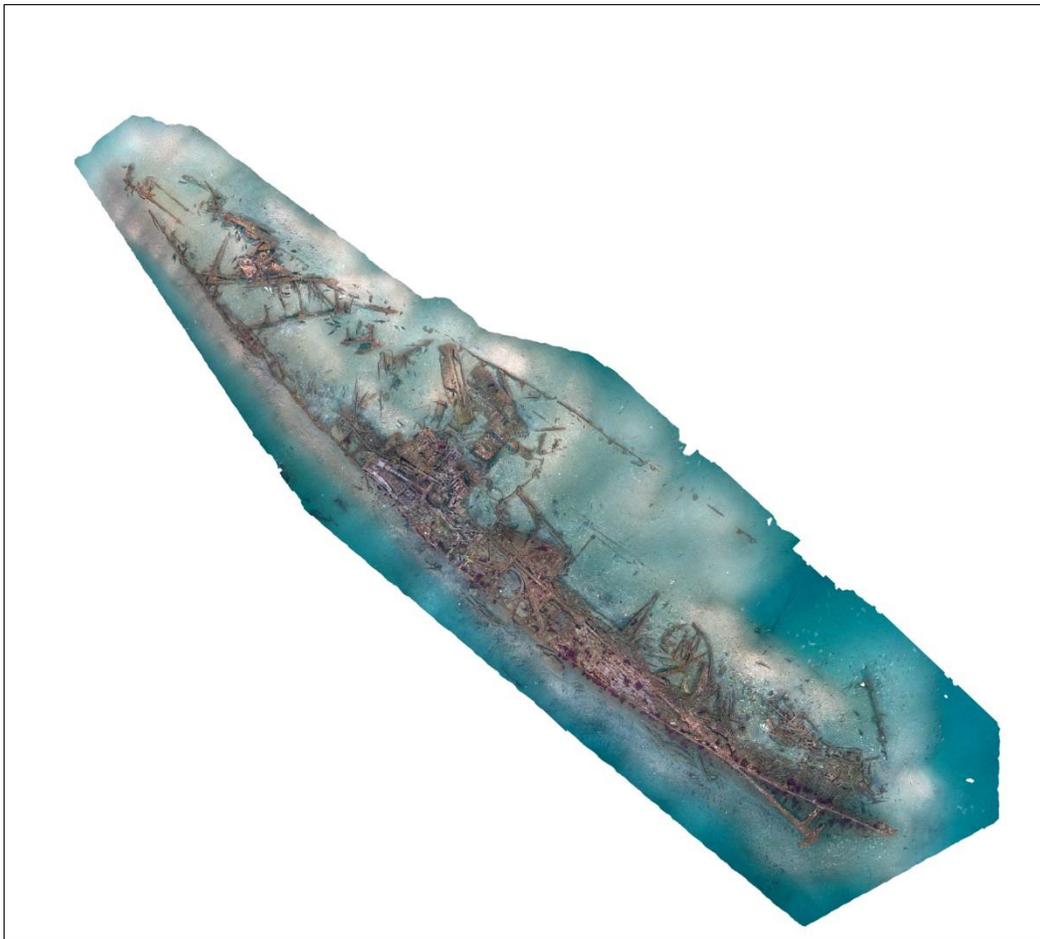


North Carolina Collaborative Archaeological Survey: Wilmington East and West Wind Energy Areas



US Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs



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February 2020

Authors:

William Hoffman
Joseph Hoyt
William Sassorossi

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By:

BOEM's Office of Renewable Energy Programs
45600 Woodland Road, Sterling, VA 20160

and

NOAA's Office of National Marine Sanctuaries
Monitor National Marine Sanctuary
100 Museum Drive, Newport News, VA 23606



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DISCLAIMER

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ABOUT THE COVER

Orthomosaic of an unidentified, early-twentieth century shipwreck (referenced as site 6537K_1) located within the Wilmington West Wind Energy Area.

ACKNOWLEDGMENTS

The *North Carolina Collaborative Archaeology Survey: Wilmington East and West Wind Energy Areas* represents the fourth in a series of successful research studies conducted by the Bureau of Ocean Energy Management (BOEM) and the National Oceanic and Atmospheric Administration's (NOAA) Monitor National Marine Sanctuary, along with other partners. These field studies are designed to survey and ground truth potential archaeological sites to support environmentally responsible renewable energy development on the Atlantic Outer Continental Shelf (OCS).

These studies follow a model—first tested and vetted offshore Massachusetts and reported in *Collaborative Archaeological Investigations and Sound Source Verifications within the Massachusetts Wind Energy Area*—that relies upon federal and state agencies, university partners, and others working together. Previous partnerships with NOAA under this framework include the *Virginia Collaborative Archaeological Survey*, the *Maryland Collaborative Archaeological Survey*, and the *North Carolina Collaborative Archaeological Survey: Kitty Hawk Wind Energy Area*. These reports are available at: <https://www.boem.gov/renewable-energy/state-activities/completed-studies>

Like its predecessor studies, this survey is the result of the concerted efforts of many individuals and organizations who brought to the project the necessary instruments, field equipment, dive operations support, and knowledge to ensure a safe, successful field season. Without committed individuals and their contributions, none of these studies would have been possible.

The authors wish especially to acknowledge Steve Hall of University of North Carolina Wilmington (UNCW) for vessel operations; John McCord of the University of North Carolina Coastal Studies Institute (CSI) for photography and videography; Jason Nunn of East Carolina University (ECU) for dive safety and support; Annie Wright of ECU for dive support; and Nathan Henry, John Morris, and Greg Stratton of the North Carolina Office of State Archaeology, Underwater Archaeology Branch for sharing background information and their expert knowledge regarding archaeological resources in the region.

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Appendix A-1

List of Abbreviations and Acronyms

3D	three-dimensional
ASD	Atlantic Shipwreck Database
AWOIS	Automated Wreck and Obstruction Information System
BOEM	Bureau of Ocean Energy Management
CSI	University of North Carolina Coastal Studies Institute
DOI	US Department of the Interior
ECU	East Carolina University
ESPIS	Environmental Studies Program Information System
ft	feet
m	meters
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
OCS	Outer Continental Shelf
RGB	Red, Green, Blue
UAB	Underwater Archaeology Branch
UNCW	University of North Carolina Wilmington
WEA	Wind Energy Area

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1 Introduction

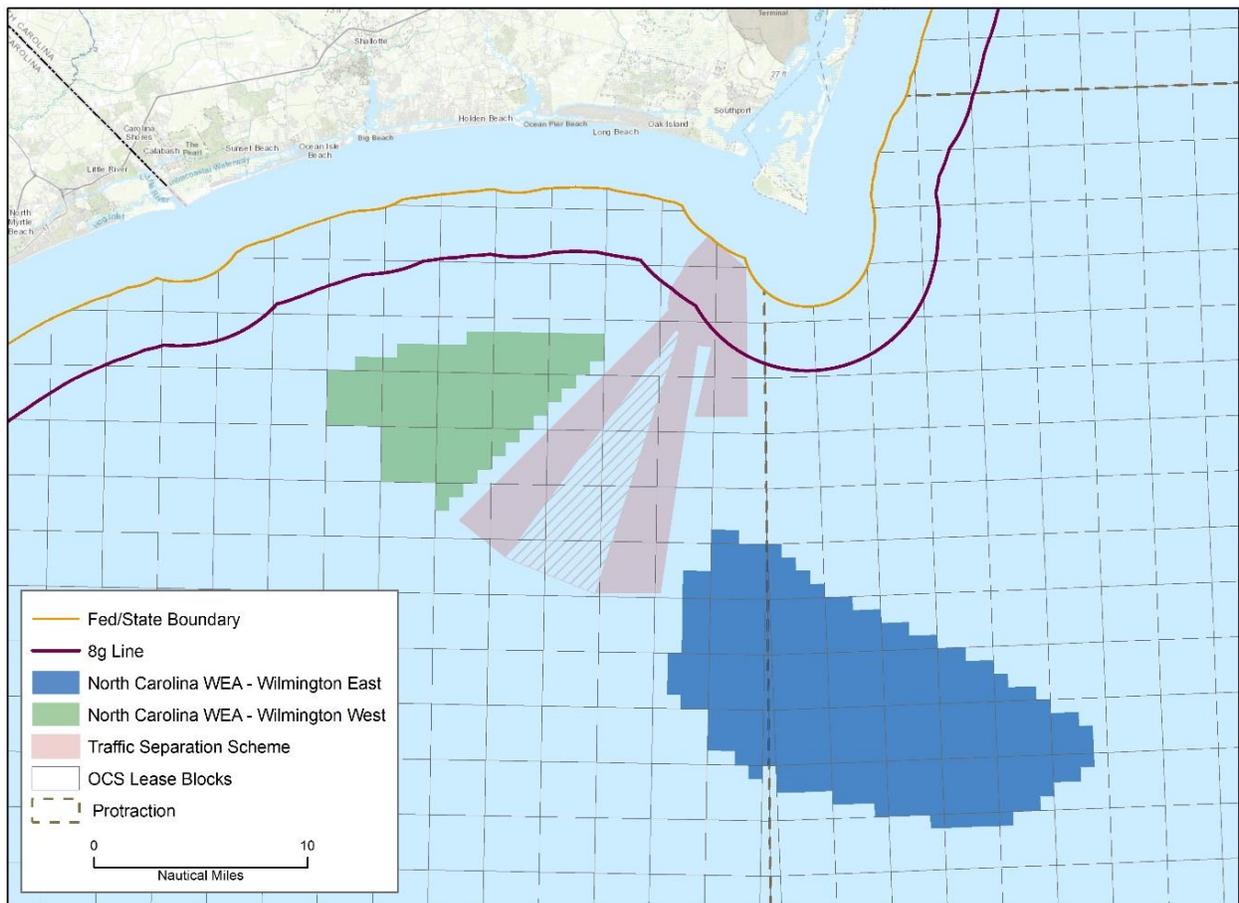
With the passage of the Energy Policy Act of 2005, The Bureau of Ocean Energy Management (BOEM) acquired regulatory authority for renewable energy activities on the Outer Continental Shelf (OCS), including wind energy development. As part of this responsibility, BOEM conducts detailed environmental analyses of projects proposed for development. The potential direct, indirect, and cumulative impacts on the human, coastal, and marine environments must be evaluated for BOEM to make environmentally sound decisions about managing renewable energy activities and developing mitigation measures to avoid or minimize impacts.

BOEM's overarching strategic goal is to achieve expeditious and orderly development of energy resources while minimizing impacts on the environment. BOEM accomplishes this goal, in part, by developing and employing sound science and partnerships. As such, BOEM unites its need to gather baseline data with efforts to leverage partnerships with other federal agencies, state agencies, universities, and tribal governments. Doing so creates efficiencies in BOEM's processes, reduces expenditures, builds relationships that will extend these efficiencies and cost reductions into the future, and provides needed data to inform sound decision-making in the present.

BOEM has designated two Wind Energy Areas (WEAs) offshore Wilmington, North Carolina identified as the Wilmington East and West WEAs (Figure 1). BOEM has a need for baseline archaeological data within wind energy areas in order to make sound decisions about how to minimize impacts, to form post-construction comparisons during monitoring of environmental changes that might be discernable later, and to assist in meeting the bureau's responsibilities under Sections 106 and 110 of the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA). Identified geophysical targets (e.g., sidescan sonar contacts and magnetic anomalies) in these areas may prove to be archaeological resources that should be avoided, or they may prove not to be resources and therefore should not prevent development within a specific area of the seafloor. Archaeological identification and ground truthing of these targets is necessary for informed, responsible decision-making and to assist BOEM in considering the effects of its undertakings subject to review under the NHPA and NEPA.

To meet these needs, BOEM invited the National Oceanic and Atmospheric Administration (NOAA) to collaborate via an Interagency Agreement to conduct a baseline archaeological survey in the vicinity of the Wilmington East and West WEAs. NOAA provided scientific and technical services, shared its resources, and assisted BOEM with conducting and analyzing the resulting data. This partnership afforded both BOEM and NOAA a unique opportunity to share equipment and expertise for mutual benefit. BOEM and NOAA finalized a research design, collaboratively performed the survey and investigations, analyzed results, and produced this jointly authored report.

A single technical Appendix was prepared to supplement this report. It contains sensitive information pertaining to the location of potential archaeological resources identified during this survey. In order to protect the locations of potential archaeological resources, the technical Appendix is not included in the publicly available version of this report.



Map ID: ERB-2018-1008

Figure 1: Location of Wilmington East and West Wind Energy Areas

1.1 Objectives

The objective of the 2017 field project was to obtain baseline archaeological data within and adjacent to the Wilmington East and West WEAs to inform future decision-making. This objective was achieved by ground truthing, via diver-based investigation, selected targets of archaeological potential. The primary goal was to determine if previously identified geophysical survey targets represent archaeological sites, and, if so, to gather preliminary documentation to assist in considering their eligibility for listing in the NRHP.

This project leveraged the results of reconnaissance-level geophysical survey conducted under BOEM studies in the region that identified potential archaeological targets warranting further investigation. This includes *Benthic Habitat Mapping and Assessment in the Wilmington-East Wind Energy Call Area* (Taylor et al. 2016) which provided a reconnaissance side scan sonar and multibeam echosounder survey of the Wilmington East WEA and identified the location of potential shipwreck sites. This project also investigated potential sites reported in BOEM's Atlantic Shipwreck Database (ASD) (TRC 2012), in addition to potential shipwreck sites identified during recent NOAA hydrographic surveys located within the vicinity of the Wilmington East and West WEAs.

1.2 Research Design

The research goals of the project were twofold: (1) determine if previously identified remote sensing targets represent archaeological resources, and if so, (2) conduct initial assessment and documentation to inform future investigations and to provide preliminary consideration regarding a site's potential eligibility for listing in the NRHP. The targets investigated were prioritized according to the following:

- First priority targets included confirmed shipwreck locations within the Wilmington East WEA from the Taylor et al. (2016) study that had not been archaeologically investigated or documented.
- Second priority targets included unconfirmed site locations reported in the vicinity of the Wilmington WEAs and South Carolina Call Areas from BOEM's ASD.
- Third priority targets included potential shipwrecks identified during NOAA hydrographic surveys located in the vicinity of the Wilmington East and West WEAs.

1.3 Scope and Limitations

This project was not designed to represent a comprehensive investigation, and therefore should only be considered as a preliminary baseline assessment upon which future investigations may be based. Furthermore, this investigation does not replace the need for additional site-specific archaeological identification survey to take place prior to future renewable energy development within the Wilmington East and West WEAs.

As with any project, certain limitations are expected and accounted for in preparing the expedition. Fiscal constraints limited the amount of time and the availability of resources, which ultimately governed the duration of the project. It was not expected that all potential targets would be ground-truthed; therefore, targets were prioritized to ensure that areas with the highest archaeological potential were investigated. The order of investigation for individual sites within these priority categories was determined in the field based on sea state, weather conditions, target depth, and distance between targets to most efficiently investigate as many sites as possible within the fieldwork window.

Additionally, working in the underwater environment poses certain limitations. Weather and sea state conditions offshore North Carolina vary greatly, and days of inactivity were anticipated and accounted for during the survey effort. High and variable currents are present offshore North Carolina, and visibility may range from zero to more than 15 meters (m) (49.2 feet [ft]). These factors produced differing degrees of in-water efficiency from day-to-day. Furthermore, the depth of many of the sites, which ranged roughly from 15.2 to 30.5 m (50 to 100 ft), limited the amount of time spent on any site. Finally, target investigation was limited only to exterior observations of archaeological sites. The research team did not conduct any activities that would impact a site in any way. This precluded establishing permanent baselines, recovering artifacts, or disturbing anything on-site.

1.4 Personnel and Roles

The following individuals participated in the investigation:

- Steve Hall – University of North Carolina Wilmington (UNCW): Captain
- William Hoffman – BOEM: Co-Principal Investigator
- Joseph Hoyt – NOAA: Co-Principal Investigator
- John McCord – CSI: Photography and Videography

- Jason Nunn – CSI/ECU: Diving Safety and Logistics
- Will Sassorossi – NOAA: Co-Principal Investigator
- Annie Wright – ECU: Archaeologist

2 Methods

2.1 Scientific Diver Investigation

Fieldwork consisted of at-sea operations from the UNCW R/V *Seahawk*, a 10.7-m (35-ft) research vessel which provided the platform for diving operations (Figure 2). Onshore operations were staged out of Southport, North Carolina.

The methodology for diver investigations consisted of the direct visual inspection of targets by scientific divers to ground-truth the remote sensing data and determine if targets represent archaeological resources. Diving operations were conducted in a “live boat” mode. This method eliminated the need for, and mitigated the possible impact of, anchoring into an archaeological resource. If, upon inspection by scientific divers, a target was determined to not be archaeological in nature, no additional investigation was conducted. If, however, targets were confirmed as archaeological resources, the following protocols were employed to guide additional documentation and assessment. The protocols were designed to provide flexibility and adaptability based on the nature of the individual site under investigation.

To achieve the project objectives, the following protocols were followed at each target:

- Conduct diver investigation to confirm the presence or absence of an archaeological site;
- Perform a rapid visual assessment of each target that is confirmed to be an archaeological resource;
- As conditions allow, produce a cursory photogrammetric model of each confirmed archaeological resource for interpretation and use in potential follow-up inquiry;
- As conditions allow, conduct additional video and photographic documentation of the site;
- Identify to what degree archaeological site preservation is influenced by environmental conditions, site formation processes, and anthropogenic impacts;
- Assess the historical significance and integrity of each confirmed archaeological resource;
- Determine whether the archaeological resource warrants further investigation; and
- If possible, determine if any confirmed archaeological resource possesses the characteristics of significance making it eligible for listing in the NRHP.



Figure 2: UNCW R/V *Seahawk*. Image courtesy UNCW.

2.2 Photogrammetry

This project utilized photogrammetry for rapid documentation of archaeological sites. Photogrammetry is a scientific process in which photographs are digitally combined to create detailed and measurable three-dimensional (3D) models. Photogrammetric models were created on several of the identified shipwreck sites yielding accurate 3D models that are valuable for research, education, and outreach. The photogrammetric process is similar to creating a photomosaic. Divers using digital, single-lens reflex cameras equipped with wide-angle rectilinear lenses in underwater housings take photographs of the shipwreck site or feature in a systematic manner. Overlapping photographs are taken in succession, capturing the subject from all angles. After image color correction and processing, photographs are then exported into high resolution .jpg or .tiff files and imported into the photogrammetry software.

Agisoft's Photoscan Pro was used to process the photogrammetric models created for the project. After importing the photographs, Photoscan Pro aligns the photos in 3D space, matching similar features in each of the photos and assigning X, Y, and Z coordinates to the images. In addition, a sparse point cloud is produced creating a rough 3D image (Figure 3).

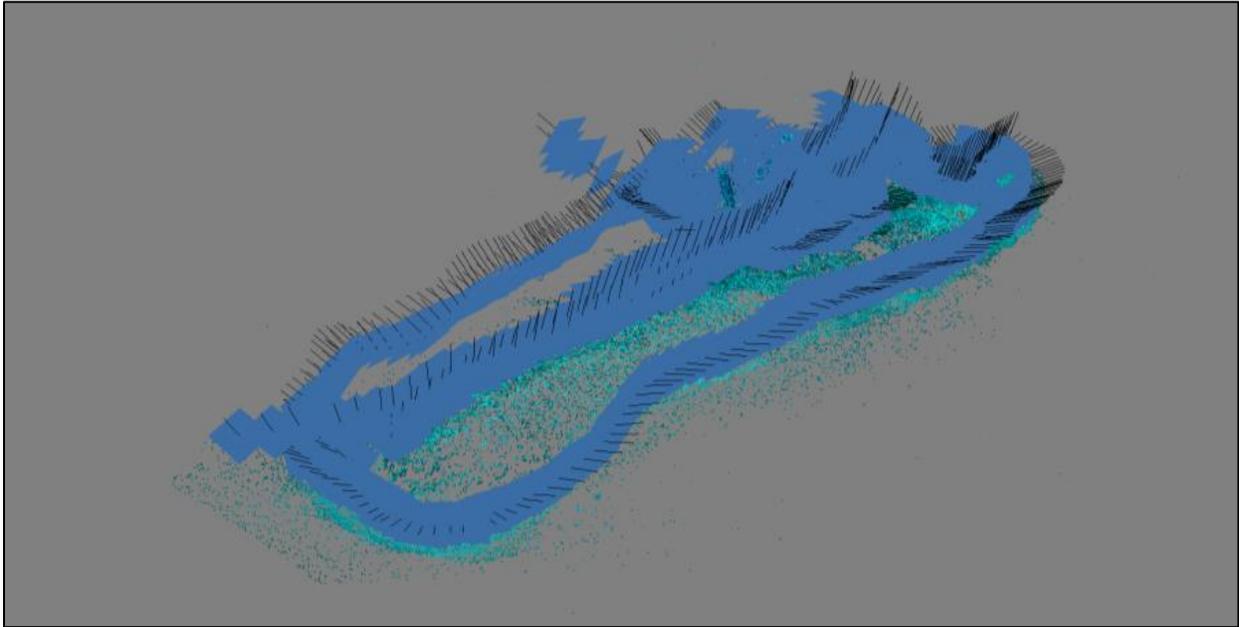


Figure 3: Example of a sparse point cloud during processing of a photogrammetric model. The blue squares indicate the location of each individual photograph taken of the site.

After the images are correctly aligned, the next step in model construction is the creation of a dense point cloud (Figure 4). The point cloud is created in 3D space, based on the aligned photographs, and their matching features. The resulting dense cloud is made up of numerous points, often as many as several million, each with their own Red, Green, Blue (RGB) and luminance value. Following dense cloud creation, the next phase of the workflow includes building the model mesh, or wireframe. Connecting the dense point cloud into a series of polygons creates the mesh. The polygons create a solid surface on which the photo texture can be applied. Edits of the mesh, including mesh decimation of outlying mesh and closing of mesh holes, can be done at this stage.

Finally, after all steps have been executed, a photo texture is applied and wrapped over the solid surface. The high-resolution photo texture is created from the aligned photographs and provides accurate photorealistic detail on top of the 3D model. If gaps in the data are observed, they can be re-photographed on subsequent dives to ensure total coverage. Once a 3D model is created, accurate measurements can be taken after producing a digital scale bar from a known measurement or providing a physical scale bar within the photos. The ability to take measurements and compare meshes between models made at different times allows one to track site change over time and is a valuable tool in site monitoring and management. Photogrammetric models are additionally valuable education and outreach tools, as they provide an accessible way for the public to experience sites in an immersive and interactive 3D way.

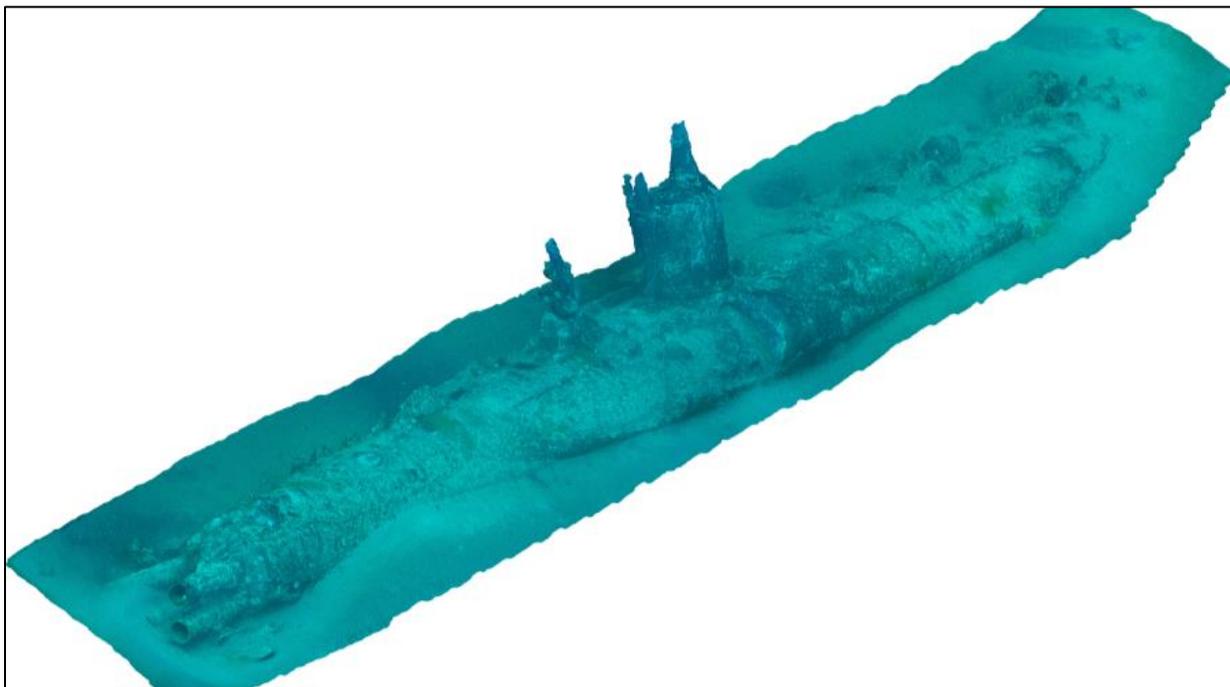


Figure 4: Example of a dense point cloud created during processing of a photogrammetric model of German U-boat.

3 Results

Field operations were conducted July 24 through August 5, 2017. The study sites, for the purposes of this report, are presented in three sections: sites located in the Taylor et al. (2016) study area, BOEM Atlantic Shipwreck Database sites, and sites from recent NOAA hydrographic surveys. The results of these investigations are detailed below.

3.1 Taylor et al. (2016) Study Sites

The *Benthic Habitat Mapping and Assessment in the Wilmington-East Wind Energy Call Area* study (Taylor, et al. 2016) identified five potential shipwreck sites and, through the multibeam echosounder survey conducted, developed reliable positioning for these sites. As a component of the habitat mapping, some sites were investigated and subjected to benthic assessments by marine biologists; however, the sites have not been fully documented or previously investigated by archaeologists. As these are known site locations, investigations under the current study focused on in-water assessments to assist with documenting the sites and considering their eligibility for listing in the NRHP.

3.1.1 Raritan

The wreck site attributed as *Raritan* is located in OCS Lease Block 6402, resting in approximately 24.3 m (80 ft) of water. The site is charted as *Raritan* in NOAA's Coast Survey database, Automated Wreck and Obstruction Information System (AWOIS) and listed in the North Carolina Office of State Archaeology, Underwater Archaeology Branch (UAB) shipwreck database. The wreck at this location has not been definitively identified; however, based on the observations made during this preliminary investigation, the site is likely to be that of *Raritan*.

Raritan was built in 1919 by the American Shipbuilding Company of Detroit, Michigan. Originally named *Lake Fairton* and later *Detroit Wayne*, the cargo vessel measured 76 m (251 ft) in length, 13.4 m (44 ft) at beam, and had a depth of hold of 7.9 m (26 ft). The vessel had one triple expansion engine, a single shaft and screw, two boilers, and grossed 2,649 tons. At the time of its sinking, it was owned by the Raritan Steamship Corporation, and its home port was New Orleans, Louisiana (Lloyd's Register of Shipping 1942).

In late February 1942, *Raritan* was traveling north from Buenaventura, Columbia to New York with a cargo of coffee. At the time, the Battle of the Atlantic of World War II had reached American waters and German U-boats had begun to appear off the East Coast, attacking merchant shipping with ruthless impunity. In an effort to evade any potential engagement with one of Germany's submarines, *Raritan* navigated as close to the coastline as possible. Unfortunately, by taking this course, it ran aground near Frying Pan Shoals on February 25, 1942 requiring the entire 29-person crew to abandon ship (Moore 1983:416). All crewmembers made it to shore safely.

Site investigation was guided by the remote sensing data collected in 2016 as part of the benthic habitat mapping and included site imaging with both multibeam echosounder (Figure 5) and side scan sonar (Figure 6). Four dive rotations were completed on July 25, 2017 to document the site with photography and video. Capture of a complete photogrammetric model was determined to not be feasible based on the size of the wreck site and the time available under this investigation; however, a small feature was photographed to create a test photogrammetric model, and additional video of both the stern and bow sections were acquired.

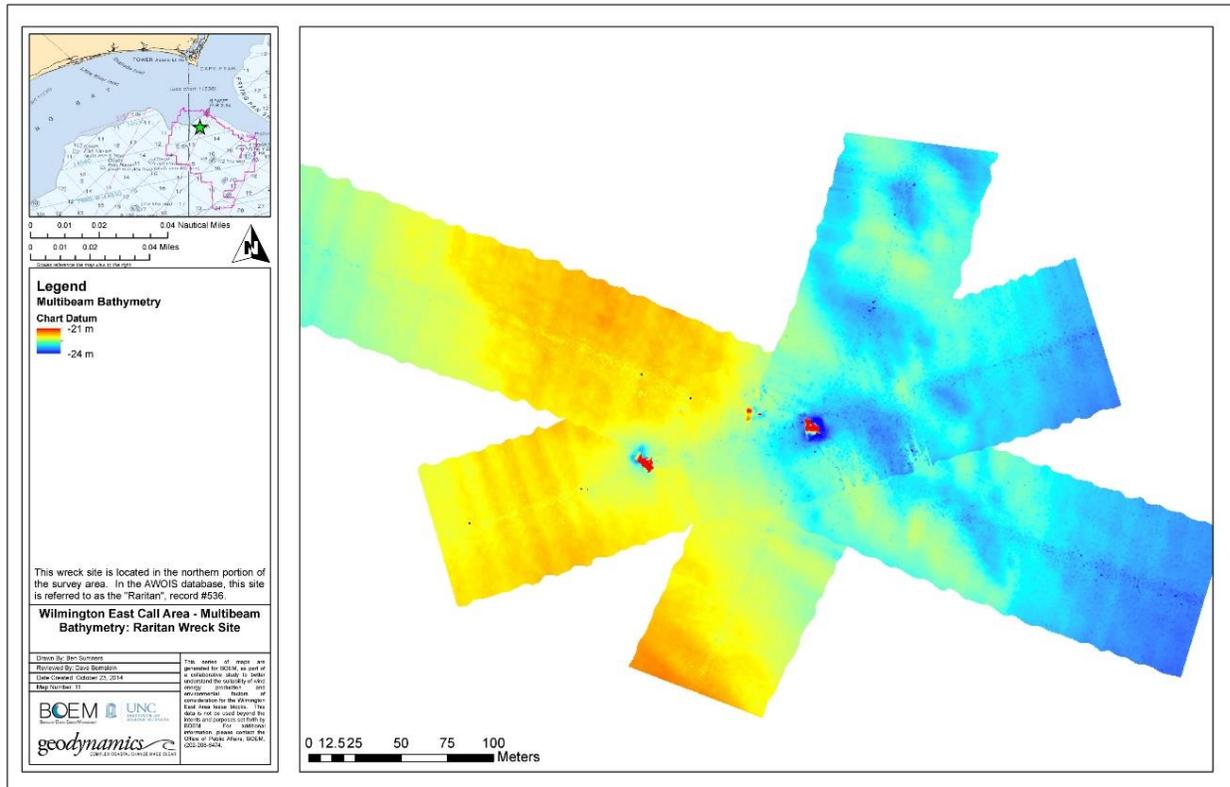


Figure 5: Multibeam Imagery of *Raritan* (Taylor, et al. 2016).

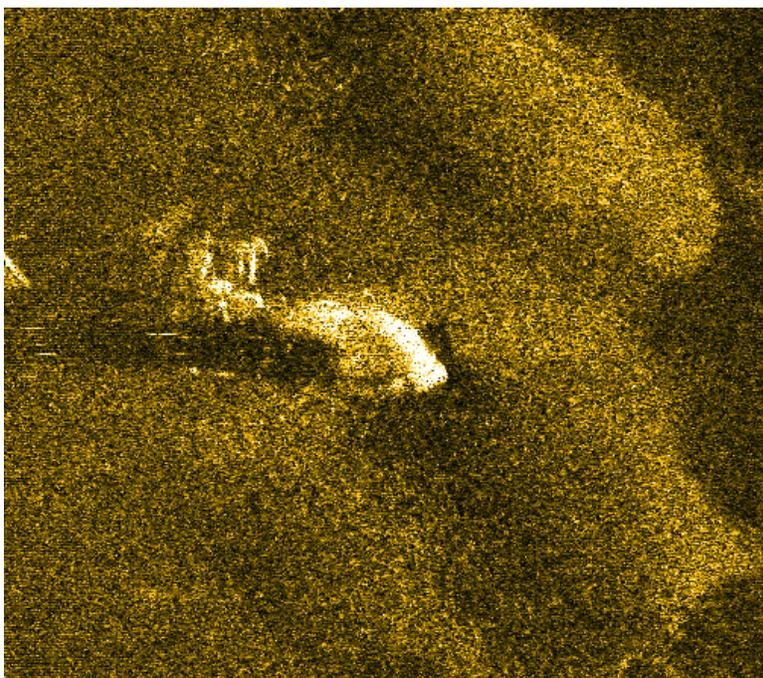


Figure 6: Side scan sonar image of *Raritan* (Taylor, et al. 2016).

As visible in the remote sensing imaging, the site is roughly oriented along an east-west axis and consists of two main features of high relief representing the bow section (located to the west) and stern section (located to the east). The total length of the wreck site is approximately 100 m (328 ft). The bow and stern sections each measure approximately 12 to 15 m (39 to 49 ft) in length and are approximately 5 to 7.5 m (16.4 to 24.6 ft) wide, respectively. Both the bow and stern sections measure approximately 5 to 7 m (15 to 20 ft) of relief above the seafloor.

The bow section is resting on its port side (Figure 7) with the bow anchors in place at the hawseholes and intact winch and deck machinery visible. The stern section is partially resting on its port side with remains of the steering quadrant visible (Figure 8). The single screw appears to have been removed or salvaged and portions of the rudder assembly are still intact (Figure 9). Further midships from the stern section rests the remains of the boilers and the triple expansion engine (Figure 10).

Adjacent to both the bow and stern sections are the remains of possible cargo winches or derrick booms on the main deck (Figure 11, Figure 12, and Figure 13). The remainder of the mid-section of the vessel appears to be missing or, possibly, covered by the sandy substrate. No evidence of the superstructure is visible and may have been removed during subsequent salvage or site clearing activities.



Figure 7: Bow of *Raritan*.



Figure 8: Steering mechanism at the stern of *Raritan*.



Figure 9: Rudder post at stern of *Raritan*.



Figure 10: Triple expansion engine (visible in the background) and one of the boilers (visible in the foreground) of the *Raritan*.



Figure 11: Possible cargo winch feature of Raritan.

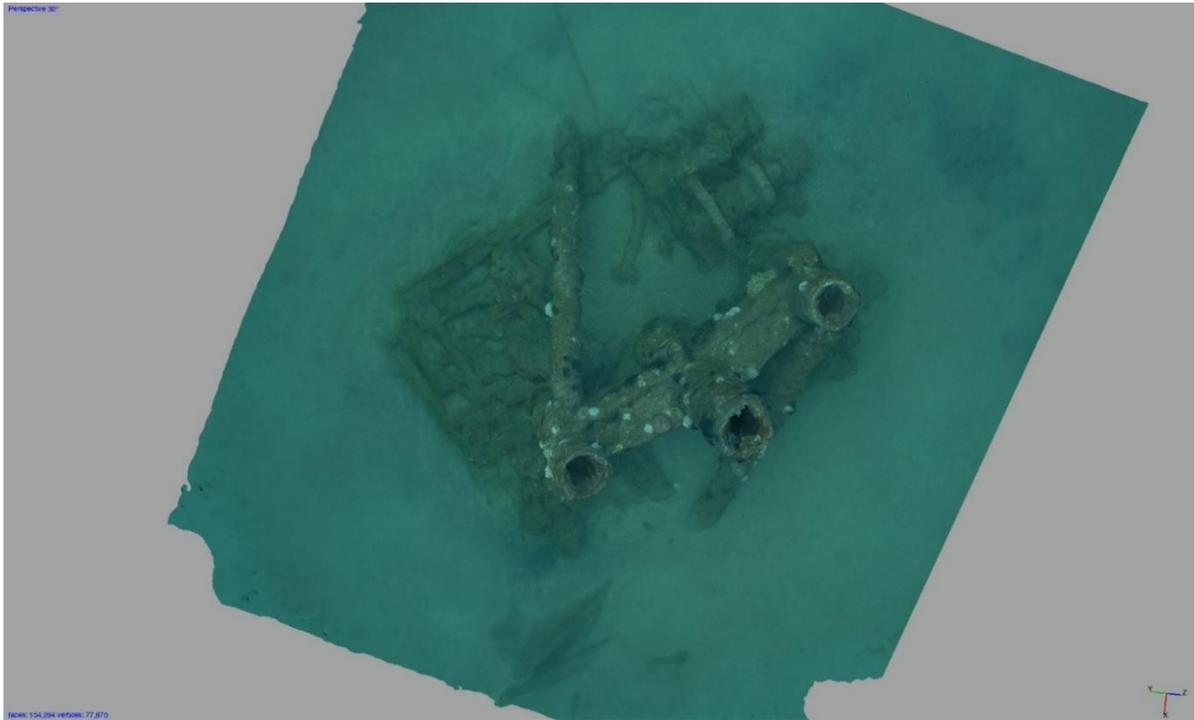


Figure 12: Plan view orthomosaic of cargo winch feature.

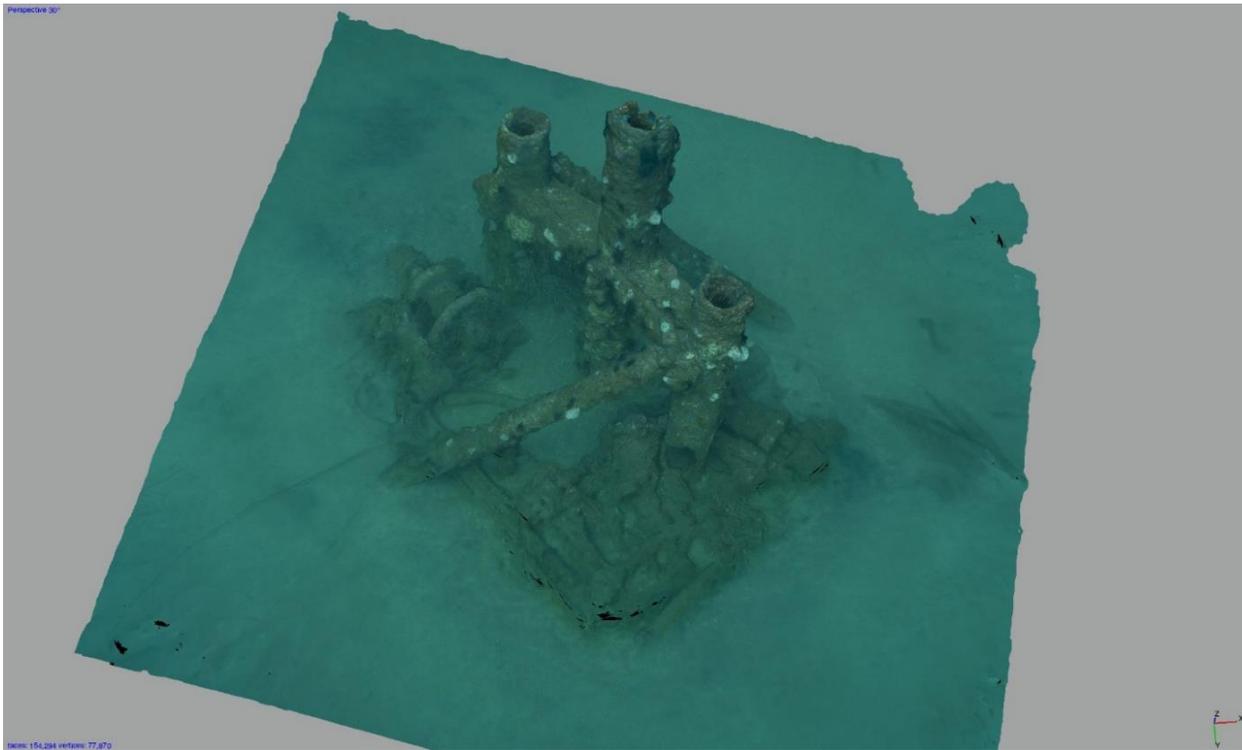


Figure 13: Oblique view orthomosaic of cargo winch feature.

3.1.2 6537K_1

The wreck site referenced as 6537K_1 is a previously unknown site possibly first identified during the benthic habitat mapping project (Taylor, et al. 2016). There is no corresponding AWOIS target, entry within the BOEM ASD, or listing in the UAB database at this geographic location. Five dive rotations were completed on July 26 and August 3, 2017 where detailed measurements and observations were gathered, and a complete photogrammetric model of the site was completed.

As visible in the remote sensing imaging, the site is oriented along an east-west axis and consists of a contiguous wreck resting at a depth of 27.4 m (90 ft) and surrounded by a shallow scour depression (Figure 14). The site measures an overall length of 33.6 m (110.24 ft) and is 6.54 m (21.46 ft) at beam.

As visible in the photogrammetric model (Figure 15), the site consists of the intact lower portion of a metal-hulled, twin-screw vessel. The wreck is resting on its starboard side at approximately 45 degrees with the port propeller and shaft exposed (Figure 16 and Figure 17). The port side of the vessel exhibits up to 1 meter (3 feet) of relief, while the starboard side of the vessel appears to be buried below the sand (Figure 18). Based on measurements taken from the scaled photogrammetric model, the overall length of the vessel was determined as approximately 33.6 m (110.24 ft) with a beam of approximately 6.54 m (21.46 ft).

The site has a high degree of integrity and does not appear to have been extensively disturbed or subjected to subsequent looting. Internal spaces of the lower hull are identifiable including the presence of a galley towards the bow, as evidenced by stacked copper cooking pots and white earthenware plates (Figure 19 and Figure 20), and a head toward the stern, as evidenced by a white granite sink and tub (Figure 21 and Figure 22). The propeller shaft is visible extending through the hull to an area of machinery debris and stack of nickel iron or Edison-style batteries (Figure 23).

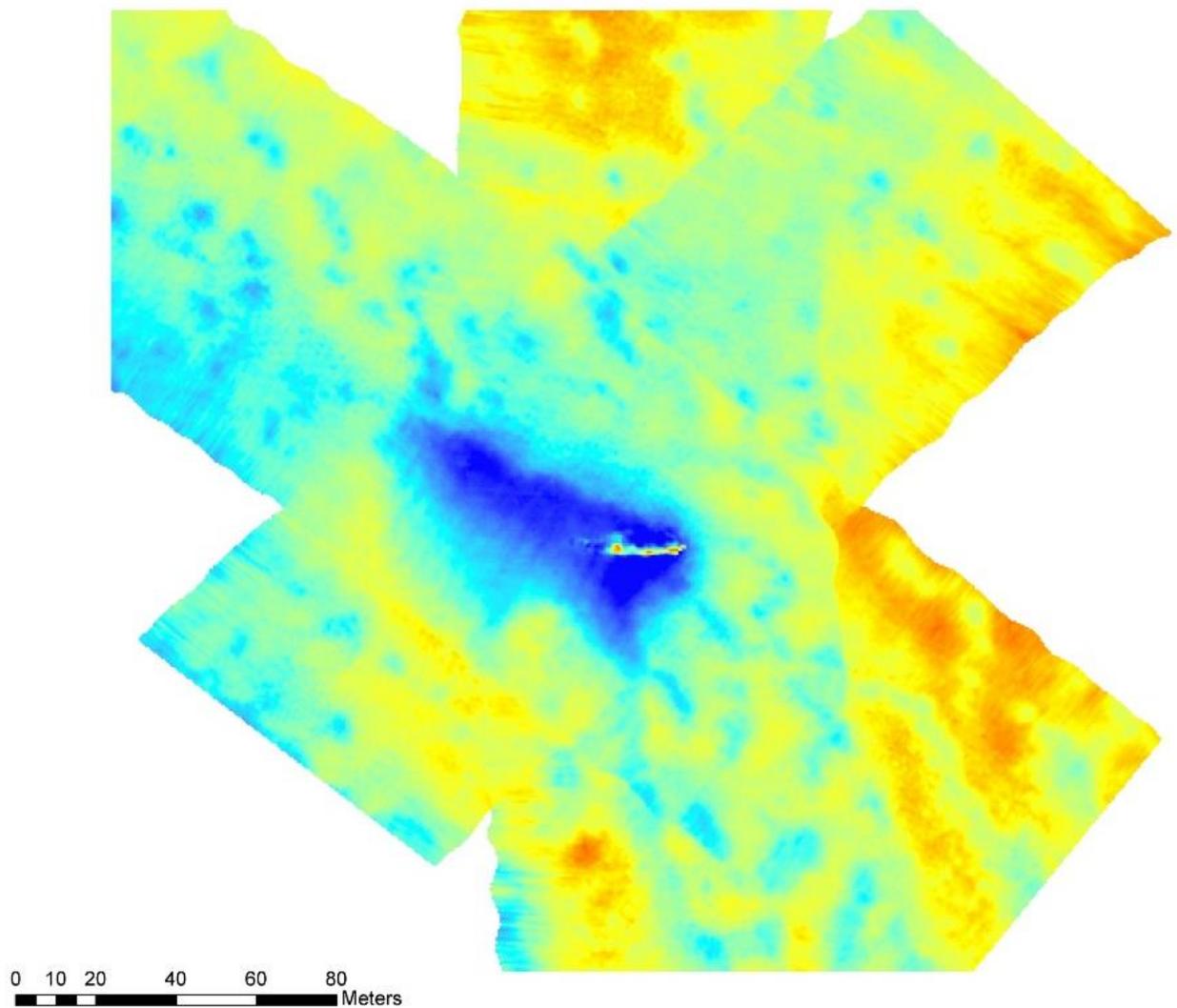


Figure 14: Multibeam Imagery of Shipwreck Site 6537K_1 (Taylor, et al. 2016).

Based on the size, hull characteristics, and visible artifact assemblage, this site likely represents the remains of an early twentieth century pleasure yacht. Compared to the UAB shipwreck database, no obvious candidates for the identity of this vessel were located based on the size, vessel type, and location. Additional research is recommended to ascertain the identity of the vessel.

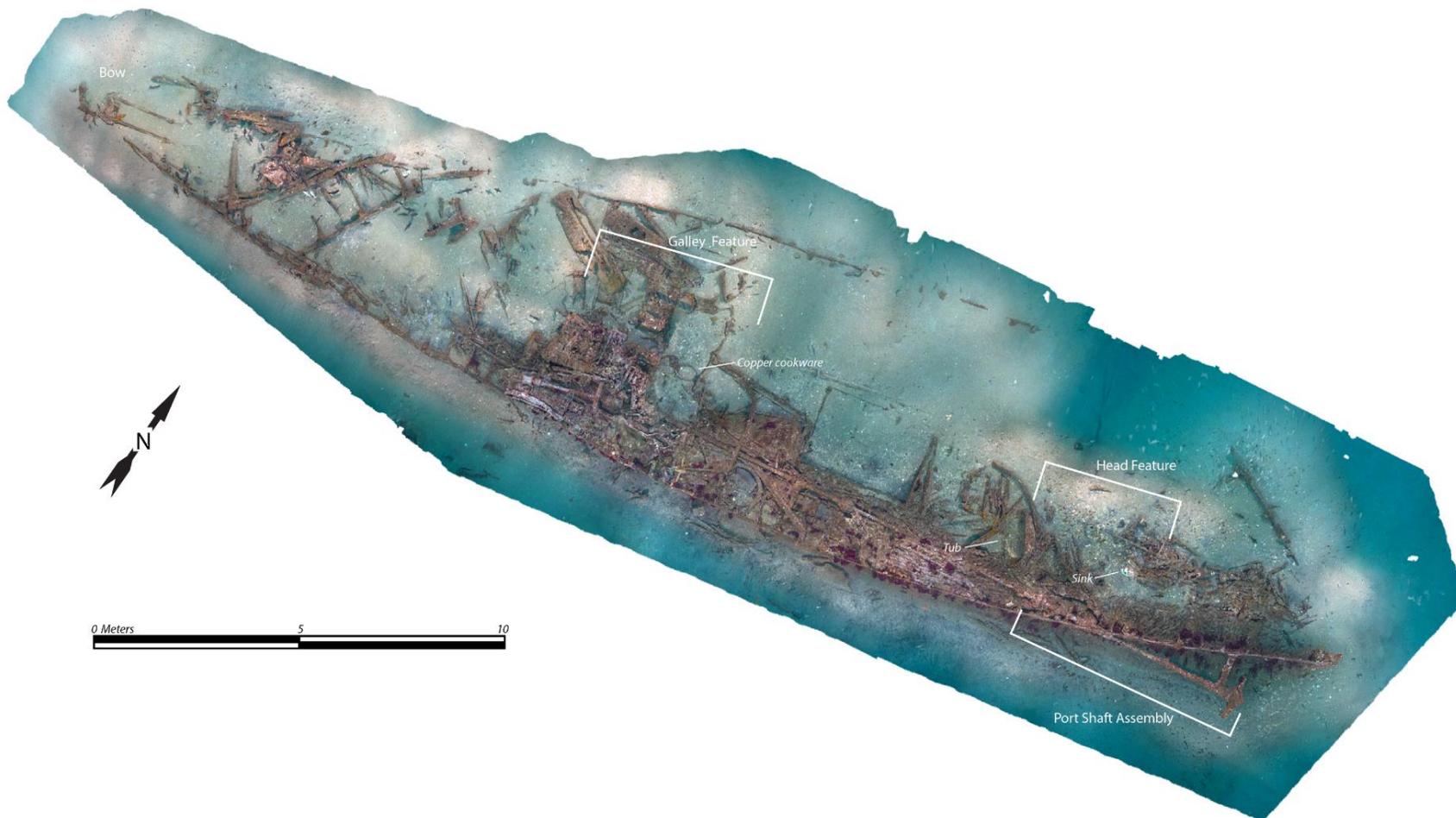


Figure 15: Orthomosaic site plan of site 6537K_1.

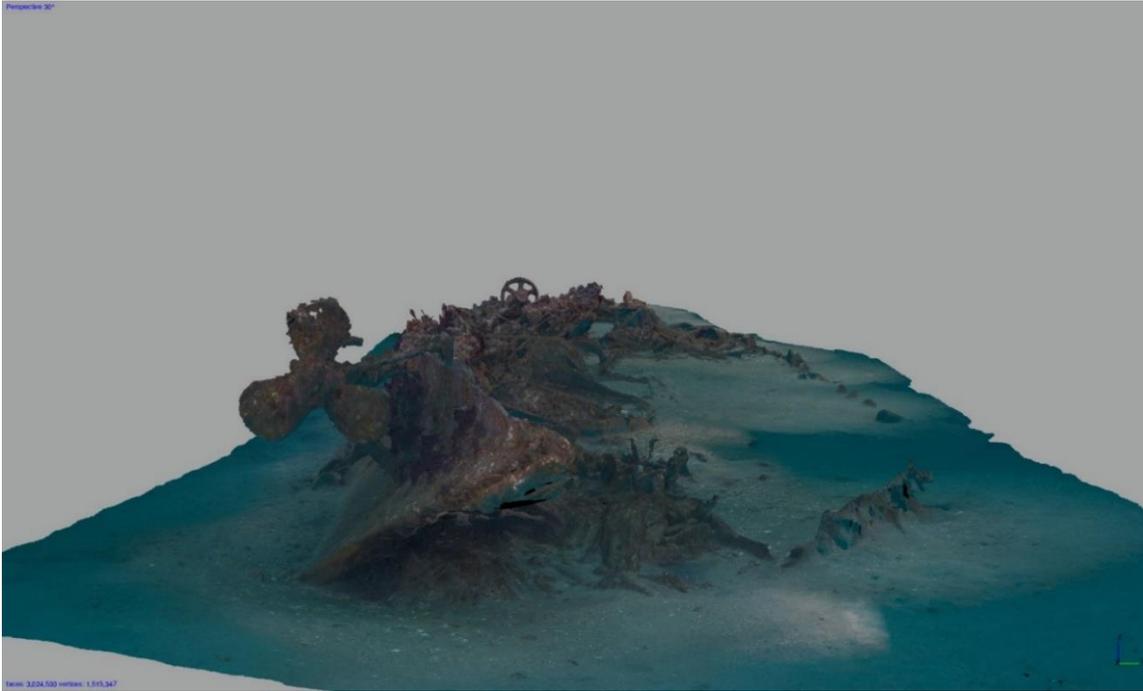


Figure 16: Orthomosaic perspective view of 6537K_1 from propeller facing towards the bow.



Figure 17: Port propeller and shaft of 6537K_1.

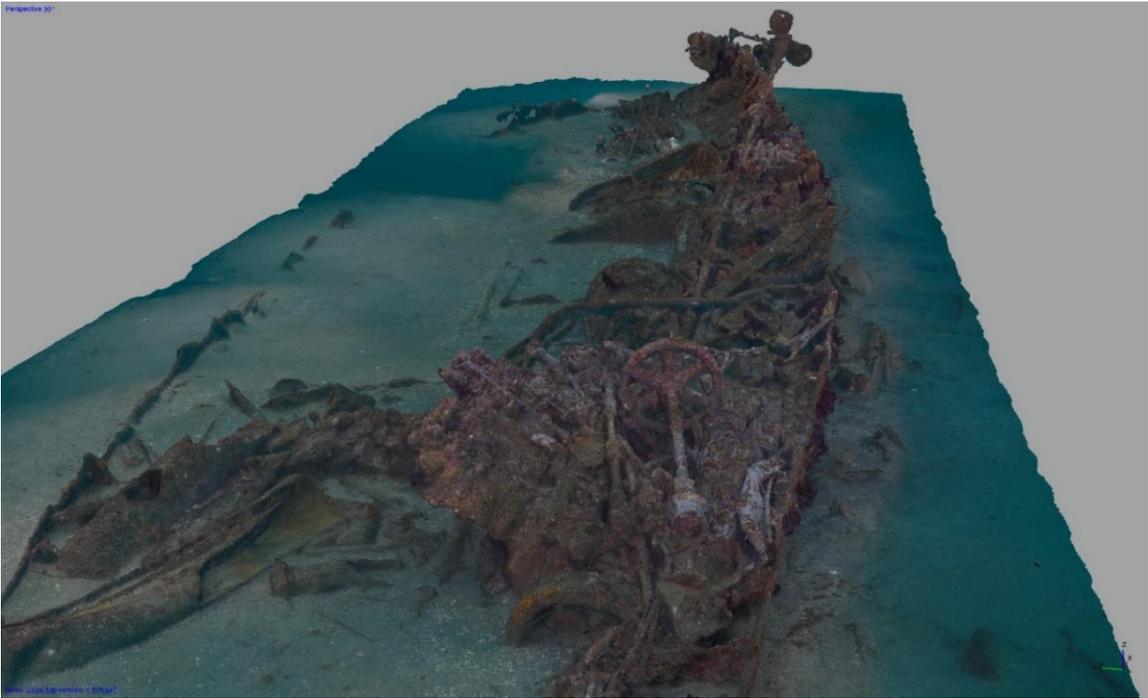


Figure 18: Orthomosaic model with perspective view at site of 6537K_1 from bow facing aft.



Figure 19: Copper cookware exposed at site of 6537K_1.



Figure 20: White earthenware plate within engine machinery remains at site of 6537K_1.



Figure 21: White granite sink at site of 6537K_1.



Figure 22: Exposed ceramic tub at site of 6537K_1.

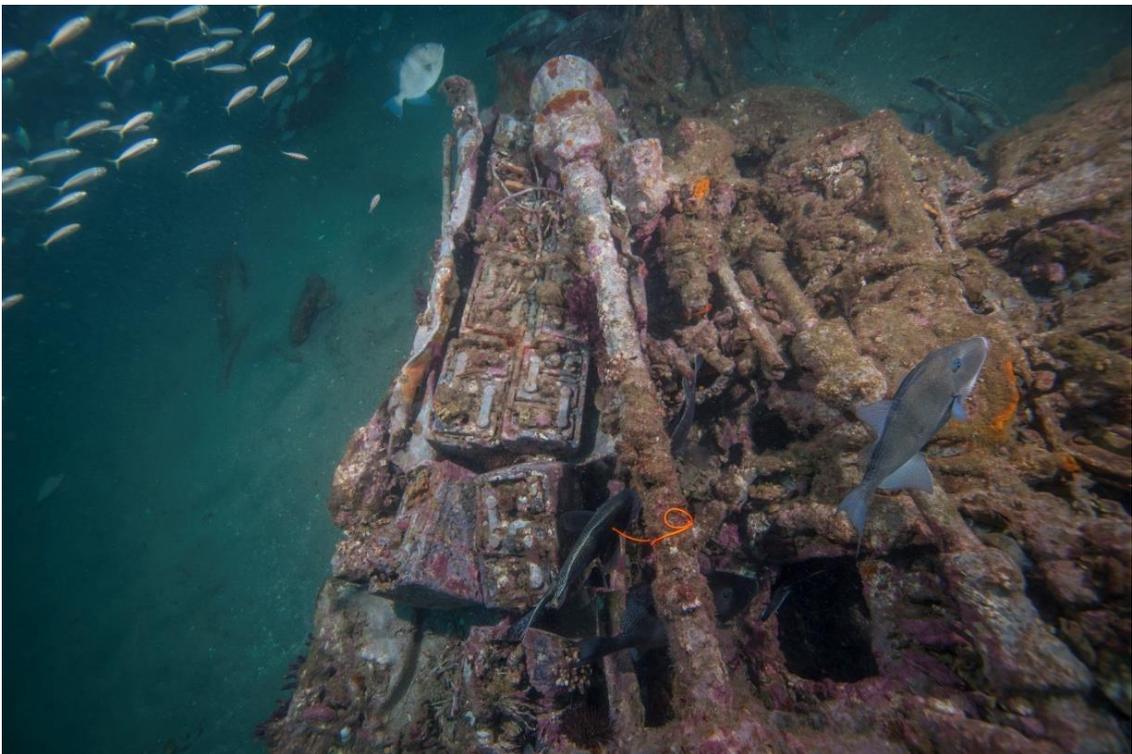


Figure 23: Batteries located on port side of site of 6537K_1.

3.1.3 Lady Margaret

The wreck site attributed as *Lady Margaret* does not have a corresponding AWOIS entry, and the site is not listed in the UAB database. A vessel named *Lady Margaret* is reported in the BOEM ASD within the region, and the site is also referenced in regional wreck diving guides (Aqua Explorers, Inc. 2009; Gentile 2003).

The site was investigated on July 27, 2017 with two dive rotations completed. Located at a depth of 30 m (100 ft), the site consists of a scatter of visible surface features. During the dive rotations, a photogrammetric model of the site was completed (Figure 24). No visible remains of the vessel's hull were observed, and the site debris extends over an area 17.1 m (56.1 ft) east to west by 8.18 m (26.83 ft) along a north to south axis. Multibeam echosounder survey in the area, completed in 2013 from NOAA ship *Ferdinand R. Hassler*, may also indicate that additional site features are located to the north and east of the main debris area mapped during the 2017 investigation (Figure 25). The site has generally low relief with the largest feature of engine debris standing approximately 1 m (3 ft) above the seafloor (Figure 26). As visible in the photogrammetric model, the prominent features of the site include two rectangular tanks, possibly fuel or water tanks, measuring 1.72 m (5.64 ft) in length, and an area of engine or other machinery debris extending approximately 7 m (22.9 ft) in length (Figure 27). Modern marine-grade electrical wiring or hose is visible within the engine debris indicating that the wreck likely represents a recent loss (Figure 28).

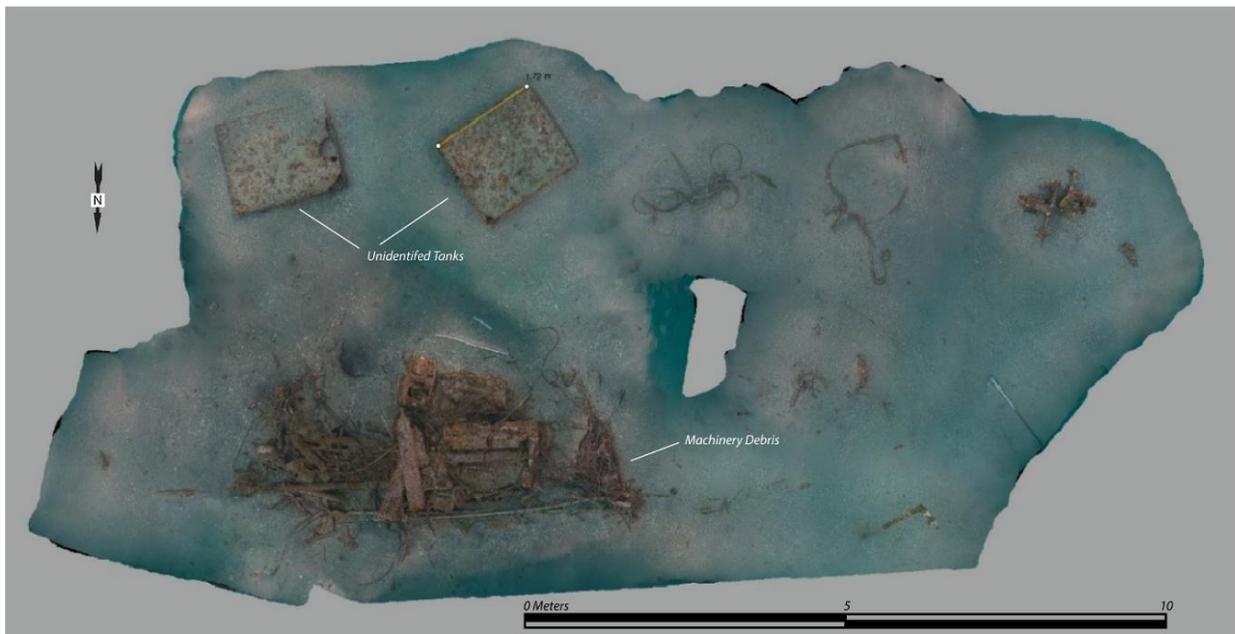


Figure 24: Orthomosaic site plan of *Lady Margaret*.

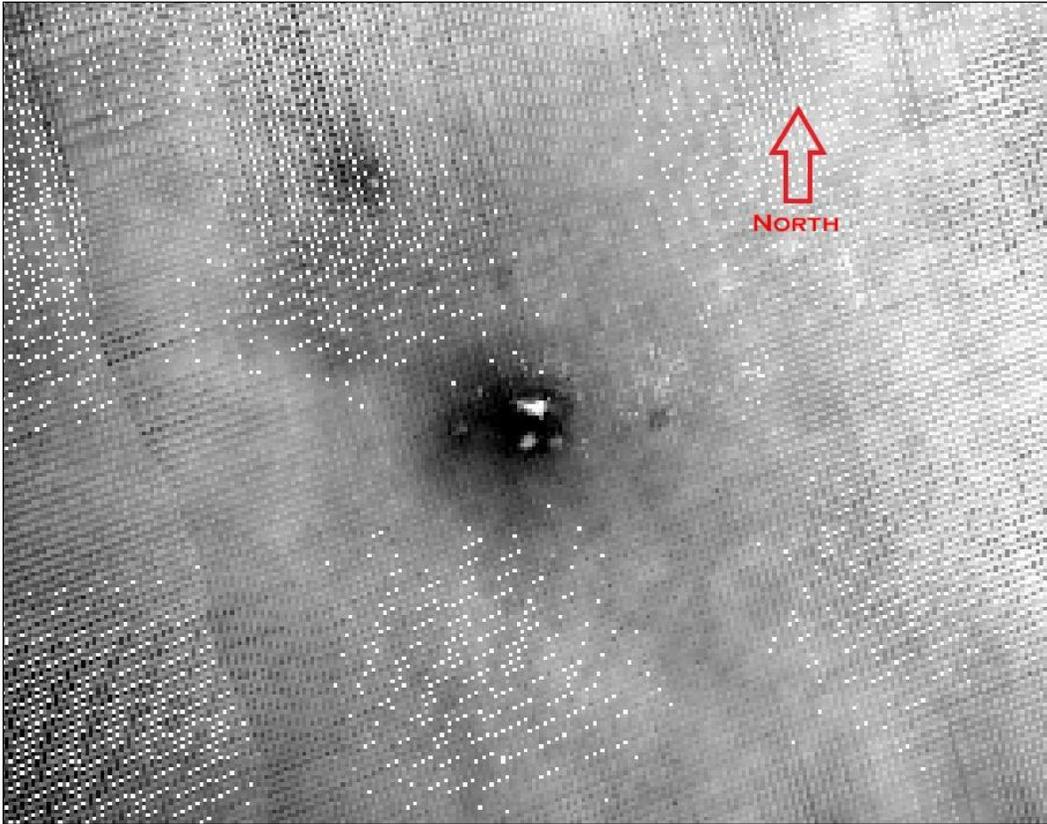


Figure 25: Multibeam backscatter image of *Lady Margaret* site illustrating main debris area and possible features located to the north and east. Image courtesy of NOAA.

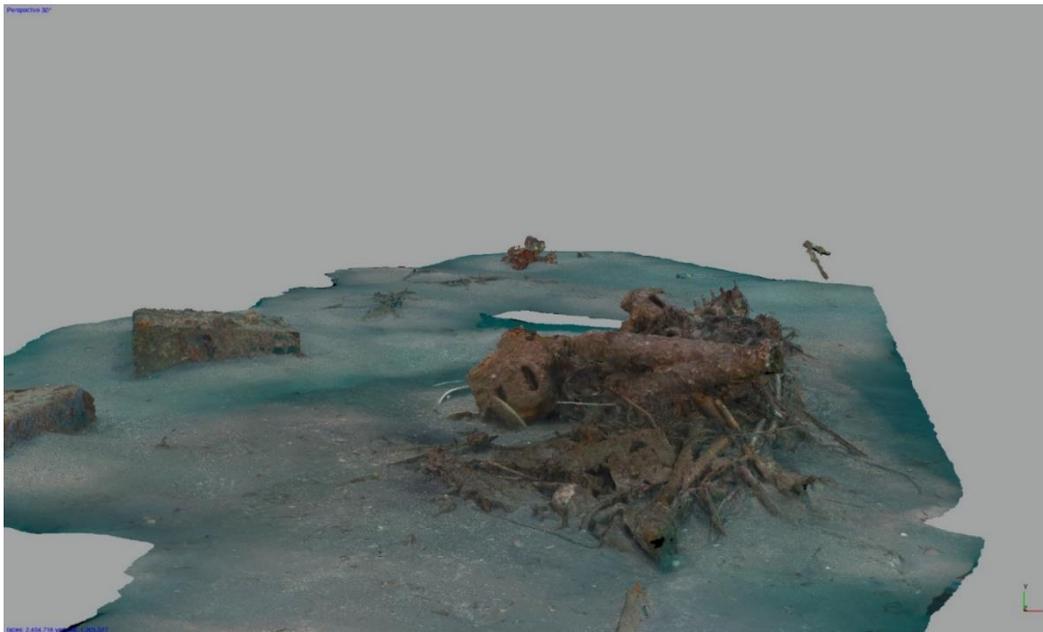


Figure 26: Orthomosaic perspective view of *Lady Margaret* illustrating site relief, engine debris is in the foreground.

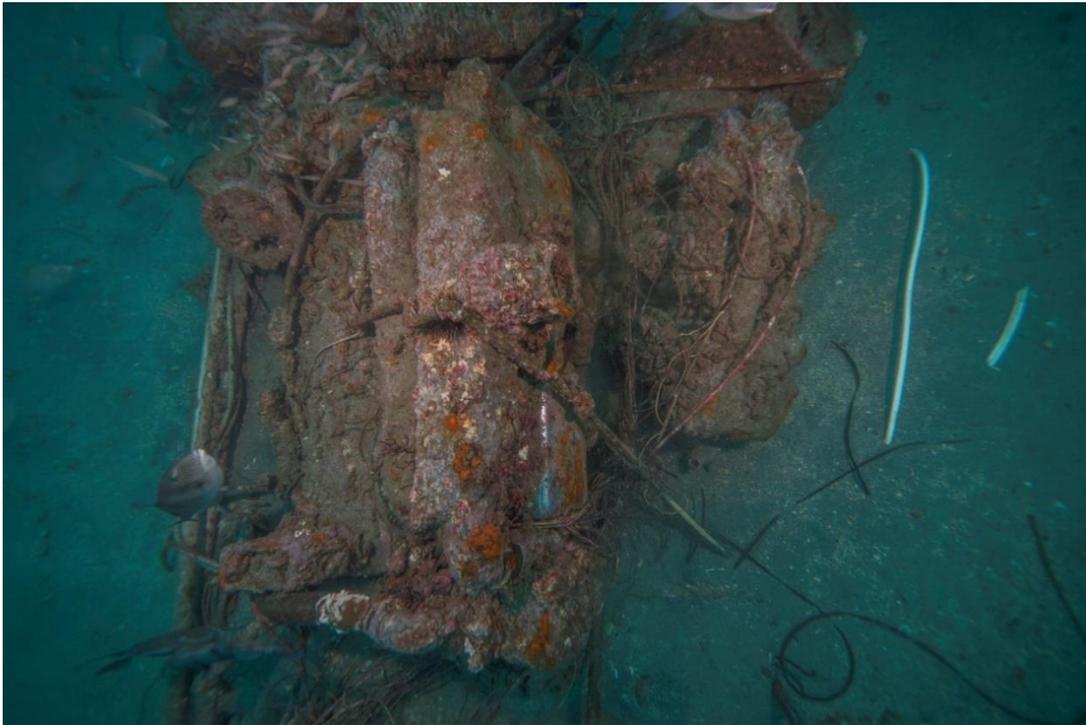


Figure 27: Unidentified machinery and gas cylinders at *Lady Margaret* site.



Figure 28: Marine-grade hose or wiring within machinery debris at *Lady Margaret* site.

Additional investigation is recommended to confirm if the site identified is conclusively that of *Lady Margaret*. A historical background and brief account of the wrecking event of *Lady Margaret* is provided in support of future research. This narrative is based on first-person accounts from Gary Schaible and Dan Jackman (2019, pers. comm.), who served as crew members on the last cruise of the vessel; Jack Schockemoehl (2019, pers. comm.), USCG pilot who served as Second Officer on the C-130 involved in the rescue effort; and Thomas Ochiltree, a Panax Newspapers correspondent and passenger on the last cruise who published a firsthand account in *Seapower Magazine* (Ochiltree 1977). Scott Schaible, son of Gary Schaible, additionally produced the short documentary film *The Lady Margaret, The Last Voyage* (Schaible 2016), which was based on interviews with the surviving crew members.

The 30.8-m (101-ft) diesel yacht *Lady Margaret* was originally built in 1930 under contract number 203 as *Silver Moon II* by Mathis Yacht Building in Camden, New Jersey (Bowling Green 2019, Tolf 1996, US Treasury Department 1954). The vessel was originally constructed for Philadelphia businessman John Zimmerman and designed by shipbuilder John Trumpy, whose work at Mathis Yacht Building fostered a post-World War I market for fine yachts and houseboats for the rich and famous (including the National Register-listed, 1925 presidential yacht *USS Sequoia*). Following a succession of owners and name changes (including *Masquerader* [c.1938], *Aras* [c.1947], *Governors Lady* [c. 1969]), the vessel was purchased in 1975 by John McGoff, President of Global Communications and the Panax Newspaper Corporation and renamed *Lady Margaret* (Tolf 1996:172; US Treasury Department 1954).

Trumpy yacht hulls during the 1930s were constructed of long leaf yellow pine or juniper with a superstructure and wheelhouse of teak, as visible in images of *Lady Margaret* during renovation in the mid-1970s (Figure 29). *Lady Margaret* had twin screws powered by diesel engines that were likely upgrades. During this renovation, the staterooms, salon, and wheelhouse were restored to original condition while the bridge was upgraded with modern electronics and the galley was upgraded with modern appliances. Additionally, a horseshoe wet bar was added to the fantail and an elevator was installed (Dan Jackman and Gary Schaible 2019, pers. comm.).

In 1976, *Lady Margaret* was transiting from its home port in Gross Point, Michigan to the owner's residence in Miami, Florida. The vessel departed Morehead City, North Carolina on November 9, 1976 under calm conditions heading south in its final leg to Florida. The vessel encountered rough seas that afternoon, that continued to build throughout the day and evening. Following hours of punishing seas, the vessel began taking on water, ultimately losing its bilge pumps and flooding the engine room. The captain radioed for assistance and USCG C-130 (HC-130B, tail number 1346) was launched to provide support. The C-130 made contact with the vessel and dropped radio location beacons and dewatering pumps. Unfortunately, due to the sea state, the crew of *Lady Margaret* was unable to retrieve the spare pumps and the vessel continued taking on water. The vessel ultimately lost power and, unable to navigate into the seas, Captain Richard Stevenson declared mayday at approximately 1:30 A.M. and prepared to abandon the ship. Coast Guard helicopters were launched and nearby ships, including the Exxon tanker *Chester*, diverted to the location to provide assistance. Eight of the vessel's passengers and crew abandoned the ship, by climbing into a life raft, which had flipped over during deployment as the vessel sank. One passenger, 27-year-old Thomas Morgan was swept overboard. Coast Guard helicopters reached the scene around 4:45 A.M. and after conducting search patterns, located the life raft and recovered the survivors with barely enough fuel remaining to return to shore. The following morning, the body of Thomas Morgan was recovered by the Coast Guard.

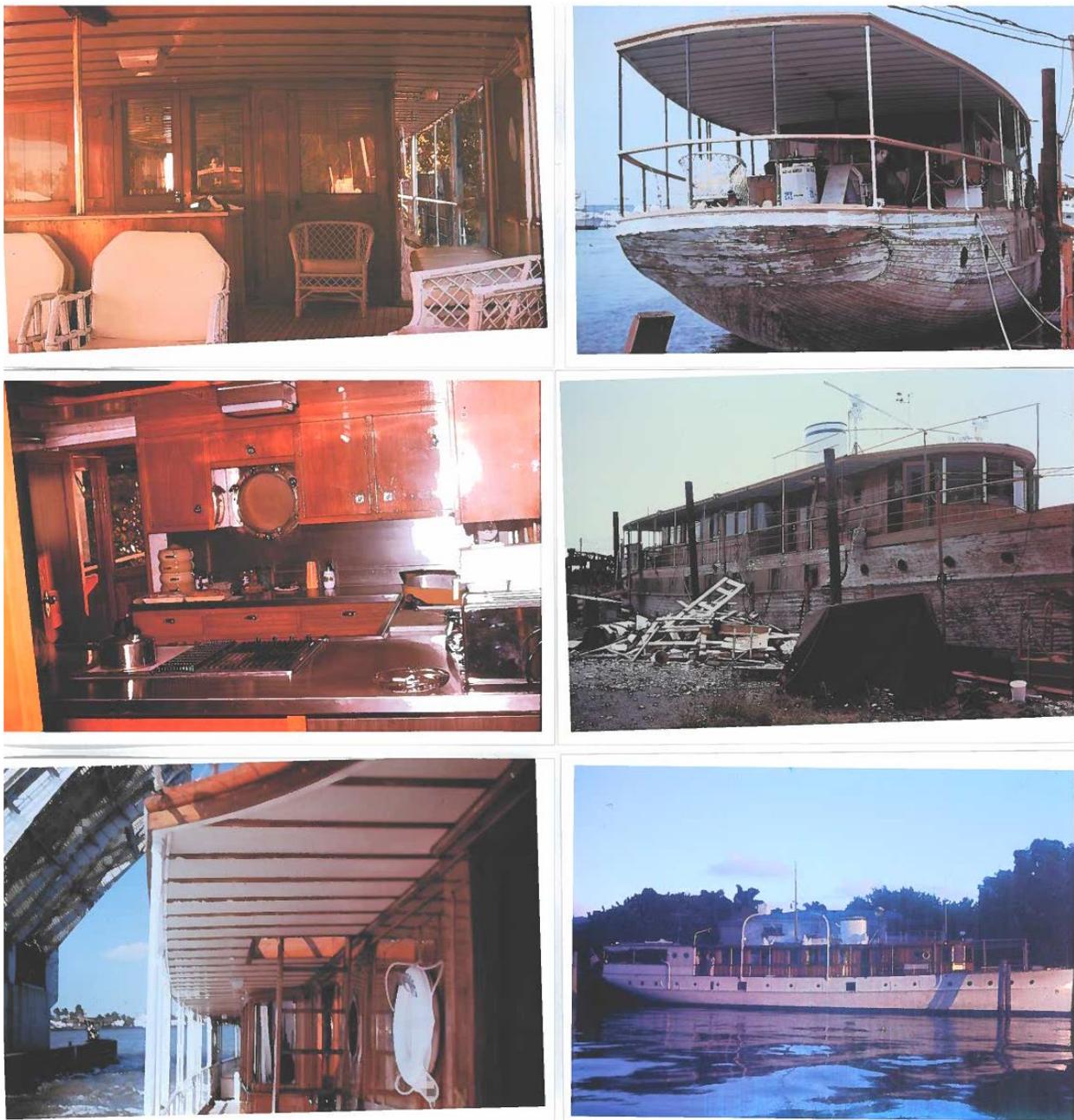


Figure 29: Interior and exterior photographs of *Lady Margaret* during a 1970s vessel overhaul. Photographs by Gary Schaible, ND, courtesy of Scott Schaible.

3.1.4 Known Wreck

The wreck referenced as “Known Wreck” has a corresponding AWOIS target as well as a BOEM ASD entry associated within 1 km (0.6 mi) of the site’s location. Two dive rotations were completed July 27, 2017 and photographic and video documentation of the site were acquired. Divers visually confirmed that the site consists of the remains of a modern barge resting upside down on the seafloor. The site is at a depth of 33.5 m (110 ft), deeper than that reported for the AWOIS target. As visible in the multibeam imagery

(Figure 30) and side scan sonar image (Figure 31), the site is generally intact and with the bow oriented towards the southwest. The site measures an overall length of 169.30 feet (51.60 m) and 23.90 feet (7.30 m) at beam with approximately 10 feet (3 m) of relief.

There are two skegs identifiable at the stern (Figure 32), which is rounded, but evolves into a flat bottom. Framing features were visible through open holes of the deteriorated hull (Figure 33). Toward the bow, which was broken and incomplete, interior cargo spaces are visible. No engine or machinery equipment were located on the site, further identifying the remains as a barge, of similar layout to a modern example, as illustrated in Figure 34.

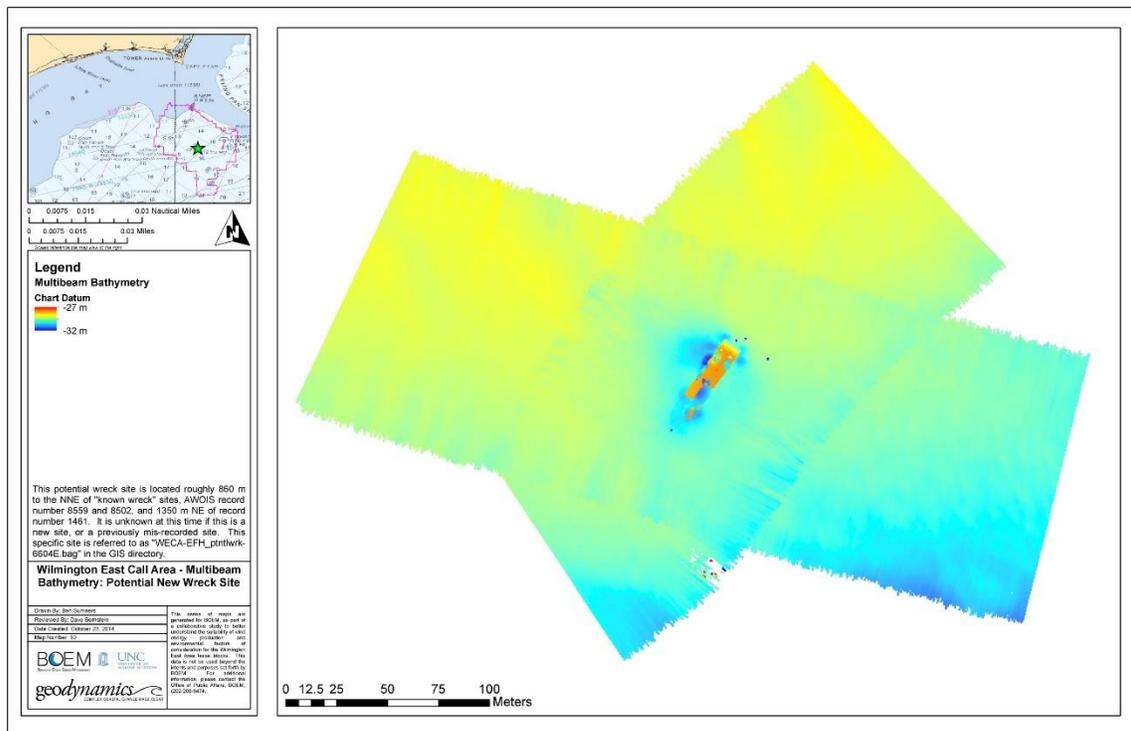


Figure 30: Multibeam imagery of the “Known Wreck” site (Taylor, et al. 2016).

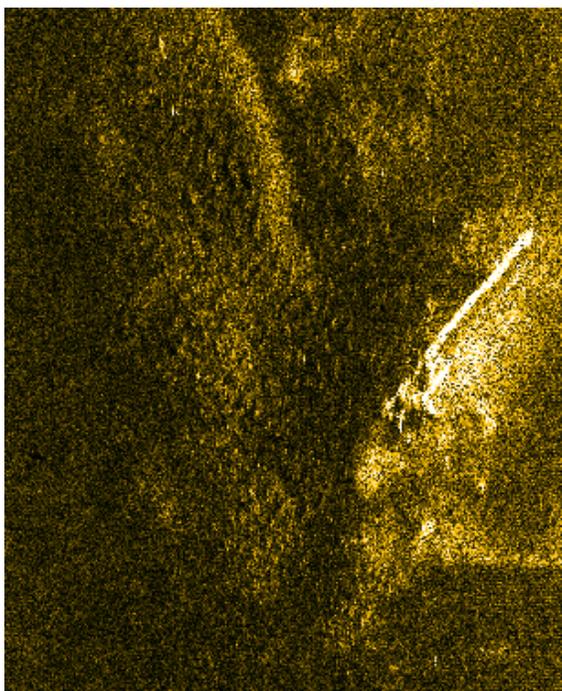


Figure 31: Side scan imagery of the “Known Wreck” site.



Figure 32: Starboard skag of “Known Wreck” site; barge is upside down.

3.1.5 City of Houston

City of Houston is charted in NOAA's AWOIS and listed in the North Carolina UAB. The vessel, an iron-hulled cargo and passenger vessel, was built to use both sail and steam power, as illustrated in a contemporary image (Figure 35). *City of Houston* measured 290 ft (88.39 m) in length by 33 ft (10.05 m) at beam, grossing 1,515 tons. The vessel was built by Reaney, Son and Archbold (later the Delaware River Iron Shipbuilding and Engine Works) in Chester, Pennsylvania and sold to the Clyde-Mallory Line, which operated cargo and passenger routes from Texas to New York (Wrecksite 2007; Shipbuilding History 2013). On the night of October 22, 1878, *City of Houston* was caught in a storm and lost off Frying Pan Shoals after it was abandoned by the crew (Cobb III and Roth 2000). This storm is referred to as the "Gail of '78" and numerous other vessels along coastal North Carolina were lost in the event (Cobb III and Roth 2000).

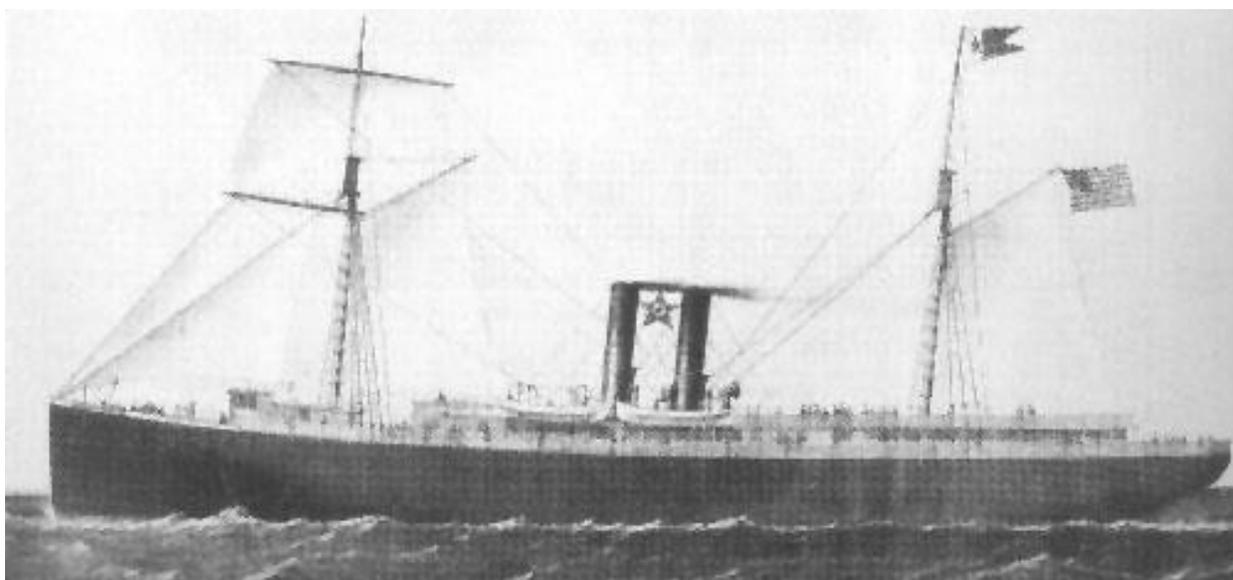


Figure 35: *City of Houston* (Wrecksite 2007).

As reported in contemporary newspaper accounts of the loss (New York Times 1878), on the evening of October 22, 1878, *City of Houston* started to take on water during the storm. By 2 A.M. that following morning, passengers were alerted to the situation and were told to make ready to abandon ship if necessary. Water continued to engulf the vessel, extinguishing and disabling the engine and machinery. At 4 A.M., lifeboats were made ready and passengers were told to put on their life preservers. No vessel in the area was able to see the sinking vessel until later in the morning of October 23, 1878 when the steamship *Margaret* sighted the distress signal of *City of Houston* and made way to assist. Captain Holmes of *Margaret* made contact with *City of Houston* around 9 A.M. that morning and began transferring passengers and crew over from the sinking vessel. Captain Stevens of *City of Houston* safely landed all crew and passengers over to *Margaret* and watched as his vessel slowly drifted away in the rough seas. *City of Houston* drifted and sank later that morning, finally succumbed to the rising water.

Four dive rotations and a photogrammetric model of the site were completed on August 2, 2017, (Figure 36). Located at a depth of approximately 30 m (100 ft), remains of the vessel were spread in a debris field of low relief over an area extending approximately 93.5 m (306.7 ft) by 41 m (134.5 ft), with the exception of the steam engine A-frame, which was the most dominant site feature rising approximately 7.6 m (25 ft) above the seafloor (Figure 37). The site was oriented along a northeast to southwest axis, with the bow

facing toward the northeast. Based on measurements taken from the scaled photomodel, the overall length of the vessel was determined as approximately 293.30 ft (89.40 m) in length with a beam of 31.46 ft (9.59 m) measured from the turn of the bilge. Other exposed features associated with steam engine include boilers (Figure 38) and a stuffing box assembly housing the shaft extending from the A-frame to the vessel's propeller (Figure 39). Throughout the midships section, lower portions of the hull were partially intact with articulated sections of the keelson and framing visible (Figure 40 and Figure 41). The upper sections of the hull framing had collapsed to the exterior creating the surrounding debris field. At the stern, the remains of a rudder post were visible (Figure 42).

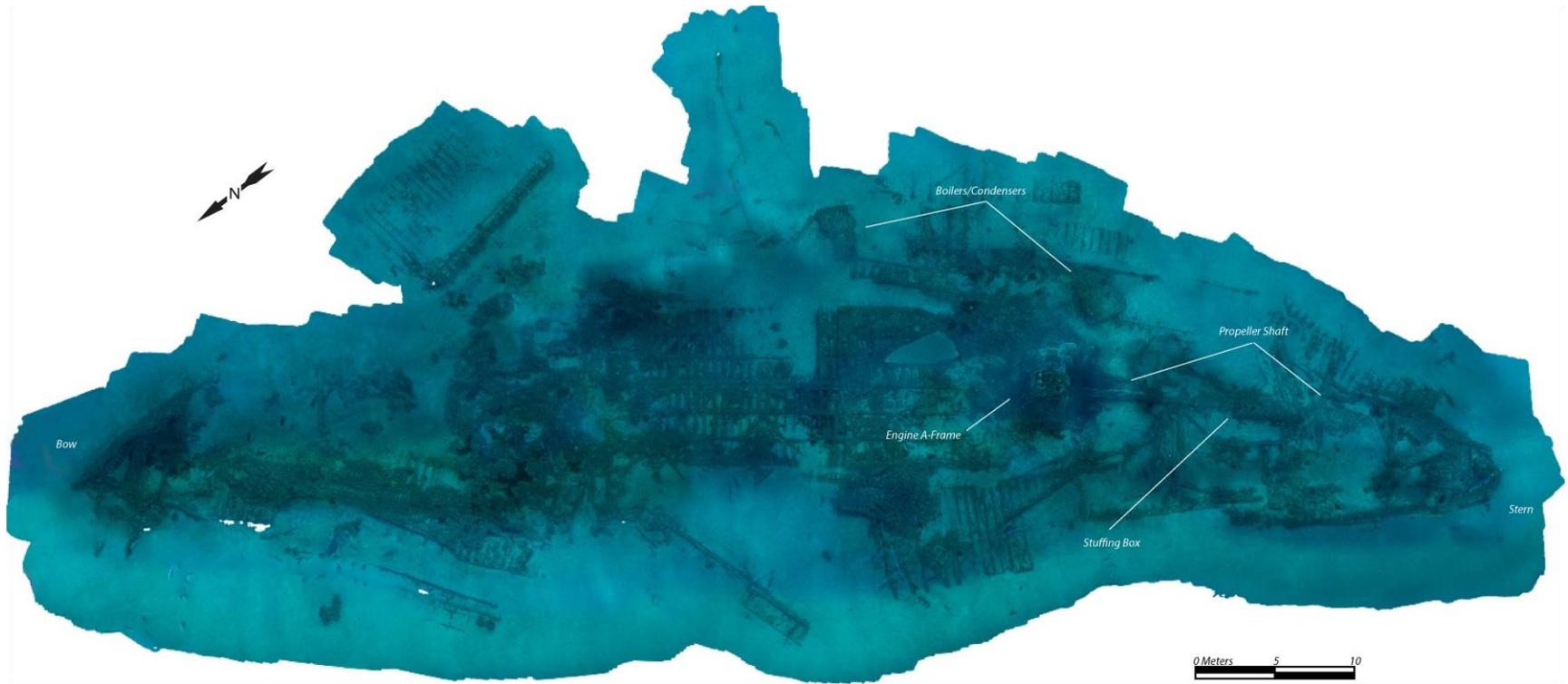


Figure 36: Orthomosaic site plan of *City of Houston*.

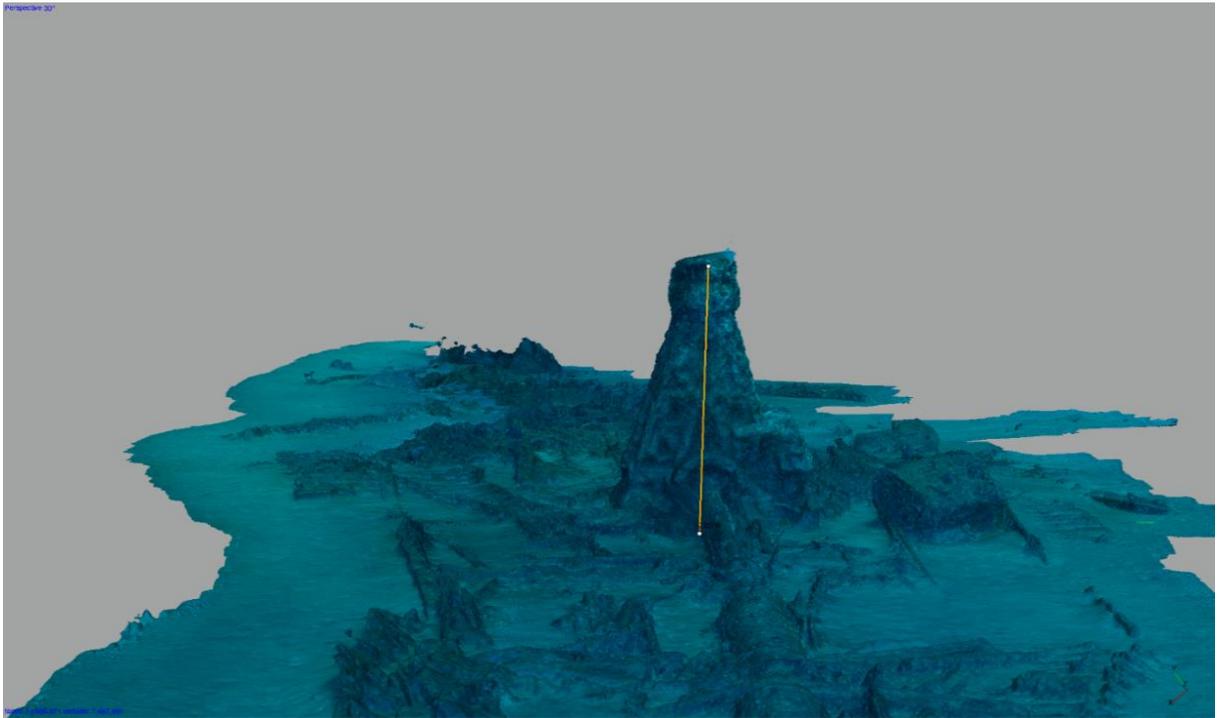


Figure 37: Oblique orthomosaic perspective looking towards the bow illustrating relief of engine A-frame of *City of Houston*.



Figure 38: Exposed boilers of *City of Houston*.

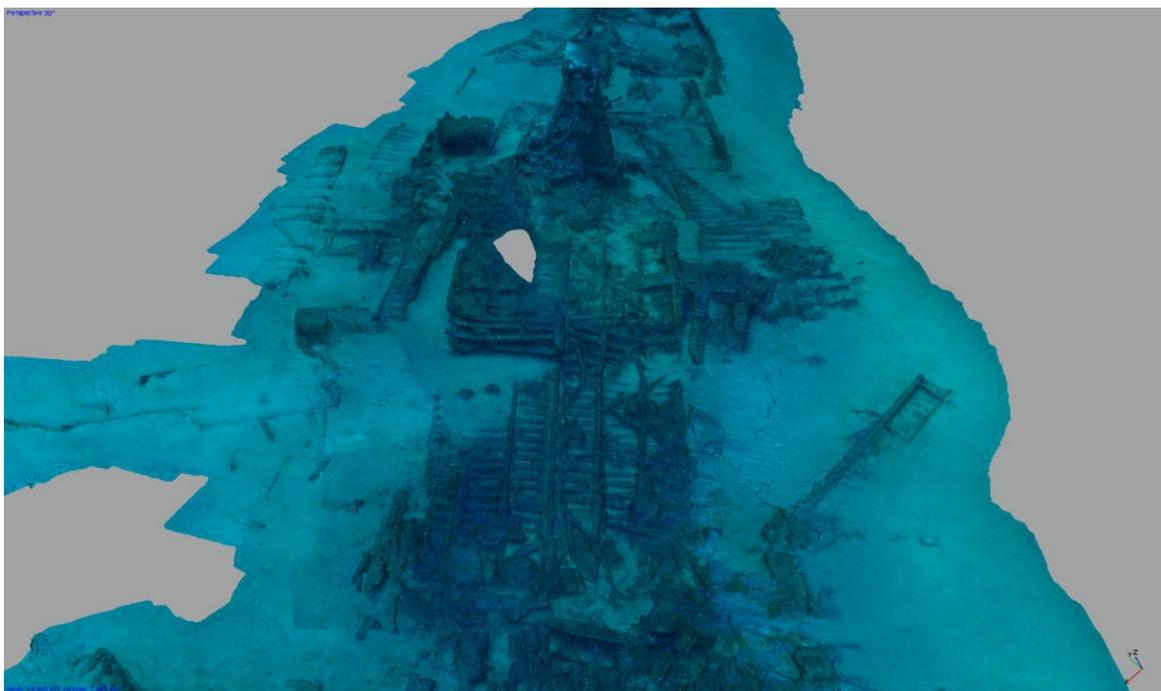


Figure 39: Potential stuffing box for propeller of *City of Houston*.



Figure 40: Orthomosaic perspective of *City of Houston* facing towards the stern illustrating intact framing midships.

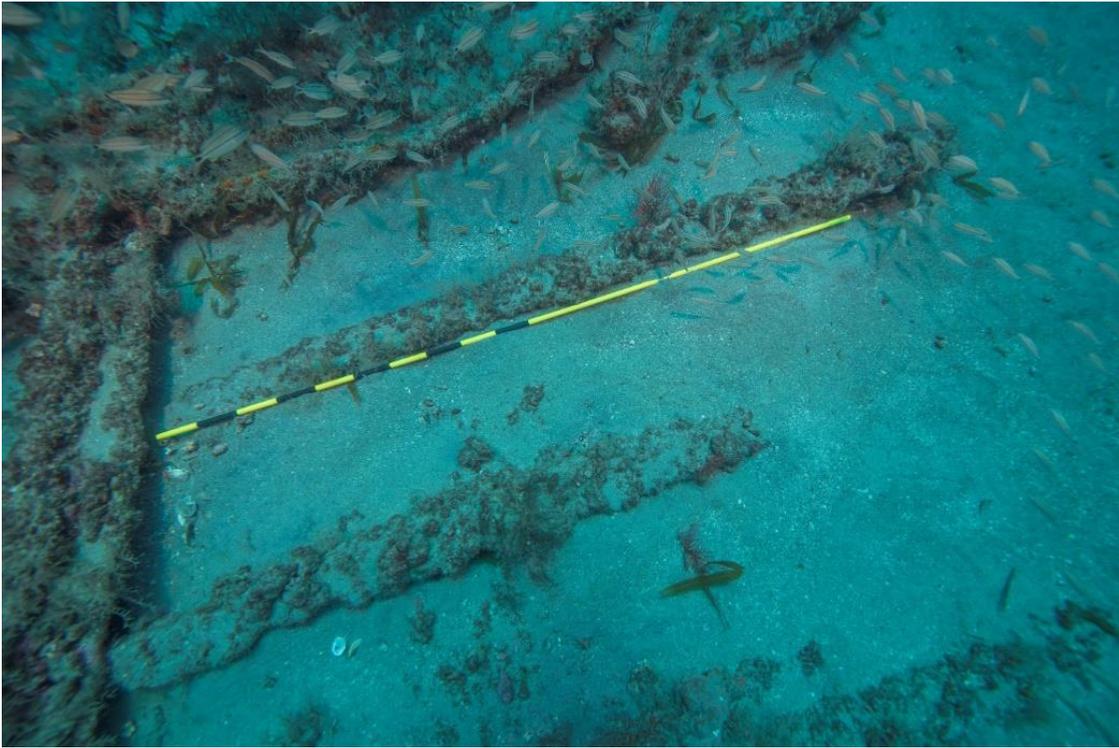


Figure 41: Detail of exposed framing of *City of Houston*, scale bar is 2 m (6.6 ft).



Figure 42: Stern section of *City of Houston* with potential rudder post remains.

3.2 Atlantic Shipwreck Database Sites

Two ASD entries reported within the Wilmington West WEA were investigated under this study. The ASD does not represent a complete listing of all potential shipwrecks located on the Atlantic OCS, but rather it serves as a baseline source of existing and available information for the purposes of corroborating and supporting archaeological identification efforts. In many cases, the locational accuracy of database entries varies greatly, some of which were obtained when locational accuracy of navigational equipment was far less reliable, and many entries are based solely on reported locations of wrecking events that have not been verified. As these sites represent reported locations, investigations under the current study focused on in-water reconnaissance to determine the presence or absence of potential archaeological sites at the reported geographic coordinates.

3.2.1 Train Cars

An attempt was made to locate a site referenced as “train cars” on July 27, 2017. No objects were observed on the seafloor at this location.

3.2.2 Jell II

Jell II is reported as part of the North Carolina Artificial Reef program. Located within Artificial Reef-445, known as the Dale McDowell Reef, *Jell II* is a 174-ft (53.03-m) vessel purposely sunk at the reef in 1991 along with other steel and fiberglass boat molds (Comer and Love-Adrick 2016). Subsequent additions to the area surrounding the artificial reef include concrete pipe, reef balls, and the purposely sunk 55-ft (16.7-m) tug, *Admiral Charlie*. One dive rotation was completed at *Jell II* on July 27, 2017 confirming the site’s location, which was reported to the North Carolina Artificial Reef Program (Figure 43). The site is located at a depth of approximately 18 m (60 ft).



Figure 43: Diver inspecting the remains of purposely sunk modern fishing vessel *Jell II*.

3.3 NOAA Hydrographic Survey Sites

Recent NOAA hydrographic surveys have identified four potential archaeological sites in the vicinity of the Wilmington East and West WEAs. These hydrographic surveys have produced reliable target locations with high archaeological potential, one of which was selected for investigation under this study.

3.3.1 27.162-meter Wreck

The site referenced as the 27.162-m wreck (designated by its charted depth from the NOAA hydrographic survey) is located to the south of the Wilmington East WEA. The site appears to be a newly identified shipwreck, and the location does not have a corresponding AWOIS target, nor is it inventoried in the BOEM ASD or listed in the North Carolina UAB database. Three dive rotations were conducted at the site on August 3, 2017 and a photogrammetric model of the site was completed.

As visible in the multibeam imagery (Figure 44), the site consisted of a contiguous wreck approximately 33 m (110 ft) in length resting at a depth of approximately 27 m (89 ft) and surrounded by a shallow scour depression. The site was oriented roughly along a northwest to southeast axis, with the bow toward the northwest. Based on the in-water investigation, the site consisted of the intact remains of a metal-hulled vessel resting on its port side, listing at approximately 45 degrees (Figure 45). The hull was generally intact up to the gunwale and exposed with only a portion of the keel and screw assembly buried in the sandy substrate (Figure 46). The stern had a distinctive fantail shape while the bow is vertical and topped with a vertical stem post. The cabin, wheelhouse, and any other above-deck superstructure were no longer extant. No debris field or other exposed features were observed surrounding the site.

Following the in-water investigation, a photogrammetric model of the site was created (Figure 47). Based on measurements taken from the scaled model, the overall length of the vessel was determined as approximately 86.94 ft (26.50 m) with a beam of 21.42 ft (6.53 m). Visible features, as observable in the photogrammetric model, include a longitudinally-oriented double bitt bollard at the bow, a windlass, a transversely-orientated double bitt bollard at the stern, and a deck-mounted steering quadrant.

Based on the vessel's size, hull characteristics, and visible features, the site likely represents the remains of an early twentieth century, ocean-going tug. Preliminary background research identified one tug loss reported in this vicinity, the *Valour* lost in 2006 (Barbee 2008); however, that vessel's dimensions and hull shape do not match those of the site identified during this survey. Additional research is recommended to identify additional potential candidates for the identity of this vessel.

A comparative vessel with similar hull shape and deck configuration is *J.A. Bisso*, a steam, screw-propelled tugboat built in 1906 in Quebec (Figure 48) (US Treasury Department 1954). *J.A. Bisso* was lost during rough weather in 1957 in transit from Sabine, Texas to New Orleans, Louisiana, and the site was investigated and documented under a 2010 BOEM study (Evans et al. 2013). In particular, the distinctive deck-mounted stern steering quadrant, as seen on the *J.A. Bisso* site plan (Figure 49), appears to be a typical feature of tugs of the early twentieth century (Caldwell 1946; Evans et al. 2013:175).

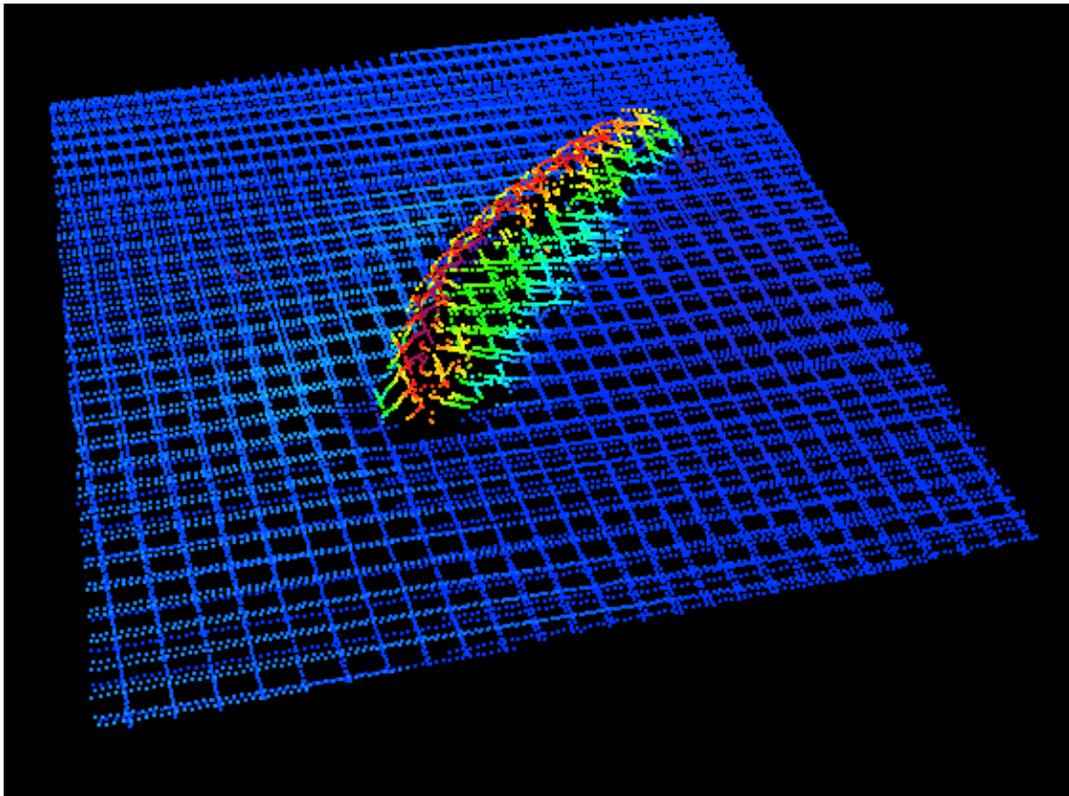


Figure 44: Multibeam image of 27.162-meter Wreck.

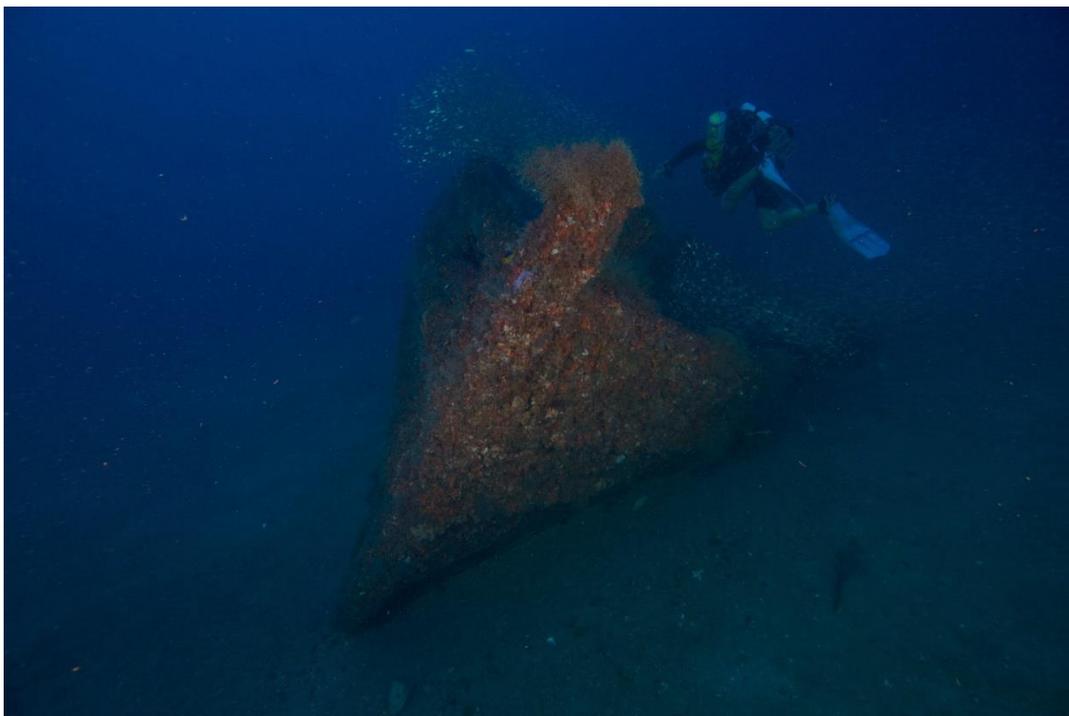


Figure 45: Bow of 27.162-meter Wreck.



Figure 46: Stern of 27.162-meter Wreck.

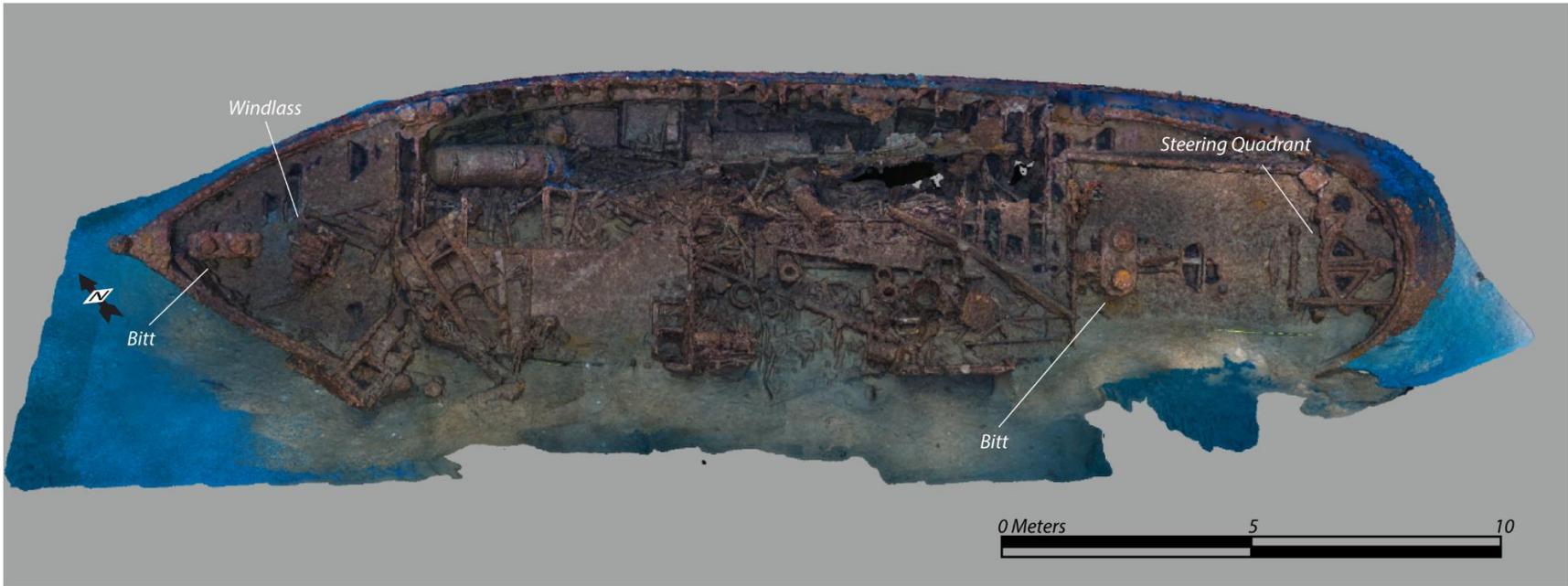


Figure 47: Orthomosaic illustrating deck features of the 27.162-meter Wreck.



Figure 48: Undated photograph of *J.A. Bisso*. Courtesy of William “Cappy” Bisso and published in Evans et al. (2013).

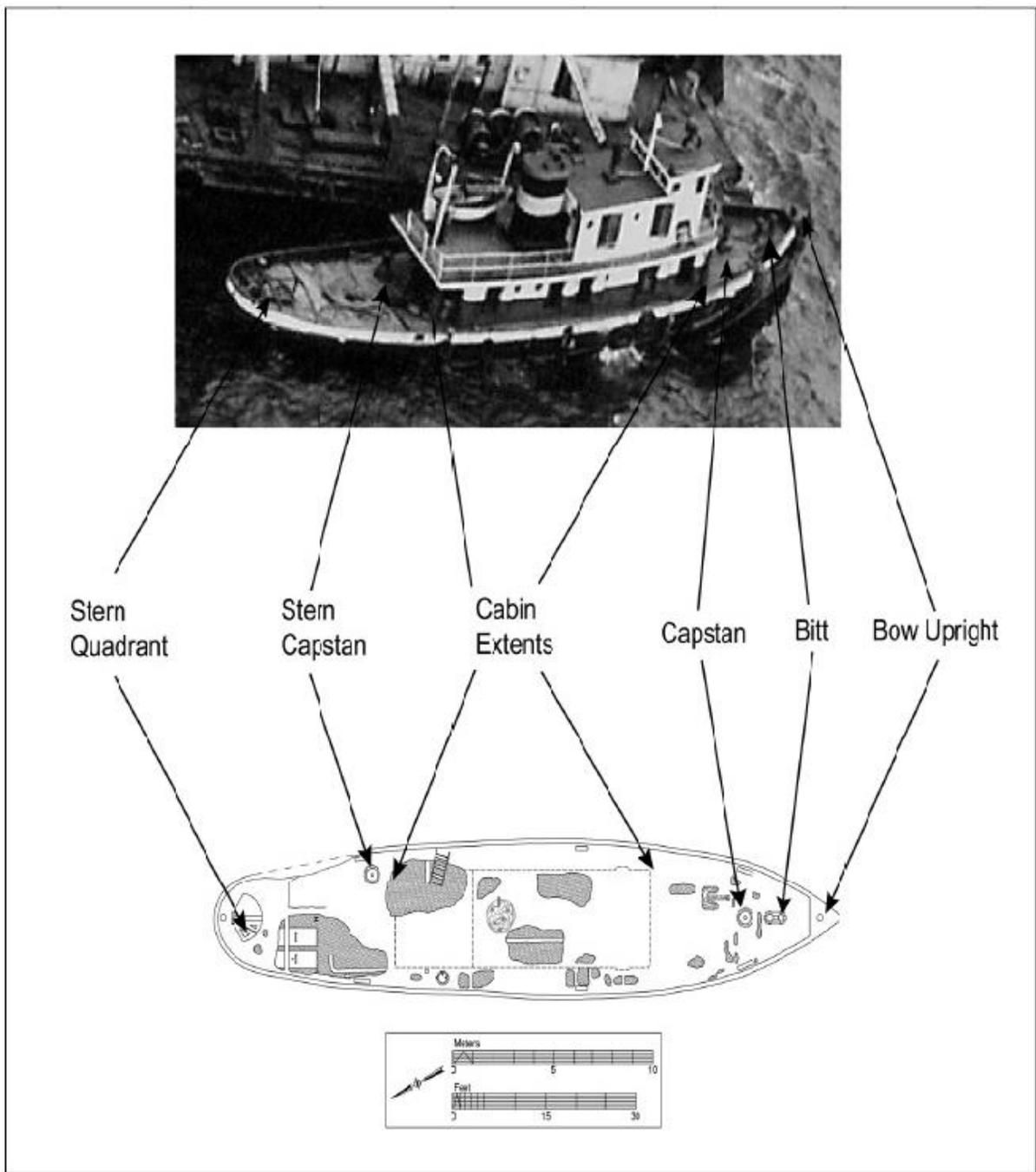


Figure 49: Site plan of *J.A. Bisso* and comparison to last known photograph of vessel (Evans et al. 2013:178).

4 Conclusions and Recommendations

This study successfully met the objective of obtaining baseline archaeological information within and adjacent to the Wilmington East and West WEAs through the investigation of eight potential archaeological sites, summarized in Table 4-1. These investigations included direct observation and documentation by archaeological scientific divers, including the completion of scaled photogrammetric models of site 6577K-1, *Lady Margaret*, *City of Houston*, and the 27.162-meter wreck. In addition to confirming the location of each site and documenting the extent of visible remains, limited background research was completed to assist in providing a preliminary recommendation regarding each site's potential eligibility for listing in the NRHP.

Avoidance buffers are recommended for five of the sites based on potential eligibility for listing in the NRHP; no further investigations are recommended for the remaining three sites. Delineation of preliminary avoidance areas is based on the results of the in-water investigation and acoustic imagery (side scan sonar or multibeam echosounder) which delineated the extent of exposed features at each site. Acoustic and visual methods are limited, however, and only indicate materials visible on the seafloor; therefore, larger buffers are recommended for sites that have disarticulated hull features and/or may contain debris fields or buried materials beyond or within the extent of any visible site remains. Avoidance areas are presented as extending from the discernable extent of visible hull remains or from a center point, in cases where a site presents disarticulated remains or debris fields. The preliminary avoidance recommendations presented in Table 4-1 may be refined if additional information is gathered, particularly through methods that may provide information regarding the presence and extent of subsurface features.

The eight sites investigated present a broad range of cultural resources spanning from the late-nineteenth century through World War II, highlighting the diversity of potential resources likely present within areas offshore North and South Carolina. While the assessment of sites under this study is preliminary, the methodological approach employed allowed the project team to complete the important first task of archaeological ground truthing. This allowed the team to distinguish targets that represent potentially significant archaeological sites warranting avoidance and further investigation from those that do not represent potentially significant archaeological resources—a task that cannot always be determined when solely relying on remote sensing data. Additionally, this study further reinforced the value of photogrammetry as a method for the rapid documentation of sites and as a tool for site monitoring to evaluate changes or impacts to sites over time. It is recommended that the methods herein employed (ground truthing, documenting, and monitoring) be applied for other WEAs.

Finally, as this was a preliminary investigation, only a general description of the sites' environment was conducted. Depending on future management strategies, it may be valuable to establish more concrete scientific descriptions of the environment and ecosystems present at each site. For example, study of water quality and chemical characteristics at each site would aid in the study of corrosion potential to assist researchers in understanding the various site formation processes acting on these sites.

Table 4-1: Matrix of Targets Investigated and Recommendations

Target	Description	Recommendation
<i>Raritan</i>	76-m (251-ft) metal-hulled cargo vessel, broken into two, that ran aground Frying Pan Shoals and sunk on February 25, 1942.	Site is considered potentially eligible for listing in the NRHP based on its association with the Battle of the Atlantic and may be eligible for inclusion under an established multiple property designation for Battle of the Atlantic-associated resources. Preliminary avoidance of this target is recommended by 100 m (328 ft) from the discernable extent of the intact bow and stern sections. Additional investigation is recommended to document and monitor the site.
"6537K_1"	34-m (110-ft) metal-hulled vessel, possibly an early-twentieth century yacht. In addition to hull remains, exposed artifact assemblage is present.	Site is considered potentially eligible for listing in the NRHP. Preliminary avoidance of this target is recommended by 50 m (164 ft) from the discernable extent of the hull remains. Additional investigation is recommended to document and monitor the site.
<i>Lady Margaret</i>	Possible remains of 31-m (101-ft), diesel yacht <i>Lady Margaret</i> built 1930 and lost 1976 during a storm.	Site is considered potentially eligible for listing in the NRHP. Preliminary avoidance of this target is recommended by 100 m (328 ft) from center point of the site. Additional investigation is recommended to document and monitor the site.
"Known Wreck"	52-m (172-ft) metal-hulled barge of undetermined age.	Site is not considered eligible for listing in the NRHP. No additional investigation recommended.
<i>City of Houston</i>	90-m (295-ft) composite-built passenger vessel that floundered and sank during a storm in 1878.	Site is considered potentially eligible for listing in the NRHP. Preliminary avoidance of this target is recommended by 100 m (328 ft) from the discernable extent of the site. Additional investigation is recommended to document and monitor the site.
Train Cars	Not identified, site not present at reported location.	No additional investigation recommended at this location.
<i>Jell II</i>	53-m (174-ft) metal-hulled fishing vessel purposely sunk as part of the North Carolina Artificial Reef Program.	Site is part of North Carolina Artificial Reef AR-445 and not considered eligible for listing in the NRHP. No additional investigation recommended.
27.162 m Wreck	26-m (87-ft) metal-hulled vessel, possibly an early twentieth century, ocean-going tug.	Site is considered potentially eligible for listing in the NRHP. Preliminary avoidance of this target is recommended by 50 m (164 ft) from the discernable extent of the hull remains. Additional investigation is recommended to document and monitor the site.

5 References

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Department of the Interior (DOI)

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.



Bureau of Ocean Energy Management (BOEM)

The mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

BOEM Environmental Studies Program

The mission of the Environmental Studies Program is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments. The proposal, selection, research, review, collaboration, production, and dissemination of each of BOEM's Environmental Studies follows the DOI Code of Scientific and Scholarly Conduct, in support of a culture of scientific and professional integrity, as set out in the DOI Departmental Manual (305 DM 3).