use of this project and, in addition to the shipboard need, and can also be used to process the project data. One possible laptop computer for this task is the Dell Latitude 7400 series which is listed on the DoIT Hardware page at Stony Brook University. This computer, configured with more memory and larger disk drive so it can also help with data processing, has an estimated price of \$1,112 on Walmart 360. We will re-evaluate our shipboard computer options and choices at the time of purchase as this is a rapidly changing market.

There will be other installation costs (Item E3, \$2,500 each year) since we expect to mobilize and demobilize the gear for each 5-day mapping project and some key pieces, especially GPS antennas and antenna wires, may need to be replaced for some installations. We will subscribe to a precise navigation service such as that provided by Fugro which transmits GPS differential correction messages from satellites to a specialized receiver on the ship (Item G9, \$3,500 each year). While similar GPS correction messages can be received over the internet, experience has shown that network connectivity is lost when the survey vessel is in the center of Long Island Sound or the weather is poor. Loss of GPS correction signals because of cellular network connection problems degrades the multibeam data quality and adds excessive time and expense to the data processing. Subscribing to this service will simplify many aspects of multibeam data reduction and improve data quality.

We are planning system installation, training and two five-day mapping cruises in Year 1 and five five-day mapping cruises in Year 2 on SoMAS vessels. A five-day mapping cruise is also planned for a UConn vessel in Year 2 which is described in a companion proposal from UConn. The multibeam system is expected to generate 10 to 20+ gigabytes per day of digital data, perhaps much more when water-column data is also logged. This will be well over 100-200 GB per survey week of raw data, and the data volume increases as the raw data is unpacked and manipulated. Similar survey projects undertaken in 2018 and 2019 resulted in about 100 GB of survey data each. My existing computers (Windows 7, Windows 10 and Linux) and data storage (large RAID arrays) have been able to work with that level of data flow. This project will more than double the data flow in Year 1 and treble that number in Year 2, and new computers and data storage, dedicated to and essential for this project, will be needed to process that data. Additional computers are also needed because new staff will be hired with the task of processing this data which is a very hands-on task. I plan to purchase a Windows 10 desktop system similar to the Dell OptiPlex 7060 highlighted on the DoIT Hardware page in Year 1 (Item D3, estimated cost \$2,800 with monitors, large memory and large hard disks) and a two similar machines in Year 2 when data processing needs and project personnel will increase (Item D3, Year 2

estimated total cost \$4,000). The need and type of these computer resources will be re- evaluated at the time of purchase.

Our data storage needs will also have to be enhanced to support the proposed research. My lab currently has several networked RAID arrays with capacities up to 48TB. New networked RAID storage will be needed for this project and we budget \$2,500 and \$5,500 in Years 1 and 2 respectively (Item D4). The Buffalo TeraStation 5810DN Desktop 32TB NAS, Hard Drives Included, currently lists for \$2,258 on Walmart 360 and would be ideal for Year 1. This is a rapidly changing market and we will re-evaluate our storage and data backup needs and choices at the time of purchase. USB disk drives and a smaller, transportable RAID array will also be needed to back up mulibeam and other data, especially during shipboard operations (Item E1, \$2500/year).

Specialized software is needed to process this data. We request funds to renew existing software licenses that are needed to work with the multibeam data and to purchase occasional needed software programs (Item E4, \$3,000 in Year 1, \$5,000 in Year 2), and for field and lab materials related to collecting, processing and reporting the data and publishing project results (Item E2, \$2,500 in Year 1 and \$5,000 in Year 2).

Travel costs include \$2,200 per year (Item C1) representing pre-installation trips to the R/V Seawolf when it is the shipyard in Fairhaven, MA each year to inspect the transducer mount, to travel to/from the R/V Seawolf ports during field work, and to travel to UConn in Avery Point for cruise planning and project discussions. UConn at Avery Point will contribute shipboard personnel during the project and we are planning to mobilize the gear on a vessel to be provided by UConn in Year 2 as described in their companion proposal. The R/V Seawolf resumed its schedule of multi-day research cruises in October 2020 following a hiatus during the initial months of the Covid-19 pandemic. Protocols for using the R/V Seawolf during the Covid-19 pandemic include crew and scientists being tested for Covid-19 and then being quarantined until test results are known and until the cruise departs. Hotel costs are budgeted for 3 nights for 8 individuals @ \$200/night to support this pre-cruise quarantine in Year 1 (Item C2). We expect that no quarantine will be needed by the time our Year 2 cruises occur. We plan to present results of our mapping study at a National or International Scientific Meeting in Year 2 and \$2,000 is budgeted for that travel (Item C3).

We will use the SoMAS R/V Seawolf during this project and ship costs are budgeted at the rate of \$8,000 per project day (Item G1) with most project days lasting 24 hours. In Year 1 we anticipate 14 ship days for system installation and testing (4 days) and for two five-day mapping cruises (10 days). In Year 2 we anticipate 25 ship days for five five-day mapping trips. The transducer array will need to be installed and removed for every field project with the help of a diver (Item G7, \$2,500 in Year 1, \$5,000 in Year 2), and we expect to use a SoMAS truck during mobilization/demobilization (Item G3, \$500 in each project year).

Several Other Direct Costs are also budgeted, including \$1,000 in shipping costs each year (Item G5), \$1,500 in equipment maintenance costs each year for the sonar and GPS mounts, (Item G8)

\$1,500 to calibrate sound-velocity probe sensors each year (Item G11), \$500 for cellular network connectivity each year (Item G10), and \$6,000 for equipment insurance each year (Item G12).

Indirect costs are calculated at 10% of total direct costs (TDC) following Sponsor policy (Item I).

Multibeam Mapping in Long Island Sound -- LISS Enhancement Stony Brook University October 1, 2020 -- September 30, 2022 PROJECT BUDGET			
BUDGET CATEGORY	A FY 2020 Year 1	B FY 2021 Year 2	A+B TOTAL Years 1 + 2 Budget REQUEST
A. PERSONNEL TOTAL:	\$116,746.00	\$ 210,847.75	\$327,593.75
1. Professor Roger Flood, PI (FT) 500/1167 ann. Hours	\$39,390.00	\$93,694.63	\$133,084.63
2. SoMAS Post-Doctoral Associate (FT) 1500/2000 ann. Hours	\$56,250.00	\$76,500.00	\$132,750.00
3. SoMAS Graduate student (FT) 750/2000 ann. Hours	\$11,250.00	\$30,600.00	\$41,850.00
4. SoMAS Undergraduate students (PT) 666/666 ann. hours	\$9,856.00	\$10,053.12	\$19,909.12
B. FRINGE BENEFITS TOTAL:	\$32,505.20	\$63,160.66	\$95,665.86
1. Senior 41% / 42%	\$16,149.90	\$39,351.74	\$55,501.64
2. Post-Doctoral Associate 25% / 24%	\$14,062.50	\$18,360.00	\$32,422.50
3. Graduate Student 16% / 16%	\$1,800.00	\$4,896.00	\$6,696.00
4. Undergraduate Student 5% / 5.5%	\$492.80	\$552.92	\$1,045.72
C. TRAVEL/TRAINING (Estimate number/purpose of trips; mileage costs; fleet costs) TOTAL:	\$7,000.00	\$4,200.00	\$11,200.00
Trip 1: Mileage and Ferry for 12 car trips/year for project meetings and cruise prep	\$2,200.00	\$2,200.00	\$4,400.00
Trip 2: Hotel for 8 for 3 days @ \$200, pre-cruise COVID quarantine (Year 1)	\$4,800.00	\$0.00	\$4,800.00
Trip 3: National or International meeting to present study results (Year 2)	\$0.00	\$2,000.00	\$2,000.00
D. EQUIPMENT TOTAL:	\$254,727.00	\$9,500.00	\$264,227.00
Item 1. Kongsberg EM2040P MkII dual swath multibeam system with motion sensor, topside computer, and SV profiler to conduct acoustic survey	\$242,027.00	\$0.00	\$242,027.00
Item 2. Dell Laptop for system computer backup	\$5,000.00	\$0.00	\$5,000.00
Item 3. Processing Computers (1 in Year 1, 2 in Year 2)	\$2,800.00	\$4,000.00	\$6,800.00
Item 4. Big RAID Disk Arrays (1 in Year 1, 2 in Year 2)	\$2,500.00	\$5,500.00	\$8,000.00
Item 5. Laptop for shipboard equipment use (2)	\$2,400.00	\$0.00	\$2,400.00
E. SUPPLIES (Itemize by major category) TOTAL:	\$10,500.00	\$15,000.00	\$25,500.00
Item 1 Disk Drives and other Computer Costs	\$2,500.00	\$2,500.00	\$5,000.00
Item 2 Field/Lab supplies	\$2,500.00	\$5,000.00	\$7,500.00
Item 3 Installation and GPS supplies	\$2,500.00	\$2,500.00	\$5,000.00
Item 4 Software Licenses and Programs	\$3,000.00	\$5,000.00	\$8,000.00
F. CONTRACTS (Identify & itemize) TOTAL:	\$0.00	\$0.00	\$0.00
none	\$0.00	\$0.00	\$0.00
G. OTHER (Specify and Itemize Costs) TOTAL:	\$166,876.81	\$227,152.00	\$394,028.81
Item 1 Ship Time R/V Seawolf \$ 8,000/day	\$112,000.00	\$200,000.00	\$312,000.00

Item 2 Installation Support and Training (Kongsberg)	\$21,790.00	\$0.00	\$21,790.00
Item 3 SoMAS truck use	\$500.00	\$500.00	\$1,000.00
Item 4 Multibeam Shipping and Fees	\$7,260.81	\$0.00	\$7,260.81
Item 5 Shipping and Express Mail	\$1,000.00	\$1,000.00	\$2,000.00
Item 6 Machine Shop and Electronics Svcs	\$6,000.00	\$2,000.00	\$8,000.00
Item 7 Installation Expenses (e.g., Diver)	\$2,500.00	\$5,000.00	\$7,500.00
Item 8 Equipment Maintenance	\$1,500.00	\$1,500.00	\$3,000.00
Item 9 GPS Satellite Service	\$3,500.00	\$3,500.00	\$7,000.00
Item 10 Cellular Charges	\$500.00	\$500.00	\$1,000.00
Item 11 Sound Velocity Probe Calibration	\$1,500.00	\$1,500.00	\$3,000.00
Item 12 Equipment Insurance	\$6,000.00	\$6,000.00	\$12,000.00
Item 13 Tuition	\$2,826.00	\$5,652.00	\$8,478.00
H. TOTAL DIRECT COSTS (SUM OF A-G)	\$588,355.01	\$529,860.41	\$1,118,215.42
I. TOTAL INDIRECT COSTS (If applicable)	\$58,835.50	\$52,986.04	\$111,821.54
10.0% of Total Direct Costs (\$588,355.01 / \$529,986.04)	\$58,835.50	\$52,986.04	\$111,821.54
J. TOTAL PROJECT COST (SUM OF H+I)	\$647,190.51	\$582,846.45	\$1,230,036.96

Multibeam Mapping in Long Island Sound -- LISS Enhancement

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Project Period: October 1, 2020 - September 30, 2022
Grant Period: October 1, 2020 - September 30, 2022

Abstract

Benthic mapping in Long Island Sound (LIS) has long been identified as a priority need and is essential to improving science-based environmental management and mitigation decisions. Sea floor landscape maps depicting habitat structure and the ecological characteristics associated with those habitats are critical pieces of information which typically integrate information from a variety of sources including acoustic bathymetry and backscatter, sedimentary, geochemical, physical, and biological data.

Analysis of the NOAA bathymetric data shows that there are two large areas in central Long Island Sound, about 40 and 100 square miles and mapped before 2004, which lack the kind of high-quality data necessary to support even the initial stages of benthic mapping. High-resolution morphological data is needed in order to extrapolate the results of the high-priority areas throughout Long Island Sound, a high priority of the LIS Cable Fund.

We propose to begin an effort, including both SoMAS and UConn facilities and investigators, to collect and process the high-resolution multibeam data needed in the larger (~100 square mile) primary study area to support the objectives of the LIS Cable Fund benthic mapping initiative. We will purchase a high-resolution multibeam mapping system that is capable of collecting the needed high-resolution multibeam bathymetry and backscatter data and water-column data and we will conduct a number of 5 day cruises, up to 24 hours/day of mapping, over two years to complete the mapping of the primary study area. System purchase, installation, acceptance and about 10 days of mapping will occur in Year 1 and about 25 to 30 days of mapping will occur in Year 2. The existence of a highly capable, shallow-water multibeam system within the Long Island Sound community will make possible a range of other projects, for example determining how fast bottom morphology and habitat characteristics change in response to shorter-term events such as seasonal anoxia and storm or storm surge or longer-term changes due to climate or ecological evolution. Little is known about how seafloor morphology evolves over those kinds of time scales.

Facilities, Equipment and Other Resources

The project primarily involves the collection of high-resolution multibeam bathymetry and acoustic data from Long Island Sound. The primary facilities that will be used are (1) the SoMAS Research Vessel R/V Seawolf, (2) a multibeam echosounder system which includes the Kongsberg EM 2040P, the Seapath 130 GPS Antenna with MRU motion and heading sensor, (3) additional sensors and computers needed for shipboard data acquisition and (4) computers, disk drives and software necessary to collect and process the multibeam bathymetry and acoustic backscatter data.

The R/V Seawolf is an 80-foot research vessel based in Port Jefferson, Long Island, NY. The R/V Seawolf is managed by SoMAS and the ship time needed to perform this work has been requested. The vessel is capable of operating 24 hours/day when appropriate personnel are onboard. I have used the R/V Seawolf during similar multibeam mapping projects and I have requested the needed ship time from SoMAS.

In order to do this work, the proposal is requesting funds to purchase a new multibeam echosounder along with a heading and motion sensor system, operating computer, appropriate cables and other components. I am currently considering purchasing the Kongsberg EM 2040P and the Seapath 130 position, heading and motion sensor, and operating/data logging computer, but the final decision will be made once funds are available. The EM 2040P is the current model of the obsolete Kongsberg EM 3000D multibeam echosounder that I operated at SoMAS starting in 1998. A new system has increased resolution in the depth and backscatter data and will collect the high-quality data needed for the proposed project.

Additional shipboard items available now at SoMAS include a sound velocity profiler, additional GPS receivers, and shipboard network components with internet access. We have been using several computers that have been exclusively used for field projects during past mapping projects. The modern multibeam mapping system relies on networked and online computing resources and many of our existing shipboard computers use obsolete operating systems such as Windows XP and Windows 7 which the University actively discourages. New computers with more secure operating systems and which are intended for exclusive use of field projects and which are described in the Budget Justification, will be needed.

Data reduction will occur on highly capable Windows and Linux computers that use large networked RAID arrays for data storage and backup. Appropriate computers (Windows 7, Windows 10 and Linux operating systems) and large disk drives are available in my lab, but the volume of data to be collected and processed during this project will require new, highly capable Windows 10 and Linux computers and dedicated high-volume data storage systems. Each of the 7 or 8 weeks of data acquisition in this proposed project is expected to collect more data than my research projects collected during similar projects in 2018 or 2019. To process this data on shipboard and in the lab, new computers need to be acquired for the exclusive use of this kind of multibeam mapping project to cope with the volume of data and the need for multiple computers to be working with the data at the same time. The details of the kinds of computers to be purchased are described in the Budget Justification. I have licenses to computer software needed to reduce and display the bathymetry and backscatter data, including CARIS software, Fledermaus software, SwathEd software and ArcMap software as well as more general work processing, spreadsheet, graphing and other data manipulation software. Funds to renew software licenses are included in the budget.

I expect that data reduction will occur primarily in my SoMAS Endeavour Hall office and lab (End 157 and 174). Recent experience also has shown that shipboard and offsite data processing is also possible. I plan to hire a Post-Doctoral Associate who will be involved with data acquisition and reduction during the program. If other space is not available, this person can share my office, End 157.

Appendix D-2. UConn Proposal

A Proposal to the

Land and Water Resources Division
Bureau of Water Protection and Land Reuse
Connecticut Department of Energy & Environmental Protection
79 Elm Street, Hartford CT 60106-5127

Attn: DeAva Lambert
tel: (860) 242-3207
email: DeAva.Lambert@ct.gov

- 1. Title:** “Acoustic data acquisition for seafloor mapping in Long Island Sound”
- 2. Organization:** University of Connecticut – Department of Marine Sciences (UConn-DMS)

Note: This proposal is UConn’s Scope of Work within Task 20-15 – “The Acoustic data acquisition for seafloor mapping in Long Island Sound” project, in the Cooperative Agreement # LI-00A00579 between DEEP and EPA

- 3. Project Leader:** Ivar G. Babb, Department of Marine Sciences
- 4. Project Period:** January 1, 2021 – September 30, 2022
Grant Period: January 1, 2021 – September 30, 2022
- 5. Funds Requested:** Year One: \$38,584 Year Two: \$120,834 Total: \$159,418

6. Project Summary:

This narrative provides the Scope of Work (SOW) proposed to be conducted by the University of Connecticut as a contractor on the Long Island Sound Study (LISS) Enhancement Grant project: “Acoustic data acquisition for seafloor mapping in Long Island Sound” led by the CT-DEEP Land and Water Resources Division. That overarching document is attached for reference. Below is a summary of the background and description of the activities proposed for the UConn portion of this project.

Benthic mapping of Long Island Sound (LIS) has long been identified as a priority need and is essential to improving science-based environmental management and mitigation decisions. Sea floor landscape maps depicting habitat structure and the ecological characteristics associated with those habitats are critical pieces of information which typically integrate information from a variety of sources including acoustic bathymetry and backscatter, sedimentary, geochemical, physical, and biological data.

In 2004, a settlement fund (LIS Cable Fund) resulting from issues surrounding cable infrastructure in LIS was created to support a benthic mapping effort. To manage this, a Steering Committee was formed consisting of representatives from CT-DEEP, US EPA Regions 1 & 2, New York Department of Environmental Conservation, New York Department of State, and the Sea Grant offices of Connecticut and New York. The committee works in a joint administrative capacity, but financial management of the fund is the responsibility of DEEP. Three areas of LIS were identified as high priority to develop a multi-phased benthic mapping effort, designated as the Phase 1 Pilot, Phase 2, and Phase 3 (Figure 1). To date the Phase I Pilot is completed and the Phase 2 is slated for completion at the end of 2020.

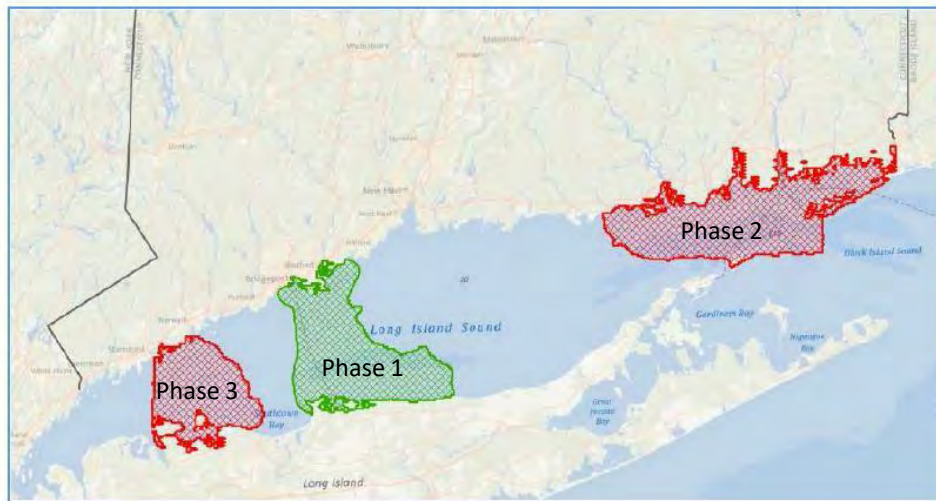


Figure 1. Priority mapping areas in Long Island Sound

7. Proposed Scope of Work – Overview:

The LIS Cable Fund is anticipated to deliver data for the proposed Phase 3 area consistent with the Phase 1 Pilot and Phase 2, and is projected to have a modest balance, which will be used to focus on the gap in the central LIS basin between the Pilot and Phase 2 areas. With the addition of funds from the LISS CCMP Enhancement Grant, the Steering Committee and its mapping partners will be able to leverage the ongoing work from the past 8 years and maximize the consistent collection and analysis of data within the LIS basin. Therefore, we propose to use the additional funding to collect and process acoustic data within the central basin, where no other recent acoustic surveys have been made, depicted as the region outlined in purple in Figure 2. The additional acoustic data acquisition of this 99.5 square-mile area within the central LIS basin supports the implementation of the 2015 CCMP by improving the scientific knowledge base essential to making informed decisions to protect and restore the health of LIS.

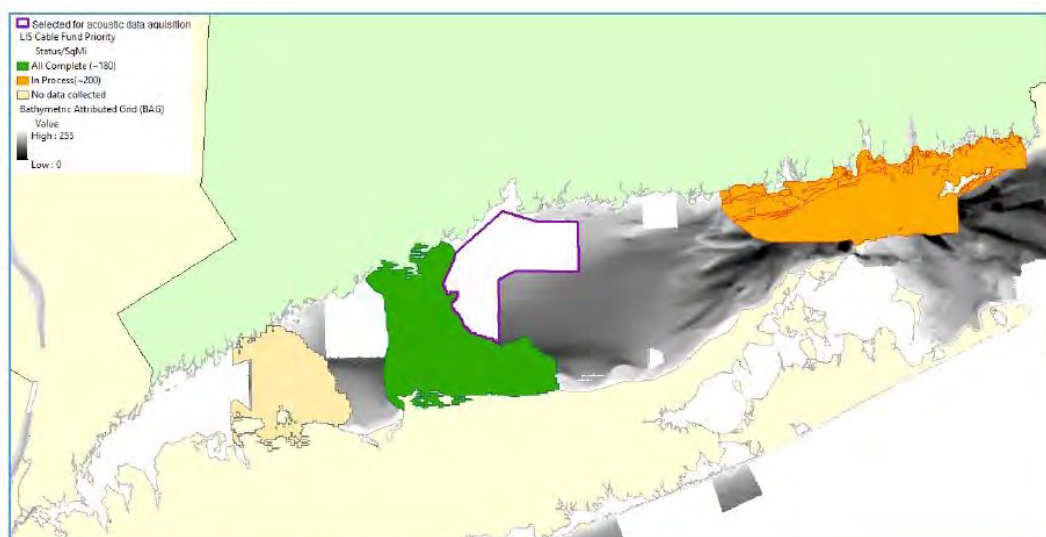


Figure 2. Area (outlined in purple) proposed for additional acoustic data acquisition

7a. Proposed Scope of Work – UConn-Department of Marine Sciences (DMS):

What is the work the Contractor (UConn) is conducting?

For Year One, a primary goal of the LISS EG proposal is to purchase a new multibeam sonar system (MBS) since coordination of leasing such gear with vessel availability has proven challenging. The proposed system is a Kongsberg EM2040c MkII with dual heads (or similar system), with motion sensor, and logging computer plus software. UConn-DMS' Acoustic Mapping Technician, Dennis Arbige will be supported to travel to and attend the installation and training of this new MBS on Stony Brook University's Research Vessel (RV) Seawolf. The MBS equipment is also proposed as a system that can be installed on UConn's RV Connecticut, when appropriate, for other LIS work. Therefore, a RV Connecticut technician will also attend the training on the new system.

The second major goal of the project for Year One is to begin mapping the designated area with the new MBS installed on the RV Seawolf with two 5-day surveys. Therefore, Dennis Arbige will participate on these two survey missions as part of the data acquisition team.

The RV Connecticut technician will also be available to participate in these cruises at the discretion of the project Principal Investigator, Roger Flood, from the Stony Brook University.

For Year Two, five additional 5-day surveys are proposed using the RV Seawolf for additional acoustic data acquisition in the area outlined in Figure 2. One additional 5-day cruise is proposed to be conducted from the RV Connecticut to both integrate this new mapping infrastructure onto this flagship vessel as a regional research tool and to finalize the acoustic data acquisition. Additional surveys onboard the RV Connecticut might be needed if there are schedule conflicts with the RV Seawolf in year two. It is also possible that the RV Connecticut could utilize this new mapping sonar infrastructure for the future LIS Cable Fund Phase 3 effort described above.

What are the project deliverables?

The project will provide human resource development through the training of UConn technicians on the use of the new multibeam sonar system (Kongsberg EM 2040P MKII). This will provide a regional resource of a skilled workforce to assist with future seafloor mapping activities in Long Island Sound. If possible, written certifications from Kongsberg will be provided to validate this training. In addition, during the survey cruises, UConn technicians will also work with tools proposed by SBU for the multibeam data processing, including CARIS HIPS and SIPS software (for bathymetry), QPC Fledermaus GeoCoder software (for backscatter) and SwathEd software programs from the University of New Brunswick (for bathymetry and backscatter).

The main deliverables from the project will be the high resolution bathymetry and backscatter map products for the 99.5 square mile area in the central Sound. The bathymetry maps will provide detailed depth and topography data as well as be the basis for derived data products such as topographic roughness and slope metrics. The backscatter or acoustic intensity maps provide a proxy for the nature of the seafloor (e.g., hard vs soft substrates). Backscatter data is also the primary data used for habitat classification software such as eCognition that has been consistently utilized as part of the Long Island Sound Cable Fund mapping effort. Per the SBU proposal, the digital data products will be in a format compatible with GIS software, referenced to NAD83 (2011) and will be accompanied by appropriate metadata. UTM Zone 18N will be used for gridded data. In addition to all of the raw data and digital products, detailed survey logs, sound velocity profile data and tidal level data measured during the surveys with appropriate metadata will also be provided as part of the deliverables package. As described above this will be led by the SBU team, with the assistance of the UConn team. It is envisioned that the UConn team will be centrally involved with the raw data acquisition on both vessels and with the first order onboard processing of the data. Final, integrated data products will be delivered by SBU.

What is the project timeline?

The following table outlines an approximate timetable for the proposed activities, and assumes a project start date of 1/1/2021. It is recognized that this timetable could slip based upon subaward processing, procurement and system delivery deadlines.

Milestone	Anticipated Date	Deliverable
Project start	1/1/2021	
Multibeam system training and field trials		
Year 1 Quarterly Project Report #1	3/31/21	*
1st Year 1 multibeam mapping cruise		
Year 1 Quarterly Project Report #2	6/30/21	*
Assist with processing 1 st Year 1 multibeam mapping results		
2nd Year 1 multibeam mapping cruise		
Assist with processing 2 nd Year 1 multibeam mapping results		
Year 1 Quarterly Project Report #3	9/30/21	*
Assist with final results of Year 1 multibeam mapping		
Year 1 Project Report	12/31/21	*
1st Year 2 multibeam mapping cruise		
Assist with processing 1 st Year 2 multibeam mapping results		
Year 2 Quarterly Project Report #1	3/31/22	*
2nd Year 2 multibeam mapping cruise		
Assist with processing 2 nd Year 2 multibeam mapping results		
3rd Year 2 multibeam mapping cruise		
Assist with processing 3 rd Year 2 multibeam mapping results		
Year 2 Quarterly Project Report #2	6/30/22	*
4th Year 2 multibeam mapping cruise		
Assist with processing 4 th Year 2 multibeam mapping results		
5th Year 2 multibeam mapping cruise		
Assist with processing 5 th Year 2 multibeam mapping results		
6th Year 2 multibeam mapping cruise		
Lead data acquisition and assist with processing of 6 th Year 2 multibeam on the RV Connecticut		*
Year 2 Quarterly Project Report #3	9/30/22	*
Assist with update of final Year 1 multibeam mapping as needed		
Assist with final combined Year 1 and 2 multibeam mapping results		
Final Project Report	12/31/22	*

Appendix Three - Historical Data Source Index

Data Type	Title/Description	Date(s)	DOI or Online Link	Alternate Link(s) and /or citations
Acoustic Sources				
a. Multibeam				
H11011	Approaches to New Haven Harbor, NOAA Ship Rude, Bathymetry, Side Scan Sonar, 8 bottom grabs	2000	https://www.ngdc.noaa.gov/nos/H10001-H12000/H11011.html	
H11043	3 Nautical Miles South of Brandford Harbor, Long Island Sound	2001	https://www.ngdc.noaa.gov/nos/H10001-H12000/H11043.html	
H11044	Oyster Point to Stratford Shoal Middle Ground, NOAA Ship Rude, MBES, SSS, 18 bottom samples	2001	https://www.ngdc.noaa.gov/nos/H10001-H12000/H11044.html	
H11255	4 Nautical Miles North of Roanoke Point Shoal, NOAA Ship Thomas Jefferson, MBES BAG	2004	https://www.ngdc.noaa.gov/nos/H10001-H12000/H11255.html	
H12438	4 Nautical Miles North of Herod Point Shoal, NOAA Ship Thomas Jefferson, MBES BAG	2012	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12438.html	
H12479	4 Nautical Miles South of Guilford, PT, NOAA Ship Thomas Jefferson, MBES BAG	2012	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12479.html	
H12480	4 Nautical Miles South of Faulkner Island, NOAA Ship Thomas Jefferson, MBES BAG	2012	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12480.html	
H12481	Offshore Approaches to New Haven, CT, NOAA Ship Thomas Jefferson, MBES BAG	2012	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12481.html	
H12485	Joshua Cove to Mansfield Pt, NOAA Ship Thomas Jefferson, Bathymetric Attributed Grid (BAG), 14 bottom samples	2013	https://www.ngdc.noaa.gov/nos/H12001-H14000/H12485.html	
b. Side Scan				
New Haven Harbor Survey	The distribution of surficial sediments in New Haven Harbor, Connecticut, and the New Haven Dumping Grounds, north-central Long Island Sound	1998	https://doi.org/10.3133/ofr98217	
c. Sub-bottom	Maps Showing the Stratigraphic Framework and Quaternary Geologic History of Eastern Long Island Sound	1987	https://doi.org/10.3133/mf1939A	
d. NOAA/NOS Hydrographic Surveys				

Data Type	Title/Description	Date(s)	DOI or Online Link	Alternate Link(s) and /or citations
H08967	Stratford Shoal Middle Ground to Herod Point, USC&GS Ship Whiting, Single Beam Sonar, Source Data Not Available	1968	https://www.ngdc.noaa.gov/nos/H08001-H10000/H08967.html	
H09008	Stratford Point to Branford Reef, NOAA Launch 1257, Single Beam Sonar, Source Data not available	1968	https://www.ngdc.noaa.gov/nos/H08001-H10000/H09008.html	
D00102	Basic Hydrographic Surve, Ship: Heck, Source Data not available	1989	https://www.ngdc.noaa.gov/nos/D00001-D02000/D00102.html	
Sediment Environments & Grain Size Sources				
a. Sedimentary Environments				
	Sedimentary Environments in Long Island Sound: A Guide to Sea-Floor Management in a Large Urbanized Estuary - USGS Fact Sheet 041-98	1998	https://pubs.usgs.gov/fs/fs41-98/	
	Maps Showing the Shape of the Marine Transgressive Surface and the Thickness of Postglacial Sediments in Long Island Sound	2000	https://pubs.usgs.gov/of/2000/of00-304/htmldocs/chap01/index.htm	
	Regional Distribution of Sea-Floor Environments in Long Island Sound	2000	https://pubs.usgs.gov/of/2000/of00-304/htmldocs/chap03/index.htm	
b. Sediment Grain Size				
	Map Showing the Distribution of Surficial Sediments in Long Island Sound	2000	https://pubs.usgs.gov/of/2000/of00-304/htmldocs/chap04/index.htm	listex_final.csv
	LISSEDDATA: Long Island Sound Surficial Sediment Data	2004	https://data.usgs.gov/datacatalog/data/USGS:25c00854-4bf5-4647-b7cb-359ab08d71fa	https://catalog.data.gov/dataset/long-island-sound-surficial-sediment-data

Data Type	Title/Description	Date(s)	DOI or Online Link	Alternate Link(s) and /or citations
	USGS usSEABED Atlantic Coast Offshore Surficial Sediment Data Release 2005 Ver 1.0 USGS Data Series 118	2005	https://pubs.usgs.gov/ds/2005/118/	Reid, J.M., Reid, J.A., Jenkins, C.J., Hastings, M.E., Williams, S.J., and Poppe, L.J, 2005, usSEABED: Atlantic coast offshore surficial sediment data release: U.S. Geological Survey Data Series 118, version 1.0. Online at https://pubs.usgs.gov/ds/2005/118/
	USGS East-Coast Sediment Analysis: Procedures, Database, and GIS Data	2014	https://woodshole.er.usgs.gov/openfile/of2005-1001/htmldocs/datacatalog.htm	
Long Island Sound Environmental Studies	Long Island Sound Environmental Studies, Poppe and Polloni	1998	https://pubs.usgs.gov/of/1998/of98-502/fpage.htm	https://pubs.usgs.gov/publication/ofr98502
Chapter 1 - Survey #8	Sidescan Sonar Images, Surficial Geologic Interpretations, and Bathymetry of New Haven Harbor, Connecticut, and the New Haven Dumping Ground, North-Central Long Island Sound	1998	https://pubs.usgs.gov/of/1998/of98-502/chapt2/8nhhbr/chp2num8.htm#int	
Chapter 3	Surfical Sediment Database		https://pubs.usgs.gov/of/1998/of98-502/chapt3/chpt3.htm#visual	
Chapter 4	A Review of Research on Benthic Communities Conducted in Long Island Sound and an Assessment of Structure and Dynamics	1998	https://pubs.usgs.gov/of/1998/of98-502/chapt4/rz1cont.htm	
Chapter 7	Long Island Sound Bibliographic Database	1998	https://pubs.usgs.gov/of/1998/of98-502/chapt7/chpt7txt.htm#biblio	
Chapter 8	Visualizing Long Island Sound Data Layers Using Geographic Mapping Tools	1998	https://pubs.usgs.gov/of/1998/of98-502/chapt8/chap8.htm#intro	

Data Type	Title/Description	Date(s)	DOI or Online Link	Alternate Link(s) and /or citations
Georeferenced Sea-Floor Mapping and Bottom Photography in Long Island Sound	Georeferenced Sea-Floor Mapping and Bottom Photography in Long Island Sound, Paskevich and Poppe	2000	https://pubs.usgs.gov/of/2000/of00-304/htmldocs/toc.htm	
Chapter 1	Maps Showing the Shape of the Marine Transgressive Surface and the Thickness of Postglacial Sediments in Long Island Sound			
Chapter 3	Regional Distribution of Sea-Floor Sedimentary Environments in Long Island Sound			
Chapter 4	Map Showing the Distribution of Surficial Sediments in Long Island Sound			
Chapter 10	A Benthic Community Geographical Information System (Gis) for Long Island Sound			
Chapter 11	Megafaunal Interactions with Sedimentary and Biological Habitats in the Nearshore Areas of Southern New England: A Pictorial Survey			
Chapter 12	Selected Bottom Photographs of Sedimentary Environments in Eastern Long Island Sound			
Seafloor Imagery Sources				
USGS Images	Selected Bottom Photographs of Sedimentary Environments in Eastern Long Island Sound	2000	https://pubs.usgs.gov/of/2000/of00-304/htmldocs/chap12/index.htm	
NURTEC Video Archive	NURC/NURTEC Dives/deployments w/in the Phase IV area 1985-2018	1988-2018	https://lismap.uconn.edu/wp-content/uploads/sites/2333/2019/02/NURTEC-UConn-Total-Dives-1985-2018.kmz	

Data Type	Title/Description	Date(s)	DOI or Online Link	Alternate Link(s) and /or citations
LISS Phase IVB 2023 SEABOSS and ROV Surveys				
	SEABOSS Sediment Grab Images		Sent directly via WeTransfer 9/7/22	
	SEABOSS Seafloor Images		Link to OneDrive sent 9/22/23	
	ROV Seafloor Images			

Appendix Four – Reviewed Data Log Files

- A. Historic NURC Dives in the Phase IV Area
- B. USGS SEABOSS Field Activity Survey Log
- C. SEABOSS Sediment Grab Image Log
- D. SEABOSS Seafloor Image Location Logs

A. Historic NURC Dives in the Phase IV Area

Projects with Video								
Project Number	Investigator	Dive System	Date	Dive #	Location	Latitude (DD)	Longitude (DD)	Bottom Type
NAGL-88-28	Zajac, Roman	MiniRover MKII	6/7/88	1	Charles Island	41.1919	-73.0369	N/A
NAGL-88-28	Zajac, Roman	MiniRover MKII	6/7/88	2	Charles Island	41.1919	-73.0369	N/A
NAGL-88-28	Zajac, Roman	MiniRover MKII	6/7/88	3	Charles Island	41.1919	-73.0369	N/A
NAGL-88-28	Zajac, Roman	MiniRover MKII	6/8/88	13	Station J	41.1721	-73.0398	N/A
NAGL-88-28	Zajac, Roman	MiniRover MKII	6/8/88	14	Station K	41.1759	-73.0393	N/A
NAGL-88-28	Zajac, Roman	MiniRover MKII	6/8/88	15	Station L	41.1872	-73.0384	Old Oyster Bed
NAGL-88-28	Zajac, Roman	MiniRover MKII	6/9/88	16	Station A	41.1915	-73.0366	N/A
NAGL-88-28	Zajac, Roman	MiniRover MKII	6/9/88	17	Station M	41.1897	-73.0387	N/A
NAGL-91-25	Stewart, Lance L.	MiniRover MKII	6/24/91	14	Stamford New Haven North	41.1553	-72.8787	Sand
NAGL-91-25	Stewart, Lance L.	MiniRover MKII	6/24/91	13	Central LIS Dump Site	41.1573	-72.8581	Soft Sediment
NAGL-91-25	Stewart, Lance L.	MiniRover MKII	6/25/91	22	East of Charles Island	41.1879	-73.0372	Hard
NAGL-92-24	Stewart, Lance L.	MiniRover MKII	5/6/92	1	Milford Inshore Site Sand Shell	41.1835	-73.0101	Shell
NAGL-92-24	Stewart, Lance L.	MiniRover MKII	5/6/92	2	Milford Inshore Site	41.1851	-73.0047	Shell
NAGL-92-24	Stewart, Lance L.	MiniRover MKII	5/6/92	3	Transitional Site	41.1869	-72.9926	Sandy/mud
NAGL-92-24	Stewart, Lance L.	MiniRover MKII	5/6/92	4	Mud Site on Milford Trawl Line	41.1868	-72.9843	Mud
NAGL-92-24	Stewart, Lance L.	MiniRover MKII	11/16/92	22	Central Long Island Sound	41.158	-72.8604	Mud
NAGL-92-24	Stewart, Lance L.	MiniRover MKII	11/16/92	23	Central Long Island Sound	41.1902	-72.9796	Mud
NAGL-92-24	Stewart, Lance L.	MiniRover MKII	11/16/92	24	Milford Sand Shell	41.185	-73.0051	Sand/shell
Projects without Video								
NAGL-92-32	Blake, Mark	MiniRover MKII	6/26/92	1	Station 1 SE of Milford Point	41.1515	-73.0462	Mud
NAGL-93-18	Lee, Douglas	Phantom 300	8/6/93	10	Branford, LIS	41.1884	-72.8089	Mud/sand
NAGL-93-18	Lee, Douglas	Phantom 300	8/6/93	11	Branford, LIS	41.1892	-72.8179	Mud/sand
NAGL-93-18	Lee, Douglas	Phantom 300	10/2/93	16	Branford, LIS	41.1884	-72.8089	Mud/sand
NAGL-93-18	Lee, Douglas	Phantom 300	10/3/93	17	Branford, LIS	41.1892	-72.8179	Mud/sand
NAGL-00-xx	Goldberg, Ronald	Hela	4/1/10	6	East Stratford Shoal "ES 5"	41 04.5907N	72 58.0881W	N/A

B. USGS SEABOSS Field Activity Survey Log

JD	Time UTC	Site type	NURTEC site	SEABOSS site	Odyssey 7 clip #	depth (approx)	grab	comment
Positions: UTM Zone 18N WGS84								
GPS Equipment: Hemisphere GPS (model ??). GPS from the our Hemisphere box with the antenna run up to the rail on the aft of the 0-1 deck, directly above the SEABOSS winch - no offset was applied to the data. Port A is going to the SEABOSS laptop (Rugged Dell); Port B (9600 baud, GPGGA and GPRMC only) is split 3x going to (1) DataBridge CF card; (2) into Global Mapper (run via Parallels on Seth's old MacBook Pro (2013)) GPS via usb to serial adapter saving 1 second GPS and NMEA log files and (3) into the Proteus to enable video overlay for the down vids.								
SEABOSS Sampling: SEABOSS 2.0 sampler is a modified Van Veen sediment grab with one GoPro 4; DSPL video cameras, Flir still camera, 3 DSPL led lights, 2 Iklite strobes and 2 green lasers. GoPro Hero4 (Hero4_6) shooting 12MP photos. GPS from the our Hemisphere box (antenna is run up to the rail on the aft of the 0-1 deck, directly above the SEABOSS winch - no offset was applied to the data. We are using a winch on loan from the WHOI winch pool. Chuck make loops in the lifting cable so that we can clip the data cable(s) to the line during long transects deployments. Sampling sites are either grab only or transect+grab (up to ~40 minutes long). Upon recovery of the sampler, both sides of the VanVeen are photographed by UNH, USGS takes 2x 2cm deep samples (one for USGS sed lab, one for LDEO), UNH John takes a small surface sample and UNH Sarah takes a boba straw sample (for eDNA).								
Video: The primary video is a down-looking DSPL camera (version #????XXXXXX), fwd is the same camera model SD video (but after day 1 we weren't using this since there was little to no visibility in the fwd, both run up the Falmat cable on the topside SEABOSS 2.0 control box. Down video comes out to the Proteus Overlay box via SDI then to the Odyssey recorder via SDI (HDMI out of the Proteus goes to the ASUS 27" monitor, SDI out from the Odyssey does out to the other Odyssey on the deck for the winch driver), the fwd video comes out the SEABOSS 2.0 control box via SDI, goes to the BlackMagic Video Assist recorder, fwd also comes out the control box via HDMI and out to a 27" ASUS monitor. Odyssey timecode was good for the first few days but through the survey, use the overlay nav/date/time on the down video. After the crew change, we switched to use the SeaViewer SeaDrop 6000 for the down video (and unplugged both ProConverts in the SEABOSS bottle to reduce the heat in the housing). The SeaViewer was set to 1080P but the HD-TVI box and Proteus was limiting the throughput resolution options. HD-TVI box was set to 1080i50fps, into the Proteus via HDMI then follow the almost the same as above (SDI to Odyssey, HDMI to 24" ASUS monitor (the 27" didn't like the 1080i input).								
Photos: Flir 5MP or 20MP camera (working sporatically, but great when its working). Using the GoPro Hero4_6 (Seth used CameraStudio app to sync on first day), calibration shots taken each day with the GPStime app on Seth's phone. Also, Roman has a point-an-shoot camera used to take topside photos of the VanVeen grab upon recovery of a sample with a sample id tag (+candid photos). Everyone is taking lots of photos with thier phones and cameras, we will collect all of those that people are willing to share on a Google Drive folder.								
-- JD 187 (all times are UTC)								
187	0000							Start of survey --

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
187	180000							leaving the dock at UCONN Avery Point
187	232200	grab	NB119	2023-008-001	clip 211	21		vob - gently hit the bottom on landing, didn't trip the sampler
			NB119	2023-008-001				very murky, muddy sediment, video looks good, not getting any great photos
187	233111		NB119	2023-008-001			y	voffb - good sample, very muddy
187	234500							done for the day. Yay! It worked
187								
187								
Friday July 7 2023 -- JD 188								
188	120109	transect and grab	NB114	2023-008-002	clip 212	12		vob - sandy mud, shells
188	120812		NB114	2023-008-002				systems lost power
188	121040		NB114	2023-008-002				power back on, down video not recorded
188	121505		NB114	2023-008-002			y	voffb - good sample
188	124412	transect and grab	NB117	2023-008-003	clip 215	10		vob
188	125250		NB117	2023-008-003			y	voffb - good sample
188	1319	transect + grab	NB115	2023-008-004	clip 216			clip

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
	1322							on deck
	1354	transect + grab	SB85-G3+T	2023-008-017	clip 233	11.1		in - first couple photos no station # in name
	1404							forward camera started late, taking sticky @5sec
	1410							changed color from purple to green
	1423						y	VOB - muddy sand
	1425							on deck
	143744	grab	SB85-G2	2023-008-018	clip 234	9.4		in - not recording fwd vid, just down vid. **Photos still say 017- oops
	143850							bottom -shells, muddy sand again
	144130						y	vob - grab
	144255							on deck
	145310	grab	SB85-G1	2023-008-019	clip 235	9.6		in water
	145410							on bottom - sandy mud, shells,

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
	145630						y	vob - grab
	151250	transect	SB86-T	2023-008-020	clip 236	6		in water - late start on the down video by ~20 seconds
								lots of huge boulders, growth, anenomes
	151930							off the ridge in into muddy sand, shells, slippersnails
	153300							fish, scup, sea robin
	153840							changed over to muddy, few shells
	153900							back to more shells again.
	153930							no shells, then shells, repeat, again
	154256						n	video went out - coming up
	170700	transect + grab	NB105	2023-008-021	clip 237	13		in water, no Flir camera (GoPro for stills while Chuck works on the Flir)
								shells, slippersnails
	171810							started recording fwd camera again (turned it to face more down)

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
							y	vob - grab
	173328	transect + grab	NB108	2023-008-022	clip 238	16		just bottom vid, no fwd, no stills
	180038							bottom
	181100						y	vob - grab
	184200	transect + grab	NB109	2023-008-023	clip 239			in water
	184400							on bottom, really murky, strong bottom current pushing SEABOSS sideways
	184800							Uconn coming to a stop to try to get a good image on vid/GoPro
	190156							something walked by
	190250						y	vob - grab
	190019							forgot to stop the down vid
	192905	transect + grab	NB106	2023-008-024	clip 240	16.9		in water
	193200							trying to get the camera working with Spinview

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
	172020							on deck
	182820	transect+grab	SB81-G3	2023-008-038	clip 255	17	y	in water
								vob
								changed heading to go over area of light backscatter
	190558							grab
	190828							on deck
	192950	grab	SB80-G1	2023-008-039	clip 256	17.2	y	in water
								vob
	193150							grab
	194303							on deck
	194215	grab	SB80-G2	2023-008-040	clip 257	17.8	y	in water
	194305							vob

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
	194500							grab
	194720							on deck
	200545	grab+T	SB80-G3	2023-008-041	clip 258	18.2	y	in water
	200715							vob
	202500							forgot to press record- recording now
	202710							grab
	202850							on deck
	204902	grab	SB77-G2	2023-008-042	clip 259	15.9	y	in water
	205020							vob - started recording
	205053							grab
	205250							on deck
	210035	grab	SB77-G3	2023-008-043		17	y	in water

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
	210130							vob
	210320							grab
	210530							on deck - forgot to record
	211255	transect+grab	SB77-G1	2023-008-044	clip 260	16.2	y	in water
	211358							vob
								transect
	214336							grab
	2211108	grab	SB76-G1	2023-008-045	clip 261	14.9		in water
	221242						y	grab
	222919	transect+grab	SB76-G2+T	2023-008-046	clip 262	14.4		in water
	223115							vob - squid in video, maybe photo
	224950						y	grab

Monday July 10 2023 -- JD 191

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
	160048	T & G	NB78	2023-008-050	267	9.9		in water transect & Grab
	162800						y	vob
	164240	T&G	NB79	2023-008-051	268	9.5		in water
	1707						y	vob video quit
		T&G	NB76	2023-008-052	269			in water
							N	system failed
	182930	T&G	NB71	2023-008-053	270	10.1		in water
							y	going with grab
	203400	T&G	NB72	2023-008-054	271	10.2		Added seaviewer camera for down looking camera. Not recording forward camera. Still using gopro @2 sec images. In water
	210000						y	vob grab
	211755	Grab	SB75-G2	2023-008-055	272	12.2		in Water
	212200						y	vob
	213806	G&T	SB75-G1	2023-008-56	273	13.2		in water

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
	124534	G	SB79-G2	2023-008-072	290	25		in water
	125247						y	vob
	130600	G	SB78-G2	2023-008-073	291	27		in water
	130924						y	vob
	132515	T & G	SB78-G1	2023-008-074	292	27		in water
	135122						y	vob
	141455	T & G	NB80	2023-008-075	293	25		in water no still pictures Flir not working - misnamed 74
	144838						y	vob
	151800	T & G	NB97	2023-008-076	294	25		in water - misnamed 75
	154750						y	vob
	161430							forgot to stop record -- probably 15+ min of deck footage
	163800	T&G	NB94	2023-008-077	295	20	y	in water - misnamed 76

<i>JD</i>	<i>Time UTC</i>	<i>Site type</i>	<i>NURTEC site</i>	<i>SEABOSS site</i>	<i>Odyssey 7 clip #</i>	<i>depth (approx)</i>	<i>grab</i>	<i>comment</i>
	164107							vob - tookk grab accidentally
	171930	T&G	NB89	2023-008-078	296	21	y	in water
	172110							vob
	174546							grab
	180330	t&G	NB84	2023-008-079	297	20	y	in water
	180505							vob
	182900							grab
	184340	t%G	NB81	2023-008-80	298	18	y	in water
	184530							vob
	191640							grab
	193550	t&G	NB87	2023-008-081	299	17	y	in water
	193720							vob

C. SEABOSS Sediment Grab Image Log

LISMaRC Site Name	SEABOSS Site Name	Photo Name	UTC	DateTime_MSE xcel	Longitude	Latitude	JD	Comments
NB119	2023-008-001	P7070009.JPG	232950	7/6/23 23:30	-72.79330525	41.16689568	JD187	Mud
NB119	2023-008-001	P7070010.JPG	232950	7/6/23 23:30	-72.79330525	41.16689568	JD187	Mud
NB114	2023-008-002	P7070019.JPG	121505	7/7/23 12:15	-72.82228753	41.22704371	JD188	Mud, shell hash
NB114	2023-008-002	P7070021.JPG	121505	7/7/23 12:15	-72.82228753	41.22704371	JD188	Mud, shell hash
NB117	2023-008-003	P7070036.JPG	125250	7/7/23 12:53	-72.80980371	41.21846202	JD188	Mud/sand lots of Crepidula
NB117	2023-008-003	P7070038.JPG	125250	7/7/23 12:53	-72.80980371	41.21846202	JD188	Mud/sand lots of Crepidula
NB115	2023-008-004	P7070046.JPG	131442	7/7/23 13:15	-72.8241	41.1999239	JD188	Mud, shell hash
NB115	2023-008-004	P7070050.JPG	131442	7/7/23 13:15	-72.8241	41.1999239	JD188	Mud, shell hash
NB118	2023-008-005	P7070054.JPG	143919	7/7/23 14:39	-72.80281772	41.20436541	JD188	Mud
NB118	2023-008-005	P7070058.JPG	143919	7/7/23 14:39	-72.80281772	41.20436541	JD188	Mud
NB120	2023-008-006	P7070066.JPG	152917	7/7/23 15:29	-72.79757076	41.17532445	JD188	Mud
NB120	2023-008-006	P7070067.JPG	152917	7/7/23 15:29	-72.79757076	41.17532445	JD188	Mud
NB116	2023-008-007	P7070074.JPG	162112	7/7/23 16:21	-72.8195346	41.18731401	JD188	Mud
NB116	2023-008-007	P7070076.JPG	162112	7/7/23 16:21	-72.8195346	41.18731401	JD188	Mud
NB113	2023-008-008	P7070081.JPG	171722	7/7/23 17:17	-72.83927829	41.16136468	JD188	Mud
NB112	2023-008-009	P7070087.JPG	181035	7/7/23 18:11	-72.83906001	41.17608126	JD188	Mud
NB112	2023-008-009	P7070090.JPG	181035	7/7/23 18:11	-72.83906001	41.17608126	JD188	Mud
SB87-G1	2023-008-010	P7070095.JPG	185807	7/7/23 18:58	-72.84591789	41.19532086	JD188	Mud
SB87-G2	2023-008-011	P7070100.JPG	192506	7/7/23 19:25	-72.84191153	41.19564408	JD188	Mud
SB87-G2	2023-008-011	P7070102.JPG	192506	7/7/23 19:25	-72.84191153	41.19564408	JD188	Mud
SB87-G3	2023-008-012	P7070104.JPG	194234	7/7/23 19:43	-72.83943376	41.19620166	JD188	Mud
SB87-G3	2023-008-012	P7070105.JPG	194234	7/7/23 19:43	-72.83943376	41.19620166	JD188	Mud
SB86-G2	2023-008-013	P7070110.JPG	205220	7/7/23 20:52	-72.86010028	41.21196217	JD188	Mud
SB86-G2	2023-008-013	P7070112.JPG	205220	7/7/23 20:52	-72.86010028	41.21196217	JD188	Mud
SB86-G3	2023-008-014	P7070122.JPG	202946	7/8/23 20:30	-72.86183788	41.17478295	JD188	This TC seems weird - higher than the next
SB86-G1	2023-008-015	P7070125.JPG	155213	7/8/23 15:52	-72.86591884	41.20799006	JD188	This TC is also higher than the next
SB86-G1	2023-008-015	P7070127.JPG	155213	7/8/23 15:52	-72.86591884	41.20799006	JD188	This TC is also higher than the next
NB111	2023-008-016	P7080003.JPG	132016	7/8/23 13:20	-72.84497125	41.21608628	JD189	TC back on track?
NB111	2023-008-016	P7080006.JPG	132016	7/8/23 13:20	-72.84497125	41.21608628	JD189	TC back on track?
SB85-G3	2023-008-017	P7080009.JPG	142322	7/8/23 14:23	-72.87584498	41.21573256	JD189	Sand with shells
SB85-G3	2023-008-017	P7080011.JPG	142322	7/8/23 14:23	-72.87584498	41.21573256	JD189	Sand with shells
SB85-G2	2023-008-018	P7080072.JPG	144120	7/8/23 14:41	-72.87046741	41.2182473	JD189	Sandy mud w shells
SB85-G2	2023-008-018	P7080076.JPG	144120	7/8/23 14:41	-72.87046741	41.2182473	JD189	Sandy mud w shells

LISMaRC Site Name	SEABOSS Site Name	Photo Name	UTC	DateTime_MSE xcel	Longitude	Latitude	JD	Comments
SB85-G1	2023-008-019	P7080131.JPG	145614	7/8/23 14:56	-72.87173854	41.21883477	JD189	Label not visible, time makes sense though, Crepidula
SB85-G1	2023-008-019	P7080133.JPG	145614	7/8/23 14:56	-72.87173854	41.21883477	JD189	Label not visible, time makes sense though, Crepidula
NB105	2023-008-021	P7080137.JPG	173307	7/8/23 17:33	-72.89487541	41.205421	JD189	Sandy, shells
NB105	2023-008-021	P7080139.JPG	173307	7/8/23 17:33	-72.89487541	41.205421	JD189	Sandy, shells
NB108	2023-008-022	P7080158.JPG	181016	7/8/23 18:10	-72.86619447	41.20256541	JD189	Mud
NB108	2023-008-022	P7080160.JPG	181016	7/8/23 18:10	-72.86619447	41.20256541	JD189	Mud
NB109	2023-008-023	P7080161.JPG	190217	7/8/23 19:02	-72.86917756	41.19499024	JD189	Mud, shell hash
NB109	2023-008-023	P7080164.JPG	190217	7/8/23 19:02	-72.86917756	41.19499024	JD189	Mud, shell hash
NB106	2023-008-024	P7080165.JPG	195416	7/8/23 19:54	-72.88400253	41.18866517	JD189	Mud
NB106	2023-008-024	P7080168.JPG	195416	7/8/23 19:54	-72.88400253	41.18866517	JD189	Mud
NB110	2023-008-025	P7080170.JPG	204406	7/8/23 20:44	-72.86152682	41.17371229	JD189	Mud
NB110	2023-008-025	P7080173.JPG	204406	7/8/23 20:44	-72.86152682	41.17371229	JD189	Mud
NB107	2023-008-026	P7080175.JPG	213803	7/8/23 21:38	-72.87748041	41.16394589	JD189	Label is incomplete, time makes sense, mud
NB107	2023-008-026	P7080177.JPG	213803	7/8/23 21:38	-72.87748041	41.16394589	JD189	Label is incomplete, time makes sense, mud
SB84-G2	2023-008-027	P7080178.JPG	222125	7/8/23 22:21	-72.89167865	41.17287226	JD189	Mud
SB84-G2	2023-008-027	P7080180.JPG	222125	7/8/23 22:21	-72.89167865	41.17287226	JD189	Mud
SB84-G1	2023-008-028	P7080182.JPG	223701	7/8/23 22:37	-72.8945365	41.17434688	JD189	Mud, some shell
SB84-G1	2023-008-028	P7080183.JPG	223701	7/8/23 22:37	-72.8945365	41.17434688	JD189	Mud, some shell
NB83	2023-008-029	P7090007.JPG	124048	7/9/23 12:41	-72.94947084	41.20759095	JD190	Mud, some shell
NB83	2023-008-029	P7090010.JPG	124048	7/9/23 12:41	-72.94947084	41.20759095	JD190	Mud, some shell
SB82-G1	2023-008-030	P7090011.JPG	130402	7/9/23 13:04	-72.91984345	41.20818047	JD190	Label not legible, time makes sense
SB82-G1	2023-008-030	P7090012.JPG	130402	7/9/23 13:04	-72.91984345	41.20818047	JD190	Label not legible, time makes sense
SB82-G3	2023-008-031	P7090013.JPG	131411	7/9/23 13:14	-72.91838996	41.20856657	JD190	Label not legible, time make sense
SB82-G3	2023-008-031	P7090014.JPG	131411	7/9/23 13:14	-72.91838996	41.20856657	JD190	Label not legible, time make sense
SB82-G2	2023-008-032	P7090017.JPG	135613	7/9/23 13:56	-72.9163785	41.2118398	JD190	Label not legible, time makes sense
SB82-G2	2023-008-032	P7090019.JPG	135613	7/9/23 13:56	-72.9163785	41.2118398	JD190	Label not legible, time makes sense
NB102	2023-008-033	P7090028.JPG	145050	7/9/23 14:51	-72.93185682	41.20037732	JD190	Lots of shell, Crepidula
NB102	2023-008-033	P7090029.JPG	145050	7/9/23 14:51	-72.93185682	41.20037732	JD190	Lots of shell, Crepidula
NB103	2023-008-034	P7090036.JPG	154046	7/9/23 15:41	-72.91263061	41.18750728	JD190	Sandy, with some shell
NB103	2023-008-034	P7090037.JPG	154046	7/9/23 15:41	-72.91263061	41.18750728	JD190	Sandy, with some shell
NB92	2023-008-035	P7090040.JPG	164106	7/9/23 16:41	-72.95755481	41.17905952	JD190	Mud

LISMaRC Site Name	SEABOSS Site Name	Photo Name	UTC	DateTime_MSE xcel	Longitude	Latitude	JD	Comments
NB92	2023-008-035	P7090042.JPG	164106	7/9/23 16:41	-72.95755481	41.17905952	JD190	Mud
SB81-G2	2023-008-036	P7090044.JPG	170531	7/9/23 17:06	-72.94187042	41.1626505	JD190	Mud
SB81-G2	2023-008-036	P7090045.JPG	170531	7/9/23 17:06	-72.94187042	41.1626505	JD190	Mud
SB81-G1	2023-008-037	P7090049.JPG	171829	7/9/23 17:18	-72.93857874	41.16184718	JD190	Mud
SB81-G1	2023-008-037	P7090050.JPG	171829	7/9/23 17:18	-72.93857874	41.16184718	JD190	Mud
SB81-G3	2023-008-038	None	190554	7/9/23 19:06	-72.93884209	41.16163355	JD190	Pics jump from SB81-G1 to SB80-G1, no SB81-G3 pic
SB80-G1	2023-008-039	P7090052.JPG	193145	7/9/23 19:32	-72.96998732	41.15915736	JD190	Mud
SB80-G1	2023-008-039	P7090055.JPG	193145	7/9/23 19:32	-72.96998732	41.15915736	JD190	Mud
SB80-G2	2023-008-040	P7090056.JPG	194455	7/9/23 19:45	-72.96826308	41.15665905	JD190	Mud
SB80-G2	2023-008-040	P7090057.JPG	194455	7/9/23 19:45	-72.96826308	41.15665905	JD190	Mud
SB80-G3	2023-008-041	P7090059.JPG	202708	7/9/23 20:27	-72.96468406	41.15544105	JD190	Mud
SB80-G3	2023-008-041	P7090060.JPG	202708	7/9/23 20:27	-72.96468406	41.15544105	JD190	Mud
SB77-G2	2023-008-042	P7090062.JPG	205055	7/9/23 20:51	-72.98650383	41.16002518	JD190	Sand
SB77-G2	2023-008-042	P7090063.JPG	205055	7/9/23 20:51	-72.98650383	41.16002518	JD190	Sand
SB77-G3	2023-008-043	P7090064.JPG	210300	7/9/23 21:03	-72.98803336	41.15843348	JD190	Sand, w/ Crepidula shell
SB77-G3	2023-008-043	P7090066.JPG	210300	7/9/23 21:03	-72.98803336	41.15843348	JD190	Sand, w/ Crepidula shell
SB77-G1	2023-008-044	P7090072.JPG	214323	7/9/23 21:43	-72.98905433	41.15863103	JD190	Sand
SB77-G1	2023-008-044	P7090074.JPG	214323	7/9/23 21:43	-72.98905433	41.15863103	JD190	Sand
SB76-G1	2023-008-045	P7090077.JPG	221240	7/9/23 22:13	-73.02539591	41.16023981	JD190	Mud
SB76-G1	2023-008-045	P7090080.JPG	221240	7/9/23 22:13	-73.02539591	41.16023981	JD190	Mud
SB76-G2	2023-008-046	P7100081.JPG	224945	7/9/23 22:50	-73.01767329	41.16603877	JD190	Mud
SB76-G2	2023-008-046	P7100083.JPG	224945	7/9/23 22:50	-73.01767329	41.16603877	JD190	Mud
NB83	2023-008-047	P7100001.JPG	121300	7/10/23 12:13	-72.98219153	41.18702003	JD191	Mud
NB83	2023-008-047	P7100002.JPG	121300	7/10/23 12:13	-72.98219153	41.18702003	JD191	Mud
NB85	2023-008-048	P7100012.JPG	123920	7/10/23 12:39	-72.97901182	41.20770084	JD191	Mud
NB85	2023-008-048	P7100013.JPG	123920	7/10/23 12:39	-72.97901182	41.20770084	JD191	Mud
NB78	2023-008-050	P7100036.JPG	162305	7/10/23 16:23	-72.99660768	41.20045119	JD191	Mud, label illegible, based on CC Log
NB78	2023-008-050	P7100037.JPG	162305	7/10/23 16:23	-72.99660768	41.20045119	JD191	Mud, label illegible, based on CC Log
NB79	2023-008-051	P7100039.JPG	170800	7/10/23 17:08	-73.00104971	41.18330875	JD191	Sand, label illegible, based on CC Log
NB79	2023-008-051	P7100040.JPG	170800	7/10/23 17:08	-73.00104971	41.18330875	JD191	Sand, label illegible, based on CC Log
NB76	2023-008-052	None						Grab failed
NB71	2023-008-053	P7100046.JPG						Time of grab unknown
NB71	2023-008-053	P7100047.JPG						Time of grab unknown
NB72	2023-008-054	P7100049.JPG	205925	7/10/23 20:59	-73.0393161	41.17282928	JD191	Sandy, with some shell

LISMaRC Site Name	SEABOSS Site Name	Photo Name	UTC	DateTime_MSE xcel	Longitude	Latitude	JD	Comments
NB72	2023-008-054	P7100051.JPG	205925	7/10/23 20:59	-73.0393161	41.17282928	JD191	Sandy, with some shell
SB75-G2	2023-008-055	P7100052.JPG	212120	7/10/23 21:21	-73.05587705	41.16222895	JD191	Mud, label says NB75, should be SB75-2
SB75-G2	2023-008-055	P7100053.JPG	212120	7/10/23 21:21	-73.05587705	41.16222895	JD191	Mud, label says NB75, should be SB75-2
NB67	2023-008-057	P7110064.JPG	120713	7/11/23 12:07	-73.06386396	41.15302862	JD192	Mud
NB67	2023-008-057	P7110065.JPG	120713	7/11/23 12:07	-73.06386396	41.15302862	JD192	Mud
NB69	2023-008-058	P7110067.JPG	125745	7/11/23 12:58	-73.0513069	41.13655162	JD192	Mud
NB69	2023-008-058	P7110069.JPG	125745	7/11/23 12:58	-73.0513069	41.13655162	JD192	Mud
NB74	2023-008-059	P7110070.JPG	134150	7/11/23 13:42	-73.01800193	41.13269561	JD192	Mud
NB74	2023-008-059	P7110071.JPG	134150	7/11/23 13:42	-73.01800193	41.13269561	JD192	Mud
NB68	2023-008-060	P7110073.JPG	142659	7/11/23 14:27	-73.04909484	41.11596538	JD192	Mud
NB68	2023-008-060	P7110075.JPG	142659	7/11/23 14:27	-73.04909484	41.11596538	JD192	Mud
NB75	2023-008-061	P7110076.JPG	150700	7/11/23 15:07	-73.01909734	41.11568459	JD192	Mud
NB75	2023-008-061	P7110077.JPG	150700	7/11/23 15:07	-73.01909734	41.11568459	JD192	Mud
NB70	2023-008-062	P7110080.JPG	154700	7/11/23 15:47	-73.03833704	41.09743514	JD192	Labels illegible, time makes sense, Mud
NB70	2023-008-062	P7110081.JPG	154700	7/11/23 15:47	-73.03833704	41.09743514	JD192	Labels illegible, time makes sense, Mud
NB73	2023-008-063	P7110083.JPG	170559	7/11/23 17:06	-73.02599381	41.08180832	JD192	Mud
NB73	2023-008-063	P7110084.JPG	170559	7/11/23 17:06	-73.02599381	41.08180832	JD192	Mud
NB77	2023-008-064	P7110086.JPG	175758	7/11/23 17:58	-72.99884928	41.06781017	JD192	Mud
NB77	2023-008-064	P7110087.JPG	175758	7/11/23 17:58	-72.99884928	41.06781017	JD192	Mud
NB82	2023-008-065	P7110089.JPG	184725	7/11/23 18:47	-72.97999108	41.07313928	JD192	Sand
NB82	2023-008-065	P7110090.JPG	184725	7/11/23 18:47	-72.97999108	41.07313928	JD192	Sand
NB91	2023-008-066	P7110095.JPG	193509	7/11/23 19:35	-72.9619936	41.07043763	JD192	Sand with shells
NB91	2023-008-066	P7110096.JPG	193509	7/11/23 19:35	-72.9619936	41.07043763	JD192	Sand with shells
NB88	2023-008-067	P7110098.JPG	202757	7/11/23 20:28	-72.96695672	41.05533186	JD192	Label illegible, time makes sense, Sand with some shells
NB88	2023-008-067	P7110099.JPG	202757	7/11/23 20:28	-72.96695672	41.05533186	JD192	Label illegible, time makes sense, Sand with some shells
NB96	2023-008-068	P7110104.JPG	202050	7/11/23 20:21	-72.96692391	41.05570895	JD192	Mud
NB96	2023-008-068	P7110105.JPG	202050	7/11/23 20:21	-72.96692391	41.05570895	JD192	Mud
NB98	2023-008-069	P7110107.JPG	220907	7/11/23 22:09	-72.94578818	41.0253679	JD192	Brown mud
NB98	2023-008-069	P7110109.JPG	220907	7/11/23 22:09	-72.94578818	41.0253679	JD192	Brown mud
NB99	2023-008-070	P7120001.JPG	114336	7/12/23 11:44	-72.94426944	41.08115435	JD193	Brown mud
NB99	2023-008-070	P7120002.JPG	114336	7/12/23 11:44	-72.94426944	41.08115435	JD193	Brown mud
SB79-G1	2023-008-071	P7120005.JPG	123235	7/12/23 12:33	-72.97035616	41.07744504	JD193	Sand with shells, label illegible, based on CC Log

LISMaRC Site Name	SEABOSS Site Name	Photo Name	UTC	DateTime_MSE xcel	Longitude	Latitude	JD	Comments
SB79-G1	2023-008-071	P7120006.JPG	123235	7/12/23 12:33	-72.97035616	41.07744504	JD193	Sand with shells, label illegible, based on CC Log
SB79-G2	2023-008-072	P7120009.JPG	125234	7/12/23 12:53	-72.96688201	41.08266197	JD193	Sand with shells, label illegible, based on CC Log
SB79-G2	2023-008-072	P7120010.JPG	125234	7/12/23 12:53	-72.96688201	41.08266197	JD193	Sand with shells, label illegible, based on CC Log
SB78-G2	2023-008-073	P7120013.JPG	130914	7/12/23 13:09	-72.9773647	41.08589021	JD193	Mud
SB78-G2	2023-008-073	P7120016.JPG	130914	7/12/23 13:09	-72.9773647	41.08589021	JD193	Mud
SB78-G1	2023-008-074	P7120019.JPG	135052	7/12/23 13:51	-72.97319367	41.09266819	JD193	Mud
SB78-G1	2023-008-074	P7120020.JPG	135052	7/12/23 13:51	-72.97319367	41.09266819	JD193	Mud
NB80	2023-008-075	P7120024.JPG	144841	7/12/23 14:49	-72.99215991	41.09942664	JD193	Mud
NB80	2023-008-075	P7120026.JPG	144841	7/12/23 14:49	-72.99215991	41.09942664	JD193	Mud
NB97	2023-008-076	P7120027.JPG	154746	7/12/23 15:48	-72.94552692	41.10099801	JD193	Mud
NB97	2023-008-076	P7120028.JPG	154746	7/12/23 15:48	-72.94552692	41.10099801	JD193	Mud
NB94	2023-008-077	P7120034.JPG	163955	7/12/23 16:40	-72.94567187	41.11586831	JD193	Sand with shells
NB94	2023-008-077	P7120035.JPG	163955	7/12/23 16:40	-72.94567187	41.11586831	JD193	Sand with shells
NB89	2023-008-078	P7120061.JPG	174642	7/12/23 17:47	-72.96347853	41.11630746	JD193	Sandy mud w tube
NB89	2023-008-078	P7120062.JPG	174642	7/12/23 17:47	-72.96347853	41.11630746	JD193	Sandy mud
NB84	2023-008-079	P7120067.JPG	182806	7/12/23 18:28	-72.97909101	41.12756726	JD193	Mud
NB84	2023-008-079	P7120070.JPG	182806	7/12/23 18:28	-72.97909101	41.12756726	JD193	Mud
NB81	2023-008-080	P7120075.JPG	191602	7/12/23 19:16	-72.99293675	41.14171131	JD193	Mud
NB81	2023-008-080	P7120077.JPG	191602	7/12/23 19:16	-72.99293675	41.14171131	JD193	Mud
NB87	2023-008-081	P7120078.JPG	200232	7/12/23 20:03	-72.9688804	41.1360341	JD193	Sand, label illegible, based on CC Log
NB87	2023-008-081	P7120080.JPG	200232	7/12/23 20:03	-72.9688804	41.1360341	JD193	Sand, label illegible, based on CC Log
NB90	2023-008-082	P7120081.JPG	210217	7/12/23 21:02	-72.96542222	41.14446006	JD193	Mud
NB90	2023-008-082	P7120082.JPG	210217	7/12/23 21:02	-72.96542222	41.14446006	JD193	Mud
NB95	2023-008-083	P7120086.JPG	215434	7/12/23 21:55	-72.94783675	41.13360694	JD193	Mud - note there is another NB95 on JD194 after NB100 in Survey Log
NB95	2023-008-083	P7120087.JPG	215434	7/12/23 21:55	-72.94783675	41.13360694	JD193	Mud - note there is another NB95 on JD194 after NB100 in Survey Log
NB86	2023-08-084	P7130001.JPG	120403	7/13/23 12:04	-72.97110483	41.17211861	JD194	Mud
NB86	2023-08-084	P7130002.JPG	120403	7/13/23 12:04	-72.97110483	41.17211861	JD194	Mud
NB100	2023-08-085	P7130003.JPG	131553	7/13/23 13:16	-72.93648831	41.18320532	JD194	Mud
NB100	2023-08-085	P7130004.JPG	131553	7/13/23 13:16	-72.93648831	41.18320532	JD194	Mud

LISMaRC Site Name	SEABOSS Site Name	Photo Name	UTC	DateTime_MSE xcel	Longitude	Latitude	JD	Comments
NB95-2	2023-08-086	P7130006.JPG	134615	7/13/23 13:46	-72.94799768	41.13558575	JD194	Mud - Take 2..got location from bottom images
NB95-2	2023-08-086	P7130007.JPG	134615	7/13/23 13:46	-72.94799768	41.13558575	JD194	Mud - Take 2..got location from bottom images
NB101	2023-08-087	P7130013.JPG	143306	7/13/23 14:33	-72.92809225	41.15030161	JD194	Mud
NB101	2023-08-087	P7130014.JPG	143306	7/13/23 14:33	-72.92809225	41.15030161	JD194	Mud
NB104	2023-08-088	P7130015.JPG	151742	7/13/23 15:18	-72.90376348	41.15591851	JD194	Mud
NB104	2023-08-088	P7130016.JPG	151742	7/13/23 15:18	-72.90376348	41.15591851	JD194	Mud
SB83-G3	2023-08-089	P7130025.JPG	153755	7/13/23 15:38	-72.90607451	41.16840278	JD194	Mud
SB83-G3	2023-08-089	P7130027.JPG	153755	7/13/23 15:38	-72.90607451	41.16840278	JD194	Mud
SB83-G2	2023-08-090	P7130030.JPG	154806	7/13/23 15:48	-72.90883294	41.16867624	JD194	Mud
SB83-G2	2023-08-090	P7130033.JPG	154806	7/13/23 15:48	-72.90883294	41.16867624	JD194	Mud
SB83-G1	2023-08-091	P7130038.JPG	162715	7/13/23 16:27	-72.90671297	41.17056879	JD194	Mud
SB83-G1	2023-08-091	P7130040.JPG	162715	7/13/23 16:27	-72.90671297	41.17056879	JD194	Mud

D. SEABOSS Seafloor Image Location Logs

Note: No images were captured for JD 187

JD188 Image Locations
JD189 Image Locations
JD190 Image Locations
JD191 Image Locations
JD192 Image Locations
JD193 Image Locations
JD194 Image Locations

ID188 Image Locations

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD188	NB114	120238	-72.8211757	41.22620889	1688731358	20230707120238_000-1.tif	SEABOSS Site: 2023-008-002 Sand with shell
JD188	NB114	120456	-72.82144338	41.22615968	1688731496	20230707120456_000-1.tif	Sand w shell fragments
JD188	NB114	120651	-72.82155863	41.22616238	1688731611	20230707120651_000-1	Sand w shell fragments
JD188	NB114	121049	-72.82156345	41.22672362	1688731849	20230707121049_000-1.tif	Sand w shell fragments
JD188	NB114	121245	-72.82200267	41.22688674	1688731965	20230707121245_000-1.tif	Sand w shell fragments
JD188	NB114	121344	-72.822215	41.22697387	1688732024	20230707121344_000-1.tif	Sand w shell fragments
JD188	NB114	121443	-72.82227584	41.22702371	1688732083	20230707121443_000-1.tif	Sand w lots of shell, No grab observed in FLIR pics, GoPro not used until NB120
JD188	NB115	132254	-72.8242989	41.20084341	1688736174	2023-008-004-20230707132254_000-1	SEABOSS Site: 2023-008-004, Mud w burrow
JD188	NB115	132522	-72.82416216	41.20096408	1688736322	2023-008-004-20230707132522_000-1.tif	Mud w burrows
JD188	NB115	132825	-72.82422847	41.2010832	1688736505	2023-008-004-20230707132825_000-1.tif	Mud w burrows
JD188	NB115	133122	-72.82383764	41.20120223	1688736682	2023-008-004-20230707133122_000-1.tif	Mud w burrow, Last image in deploy, no grab observed
JD188	NB120	152025	-72.79814686	41.17468336	1688743225	G0031782.JPG	SEABOSS Site: 2023-008-006, no FLIR images, used GoPro, Mud
JD188	NB120	152249	-72.79802445	41.17478788	1688743369	G0031854.JPG	Poor vis, mud w some shell
JD188	NB120	152457	-72.79786053	41.1749495	1688743497	G0031918.JPG	Poor vis, mud w some shell
JD188	NB120	152817	-72.79760406	41.17526797	1688743697	G0032018.JPG	Poor vis, mud w some shell
JD188	NB120	152921	-72.79755917	41.17532796	1688743761	G0032050.JPG	Last image w bottom in sight, cant tell if grab was taken
JD188	NB116	161600	-72.81965988	41.1875852	1688746560	G0062737.JPG	SEABOSS Site: 2023-008-007, poor vis, a shell is only thing visible
JD188	NB116	161818	-72.81960078	41.18745807	1688746698	G0062806.JPG	Image as grab taken?
JD188	NB116	162126	-72.81953598	41.18731498	1688746886	G0062900.JPG	Bottom visible (barely) again, then system recovered
JD188	NB117	124440	-72.81043533	41.2193317	1688733880	2023_188_2-20230707124440_000-1.tif	SEABOSS Site: 2023-08-003, Sand with shells
JD188	NB117	124745	-72.81046633	41.21908579	1688734065	2023_188_2-20230707124745_000-1.tif	Sand w fine shell fragments
JD188	NB117	124800	-72.81045049	41.21906798	1688734080	2023_188_2-20230707124800_000-1.tif	Sand w fine shell fragments, bryozoan tuft?
JD188	NB117	124957	-72.8101529	41.21892651	1688734197	2023_188_2-20230707124957_000-1.tif	Sand w fine shell fragments, bryozoan tuft?
JD188	NB117	125201	-72.80987449	41.21864282	1688734321	2023_188_2-20230707125201_000-1.tif	Muddy sand w shells
JD188	NB117	125311	-72.80981887	41.21851189	1688734391	2023_188_2-20230707125311_000-1.tif	Muddy sand w shells, Last image, no grab recorded
JD188	NB113	170216	-72.83866003	41.16002269	1688749336	G0073269.JPG	SEABOSS Site:2023-008-008, poor vis, mud
JD188	NB113	170400	-72.83865668	41.16002548	1688749440	G0073321.JPG	Mud, burrows

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD188	NB113	170720	-72.83877399	41.16033947	1688749640	G0073421.JPG	Mud, burrows
JD188	NB113	171042	-72.83889903	41.16070525	1688749842	G0073522.JPG	Mud, burrows
JD188	NB113	171330	-72.83904169	41.16099203	1688750010	G0073606.JPG	Burrows, shell hash
JD188	NB113	171610	-72.83920615	41.16126127	1688750170	G0073686.JPG	Mud, burrows
JD188	NB113	171718	-72.839276	41.16135264	1688750238	G0073720.JPG	Last image before grab, mud
JD188	NB112	175955	-72.83904478	41.17530152	1688752854	G0084005.JPG	SEABOSS Site: 2023-008-009, Mud
JD188	NB112	180346	-72.83903977	41.17555659	1688753085	G0084120.JPG	Mud, burrow
JD188	NB112	180707	-72.8390302	41.1759444	1688753286	G0084221.JPG	Lo vis, mud
JD188	NB112	181038	-72.83904807	41.17608206	1688753497	G0084326.JPG	Mud, Last image before grab
JD188	SB87-G1	183916	-72.84657045	41.19446153	1688755215	G0094543.JPG	SEABOSS Site: 2023-008-010, mud
JD188	SB87-G1	184214	-72.84645487	41.19460821	1688755393	G0094632.JPG	Shell hash
JD188	SB87-G1	184532	-72.84633358	41.19477324	1688755591	G0094731.JPG	Mud, shell
JD188	SB87-G1	184852	-72.84621544	41.1949397	1688755791	G0094831.JPG	Mud, shell
JD188	SB87-G1	185218	-72.84608458	41.19510348	1688755997	G0094934.JPG	Mud, burrow
JD188	SB87-G1	185800	-72.84592559	41.19531929	1688756339	G0095105.JPG	Last image before grab, mud shell
JD188	SB87-G1	185802	-72.84592517	41.19531997	1688756341	G0095106.JPG	Mud, image at time of grab
JD188	SB87-G2	192339	-72.84191804	41.19564699	1688757878	G0105226.JPG	SEABOSS Site: 2023-008-11, mud, burrow
JD188	SB87-G2	192501	-72.84191672	41.19564376	1688757960	G0105267.JPG	Mud, burrow, shell fragments, last image before grab
JD188	SB87-G3	194034	-72.83943287	41.19619629	1688758893	G0125418.JPG	SEABOSS Site: 2023-008-012, first useful image, grab only site, mud w small burrows
JD188	SB87-G3	194248	-72.8394371	41.19619989	1688759027	G0125485.JPG	Mud, some shell, gray sediment on bottom, system recovered after this, grab taken - not clear
JD188	SB86-G2	201222	-72.85777958	41.21047083	1688760801	G0135588.JPG	SEABOSS Site: 2023-008-013, shell hash
JD188	SB86-G2	201322	-72.85777814	41.21046921	1688760861	G0135623.JPG	Last image before grab, mud, shell hash
JD188	SB86-G3	202746	-72.85878752	41.21025732	1688761725	G0145720.JPG	SEABOSS Site: 2023-008-014, Mud w/ shell hash, whelk shell
JD188	SB86-G3	202940	-72.8587868	41.21026557	1688761839	G0145777.JPG	Last image before grab, mud, shell
JD188	SB86-G1	205042	-72.86010641	41.21195667	1688763101	G0155873.JPG	SEABOSS Site: 2023-008-015, first useable, shell
JD188	SB86-G1	205213	-72.86010369	41.21195975	1688763192	G0155919.JPG	Last image before grab, mud, shells

JD189 Image Locations

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD189	NB111	122406	-72.84537067	41.22072938	1688819046	2023-008-016-20230708122406_000-1	SEABOSS Site: 2023-08-016, Mud w/ burrow
JD189	NB111	122905	-72.84533864	41.22032652	1688819345	2023-008-016-20230708122905_000-1.tif	Shell hash over entire image
JD189	NB111	123358	-72.84529228	41.21991412	1688819638	2023-008-016-20230708123358_000-1.tif	Mud
JD189	NB111	123904	-72.84525406	41.21949524	1688819944	2023-008-016-20230708123904_000-1.tif	Mud
JD189	NB111	124249	-72.84522415	41.21917717	1688820169	2023-008-016-20230708124249_000-9.tif	Mud w lighter gray surface "deposits"
JD189	NB111	124805	-72.8451824	41.218736	1688820485	2023-008-016-20230708124805_000-72.tif	Mud w burrow and light gray deposit
JD189	NB111	125300	-72.84513514	41.21833241	1688820780	2023-008-016-20230708125300_000-131.tif	Mud, small burrows
JD189	NB111	125801	-72.84511461	41.21791721	1688821081	2023-008-016-20230708125801_000-191.tif	Mud, small burrows
JD189	NB111	132018	-72.84496834	41.216085	1688822418	2023-008-016-20230708132018_000-458	Mud, image at time of grab
JD189	SB85-G3-T	140400	-72.87651734	41.21441407	1688825040	2023-008-017-20230708140400_000-92.tif	SEABOSS Site: 2023-08-017, mud w burrow and few small shell fragments
JD189	SB85-G3-T	140901	-72.87640846	41.21462653	1688825341	2023-008-017-20230708140901_000-152.tif	Mud w few small shell fragments
JD189	SB85-G3-T	141301	-72.8762623	41.21493611	1688825581	2023-008-017-20230708141301_000-200.tif	Mud w few small shell fragments
JD189	SB85-G3-T	141801	-72.87605335	41.2153269	1688825881	2023-008-017-20230708141801_000-260.tif	Mud w few small shell fragments
JD189	SB85-G3-T	142152	-72.87588469	41.21563562	1688826112	2023-008-017-20230708142152_000-305.tif	Mud, shell fragments, Sponge??
JD189	SB85-G3-T	142302	-72.87583826	41.21572217	1688826182	2023-008-017-20230708142302_000-319.tif	Mud w few small shell fragments, tubes
JD189	SB85-G3-T	142332	-72.87583893	41.21572901	1688826212	2023-008-017-20230708142332_000-325.tif	Mud w shell fragments, last image before grab
JD189	SB85-G2	143928	-72.87038437	41.21831435	1688827168	2023-008-017-20230708143928_000-1.tif	SEABOSS Site: 2023-08-018, mud w lots of shells - Crepidula?
JD189	SB85-G2	144054	-72.87046469	41.21826115	1688827254	2023-008-017-20230708144054_000-9.tif	Mud w shell fragments
JD189	SB85-G2	144112	-72.8704681	41.21825436	1688827272	2023-008-017-20230708144124_000-15.tif	Mud w shell fragments
JD189	SB85-G2	144134	-72.87046737	41.21824718	1688827294	2023-008-017-20230708144134_000-17.tif	Mud w shell fragments, last image before grab
JD189	SB85-G1	145452	-72.87173913	41.21882997	1688828092	2023-008-019-20230708145452_000-1.tif	SEABOSS Site: 2023-08-019, mud w shell fragments
JD189	SB85-G1	145553	-72.87174124	41.21883363	1688828153	2023-008-019-20230708145553_000-1.tif	Mud w lots of shell fragments - Crepidula?
JD189	SB85-G1	145617	-72.87173628	41.21883451	1688828177	2023-008-019-20230708145617_000-1.tif	Mud w shell fragments, last FLIR image - before grab? Check GoPro pics
JD189	SB86-T	151407	-72.86212198	41.21132534	1688829247	2023-008-020-20230708151407_000-4.tif	SEABOSS Site: 2023-08-020, boulders w bryozoans
JD189	SB86-T	151507	-72.8621178	41.21131767	1688829307	2023-008-020-20230708151507_000-16.tif	Sand, boulder w bryozoan and Astrangia
JD189	SB86-T	151527	-72.86211669	41.21132055	1688829327	2023-008-020-20230708151527_000-20.tif	Sand, boulder w bryozoan and Astrangia
JD189	SB86-T	151607	-72.86206793	41.21134811	1688829367	2023-008-020-20230708151607_000-28.tif	Sand, boulder w bryozoan and Diadumene anemone
JD189	SB86-T	151722	-72.86195691	41.21139361	1688829442	2023-008-020-20230708151722_000-43.tif	Boulder w bryozoan and Diadumene anemone

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD189	SB86-T	151848	-72.86181344	41.21144532	1688829528	2023-008-020-20230708151848_000-60.tif	Boulder w bryozoan and Diadumene anemone
JD189	SB86-T	152013	-72.8616744	41.21149469	1688829613	2023-008-020-20230708152013_000-77.tif	Sand, cobble, small shell fragments
JD189	SB86-T	152113	-72.86157177	41.21153056	1688829673	2023-008-020-20230708152113_000-89.tif	Sand, boulder w bryozoans, shell fragments
JD189	SB86-T	152313	-72.86136676	41.21160514	1688829793	2023-008-020-20230708152313_000-113.tif	Sand shell fragments
JD189	SB86-T	152513	-72.86117499	41.21167637	1688829913	2023-008-020-20230708152513_000-137.tif	Sand, shell fragments, bryozoans
JD189	SB86-T	152813	-72.86088303	41.21179271	1688830093	2023-008-020-20230708152813_000-173.tif	Sand w shell fragments - Crepidula?
JD189	SB86-T	153113	-72.860577	41.21191441	1688830273	2023-008-020-20230708153113_000-209.tif	Sand w shell fragments - Crepidula?
JD189	SB86-T	153243	-72.86044428	41.21198115	1688830363	2023-008-020-20230708153243_000-227.tif	Sand w shell fragments , Sea Robin
JD189	SB86-T	153313	-72.86039928	41.21200398	1688830393	2023-008-020-20230708153313_000-233.tif	Sand shell fragments
JD189	SB86-T	153338	-72.86035806	41.21202212	1688830418	2023-008-020-20230708153338_000-238.tif	Sand, tube, shell fragments, last FLIR - checked GoPro images for grab validation, no TC close..skipped to 17 per previous site nots
JD189	NB105	171027	-72.89684329	41.20641363	1688836227	G0068981.JPG	SEABOSS Site: 2023-08-021, Muddy sand w lots of large shell fragments
JD189	NB105	171207	-72.89679291	41.20639988	1688836327	G0069031.JPG	Muddy sand w shell fragments
JD189	NB105	171317	-72.89668177	41.20634703	1688836397	G0069066.JPG	Muddy sand w lots of large shell fragments
JD189	NB105	171457	-72.89651692	41.20626683	1688836497	G0069116.JPG	Muddy sand w shell fragments, small cobbles?
JD189	NB105	171813	-72.89622166	41.20612027	1688836693	G0069214.JPG	Muddy sand w lots of large shell fragments
JD189	NB105	172135	-72.89591605	41.205959	1688836895	G0069315.JPG	Muddy sand w shell fragments, small cobbles?
JD189	NB105	172451	-72.89561117	41.20580496	1688837091	G0069413.JPG	Muddy sand w shell fragments
JD189	NB105	172813	-72.89530444	41.20565391	1688837293	G0069514.JPG	Muddy sand w lots of large shell fragments
JD189	NB105	173151	-72.8949726	41.20548002	1688837511	G0069623.JPG	Muddy sand w shell fragments
JD189	NB105	173305	-72.89487277	41.20541991	1688837585	G0069660.JPG	Grab taken, muddy cloud
JD189	NB108	180039	-72.86542614	41.20282801	1688839239	G0080045.JPG	SEABOSS Site: 2023-08-022, first useable image, mud burrows
JD189	NB108	180305	-72.86552986	41.20278286	1688839385	G0080118.JPG	Hit bottom, mud cloud...no grab?
JD189	NB108	180441	-72.86568936	41.2027283	1688839481	G0080166.JPG	Mud w burrows
JD189	NB108	180803	-72.86603281	41.2026137	1688839683	G0080267.JPG	Mud, terrible visibility
JD189	NB108	181105	-72.86619264	41.20256665	1688839865	G0080358.JPG	Mud, just before grab?..lots of images of same spot on bottom, but no cloud from grab, the next images are moving up in water column?

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD189	NB109	184306	-72.8702517	41.19601236	1688841786	G0110626.JPG	SEABOSS Site: 2023-08-023, Terrible vis, mud cloud, first image, appears SEABOSS hit the bottom, not sure if grab tripped on this image
JD189	NB109	184628	-72.870063	41.19587808	1688841988	G0110727.JPG	Mud, light gray surface "deposits"
JD189	NB109	185034	-72.86989007	41.19569761	1688842234	G0110850.JPG	Shell hash?
JD189	NB109	185430	-72.86961704	41.19543645	1688842470	G0110968.JPG	Mud, burrows, deposits, few shell fragments
JD189	NB109	185752	-72.86938841	41.19521664	1688842672	G0111069.JPG	Mud, burrows
JD189	NB109	190136	-72.86915467	41.19497855	1688842896	G0111181.JPG	Mud, Libinia in image
JD189	NB109	190238	-72.86917744	41.19499042	1688842958	G0111212.JPG	Mud, burrows, Image just before grab, lots of same place, then up in the water column, no cloud visible
JD189	NB106	193050	-72.88258271	41.18730124	1688844650	G0121605.JPG	SEABOSS Site: 2023-08-024, First image on bottom is mud w a cloud as system hit bottom
JD189	NB106	193408	-72.88264914	41.18739932	1688844848	G0121704.JPG	Mud, Sea Robin in image
JD189	NB106	193740	-72.88285447	41.18766505	1688845060	G0121810.JPG	Mud, burrow
JD189	NB106	194420	-72.88326141	41.18812567	1688845460	G0122010.JPG	Terrible vis, switched to 200 sec interval
JD189	NB106	195104	-72.88375771	41.18852965	1688845864	G0122212.JPG	Mud, burrow, small shell fragments
JD189	NB106	195414	-72.88400506	41.18866393	1688846054	G0122307.JPG	Mud w burrow, shell fragments, next image is the grab
JD189	NB106	195416	-72.88400528	41.18866392	1688846056	G0122308.JPG	Mud, cloud as grab taken
JD189	NB110	202028	-72.86207314	41.17540914	1688847628	G0132810.JPG	SEABOSS Site: 2023-08-025, First useful image, mud, burrow
JD189	NB110	202500	-72.86199972	41.17523561	1688847900	G0132946.JPG	Terrible vis, large burrow
JD189	NB110	202754	-72.86190973	41.17499997	1688848074	G0133033.JPG	Mud, burrow
JD189	NB110	203026	-72.8618418	41.17479097	1688848226	G0133109.JPG	Mud, Libinia stirring up mud bottom
JD189	NB110	203346	-72.86175593	41.17451968	1688848426	G0133209.JPG	Mud, tubes
JD189	NB110	204036	-72.86161582	41.1739631	1688848836	G0133414.JPG	Mud, tubes
JD189	NB110	204406	-72.86152542	41.17371035	1688849046	G0133519.JPG	Mud, burrow, image before grab
JD189	NB110	204408	-72.8615256	41.17371137	1688849048	G0133520.JPG	Mud cloud, image at grab
JD189	NB107	211234	-72.87752825	41.16265469	1688850754	G0144342.JPG	SEABOSS Site: 2023-08-026, First useable image, mud, tube
JD189	NB107	211626	-72.8775785	41.16282775	1688850986	G0144458.JPG	Bad vis, no lasers, light clay deposit on surface
JD189	NB107	211708	-72.87759501	41.16288131	1688851028	G0144479.JPG	Mud, gray clay, burrow
JD189	NB107	212022	-72.87769426	41.16314498	1688851222	G0144576.JPG	Mud,, small depressions
JD189	NB107	212352	-72.87778652	41.1634294	1688851432	G0144681.JPG	Mud
JD189	NB107	212712	-72.87762762	41.16344373	1688851632	G0144781.JPG	Mud, small burrow, track

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD189	NB107	213200	-72.87718206	41.16363867	1688851920	G0144925.JPG	Mud, burrow, shells
JD189	NB107	213628	-72.87739558	41.16386443	1688852188	G0145059.JPG	Poor vis, mud, one shell
JD189	NB107	213804	-72.8774806	41.16394612	1688852284	G0145107.JPG	Image before grab

JD190 Image Locations

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD190	NB93	120938	-72.94702077	41.209361	1688904578	2023-08-029-07092023120938-19.tiff	SEABOSS Site: 2023-08-029, first useable image, mud, shell fragments
JD190	NB93	121039	-72.94704296	41.209346	1688904639	2023-08-029-07092023121039-31.tiff	Mud, shells, Crepidula?
JD190	NB93	121242	-72.94721159	41.209232	1688904762	2023-08-029-07092023121242-43.tiff	Mud
JD190	NB93	121428	-72.94735825	41.209139	1688904868	2023-08-029-07092023121428-73.tiff	Mud, shells
JD190	NB93	121736	-72.94760956	41.208961	1688905056	2023-08-029-07092023121736-98.tiff	Mud, shell, NOTE: Camera taking many dark shots, plan is to skip 200 images, but not always possible as many are dark
JD190	NB93	122045	-72.94787537	41.208789	1688905245	2023-08-029-07092023122045-129.tiff	Mud, shell
JD190	NB93	122345	-72.94812572	41.208627	1688905425	2023-08-029-07092023122345-146.tiff	Mud, shell
JD190	NB93	122748	-72.94839374	41.208399	1688905668	2023-08-029-07092023122748-8.tiff	Mud, shell
JD190	NB93	123144	-72.94868004	41.208117	1688905904	2023-08-029-07092023123144-29.tiff	Mud, shell, other
JD190	NB93	123543	-72.94901861	41.207884	1688906143	2023-08-029-07092023123543-62.tiff	Mud, small shell fragments
JD190	NB93	124054	-72.94947266	41.207585	1688906454	2023-08-029-07092023124054-92.tiff	Mud, shell, Last image before grab
JD190	SB82-G1	130351	-72.9198526	41.208181	1688907831	2023-08-030-07092023130351-4.tiff	SEABOSS Site: 2023-08-030, First useable image on bottom, sand, shell fragments, Crepidula?
JD190	SB82-G1	130401	-72.91984611	41.20818	1688907841	2023-08-030-07092023130401-9.tiff	Sand lots of shell fragments
JD190	SB82-G1	130418	-72.91983292	41.20818	1688907858	2023-08-030-07092023130418-17.tiff	Sand, lots of shell fragments, Last image before grab
JD190	SB82-G3	131351	-72.91839492	41.208569	1688908431	2023-08-031-07092023131351-2.tiff	SEABOSS Site: 2023-08-031, First useful pic on bottom, lots of shells
JD190	SB82-G3	131403	-72.91839243	41.208567	1688908443	2023-08-031-07092023131403-10.tiff	Lots of shells, sponge
JD190	SB82-G3	131430	-72.91838985	41.208567	1688908470	2023-08-031-07092023131430-23.tiff	Lots of shells, Last image before grab
JD190	SB82-G2-T	132845	-72.91455131	41.213606	1688909325	2023-08-032-07092023132845-4.tiff	SEABOSS Site 2023-08-032, First useable pic on bottom, dense Crepidula shells
JD190	SB82-G2-T	133142	-72.91478989	41.213422	1688909502	2023-08-032-07092023133142-44.tiff	Dense Crepidula
JD190	SB82-G2-T	133444	-72.91494886	41.213249	1688909684	2023-08-032-07092023133444-64.tiff	Dense Crepidula
JD190	SB82-G2-T	133736	-72.91509962	41.213069	1688909856	2023-08-032-07092023133736-82.tiff	Dense Crepidula
JD190	SB82-G2-T	134043	-72.91527587	41.2128	1688910043	2023-08-032-07092023134043-97.tiff	Dense Crepidula
JD190	SB82-G2-T	134346	-72.91550021	41.212604	1688910226	2023-08-032-07092023134346-118.tiff	Crepidula shell fragments
JD190	SB82-G2-T	134742	-72.91579164	41.212362	1688910462	2023-08-032-07092023134742-153.tiff	Dense Crepidula

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD190	SB82-G2-T	135142	-72.91608117	41.212103	1688910702	2023-008-032-07092023135142-185.tiff	Dense Crepidula
JD190	SB82-G2-T	135614	-72.9163791	41.211839	1688910974	2023-008-032-07092023135614-213.tiff	Last before grab - Crepidula
JD190	NB102	141643	-72.92927247	41.202171	1688912203	2023-008-032-07092023141643-3.tiff	SEABOSS site: 2023-08-033 BUT they didn't change the name from -032, First useable on bottom, sand, Crepidula shell
JD190	NB102	141831	-72.92933608	41.202133	1688912311	2023-008-032-07092023141831-34.tiff	Sand with a few shell fragments
JD190	NB102	142134	-72.92952938	41.20198	1688912494	2023-008-032-07092023142134-59.tiff	Sand with more shell fragments
JD190	NB102	142417	-72.92971291	41.201812	1688912657	2023-008-032-07092023142417-76.tiff	Dense Crepidula
JD190	NB102	142719	-72.92994406	41.201605	1688912839	2023-008-032-07092023142719-93.tiff	Sand w few shell fragments
JD190	NB102	143022	-72.93020322	41.201443	1688913022	2023-008-032-07092023143022-111.tiff	Dense Crepidula
JD190	NB102	143321	-72.93044279	41.201268	1688913201	2023-008-032-07092023143321-147.tiff	Dense Crepidula
JD190	NB102	143726	-72.93079619	41.20106	1688913446	2023-008-032-07092023143726-198.tiff	Sand w few shell fragments
JD190	NB102	144152	-72.93116083	41.200816	1688913712	2023-008-032-07092023144152-5.tiff	Sand w few shell fragments
JD190	NB102	144600	-72.93152008	41.200589	1688913960	2023-008-032-07092023144600-39.tiff	Sand w few shell fragments
JD190	NB102	145051	-72.93184858	41.200381	1688914251	2023-008-032-07092023145051-56.tiff	Sand, Crepidula, Last image before grab
JD190	NB103	151926	-72.91331898	41.186015	1688915966	G0029036.JPG	SEABOSS Site: 2023-08-034, no useful FLIR images, first useable image on bottom, mud w single Crepidula?
JD190	NB103	152926	-72.91300978	41.186695	1688916566	G0029336.JPG	Mud
JD190	NB103	153605	-72.9127897	41.187182	1688916965	G0029536.JPG	Mud, burrows
JD190	NB103	154052	-72.91262688	41.187525	1688917252	G0029679.JPG	Mud, mud cloud at Last image before grab
JD190	NB92	162638	-72.95814746	41.179987	1688919998	GOPR9760.MP4	SEABOSS site: 2023-08-035, appears they switched from images to video, as there are no images at end of subdirectory 101GOPRO, used UTC at start of the video, Bottom in site on video, mud w burrows
JD190	NB92	163624	-72.95772238	41.179405	1688920584	GP029760.MP4	Start of 2nd video, mud, burrows
JD190	NB92	164006	-72.95757837	41.179114	1688920806	GP029760.MP4	Mud, grab at 16:40:09
JD190	SB81-G2	170151	-72.94185327	41.162656	1688922111	GOPR9762.MP4	SEABOSS Site: 2023-08-036, UTC for start of Video
JD190	SB81-G2	170353	-72.94188146	41.162662	1688922233	GOPR9762.MP4	On bottom, mud w burrows
JD190	SB81-G2	170435	-72.94186433	41.162653	1688922275	GOPR9762.MP4	Mud, grab taken at 17:04:35
JD190	SB81-G1	171435	-72.93857679	41.161844	1688922875	GOPR9763.MP4	SEABOSS Site: 2023-08-037, UTC for start of Video

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD190	SB81-G1	171620	-72.9385829	41.161847	1688922980	GOPR9763.MP4	On bottom, mud
JD190	SB81-G1	171732	-72.93857429	41.161845	1688923052	GOPR9763.MP4	Grab taken, mud
JD190	SB81-G3	182443	-72.94038094	41.159517	1688927083	GOPR9764.MP4	SEABOSS Site, 2023-080038UTC at start of video on deck
JD190	SB81-G3	182734	-72.94040765	41.159521	1688927254	GOPR9764.MP4	On bottom, mud, burrows
JD190	SB81-G3	183336	-72.94035073	41.159664	1688927616	GOPR9764.MP4	End of video, mud, burrows
JD190	SB81-G3	183337	-72.9403504	41.159664	1688927617	GP019764.MP4	Start of next video, mud, burrows
JD190	SB81-G3	183529	-72.94035155	41.159656	1688927729	GP019764.MP4	Video ends at TC 18:35:29 - no grab?, subsequent video GOPR9765 only on deck, Log says grab @ 190558?
JD190	SB80-G1	193058	-72.96997909	41.159148	1688931058	G0039827.JPG	SEABOSS Site: 2023-08-039, First useable image on bottom, mud w lots of burrows, gray surface "deposits"
JD190	SB80-G1	193140	-72.96999331	41.159154	1688931100	G0039848.JPG	Mud w gray surface
JD190	SB80-G1	193147	-72.96999805	41.159155	1688931107	G0039851.JPG	Mud w gray surface, Last image before grab
JD190	SB80-G2	194312	-72.96826808	41.156665	1688931792	G0049991.JPG	SEABOSS Site: 2023-08-040, First useable image on bottom, mud w gray surface
JD190	SB80-G2	194408	-72.96826422	41.156666	1688931848	G0050019.JPG	Mud w burrow
JD190	SB80-G2	194506	-72.96826651	41.156661	1688931906	G0050049.JPG	Mud, Last image before grab
JD190	SB80-G3	200721	-72.96394433	41.153995	1688933241	G0070204.JPG	SEABOSS Site: 2023-08-041, First useable on bottom, mud w burrows
JD190	SB80-G3	201039	-72.96404733	41.154169	1688933439	G0070303.JPG	Mud, bioturbated
JD190	SB80-G3	201721	-72.96433825	41.154687	1688933841	G0070504.JPG	Mud w burrows
JD190	SB80-G3	202359	-72.96459401	41.155205	1688934239	G0070703.JPG	Mud w burrows
JD190	SB80-G3	202711	-72.96468409	41.155439	1688934431	G0070799.JPG	Mud, Last image before grab
JD190	SB77-G2	205023	-72.98649859	41.160024	1688935823	G0081062.JPG	SEABOSS Site: 2023-08-042 First useable on bottom, mud w small shell fragments
JD190	SB77-G2	205031	-72.9864987	41.160025	1688935831	G0081066.JPG	Mud w small shell fragments
JD190	SB77-G2	205057	-72.9865017	41.160026	1688935857	G0081079.JPG	Mud w small shell fragments, Last image before grab
JD190	SB77-G3	210133	-72.98803464	41.158438	1688936493	G0091250.JPG	SEANOSS Site: 2023-08-043, First useable on bottom, mud w Bryozoand tufts?
JD190	SB77-G3	210227	-72.98803564	41.158436	1688936547	G0091277.JPG	Mud w shell fragments
JD190	SB77-G3	210323	-72.98803035	41.158434	1688936603	G0091305.JPG	Mud w shell fragments, Last image before grab

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD190	SB77-G1	211428	-72.98755045	41.156757	1688937268	G0101444.JPG	SEABOSS Site: 2023-08-044, First useable image on bottom, mud w shell fragments
JD190	SB77-G1	212430	-72.98813756	41.157302	1688937870	G0101745.JPG	Mud, burrows, bryozoan tufts
JD190	SB77-G1	213210	-72.98862154	41.157842	1688938330	G0101975.JPG	Mud, burrows, bryozoan tufts
JD190	SB77-G1	213850	-72.98889998	41.158343	1688938730	G0102175.JPG	Mud, burrows, bryozoan tufts
JD190	SB77-G1	214330	-72.98905334	41.158635	1688939010	G0102315.JPG	Mud w shell fragments, Last image before grab
JD190	SB76-G1	221203	-73.02540153	41.160237	1688940723	G0112455.JPG	SEABOSS Site: 2023-08-05, First useable on bottom, mud w gray deposits
JD190	SB76-G1	221211	-73.02540178	41.160238	1688940731	G0112459.JPG	Mud w burrows and gray deposits
JD190	SB76-G1	221229	-73.02539934	41.160241	1688940749	G0112468.JPG	Mud w burrows, Last image before grab
JD190	SB76-G2	223106	-73.0167603	41.167254	1688941866	G0122775.JPG	SEABOSS Ssite: 2023-08-046, First useable image on bottom, mud w shell fragments
JD190	SB76-G2	223426	-73.01693891	41.167113	1688942066	G0122875.JPG	Mud w shell fragments
JD190	SB76-G2	224116	-73.01727815	41.166609	1688942476	G0123080.JPG	Mud w burrow
JD190	SB76-G2	224756	-73.01762239	41.166114	1688942876	G0123280.JPG	Mud w burrows
JD190	SB76-G2	224942	-73.0176751	41.166023	1688942982	G0123333.JPG	Mud w small shell fragments, burrow, Last image before grab

ID191 Image Locations

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD191	NB83	123619	-72.97899813	41.2076992	1688992579	G0013581.JPG	SEABOSS 2023-008-047, FLIR images no good - used GP, First useable image, TC does not match up w/ the log file, mud bottom
JD191	NB83	123759	-72.97900439	41.2076973	1688992679	G0013631.JPG	Mud
JD191	NB83	123925	-72.9790151	41.2077008	1688992765	G0013674.JPG	Last image before grab, Mud
JD191	NB85	144852	-72.98070681	41.2043088	1689000549	G0023750.JPG	SEABOSS Site: 2023-008-048, FLIR still stripy, used GP. Log data indicates TC of 123915 for VOB, but the GP indicates 144852?, First useable bottom pic, Mud w/ burrows
JD191	NB85	145302	-72.98093984	41.2045372	1689000799	G0023800.JPG	Mud w small burrows
JD191	NB85	145702	-72.98120887	41.2047941	1689001039	G0023850.JPG	Mud w small burrows
JD191	NB85	150122	-72.98149326	41.2050869	1689001299	G0023900.JPG	Mud w a few small shell fragments
JD191	NB85	150612	-72.9818113	41.2054057	1689001589	G0023958.JPG	Mud w a few small shell fragments
JD191	NB85	151122	-72.9821499	41.2057177	1689001899	G0024020.JPG	Last image before grab, Mud w small burrows
JD191	NB85	163302	-73.00000273	41.1892736	1689006799	G0084106.JPG	UTC check pic..Iphone indicates 4:32:51, GP indicates 163302...11 seconds fast
JD191	NB85-T	164305	-73.00336636	41.1823496	1689007402	G0094174.JPG	First useable pic on bottom - dense Crepidula, the UNIX time = 164322..17 sec difference
JD191	NB85-T	164357	-73.00332457	41.182368	1689007454	G0094200.JPG	
JD191	NB85-T	164447	-73.00324195	41.1824047	1689007504	G0094225.JPG	Diminishing Crepidula density
JD191	NB85-T	164537	-73.00315629	41.1824402	1689007554	G0094250.JPG	Some Crepidula
JD191	NB85-T	164857	-73.00284142	41.1825665	1689007754	G0094350.JPG	Skipped 100, some Crepidula
JD191	NB85-T	165036	-73.00267595	41.1826334	1689007853	G0094400.JPG	Skip 50, back in dense Crepidula
JD191	NB85-T	165217	-73.00250337	41.1826962	1689007954	G0094450.JPG	less dense Crepidula
JD191	NB85-T	165447	-73.00226057	41.1827944	1689008104	G0094525.JPG	Denser Crepidula
JD191	NB85-T	165807	-73.00193898	41.1829321	1689008304	G0094625.JPG	Shell hash
JD191	NB85-T	170245	-73.00148872	41.1831141	1689008582	G0094764.JPG	Begin dense Crepidula band
JD191	NB85-T	170605	-73.00117678	41.183256	1689008782	G0094864.JPG	Shell hash
JD191	NB85-T	170717	-73.00106692	41.1833141	1689008854	G0094900.JPG	Image G009893 begins dense Crepidula band, system raised after this 4900 image
JD191	NB85-T	170809	-73.00106554	41.1833007	1689008906	G0094926.JPG	Last image before what appears to be a grab, log says no grab for 049, mud cloud, shell fragments, sandy mud
JD191	NB78-T	173113	-73.01185404	41.1835244	1689010290	G0105065.JPG	First useabel pic - Crepidula bottom = not sure what to believe
JD191	NB78-T	173253	-73.01171708	41.183572	1689010390	G0105115.JPG	Dense Crepidula

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD191	NB78-T	173433	-73.01156155	41.1836344	1689010490	G0105165.JPG	Moderate Crepidula
JD191	NB78-T	173753	-73.01126654	41.1837481	1689010690	G0105265.JPG	Moderate Crepidula
JD191	NB78-T	174005	-73.01121568	41.1837702	1689010822	G0105331.JPG	Last image before grab
JD191	NB78-T	160216	-72.99516166	41.2016666	1689004953	2023-008-050-07102023160216-0.tiff	First image on bottom - appears muddy
JD191	NB78-T	162217	-72.9965819	41.200472	1689006154	2023-008-050-07102023162217-128.tiff	Last FLIR image on bottom..sandy mud
JD191	NB79-T	164318	-73.00336655	41.1823498	1689007415	2023-008-051-07102023164318-0.tiff	First pic, dense Crepidula
JD191	NB79-T	164519	-73.0031811	41.1824289	1689007536	2023-008-051-07102023164519-13.tiff	Sand and shell hash
JD191	NB79-T	164723	-73.00299305	41.1825074	1689007660	2023-008-051-07102023164723-28.tiff	Sand and shell hash
JD191	NB79-T	164921	-73.00279768	41.1825853	1689007778	2023-008-051-07102023164921-44.tiff	Moderate Crepidula
JD191	NB79-T	165118	-73.00260429	41.1826556	1689007895	2023-008-051-07102023165118-57.tiff	Light Crepidula
JD191	NB79-T	165315	-73.00240684	41.1827302	1689008012	2023-008-051-07102023165315-72.tiff	Sand and shell hash
JD191	NB79-T	165517	-73.002214	41.1828156	1689008134	2023-008-051-07102023165517-89.tiff	Sand and shell hash
JD191	NB79-T	165914	-73.00182753	41.1829729	1689008371	2023-008-051-07102023165914-119.tiff	Jumped 400 pics - Sand and a few Crepidula
JD191	NB79-T	170114	-73.0016339	41.1830558	1689008491	2023-008-051-07102023170114-130.tiff	
JD191	NB79-T	170650	-73.00110534	41.183288	1689008827	2023-008-051-07102023170650-184.tiff	Last image - Sand and shell hash
JD191	NB79-T	164319	-73.00336637	41.1823497	1689007416	G0094181.JPG	Dense Crepidula, but way up in water column vs FLIR
JD191	NB79-T	164723	-73.00299305	41.1825074	1689007660	G0094303.JPG	Sand and shell hash
JD191	NB79-T	164921	-73.00279768	41.1825853	1689007778	G0094362.JPG	Light Crepidula
JD191	NB71	185837	-73.03230335	41.1831023	1689015518	2023-008-53-07102023185837-0.tiff	SEABOSS Site: 2023-008-053, the only FLIR image from this deploy, dense Crepidula
JD191	NB72	204005	-73.04104814	41.1735511	1689021606	2023-008-054-07102023204005-0.tiff	SEABOSS Site: 2023-08-054 First image recorded, sandy w shell hash
JD191	NB72	204201	-73.04090173	41.1734316	1689021722	2023-008-054-07102023204201-9.tiff	Sand w shell
JD191	NB72	204223	-73.04087282	41.1734042	1689021744	2023-008-054-07102023204223-13.tiff	Sand w shell
JD191	NB72	204251	-73.04083461	41.1733777	1689021772	2023-008-054-07102023204251-16.tiff	Last useable FLIR image
JD191	NB72	204252	-73.04083349	41.1733768	1689021773	G0136208.JPG	Switched to GoPro images
JD191	NB72	204422	-73.04072592	41.1733051	1689021863	G0136254.JPG	Sand w shell
JD191	NB72	204614	-73.04057344	41.1731911	1689021975	G0136310.JPG	Sand w shell
JD191	NB72	204930	-73.04023729	41.1730859	1689022171	G0136408.JPG	Sand w shell
JD191	NB72	205300	-73.03987529	41.1729894	1689022381	G0136513.JPG	Sand w shell
JD191	NB72	205634	-73.03951193	41.172886	1689022595	G0136620.JPG	Sand w shell
JD191	NB72	205936	-73.03931603	41.1728326	1689022777	G0136711.JPG	Last image before grab, muddy sand
JD191	SB75-G2	212101	-73.05587534	41.1622311	1689024062	2023-008-055-07102023212101-11.tiff	SEABOSS Site: 2023-08-055, first useable FLIR image, sand and shell
JD191	SB75-G2	212112	-73.05587468	41.1622294	1689024073	2023-008-055-07102023212112-15.tiff	Sandy mud, burrow, last image before grab

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD191	SB75-G1	214811	-73.05308492	41.1563678	1689025692	2023-008-056-07102023214811-3.tiff	SEABOSS Site: 2023-08-056, Only 3-4 good FLIR images, way too dark, switch to GoPro shell hash
JD191	SB75-G1	214811	-73.05308492	41.1563678	1689025692	G0157283.JPG	Sandy mud w shells
JD191	SB75-G1	215131	-73.05316134	41.1564419	1689025892	G0157383.JPG	Sandy mud w shells
JD191	SB75-G1	215537	-73.0532453	41.1565382	1689026138	G0157506.JPG	Poor vis, burrow, shell
JD191	SB75-G1	215857	-73.05332766	41.1565986	1689026338	G0157606.JPG	Sandy mud w tracks
JD191	SB75-G1	220034	-73.05332931	41.1566004	1689026435	G0157654.JPG	Last image before grab, sandy mud

JD192 Image Locations

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD192	NB67	114603	-73.06547952	41.15434964	1689075964	2023-008-057-07112023114603-8.tiff	SEABOSS Site: 2023-08-057, first useable, but dark image, mud
JD192	NB67	114916	-73.06524523	41.15414442	1689076157	2023-008-057-07112023114916-45.tiff	Mud w tracks, lots of previous images not useable
JD192	NB67	115055	-73.06512396	41.15404685	1689076256	2023-008-057-07112023115055-63.tiff	Mud
JD192	NB67	115246	-73.06498917	41.15392808	1689076367	2023-008-057-07112023115246-84.tiff	Mud, burrow
JD192	NB67	115447	-73.06483324	41.15380534	1689076488	2023-008-057-07112023115447-105.tiff	Mud w surface clumps
JD192	NB67	115646	-73.06468749	41.15368604	1689076607	2023-008-057-07112023115646-133.tiff	Mud, burrows, tracks
JD192	NB67	115854	-73.06452601	41.15355952	1689076735	2023-008-057-07112023115854-161.tiff	Start of Crepidula shells
JD192	NB67	120120	-73.06434173	41.15340331	1689076881	2023-008-057-07112023120120-184.tiff	Moderate Crepidula continues
JD192	NB67	120314	-73.06417152	41.15327683	1689076995	2023-008-057-07112023120314-211.tiff	Mud w shells
JD192	NB67	120514	-73.06398616	41.15313707	1689077115	2023-008-057-07112023120514-237.tiff	Mud w tracks
JD192	NB67	120720	-73.0638608	41.15302575	1689077241	2023-008-057-07112023120720-264.tiff	Image at grab, dark
JD192	NB69	123534	-73.05340627	41.13735921	1689078935	2023-008-058-07112023123534-6.tiff	SEABOSS Site: 2023-08-058, Mud w burrows
JD192	NB69	123753	-73.053163	41.13731657	1689079074	2023-008-058-07112023123753-29.tiff	Mud, tube
JD192	NB69	124014	-73.05294361	41.137223	1689079215	2023-008-058-07112023124014-59.tiff	Mud w deposits on surface
JD192	NB69	124335	-73.05262916	41.13708093	1689079416	2023-008-058-07112023124335-99.tiff	Mud
JD192	NB69	124546	-73.05240431	41.13700532	1689079547	2023-008-058-07112023124546-115.tiff	Mud fine shell hash
JD192	NB69	124920	-73.05206401	41.13685954	1689079761	2023-008-058-07112023124920-25.tiff	Mud w deposits on surface
JD192	NB69	125301	-73.05170437	41.13671853	1689079982	2023-008-058-07112023125301-71.tiff	Mud, burrows
JD192	NB69	125741	-73.05129395	41.13655331	1689080262	2023-008-058-07112023125741-139.tiff	Last good image before grab, mud, tube
JD192	NB74	132553	-73.01890381	41.13461404	1689081954	2023-008-059-07112023132553-2.tiff	SEABOSS Site: 2023-08-059, first useable image, mud, burrows
JD192	NB74	132845	-73.01876339	41.13432455	1689082126	2023-008-059-07112023132845-48.tiff	Mud, tubes
JD192	NB74	133141	-73.01858681	41.13394565	1689082302	2023-008-059-07112023133141-92.tiff	Mud, burrows
JD192	NB74	133444	-73.01839117	41.13354049	1689082485	2023-008-059-07112023133444-137.tiff	Mud, tubes
JD192	NB74	133743	-73.0182216	41.13314645	1689082664	2023-008-059-07112023133743-178.tiff	Mud, burrows, tubes
JD192	NB74	134138	-73.01800255	41.13267337	1689082899	2023-008-059-07112023134138-241.tiff	Image before grab, mud
JD192	NB68	141248	-73.05079572	41.11715189	1689084769	2023-008-060-07112023141248-5.tiff	SEABOSS Site: 2023-08-060, first useable image, mud
JD192	NB68	141516	-73.05059401	41.11700613	1689084917	2023-008-060-07112023141516-33.tiff	Mud, burrows, tubes
JD192	NB68	141821	-73.05017345	41.11671392	1689085102	2023-008-060-07112023141821-75.tiff	Mud, burrows, gray surface deposit
JD192	NB68	142117	-73.04977187	41.11644042	1689085278	2023-008-060-07112023142117-121.tiff	Mud, large tubes
JD192	NB68	142444	-73.04930275	41.11611595	1689085485	2023-008-060-07112023142444-1.tiff	Mud, burrow
JD192	NB68	142707	-73.04906012	41.11594401	1689085628	2023-008-060-07112023142707-34.tiff	Last image before grab, mud
JD192	NB75	145536	-73.02076709	41.11651713	1689087337	2023-008-061-07112023145536-2.tiff	SEABOSS Site: 2023-08-061, first useable, mud, tube
JD192	NB75	145745	-73.02043645	41.11634445	1689087466	2023-008-061-07112023145745-29.tiff	Mud, flounder
JD192	NB75	150149	-73.01979217	41.11604804	1689087710	2023-008-061-07112023150149-19.tiff	Mud, tube

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD192	NB75	150445	-73.01933877	41.11582758	1689087886	2023-008-061-07112023150445-62.tiff	Mud, light gray deposit on surface
JD192	NB75	150716	-73.01909483	41.11568369	1689088037	2023-08-061-07112023150716-9.tiff	Last image at grab, mud, small gray deposits
JD192	NB70	153446	-73.03898959	41.0990077	1689089687	2023-008-062-07112023153446-6.tiff	SEABOSS Site: 2023-08-062, mud, tubes
JD192	NB70	153510	-73.03897057	41.09895572	1689089711	2023-008-062-07112023153510-11.tiff	Last FLIR imag, mud, burrow
JD192	NB70	153512	-73.03896892	41.09895138	1689089713	G0081508.JPG	GoPro image of same location, mud, tubes
JD192	NB70	154012	-73.03869128	41.098278	1689090013	G0081658.JPG	Mud, tube?
JD192	NB70	154510	-73.03841302	41.09761942	1689090311	G0081807.JPG	Mud, several burrows
JD192	NB70	154636	-73.03833947	41.09743805	1689090397	G0081850.JPG	Mud, burrows
JD192	NB70	154714	-73.03834432	41.09743642	1689090435	G0081869.JPG	Last image before grab
JD192	NB73	170240	-73.02623712	41.08195003	1689094961	2023-008-063-07112023170240-1.tiff	SEABOSS Site 2023-08-063, first useable, mud, burrow
JD192	NB73	170402	-73.0261183	41.08187918	1689095043	2023-008-063-07112023170402-13.tiff	Mud
JD192	NB73	170501	-73.02603003	41.08182995	1689095102	2023-008-063-07112023170501-19.tiff	Last FLIR image, mud, burrow
JD192	NB73	170502	-73.02602875	41.08182911	1689095103	G0102733.JPG	GoPro at same location, poor vis, mud
JD192	NB73	170614	-73.02599865	41.08181417	1689095175	G0102769.JPG	Image at grab, mud
JD192	NB77	175130	-72.99884488	41.06828045	1689097891	2023-008-064-07112023175130-1.tiff	SEABOSS Site: 2-23-08-064, first image, mud
JD192	NB77	175327	-72.99884525	41.06811328	1689098008	2023-008-064-07112023175327-19.tiff	Mud, burrow
JD192	NB77	175526	-72.99884806	41.06794923	1689098127	2023-008-064-07112023175526-37.tiff	Mud, burrow
JD192	NB77	175723	-72.99884994	41.06779403	1689098244	2023-008-064-07112023175723-61.tiff	Mud
JD192	NB77	175758	-72.99885586	41.06780449	1689098279	2023-008-064-07112023175758-66.tiff	Last image before grab, mud, burrow
JD192	NB82	182208	-72.97807724	41.07446119	1689099729	2023-008-065-07112023182208-20.tiff	SEABOSS Site: 2023-08-065, first useable, mud, tubes
JD192	NB82	182306	-72.97808905	41.07444728	1689099787	2023-008-065-07112023182306-39.tiff	Mud, tube
JD192	NB82	182509	-72.97827408	41.07433048	1689099910	2023-008-065-07112023182509-52.tiff	Mud, bryozoan on shell?
JD192	NB82	182802	-72.97852762	41.07417181	1689100083	2023-008-065-07112023182802-81.tiff	Sandy mud, shells
JD192	NB82	183129	-72.97882007	41.07398526	1689100290	2023-008-065-07112023183129-115.tiff	Sandy mud, shells
JD192	NB82	183425	-72.97904215	41.07381474	1689100466	2023-008-065-07112023183425-142.tiff	Sandy mud, shells
JD192	NB82	183854	-72.97940746	41.07354301	1689100735	2023-008-065-07112023183854-177.tiff	Sandy mud, shells
JD192	NB82	184241	-72.97971761	41.07332354	1689100962	2023-008-065-07112023184241-217.tiff	Sandy mud, shells
JD192	NB82	184717	-72.97999315	41.07314438	1689101238	2023-008-065-07112023184717-259.tiff	Last image before grab, mud, shell
JD192	NB91	190906	-72.9644024	41.07040065	1689102547	2023-008-066-07112023190906-0.tiff	SEABOSS Site: 2023-08-066, Sandy mud, shell
JD192	NB91	191308	-72.96435125	41.07043414	1689102789	2023-008-066-07112023191308-34.tiff	Sandy mud, shell
JD192	NB91	191606	-72.96402285	41.07042735	1689102967	2023-008-066-07112023191606-64.tiff	Sandy mud, shell
JD192	NB91	191903	-72.96369746	41.07043294	1689103144	2023-008-066-07112023191903-95	Sandy mud, shell, small burrows
JD192	NB91	192300	-72.96325977	41.07043053	1689103381	2023-008-066-07112023192300-138.tiff	Sandy mud, shell, small burrows
JD192	NB91	192604	-72.9629216	41.07042929	1689103565	2023-008-066-07112023192604-174.tiff	Sandy mud, shell
JD192	NB91	192905	-72.96258029	41.07044365	1689103746	2023-008-066-07112023192905-213.tiff	Sandy mud

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD192	NB91	193303	-72.96214051	41.07044064	1689103984	2023-008-066-07112023193304-258.tiff	Sandy mud, shell
JD192	NB91	193523	-72.96199643	41.07043862	1689104124	2023-008-066-07112023193523-292	Last image before grab, mud, shells
JD192	NB88	200235	-72.96687715	41.05729311	1689105756	2023-008-067-07112023200235-6.tiff	SEABOSS Site: 2023-08-067, Sandy mud, shell
JD192	NB88	200903	-72.96682979	41.05677688	1689106144	2023-008-067-07112023200903-8.tiff	Sandy mud, shell
JD192	NB88	201403	-72.96681489	41.05634462	1689106444	2023-008-067-07112023201403-43.tiff	Sandy mud, shell
JD192	NB88	201909	-72.9668863	41.05592264	1689106750	2023-008-067-07112023201909-72.tiff	Sandy mud, shell, few Crepidula
JD192	NB88	202402	-72.96695835	41.05551928	1689107043	2023-008-067-07112023202402-109.tiff	Sandy mud, shell
JD192	NB88	202801	-72.9669604	41.05533347	1689107282	2023-008-067-07112023202801-133.tiff	Last image before grab, sandy mud, shell
JD192	NB96	205454	-72.95274562	41.04017562	1689108895	2023-008-068-07112023205454-0.tiff	SEABOSS Site: 2023-08-068, Muddy sand, shell
JD192	NB96	205950	-72.95255149	41.04005734	1689109191	2023-008-068-07112023205950-50.tiff	Sandy mud, small burrows
JD192	NB96	210457	-72.95216121	41.03975936	1689109498	2023-008-068-07112023210457-102.tiff	Sandy mud, small shells
JD192	NB96	210859	-72.95183859	41.03953348	1689109740	2023-008-068-07112023210859-143.tiff	Sandy mud, tube
JD192	NB96	211313	-72.95151118	41.03928846	1689109994	2023-008-068-07112023211313-186.tiff	Sandy mud, two small shells
JD192	NB96	211734	-72.9511922	41.03901923	1689110255	2023-008-068-07112023211734-230.tiff	Mud, small burrow
JD192	NB96	212059	-72.95112039	41.03892547	1689110460	2023-008-068-07112023212059-260.tiff	Last image before grab, mud
JD192	NB98	214707	-72.94737622	41.02409025	1689112028	2023-008-069-07112023214707-48.tiff	SEABOSS Site: 2023-08-069, 47 images skipped, overexposed, muddy sand, few shells
JD192	NB98	215039	-72.9471441	41.02433459	1689112240	2023-008-069-07112023215039-84.tiff	Hard substrate with Astrangia (northern star coral)
JD192	NB98	215225	-72.94703617	41.02446057	1689112346	2023-008-069-07112023215225-102.tiff	Cobble, small boulder continues, Astrangia, bryozoans
JD192	NB98	215459	-72.94684743	41.02461687	1689112500	2023-008-069-07112023215459-128.tiff	Sandy mud w small shells
JD192	NB98	215855	-72.94655221	41.02485191	1689112736	2023-008-069-07112023215855-168.tiff	Sandy mud
JD192	NB98	220357	-72.94616897	41.02513951	1689113038	2023-008-069-07112023220357-219.tiff	Sandy mud
JD192	NB98	220735	-72.94584952	41.02533305	1689113256	2023-008-069-07112023220735-256.tiff	Sandy mud, burrow
JD192	NB98	220927	-72.94578843	41.02536554	1689113368	2023-008-069-07112023220927-275.tiff	Last image before grab, sandy mud

JD193 Image Locations

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD193	NB99	112157	-72.94336018	41.0796556	1689160917	2023-008-069-07122023112157-5.tiff	SEABOSS Site: 2023-08-070, Image names are wrong as noted in Survey Log, should be 070, not 069, first useable image on bottom, mud w tube
JD193	NB99	112529	-72.94352568	41.07991897	1689161129	2023-008-069-07122023112529-27.tiff	Mud, burrow
JD193	NB99	112948	-72.94371899	41.08019195	1689161388	2023-008-069-07122023112948-49.tiff	Mud, burrow
JD193	NB99	113537	-72.94398692	41.08064236	1689161737	2023-008-069-07122023113537-77.tiff	Mud
JD193	NB99	113959	-72.94417272	41.08097049	1689161999	2023-008-069-07122023113959-98.tiff	Mud small burrows
JD193	NB99	114307	-72.9442806	41.08113764	1689162187	2023-008-069-07122023114307-114.tiff	Mud, burrow, last image before grab
JD193	SB79-G1	121848	-72.96917489	41.0769579	1689164328	2023-008-071-07122023121848-0.tiff	SEABOSS Site: 2012-08-071, First image on bottom, tubes, shells, bryozoans
JD193	SB79-G1	121940	-72.96924666	41.07700314	1689164380	2023-008-071-07122023121940-5.tiff	Hard substrate w bryozoans and Astrangia
JD193	SB79-G1	122028	-72.96931015	41.07704867	1689164428	2023-008-071-07122023122028-11.tiff	Small boulders w bryozoans and Astrangia
JD193	SB79-G1	122211	-72.96944971	41.07714568	1689164531	2023-008-071-07122023122211-8.tiff	Boulder field continues
JD193	SB79-G1	122245	-72.96949969	41.07717813	1689164565	2023-008-071-07122023122245-14.tiff	Last of hard substrate
JD193	SB79-G1	122307	-72.96953085	41.07719944	1689164587	2023-008-071-07122023122307-17.tiff	Mud w shells
JD193	SB79-G1	122451	-72.96968337	41.07728645	1689164691	2023-008-071-07122023122451-31.tiff	Mud w shells
JD193	SB79-G1	122853	-72.97007287	41.07738637	1689164933	2023-008-071-07122023122853-14.tiff	Mud w attached bryozoan, last FLIR image
JD193	SB79-G1	122857	-72.97008019	41.07738793	1689164937	G0030908.JPG	Corresponding GoPro image, poor vis, mud w shells, tube
JD193	SB79-G1	123159	-72.97038458	41.0774498	1689165119	G0030999.JPG	Small boulders w bryozoans and Astrangia, last GoPro in Roll 113GOPRO
JD193	SB79-G1	123253	-72.97035373	41.07744604	1689165173	G0031026.JPG	Image at time of grab, mud, shell
JD193	SB79-G2	124847	-72.96689931	41.08266437	1689166127	G0041202.JPG	SEABOSS Site: 2023-08-072, FLIR images all useless, stripped w /color, first useful image from GoPro, appears to be bryozoans, Astrangia?, poor vis
JD193	SB79-G2	125017	-72.96689373	41.08267282	1689166217	G0041247.JPG	Mud, shell
JD193	SB79-G2	125215	-72.96689627	41.08266685	1689166335	G0041306.JPG	Mud, shell, Astrangia on small rock?
JD193	SB79-G2	125253	-72.96688853	41.08266834	1689166373	G0041325.JPG	Image at grab, Mud, shell
JD193	SB78-G2	130805	-72.97729991	41.08583381	1689167285	2023-008-073-07122023130805-1.tiff	SEABOSS Site: 2023-08-073, first useable image on bottom, mud w/ burrows and microdepressions
JD193	SB78-G2	130837	-72.97733577	41.08587128	1689167317	2023-008-073-07122023130837-8.tiff	Mud, burrow, small depressions
JD193	SB78-G2	130916	-72.97736858	41.0858923	1689167356	2023-008-073-07122023130916-15.tiff	Image taken at grab, mud
JD193	SB78-G1	132933	-72.97267215	41.09100843	1689168573	2023-008-074-07122023132933-7.tiff	SEABOSS Site: 2023-08-074, first useable image on bottom, mud w small bioturbation clumps
JD193	SB78-G1	133118	-72.97272211	41.09114041	1689168678	2023-008-074-07122023133118-15.tiff	Mud w burrow and gray surface deposits
JD193	SB78-G1	133547	-72.97284899	41.09150155	1689168947	2023-008-074-07122023133547-42.tiff	Mud w burrow and gray surface deposits

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD193	SB78-G1	133658	-72.97288294	41.09159849	1689169018	2023-008-074-07122023133658-51.tiff	Mud w burrow and gray surface deposits
JD193	SB78-G1	134024	-72.97291245	41.09186075	1689169224	2023-008-074-07122023134024-75.tiff	Mud w tubes
JD193	SB78-G1	134416	-72.9730261	41.09217997	1689169456	2023-008-074-07122023134416-102.tiff	Mud w burrow and gray surface deposits
JD193	SB78-G1	134858	-72.97315234	41.09255964	1689169738	2023-008-074-07122023134858-130.tiff	Mud w burrow and gray surface deposits
JD193	SB78-G1	135017	-72.97319275	41.09266361	1689169817	2023-008-074-07122023135017-139.tiff	Mud w gray surface deposits
JD193	SB78-G1	135105	-72.97319617	41.09267342	1689169865	2023-008-074-07122023135105-149.tiff	Image at grab, mud
JD193	NB80	141858	-72.9941058	41.10092824	1689171538	G0073190.JPG	SEABOSS Site: 2023-08-075, no FLIR images, terrible vis, first image w/ bottom visible, mud w burrows
JD193	NB80	142222	-72.99394662	41.1007924	1689171742	G0073292.JPG	Bad vis, two brown spots on GoPro lens, mud w burrows
JD193	NB80	142904	-72.9934374	41.10039116	1689172144	G0073493.JPG	Mud, burrow
JD193	NB80	142946	-72.99337994	41.10035382	1689172186	G0073514.JPG	Good image, mud w burrow and small depressions
JD193	NB80	143312	-72.99311768	41.10014352	1689172392	G0073617.JPG	Mud, tube
JD193	NB80	144814	-72.99217306	41.09943636	1689173294	G0074068.JPG	Hundreds of images too high in water column, first one w/ bottom in sight, Mud, shell, burrow
JD193	NB80	144912	-72.9921675	41.09943063	1689173352	G0074097.JPG	Image at time of grab, mud
JD193	NB97	164939	-72.94484093	41.11602758	1689180579	2023-008-076-07122023164939-8.tiff	SEABOSS Site: 2023-08-076, but log says "misnamed 75", not sure what this means, there were no FLIR images named 075, will use the ones named 076 here, as it matches Survey Log for NB97
JD193	NB97	165137	-72.94463247	41.11608319	1689180697	2023-008-076-07122023165137-23.tiff	Mud w/ shells
JD193	NB97	152114	-72.9448192	41.10299112	1689175274	G0084297.JPG	First useable GoPro image, Mud w shells
JD193	NB97	152248	-72.94487555	41.10285992	1689175368	G0084344.JPG	Poor vis, useable image, mud w shells
JD193	NB97	153252	-72.94515545	41.10211161	1689175972	G0084646.JPG	Mud, some shell
JD193	NB97	154035	-72.94537465	41.10153239	1689176435	G0084877.JPG	Good pic, mud w burrow
JD193	NB97	154334	-72.9454515	41.10128873	1689176614	G0084967.JPG	Mud, burrows, gray surface deposit
JD193	NB97	154505	-72.94547925	41.10116559	1689176705	G0085012.JPG	Mud, burrows, gray surface deposit
JD193	NB97	154806	-72.94552936	41.10099572	1689176886	G0085103.JPG	Image at grab, mud
JD193	NB94	164841	-72.94493793	41.11600431	1689180521	2023-008-076-07122023164841-5.tiff	SEABOSS Site: 2023-08-77, first useable, mud, burrows, shell
JD193	NB94	165042	-72.94473243	41.11605817	1689180642	2023-008-076-07122023165042-16.tiff	Mud, shell
JD193	NB94	165241	-72.94452835	41.11612275	1689180761	2023-008-076-07122023165241-31.tiff	Mud, shell
JD193	NB94	165456	-72.94430485	41.11621217	1689180896	2023-008-076-07122023165456-43.tiff	Mud
JD193	NB94	165649	-72.94412583	41.11628698	1689181009	2023-008-076-07122023165649-52.tiff	Mud, shell, small burrows
JD193	NB94	165953	-72.94382499	41.11640178	1689181193	2023-008-076-07122023165953-63.tiff	Last FLIR image on file, mud, will check GoPro images

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD193	NB94	165954	-72.9438229	41.11640225	1689181194	G0105843.JPG	Concurrent GoPro image, poor vis, mud
JD193	NB94	170128	-72.94364509	41.11642857	1689181288	G0105890.JPG	Mud, shell, Crepidula??
JD193	NB94	170430	-72.94332985	41.1164857	1689181470	G0105981.JPG	Mud, shell
JD193	NB94	170526	-72.94330794	41.11648544	1689181526	G0106009.JPG	Last image before recovery, grab taken earlier, per Survey Log
JD193	NB89	172300	-72.96109487	41.11669381	1689182580	2023-008-078-07122023172300-0.tiff	SEABOSS Site: 2023-08-078, first FLIR image, mud, burrow, tube
JD193	NB89	172431	-72.96125625	41.11662058	1689182671	2023-008-078-07122023172431-6.tiff	Mud, shells
JD193	NB89	172659	-72.96148374	41.11652025	1689182819	2023-008-078-07122023172659-15.tiff	Mud, tube
JD193	NB89	172934	-72.96175526	41.11641523	1689182974	2023-008-078-07122023172934-25.tiff	Mud, small burrows
JD193	NB89	173216	-72.96203942	41.11634812	1689183136	2023-008-078-07122023173216-36.tiff	Mud, clump of shells, Crepidula?
JD193	NB89	174106	-72.96300939	41.11630585	1689183666	2023-008-078-07122023174106-4.tiff	Lots of FLIR images bad, this is next useable, Mud w shell
JD193	NB89	174320	-72.96325397	41.11631026	1689183800	2023-008-078-07122023174320-13.tiff	3rd from last FLIR image, no grab, will check GoPro
JD193	NB89	174321	-72.9632564	41.11631014	1689183801	G0116823.JPG	Corresponding GoPro timecode, very poor vis, mud w burrows
JD193	NB89	174615	-72.96347481	41.11630447	1689183975	G0116910.JPG	Mud, burrows
JD193	NB89	174625	-72.96347457	41.1163033	1689183985	G0116915.JPG	Image at grab, mud
JD193	NB84	180759	-72.97741906	41.12844766	1689185279	2023-008-079-07122023180759-0.tiff	SEABOSS Site: 2023-08-079, First image, mud w/ burrows
JD193	NB84	180845	-72.97749557	41.1284187	1689185325	2023-008-079-07122023180845-4.tiff	Mud, burrows, shell
JD193	NB84	181222	-72.97784965	41.12828091	1689185542	2023-008-079-07122023181222-1.tiff	Mud, burrows, shell
JD193	NB84	181444	-72.97808094	41.12818925	1689185684	2023-008-079-07122023181444-14.tiff	Mud, burrows
JD193	NB84	181744	-72.97831987	41.12802432	1689185864	2023-008-079-07122023181744-26.tiff	Mud, burrows, tube
JD193	NB84	181948	-72.97848291	41.12790219	1689185988	2023-008-079-07122023181948-35.tiff	Mud, burrows, tube
JD193	NB84	182319	-72.97878255	41.12770975	1689186199	2023-008-079-07122023182319-51.tiff	Mud, burrows, image color varying a lot
JD193	NB84	182525	-72.97898328	41.12761935	1689186325	2023-008-079-07122023182525-61.tiff	Mud, tracks on surface
JD193	NB84	182814	-72.97909149	41.12756709	1689186494	2023-008-079-07122023182814-77.tiff	Mud, tube, image close to bottom, will check GoPro to check if this was just before the grab
JD193	NB84	182827	-72.97909385	41.12756588	1689186507	G0127778.JPG	Image at grab, same tube as in previous image
JD193	NB81	184720	-72.99141997	41.14060158	1689187640	2023-008-80-07122023184720-2.tiff	SEABOSS Site: 2023-080, First image on seafloor, light mud w burrows
JD193	NB81	184952	-72.99155749	41.1407314	1689187792	2023-008-80-07122023184952-16.tiff	Mud, burrows, surface deposit
JD193	NB81	185500	-72.9918563	41.14092641	1689188100	2023-008-080-07122023185500-2.tiff	Mud, burrows
JD193	NB81	185807	-72.99203202	41.14103369	1689188287	2023-008-080-07122023185807-1.tiff	Mud, tube
JD193	NB81	191254	-72.99281775	41.14162145	1689189174	2023-008-080-07122023191254-0.tiff	Mud, burrows, surface deposit
JD193	NB81	191549	-72.99294241	41.14171526	1689189349	2023-008-080-07122023191549-87.tiff	Mud

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD193	NB81	191605	-72.99293647	41.14171104	1689189365	2023-008-080-07122023191605-95.tiff	Image at bottom grab, mud, small depression
JD193	NB87	193737	-72.96888903	41.13470584	1689190657	2023-008-081-07122023193737-0.tiff	SEABOSS Site: 2023-08-081, Sandy mud?, shell
JD193	NB87	193838	-72.96887934	41.13475616	1689190718	2023-008-081-07122023193838-30.tiff	Sandy mud, shell
JD193	NB87	194139	-72.96888328	41.13492233	1689190899	2023-008-081-07122023194139-120.tiff	Sandy mud, shell
JD193	NB87	194430	-72.96888837	41.13507991	1689191070	2023-008-081-07122023194430-205.tiff	Sandy mud, shell, note - camera working well lots of images, every 2 secs, will advance more
JD193	NB87	194833	-72.96888536	41.13530688	1689191313	2023-008-081-07122023194833-326.tiff	Sandy mud, shell
JD193	NB87	195233	-72.96888987	41.13552987	1689191553	2023-008-081-07122023195233-445.tiff	Sandy mud, shell
JD193	NB87	195633	-72.96888128	41.1357568	1689191793	2023-008-081-07122023195633-563.tiff	Sandy mud, shell
JD193	NB87	200035	-72.96888861	41.13598117	1689192035	2023-008-081-07122023200035-682.tiff	Sandy mud, shell
JD193	NB87	200243	-72.96888457	41.13603733	1689192163	2023-008-081-07122023200243-746.tiff	Sandy mud, shell, tube - last before grab...need to check GoPros
JD193	NB87	200252	-72.96888111	41.13603491	1689192172	G0150193.JPG	Image at grab confirmed
JD193	NB90	203110	-72.96762758	41.14411796	1689193870	2023-008-082-07122023203110-39.tiff	SEABOSS Site: 2023-08-082, First useful image, sandy mu, tube and shell
JD193	NB90	203311	-72.96748058	41.14414718	1689193991	2023-008-082-07122023203311-61.tiff	Mud, color balance off, very blue
JD193	NB90	203510	-72.96735637	41.14416606	1689194110	2023-008-082-07122023203510-82.tiff	Mud
JD193	NB90	203816	-72.96713649	41.14422547	1689194296	2023-008-082-07122023203816-147.tiff	Mud, small shells and depression
JD193	NB90	204215	-72.96684268	41.14428035	1689194535	2023-008-082-07122023204215-174.tiff	Mud
JD193	NB90	204622	-72.96653724	41.14433445	1689194782	2023-008-082-07122023204622-201.tiff	Mud w small depression
JD193	NB90	205025	-72.96625285	41.14437481	1689195025	2023-008-082-07122023205025-232.tiff	Mud, small shells
JD193	NB90	205523	-72.96588937	41.1444227	1689195323	2023-008-082-07122023205523-270.tiff	Mud w small depressions
JD193	NB90	210028	-72.96552594	41.14445582	1689195628	2023-008-082-07122023210028-309.tiff	Mud
JD193	NB90	210218	-72.96541532	41.14446156	1689195738	2023-008-082-07122023210218-323.tiff	Mud w burrows. Last FLIR image, check GoPro re: grab
JD193	NB90	210243	-72.96542645	41.14445945	1689195763	G0151988.JPG	Image at grab

ID194 Image Locations

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD194	NB86	114751	-72.97134916	41.17314417	1689248871	2023-008-084-07132023114751-4.tiff	SEABOSS Site: 2023-08-084, First useable, but still dark image, mud
JD194	NB86	115002	-72.97130488	41.17297039	1689249002	2023-008-084-07132023115022-8.tiff	Mud w burrow, long, 50-60 sec interval between pics
JD194	NB86	115415	-72.97122202	41.17263336	1689249255	2023-008-084-07132023115415-18.tiff	Mud w burrow and lots of small shell hash
JD194	NB86	115827	-72.97113768	41.17227873	1689249507	2023-008-084-07132023115827-28.tiff	Mud some shell
JD194	NB86	120130	-72.97110645	41.17212565	1689249690	2023-008-084-07132023120130-34.tiff	Mud, burrow, few small shell hash
JD194	NB86	120359	-72.97110539	41.17211902	1689249839	2023-008-084-07132023120359-3.tiff	Mud, Image before grab
JD194	NB86	120407	-72.97110493	41.17211766	1689249847	2023-008-084-07132023120407-4.tiff	Mud cloud image at grab
JD194	NB100	124003	-72.938613	41.18569498	1689252003	2023-008-085-07132023124003-8.tiff	SEABOSS Site: 2023-08-085, Mud w light gray surface deposits
JD194	NB100	124420	-72.93835553	41.18539546	1689252260	2023-008-085-07132023124420-24.tiff	Mud w shell hash
JD194	NB100	124824	-72.93810856	41.18511659	1689252504	2023-008-085-07132023124824-40.tiff	Mud w few shells
JD194	NB100	125226	-72.93786946	41.18483146	1689252746	2023-008-085-07132023125226-55.tiff	Mud
JD194	NB100	125736	-72.93756857	41.18447245	1689253056	2023-008-085-07132023125736-69.tiff	Mud w few gray surface deposits
JD194	NB100	130120	-72.9373465	41.18421028	1689253280	2023-008-085-07132023130120-76.tiff	Mud w few gray surface deposits
JD194	NB100	130649	-72.93701889	41.18382695	1689253609	2023-008-085-07132023130649-87.tiff	Mud w larger burrow
JD194	NB100	131048	-72.93677846	41.18354578	1689253848	2023-008-085-07132023131048-96.tiff	Mud
JD194	NB100	131553	-72.93648831	41.18320532	1689254153	2023-008-085-07132023131553-106.tiff	Mud w few gray surface deposits, last image before grab?
JD194	NB100	131624	-72.93650005	41.18321828	1689254184	G0024989.JPG	Mud w cloud, image at the grab site
JD194	NB95-G2	134531	-72.94799536	41.13559559	1689255931	2023-008-086-07132023134531-0.tiff	SEABOSS Site: 2023-08-086, Grab #2 at this site, Mud
JD194	NB95-G2	134545	-72.94799847	41.13559253	1689255945	2023-008-086-07132023134545-1.tiff	Image before grab? GoPro check
JD194	NB95-G2	134615	-72.94799768	41.13558575	1689255975	G0035140.JPG	Mud cloud, burrow image at grab
JD194	NB101	140824	-72.927883	41.15218215	1689257304	2023-008-087-07132023140824-0.tiff	SEABOSS Site: 2023-08-087, First image, mud, burrows, small shell fragments
JD194	NB101	141029	-72.92788706	41.15207798	1689257429	2023-008-087-07132023141029-8.tiff	Mud, shell fragments
JD194	NB101	141214	-72.92787893	41.15194264	1689257534	2023-008-087-07132023141214-16.tiff	Mud, small and large burrows
JD194	NB101	141638	-72.92785992	41.15155514	1689257798	2023-008-087-07132023141638-33.tiff	Mud, burrows
JD194	NB101	142143	-72.92794876	41.15113696	1689258103	2023-008-087-07132023142143-42.tiff	Mud, burrow, tube
JD194	NB101	142745	-72.92804037	41.15063819	1689258465	2023-008-087-07132023142745-58.tiff	Mud, burrow
JD194	NB101	143122	-72.92808025	41.15043006	1689258682	2023-008-087-07132023143122-77.tiff	Mud, burrows
JD194	NB101	143322	-72.92808799	41.15030751	1689258802	2023-008-087-07132023143322-92.tiff	Mud, last FLIR image...will check GoPro for grab
JD194	NB101	143332	-72.92808345	41.15031044	1689258812	G0046053.JPG	Mud, cloud image at grab
JD194	NB104	145304	-72.90220027	41.1574175	1689259984	2023-008-089-07132023145304-0.tiff	SEABOSS Site: 2023-08-088...all images mis-named as 089, first FLIR pic, mud
JD194	NB104	145610	-72.90234652	41.15722402	1689260170	2023-008-089-07132023145610-18.tiff	Mud, small burrows
JD194	NB104	150023	-72.90257217	41.15702446	1689260423	2023-008-089-07132023150023-40.tiff	Mud, tracks, shell

JD#	LISMaRC Site	UTC	Longitude DD	Latitude DD	UNIX Time	Image Name	Comments
JD194	NB104	150426	-72.90285776	41.15677876	1689260666	2023-008-089-07132023150426-60.tiff	Mud, small shell fragments
JD194	NB104	150822	-72.90313609	41.1565174	1689260902	2023-008-089-07132023150822-78.tiff	Mud, shell
JD194	NB104	151114	-72.90333667	41.15633169	1689261074	2023-008-089-07132023151114-91.tiff	Mud w small depression
JD194	NB104	151236	-72.9034328	41.15624524	1689261156	2023-008-089-07132023151236-98.tiff	Mud w burrows, last FLIR image, no grab, check GoPro
JD194	NB104	151618	-72.90368239	41.15600048	1689261378	G0056895.JPG	Mud w small burrows and tube, GoPro images continue on this deply
JD194	NB104	151808	-72.90376149	41.15593581	1689261488	G0056950.JPG	Mud, burrows, image at grab
JD194	SB83-G3	153755	-72.90607451	41.16840278	1689262675	G0067079.JPG	SEABOSS Site: 2023-08-089, No FLIR images, first useable image of bottom, mud, burrows
JD194	SB83-G3	153819	-72.90607254	41.16840235	1689262699	G0067091.JPG	Mud, image at time of the grab
JD194	SB83-G2	154812	-72.90883337	41.16867485	1689263292	G0077177.JPG	SEABOSS Site: 2023-08-090, first useable image, mud, burrows
JD194	SB83-G2	154828	-72.90883392	41.16867674	1689263308	G0077185.JPG	Mud, image taken at the grab
JD194	SB83-G1	160153	-72.90854733	41.16918615	1689264113	G0087306.JPG	SEABOSS Site: 2023-08-091, first image of bottom, mud, burrows
JD194	SB83-G1	160323	-72.90848843	41.16925445	1689264203	G0087351.JPG	Mud, burrows, poor visibility
JD194	SB83-G1	160501	-72.90838275	41.16935978	1689264301	G0087400.JPG	Mud, burrows, poor visibility
JD194	SB83-G1	160623	-72.90827678	41.16944205	1689264383	G0087441.JPG	Mud, burrows, 3rd from last image, no grab seen