U.S. Army Corps of Engineers
Charleston District

APPENDIX E

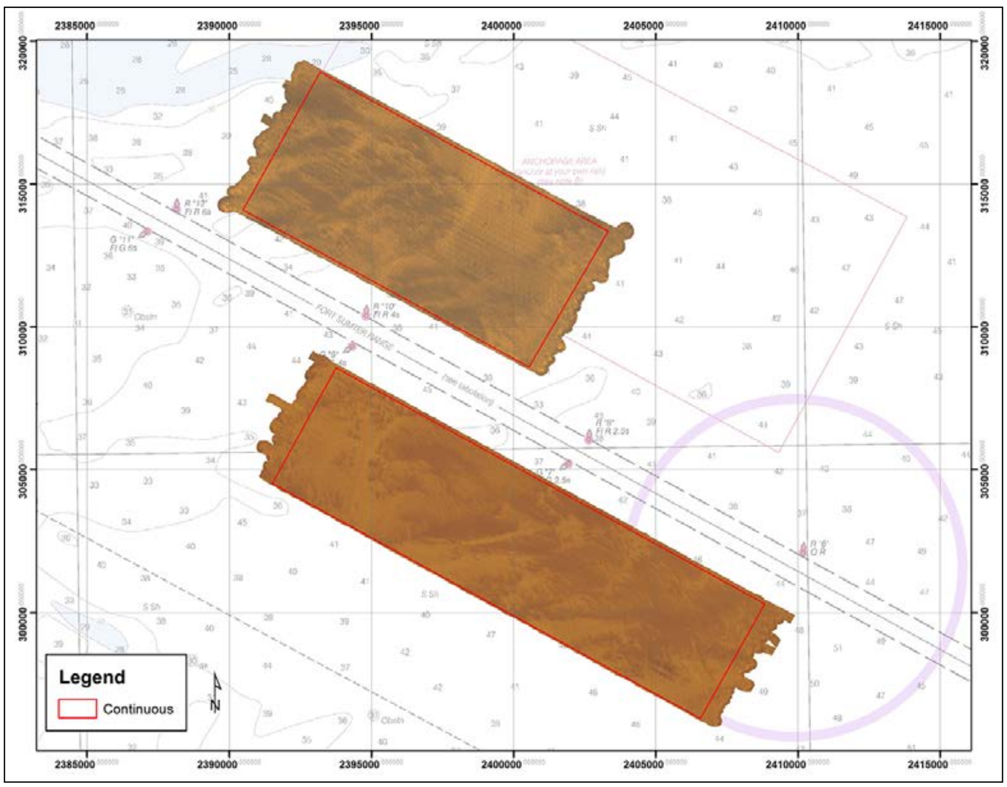
CHARLESTON HARBOR POST 45
BENEFICIAL USE OF DREDGED MATERIAL
SUPPLEMENTAL ENVIRIONMENTAL ASSESSMENT
CHARLESTON, SOUTH CAROLINA

Cultural Resources Report of Findings in Support of Beneficial Use Analysis

30 September 2016

REPORT OF FINDINGS

CULTURAL RESOURCES SURVEY FOR THE POST 45 CHARLESTON HARBOR PROJECT IMPACT AREA AND ARTIFICIAL REEF SITE CLEARANCE, CHARLESTON, SOUTH CAROLINA



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FINAL REPORT ♦ AUGUST 2016

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ABSTRACT

The South Carolina State Ports Authority, in concert with the U.S. Army Corps of Engineers, Charleston District is currently proposing to deepen the Charleston Harbor Entrance Channel from 45 feet to 52 feet in order to meet the evolving needs of the harbor and the vessels of increasing size that use it. As part of the recently completed Charleston Harbor Post 45 Integrated Feasibility Report/Environmental Impact Statement, two mitigation areas were identified for the construction of eight 33-acre artificial reefs adjacent the entrance channel from 8 to 12 miles offshore Charleston Harbor. In order to comply with their responsibilities towards cultural resources, Panamerican Consultants, Inc., under subcontract to Dial Cordy and Associates, Inc., conducted a comprehensive remote sensing survey of the two mitigation areas for the agencies. Performed between 19 February and 26 May 2016, the survey utilized a magnetometer, sidescan sonar, and subbottom profiler.

In total, 144 magnetic anomalies and 25 sidescan sonar contacts were recorded within the Project Area. A total of 104 anomalies and 16 sonar targets were recorded in Mitigation North, and 40 anomalies and seven sonar targets were recorded in Mitigation South. Analysis of the data indicates a lack of anomalies or sonar targets that can unequivocally be considered potentially significant; however, a single noteworthy cluster of anomalies is located in Mitigation North. Consisting of anomalies M-18, M-19, M-22, M-23, and M-24, the cluster is most likely not significant. Because of the uncertainty concerning the source of the magnetics, it is suggested that a 100-foot avoidance zone around its perimeter be implemented. In addition to this cluster, there is a single interesting sonar contact also located in Mitigation North, C008. It consists of two linear objects, possibly cables or geological features, and lacks magnetic signature. Because of the uncertainty concerning C008's identification, it is also suggested that a 100-foot avoidance buffer around its perimeter be implemented. In addition to these targets, there is a single paleofeature in Mitigation North that should be avoided. While it is buried approximately 10 feet and should not be affected by project activities, to ensure no impact to this feature a 100-foot avoidance buffer around its perimeter should be enforced. With these safeguards in place, no additional archaeological work is warranted.

ACKNOWLEDGEMENTS

The successful completion of this project is the direct result of the input and hard work of numerous individuals. The authors would first like to thank the South Carolina Ports Authority and the U.S. Army Corps of Engineers, as well as Dial Cordy and Associates, Inc., and specifically Mr. Steve Dial for allowing Panamerican Consultants, Inc. the opportunity to conduct this investigation.

The authors would also like to thank the survey crew who partook in this investigation. The remote sensing survey crew consisted of Mr. Will Wilson and Mr. Robert Hunsaker.

In-house Panamerican Consultants, Inc. personnel, who must be thanked for their assistance with this report production, include Kate Gilow, Office Manager, and Anna Hinnenkamp-Faulk, Editor.

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I. INTRODUCTION

The South Carolina State Ports Authority, in concert with the U.S. Army Corps of Engineers (USACE), Charleston District is currently proposing to deepen the Charleston Harbor Entrance Channel from 45 feet to 52 feet in order to meet the evolving needs of the harbor and the vessels of increasing size that use it. As part of the recently completed Charleston Harbor Post 45 Integrated Feasibility Report/Environmental Impact Statement (IFR/EIS), the USACE committed to pre-construction impact site hardbottom habitat refinements. The Final IFR/EIS anticipated that approximately 28.6 acres of hardbottom habitat may be adversely impacted by construction in the Charleston Harbor Entrance Channel. This area was determined based upon a proxy dataset. The Final IFR/EIS committed to refining this area and then further analyzing the habitat to define success criteria for future mitigation projects, one of which is the construction of eight 33-acre artificial reefs adjacent the Charleston Harbor Entrance Channel from 8 to 12 miles offshore (Figure 1-01).

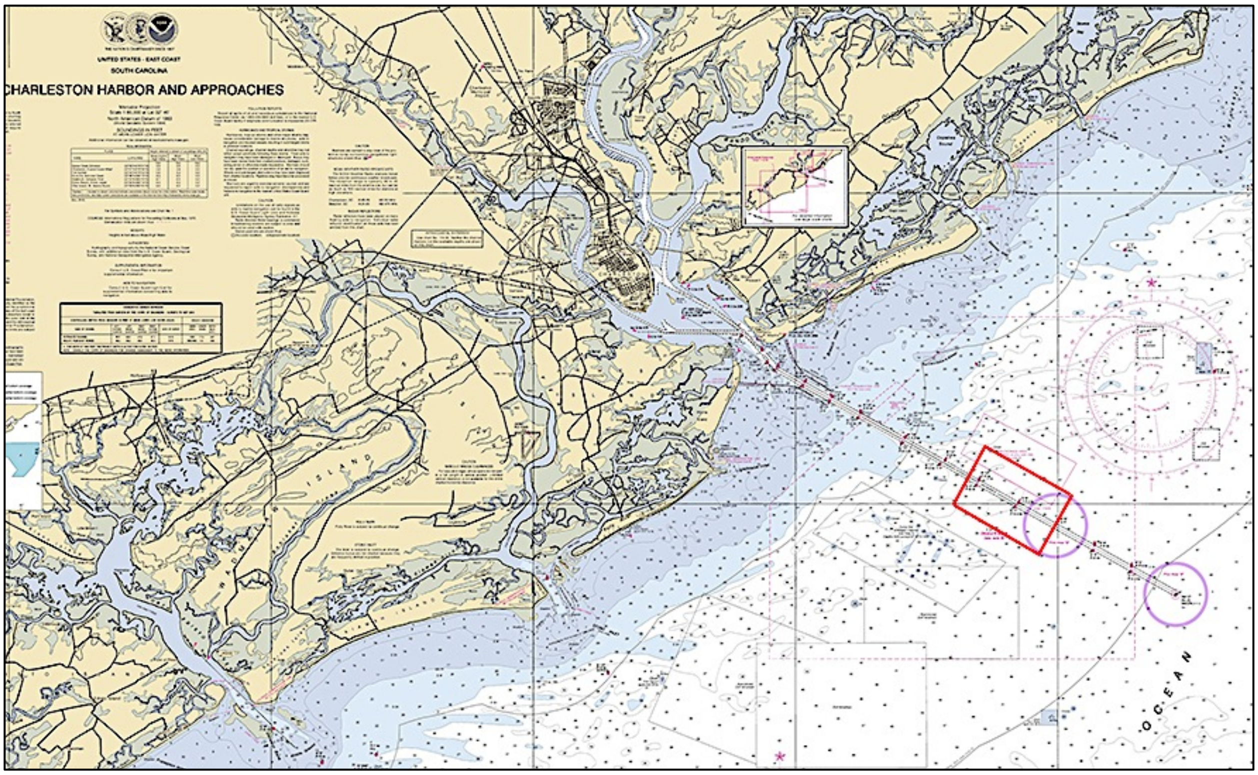

Figure 1-01. General proposed artificial reef location map (excerpt from National Oceanic and Atmospheric Administration [NOAA] Chart No. 11521-12-2010).

Relative to the construction of artificial reefs, as a stipulation to environmental permit requirements, the agencies must consider the effects that their project activities will have on cultural resources. Therefore, they are responsible for determining if any potential cultural resources are located within the areas designated for reef construction, and if so, are eligible for listing on the National Register of Historic Places (NRHP) prior to the implementation of any project activities. The Federal statutes regarding these responsibilities include: Section 106 of the National Historic Preservation Act of 1966, as amended (PL 89-665); the National Environmental Policy Act of 1969; the Archaeological Resources Protection Act of 1987; the Advisory Council on Historic Preservation Procedures for the Protection of Historic and Cultural Properties (36 CFR Part 800); and the Abandoned Shipwreck Act of 1987 (*Abandoned*

Shipwreck Act Guidelines, National Park Service, *Federal Register*, Vol. 55, No. 3, 4 December 1990, pages 50116-50145).

In order to comply with the agencies' responsibilities towards cultural resources, Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee, was subcontracted by Dial Cordy & Associates, Inc. (DC&A) of Wilmington, North Carolina to help conduct a comprehensive cultural resources remote sensing survey of two large mitigation tracts identified for reef construction known as "Mitigation North" and "Mitigation South" (collectively the current survey's Project Area; Figure 1-02).

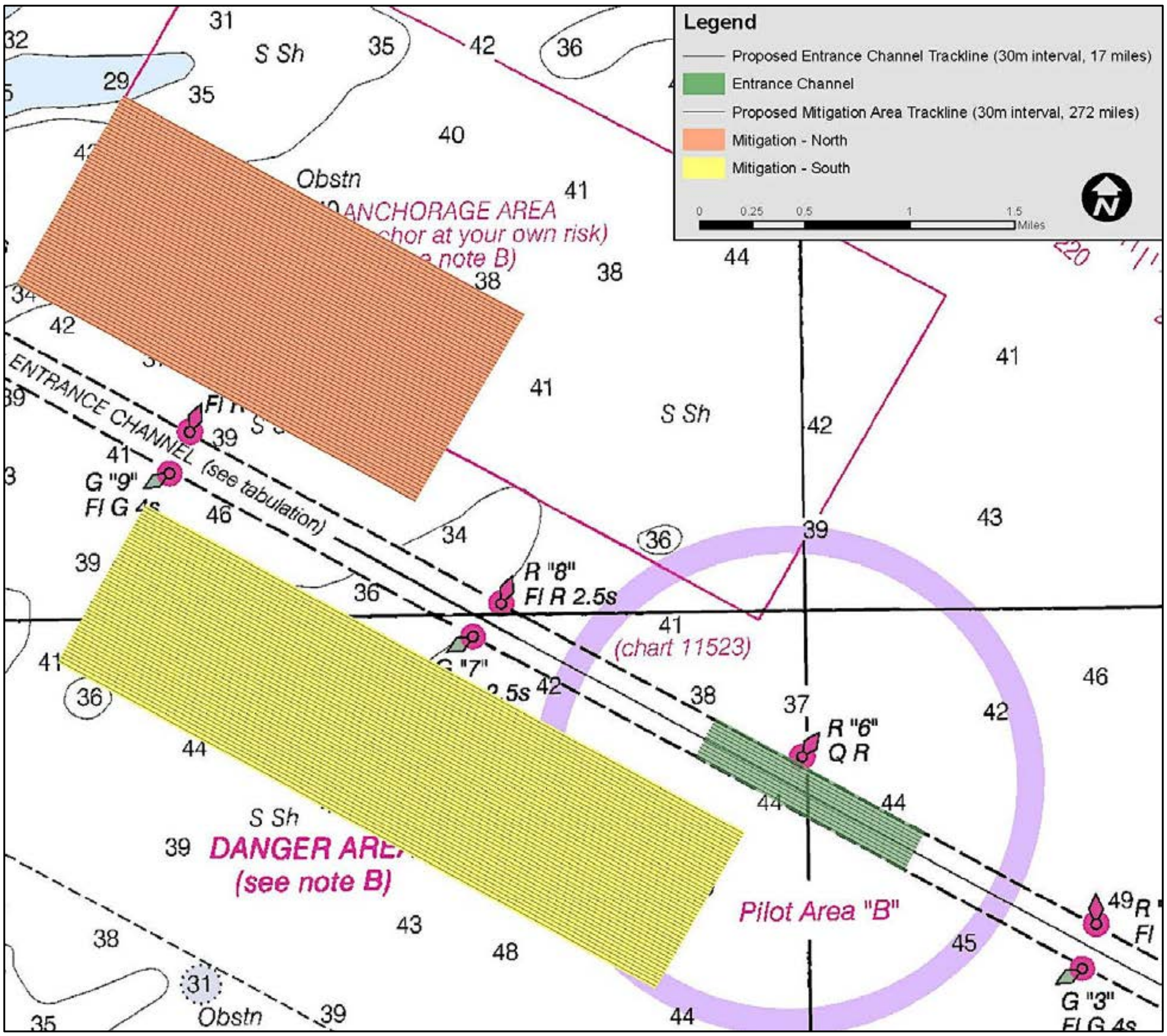

Figure 1-02. Project Area survey location map (map courtesy of Dial Cordy and Associates, Inc.).

Performed between 19 February and 26 May 2016, the survey utilized a magnetometer, sidescan sonar, and subbottom profiler. A total of 144 magnetic anomalies and 25 sidescan sonar contacts were recorded within the Project Area. A total of 104 anomalies and 16 sonar targets were recorded in Mitigation North, and 40 anomalies and seven sonar targets were recorded in Mitigation South. Analysis of the data indicates a lack of anomalies or sonar targets that can be considered potentially significant. Furthermore, a review of the subbottom data did not detect any buried paleofeatures that would have the potential to contain submerged prehistoric sites in Mitigation South. The single paleofeature recorded in Mitigation North is buried approximately 10 feet deep and will not be affected. Subsequently, no additional archaeological work is recommended.

Divided into chapters on Historical Context, Methods, Investigative Findings, Conclusions and Recommendations, and References Cited, the following report presents the conduct and results of the investigation. *Appendix A: Documentation of Vessel Losses as Presented in Gayes et al. 2013* concludes the report.

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II. HISTORICAL CONTEXT

Divided into three major sections, this background narrative is written to present information relevant to surveying for and identifying prehistoric and historic submerged cultural resources in the form of prehistoric archaeological sites and shipwreck sites. In the first section, the geologic setting and local sea level history are described in order to reconstruct paleoenvironmental and paleolandscape conditions of the Project Area in order to better understand past paleolandscapes in the Project Area. Next, a cultural historical narrative is presented that describes the evolution of human occupation of the Project Area as it progressed from the late Pleistocene through the early Historic periods. In this case, Paleoindian through Late Middle Archaic prehistoric culture groups were around while the survey area was subaerially exposed. Last, the navigation history of the area is presented to establish the type, frequency, and time periods of expected shipwreck sites.

PALEOENVIRONMENTAL SETTING

GEOLOGY

The survey area is located offshore of the modern Charleston Harbor, South Carolina, in the center of a large, curved, embayment called George Bight that stretches from Myrtle Beach, South Carolina in the north and St. Marys River, Florida in the south (Figure 2-01). To the west, along the coast, are a series of drumstick barrier islands, and their marsh land lagoons, that first formed about 40,000 years ago with higher sea levels and then again over the last 6,000 years with Holocene sea level rise and continental shelf transgression (Booth et al. 1999). The survey area is from approximately 8 to 12 miles statute miles offshore in 35 to 50 feet of water (10 to 15 meters), on the "inner" shelf. To the east and extending offshore, a large expanse of continental shelf gradually slopes to the shelf break located 65 statute miles (100 kilometers) offshore, where coastlines were located at full glacial times.

The Georgia Bight is referred to as a "passive" continental margin meaning that it is not tectonic or isostatically influenced, although evidence for isostasy farther from the ice margins than expected seems to be gaining consensus even as far south as the project area in South Carolina (Baldwin et al. 2006; Colquhoun et al 1995:6). The Georgia Bight is the result of "paleo-oceanographic processes" (TRC Environmental Corporation 2012:109) which is to say regression and transgression over several cycles of glaciation and deglaciation, exposing and then flooding creating patterned paleolandscape settings formed from reworking and development of marine-derived and terrestrially-derived sediments. These glacial – interglacial "couplets" - eleven over the past 2.8 million years - are caused by Earth orbit parameters (Emiliani 1975) but it is only the last, "Flandrian", latest Pleistocene—early Holocene melting of huge expanses of glaciers and concomitant transgression of the continental shelves by rising sea levels that is of concern for this project area. This is because the earliest vestiges of human occupation of the region outlined below are constrained to these times. Basically, glacial melting started globally about 17,000 calBP, slowed substantially by 6,000 calBP, and has fluctuated in relatively minor ways (geologically) since. Sea levels for this project are discussed more below.

The continental shelf of the Georgia Bight is covered with a significant amount of transgressive lag deposits in the form of a marine sediment bed drape. Ravinement (erosion) is dominant during transgression, meaning that terrestrial deposits are truncated and redeposited into marine dominated sediments with sea level rise.

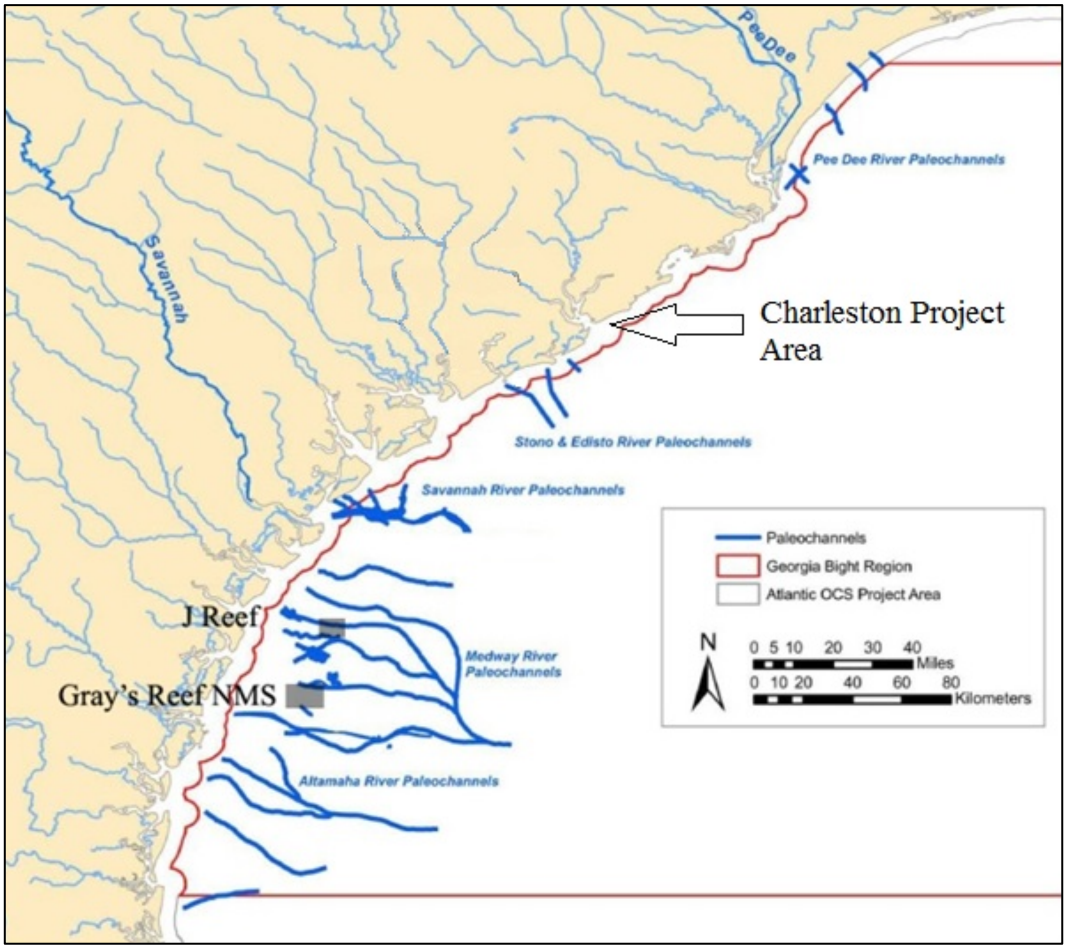


Figure 2-01. Adapted from TRC Environmental Corporation (2012), this figure shows a portion of the Georgia Bight's known paleochannels, J Reef and Gray's Reef, and the location of the Charleston Project Area.

Much of the Georgia Bight is covered with a 1-2 meter (thin) veneer of sandy sediments (Harris et al. 2005, TRC Environmental Corporation 2012). These are, the "eroded relicts of earlier subaerial coastal landforms characterized by dunes, wetlands, coastal rivers and forest much like today" (TRC Environmental Corporation 2012:109). These sediments have been reworked within the sand and shell marine dominated sediments that form the "palimpsest sand sheet" that blankets the continental shelf. This sand sheet is also reworked and moved by bottom currents generated by storms, tides, and wind depending.

Large areas of sand offshore are interspersed with rocky outcrops of "hard bottom" (TRC Environmental Corporation 2012:111) that are Miocene and Pliocene aged limestones scattered as erosional remnants, ledges, and "ramps". Some of these features indicate weathering in subaerial (exposed) conditions, including evidence for stream erosion, and karst formation (TRC Environmental Corporation 2012: 111). Notches in Pliocene aged Raysor Formation at the 20 m isobath, indicate a still stand, but its age of formation is unknown. These limestone outcrops are the main geomorphic features that occur in the Georgia Bight, some having live bottoms like Grays Reef and J reef shown in Figure 2-01 indicating sustained exposure of the outcrop.

Other geomorphic features more relevant to the study area include Pleistocene and Holocene aged shoal complexes made up of silt to gravel size sediments of terrigenous origin, abundant shell, and areas of dispersed peat (Sexton et al. 1992). The seaward relief of these features can be steep, with the near-coastal portions less of a slope. The shoal complex seaward of the Santee/PeeDee Delta is the largest, deltaic deposit with shore parallel scarps that are evidence of pause or still stand during Holocene sea level rise. The islands are supposed to be migrating along with sea level rise, but abandoned examples could be expected given the magnitude and rapidity of some sea level rise estimates.

Sources of terrigenous sediments are the rivers draining the coastal plain, including re-working from previous high stand materials as parent materials for subaerial pedogenesis and landforms, with reworking again with Holocene transgression. Sediment packages build up in the lagoon on the lee of the islands, and if those were preserved offshore, they could be expected to retain stratigraphic integrity and be at or near locations of human activities and refuse.

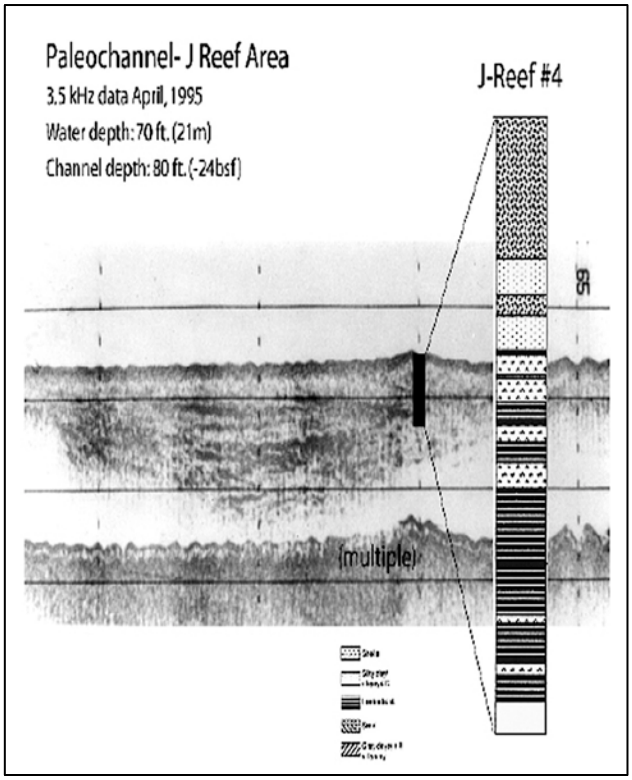


Figure 2-02. An example of a paleochannel underneath the sand sheet cover from Garrison et al. (2008) that is analogous to nearby paleochannel features.

Drowned coastal stream and river "paleochannels" occur, but most are truncated and buried under the sand sheet drape such that they are not usually apparent on the surface in bathymetry (Figure 2-02). Therefore, they cannot be adequately remotely sensed with bathymetric or side scan sonar devices; rather, they need be remotely sensed with seismic subbottom profiler devices (Baldwin et al. 2006). Studies by Garrison (et al. 2008) and others (Baldwin et al. 2006; Harris et al. 2005) confirm that paleochannels are buried, albeit shallowly, under the reworked marine sediment drape cover (TRC Environmental Corporation 2012). Baldwin et al. 2006 used a dense pattern of subbottom profiler lines over great space to reconstruct, and offer ages for, the paleochannels offshore South Carolina.

Figure 2-01 above shows the TRC Environmental Corporation (2012) compilation of Geographic Information System (GIS) data for the Paleo-Altamaha, Paleo-Savannah and Paleo-Meway rivers offshore of Georgia, and the Stono-Edisto and Pee Dee paleochannels offshore of South Carolina. Several generations of the ancestral Pee Dee River system have been mapped beneath and along the coast and inner continental shelf revealing a complex pattern of paleochannels of different ages (Baldwin et al. 2006).

During sea level low stands drainage valleys are shallowly incised into the continental shelf and backfilled with various sediment types depending on local conditions and sea level rise and fall rates. Paleovalleys have backfilled during cyclic changes in sea level with sediments types ranging from estuarine muds to clean shelly sands (Harris et al. 2005). Quaternary paleochannels tend to be filled with muds, sandy muds and muddy sands, whereas tidally scoured paleochannels general contain clean shelly sands.

Prior to 7000 years ago, the islands would have been part of the mainland, hill-like ridges with valleys in between with tributary gullies cutting into the hills (Figure 2-03). The marshes surrounding the project area would have been dryer swales. In a similar way, Garrison and Tribble (1981) model the paleolandscape of the marshland during the late Pleistocene—Early Holocene as grassland and savannas with non-tidal perched streams and possible spring connections. If these spring locations could be identified there may be archaeological remains around them.

The age of a peat bed marking coastal marsh at Cracker Tom Marsh on St. Catherine's Island, Georgia was around 6800 calBP (Booth and Rich 1999. Rich and Booth 2011:134); however, in the coastal plains of the project area, archaeological sites are lacking in this middle Holocene (and earlier) age frame (Turck et al. 2011). Sites earlier than 6800 calBP are either missing or possibly located in buried stratigraphic units buried by later Holocene transgression and sedimentary processes, or in areas offshore that have been submerged. An exposed paleolandscape setting 28 feet below the river water level found in the St. Augustine River area confirms the potentials for this kind of buried archaeology. The radiocarbon age of an in-place stump there was 8100 calBP (7300 +/- 40 BP; Beta 36234) (James et al. 2012).

SEA LEVEL HISTORY

As alluded to above, global sea levels have fluctuated over the past 2.8 million years during 11 cycles of glacially driven advancements and retreats of sea levels across the continental shelves of the world (Emiliani 1975). The last full extent of glaciers, known as the late glacial maximum or LGM, occurred between 26,500 and 19.000 calBP years ago, resulting in coastlines 100 meters or more lower in elevation than today. At that time global eustatic (glacially controlled) sea levels fluctuated at the continental shelf break 100 kilometers (65 miles) from the survey area.

Sea levels have been rising continuously since 17,000 calBP (Table 2-01 and Figure 2-04), but this continuous melting has been punctuated by three significant Melt Water Pulses (MWP 1a, 1b and 1c; Blanchon 2011; Blanchon and Shaw 1995). These pulses indicate major rapid ice events resulting from ice sheet collapse (Blanchon and Shaw 1995) as well as sources of displaced populations retreating from the high water during storm front and other erosional processes (Waters 1992).

Blanchon (2011) has published recently on the magnitudes and rates of these three melt water pulses as estimated from drowned corals around the world: MWP 1a is estimated to have been 13.5 meters of sea level rise over 290 yrs. at 14,600 calBP (12,600 BP). MWP 1b was a 7.5-meter rise of sea level in 160 yrs. at 11,400 calBP (10.000 BP). MWP 1c is a recent addition to the reconstruction of glacial melting that is estimated to have occurred at 8,000 calBP (7200 BP) with 6.5-meters of sea level rise in less than 140 years at 8,000 calBP.

Marine terraces are markers of paleoshorelines still stands of sea level at times of relative stability or stasis. Several paleoshorelines occur above today's coastline and Clovis or Younger Dryas shorelines have been identified in the Gulf of Mexico (Faught and Donoghue 1997) and the North Atlantic Bight, (Nordjford et al. 2006). In general, terraces are "bounded by a steeper ascending slope on the landward side and a steeper descending slope on the seaward side. Due to its reasonably flat shape the terrace is often used for anthropogenic structures like settlements and infrastructure" (Pirazzoli 2005:632-633). Drowned shorelines can be locations of prehistoric archaeological sites, although the potential for truncation and reworking is high. Apparently, there is no scarp-like feature in the Georgia Bight to correlate with these.

ARCHAEOLOGICAL SEA LEVEL EVIDENCE 1293

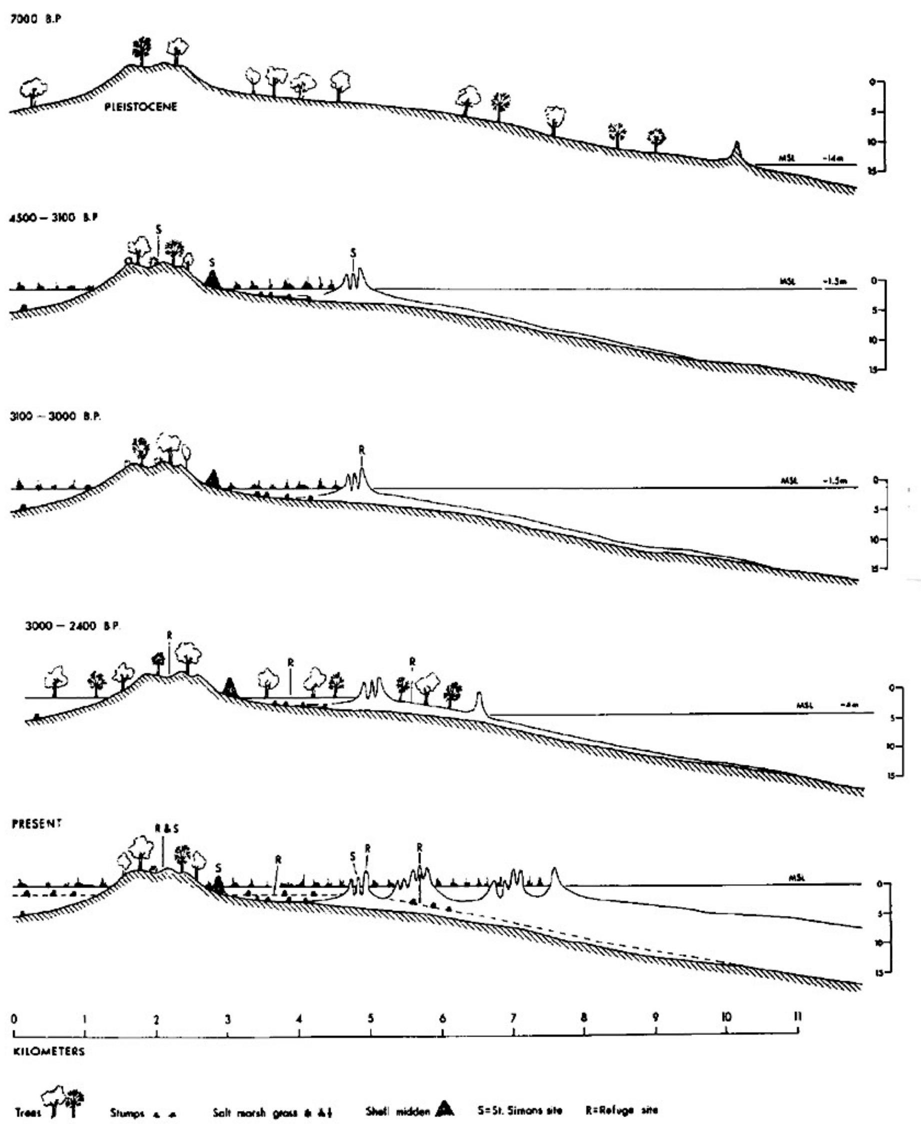


FIG. 2.—Schematic cross-section showing changes in coastal morphology and sites of Indian occupation on the Georgia coast from 7000 B.P. to present. This reconstruction is a composite of data gathered along the whole Georgia coast. The profile, however, is based on the area immediately south of the Savannah River where maximum shoreline progradation has occurred.

Figure 2-03. Conceptual drawing of the different land forms that the islands had at different stages of the transgression, including a proposed regression (As presented in DePratter and Howard 1981:1293:Figure 2).

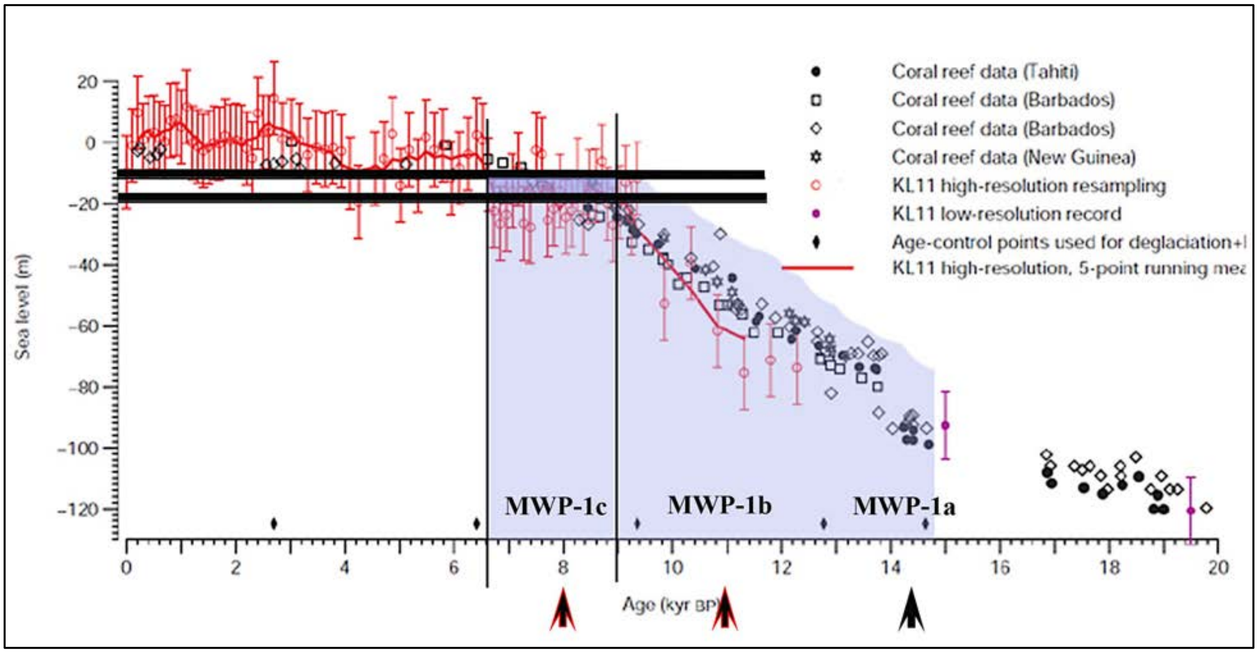


Figure 2-04. Reproduction of the Siddall et al. (2003) global eustatic sea level curve, showing areas in grey that would indicate **exposure of the study area for human occupation, and the zone between 10 and 18 meters, Blanchon (2011) chronology of MWPs 1a, 1b, and 1c marked with arrows. The horizontal lines represent the survey area depths, indicating submergence after 6,500 calYBP and before 9,000 calYBP.**

Local geologic conditions, or proximity to the weight of the glaciers, or other factors can affect the relative, apparent, local sea level. This is especially true for the coastal portions of the Georgia Bight, in those areas of the inner lagoonal systems (Colquhoun and Brooks 1986; Colquhoun et al. 1995).

The survey area is from approximately 8 to 12 miles offshore in 35 to 50 feet of water. Table 2-01 shows that this area would have been subaerially exposed through the first two melt water pulses, and probably submerged during the last melt water pulse, somewhere between 9,000 calBP and 6,500 calBP (8,500 and 6,000 BP; see Figure 2-04 above).

Table 2-01. Characterization of Late Pleistocene and Holocene Transgression Sequence, Magnitude and Rates.*

Time Period (BP)	Description
Late Glacial Maximum 26,500 to ~19,000 calBP Melting begins 17,000 calBP Melt Water Pulse IA 14,600 calBP 13.5 meters in 290 years	Full glacial conditions, sea levels at maximum lowering and full exposure of the continental shelf offshore. 120-60m. Glacial melting begins after 14,000 with a major pulse of melting at 14,600 calBP (Blanchon 2011) at a rate and magnitude of 13.5 meters in 290 years Almost half of the total glacial melting occurred between MWP 1a and MWP 1b. Sea levels rose somewhere between 40- and 60-meter isobaths depending on regional particulars (Lowery et al. 2012; Siddall et al. 2003).
Younger Dryas (YD) 13,000 to 11,400 calBP Reversal of melting to glacial conditions	Younger Dryas return to glacial conditions. The abrupt initiation of climate change is absolutely coterminous with the appearance of Clovis Paleoindian cultural groups.

Time Period (BP)	Description
Melt Water Pulse IB 11,400 to 9,000 calBP 7.5 meters in 160 years	Dramatic glacial melting occurred a second time known as MWP IB. Early Archaic cultural time frame
Melt Water Pulse 1C at 8,000 calBP 6.5 meters in less than 140 years	MWP 1C is the last pulse of meltwater. Middle Archaic cultural time frame
After 5000 less than 5 m below today, fluctuations	High and low stands proposed by

*From Blanchon 2011

Relative sea levels have fluctuated along South Carolina's coast after 6000 BP as sea levels began to affect the modern barrier islands. Depratter and Howard (1981) and Colquhoun and Brooks (1986) have shown a high stand and subsequent regression that Gayes et al. (1992) constrained between 5,300 and 3,600 BP (Colquhoun et al 1995). These fluctuations are shown in the sea level curve in Figure 2-05 and they have been reconstructed using archaeological site distributions in combination with other radiocarbon evidence. The implication is that the study area was terrestrial before 8,000 calBP, probably near coastal after that, until submergence around 6,000calBP.

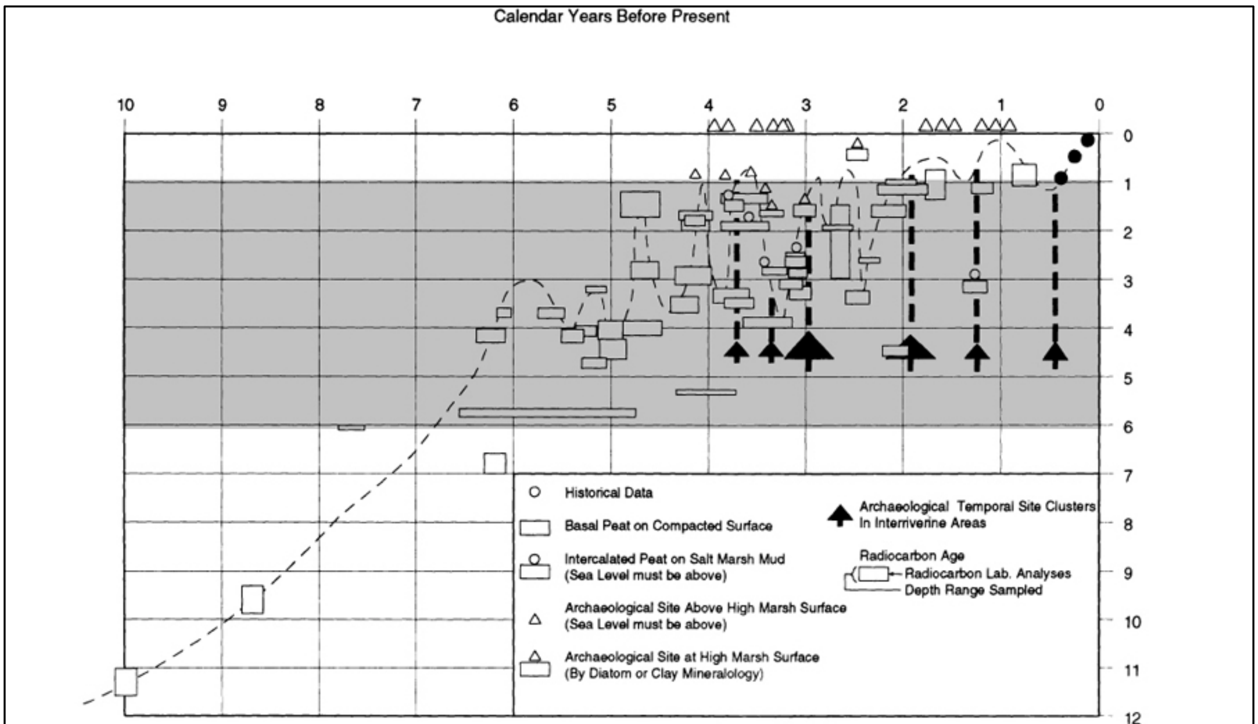


Figure 1. **Historic and Holocene high marsh and estuarine associated archeologic sea level indicators relative to the present high marsh surface, South Carolina coastal zone (after COLQUHOUN and BROOKS, 1986).**

Figure 2-05. Fluctuating sea level curve for South Carolina from Colquhoun et al. 1995 relevant to the project area showing depths recorded in the nearby Charleston area. The implication is that the study area was terrestrial before 8,000 calBP, probably near coastal after that until submergence around 6000 calBP.

PREHISTORIC CONTEXT

PALEOINDIAN AND EARLY ARCHAIC CULTURE GROUPS

The chronological and spatial distributions of archaeological sites in the local area inform on when and where sites might be located offshore in the Charleston Project Area, whereas the cultural material assemblages and diagnostic artifacts inform on the chronology and cultural historical group encountered.

Given the details described above in the sections on Geology and Sea Level History, the time-use-range of the survey area when it was subaerial would include latest Pleistocene pre- or proto-Clovis Paleoindians, Clovis and later lanceolate using Paleoindians, and early Holocene, Clovis related notched point making people until about 9,000 calBP, as well as Middle and possibly early Late Archaic people.

Pre- or perhaps we might say "proto-" Clovis sites are proposed at Mile Point in Maryland, Topper in South Carolina, Page Ladson in Florida, and, even though far away, Buttermilk Creek in Texas (Dunbar 2006; Lowery et al. 2010; Goodyear 2005; Waters 2012). Theoretically, sites of these ages (pre-13,000 calBP) could have existed all the way out to the shelf break/LGM coastline where at least one artifact and some megafaunal remains have been discovered (Lowery 2009), and human activities could be represented around the survey area if it offered resources or topography conducive to human presence.

Regardless of whether there are pre-Clovis sites in the Southeast or not, this region (the Southeast) has produced the most abundant numbers of diagnostically early artifacts (fluted and unfluted lanceolates) of anywhere in North America. These data indicate Clovis Paleoindian intrusion sometime in the late Pleistocene, settling in the Early Holocene, and shared lithic reduction strategies and artifact assemblages that indicate survival and cultural continuity well into middle Holocene time and therefore, in a general sense, very likely to have forays on and around the study area (Anderson et al. 1996; Ledbetter et al. 1996).

Figure 2-06 shows contours of the frequency of fluted and unfluted lanceolates contoured in Surfer (at 2 points per interval), using data with county level positioning data from the Paleoindian Database of the Americas (PIDBA) that can be found online. The filled circles in Figure 2-06 represent sites with diagnostics, or stratigraphic exposures, or age estimates of 9,000 calBP (8,000 BP) or older, or some combination of all of the above especially those described by O'Steen (1996) and Ledbetter et al. (1996).

Three time frames have been estimated to date the Clovis and Clovis-related projectile point types that if found would be diagnostic: Early Paleoindian fluted lanceolate point forms (ca. 13,000–12,700 calBP); Middle Paleoindian fluted and unfluted lanceolates such as Cumberland, Suwannee, Simpson, Quad, and Beaver Lake (ca. 12,700 to 12,500 B.P) and, finally, Late Paleoindian incipient corner- and side-notched forms like Dalton, Greenbriar, Hardaway Side Notched (ca. 12,500 to 11,400 B.P.) (Anderson et al. 1990:6-9; 1996:7-8).

Even though the evidence is rare in the Southeast, and the degree to which hunting megafauna contributed to Paleoindian subsistence is assumed rather than confirmed, the remains of extinct Pleistocene animals have been found in submerged contexts that are indicative, potentially, of co-existence with early human populations and in contexts when sea levels were lower. For instance, in Florida, a Bison antiquus skull with an embedded projectile point fragment was found in the Wacissa River as well as other evidence of association (Webb et al. 1984). Dunbar and Webb (1996:333-350) have reported several worked mammoth, mastodon, and horse bones as well as carved-ivory implements made from mammoth tusks, presumably while the ivory was still in a green state. Wright (1976:319) reported remains of *Mammut americanum* dredged up at the Surfside Springs site in South Carolina, as well as *Bison*, *Cervus*, and *Ursus* from the deposits that also contained two bifacially modified artifacts (see Goodyear et al. 1989:6).

Closer to the study area, a proximal fragment of a proboscidean rib was found on Edisto Beach apparently from submerged context (Goodyear et al. 1989:9). One edge of the rib displays a fairly continuous series of grooves or incisions that are proposed to have been produced by human action.

While the degree to which megafauna contributed to Paleoindian subsistence in the Southeast remains conjectural, it is certainly agreed that post-Paleoindian, post- late Pleistocene, early Archaic, and early Holocene assemblages indicate a wide range of activities including exploitation of local mammals and birds such as found at Dust Cave in northern Alabama, as well as bone and wood working, and indications of longer term settlements (Sherwood et al. 2004). More significantly, the chipping technologies indicate cultural affiliation (descent with modification) with the makers of fluted points almost two thousand years earlier. Any coastal adaptations would be located on the outer continental shelf, well away from the survey area.

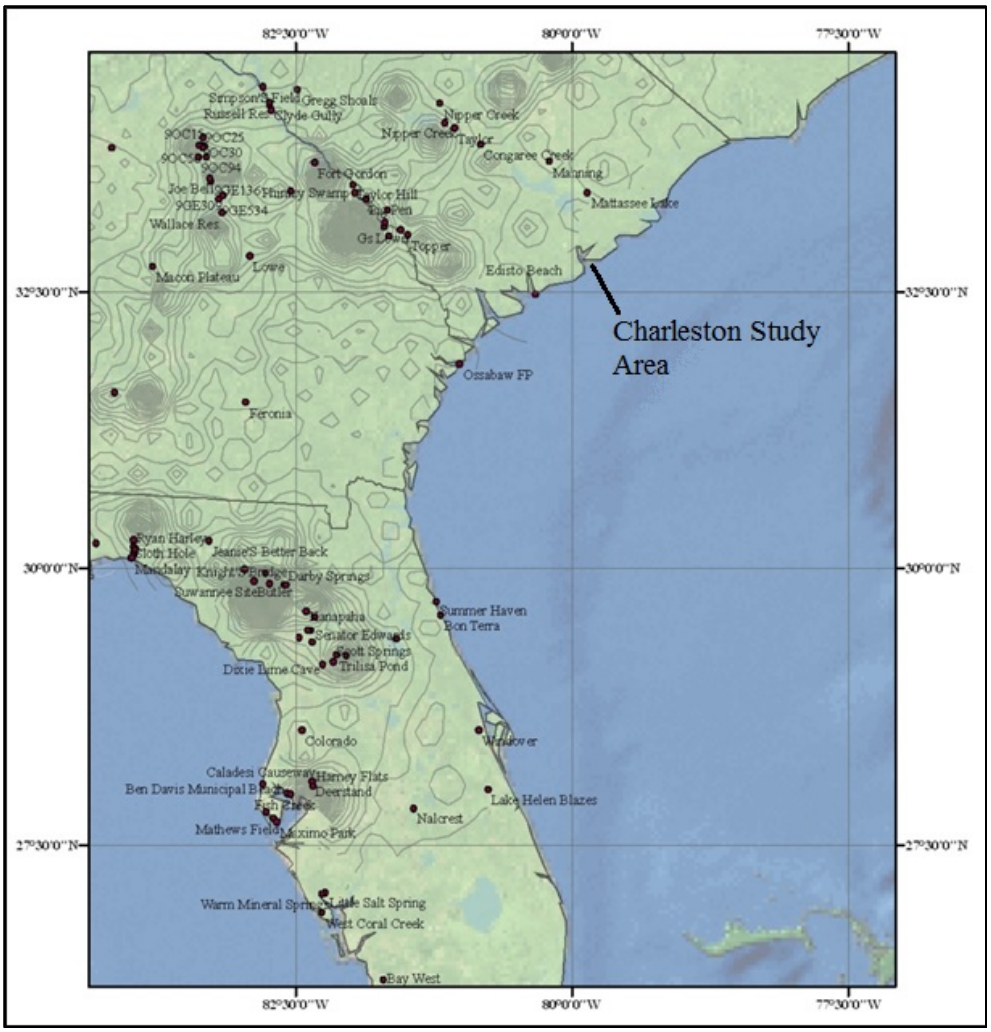


Figure 2-06. A composite of ARCOOP (Archaeological Research Cooperative) data of archaeological sites earlier than 9,000 calBP (black dots), and distribution of Paleoindian lanceolates contoured from PIDBA data (Paleoindian Database of the Americas). Note the cluster of late Paleoindian and Early Archaic sites up the Savannah and Pee Dee Rivers.

Diagnostics from a pan-regional sequence of early Holocene Early Archaic projectile point traditions that covers two millennia 11,400 to 9000 calBP would represent a means of determining the chronology and culture association of a submerged prehistoric site or isolated finds from the dredge material. This early group includes the Side-Notched Tradition (11,400 – 10,500 calBP), Corner-Notched Tradition (10,500 – 10,200 calBP), and the Bifurcate Tradition (10,200 – 9000 calBP), although the latter is more common to the north (Elliott and Sassaman 1995:21-26).

Inspection of the Georgia Bight coastal areas in Figure 2-06 shows that diagnostics and early sites have been found most frequently inland, along the Savannah River between Georgia and South Carolina and in the Oconee River behind the Wallace Dam. The best stratigraphic sequence is 9GE309,located on the alluvial plains of the Oconee River (Ledbetter et al. 1996:272; O'Steen 1996:99-100). Excavations revealed that the bottom-most deposits contained Clovis points while overlying strata yielded artifacts from earliest to latest in stratigraphic order: Clovis, Dalton/Big Sandy, Kirk Corner Notched, Bifurcates, and Kirk Stemmed varieties.

Examples of any of these diagnostics could have been left in the survey area in the past, when it was in a terrestrial configuration. A fluted biface was found underwater at Ossabaw that confirms this proposal (Ray 1986) as do the discoveries of ivory tool fragment and bifurcated projectile point made at Grays Reef indicating human presence. The Ossabaw artifact has been designated as a "Clovis" point, but it is more consistent as a fluted biface preform, the Gray's Reef biface shown in Figure 2-07.

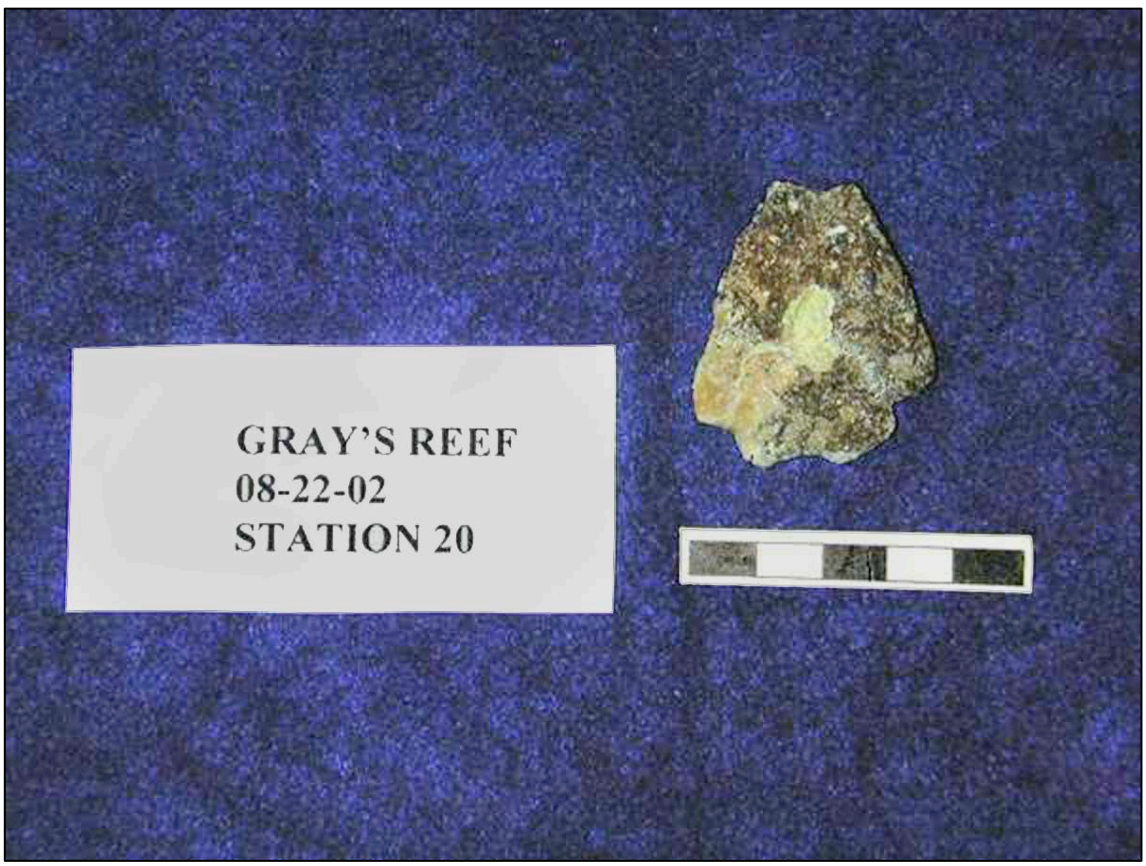


Figure 2-07. Bifurcate base projectile point found at Gray's Reef, note the corrosion and patination of the surface of the material from exposure to the saltwater environment (photo courtesy of E. Garrison; scale in centimeters).

It would appear based on current knowledge that Paleoindian and Early Archaic sites do not occur in the coastal areas of South Carolina; however, it is a very potential problem that the sites exist but are buried by more recent sediments in the coastal plain and marshlands and have yet to be discovered.

MIDDLE AND LATE ARCHAIC GROUPS

The Middle Archaic in Georgia may be demarcated by the appearance of stemmed projectile points rather than notched or bifurcate base varieties (Chapman 1985:148), but the extremely low numbers of Middle Archaic sites known from the coast seem to be indicating low probabilities for these sites in the inland waterways and marshes, unless they are buried by sedimentation.

Archaeological sites increase in great numbers on barrier islands in Late Archaic time frames after 5,000 calBP, when evidence shows people exploiting a rich variety of resources in the marshland estuaries, particularly shellfish and other aquatic resources (Figure 2-08). Slightly earlier sites of these culture groups could be submerged in the survey area because the environments they utilized occurred out there and then migrated inland, retreating from the rising coastline.

Middle Archaic

The Middle Archaic can include demarcation by the appearance of stemmed bifaces (Chapman 1985:148). The earliest Middle Archaic hafted biface types of this genre are the Kirk Stemmed, Kirk Serrated, and Stanley Stemmed types. On the other hand, Morrow Mountain projectile points are clearly one of the better known Middle Archaic stemmed points recovered from the South Atlantic Slope. Sassaman and Anderson (1995:24) reviewed a series of radiometric assays associated with various Morrow Mountain contexts in Tennessee, Alabama, Georgia, and South Carolina. The date estimates ranged from approximately 7500 to 5500 B.P. well within the range of Later Middle Archaic points that are found in the Coastal Plains of the region including the Guilford-related Brier Creek type. Sassaman and Anderson (1990:153) indicated that Brier Creek was possibly a Coastal Plain version of Guilford. They described a stratigraphic sequence at the Pen Point site in the Savannah River in which Brier Creek was found in a context lying above Morrow Mountain and below Savannah River Stemmed. Elliott and Sassaman (1995:34) suggested Guilford dates ranging from 6000 to 5000 B.P. They also mentioned the presence of other presumably coeval types resembling the closely related Sykes, White Springs, and Benton types. These varieties could be useful diagnostics if found in offshore contexts.

Sassaman and Anderson (1995:149) pointed out that Middle Archaic sites are not very abundant in the South Atlantic Coastal Plain. Inasmuch as a vegetation or ecotone shift related to sea level rise may have occurred during this period in which pine expanded at the expense of oak, some researchers have suggested that the pine-rich forests were not as productive and therefore less attractive for human exploitation. Nevertheless, there is sufficient evidence of Middle Archaic activities in the region to conclude that the Coastal Plain was not completely abandoned. If there were more cores in the marshes, we might have had better control on the development of the marshes as sea levels approached today's levels. Likewise, the ecotones of interest to the prehistoric inhabitants may have existed farther offshore, with slightly lower sea levels.

Late Archaic

The earliest archaeological sites along the Georgia Bight barrier islands date to about 4,000 years ago, when evidence shows people exploiting a rich variety of resources in the marshland estuaries, particularly shellfish (Turck et al. 2011). Three types of Late Archaic sites have been identified that might be used for modeling the kinds of sites expected in the study area: (1) scattered sites along marsh edges and bluffs (including those not bearing substantial shell accumulations), (2) marsh shell middens, and (3) shell rings (Waring 1968). Shellfish collecting also appears to have been an important activity in riverine settings, particularly along the

Savannah and Ogeechee rivers (Elliott and Sassaman 1995:143). Other common diagnostic artifacts include net sinkers, steatite vessels, and shell ornaments. In addition, there were weir features and other technologies for aquatic and avian resources (Elliott and Sassaman 1995:38-38). These features could be expected in the study area in intact situations.

Crook (2007) has described research at the Bilbo Site (9CH4) in Savannah that indicates evidence of a pile-dwelling and shell midden during the late middle Holocene about 4,000–3,000 years B.P. Crook argues that pile dwellings "were a central feature of the cultural adaptive system, allowing settlements to be located in wetlands that provided optimal access to the evolving food resources of multiple, dynamic environments" (Crook 2007:223). One of these may have been located in nearby Edisto Beach.

There is little potential for Woodland or later culture groups in the Charleston study area and therefore no need to continue describing the local prehistoric background.

Figure 2-08. Cover of Thomas (2008) showing Native Americans along Georgia's coast and the array of features and structures they had built for catching, processing, and preserving marshland fauna. These kinds of features can be preserved offshore given local preservation parameters.

POTENTIAL FOR SUBMERGED PREHISTORIC SITES

As Garrison et al. (2012) point out, the potential for sites offshore is directly related to the presence of more recent quaternary age strata, which are most often significantly eroded. Sediment packages can build up in the lagoon on the lee of barrier islands, and if those were preserved offshore they could be expected to retain stratigraphic integrity and be at or near locations of human activities and refuse.

The margins of paleochannels and terraces are prime locales for submerged prehistoric sites, and it is known that paleochannels can be preserved offshore. On the other hand, paleochannels are not perceivable by bathymetry because of the marine sediment cover, indicating that seismic (subbottom profiler) remote sensing is a critical tool for site survey and prediction (Garrison et al. 2008).

HISTORIC CONTEXT

The initial European contact within the Carolinas took place in 1514, as Luis Vasquez de Ayllon sent an agent to find a source of labor for his plantations in the Caribbean. Supported by Ayllon, Francisco Gordillo sailed in 1521 along the American coastline north of Florida. Although the adventure was unprofitable for Ayllon, he still held hopes of profiting in the region. In 1523, he received a patent from the King of Spain to explore the coast and set up a colony. After an early reconnaissance, he fitted out four vessels with over 500 colonists and left Santo Domingo for the Carolinas in 1526 (Edgar 1998:21; Morison 1971:332). The landing near the Cape Fear River was unsuccessful and the colonists moved south to establish San Miguel de Gualdape. By 1527, Ayllon was dead and the colony broke up with roughly 150 survivors sailing back to Hispaniola (Coker 1987:2).

Three years after Gordillo's original Carolina reconnaissance, Giovanni da Verrazzano, an Italian from Florence sailing for the King of France, left Europe on a voyage to find a route to China in January 1524. His vessel, *La Dauphine*, weighed 100 tons and was manned by a crew of fifty. Verrazzano coasted south along the eastern coast of present-day South Carolina for approximately 100 miles, but turned north to avoid the Spanish who had dominant control over Caribbean and Florida waters. After some brief reconnaissance along the coast, he continued north on his voyage and eventually returned to France in July. Verrazzano was able to conclude that he did not reach China, but a New World (Morison 1971:314). The French, however, did not follow up on Verrazzano's discovery of these new lands.

The Spanish expedition of Hernando de Soto trekked the Southeast from Florida to the Mississippi River. Part of Soto's itinerary took him through the sand hills and piedmont region of South Carolina. His expedition aided in reinforcing the Spanish claim to the lands north of Florida. In 1559, King Philip II of Spain ordered a settlement at Punta Santa Elena in present-day Port Royal Sound. Considered by the Spanish to be the best natural harbor in the Southeast, this settlement was to act as a buffer to other encroaching European powers. The settlement failed, as a hurricane killed 26 colonists and destroyed three of the four vessels (Edgar 1998:22-26).

During 1562, the French sent two more vessels to explore the Carolina coast. Jean Ribaut took possession of the area in the name of the King of France Charles IX. The original settlement at Port Royal did not survive long as there was internal dissension and the post was abandoned. The French were not discouraged, and two years later a second attempt by Rene deLaudonniere established a settlement at Fort Caroline, on the St. Johns River in Florida (Coker 1987:3). The French settlement in Florida was a danger to the Spanish homeward fleets carrying New World wealth to Spain. King Philip II of Spain dispatched Menendez de Aviles to eradicate the problem in 1565. Fort Caroline was taken by a land assault, and after a promise of fair treatment, the defenders were all put to death. The French avenged the treachery three years later by retaking the fort and all killing all the Spanish prisoners (Morison 1971:470). In an attempt to maintain sovereignty over the region, the Spanish resettled Port Royal in 1566. When Francis Drake captured and burned St. Augustine in 1586, the post was abandoned.

Being on the edge of the empire, South Carolina took on a frontier characteristic. The English, late into the colonization lottery, established New World colonies concentrated north of Virginia. Attempts to settle the area between Virginia and Spanish Florida failed until the 1660s. On March 24, 1663, King Charles II of England granted a charter to eight men to be the "absolute lords and proprietors" of a colony between Virginia and Spanish Florida (Edgar 1998:39). With the aid of the local Indians, the English established their first permanent South Carolina settlement at Charles Towne in 1670, along Ashley River's western bank (Figure 2-09). A decade later, the population had exponentially grown to about 1,200 residents moving towards the convergence of the Cooper and Ashley rivers called Oyster Point (Coker 1987:8; Watts 1995c:4).

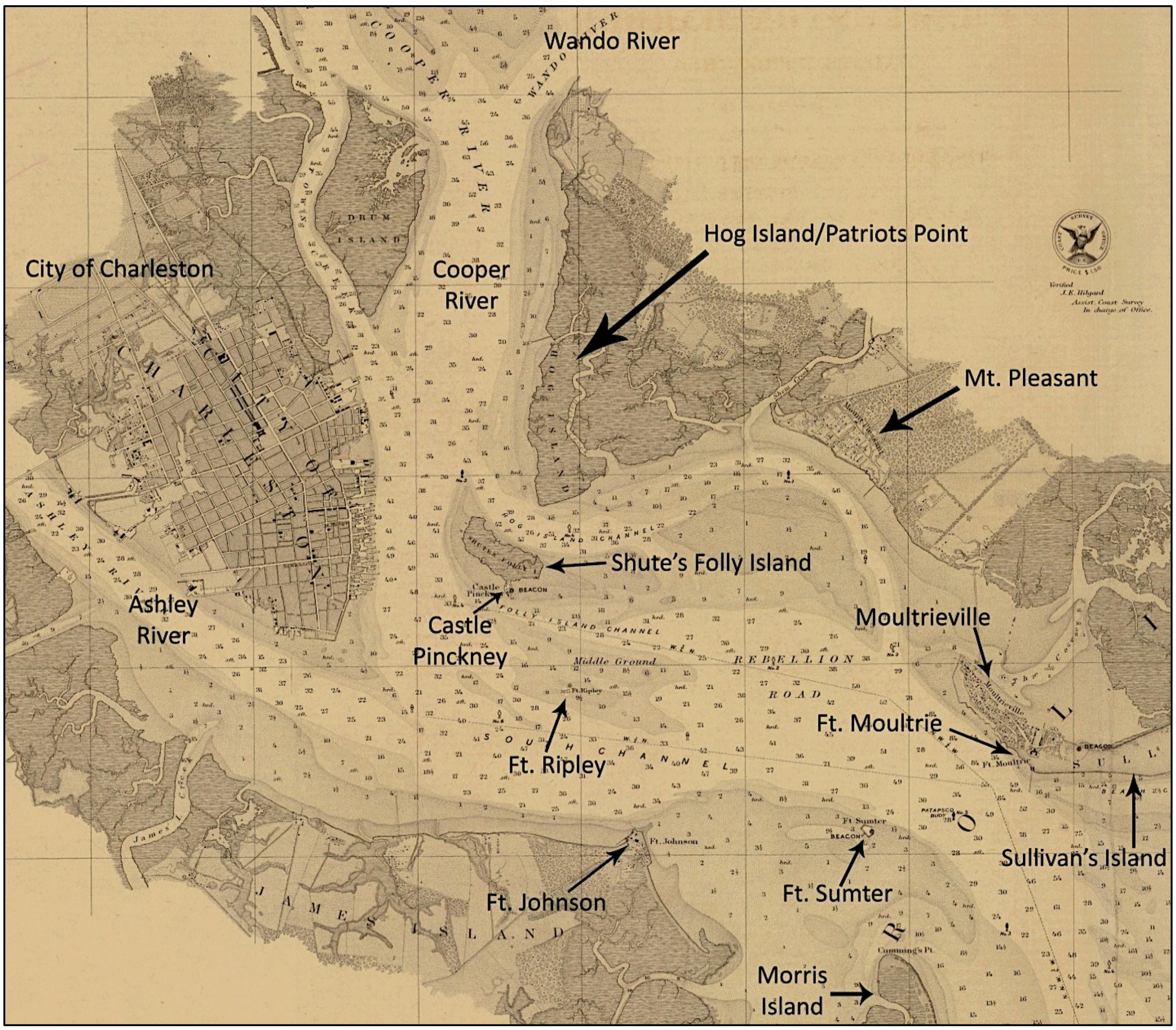


Figure 2-09. 1870 chart of the Charleston Harbor region showing general location of towns and late Civil War fortifications in relation to the Project Area (Chart 431 from the National Oceanic and Atmospheric Administration [NOAA] Office of Coast Survey's Historical Map and Chart Collection).

Advantageously situated just off the Gulf Stream, Charleston became an English commercial center attracting a number of entrepreneurs. Close proximity to the Spanish and French colonies in the Caribbean encouraged both legal and illegal trade. During the early colonial periods, piracy was an activity that was tolerated, and sometimes encouraged, if the intended targets were colonial adversaries and an advantage was to be gained (Ritchie 1986:11-26). New York, Boston, Newport, and Charleston were havens for many pirates in America (Cordingly 1995:15). In Charleston ,no authorities confronted local pirates and "in fact, they may have encouraged these outlaws of the sea, since their booty was scattered around generously" (Coker 1987:10). At first, these coastal ports took advantage of the "wealth" created by these individuals; however, as the region's frontier moved inland and coastal ports expanded to become economic and cultural centers, residential attitudes on piracy began to change by the end of the seventeenth century.

British initiative to stop piracy took an active role at the beginning of the eighteenth century as a new form of national policy. The penalty for piracy was death, usually by hanging. Charleston saw one of the largest executions of pirates in 1717, with the demise of Captain Stede Bonnet, when he and 29 of his men were hanged (Cordingly 1995:245). Royal Navy vessels patrolled the coast of South Carolina to keep both marauders and Spanish away from the colony. In 1724, George Anson was stationed at Charleston as a permanent feature of English protection. When he left his station in 1730, the colony was in a much more tranquil state (Coker 1987:29-34). Ironically, Anson made his fortune by sacking the *Cobadonga*, a Spanish Manila galleon (in the Philippines), during the 1740s, which many considered an act of piracy.

The English soon established Savannah, Georgia on the banks of the Savannah River in 1733, between South Carolina and Spanish Florida. This colony acted as a buffer to Charleston and aided in the growth and relative security of South Carolina. The final Spanish land advance north was stopped in 1742, at the Battle of Bloody Marsh on St. Simons Island, Georgia (Ginn 1987). The Treaty of Paris (1763) settled the matter, as the Spanish relinquished all claim to lands north of the St. Mary's River. With the population expanding into the interior, the production of agricultural goods for exporting trade began to flourish. Timber, naval stores, rice, indigo, and eventually cotton were the main agricultural products exported from the coast and the interior of South Carolina.

Additional settlements inland added to the safety and prosperity of Charleston. Charleston was geographically set to flourish as a natural port as products from inland increased, with the surrounding rivers acting as natural highways into the interior. Numerous areas of the upcountry were marked off to be settled under the guidance of Governor Robert Johnson in 1730 (Meriwether 1974:19). Regardless of the political and religious considerations, the new interior population completed two essential tasks. Most essential in the early eighteenth century, these townships acted as buffers and a first line of defense from native populations. Secondly, as the frontier became settled, these areas became major producers of agricultural goods and stores, eventually increasing trade in Charleston.

Charleston was the main *entrepôt* for the colony of South Carolina. Produce coming down from the numerous rivers that surrounded Charleston was funneled to the wharves of Charleston for export. During the Colonial period, the major export products were naval stores, timber, rice, and indigo. Each had been supported at one time or another with a bounty from Great Britain. Trade was to be the economic driving force of the colony. Vessels sailing from the Caribbean to points north and Europe could easily stop over to fill their vessels with local products. Charleston, one of only two major ports in the southeast (the second being Savannah) extended its trade influence into Georgia and North Carolina. Just prior to the American Revolution, the port cleared approximately 450 vessels and had total annual imports and exports to Great Britain of some 800,000 pounds (Labaree 1999:101-103).

For the southern colonies, Charleston controlled the importation of slaves. Slave trade into the port was so large that "between 1700 and 1775, 40% of the Africans imported into North America came through Charleston" (Edgar 1998:67). The Carolina low country produced rice and indigo, and soon cotton would be the major cash crop. Such large tracts of land required a large work force, generally made up of African slaves.

When Lord Campbell left Charleston in 1775, effective British rule in the colony ended. In the spring of 1776, South Carolina became the second rebellious colony to draft a constitution. The British were not slow to react. They quickly sent a force of 11 ships and 2,900 army regulars to take Charleston. What came to be known as the Battle of Sullivan's Island was a victory for the locals (Edgar 1998:226-7). The early victory was not to last as the British, after taking Savannah in 1778, returned for the capture of Charleston. By mid-May 1780, the British succeeded in taking the city (Labaree 1999:146). From Charleston, the British fought the colonials and established control over the city, which became a haven for South Carolina Tories (supporters of the King). The last of the British and Tories evacuated the city on December 14, 1782, essentially ending the Revolutionary War in South Carolina (Edgar 1998:237-240).

Eli Whitney and his invention of the cotton gin in 1793 are considered by historians to be both a boon and bane to the American South (Wallace 1951). With the invention, the entire southern region became locked into an agricultural economy based on cotton. In 1791, South Carolina raised about 1,500,000 pounds of cotton and by 1834 approximately 65,500,000 pounds were produced, an increase of almost 4,400% (Wallace 1951:364). Cotton was the primary commodity grown for export. Rivers offered the best form of transportation, as hauling bales of the relatively bulky commodity overland was expensive. Vessels powered by steam did ascend from Charleston as far as Columbia and Camden through the mid-nineteenth century; however, steam was generally confined along coastal routes or to the port of Charleston as inland traffic and commerce was eventually taken over by railroads.

Steam in another form was to influence the internal improvements of the state. By 1835, a 136-mile long stretch of railroad track was laid between Charleston and Hamburg, making Charleston one of the early rail centers. By 1860, every district in the state with one exception was connected to Charleston or Columbia by railroad. Rivers were no longer the single means of transporting cotton and "once tracks could run to Charleston's docks, more cotton was shipped to the port by rail" (Edgar 1998:283). The railroad and state turnpikes inhibited river and canal traffic after the mid-nineteenth century. Railroads were more dependable than river traffic, not relying on water levels or hindered by obstructions (Wallace1951:375).

Eventually road construction challenged traffic along all of South Carolina's rivers. Wallace notes when discussing transportation improvements in South Carolina, that "the State Road ran from Charleston by the later Holly Hill and Cameron and two miles west of St. Matthews on by Columbia, and thence up the western side of the Broad very near the river, and, crossing the Enoree, very near that stream on its eastern side, on over Saluda Gap in Greenville County into North Carolina" (Wallace 1951:375). The development of these suitable roadways, similar to railroads, had a drastic effect upon river transportation in the southeast.

Prior to the Civil War, South Carolina was one of the wealthiest states per capita, surpassed only by the other slave-holding states of Mississippi and Louisiana. Economic indicators such as personal property, real estate value, bank deposits and exports were all on the increase. On the eve of the Civil War, per capita wealth was $846, excluding slaves. Including slaves, the figure jumped to $2,017. Charleston, headquarters of the state bank, also held nearly 75% of all private banking capital in the state (Edgar 1998:284-5). By the 1860s, over 40,000 inhabitants in the city of Charleston made the port town the largest concentration of people in South Carolina. With approximately 5% of the total population of the state, Charleston became a political, economic trade center for the southern states.

With the election of Lincoln during the presidential campaign of 1860, South Carolinians began to take action that would affect the future of the nation. In Washington, the congressional delegation for South Carolina resigned and the state legislature called for a state convention to be held to decide the issue of secession. On December 20, 1860, at Charleston, the 169 delegates of the Secession Convention made a unanimous decision. South Carolina became the first state to claim its right and need to secede from the United States (Edgar 1998:350-2). The Civil War devastated the state of South Carolina and the city of Charleston. After the initial repulse of the *Star of the West* by cadets from the Citadel from re-supplying Fort Sumter in 1861, to the beginning of the Civil War with the fort's bombardment, an initial state of euphoria swept the South.

Prior to the outbreak of the conflict, floating batteries were established and placed to oppose the Federal troops at Fort Sumter. Initiated by Captain John Hamilton, and based on British and French designs used during the Crimean War of 1854, the batteries were basically barges with an iron-covered casemate on one face. Just two days before the bombardment of Sumter, the floating battery was grounded on the west end of Sullivan's Island (Coker 1987:207-8).

The initial naval blockades of southern ports proved unsuccessful as vessels entered and exited the ports almost at will. Due to its ineffectiveness, there was an international protest of the policy. Over time, as ports fell and the Union became more efficient at the techniques of blockade, the south was slowly strangled from receiving foreign aid. In order to close off Charleston, an active trade center that could support the Confederate cause, the Union decidedly blockaded the port with what became known as the "Stone Fleet." Various vessels filled with stone were deposited in the channels of Charleston in 1861. The Stone Fleet's efficacy was almost immediately diminished by the force of the natural scouring of tides as the redirected tidal waters of the harbor made new channels.

With the failure of the Stone Fleet to close the harbor at Charleston, a fleet of Union naval vessels was detached to enforce the blockade. Sitting in the harbor were some of the newest and most advanced designs in naval warfare such as the *New Ironsides* (Figure 2-10). The *New Ironsides* were an attempt by the Union to produce a steam driven vessel with the cannon of a traditional sail man-of-war in order to make a "broadside ironclad." The steam-powered vessel was rigged as a bark, and for most of her active career the masts were removed. Her presence at Charleston caused great consternation to the Confederates. On one occasion, she took 70 hits off Fort Moultrie and in another operation supported the grounded Union vessel *Weehawken*, taking 50 hits without major damage (Canney 1993:15-20).

Port after port fell to relentless Union attacks. By mid-November 1861, Port Royal was in Federal hands. Federal forces gathered at the mouth of the Savannah River in 1861 and effectively cut the Confederate Port of Savannah off from commerce. The fall of Fort Pulaski on April 11, 1862, sealed the fate of the city and river. During the spring of 1862, Union forces looking south took numerous port towns of Florida including St. Augustine and Jacksonville. In spite of two forts guarding the Mississippi and a line of obstructions, New Orleans fell to Farragut in the spring of 1862. For the Confederates only a few Texan ports, Mobile in Alabama, Charleston, and Fort Fisher on the Cape Fear River in North Carolina held out through 1864.

Charleston, the first to fight, was one of the last port cities of the Confederacy to be taken by Union forces. The defenses and ingenuity of the Natives created some unique accomplishments with floating batteries, torpedo boats, semi-submersibles, and a submarine. Charleston utilized her resources to punish the Union for her stranglehold, effectively holding out until February 1865.

To take war to the Union forces another method was undertaken with varying degrees of success. The United States was not a signatory to the Declaration of Paris (1856), but the US said it would respect the principles of the declaration during the Civil War, which outlawed privateers as a means of war (Kemp 1993:237). Not being constrained by the international statute, the South issued letters of mark, commissions for privateers. The first privateer to make a prize for the south was a Charleston-built pilot boat. The *Number 7* captured the Yankee brig *Joseph*, a prize worth $30,000. Other Charleston privateers were to follow with mixed results (Coker1987:211).

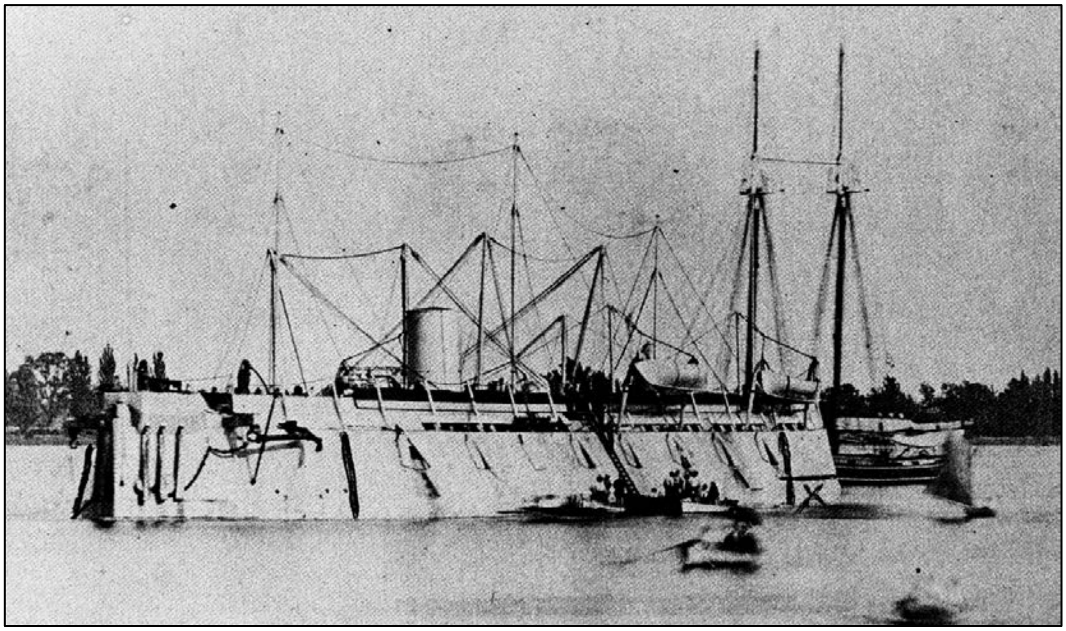


Figure 2-10. ***New Ironsides*** **at the Cramp Shipyard in Philadelphia, 1862 (as presented in Coker 1987:257).**

Defending the harbor from the blockading Union fleet, South Carolina built several ironclad vessels. The first constructed was the *Palmetto State* at the Marsh and Sons yard, followed by the *Chicora*, constructed at the Eason Shipyard. Both vessels were ready for combat by October of 1862 (Coker 1987: 224; Scharf 1996:670). Although slow (due to a lack of powerful steam engines), the ironclads made a strong impression. On the last day of January, the two Charleston-built ironclads surprised the Union blockaders. The *Mercedita*, *Keystone State*, *Memphis*, *Housatonic*, *Quaker City*, and *Augusta* were attacked and driven off. The *Mercedita* and the *Keystone State* struck their colors and surrendered, but the *Keystone State* managed to steam out of range and be towed by the *Memphis* to Port Royal. The blockade was broken, and under international law had to be lifted for 30 days. The Lincoln administration did not acknowledge that the blockade had been broken and refused to honor the international statute (Coker 1987:227-9). Soon after the attack, the Union sent a fortified squadron posted off Charleston, which included monitor vessel types and the Union's most powerful vessel, the *New Ironsides*.

The third ironclad constructed at Charleston took the name of its home port. Built by James Eason, an iron shortage in the south delayed her construction and she entered service in early 1864, armed with four Brooke Rifles on the broadside and two IX smoothbores on fore and aft pivots, and reported to have a propeller wheel of 8.5 feet (Coker 1987:232; Scharf 1996:671). The last ironclad built at Charleston was larger than the preceding three and in fact, it was the largest constructed in the Confederacy. The *Columbia* was built by F.M. Jones and launched in early March 1864. Pierced with eight ports for cannon, she would have been a formidable foe for the Union blockaders; however, with a relatively deep draft, the vessel collided with an obstruction and was stranded, stripped of arms, and was finally taken by the Union (Coker 1987:232-3; Scharf 1996:706).

The effectiveness of the Union blockade of Charleston Harbor prompted the Confederates to devise numerous inventions and modifications to traditional naval tactics. One of these inventions included torpedo boats. In August 1863, the *Torch,* with an underpowered steam engine, was the next to attempt a torpedo boat attack. The intended target was the *New Ironsides*, the nearly invincible Union broadside ironclad. The initial attack failed and the *Torch* retreated in the face of one of the strongest vessels of the Union's navy(Coker 1987:256-7).

A type of vessel that could offer protection to an attacking crew was a semi-submersible vessel called the *David*. A vessel powered by a steam engine with a cigar-shaped hull that was mostly awash appeared to be the answer to the torpedo boat question. Thin strips of iron on the top of the hull were the only armor protection for the craft. While underway, the vessel could submerge to a point where only the cockpit coaming and smoke stack were above the water. A spar with an explosive charge was the only offensive weapon the vessel carried (Coker 1987:257-261; Scharf 1996:758).

With the *New Ironsides* still on station off Charleston, the vessel again became a target of the improved torpedo boat. During the evening of October 5, 1863, the *David* set off in search of the Union blockader, under the command of a Lieutenant Glassell. A sentinel sighted the attacker and called out but was shot dead by Glassell moments before the torpedo struck. The violent explosion rocked the *New Ironsides* and the wash was such that it entered the *David's* smoke stack and doused the boilers. Two of the *David*'s four-man crew were captured, while the other two relit the boiler and made their escape with at least 13 bullet holes from small arms fire. The explosive had hit the frigate's armor plate and did not penetrate through the hull (Coker 1987:261-2; Scharf 1996:759). Although not sunk by the assault, the *New Ironsides* was damaged enough to be removed from service and repaired later. This hostile attack caused the Union to take extra precautions against torpedo boat attacks. Other modified *David*s were constructed and employed around Charleston, but none were as successful as the first attempt.

The first true and successful submarine, the *H.L. Hunley ,*was moved to Charleston in August of 1863 from Mobile. The first unsuccessful trial resulted in the death of five of the crewmen. There was no lack of volunteers to fill the place of the deceased. Other trials were more successful and on February 17, 1864, the *Hunley* espied the steam sloop-of-war *Housatonic* and placed the spar torpedo in the starboard quarter. The *Housatonic* sank in four minutes with five men killed (Coker 1987:264-5; Scharf 1996:760-1). The intact remains of the *Hunley* rested approximately 600 meters away from the *Housatonic* (National Park Service 1998:60).

Confederate forces evacuated the city of Charleston on February 17, 1865. Upon abandoning the "birth place" of rebellion, the southern forces burned and scuttled all military equipment that could be used by the Federal forces. The ironclads were burnt at the Charleston waterfront. Numerous other vessels were lost, destroyed or scuttled in the harbor during the war. The Civil War destroyed Charleston; buildings lay in rubble, and the transportation infrastructure was in ruins.

After the Civil War, it would take years before Charleston would regain its position as a center for the southern economy. Once Colonel Quincy A. Gillmore was appointed the supervising engineer for river and harbor improvements (from Cape Fear to St. Augustine), Charleston's trade and economy improved. In 1871, an engineering office was established in Charleston and by 1877, an alliance of Southern and Midwestern members of Congress obtained "federal funds for river and harbor improvements" (Watts 1986:46; Moore 1981:32-33). Once cleared of major hazards, local ferries, such as the Sullivan's Island Ferry Company, transported people from Charleston to Mt. Pleasant and Sullivan's Island (Figure 2-11). Tourism to the Isle of Palms became a new source of needed income for the region (Watson 2004).

During the late nineteenth-century, a number of events would affect Charleston Harbor and the larger area of Charleston. Wharf fires raged during the years 1875, 1879, 1880, and 1885, and hurricanes struck violently in 1871, 1873, 1885, and 1893 (South Carolina State Ports Authority 1991:9); however, one of the most damaging and powerful events to take place in Charleston was the earthquake of 1886. The earthquake struck at night on August 31. Reportedly, the quake lasted less than a minute but with its 7.3 magnitude damaged 2,000 buildings; some of which can be seen today (Coffman and Hake 1970; U.S. Geological Survey 2010).

Offshore on the approaches to Charleston Harbor, immediately nearby the current survey areas, a light-vessel would be erected to stand watch for guiding ongoing vessels. Six different lightships were assigned off Charleston starting in 1854 until 1933 (U.S. Coast Guard 2016a). Rattlesnake Shoal lightship was anchored "8 ½ miles easterly from Fort Sumter off the east end of Rattlesnake Shoal" (U.S. Coast Guard 2016a). From 1854 to 1894, the station maintained the name Rattlesnake Shoal with the exception of when the station was vacant during the Civil War (specifically 1861-1863). The station was renamed the Charleston Light-Vessel (LV) on May 31, 1894, and relocated further south towards the main channel. Figure 2-12 shows light-vessel no. 34 on Charleston station (U.S. Coast Guard 2016b). Vaughn & Fisher of Philadelphia built the sailing vessel in 1865 with two lanterns, each with eight fountain-burner oil lamps. The 101-foot lightship served 59 years at multiple locations before being retired in 1924 and sold. No lightships are known to have sunk off Charleston.

The population of Charleston reached 50,000 inhabitants by 1880 and its ocean-borne trade continued to increase. The principal exports of Charleston continued to be cotton, rice, and during the 1870s, phosphate from up the Ashley River began to dominate the exporting market (Annan and Gabriel 2002; Watts 1986:49). By the 1890s, the value of phosphates declined as the popular material had fully saturated the market, successfully ending the industry. Charleston's industrial base had faltered with the continued expansion of the inland railroad systems. With more goods being exported by rail, Charleston experienced a severe decline in trade. Charleston's exports "for the 1900–1909 period [were] less than a fourth of the value of the 1885–1894 trade" (Watts 1986:49; Moore 1981:169).

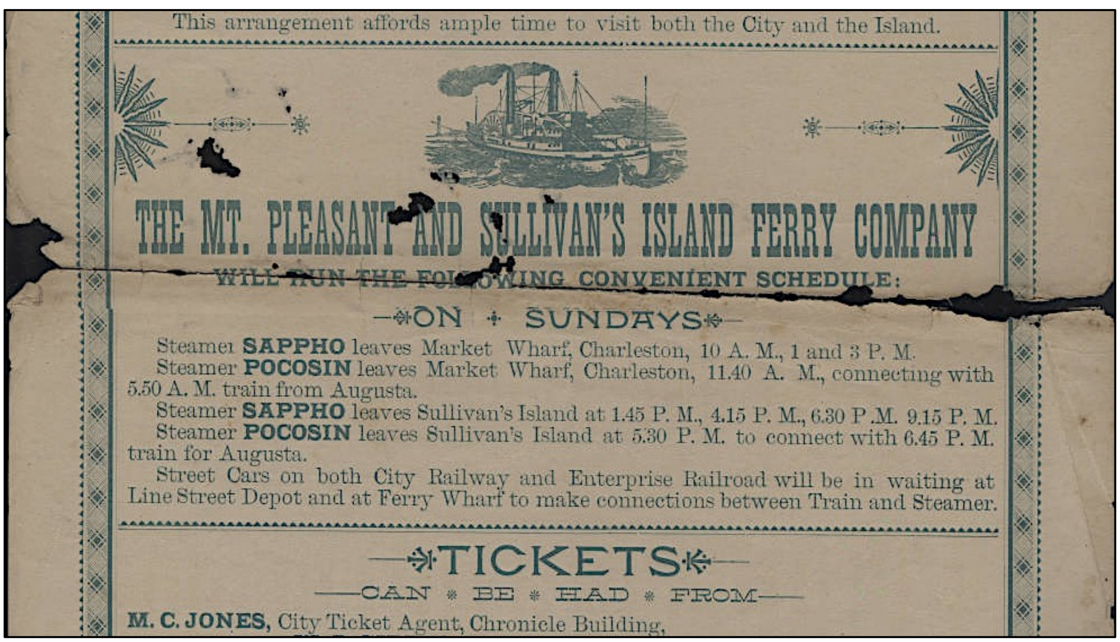


Figure 2-11. A portion of a 1890s flyer showing excursions to Sullivan's Island and the ferry schedules for the Mt. Pleasant and Sullivan's Island Ferry Company (courtesy of The South Caroliniana Library, University of South Carolina).

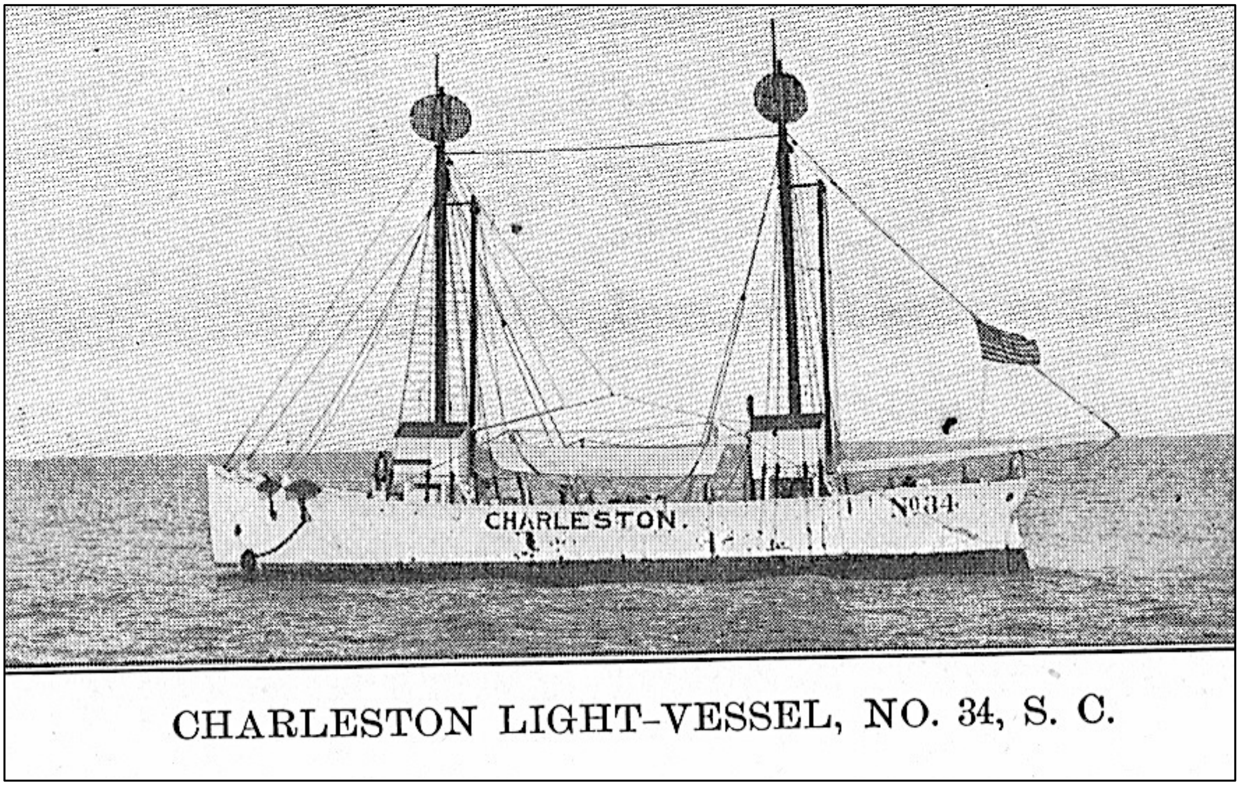


Figure 2-12. 1907 photograph of the Charleston Light-vessel No. 34 which sat just off the current Project Area from 1880-1886 and 1892-1924 (courtesy of the U.S. Coast Guard Historian's Office).

Charleston's industry base began to improve with the establishment of the Charleston Naval Shipyard in 1901 and with the relocation of a naval base to the area (Watson 2004; Watts 1986). New installations at the Navy base also brought expansion to Charleston's Naval Yard in preparation for World War I; however, after the war the local community no longer saw the need for the large military presence. The Great Depression did nothing to support the area of Charleston. The naval base developed slowly until 1941 with the outbreak of World War II. By 1941, the naval base became the area's largest industry (Watts1986:49-50). The base's large water transportation facilities, developed during World War I, were turned over to the city in 1947, which then relinquished them to the State Ports Authority. Post-World War II, the port of Charleston once again thrived, becoming one of the South Atlantic's most important ports (Watts 1986:50).

NAVIGATIONAL IMPROVEMENTS

During Reconstruction, it became apparent that the harbor at Charleston needed to be cleared of wartime obstructions and hazards. The USACE were responsible for the task of clearing the dangers to navigation at Charleston (Figure 2-13). The 1873 Annual Report of the Chief of Engineers specified that:

> "On the 31st day of October, 1871, a contract was entered into with Mr. Benjamin Maillefert for the removal of the five following named and described wrecks for the sum of $10,800, and the proceeds of the wrecks, viz:
>
> The *Palmetto State*, an iron-clad gun-boat, sunk in the mouth of Town Creek, just above the city, in 1865.
>
> The *Charleston* and *Chicora*, two wrecks near each other, in the Cooper River, below Drum Island, off Marshall's wharf.

> The *Beatrice* and her companion, two wrecks near the inner mouth of Beach Channel of the north side of Drunken Dick Shoal" [U.S. Army Corps of Engineers 1873:652-3].

The USACE documented that all the wrecks had been removed as per the stipulations in the contract. Later they reported that contracts had been signed for the removal of the wreck of the monitor *Patapsco* near Fort Sumter. Future work considered the removal of an unnamed wreck near Fort Sumter, the *Weehaken*, the *Housatonic*, an unnamed wreck near the end of Bowman Jetty, and some dredging (U.S. Army Corps of Engineers 1873:652).

The following year it was reported that the wrecks of the *Patapsco*, the unnamed wreck near Fort Sumter, the *Weehawken*, and the *Housatonic* were removed to the required depth. In the same area as the *Housatonic*, "the torpedo-boat, sunk at the same time and place, could not be found" (U.S. Army Corps of Engineers 1874:728). Other improvements, such as dredging and jetty construction, are also stated for that year.

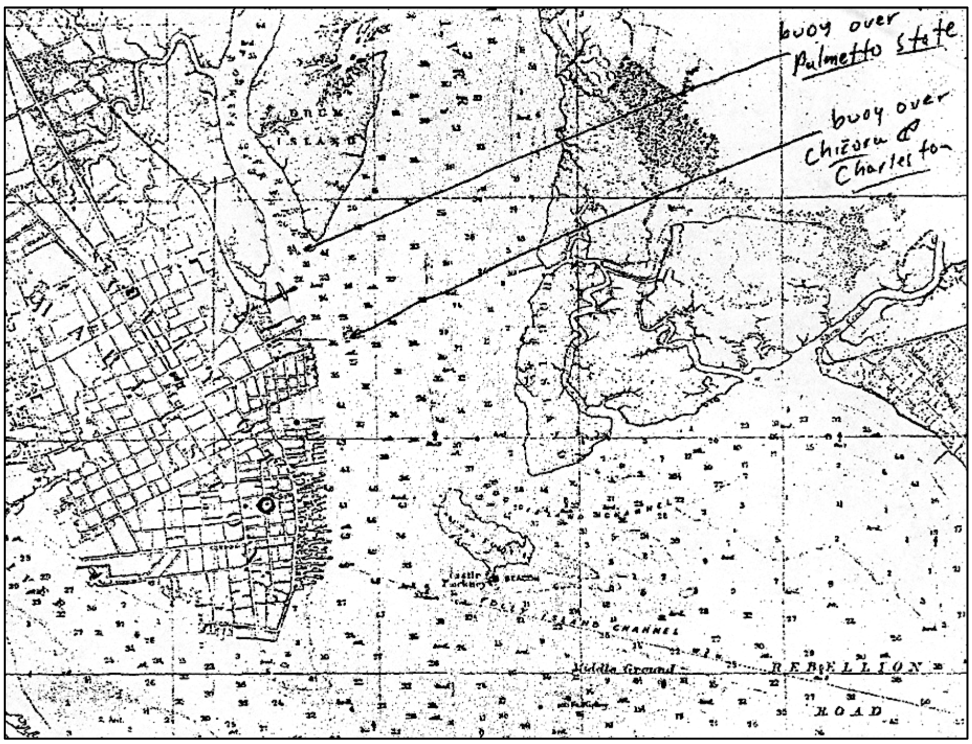


Figure 2-13. 1870s map showing the buoyed wreck location of the CSS *Palmetto State*, *Chicora*, and *Charleston* (courtesy of the Naval Historical Center).

During 1875, a recap of the previous work was reported for the improvement of Charleston Harbor. "The original project for this improvement comprised the removal of sundry wrecks sunk during the Civil War, the removal of 125 feet from the outer end of Bowman Jetty, projecting from Fort Moultrie into Beach Channel, and dredging in that channel to 15 feet at mean low water" (U.S. Army Corps of Engineers 1875:76). Wreck sites removed and reported on included the *Stono*, *Prince of Wales* and *Juno* near the jetty, and the monitor *Keokuk* was removed from the shipping channel. For the first time in the federal reports, there is the indication of local interest relative to the harbor, as it notes that the "municipal authorities" have taken steps to do some harbor improvements (U.S. Army Corps of Engineers 1875:5). It appears the engineers considered the wreck removal of Charleston Harbor complete.

By the 1876 edition report, there are no mentions of wreck removal. The five paragraphs expended on improvements of the ship-channel in Charleston Harbor exclusively focus on dredging and jetty work, or appropriations (U.S. Army Corps of Engineers 1876:82). The lack of comments on Civil War wreckage removal may indicate that there were no other unnatural obstructions or hazards to navigation in Charleston Harbor.

PREVIOUS INVESTIGATIONS

Previous research by scholars and American History enthusiasts has incredibly advanced our understandings of maritime and military history at Charleston Harbor. These resources include works by historians E. Lee Spence (1980, 1984) and Clive Cussler, the Naval Historical Center, and archaeologists Gordon Watts for USACE (1986, 1989, 1995a, 1995b, 1995c), James Spirek (2012), and Christopher Amer. The production of several Civil War vessels and the conflicts between Federal and Confederate forces within Charleston Harbor have been a central focus for research and interpretation (Gaines 2008:141-157; Spirek and Amer 2004; Spirek 2012). A review of this literature and the following cultural resource surveys provide historical context and aid in the possible anomalies in the Charleston Harbor Channel Entrance.

One of the best tools for accurately assessing the potential for unknown submerged cultural resources is to compare the Project Area with findings and results of previous investigations, including both remote sensing and cultural resources surveys, which have been completed in or near the current Project Area. Varying in the degree of applicability to Panamerican's research, these studies allow for the identification of potentially significant resources and aid in the recognition of specific problems or aspects that are inherent in the assessment of survey data and in identifying potential resources. In order to ascertain the presence of submerged archaeological sites and investigations in or adjacent to the Project Area, several resources were researched: the South Carolina Institute of Archaeology and Anthropology (SCIAA) archaeological site files; Panamerican's report archives; and the local watershed management survey studies were reviewed.

Generally, 24 submerged cultural resource surveys were found to have been conducted from 1976 to 2013, either near Charleston Harbor or in the immediate Project Area (Table 2-02). An examination of these previous investigations did not identify any potential significant archaeological shipwrecks or resources immediate to the current Project Area.

Conducted in 1976, Alan Albright, and other personnel from the SCIAA's Underwater Research Division, performed a remote-sensing survey off the Cooper River for an expanding Amoco facility. The survey did not reveal any archaeological sites and only modern debris within the river bottom was identified (Albright 1976). Later in 1979, Albright surveyed the east bank of the Wando River north of Hobcaw Creek and the current Project Area (Albright 1980). The initial remote sensing survey looked at the river channel for a proposed dock for the SC State Ports Authority. Modern remains were noted along with two significant anchors, which were recovered for display. No underwater specific archaeological sites were determined in the area; however, the entire survey area received the site number 38CH425.

Table 2-02. Previous Submerged Cultural Resources Investigations.

Author	Year	Title
Albright	1976	Underwater Archeological Survey of Proposed Cooper River Dredge Area adjacent to the Amoco Facilities
Watts	1979	Submerged Cultural Resource Survey and Assessment of the Mark Clark Expressway, Wando River Corridor, Charleston and Berkeley Counties, South Carolina
Albright	1980	Underwater Archaeological Survey of the Wando River

Author	Year	Title
Watts	1980	Submerged Cultural Resource Survey and Assessment of the Mark Clark Expressway, Wando River Corridor, Charleston and Berkeley Counties, South Carolina, Addendum Report
Watts	1986	A Cultural Resource Reconnaissance of Charleston Harbor at Charleston South Carolina
Watts	1987a	An Underwater Archaeological Survey of the Grace Memorial Bridge Replacement Study Area, Charleston, South Carolina
Watts	1987b	An Underwater Archaeological Survey of the Highway 700 Bridge Replacement Alignments on the Stono River and Penny's Creek near Charleston, South Carolina
Simmons	1988	Reconnaissance Survey Report: Underwater Archaeological Investigations of Selected Targets Sites in Charleston Harbor, SC
Beard	1989	1989 Reconnaissance Survey Report: Underwater Archaeological Investigations of Selected Target Sites in Charleston Harbor, South Carolina
Watts	1989	Historical and Cartographical Research and a Cultural Resource Identification and Assessment Survey for Homeporting of SSN Submarine's Charleston Naval Complex, Charleston, South Carolina
Watts	1992	A Submerged Cultural Resource Survey for Proposed Bridge Construction, North Rhett Avenue, Berkeley County, South Carolina
Harris et al.	1993	The Cooper River Survey: An Underwater Reconnaissance of the West Branch. South Carolina
Hall	1995	1995 Underwater Archaeological Testing of Two Submerged Wharf Structures at Historic Moreland Landing on the Cooper River, Berkeley County, South Carolina
Watts	1995a	Historical Documentation and Archaeological Remote Sensing Survey at Charleston Harbor, Charleston County, SC
Watts	1995b	A Submerged Cultural Resource Management Document and GIS Database for the Charleston Harbor Project Study Area, Charleston South Carolina
Watts	1995c	Underwater Archaeological Site Survey at Charleston Harbor, Charleston SC. Modification 2
Krivor and Tuttle	2000	Underwater Archaeological Survey at the Charleston Deepening Project, Charleston, South Carolina
Wilbanks and Pecorelli	2006	An Underwater Cultural Resources Survey of Selected Portions of the Proposed South Carolina State Ports Authority, Charleston Naval Center, Marine Container Terminal
Wilbanks	2008a	An Underwater Cultural Resources Survey of Proposed Marina on the Wando River, Daniels Island, S. C. Appendix A in Eric Poplin and Emily Jateff, Investigation and Evaluation of Unexamined Portions of 38BK815 Proposed Daniel Island Marina, Daniel Island, South Carolina
Wilbanks	2008b	Target Identification Survey in the Area of a Proposed Marina on the Wando River, Daniels Island, S. C. Appendix A in Eric Poplin and Emily Jateff, Investigation and Evaluation of Unexamined Portions of 38BK815 Proposed Daniel Island Marina, Daniel Island, South Carolina
Wilbanks	2009	Cultural Resources Survey of the Area Between Proposed Wando Marina and USCOE Spoil Area, Charleston, South Carolina
Poplin and Jateff	2009	Investigation and Evaluation of Unexamined Portions of 38BK815 Proposed Daniel Island Marina, Daniel Island, South Carolina
Gayes et al.	2013	Hardbottom and Cultural Resource Surveys of the Post 45 Charleston Harbor Project Study Area, Charleston, South Carolina
James and Gifford	2013	Diver Identification and Assessment of Anomalies in the Lower Harbor of the Charleston Harbor Post 45 Study Area, Charleston, South Carolina

Gordon Watts for Tidewater Atlantic Research (TAR) of Washington, North Carolina, would conduct the majority of the remote-sensing and underwater investigations for Charleston Harbor and in the connecting Cooper and Wando Rivers. In 1979, TAR surveyed a portion of the Wando River for SCDOT's proposed Mark Clark corridor (Watts 1979). The survey identified three potential sites (38BK426, 38BK427, and 38BK428) containing the remains of a hull structure with artifacts. Further inspection of the sites prompted SCIAA archaeologist Lynn Harris to say that 38BK426 and 38BK427 were the same vessel, still containing a lead-sheathed wooden hull. Both shipwrecks (38BK426/427 and 38BK428) were considered to be turn-of-the-nineteenth-century vessels. Watts suggested the three sites were significant enough for NRHP status (Watts 1980).

In 1985, the USACE, Charleston District contracted with TAR for "anticipation of deepening and widening sections of the navigation channel, enlarging an anchorage basin, modifying and enlarging turning basins and modifying and widening selected channel segments in the Charleston Harbor" (Watts 1986:i). TAR completed a literature and archival investigation as well as a reconnaissance level remote-sensing survey to locate and assess any potentially significant submerged cultural resources within the project area.

The remote sensing survey located eighty-four magnetic and sidescan sonar anomalies (Watts 1986). Of these targets, thirty-four were subsequently examined using the magnetometer and sidescan sonar for purposes of identification and location; the remaining 50 targets were identified as modern debris (pipes, cables, sunken buoys). Nineteen of the 34 targets had signatures that were deemed necessary for on-site examination. Of the 19 targets, 13 were rated as high priority for Phase II investigation while the remaining six were rated as moderate priority for limited on-site reconnaissance (Watts 1986:i). TAR concluded that while many of these anomalies are likely modern debris "they cannot be reliably eliminated from additional consideration on the basis of remote-sensing data alone" (Watts 1986:107). In order to assess historic and archaeological significance, TAR recommended physical examination of each site "where proposed channel improvements will significantly extend the traditionally maintained channel" (Watts 1986:107).

SCIAA archaeologists using remote sensing equipment and diver inspection would investigate targets detected by TAR's 1986 survey. In a 1988 investigation, three anomalies were identified as modern debris with the exception of a nineteenth-century iron shank, determined not culturally significant (Simmons 1988). The anomalies were nearby the Custom House Reach, the Lower Reach of Town Creek, and Hog Island. David Beard (1989) would later return to examine eight more sites from the 1986 survey. Diver inspections of the seven targets yielded no significant finds. The eighth target could not be located at the time. Later the eighth target would be struck by dredging activities in 2000 at the crossing of Hog Island Reach and Town Creek Lower Reach. Panamerican (Krivor and Tuttle 2000) would perform an investigation on this target (which follows below).

TAR returned to working with Garrow & Associates, Inc. for an underwater archaeological survey of selected portions of the Grace Memorial Bridge replacement between Charleston and Mt. Pleasant (Watts 1987a). The full study provided an architectural, archaeological, and historical survey of the surrounding area of the Grace Memorial Bridge (Reed et al. 1989). Remote sensing detected 17 anomalies, with all being determined as modern debris. No archaeological sites were determined by TAR's underwater survey. During the same year, TAR surveyed for another area regarding bridge replacement on Highway 700 over the Stono River (Watts 1987b). Again, no significant sites or resources were noted.

In 1989, TAR conducted a remote sensing survey nearby Shipyard Creek (Watts 1989). A total of 24 anomalies were detected with magnetometer and sidescan sonar equipment. Review of the magnetic and acoustic data identified all but nine as debris. Diver investigation of the final targets further concluded all were modern. A survey by TAR on Goose Creek, northeast of the Project Area in Berkeley County, regarding another bridge replacement also did not detect any significant finds (Watts 1992).

Well north of the Project Area, SCIAA archaeologists conducted an underwater archaeological survey of the Cooper River in 1993 (Harris et al. 1993). Historical maritime cultural resources and prehistoric resources were noted along the northern reaches of the Cooper River. A variety of artifacts and watercrafts were reported and revisiting a few archaeological sites was discussed, including four canoes (38BK52), a barge (38BK62), and the Mepkin Abbey shipwreck (38BK48).

In 1994, Mid-Atlantic Technology performed underwater archaeological testing for identification of submerged resources along the Cooper River in the area known as Moreland Landing (Hall 1995). North of the current Project Area, archaeologists identified three historic wharves and the remains of a buried eighteenth-century wreck. Excavations revealed the presence of two different wharves types at Moreland Landing.

In 1994, TAR would return to conduct significant historical research in the area of Charleston Harbor for proposed dredging of deepening channels (Watts 1995a, 1995b). Using a sidescan sonar and magnetometer, 32 anomalies were detected within the project's survey area. Review of the recorded data identified 26 as modern materials. No new sites were located; however, the USS *Patapsco* (38CH270) was revisited by TAR that year. The last eight targets were to be investigated by divers, but only two were inspected and found not culturally significant (Watts 1995c).

In 2000, the USACE, Wilmington/Charleston District was informed that a wreck site might have been damaged during channel maintenance operations within Charleston Harbor. A large bucket dredge inadvertently recovered a large, encrusted cannon as well as a propeller/shaft and associated hull section. After being recorded by archaeologists from SCIAA, the artifacts were re-deposited in a disposal site in Charleston Harbor to prevent further degradation. As a result, archaeologists from Panamerican conducted an intensive remote-sensing refinement survey and diver investigations of five targets within Charleston Harbor and the Cooper River of South Carolina as part of the Charleston Harbor Deepening Project (Krivor and Tuttle 2000). A remote sensing refinement survey and diver investigation of the first target confirmed that no potentially significant submerged cultural resources remained at this location. The material placed at the disposal site did not meet eligibility requirements under the National Register of Historic Places (NRHP); however, they should be considered historically significant and protected as such. The four other sites examined either did not contain any cultural materials or consisted of modern debris and are not eligible for listing on the NRHP. No further archaeological research was recommended for the four target areas.

A survey near the former Charleston Navy Base in Cooper River was performed by Diversified Wilbanks, Inc. for Brockington and Associates, Inc. and the South Carolina State Ports Authority in 2006 (Wilbanks and Pecorelli 2006). Four anomalies were detected in two survey project areas. One target was found to be outside the Area of Potential Effect (APE) and the other three were modern debris.

Wilbanks returned to work with Brockington and Associates, Inc. again for a proposed marina at Daniel Island in the Wando River (Wilbanks 2008a, 2008b, 2009; Poplin and Jateff 2009). The underwater portion of the survey examined the bottom of the river, the intertidal shore, and the former "Daniell's pier". Archaeologists did not identify archaeological sites (terrestrial or underwater) within the APE. One anomaly was detected inside the APE by remote sensing and requires further diver investigation to determine eligibility.

Most relevant to the current study is the early 2013 geophysical and cultural resource survey that Coastal Carolina University's (CCU) Center for Marine and Wetland Studies conducted, which examined portions of the Charleston Harbor, the entrance channel, and the Ocean Dredge Material Disposal Site (ODMDS) (shown in Figure 2-14) (Gayes et al. 2013). Employing a magnetometer, sidescan sonar, subbottom profiler, and single beam bathymetry equipment, researchers were able to delineate anomalies with no additional investigation warranted with the exception of three anomalies (LH1-001, LH1-009, and LH5-013) found inshore and outside of the current Project Area.

Just south of the entrance channel, archaeologists examined a portion of the proposed Ocean Dredged Material Disposal Site (ODMDS) expansion and investigated three areas for hardbottom habitat: HB1, HB2, and HB3 (Gayes et al. 2013); however, CCU did not focus on these hardbottom habitat areas for cultural resource assessment. The survey area HB1 falls into Panamerican's current survey area and was not surveyed for cultural resources by CCU, as it was a part of the "ODMDS monitoring zone" (Gayes et al. 2013:10). Survey area OD2 identified 31 anomalies as debris or crab pots (Gayes et al. 2013:261-265).

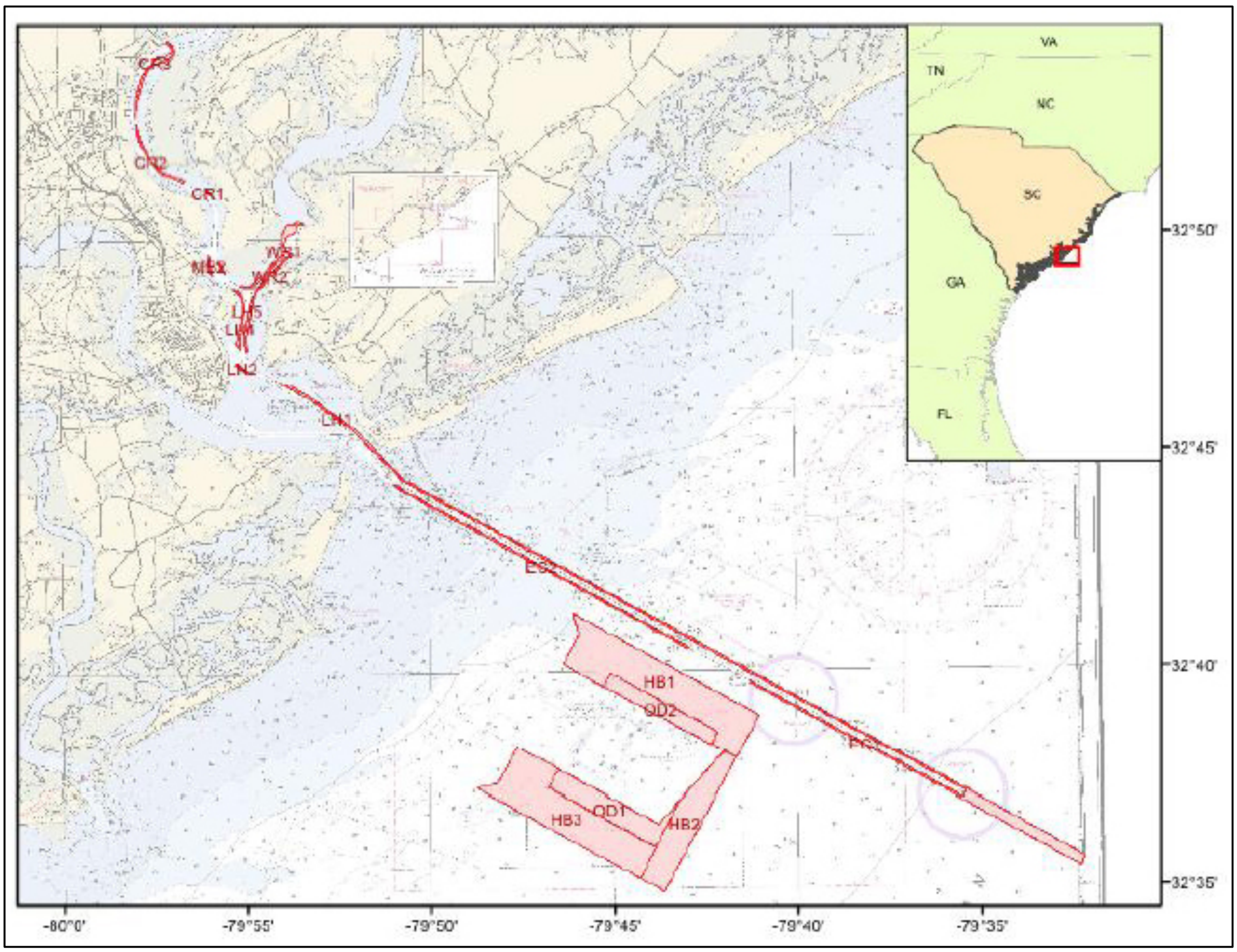


Figure 2-14. Coastal Carolina University's 2013 survey of Charleston Harbor and the Ocean Dredge Material Disposal Site (ODMDS). Hardbottom habitat 1 (HB1) contains a portion of the current survey area but was only examined for its geophysical features (Gayes et al. 2013:12).

Panamerican Consultants, Inc. conducted in September 2013, a diver investigation designed to locate, identify, and assess NRHP significance, the results of the Coastal Carolina University's investigation (James and Gifford 2013). The diver assessment indicated that two of the targets, LH1-009 and LH5-013, represented by surface debris fields with large magnetic signatures, were comprised of modern debris and do not represent significant cultural resources sites. The third anomaly, LH1-001, was represented by an extremely large buried anomaly with no acoustic signature. Extensive subsurface probing failed to locate the anomaly source indicating it is too small to contact with a probe (i.e., wire rope) or is too deeply buried to locate (i.e., more than 8 feet below sediment). A review of the subbottom record indicates a lack of detectable buried structure. Because the parameters for the proposed channel deepening and modification project were not known (i.e., depth of dredging), it was unclear if the target will be adversely impacted by project activities. It was recommended that the USACE, Charleston District determine the exact parameters of the project activities and subsequently determine if any portion of Target LH1-001 will be adversely impacted. If dredging will be conducted at this target, it is recommended that an archaeologist monitor dredging at this target.

While not a part of the Project Area, previous archaeological investigations have been performed in Charleston Harbor examining the numerous maritime events, blockade vessels, and blockade-runners, which navigated the area during the Civil War. Initially, the *H. L. Hunley*'s location was identified during the 1995 expedition by the National Underwater and Maritime Agency (NUMA). The following year the National Park Service (NPS), SCIAA, and NHHC investigated both the submarine and the *Housatonic*, which was found buried meter approximately 1.2–3.6 meters [4–12 feet]) below the seabed and in 30 feet of water (Conlin 2005). In 2000, the *Hunley* was recovered and currently remains in conservation. The *Housatonic* wreck site was examined in the summer of 1999 for additional information regarding the attack on the ship and collected a number of artifacts for conservation (Conlin 2005).

SCIAA received a grant in 2008 to study the maritime events and naval operations of the Civil War in Charleston Harbor by the National Park Service's American Battlefield Protection Program (Spirek 2012). The project successfully identified the locations of the First and Second Stone Fleets and gathered additional information on a number of wreck sites in the naval battlefield. Figure 2-15 illustrates the naval operations to occur off Charleston and the nearest to the Project Area. The Union Blockade's Stone Fleets and the blockade-runners reflect, "the Union desire to thwart access in and out of the harbor and the Confederate attempts to evade and to break the blockade, especially evidenced at the *Hunley* and *Housatonic* naval engagement site" (Spirek 2012:151). While maritime losses did not occur in the vicinity of the Project Area, the area undoubtedly observed Union and Confederate vessel activity.

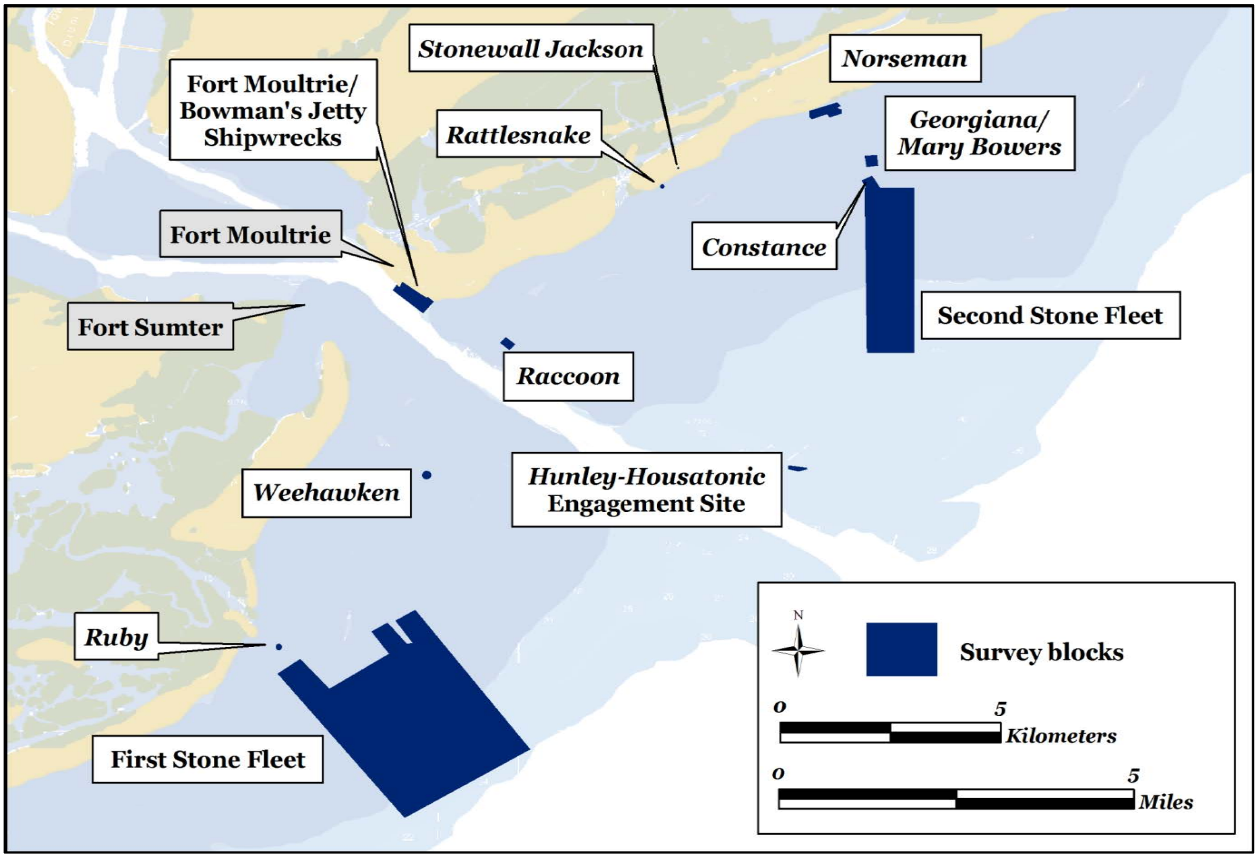


Figure 2-15. Blockade survey areas by SCIAA off Charleston Harbor showing the locations of the outer and inner blockades and related Civil War shipwrecks (Spirek 2012:152). The current Project Area is found further southeast along the main channel.

SHIPWRECKS, AUTOMATED WRECK AND OBSTRUCTION INFORMATION SYSTEM, AND HISTORIC SITES INVENTORY

The most up-to-date documented listing of known vessels lost in the Charleston Harbor area comes from Coastal Carolina University's recent remote sensing survey (Gayes et al. 2013). The list includes intensive historical and archaeological research of the Charleston Harbor through discussion with authoritative individuals (Spirek and Amer 2004; Watts 1986; Gaines 2008; Spirek 2012). This listing has been included in this report as *Appendix A: Documentation of Vessel Losses as Presented in Gayes et al. 2013*.

Discussions with SCIAA's Jim Spirek were performed to review state archaeological site files and it was determined that no archaeological shipwreck sites were located within or immediately nearby the current Project Area. Additionally no remote sensing surveys have been conducted in the area by SCIAA archaeologists. Analysis of archaeological state site files at SCIAA relative to the current archaeological investigation identified no nautical archaeological sites adjacent to this project area.

The most comprehensive and up-to-date list of shipwrecks for the U.S. is the National Oceanic and Atmospheric Administration (NOAA) Automated Wrecks and Obstructions Information System (AWOIS). This list can be accessed from the internet at http://anchor.ncd.noaa.gov/awois/search.cfm. An interactive page appears and queries the user for information to aid in the search of shipwrecks such as name, navigation chart, or coordinates. An examination of the offshore survey areas via AWOIS did not identify any wrecks or obstructions within the Project Area. One shipwreck and one obstruction were noted just outside of the Project Area and are described in Table 2-03 and shown in Figure 2-16.

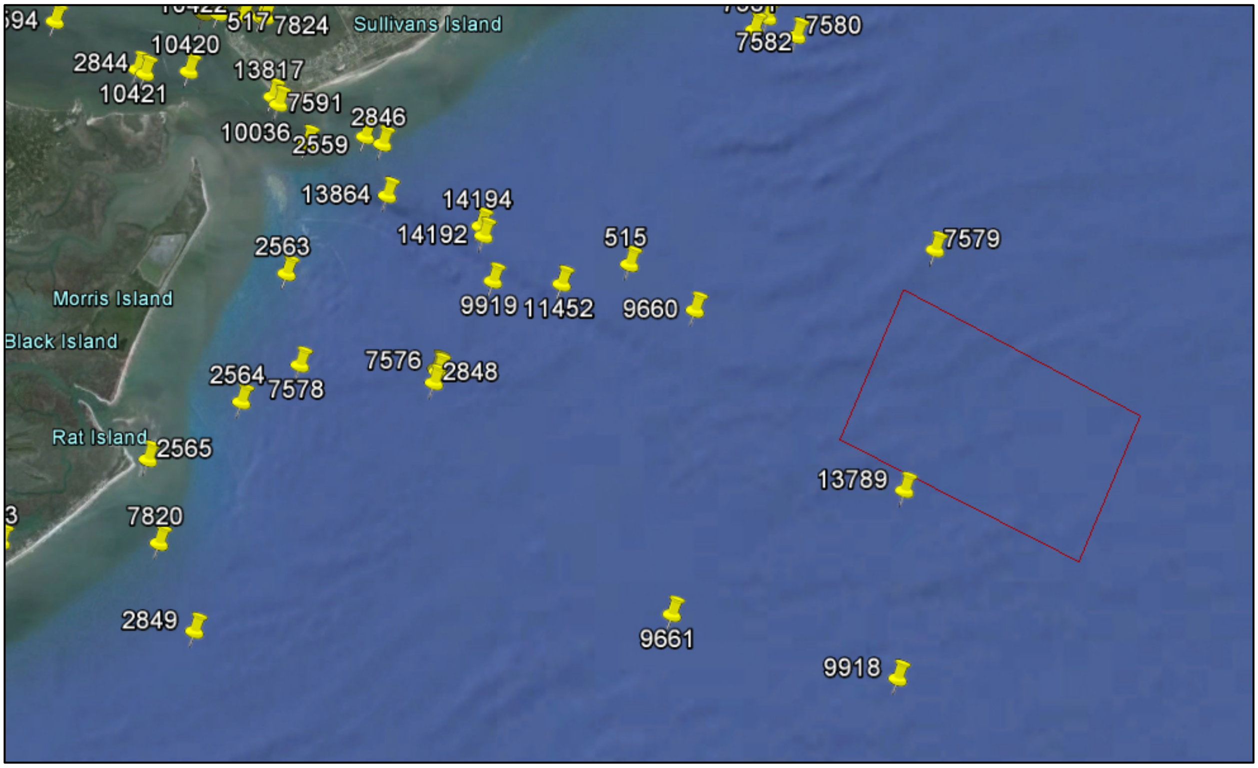


Figure 2-16. AWOIS shipwreck and obstruction data plotted nearby the Charleston Harbor entrance channel Project Area, which is, highlighted red (location is approximate).

Table 2-03. Vessels and obstructions near the Project Area according to NOAA's AWOIS.*†

Record	Latitude (Dec Degrees)	Longitude (Dec Degrees)	Description	Comment
7579	32.721803	-79.707753	Unknown, shipwreck	Sunken wreck of 65-ft steel pilot boat, which burned and sank in the Anchorage Area north of Charleston Harbor Entrance Channel, in about 31 feet of water. The position is approximate. The wreck was described as lying upside-down.
9660	32.710456	-79.761469	Obstruction, Artificial Reef	Artificial reef containing numerous obstructions and two sunken deck barges.
9661	32.653333	-79.766667	Obstruction	Dump site with three obstructions.
9918	32.641286	-79.716394	Obstruction	Unidentified obstruction.
13789	32.676533	-79.714753	Obstruction	Unidentified obstruction.

CARTOGRAPHIC REVIEW

Another excellent tool for identifying shipwrecks within or adjacent to the Project Area is a review of historic navigation maps and charts for the area. Often noting shipwrecks, obstructions, and other various hazards for the mariner, many of these maps can be accessed from NOAA's Office of Coast Survey's Historical Map and Chart Collection at www.historicalcharts.noaa.gov/historicals/search, while others are found in various repositories, publications, or websites. The NOAA website allows the researcher to specify the area or region of interest and then review all available maps for that area. Another valuable utility provided by this site is the virtual magnification feature, which allows the researcher to zoom in and out of specific areas.

The location of Project Area's north and south mitigation areas are identified by the large reddish rectangle, which appears on all the following charts. Charts focused specifically on the Charleston Harbor before the 1950s only illustrated half of the survey area. Charts showing the approaches to Charleston Harbor illustrated a little more of the Project Area, but unfortunately cut off a corner of the area. This is noted in the first two charts from 1886 and 1911 (Figure 2-17 and 2-18). These charts are overlaid on top of the recent 2014 nautical chart.

Illustrated in Figure 2-17,is one of the earliest navigation charts available relative to the current Project Area dating to 1886. Close examination of the map includes hydrographic data for the approaches to Charleston Harbor and identifies the channels and buoys. The old main channel is shown on this chart and part of the modern channel is identified as a swash channel in the 1880s. One shipwreck is found off the old channel and circled in red. The Rattlesnake Shoal Light-vessel with its bell is noted just off the Project Area. No shipwrecks are found in or immediately nearby the current project areas.

The next navigation chart from the NOAA website dates to 1911 (Figure 2-18). The chart closely resembles the previous 1886 chart; however, the swash channel is now the main entrance into Charleston Harbor. The Rattlesnake Shoal Light-vessel is now renamed as the Charleston Light-vessel and moved slightly south, guiding vessels just outside the Project Area. No cultural features (i.e., shipwrecks) are represented at or near the Project Area on the map.

Illustrated in Figure 2-19, the next available map from NOAA dates to 1934. The entrance channel to Charleston is listed as 29 feet deep and is slowly extending towards the east offshore. No cultural features (i.e., shipwrecks) are represented at or near the Project Area on the map.

Illustrated in Figure 2-20, the next available navigation chart from the NOAA website dates to 1957. No shipwrecks are represented at or near the Project Area on the map; however, two obstructions are listed south and outside of the Project Area. The Project Area and the surrounding waters are noted as dangerous due to unexploded depth charges.

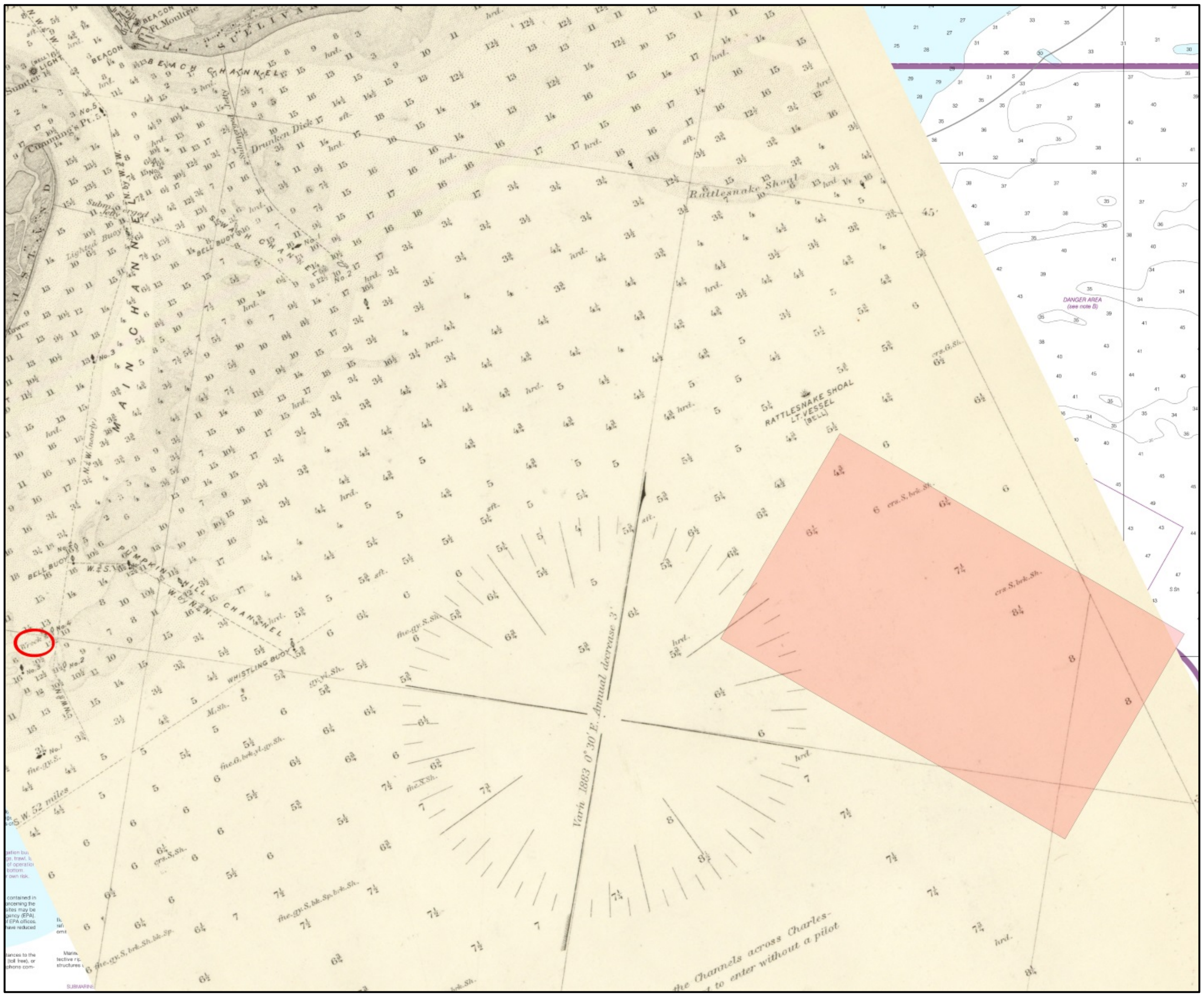


Figure 2-17. 1886 chart excerpt showing the old channel entrance into Charleston Harbor on the left with a wreck (circled red). The modern channel is identified as a swash channel during this period (Chart LC00154 from NOAA's Office of Coast Survey's Historical Map and Chart Collection).

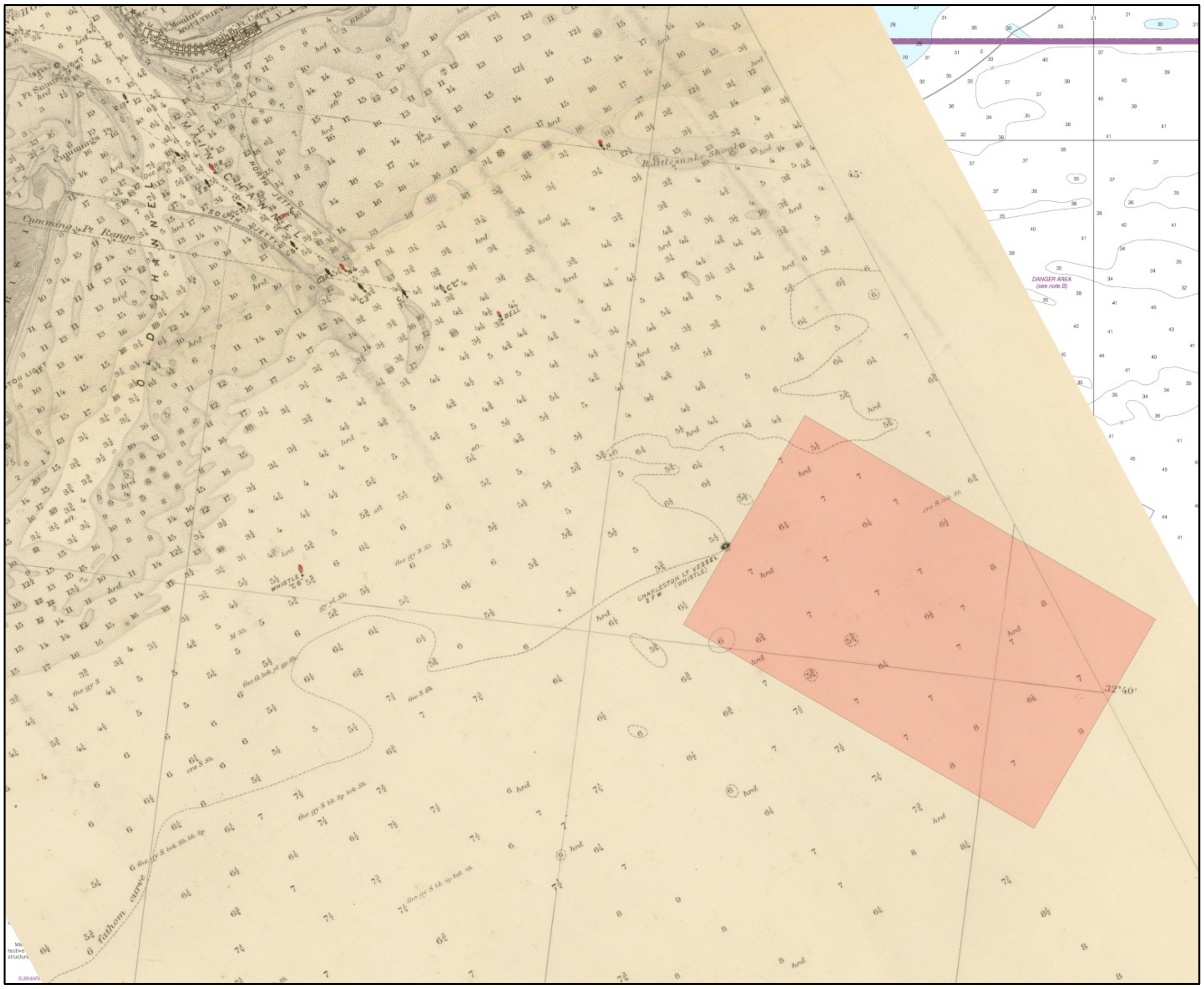


Figure 2-18. 1911 chart excerpt showing the new main channel into Charleston Harbor (Chart LC00154 from NOAA's Office of Coast Survey's Historical Map and Chart Collection).

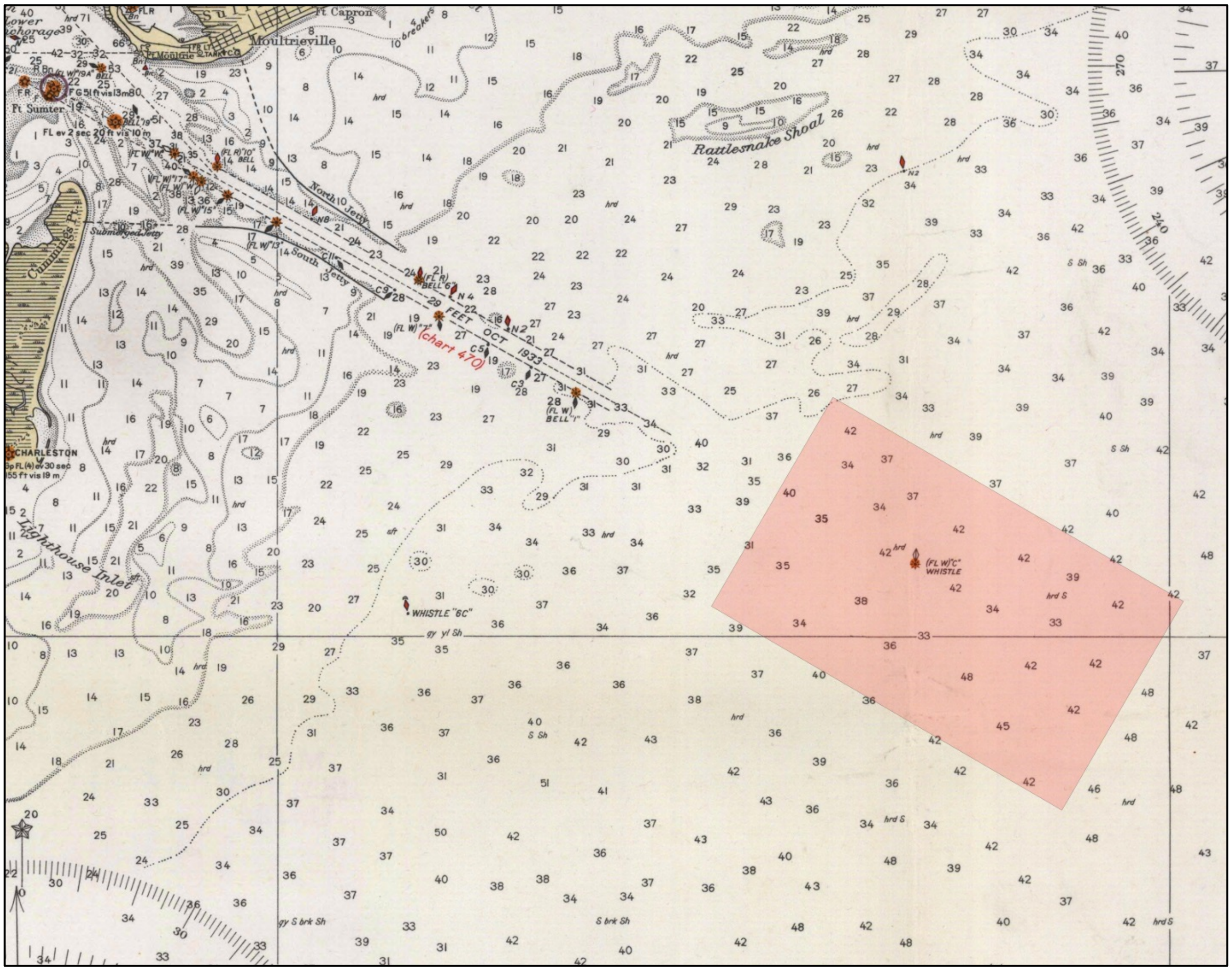


Figure 2-19. 1934 chart excerpt showing the entrance channel into Charleston Harbor extending further east offshore (Chart 1239 from NOAA's Office of Coast Survey's Historical Map and Chart Collection).

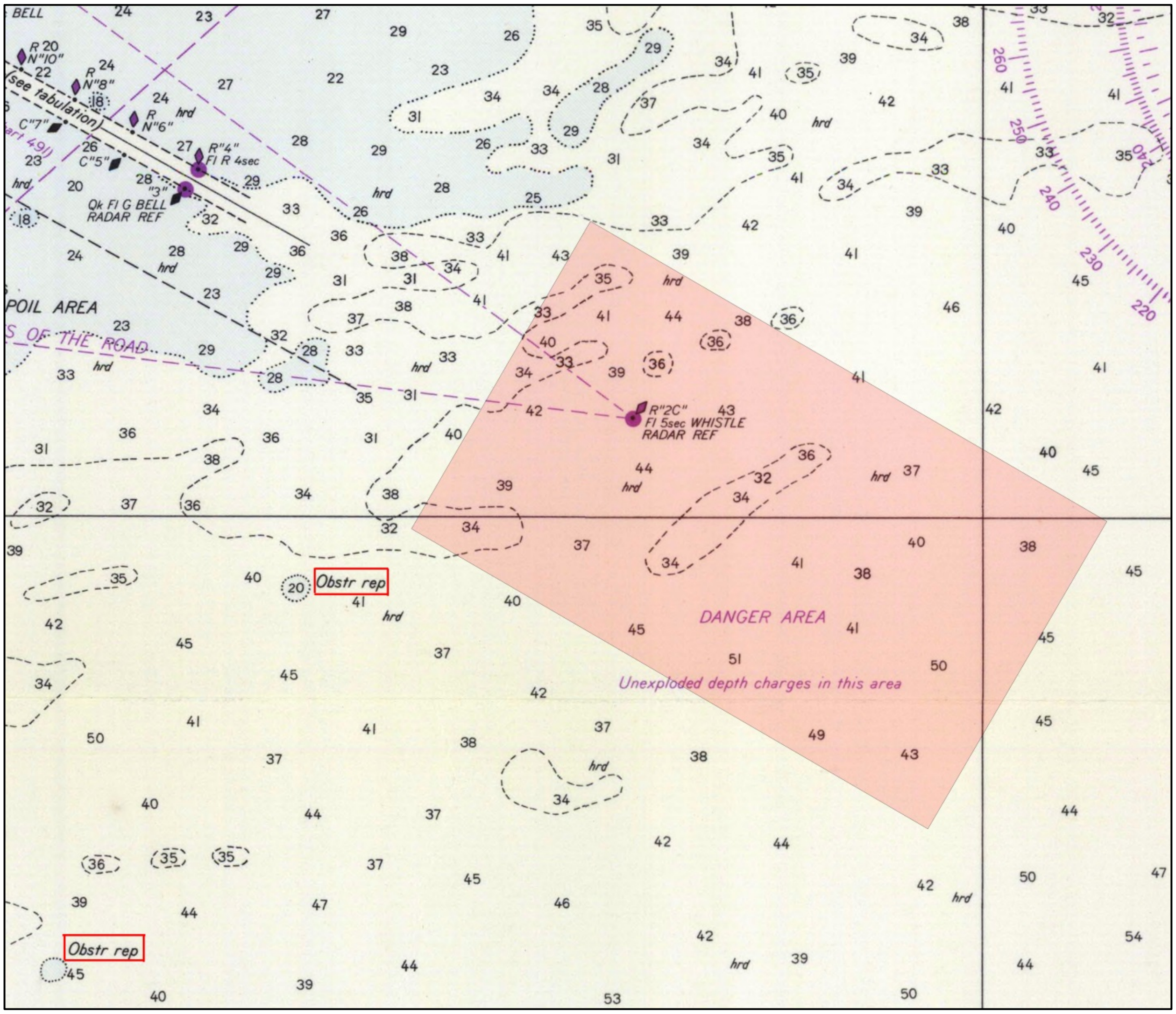


Figure 2-20. 1957 chart excerpt showing the extending entrance channel of Charleston Harbor with two obstructions listed outside the Project Area (Chart 1239 from NOAA's Office of Coast Survey's Historical Map and Chart Collection).

The 1976 chart (Figure 2-21) shows the channels well marked with navigation aids entering into the Project Area. One obstruction is noted south of the survey area inside the marked disposal area. The Project Area and surrounding waters are still noted as dangerous. No cultural features (i.e., shipwrecks) are represented at or near the Project Area on the map.

The 1996 chart illustrated in Figure 2-22 has exceptional detail for the Project Area. Part of the Project Area is now an Anchorage Area and the chart warns vessels to "anchor at own risk". One shipwreck found north of the Project Area in the Anchorage, is potentially the remains of the steel pilot boat that was noted as sunk in the area by AWOIS. One obstruction is located outside and south of the channel.

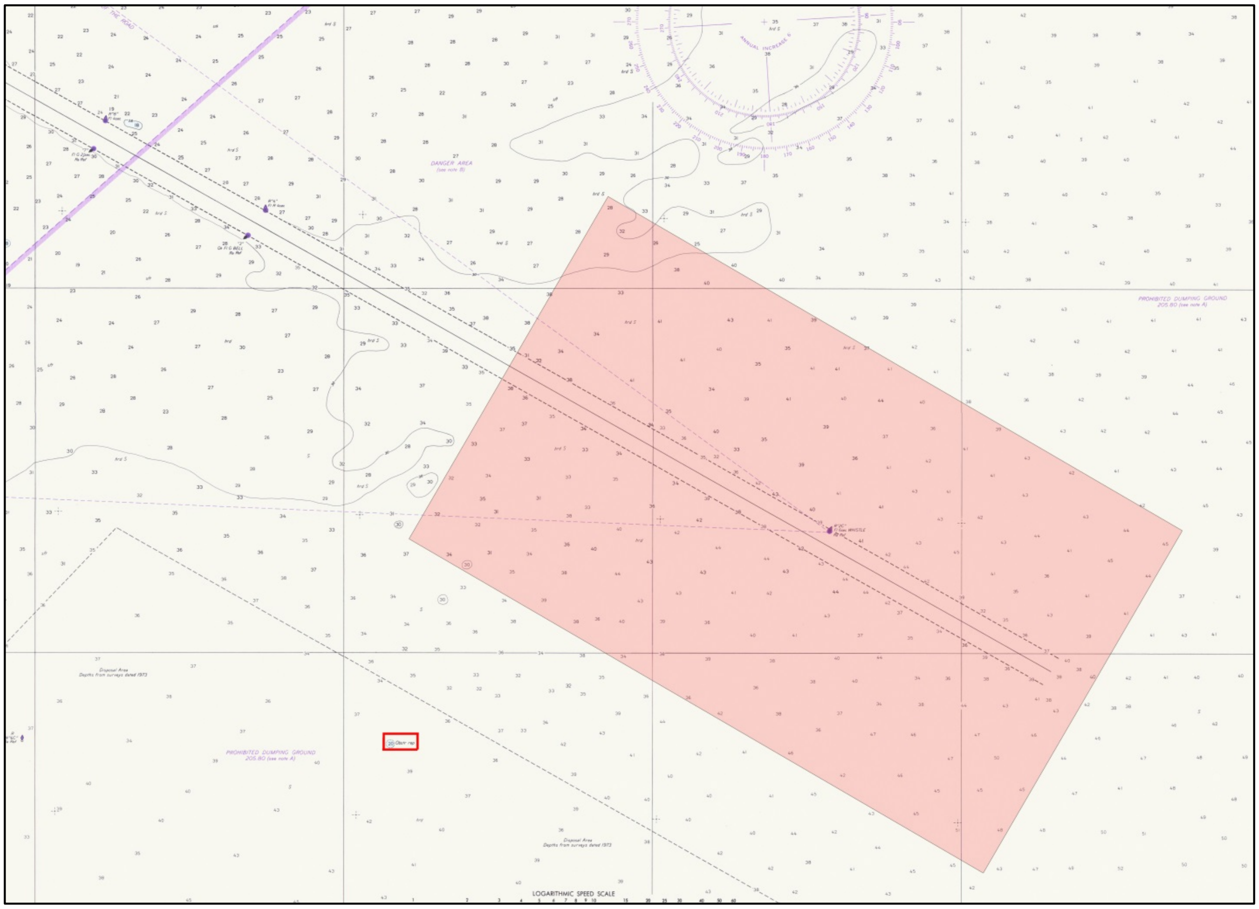


Figure 2-21. 1976 chart excerpt showing the entrance channel extending into the Project Area. One obstruction is found outside the Project Area in the disposal area (Chart 11523 from NOAA's Office of Coast Survey's Historical Map and Chart Collection).

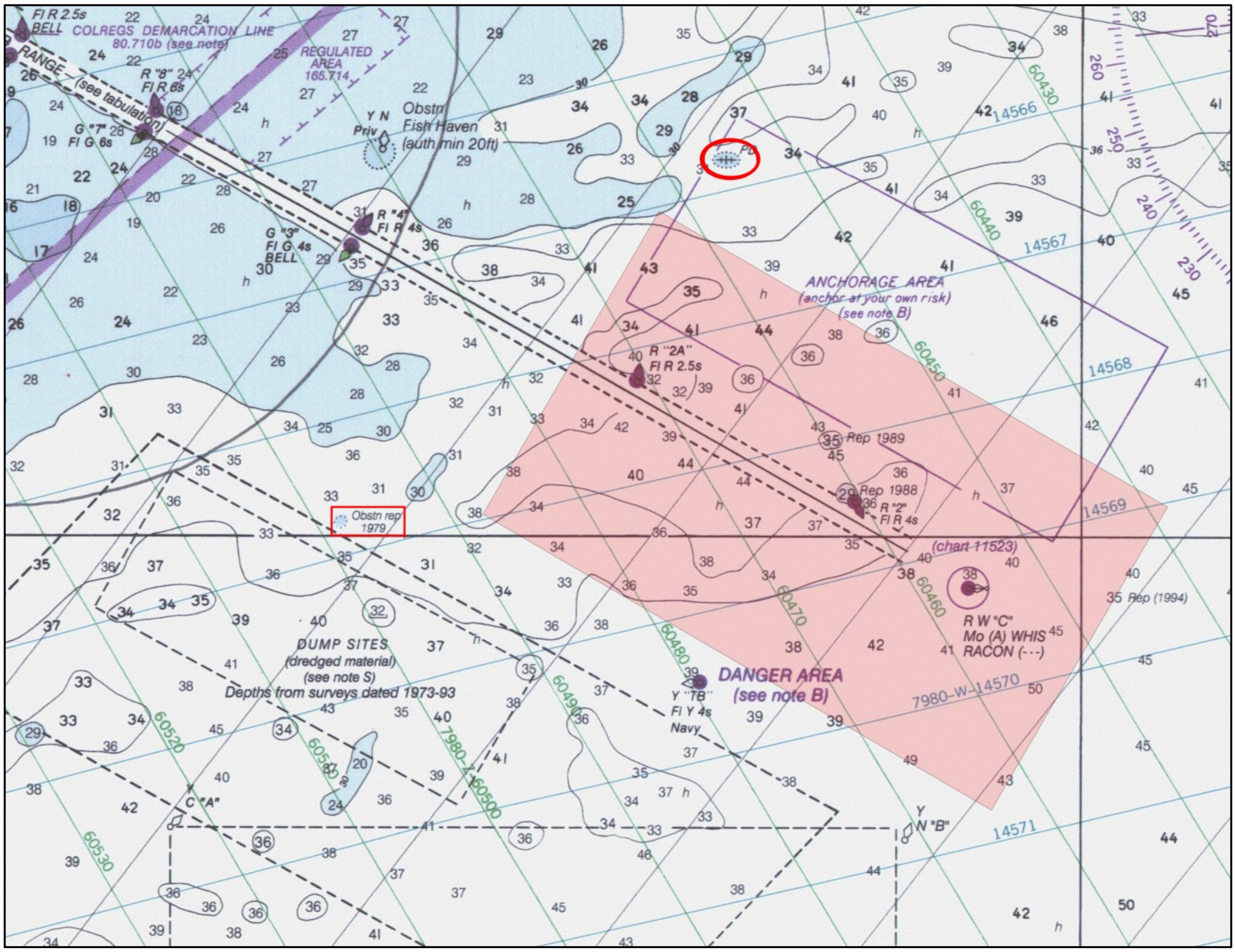


Figure 2-22. 1996 chart excerpt of the entrance channel to Charleston Harbor showing the anchorage area and one wreck north of the Project Area (Chart 11521 from NOAA's Office of Coast Survey's Historical Map and Chart Collection).

The 2014 chart shown in Figure 2-23 is a very detailed and contemporary map of the Charleston Harbor Entrance Channel with the Project Area. It shows a channel well marked by navigation aids and provides information on the Dangerous Areas located outside the channel. The dangerous areas are noted as the "Area is open to unrestricted surface navigation but all vessels are cautioned neither to anchor, dredge, trawl, lay cables, bottom, nor conduct any similar type of operation because of residual danger from mines on the bottom. Anchorage in the designated area is at your own risk". A large purple circle identifies the Pilot Area in the channel.

Two shipwrecks are found outside of the Project Area and the artificial reef is noted with wrecks and obstructions just north of the channel (left large oval). All three wreck locations are shown with red arrows. Red squares outline the locations of obstructions and identify one obstruction within the Project Area towards the center left in the anchorage area.

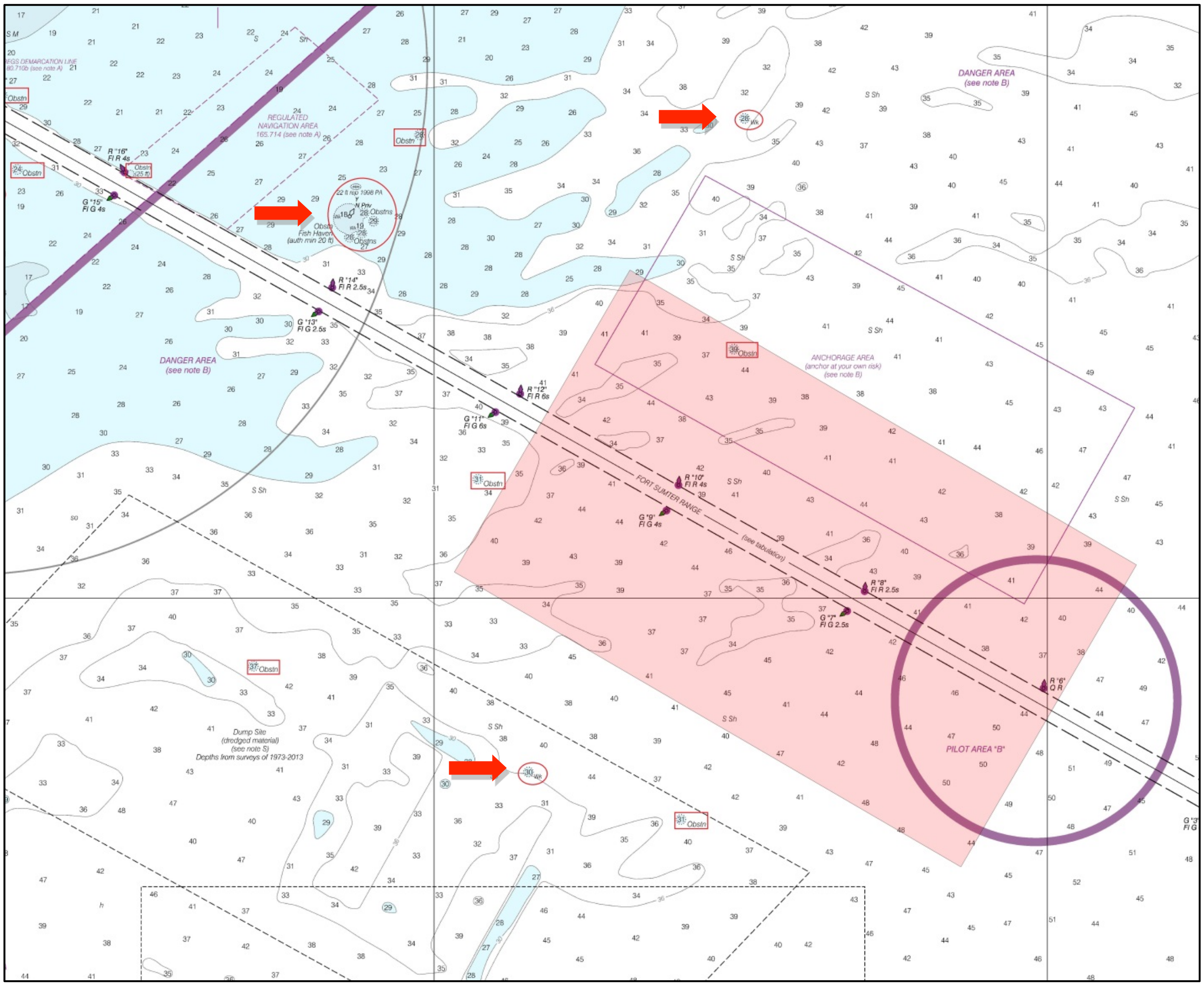


Figure 2-23. 2014 chart excerpt of the Charleston Harbor with three shipwrecks locations (marked with red arrows) found outside the Project Area (Chart 11528 from NOAA's Office of Coast Survey's Historical Map and Chart Collection). The left oval identifies the artificial reef, which contains sunken barges and obstructions. One obstruction is noted in the Project Area (marked by a red square).

PROJECT AREA ENVIRONMENT

Located adjacent to the channel between 9 and 12 miles offshore from the entrance to Charleston Harbor, the Project Area sees fairly constant vessel traffic. The presence at times of large commercial vessels, predicated aborting several lines during the survey. Figure 3-01 conveys the environment of the Project Area, illustrates the working conditions of the survey area—during one of the calm days. Conducted during winter and early spring, the sea state often fluctuated from good to bad, with numerous weather days being encountered. Because of allowable weather windows, the survey was conducted in three periods: 19 to 28 February; then again from 25 to 30 April; and finally 23 to 26 May.

Figure 3-01. View is the southern Project Area. Boom at left holds the Subbottom profiler. The smooth sea-state shown here is the exception rather than the rough norm encountered during the survey. Note Freighter approaching in distance.

PERSONNEL

All personnel involved with the remote sensing survey had more than requisite experience to effectively and safely complete the project as contracted. Stephen R. James, Jr., M.A., Register of Professional Archaeologists (RPA) served as the Project Manager and Principal Investigator; Will Wilson, M.A., RPA served as Remote Sensing Specialist; Robert "Duke" Hunsaker who served as the boat captain for survey operations and is also well versed in all remote sensing technologies and equipment. Wilson also processed and analyzed the remote sensing data, along with James, Jr. Erica Gifford, M.A., RPA conducted archival research in Columbia, South Carolina.

REMOTE SENSING SURVEY EQUIPMENT

The remote sensing tools chosen for this investigation were the magnetometer (to detect ferrous materials), sidescan sonar (to create images of the bottom), and the subbottom profiler (to reconstruct the structure of the underlying sediment beds). Locational control was conducted with DGPS technology. Analysis of the data was conducted with Hypack and SonarWiz.MAP (described in detail below).

DIFFERENTIAL GLOBAL POSITIONING SYSTEM

The primary consideration in the search for any submerged item is positioning. Accurate positioning is essential during the running of survey tracklines, and it is essential in returning to recorded locations for remote sensing refinement or diver investigations. Positioning was accomplished on the project using two Trimble DSM12/212 Global Positioning System (GPS) and antennae; one was used for the subbottom, and one split to the navigation/magnetometer computer and to the sidescan (Figure 3-02).

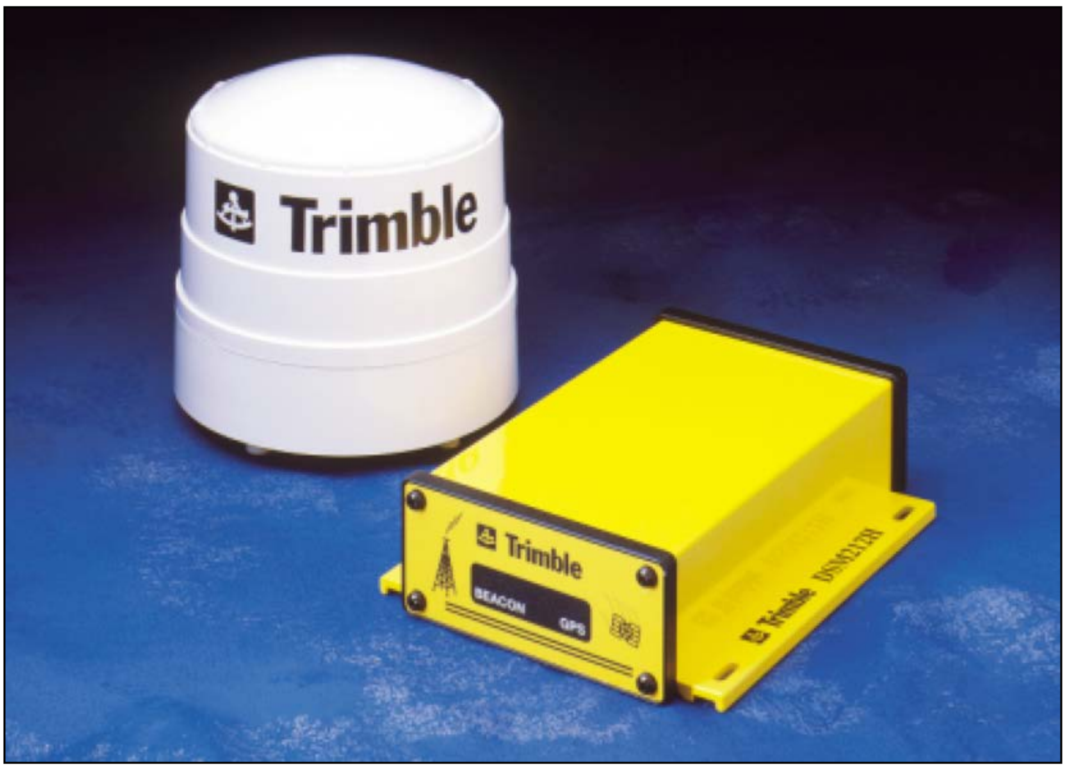


Figure 3-02. Trimble Navigation DSM 12/212 global-based positioning system used during the investigation.

The DSM12/212 GPS attains sub-meter precision with a dual-channel Minimum-Shift Keying (MSK) differential beacon receiver. This electronic device combines data from satellites and shore-based differential beacon stations, which increase the precision of the satellite data alone. DGPS positions were updated at 1-second intervals, the same rate as the magnetic data were recorded (Trimble Navigation Limited 1998:1-2).

The project was planned in NAD83 South Carolina State Plane East, U.S. survey feet, and all sidescan, subbottom, and magnetometer target data have been converted to this datum and projection. The Differential Global Positioning System (DGPS) data streams are in geographic format, WGS84 (i.e., latitude, longitude), and converted in real time by the navigation software.

Navigation was conducted with a Capaccino Twister PC computer, using the 2011 version of the Hypack Max for navigation, which was written and developed by Coastal Oceanographics, Inc. specifically for marine survey applications. The magnetometer data were acquired with this program as well.

All positioning coordinates are based on the position of either of the two DGPS antennae. Layback for each of the remote sensing devices was noted and used in the target location determination (Figure 3-03). This layback information is critical for accurate positioning of targets in the data analysis phase and to relocate any targets for additional investigations.

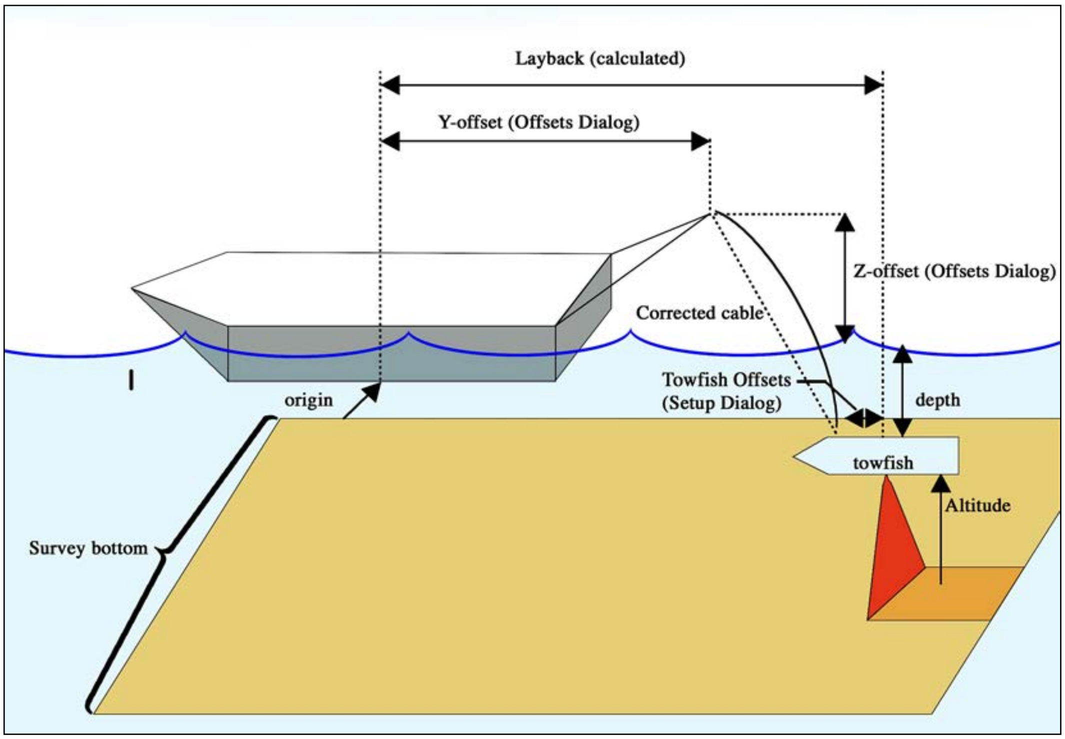


Figure 3-03. Equipment schematic illustrating layback (courtesy of Coastal Oceanographics, Inc.).

MAGNETOMETER

Magnetometers measure the intensity of magnetic forces with a sensor that measures and records the ambient (background) magnetic strength and deviations from the ambient background (anomalies) caused by ferrous and some other sources (Breiner 1973). These measurements are recorded in nanoteslas, the standard unit of magnetic intensity.

The success of the magnetometer to detect anomalies in local magnetic fields has resulted in the instrument being a principal remote sensing tool of maritime archaeologists because of anomalies that can be components of shipwrecks and other historic debris or objects hazardous to dredging or navigation. While it is not possible to identify specific ferrous objects from the magnetic field contours, it is occasionally possible to approximate shape, mass, and alignment characteristics of wrecks or other structures based on complex magnetic field patterns. In addition, other data (historic accounts, use patterns of the area, diver inspection), which overlap data from other remote sensing technologies, such as the sidescan sonar and prior knowledge of similar targets, can lead to an accurate identification of potential targets. Finally, it must be noted that other sources of magnetic field variation can overwhelm any smaller objects. These include: electrical magnetic fields that surround power transmission lines, underground pipelines, navigation buoys, or bridges and dock structures, which can be quite extensive when the feature is massive.

There are three types of commercially available marine magnetometers available: proton precession; cesium; and Overhauser. Panamerican has determined that the Marine Magnetics SeaSPY Overhauser magnetometer is the most stable and precise magnetometer available, and therefore, it is the magnetometer used for this survey (Figure 3-04). The system was powered by a 110-volt gasoline-powered generator. Data were stored in the navigation computer and archived. The SeaSPY is capable of sub-second recordation for precise locational control, but data were collected at 1-second intervals, providing a record of both the ambient field and the character and amplitude of the encountered anomalies.

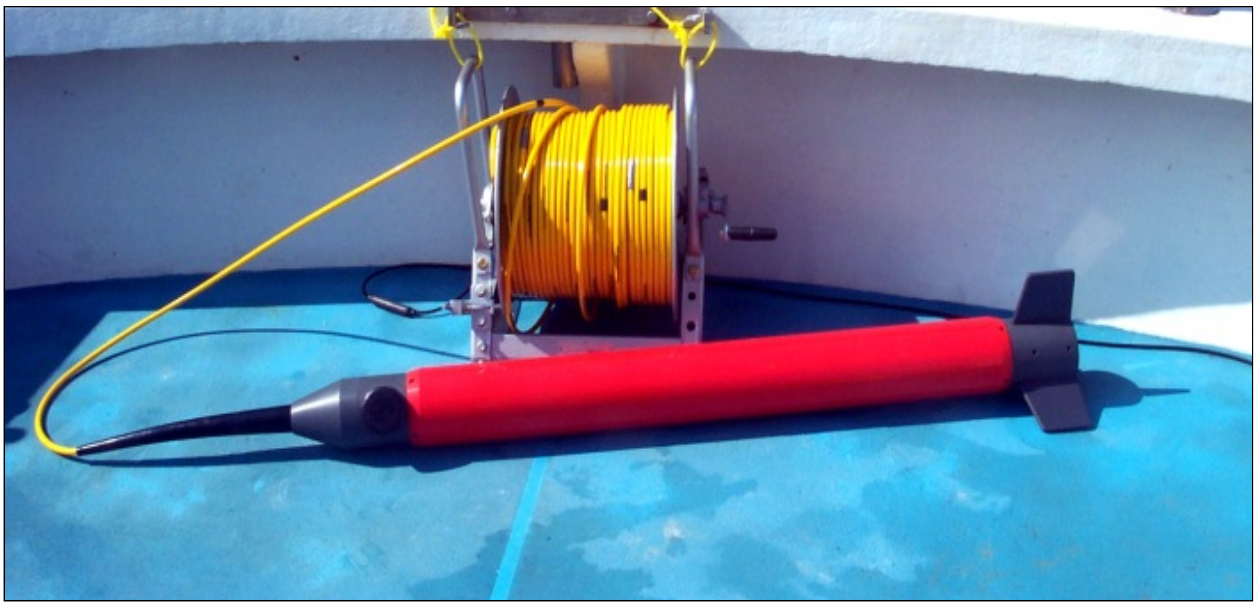


Figure 3-04. Marine Magnetics SeaSPY overhauser magnetometer, one of two types employed during the survey.

SIDESCAN SONAR

Sidescan sonars produce images by "pinging" the water column with acoustic energy (sound), and then they determine distance and reflective strength of objects from the echoed returns. Under ideal circumstances (low energy wave and current conditions), they are capable of providing near-photographic images of submerged bottomland, on either side of a trackline of a survey vessel. A portion of the record from directly below the vessel is absent due to the physics of the system and depth of the water under the towfish.

The remote sensing instrument used to search for physical features on or above the ocean floor was a Marine Sonic Technology (MST) HDS sidescan sonar system (Figure 3-05). The sidescan sonar is an instrument that, through the transmission of dual fan-shaped pulses of sound and reception of reflected sound pulses, produces an acoustic image of the bottom. Under ideal circumstances, the sidescan sonar is capable of providing a near-photographic representation of the bottom on either side of the trackline of a survey vessel.

The Sea Scan PC has internal capability for removal of the water column from the instrument's video printout, as well as correction for slant range distortion. This sidescan sonar was utilized with the navigation system to provide manual positioning of fix or target points on the digital printout. Sidescan sonar data are useful in searching for the physical features indicative of submerged cultural resources. Specifically, the record is examined for features showing characteristics such as height above bottom, linearity, and structural form. Additionally, potential acoustic targets are checked for any locational match with the data derived from the magnetometer and the subbottom profiler.

The MST HDS sidescan sonar was linked to a towfish that employed a 800/900 kilohertz power setting and a variable side range of 20 meters-per-channel (131 feet) on each of the survey lines. The 20-meters-per-channel setting was chosen to provide detail and 100% overlapping coverage with the 50-foot line spacing to insure full coverage of the survey area. The power setting was selected in order to provide maximum possible detail on the record generated; 900 kilohertz was the preferred frequency.

Figure 3-05. Marine Sonic Technology HDS sidescan sonar with 800/900 kilohertz towfish employed during the survey.

SUBBOTTOM PROFILER

Employed to determine the character of near-surface geologic features over the survey area, subbottom profilers generate low frequency (0.5 to 30 kilohertz) sound pulses capable of penetrating the seabed and reflecting off sediment boundaries or larger objects below the surface. The data are then processed and reproduced as cross sections based on two-way travel time (the time taken for the pulse to travel from the source to the reflector and back to the receiver). This travel time is then interpolated to depth in the sediment column by calculating at 1,500 meters-per-second (the average speed of sound in water).

Subbottom profilers have different ranges of sound wave frequency (sparkers, boomers, pingers, and chirp systems). Sparkers and boomers operate at low frequency (5 hertz to 2 kilohertz) and afford deep geologic penetration and low resolution, useful for deep geologic time. Pingers

(3.5 and 7 kilohertz) are more useful to penetrate late Pleistocene- and Holocene-aged deposits or paleolandscape features of interest to prehistoric archaeologists. CHIRP systems sweep multiple frequency ranges and are the most precise and accurate of the subbottom profiler systems, and they operate at ranges of between 3 to 40 kilohertz. The resolution can be on the order of 10 centimeters (6 inches) depending on sediment type and the quality of the acoustic return.

Panamerican employed an EdgeTech 3100 CHIRP subbottom profiler system with a topside power unit, laptop processor and SB-424 towfish. The device was operated at a setting of 4 to 16 kilohertz, the lowest setting of the device, for maximum penetration (Figure 3-06).

Figure 3-06. The EdgeTech SB-424 towfish employed during the survey.

Seismic cross sections reconstruct the shapes and extents of reflectors such as facies in channel sediments, rock/sediment interfaces, marine sand bed cover, and so forth. In addition to subbottom profiling, and depending on the density of data points, the first bottom return data can be used for high-resolution bathymetry. Shipwrecks can be studied with subbottom profilers once their location is known. Finding shipwrecks with subbottom profiler survey is less useful.

High and low amplitude reflectors (light and dark returns) distinguish differences of sediment characteristics such as particle size and consolidation (Stevenson et al. 2002). Facies contacts can be identified by discontinuities in the extent, slope angle, or shape of the reflector returns. This latter fact is important when identifying the sinusoidal shapes of drowned channel systems and other relict and buried fluvial system features (e.g., estuarine, tidal, lowland, upland areas around drainage features). Parabolic-shaped reflectors indicate individual objects of sufficient size and consolidation. The parabolic shape is the result of sound propagating outwardly from the item. There are also five types of signals that may cause misinterpretation in the two dimensional records: direct arrivals from the sound source; water surface reflection; side echoes; reflection multiples; and point source reflections. Judicious analysis is required to identify them.

Peats tend to reflect strongly, as do other fine-grained or muddy sediments. Sand and shell deposits are less reflective, and difficult to penetrate without lower seismic frequencies such as those employed by the profiler system used here.

SURVEY VESSEL

The vessel employed during the remote sensing survey was DC&A's 25-foot Parker 2520-XL *Haley Ann* (Figure 3-07) a modified "V"-hulled motor vessel powered by twin 125-horsepower Yamaha outboards. The vessel has a covered cabin and an ample, covered-deck area for the placement and operation of the necessary remote sensing equipment. The vessel conformed to all U.S. Coast Guard specifications, according to class, and had a full compliment of safety equipment. It carried all appropriate emergency supplies, including lifejackets, a spare parts kit, a tool kit, first-aid supplies, a flare gun, and air horns.

Figure 3-07. Dial Cordy and Associates, Inc.'s 25-foot *Haley Ann* employed for the survey investigations.

SURVEY PROCEDURES

Spaced at 100-foot intervals, transects lines covered 123.6 survey line miles for the Mitigation North survey area, and 149.49 survey line miles for the Mitigation South survey area (Figures 3-08 and 3-09). The magnetometer, sidescan, subbottom profiler, and DGPS were mobilized, tested, found operational, and thus, the trackline running began. The helmsman viewed a video monitor, linked to the DGPS and navigational computer, to aid in directing the course of the vessel down the survey tracklines. The monitor displayed the pre-plotted trackline, the real time position of the survey vessel, and the path of the survey vessel. The speed of the survey vessel was maintained at approximately 3 to 4 knots for the uniform acquisition of data. As the survey vessel maneuvered down each trackline, the navigation system monitored the position of the survey vessel relative to the tracklines every second, each of which was recorded by the computer. Event marks delineated the start and end of each trackline. The positioning points along the traveled line were recorded on the computer hard drive and the magnetic data were also stored digitally.

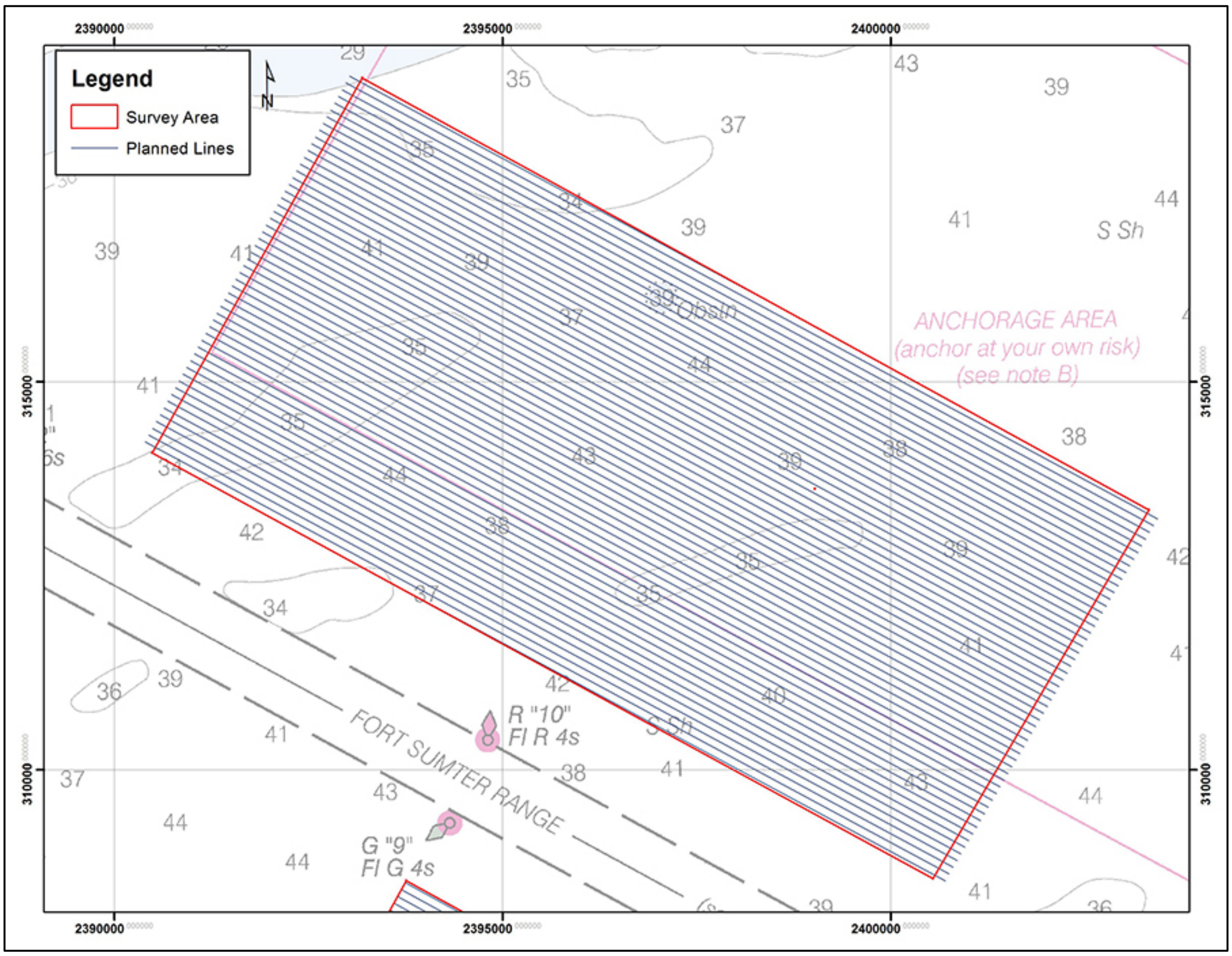


Figure 3-08. Planned survey lines for the Mitigation North survey area.

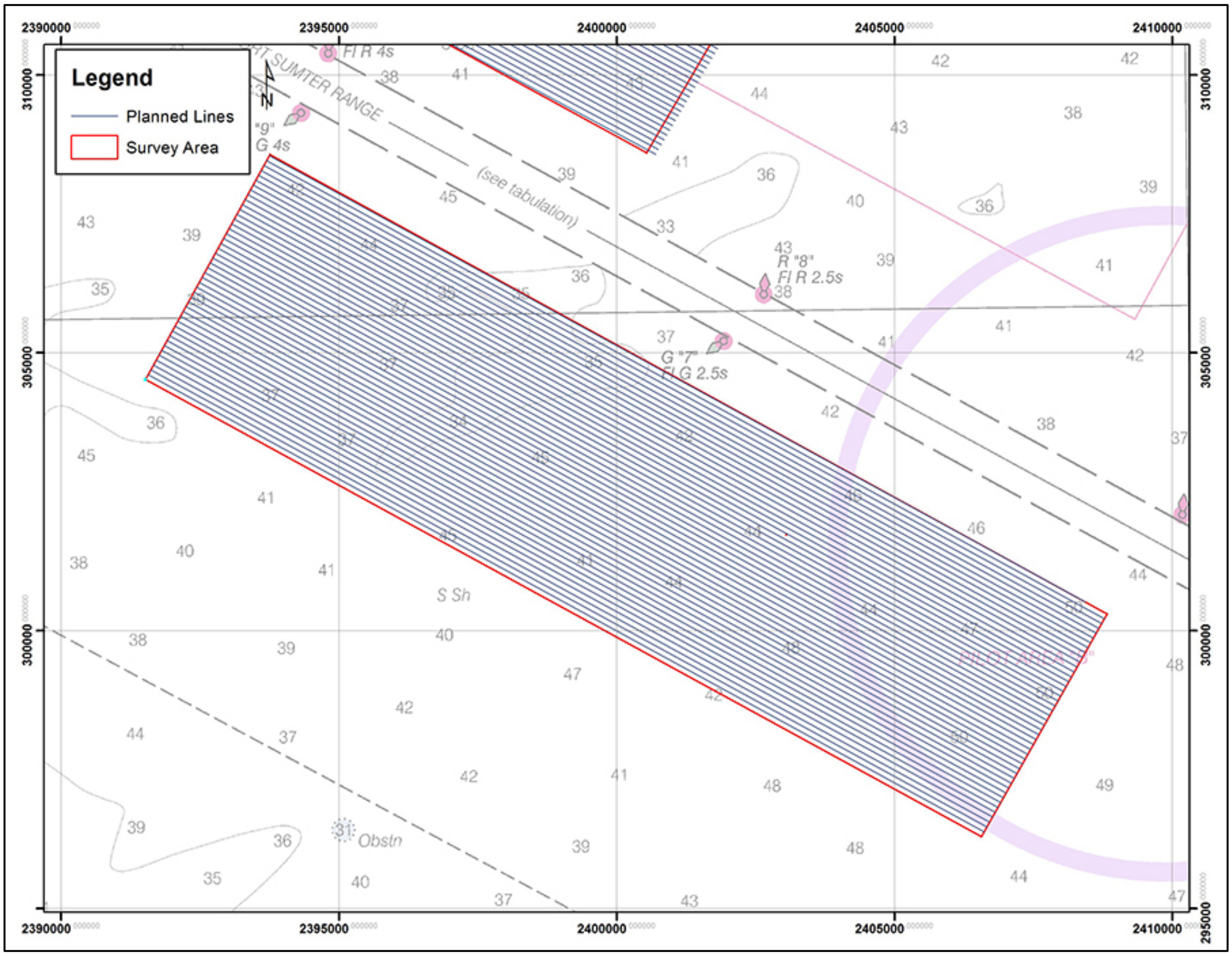


Figure 3-09. Planned survey lines for the Mitigation South survey area.

DATA ANALYSIS

DATA PROCESSING

Once collected, survey data are processed and analyzed using an array of software packages designed to display, edit, manipulate, map, and compare proximities of raster, vector, and tabular data. These packages include SonarWiz.MAP for mosaicing sidescan sonar and subbottom profiler data, mapping target extents and generating target reports, figure details, and Geographic Information System (GIS) layers; Hypack Single Beam Editor, Hypack TIN Modeler, and Hypack Export for tabulating anomaly characteristics and contouring magnetic data, and generating GIS data layers. ESRI ArcMap and ArcView are used to display the data on background charts, to conduct a "proximity analysis" for each of the three types of targets (e.g., see which magnetometer, sidescan, and subbottom profiler anomalies are near each other and may explain each other) and to create maps and figures for this report.

MAGNETIC DATA COLLECTION AND PROCESSING

Data from the magnetometer are collected using Hypack Max. The data are stored as *.RAW files by line, time, and day. Raw data files are opened, and layback parameters are set. Contour maps are produced of the magnetic data with the TIN Modeler. The DXF file is saved and exported into the combined GIS database. The contour maps allow a graphic illustration of anomaly locations, spatial extent, and association with other anomalies. Magnetic data are reviewed by the Hypack Single Beam Editor (Figure 3-10), and the location, strength, duration, and type of anomaly are transcribed to a spreadsheet along with comments.

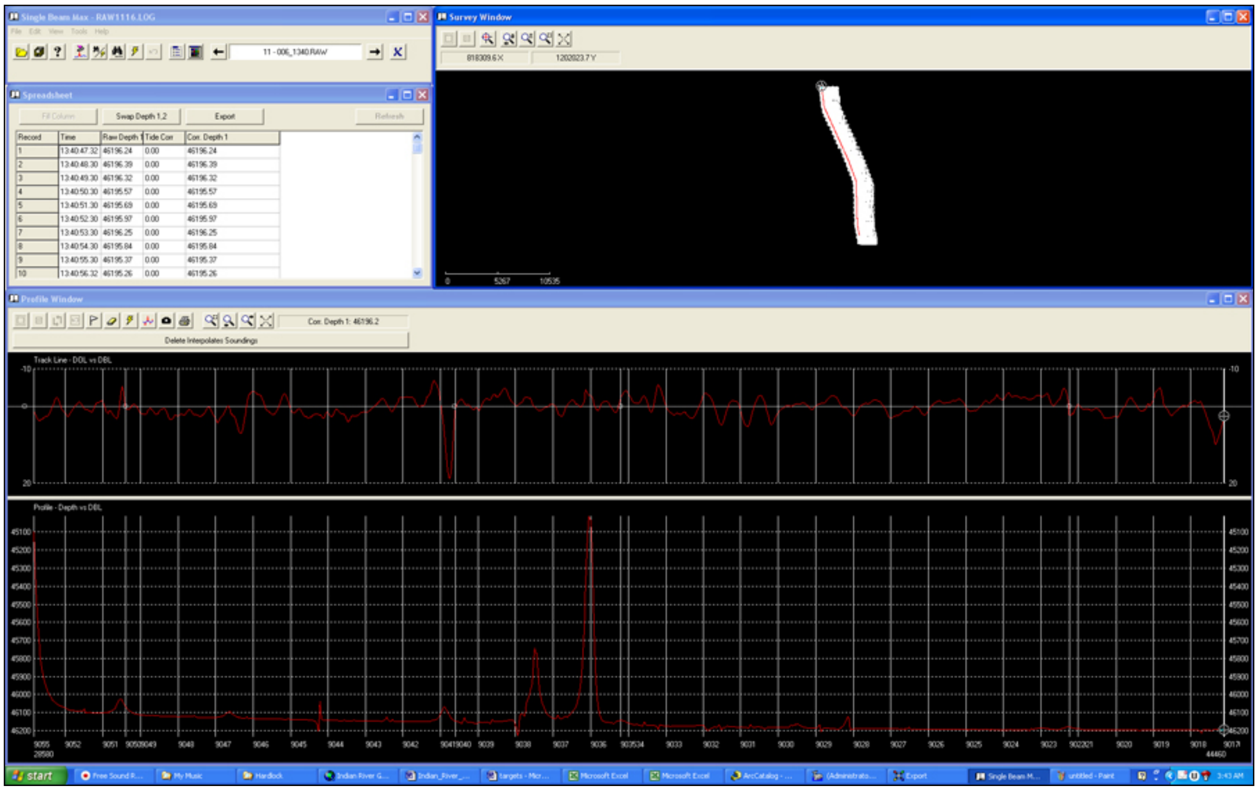


Figure 3-10. Hypack Single Beam Editor magnetic data display of a section of a survey line. Using these windows one can analyze anomaly position, strength, duration, and type. The peaks of these variations are the locations of target coordinates; their width is the duration.

SIDESCAN SONAR DATA COLLECTION AND PROCESSING

Post-processing of sidescan sonar is accomplished using SonarWiz.MAP, a product that enables the user to view the sidescan data in digitizer waterfall format, pick targets and enter target parameters including length, width, height, material, and other characterizations into a database of contacts. In addition, SonarWiz.MAP "mosaics" the sidescan data by associating each pixel (equivalent to about 10 centimeters) of the sidescan image with its geographic location determined from the DGPS position (layback rectified) and distance from the DGPS position (Figure 3-11). SonarWiz.MAP is the industry standard for mosaicing capability, and the results are exported as geo-referenced Tiffs for importing to the GIS database of the project. SonarWiz.MAP can generate target reports in PDF, Word, or Excel format. Panamerican utilizes the Word format for reports (Figure 3-12).

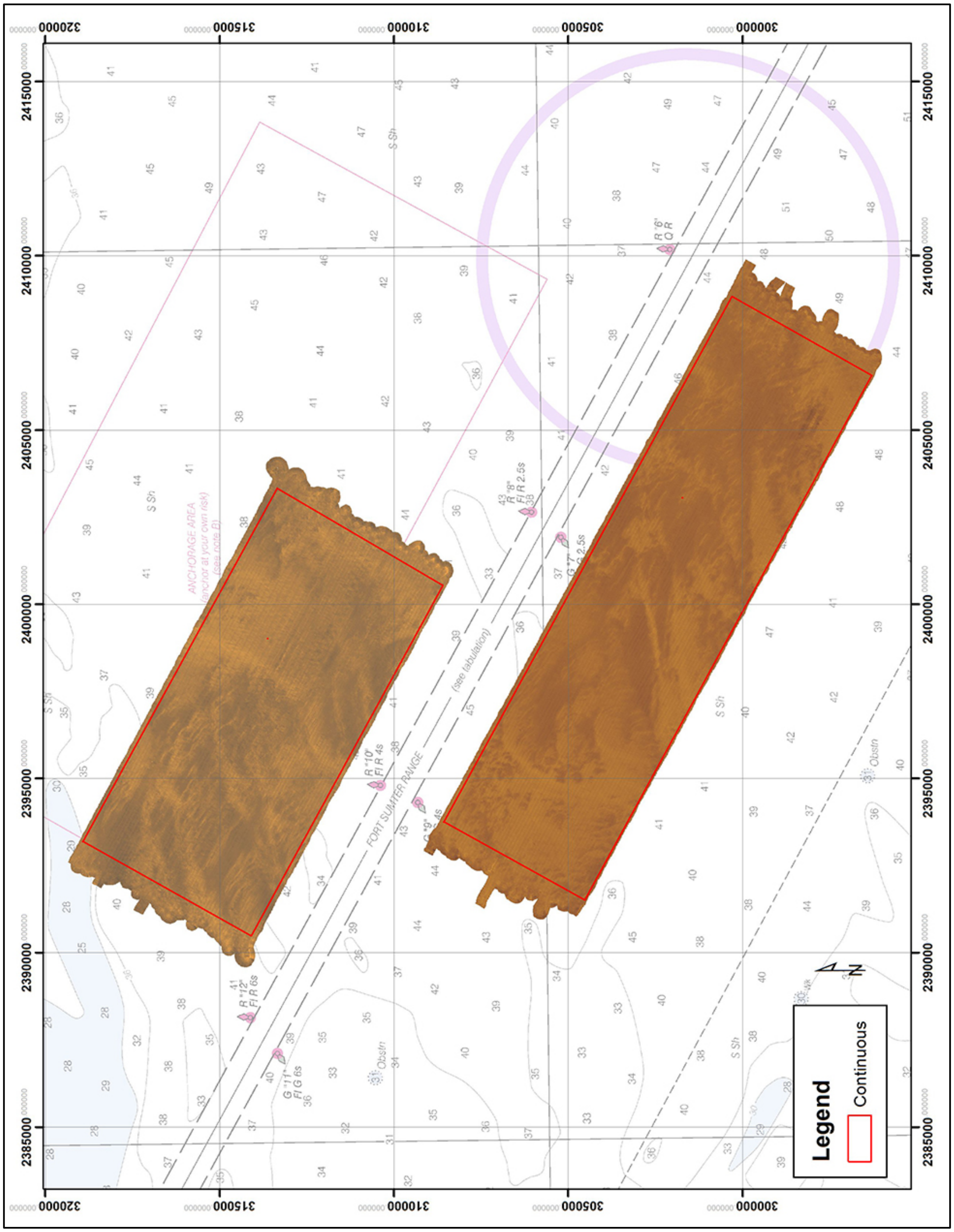


Figure 3-11. Sonar mosaic generated in SonarWiz.MAP showing 100% coverage of the mitigation areas.

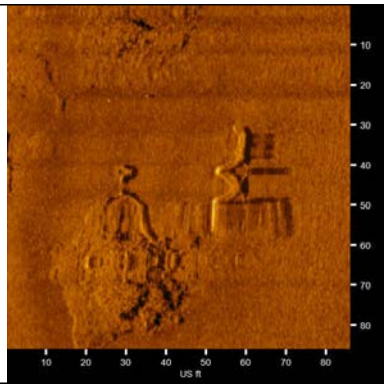
 	C008 • Sonar Time at Target: 4/29/2016 11:09:55 PM • Click Position 32.6900473222 -79.7127303449 (WGS84) 32.6898690740 -79.7129290539 (NAD27LL) 32.6900473222 -79.7127303449 (LocalLL) (X) 2396018.19 (Y) 314184.51 (Projected Coordinates) • Map Projection: SC83F • Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0032.sds • Ping Number: 97891 • Range to target: 70.68 US ft • Fish Height: 20.70 US ft • Heading: 0.000 Degrees • Event Number: (-1) • Line Name: 2016FEB28_0032 • Water Depth: 0.00 US ft	Dimensions and attributes • Target Width: 2.87 US ft • Target Height: 0.39 US ft • Target Length: 26.96 US ft • Target Shadow: 1.43 US ft • Mag Anomaly: • Avoidance Area: • Classification1: linear objects • Classification2: • Area: • Block: • Description: Two linear objects,possibly cables or geological features

Figure 3-12. SonarWiz.MAP sonar contact data automatically generated in tabular format. The target pictured here is Contact C008, appears to be two linear, cable-like objects.

Subbottom Profiler Data Processing and Analysis

Post processing of subbottom profiler data, like the sidescan data, is done with SonarWiz.MAP, which in this case enables the user to view the subbottom data in a planar, trackline format. The user may view the data in a digitizer window as a waterfall format, allowing the digitizing of subbottom features of interest, linear extent, depth, and type (Figure 3-13). SonarWiz.MAP batch processes waterfall images to *.JPG formats in order to generate figures (Figure 3-14). Sidescan mosaics and the contact databases are exported to the GIS database as *.SHP files. SonarWiz.MAP also allows the user to calculate the amount of sonar coverage and illuminate gaps to ensure full coverage of the Project Area.

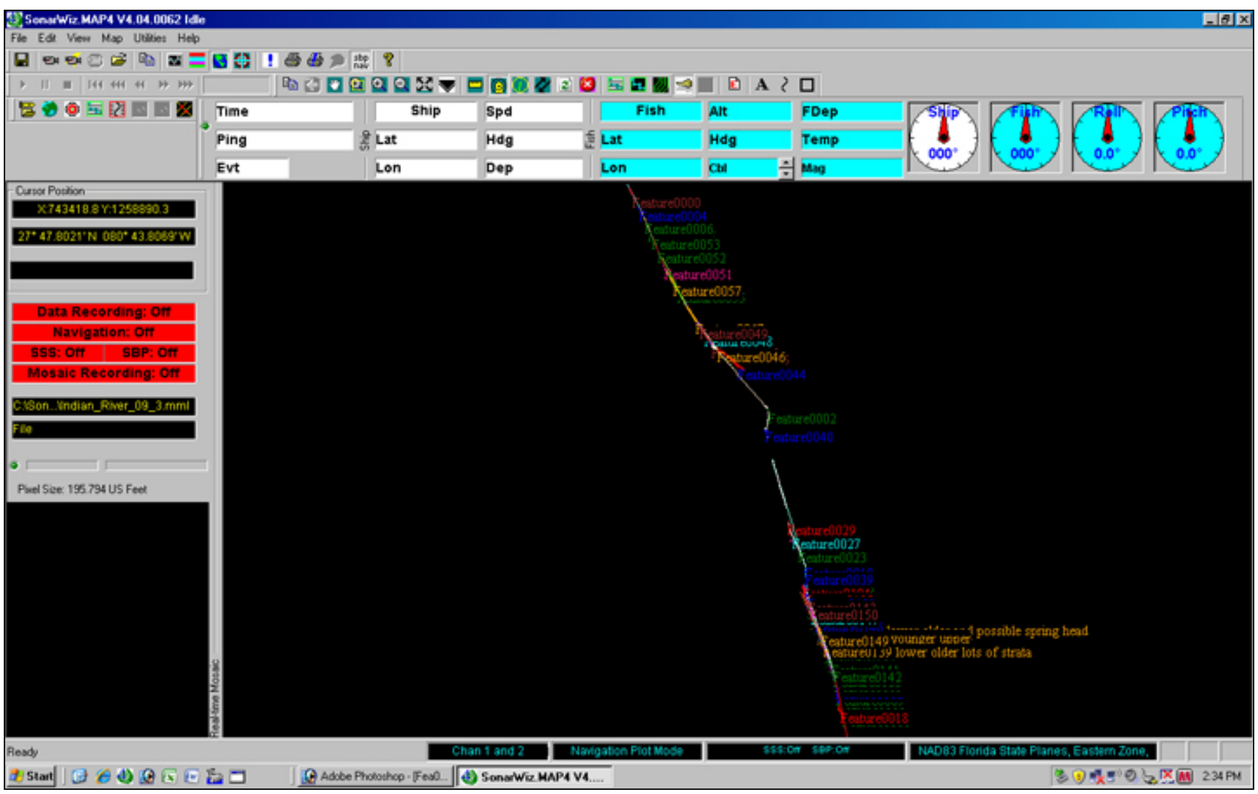


Figure 3-13. Trackline configuration example and various "reflector" features digitized.

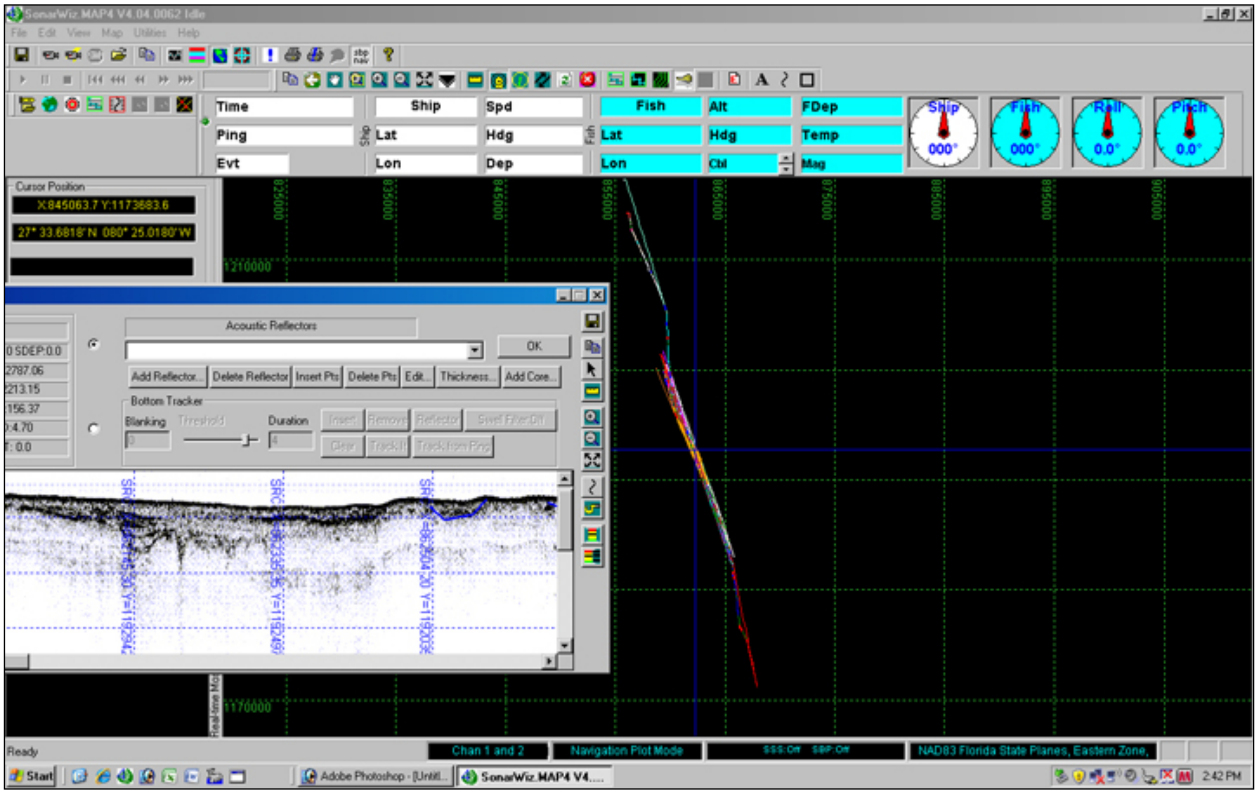


Figure 3-14. SonarWiz.MAP Subbottom waterfall image example showing the seismic profile-digitizing window. The blue cross hairs in the background chart show the location of the cursor, which at the time of the image was directly over the peak of the positive relief feature shown.

GEOGRAPHIC INFORMATION SYSTEMS ANALYSIS

A project GIS database is constructed using geo-referenced images and layers generated during the magnetometer, sidescan, and subbottom data analyses. Other layers can be added, such as orthophoto quads or navigation charts. Several important things are accomplished by GIS compilation. First, the collected data are compared to one another and evaluated for accuracy and consistency of the positioning information. Secondly, magnetic, sidescan, and other remote sensing targets are compared for relationship (proximity analysis). Employing the data in GIS, one can easily zoom in to further analyze spatial relationships as well as magnetic signature characteristics (Figure 3-15).

DATA ANALYSIS CRITERIA, THEORY, AND COMMENTARY

The remote sensing survey of the Project Area intended to locate and identify the presence or absence of potentially significant submerged cultural resources, and, if present, might be adversely affected by proposed plans; however, the interpretation of remote-sensing data obtained from both the magnetometer and sidescan sonar, as stated by Pearson et al. (1991), "relies on a combination of sound scientific knowledge and practical experience". The evaluation of remote-sensing anomalies, with regard to a determination that the anomaly does or does not represent shipwreck remains, depends on a variety of factors. These include the detected characteristics of the individual anomalies (e.g., magnetic anomaly strength and duration, sidescan image configuration), associated with other sidescan or magnetic targets on the same or adjacent lines, and relationships to observable target sources such as channel buoys or pipeline crossings, etc.

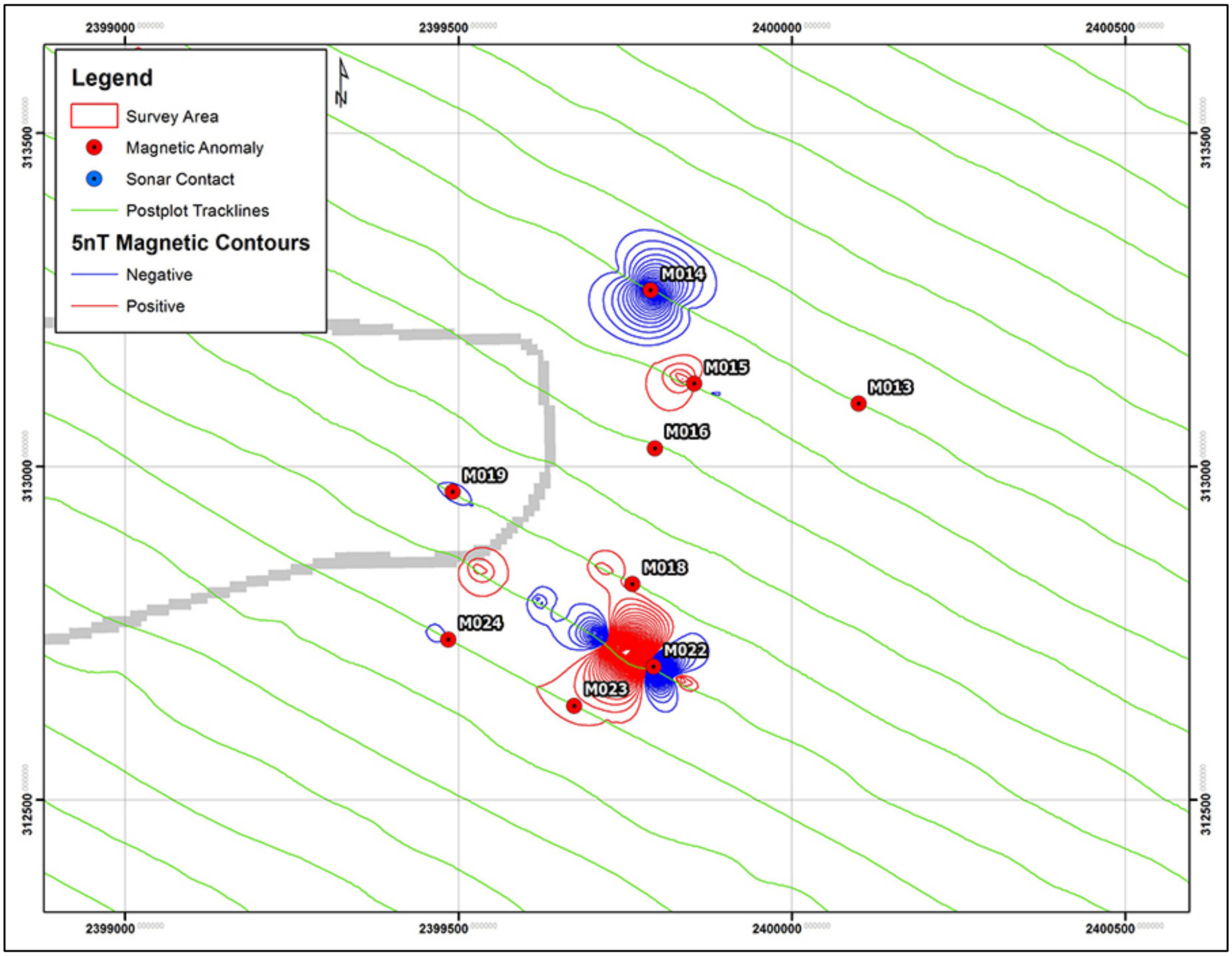


Figure 3-15. Magnetic contour map in GIS with the ENC chart as the background. Map presents layers of magnetic anomalies, sonar contacts, magnetic contours, and survey track lines.

MAGNETOMETER

Interpretation of data collected by the magnetometer, the tool of choice by the underwater archaeologist for locating shipwrecks, is perhaps the most problematic. Magnetic anomalies are evaluated and prioritized based on magnetic amplitude or deflection of nanotesla intensity from the ambient background in concert with duration or spatial extent (distance in feet along a trackline of an anomaly influences the ambient background); they are also correlated with sidescan targets. Because the sonar record gives a visible indication of the target, identification or evaluation of potential significance is based on visible target shape, size, and presence of structure, as well as association with magnetic anomalies. Targets, such as isolated sections of pipe, normally can be discarded immediately as non-significant, while large areas of above-sediment wreckage are generally easy to identify.

The problems of differentiating between modern debris and shipwrecks, based on remote-sensing data, have been discussed by a number of authors. This difficulty is particularly true in the case of magnetic data, which have received the most attention in the current body of literature dealing with the subject. Pearson and Saltus (1990:32) state "even though a considerable body of magnetic signature data for shipwrecks is now available, it is impossible to positively associate any specific signature with a shipwreck or any other feature". There is no doubt that the only positive way to verify a magnetic source object is through physical examination; however, the size and complexity of a magnetic signature does provide a usable key for distinguishing between modern debris and shipwreck remains (see also Garrison et al. 1989; Irion and Bond 1984; Pearson et al. 1993). Specifically, the magnetic signatures of most shipwrecks tend to be large in area and tend to display multiple magnetic peaks of differing amplitude.

In a study conducted for the Minerals Management Service for magnetic anomalies in the northern Gulf of Mexico, Garrison et al. (1989) indicate that a shipwreck signature will cover an area between 10,000 and 50,000 square meters. In an effort to assess potential significance of remote-sensing targets, the Pearson et al. (1991) study, using the Garrison et al. (1989) study, as well as years of "practical experience," developed general characteristics of magnetometer signatures most likely to represent shipwrecks. The report states that "the amplitude of magnetic anomalies associated with shipwrecks varies considerably, but, in general, the signature of large watercraft or portions of watercraft, range from moderate to high intensity (greater than 50 nanoteslas) when the sensor is at distances of 20 feet or so" (Pearson et al. 1991:70). Employing a table of magnetic data from various sources as baseline data, the report goes on to state that "data suggests that at a distance of 20 feet or fewer, watercraft of moderate size are likely to produce a magnetic anomaly (this would be a complex signature [i.e., a cluster of dipoles and/or monopoles]) greater than 80 or 90 feet across the smallest dimension..." (Pearson et al. 1991:70).

While establishing baseline amounts of amplitude and duration reflective of the magnetic characteristics for a shipwreck site, the report "recognizes that a considerable amount of variability does occur" (Pearson et al. 1991:70). Generated in an effort to test the 50-nanotesla/80-foot criteria and to determine the amount of variability, Table 3-01 lists numerous shipwrecks as well as single- and multiple-source objects located by magnetic survey and verified by divers. All shipwrecks met and surpassed the 50-nanotesla/80-foot criteria, the majority of single-object readings fell below the criteria (with the exception of the pipeline, the two sections of pipe, and one of the seven rocket motors); however, the signature of the pipeline should appear as a linear feature on a magnetic contour map and should not be confused with a single-source object. The strengths of the two sections of pipe represent refinement readings that sought to produce the highest reading possible and should perhaps be discounted from the sample. Further, because of their association with the space program, rocket motors, which are single-source objects, must be considered potentially significant. While the shipwrecks and most single-source objects adhere to the 50-nanotesla/80-foot criteria, the multiple-source objects do not. If all targets listed on the table required prioritization of potential significance based on the 50-nanotesla/80-foot criteria, the two multiple-source object targets would be classified as potentially significant.

Table 3-01. Compilation of Magnetic Data from Various Sources.

Vessel (Object)	Type and Size	Magnetic Deviation	Duration (ft.)	Reference
Shipwrecks				
Egmont Shoal wreck	19th century Wooden-hulled copper clad sailing vessel	67	160	Krivor 2005
USS Narcissus	Civil War wooden tug	582	176	Krivor 2005
J.D. Hinde	129-ft. wooden sternwheeler	573	110	Gearhart and Hoyt 1990
Utina	267-ft. wooden freighter	690	150	James and Pearson 1991; Pearson and Simmons 1995
Mary Somers	iron-hulled sidewheeler	5000	400	Pearson et al. 1993
Gen C.B. Comstock	177-ft. wooden hopper dredge	200	200	James et al. 1991

Vessel (Object)	Type and Size	Magnetic Deviation	Duration (ft.)	Reference
Mary	234-ft. iron-hulled sidewheeler	1180	200	Hoyt 1990
El Nuevo Constante	126-ft. wooden collier	65	250	Pearson et al. 1991
James Stockton	55-ft. wooden schooner	80	130	Pearson et al. 1991
Homer	148-ft. wooden side-wheeler	810	200	Pearson and Saltus 1990
modern shrimp boat	segment 27-x-5 ft.	350	90	Pearson et al. 1991
Confederate Obstructions	numerous vessels with machinery removed and filled with construction rubble	110	long duration	Irion and Bond 1984
Shrimp Boat	modern	162	110	Watts 2000
Single Objects				
pipeline	18-in. diameter	1570	200	Duff 1996
Pipe/mast/davit	18 in. by 26 ft.	475	104	Lydecker 2007
Pipe	3 in. by 10 ft.	55	352	Krivor 2005
anchor	6-ft. shaft	30	270	Pearson et al. 1991
iron anvil	150 lbs.	598	26	Pearson et al. 1991
engine block	modern gasoline	357	60	Rogers et al. 1990
steel drum	55 gallon	191	35	Rogers et al. 1990
pipe	8-ft. long by 3 in. diameter	121	40	Rogers et al. 1990
railroad rail segment	4-ft. section	216	40	Rogers et al. 1990
7 Rocket Motors	8 ft. to 34 ft. in length	61 to 422	75 to 180	Watts 2000
Multiple Objects				
anchor/wire rope	8-ft. modern stockless/large coil	910	140	Rogers et al. 1990
cable and chain	5 ft.	30	50	Pearson et al. 1991
scattered ferrous metal	14-x-3 ft.	100	110	Pearson et al. 1991

While the 50-nanotesla/80-foot criteria is a good general guide for most conditions, several recent studies have suggested that a 50-nanotesla/80-foot duration applied to remote sensing data as a baseline for all wreck sites is much too low. Allowing for a larger and more focused database on which to assess signature characteristics of specific vessel classes, the findings from these investigations argue for higher nanotesla and duration criteria for specific types of sites. Table 3-02 indicates the sizable magnetic deviation and duration of previously recorded and located steamboat wreck sites. However, there is one exception, each of the known steamboat wrecks investigated has a magnetic deviation of at least 500 nanoteslas and a duration of no fewer than 110 feet, usually in the 200-plus feet range. As opposed to single objects, steamboat wrecks documented during previous investigations are generally much larger in magnetic strength (although not always), tend to have a longer duration, and typically have multi-component signatures. It should be noted, however, that each steamboat wreck signature differs markedly due to environmental conditions, amount of hull/machinery remaining, and the depth of water/overburden over the wreck site.

Furthermore, it should be inferred that one of the biggest influences on a wreck site's magnetic signature is directly related to the distance from the magnetometer sensor to the wreck site. As stated in Pearson and Birchett:

> "For a typical iron object, the intensity of its magnetic signature [i.e., anomaly] is inversely proportional to the cube of the distance. One pound of iron, for example, would produce an anomaly of 100 nanoteslas at a distance of 2 feet. At a distance of 10 feet the same pound of iron would produce an anomaly of only 1 nanotesla. A 1,000-ton ship could produce a 700-nanotesla anomaly at 100 feet and a barely discernible 0.7-nanotesla anomaly at 1,000 feet" [Pearson and Birchett 1999:4-13].

An example of a steamboat wreck that produces a magnetic signature of less than 500 nanoteslas involves the purported *Undine* site investigated by Panamerican in 1999 and 2000. During 1999, remote sensing operations located a magnetic anomaly with a magnetic deflection of 193 nanoteslas with a duration of 300 feet. During the 2000 field investigations, the anomaly was identified as the remnant of a charred steamboat approximately 38 to 40 feet below the river's surface, and buried 8 feet below riverbed sediments. Historic records indicate the *Undine* was extensively salvaged after the scuttling incident whereupon everything of value including all iron plating, machinery, and cannon were removed from the wreck, but the hull remained in place (James and Krivor 2000:16-17). While only a small portion of the wreck site was uncovered (due to the extensive amount of overburden) it was evident that little of the hull is extant, only just to the turn of the bilge.

It should also be stated that two of the wreck sites with either small areas of deviation or low nanotesla deflections, the *J.D. Hinde* and the purported *Undine*, represent either partial hull remains (*J.D. Hinde*) or were heavily burned and salvaged (*Undine*). Historic records indicate the *J.D. Hinde* was also salvaged after the wrecking process. Retaining none of her steam machinery or wheels, half of the vessel was no longer present, most likely as a result of dredging; both salvage and dredging the obvious reason for its small magnetic duration (James and Pearson 1993:22). Salvage efforts often sought to remove any cargo as well as any machinery, cannon, anchors, or other goods of value. During the Civil War, the salvage of iron for reuse was often paramount. As stated by John B. Jones on 11 August 1863, "the iron was wanted more than anything else but men" (Black 1958:200). Therefore, it may be speculated that any wreck site that (1) has been salvaged in the past; (2) has been exposed to excessive environmental processes (i.e., current); or (3) has been impacted by channelization efforts (i.e., dredging) will produce a lower nanotesla deflection (due to less ferrous metal on site) than a wreck not exposed to similar processes.

Table 3-02. Magnetic Data from Steamboat Wreck Sites.

Vessel (object)	Type & Size	Magnetic Deviation	Duration (feet)	Reference
Shipwrecks				
Star of the West	172-ton ocean-going sidewheel	8,300	400	Krivor et al. 2002
3MO69 (unidentified)	wooden sidewheeler	2,961	299	Buchner and Krivor 2001
Caney Creek Wreck	sidewheeler	2,790	unknown	Hedrick 1998
Mary E. Keene	236-ft. sidewheeler	1,700	220	Robinson 1998
John Walsh	275-ft. sidewheeler	1,602	280	James et al. 2002
New Mattie	130-ft. wooden sternwheeler	1,491	200	Buchner and Krivor 2001
35th Parallel	sidewheeler	1,414	320	Saltus 1993
Scotland	sidewheeler	1,322	200	Kane et al. 1998
"Boiler" wreck (unidentified steamboat)	sidewheeler/sternwheeler (?)	1,164	500	Saltus 1993
Hartford City	150-ton sidewheeler	856	400	Krivor et al. 2002
Mary Somers	iron-hulled sidewheeler	5000	325	Pearson et al. 1993
Homer	148-ft. wooden sidewheeler	810	200	Pearson and Saltus 1993
E.F. Dix/Eastport	sidewheeler/ironclad	800	360	Pearson and Birchett 1995
Choctaw	223-ton sternwheel towboat	797	250	Krivor et al. 2002
J.D. Hinde	129-ft. wooden sternwheeler	573	110	Gearhart and Hoyt 1990

Vessel (object)	Type & Size	Magnetic Deviation	Duration (feet)	Reference
Oklahoma Wreck	sidewheeler	497	300	M.C. Krivor, personal communication 2005
Undine	sternwheeler	200	300	James and Krivor 2000

If the signatures of the entire steamboat wrecks listed in Table 3-02 are averaged, an average magnetic deviation of 1,576 nanoteslas with an average duration of 234 feet is obtained. While the sensor distance, environmental factors, and the amount of ferrous metal remaining on any given steamboat site must be taken into account, previously identified wreck sites have tended to produce sizable +200-nanotesla magnetic deviations with a minimum duration of 110 feet. While the 110-foot duration represents the lowest duration of any of the known steamboat wreck sites, it must be stated that in such cases a portion of the wreck is no longer extant due to previous salvage and dredging/channelization efforts. However, until further surveys show that this short duration is an "anomaly" so to speak, it must be employed as the baseline duration. Similarly, with the exception of the *Undine* site, which as stated previously was heavily salvaged, all other surveyed steamboats have nanotesla deviations approaching 500 s or above, but its 200-nanotesla reading must be employed as the baseline amplitude.

While the data indicates the validity of employing specific nanotesla strength and duration criteria when assessing magnetic anomalies, other factors must be taken into account. Pearson and Hudson (1990) have argued that the past and recent use of a water body must be an important consideration in the interpretation of remote sensing data; in many cases, this should supposedly be the most important criterion. Unless the remote sensing data, the historical record, or the specific environment (i.e., harbor entrance channel) provides compelling and overriding evidence, it is otherwise believed that the history of use should be a primary consideration in the interpretation. The constitution of "compelling evidence" is, to some extent, left to the discretion of the researcher; however, in settings where modern commercial traffic and historic use have been intensive, such as the current project area, the presence of a large quantity of modern debris must be anticipated. In harbor, bay, or riverine situations where traffic is heavy, this debris will be scattered along the channel Right Of Way (ROW), although it may be concentrated in areas where traffic would slow or halt, and it will appear on remote sensing survey records as discrete, small objects. This is in fact the case for many of the anomalies recorded during the current investigation.

In addition to anomaly strength and duration considerations, all anomalies were assessed for type (monopole [negative or positive influence], dipole [negative and positive influence], or complex) and association with other magnetic anomalies (i.e., clustering) and sidescan sonar targets. With regard to analysis of these anomalies, relative to potential significance, many will be found to represent a small, single source object (a localized deviation), and are generally identified and labeled as non-significant, especially in an area of high use (however, this is not generally the case with the current environment). As seen on contour maps, the contour lines for this type of anomaly can be seen to approach, or go to but not beyond, the adjacent survey trackline on which it is located. This visual interpretation is corroborated during the analysis of the electronic magnetometer strip-chart data of each survey trackline. An examination of the strip-chart will show that the target was recorded only on a single transect, and that it was not recorded (i.e., did not influence the ambient magnetic background) on adjacent lines. This is especially true when an anomaly's readings are large deviations but are recorded on only one line. This indicates the source for this target must be a small, discrete object, and the magnetometer sensor must have passed closely by or directly over the object in order to generate the large readings on this survey line, yet not be recorded or have had an influence on adjacent lines, especially relevant when employing a 50-foot transect interval. Because these anomalies represent single-source objects, they are not considered representative of a potentially significant submerged cultural resource and are not recommended for avoidance.

SIDESCAN SONAR

In contrast to magnetic data, sidescan interpretation is less problematic, as objects are reconstructed as they look to the eye. Targets, such as isolated sections of pipe, can normally be immediately discarded as non-significant, while large areas of above-sediment wreckage as well as some exposed potential paleofeatures (i.e., rock outcrops) are generally apparent. The chief factors considered in analyzing sidescan data, with regard to wreckage, include: linearity, height off bottom, size, associated magnetics, and environmental context. Since historic resources in the form of shipwrecks usually contain large amounts of ferrous compounds, complex sidescan targets with complex magnetic anomalies are of the greatest importance. The usual outcome of targets with no associated magnetics are items, such as rocks, trees, and other non-historic debris of limited interest to the archaeologist.

CLUSTERING

Since an archaeological remote sensing survey involves the collection of several different types of data, each of which has the potential to locate significant cultural resources, attention must be given to groups of targets. These groupings, referred to as clustering, occur when a target exists that produces both a sidescan sonar return and a magnetic signature. In addition, a magnetic source that extends across several survey lines will produce an anomaly on each line, and since these anomalies are related they will form a cluster. Previously discovered archaeological sites will also be considered as an aspect of clustering. Although criteria used to determine a cluster is somewhat subjective, anomalies, sidescan targets, and previously identified archaeological sites will generally be included in a cluster if they lie within 65 feet of one another.

SUBBOTTOM PROFILER ANALYSIS

Subbottom profilers generate low frequency acoustic waves that penetrate the seabed and reflect off boundaries or objects located in the subsurface. The data are then processed and reproduced as a cross section using two-way travel time to determine depth (the time taken for the pulse to travel from the source to the reflector and back to the receiver by a constant). The shapes, relationships, and extents of reflectors are used to infer bottom and subbottom geomorphological characteristics.

In general, high and low amplitude linear reflectors (light and dark lines) distinguish between sediment beds; parabolic reflectors indicate point-source objects with sound propagating out from them; and erosional or non-depositional contacts can be identified by discontinuities in extent, slope angle, and the shape of the reflector morphology. This latter fact is important when identifying buried and drowned channel systems and other relict and buried fluvial system features (e.g., estuarine, tidal, lowland, and upland areas around drainage features).

In caution, there are five spurious signals that may cause confusion in the two-dimensional records that specialists recognize: direct arrival from the sound source, reflection multiples, water surface reflection, side echoes, and point-source reflections. Judicious analysis is required to identify these sound underwater imagery phenomena. Precise inference of a sediment bed or other anomaly from the subbottom profiler data would necessitate coring or excavation.

While it is challenging to know which reflectors are significant, the intent is to identify paleolandscape features likely to be conducive to human occupation and where preservation may be enhanced based on local geology and archaeology. In analysis, seismic returns indicating positive relief features as possible mounds and negative relief features as a probable channel or other fluvial feature with margins and sediment beds indicate higher potentials for prehistoric remains.

METHOD AND THEORY FOR RECOGNITION OF A SUBMERGED PREHISTORIC SITE

Panamerican's methodology for identifying submerged prehistoric sites entails developing criteria for the discovery of a "site" in any particular setting. The criteria are based on the geology and archaeology of the Project Area and models of site submergence. Models for the presence and preservation of submerged archaeological sites are discussed by several researchers, including Waters (1992) in his chapter on coastal processes, Kraft et al. (1983), and others. Much of this has to do with the identification of landforms identifiable with remote sensing that have the potential for archaeological site presence. For instance, two models used in this project were horizontal surfaces near channel features and positive relief features considered potentially to represent midden feature(s). Causeways, fishing weirs, or other prehistoric infrastructure features are difficult to identify.

Publications are more limited that are specific to recognizing sedimentary signatures of the deposits that make up sites that have been transgressed by rising sea levels and then remained submerged, perhaps buried, until exposure. One such study specifically focused on such information is Gagliano et al.'s (1982) *Sedimentary Studies of Prehistoric Archaeological Sites: Criteria for the identification of submerged archaeological Sites of the Northern Gulf of Mexico Continental Shelf*. This document is one of high value but limited distribution. Gagliano's group chose 15 terrestrial sites in Louisiana and Texas as analogs from eight identifiable and mapable landforms with which archaeological sites are commonly and consistently associated on land, terrestrially. Their local geomorphic features included major natural levee, minor natural levee, Chenier and accretion ridges, barrier island, salt dome margin, estuarine margin, channel on Pleistocene terrace, and lake margins. They sampled sediments with excavations and box core sampling; recorded color, bedding, and contact descriptions; sorted the sediments to particle size; conducted point count and grain size analysis; and then geochemically analyzed the samples by levels. They showed that sites were recognized most frequently by shell content, fish bones, and charred wood. Some ceramic and lithic artifacts were identified, but they were rare and often small.

Another aspect to realize about submerged prehistoric sites is that virtually all examples of inundated sites are partially, or wholly, reworked in ways somewhat analogous to deflation (Fischer 1995; Masters and Flemming 1983). This is caused by fluidization of sediments at times of inundation and the removal of fine particles that are often re-deposited with material by subsidence of the inundation or wave action. Faught (1996, 2002–2004) has shown sites with late Pleistocene, early Holocene, and middle Holocene artifacts to be re-worked by sea level rise and submergence, but that artifact arrays remain cohesive as surface and near surface remains.

Because of these factors, recognition that deposits are indeed cultural is not always immediately apparent to the diver, or at first glance of the collected materials. Artifacts are important, but not always part of the site, as Gagliano et al. (1982) has systematically determined. Expectations for midden deposits include dominance of unarticulated specimens of particular mollusk species, faunal bone, and manuports (i.e., geologic items out of place). On the other hand, discovery of any artifact would be important, especially in any sediment bed below a marine bed.

IV. INVESTIGATIVE FINDINGS

REMOTE SENSING SURVEY RESULTS

Employing the above discussions on target analysis, magnetic anomalies were assessed for potential significance based on magnetic deviation (above and/or below ambient background), duration (distance in feet along a trackline an anomaly influences the ambient background), size relative to being detected on more than one transect (i.e., single source), type (monopole [negative or positive influence], dipole [negative and positive influence], or complex), and association with other magnetic anomalies (i.e., clustering) and/or sidescan sonar targets. Sidescan sonar contacts, as visual images, were assessed for structure, linearity, height off bottom, size, associated magnetics, visual surface associations (i.e. channel buoys, cruise ships, etc.), and environmental context (i.e., heavily trafficked dredged channel). Subbottom features were assessed as to feature type, and association with other subbottom features and sidescan targets.

Extensive review and analysis of all the anomalies indicate that they are not considered representative of potentially significant submerged cultural resources. The majority of anomalies are single-source anomalies and all are thought to represent miscellaneous modern debris. As described previously, examination of both the contour map and the strip-chart for these anomalies indicate that each target was recorded only on a single transect, and neither was recorded (i.e., did not influence the ambient magnetic background) on adjacent lines. Some of the single source anomaly readings are large deviations, yet were recorded on only one line, which indicates the source for these targets must be small, discrete objects. The single source anomaly type is not considered representative of a potentially significant submerged cultural resource.

The Project Area consists of two survey areas: Mitigation North and Mitigation South. Within the Project Area 144 magnetic anomalies and 25 sidescan sonar contacts were recorded (Table 4-01). A total of 104 anomalies and 16 sonar targets were recorded in the Mitigation North portion, and 40 anomalies and seven sonar targets were recorded in the Mitigation South portion. Magnetic contour maps showing the locations for anomalies and sonar contacts for the Mitigation North are presented in Figures 4-01 through 4-05, while the Mitigation South is presented in Figures 4-06 through 4-11. Sonar targets for the same are presented in Tables 4-02 and 4-03.

Located in the Mitigation North, a single cluster of anomalies is the only interesting anomaly observed in the data; however, it is not considered significant. The cluster is comprised of Anomalies M18, M19, M22, M23, and M24 (see Figures 4-05 and 4-12). The main anomaly is M22, with a magnetic deviation of 519 nanoteslas; however, it appears to not influence the opposite lines, suggesting it is a single-point source that is almost linear in its duration. Because other anomalies in the immediate vicinity that form the cluster also appear to be generated by single-point sources, it is felt that the anomaly is not complex and most likely not significant. All the anomalies in the cluster lack associated acoustic sources. Presented in Figure 4-13, the acoustic image that shows the location of M18, M22, and M23 illustrates the absence of a sonar contact and indicates burial of the anomaly source(s). The figure does show a rise in elevation at a large area that contains M22, suggesting a possible geologic source, although a magnetic deviation of 519 nanoteslas argues against this possibility. Because of the uncertainty concerning the source of the magnetics, it is suggested that an avoidance zone around its perimeter be implemented.

In addition to this cluster, there is a single interesting sonar contact (C008) in the Mitigation North that lacks a magnetic signature (see Figure 4-06; Tables 4-02 and 4-03). Figure 4-14 illustrates that C008 is comprised of two linear objects, possibly cables or geological features. Because of the uncertainty concerning C008's identification, it is suggested that an avoidance zone around its perimeter be implemented.

As previously stated, 40 anomalies and seven sonar targets were recorded in the Mitigation South. A review of the Mitigation South data indicates no anomaly or sidescan sonar target that is considered potentially significant.

Table 4-01. Magnetic Anomalies in the Project Area.*

Target	Nanoteslas	Duration (feet)	Type	Easting	Northing	Association	Map	Notes
Northern Area								
M001	7	150	M	2402760	313714		2	SPS
M002	8	190	D	2397842	316230	M04	2	Unknown
M003	14	140	M	2395956	317254		1	SPS
M004	5	310	D	2397786	316162	M02	2	Unknown
M005	11	140	M	2395800	317113		1	SPS
M006	6	170	D	2393752	318207		1	SPS
M007	9	185	D	2398011	315581		2	SPS
M008	12	205	D	2395524	316697		1	SPS
M009	7	105	D	2398081	315323		2	SPS
M010	18	280	D	2397184	315688	M10, C002	2	Debris
M011	7	200	D	2394200	316845		1	SPS
M012	9	190	D	2395742	315887		1	SPS
M013	7	205	D	2400100	313095		2	SPS
M014	118	165	M	2399788	313265	M15, M16	2	Unknown
M015	32	245	C	2399854	313125	M14, M16	2	Unknown
M016	6	225	M	2399795	313028	M14, M15,	2	Unknown
M017	21	205	D	2396718	314576		3	SPS
M018	17	305	D	2399761	312824	M19, M22, M23, M24	4	Unknown
M019	6	235	M	2399492	312962	M18, M22, M23, M24	2	Unknown
M020	9	235	C	2395822	314938	M20, C005	3	Debris
M021	20	120	M	2393778	315931		1	SPS
M022	519	485	C	2399793	312700	M18, M19, M23, M24	4	Unknown
M023	9	350	M	2399674	312642	M18, M19, M23, M24	4	Unknown
M024	13	130	D	2399485	312741	M18, M19, M22, M23	4	Unknown
M025	14	120	D	2398752	313132		2	SPS
M026	11	145	D	2392427	316535		1	SPS
M027	49	130	M	2393062	316094		1	SPS
M028	11	195	D	2402185	311059	C006	4	Tire
M029	11	155	M	2401357	311278	M32	4	Unknown
M030	12	160	M	2392863	315855	M30, C007	1	Debris
M031	10	275	D	2395126	314522		3	SPS

Target	Nanoteslas	Duration (feet)	Type	Easting	Northing	Association	Map	Notes
M032	13	260	M	2401340	311185	M29	4	Unknown
M033	23	175	D	2400072	311736		4	SPS
M034	9	145	M	2393218	315435		1	SPS
M035	17	135	D	2395031	314353		3	SPS
M036	9	230	M	2396396	313497		3	SPS
M037	5	345	C	2395203	314130		3	SPS
M038	7	304	C	2397928	312566		4	SPS
M039	6	250	M	2396165	313394	M42	3	Unknown
M040	11	210	M	2394367	314252	M47, M50, M53, M56	3	Unknown linear string of low-intensity anomalies, possibly following geological feature
M041	11	180	M	2395343	313742		3	SPS
M042	8	265	C	2396010	313367	M39	3	Unknown
M043	8	260	D	2399449	311514		4	SPS
M044	13	185	D	2397453	312478		4	SPS
M045	8	585	C	2395766	313394	C009	3	cable or pipe
M046	7	400	C	2395142	313714		3	SPS
M047	12	310	M	2394175	314242	M47, M50, M53, M56	3	Unknown linear string of low-intensity anomalies, possibly following geological feature
M048	29	415	C	2393037	314854		3	SPS
M049	22	270	C	2392794	314873	M52, M57	3	Unknown
M050	9	240	M	2394083	314180	M40, M47, M53, M56	3	Unknown linear string of low-intensity anomalies, possibly following geological feature
M051	9	120	M	2397262	312344		4	SPS
M052	28	195	D	2392862	314706	M49, M57	3	Unknown
M053	10	175	M	2393888	314057	M40, M47, M50, M56	3	Unknown linear string of low-intensity anomalies, possibly following geological feature
M054	10	165	M	2397042	312230		4	SPS
M055	7	460	C	2395693	312955		3	SPS
M056	1	270	M	2393751	314005	M40, M47, M50, M53,	3	Unknown linear string of low-intensity anomalies, possibly following geological feature
M057	53	510	C	2392746	314547	M49, M52,	3	Unknown
M058	14	190	M	2393256	314168		3	SPS
M059	21	235	M	2394872	313290		3	SPS
M060	16	250	M	2395224	313119	C010	3	Debris
M061	10	375	C	2395796	312795		3	SPS
M062	6	200	M	2393803	313741	M66	3	Unknown
M063	37	185	D	2392478	314357		3	SPS
M064	8	165	M	2392785	314195		3	SPS
M065	30	210	M	2393371	313880	M70	3	Unknown

Target	Nanoteslas	Duration (feet)	Type	Easting	Northing	Association	Map	Notes
M066	16	330	M	2393826	313638	M62,	3	Unknown
M067	14	160	M	2395896	312401	C011	3	Rectangular object
M068	7	320	C	2394031	313410		3	SPS
M069	8	205	M	2393549	313657		3	SPS
M070	21	235	M	2393234	313833	M70	3	Unknown
M071	37	210	M	2391138	314963		3	SPS
M072	12	300	M	2394101	313257		3	SPS
M073	11	230	D	2395576	312449	M75	3	Unknown
M074	12	290	M	2394102	313256		3	SPS
M075	12	150	D	2395473	312400	M73	3	Unknown
M076	8	250	D	2394917	312706		3	SPS
M077	18	190	D	2394410	312976		3	SPS
M078	33	405	C	2393792	313306	M79	3	Unknown
M079	8	430	C	2393838	313173	M78	3	Unknown
M080	19	225	M	2401019	309191		4	SPS
M081	15	435	C	2395126	312362	M86, M87, M91, M93, M99	3	Unknown
M082	9	245	D	2391648	314230		3	SPS
M083	13	215	M	2392460	313688		3	SPS
M084	10	165	M	2392757	313529		3	SPS
M085	9	240	D	2393333	313218		3	SPS
M086	21	310	M	2395265	312174	M81, M87, M91, M93, M99	3	Unknown
M087	66	640	C	2395006	312203	M81, M86, M91, M93, M99	3	Unknown
M088	17	315	D	2393074	313227		3	SPS
M089	12	375	C	2391820	313904	M90	3	Unknown
M090	17	340	C	2391827	313805	M89	3	Unknown
M091	6	545	C	2395013	312079	M81, M86, M87, M93, M99	3	Unknown
M092	6	145	M	2399900	309328	M92, M96	4	Unknown
M093	40	620	C	2394874	312033	M81, M86, M87, M91, M99	3	Unknown
M094	13	165	M	2390796	314237	M94, M95	3	Unknown
M095	22	325	D	2390884	314087	M94, M95	3	Unknown
M096	8	305	D	2399859	309257	M92, M96	4	Unknown
M097	6	240	M	2395722	311350	M104, C016	3	Rectangular object
M098	19	325	M	2395226	311630		3	SPS
M099	40	355	D	2394727	311895	M81, M86, M87, M91, M93	3	Unknown
M100	23	210	D	2394478	312021		3	SPS
M101	8	140	M	2393896	312332	M101	3	Unknown
M102	16	150	M	2393898	312234	M102	3	Unknown
M103	24	130	M	2394188	312080		3	SPS

Target	Nanoteslas	Duration (feet)	Type	Easting	Northing	Association	Map	Notes
M104	13	125	M	2395758	311221	M97, C016	3	Rectangular object
Southern Area								
M105	8	205	M	2401892	304093		6	SPS
M106	13	240	M	2395645	307496		5	SPS
M107	10	290	C	2398262	305963	M107, C018	6	Cable
M108	26	2075	M	2399623	305220		6	Probable passing ship
M109	27	205	M	2400807	304579		6	SPS
M110	17	195	M	2399192	305335		6	SPS
M111	5	255	M	2396827	306631	C021	5	Debris
M112	29	340	M	2399398	305117	C020	6	Debris
M113	26	145	M	2399638	304989		6	SPS
M114	5	280	M	2401117	304186	C019	6	Pipe
M115	22	240	M	2398113	305701		6	SPS
M116	7	250	D	2394907	307442		5	SPS
M117	9	890	M	2393842	307919		5	SPS
M118	6	750	M	2406300	301118		7	SPS
M119	17	240	M	2398383	305332		6	SPS
M120	8	210	M	2396843	306165	M121, M123, M124	5	Unknown
M121	23	285	M	2396882	306036	M120, M123, M124	5	Unknown
M122	7	205	M	2398324	305122		6	SPS
M123	21	275	D	2396759	305989	M120, M121, M124	5	Unknown
M124	12	320	M	2396723	305890	M120, M121, M123	5	Unknown
M125	5	205	M	2396484	305457		5	SPS
M126	6	180	D	2406228	300128		7	SPS
M127	9	175	M	2395376	305933		5	SPS
M128	5	200	M	2402977	301332		9	SPS
M129	4	185	M	2406194	299114		10	SPS
M130	36	305	M	2399635	302478	M133, C022	9	Debris
M131	4	185	M	2395553	304703	M132, M134	5	Unknown
M132	22	245	M	2395575	304589	M131, M134	5	Unknown
M133	7	320	M	2399665	302347	M130, C022	9	Debris
M134	8	150	D	2395552	304478	M131, M132	5	Unknown
M135	9	210	D	2394907	304717		5	SPS
M136	14	250	M	2394715	304602	C023	5	Debris
M137	9	225	D	2397106	303294	M139	8	Unknown
M138	12	250	D	2397680	302977		6	SPS
M139	8	130	M	2397057	303201	M137	8	Unknown
M140	11	290	D	2398622	301780		9	SPS
M141	8	145	M	2393545	304212		5	SPS
M142	10	210	D	2400425	299979		9	SPS
M143	6	120	M	2400159	300134	C025	9	Debris
M144	6	160	M	2391594	304591		5	SPS

*Coordinates in NAD83 South Carolina State Plane U.S. Survey Feet.

Key: M= Monopole; D= Dipole; C= Complex; SPS= Single-Point Source

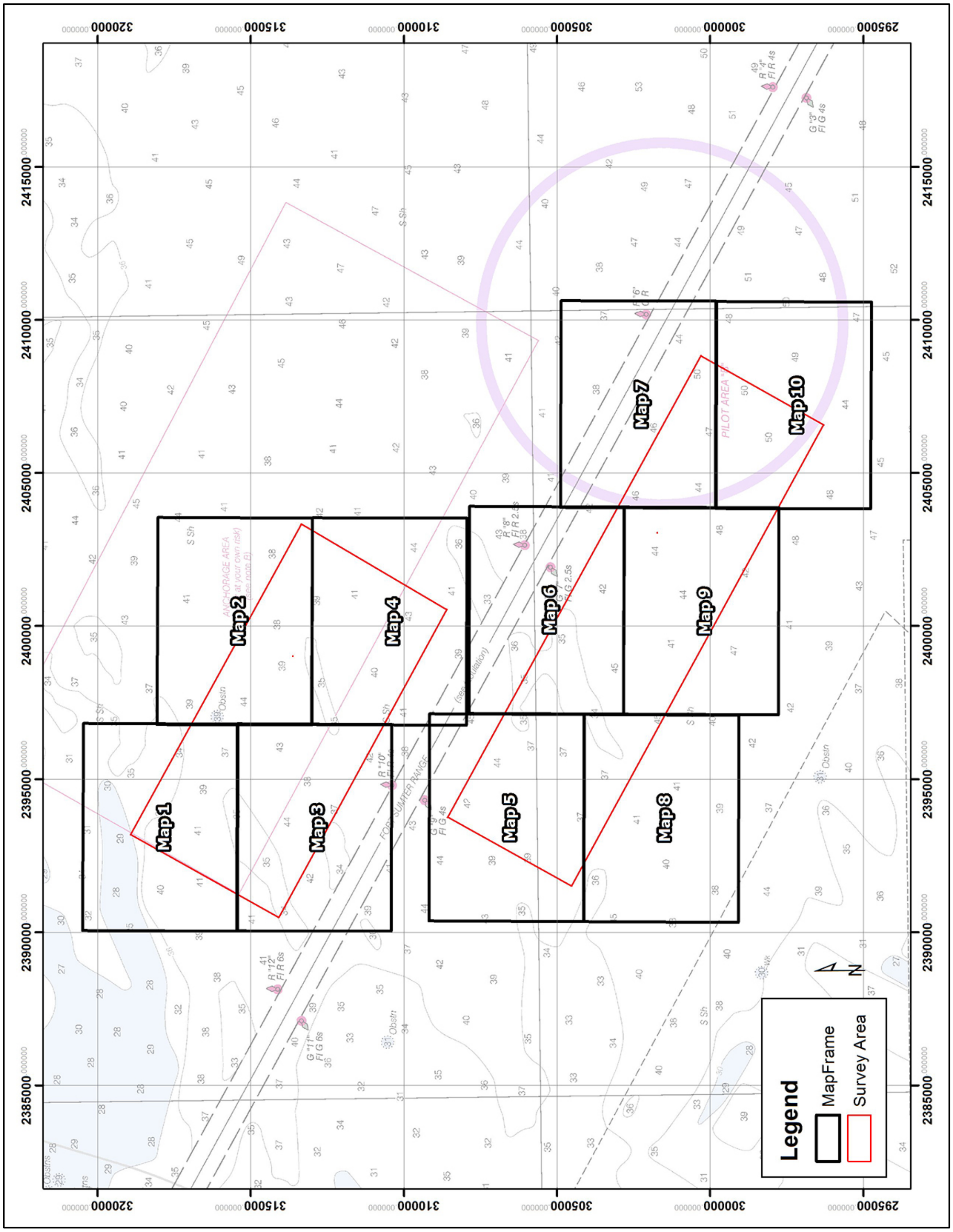


Figure 4-01. Magnetic Contour Map Key for the Project Area.

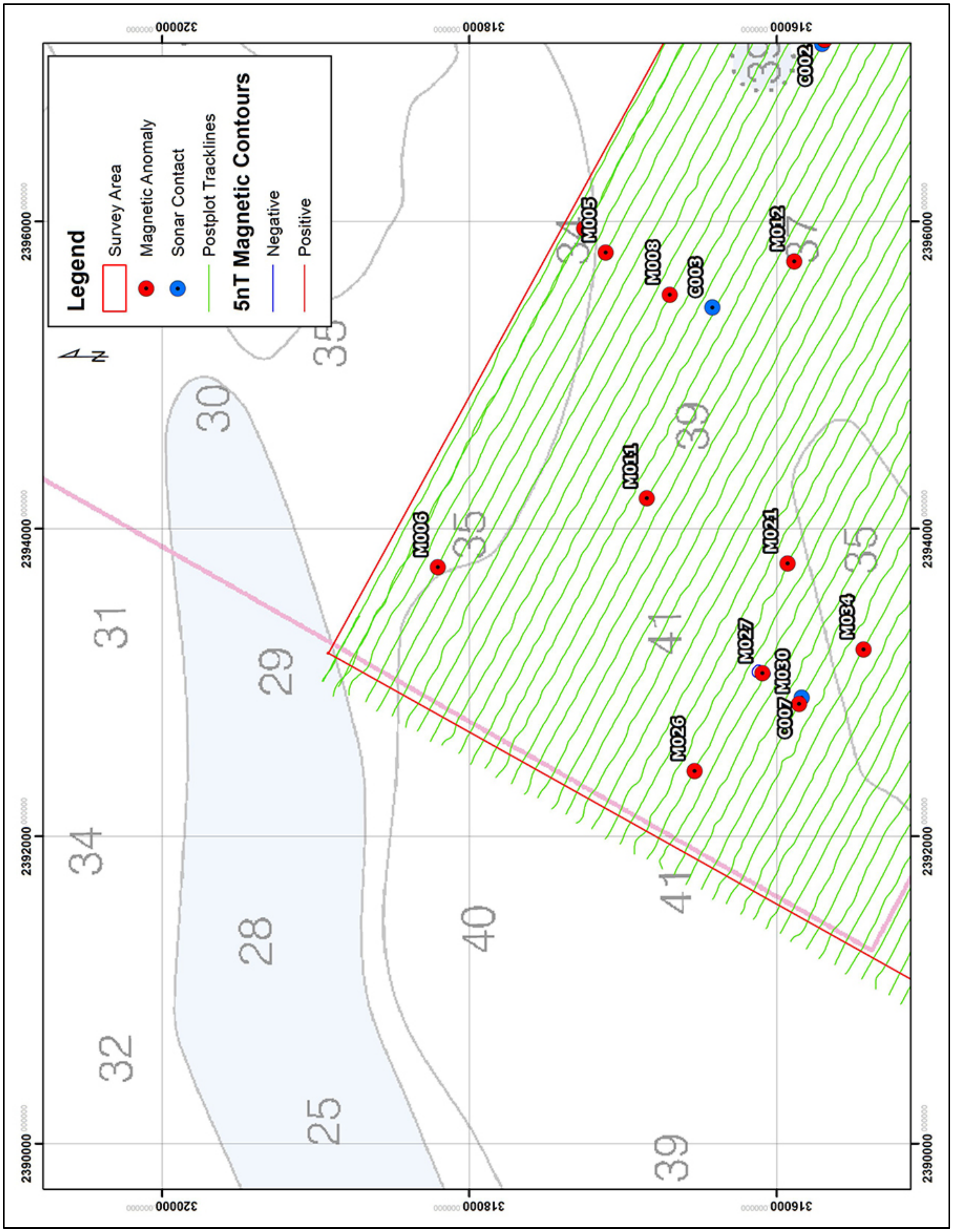


Figure 4-02. Magnetic Contour Map 1 for the Project Area (Mitigation North portion).

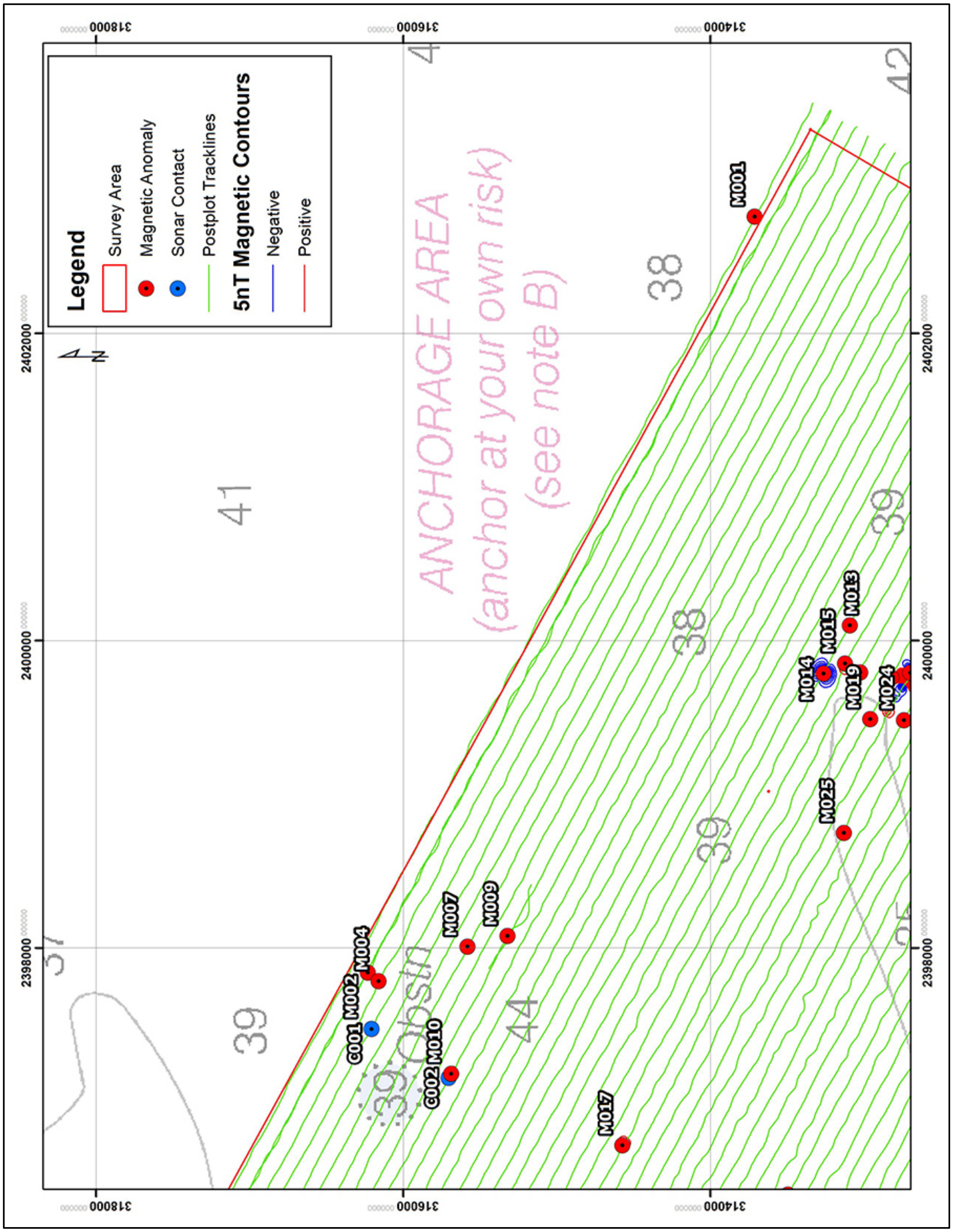


Figure 4-03. Magnetic Contour Map 2 for the Project Area (Mitigation North portion)

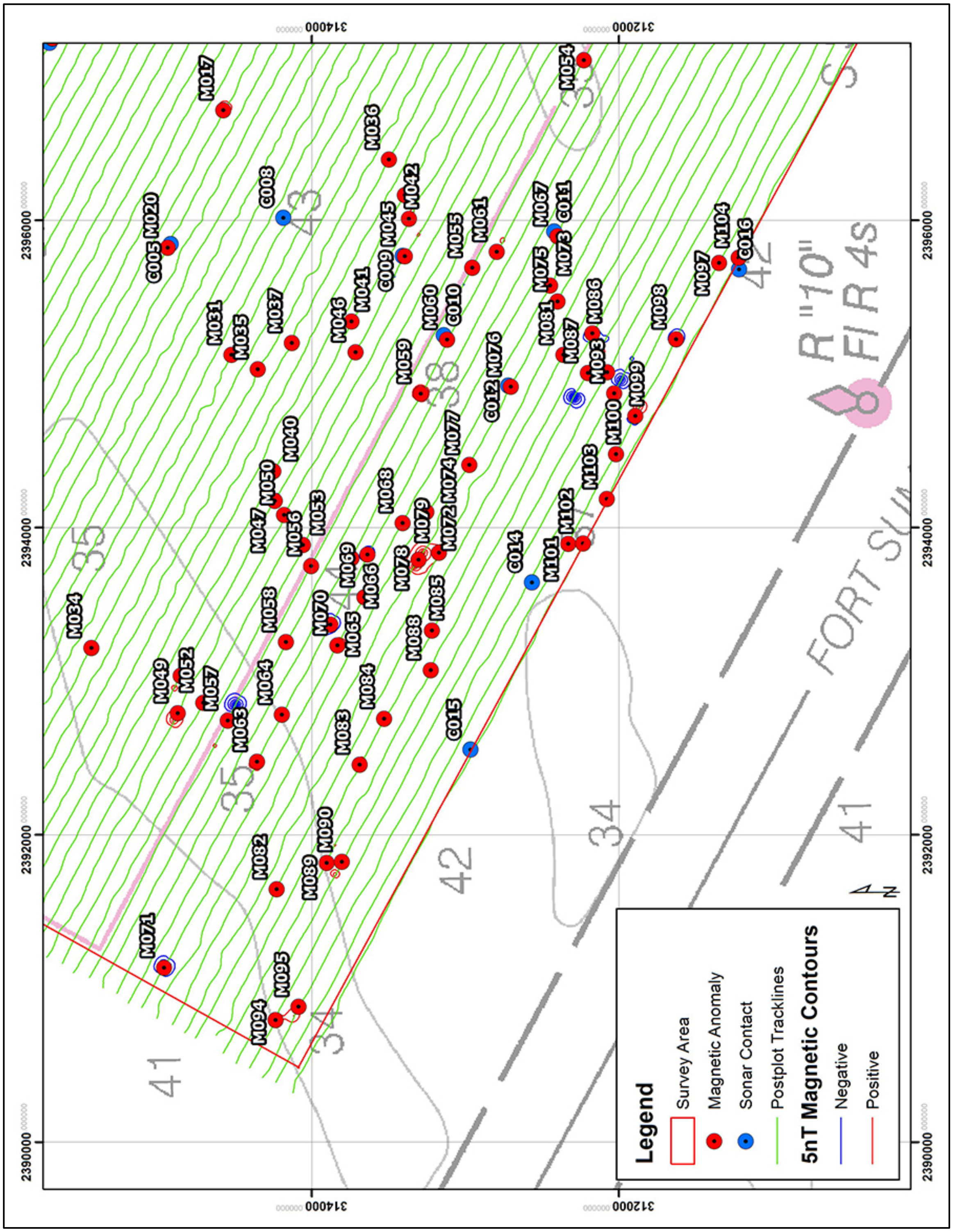


Figure 4-04. Magnetic Contour Map 3 for the Project Area (Mitigation North portion).

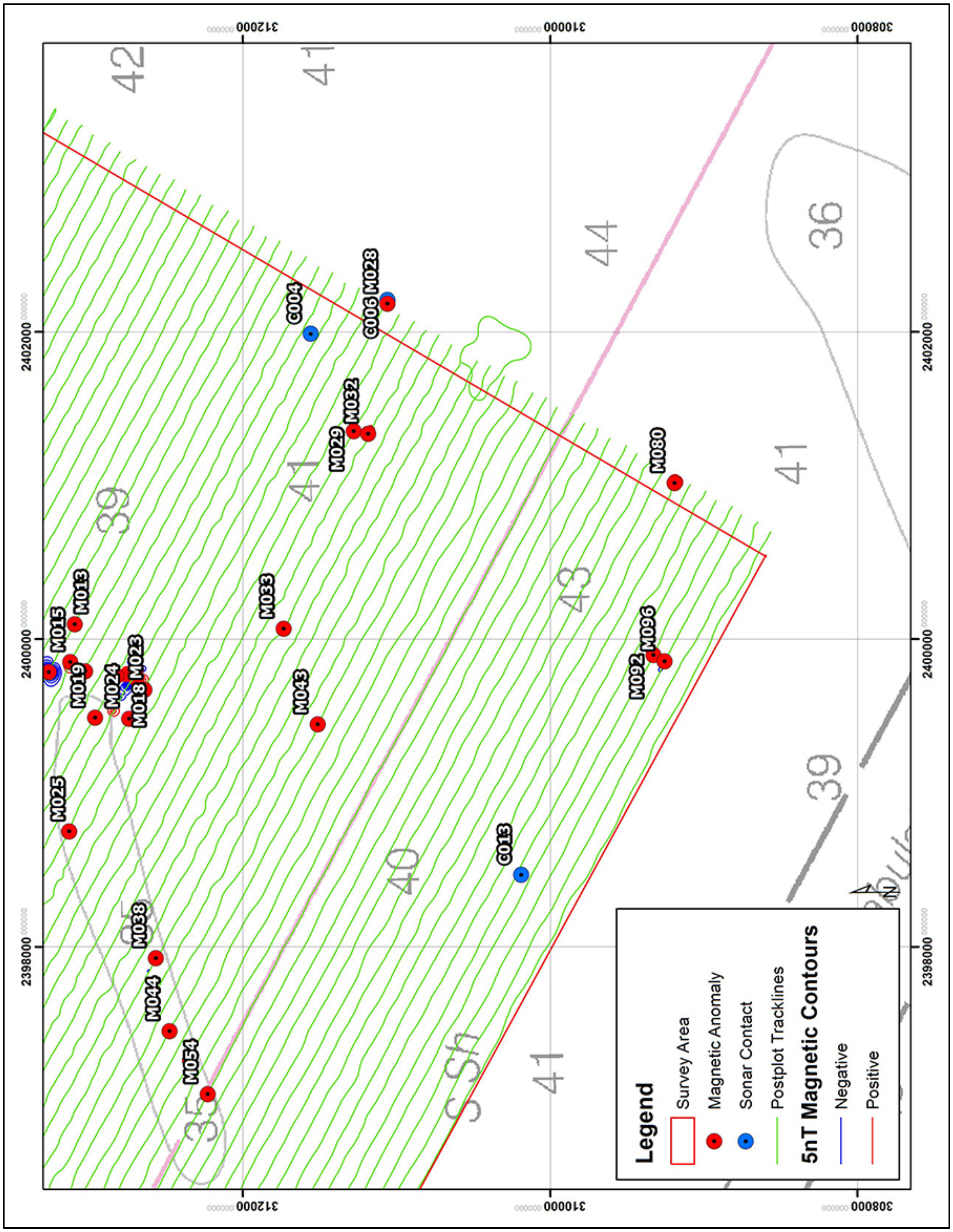


Figure 4-05. Magnetic Contour Map 4 for the Project Area (Mitigation North portion).

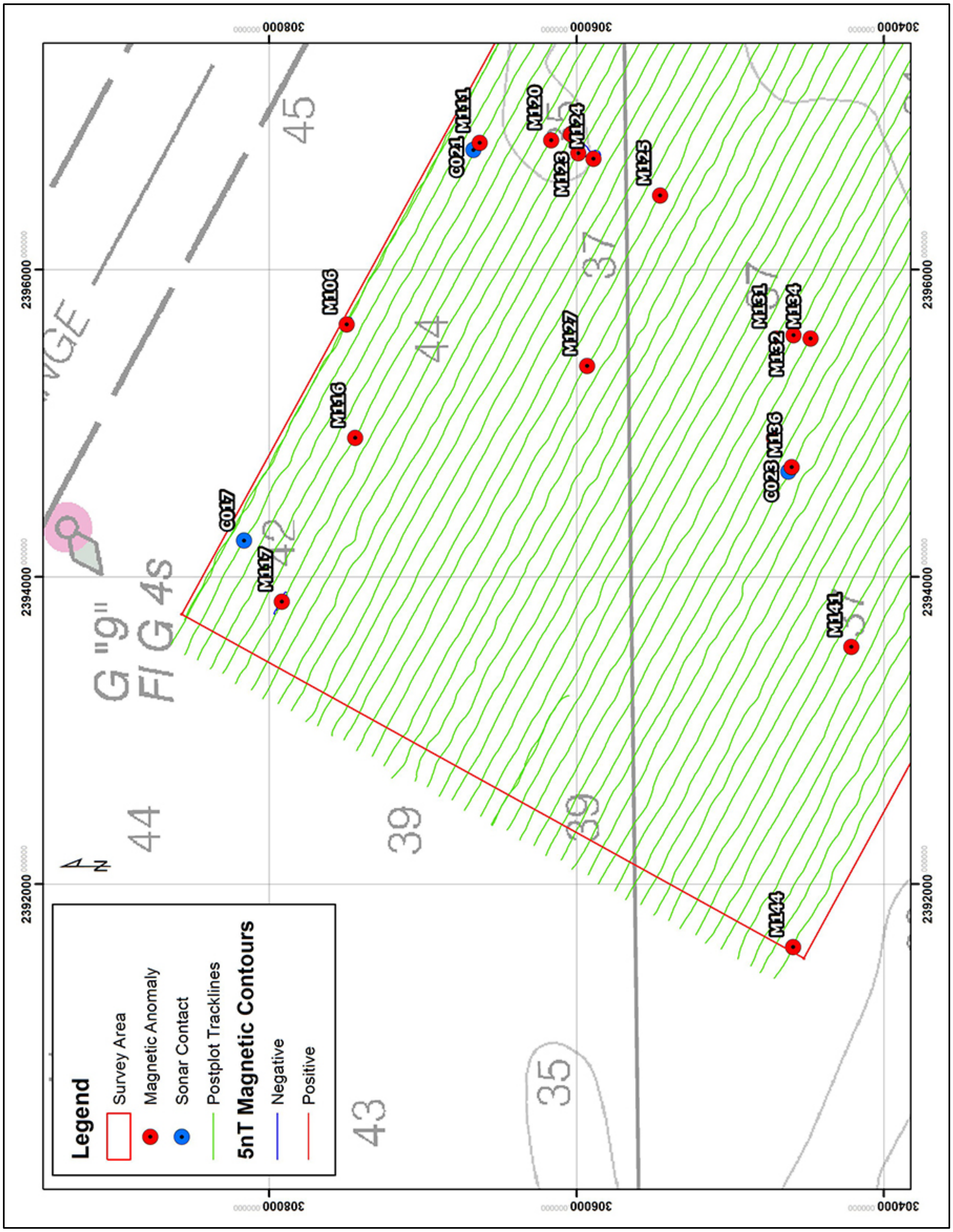


Figure 4-06. Magnetic Contour Map 5 for the Project Area (Mitigation South portion).

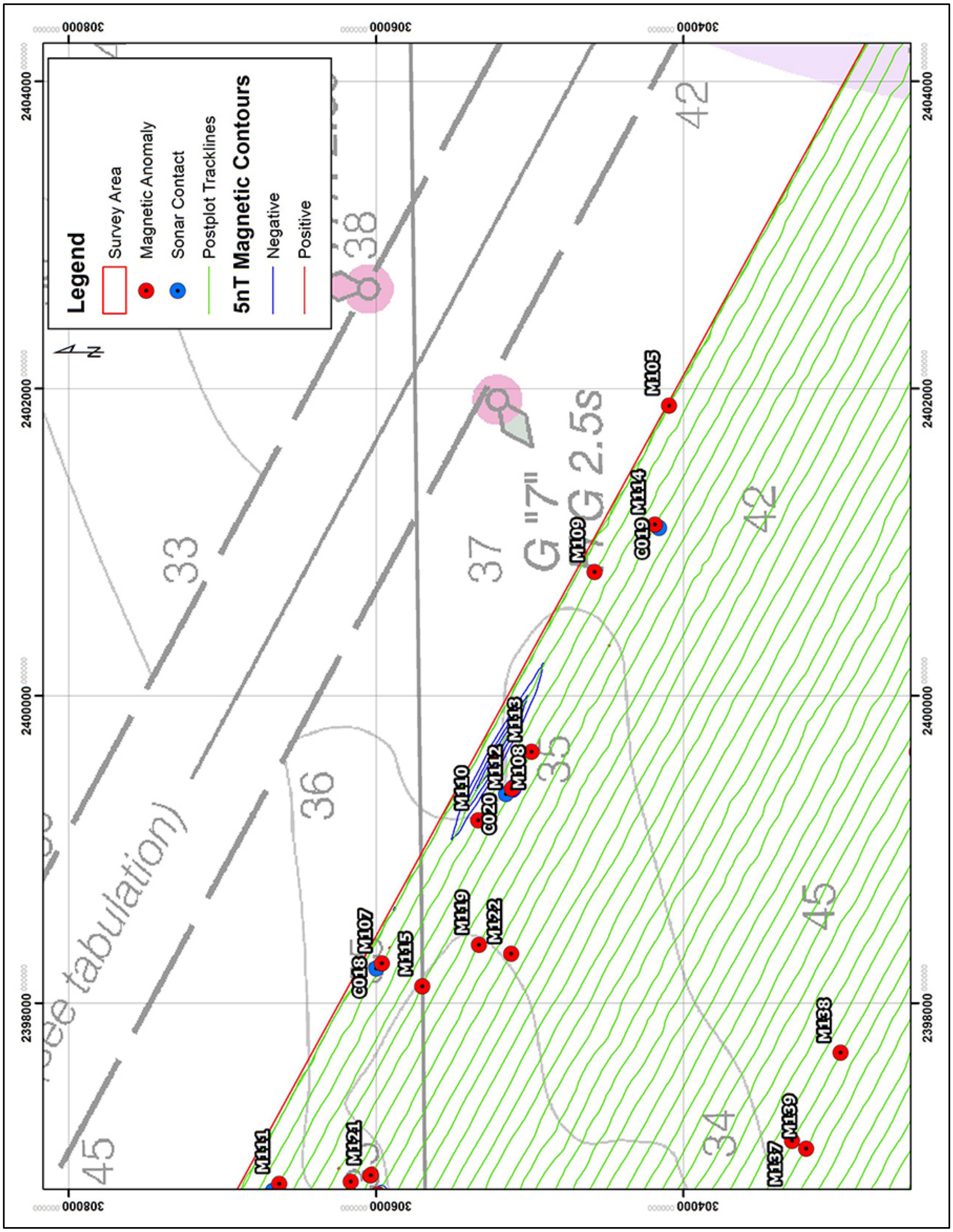


Figure 4-07. Magnetic Contour Map 6 for the Project Area (Mitigation South portion).

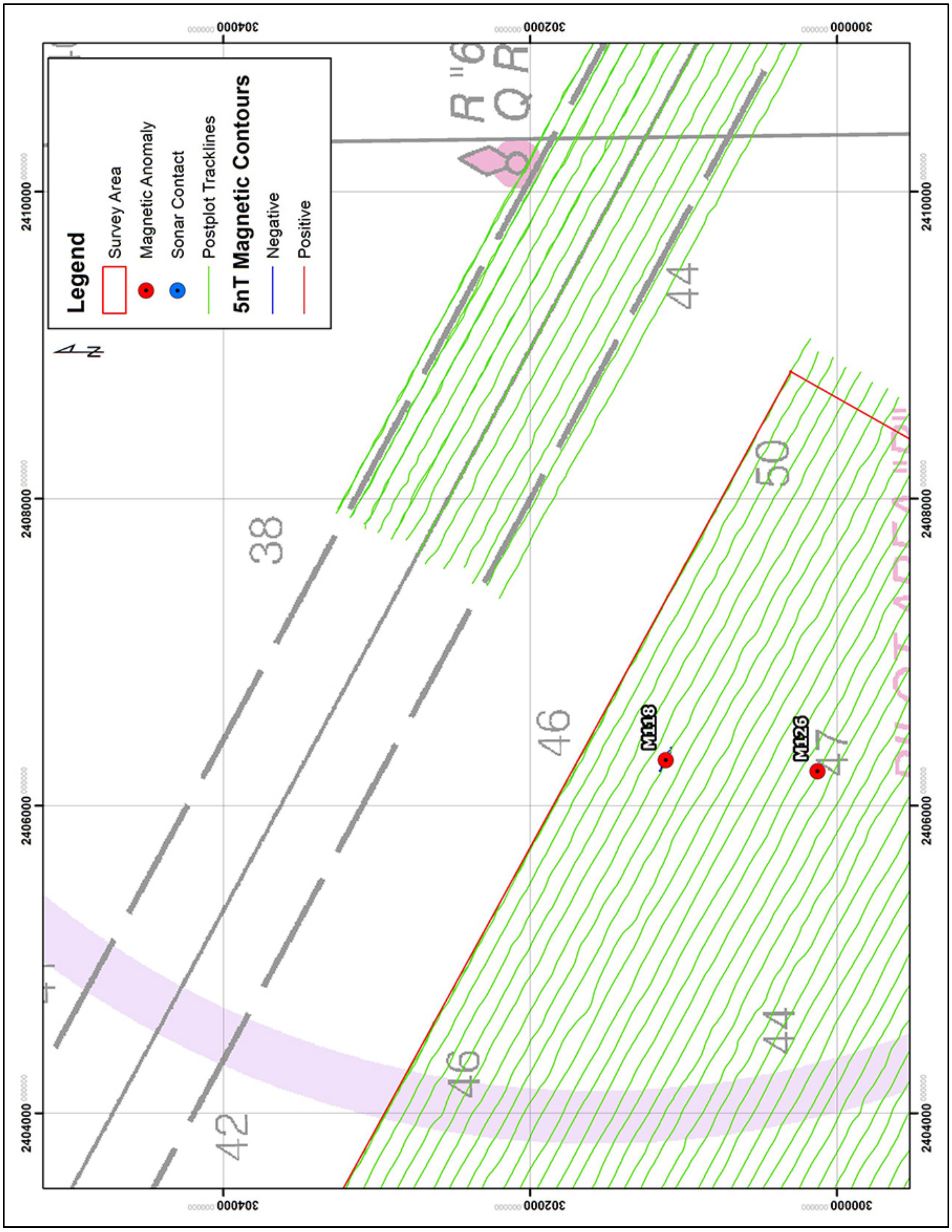


Figure 4-08. Magnetic Contour Map 7 for the Project Area (Mitigation South portion).

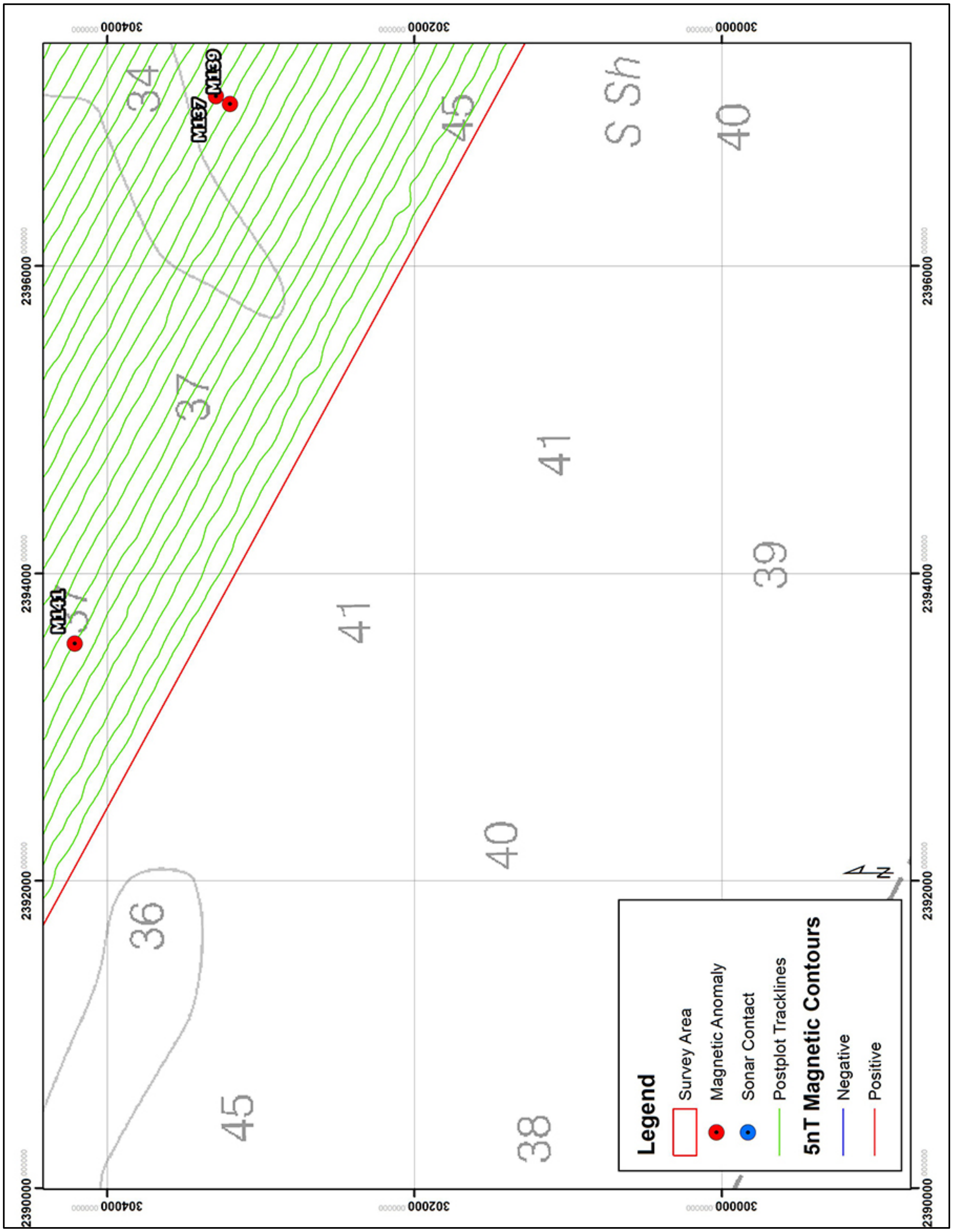


Figure 4-09. Magnetic Contour Map 8 for the Project Area (Mitigation South portion).

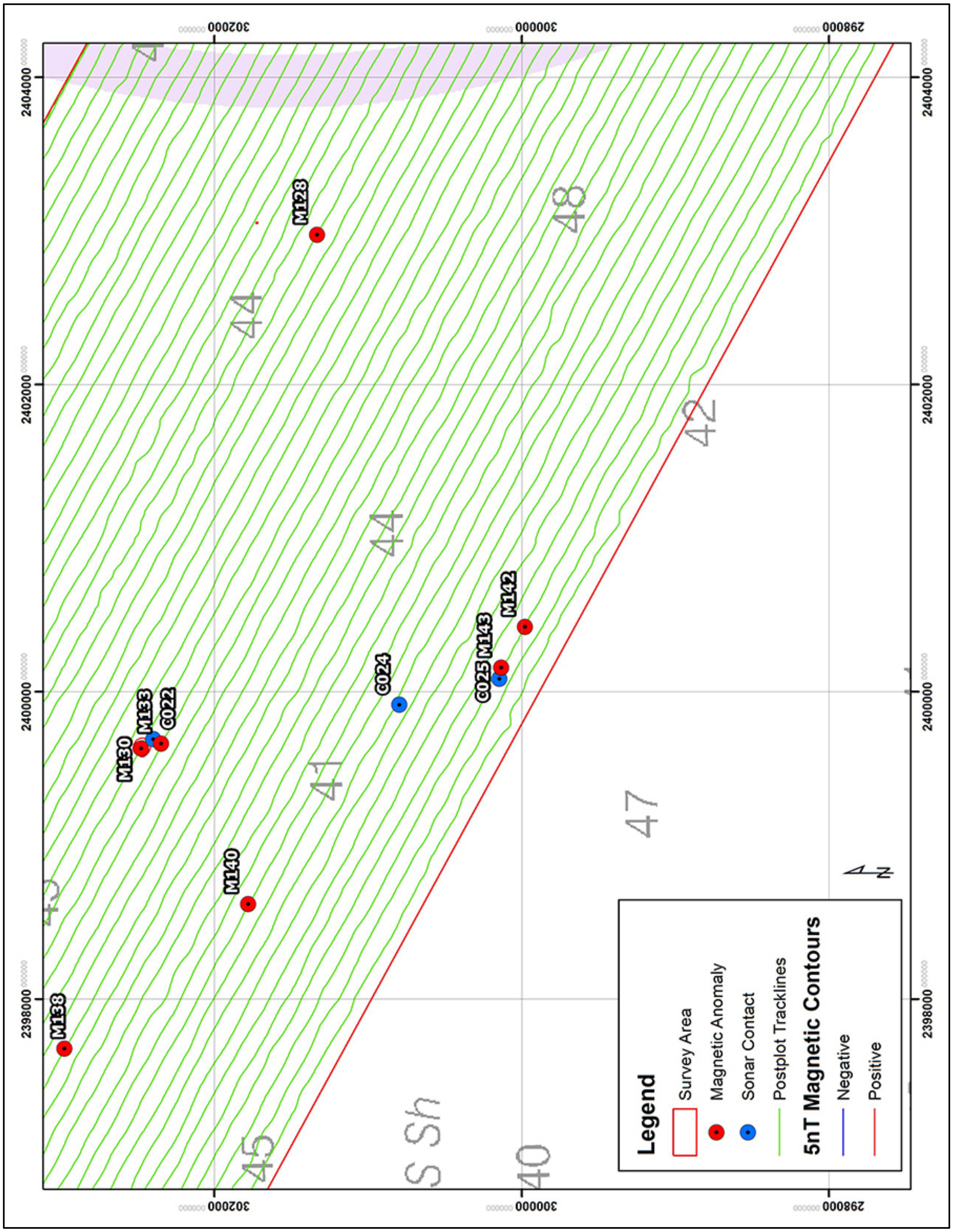


Figure 4-10. Magnetic Contour Map 9 for the Project Area (Mitigation South portion).

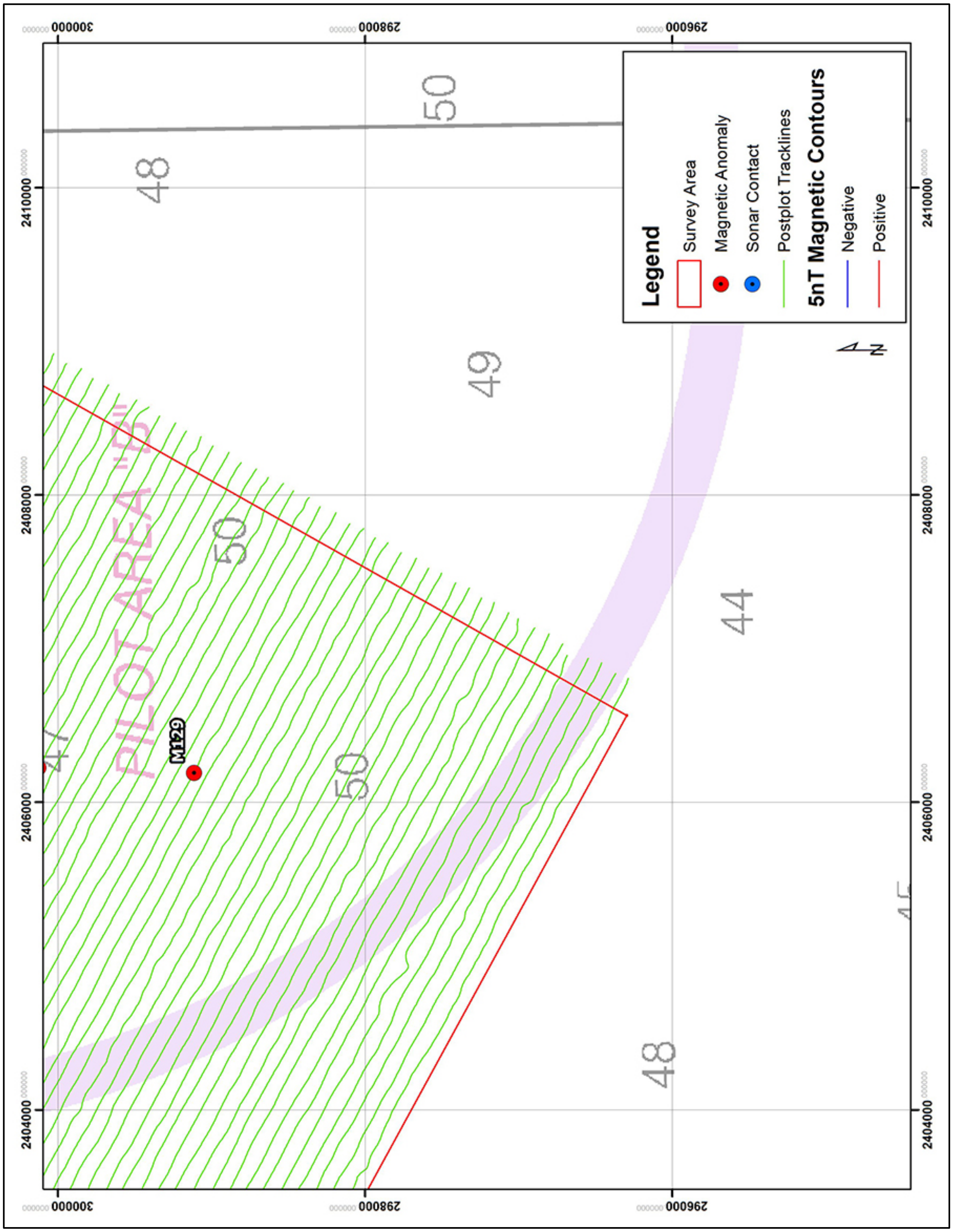


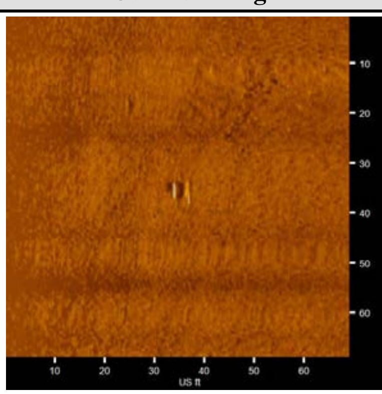
Figure 4-11. Magnetic Contour Map 10 for the Project Area (Mitigation South portion).

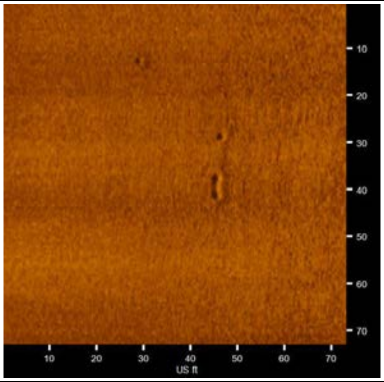
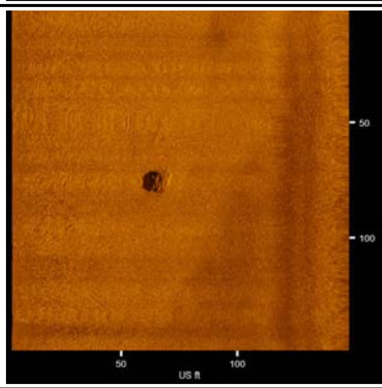
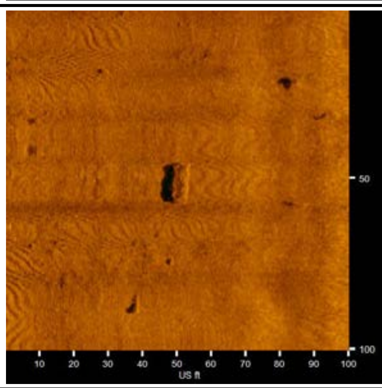
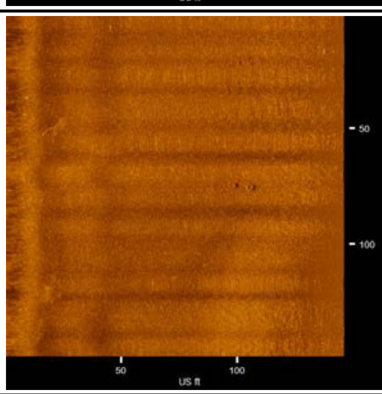
Table 4-02. Sidescan Sonar Targets in the Project Area.*

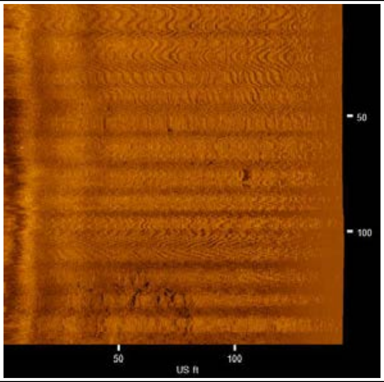
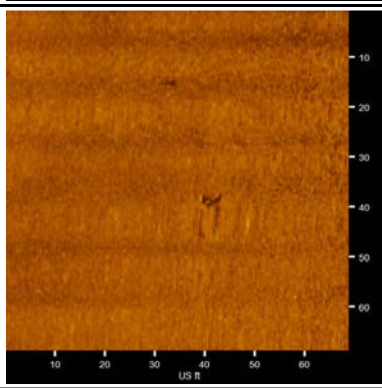
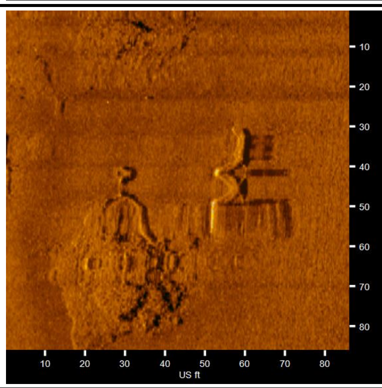
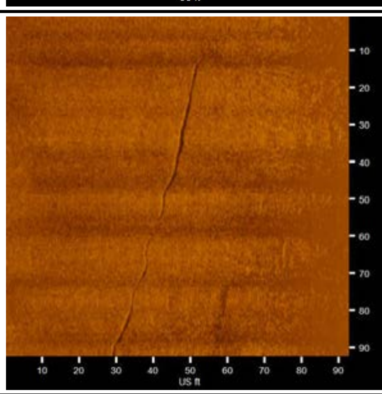
Contact	Description	Width (ft.)	Length	Height	Easting	Northing	Association	Map
C001	debris	3.78	4.1	0.38	2397500	316192		2
C002	debris	2.31	5.47	0.38	2397156	315706	M10	2
C003	unknown	7.46	9.17	1.6	2395443	316420		1
C004	rectangular object	4.01	12.3	1.57	2401991	311558		4
C005	debris	3.21	2.88	0.27	2395847	314919	M20	3
C006	tires	3.09	4.32	0.47	2402210	311059	M28	4
C007	debris	1.83	2.2	6.49	2392904	315838	M30	1
C008	linear objects	2.87	26.96	0.39	2396018	314185		3
C009	linear object	0.91	84.44	0.18	2395769	313410	M45	3
C010	debris	2.12	2.03	1.41	2395253	313141	M60	3
C011	rectangular object	4.98	6.35	1.57	2395927	312423	M67	3
C012	debris	2.33	5.47	0.42	2394925	312722		3
C013	pipe	1.47	9.79	0.86	2398471	310190		4
C014	debris	4.71	3.26	0.36	2393645	312568		3
C015	linear object	4.34	8.4	1.12	2392557	312967		3
C016	rectangular object	4.45	4.44	1.17	2395682	311219	M97, M104	3
C017	tires	4.94	12.96	1.39	2394237	308165		5
C018	cable	0.8	19.5	0.29	2398229	306000	M107	6
C019	pipe	0.81	39.81	0.33	2401095	304159	M114	6
C020	debris	2.87	8.13	0.67	2399363	305154	M112	6
C021	debris	2.89	2.61	0.36	2396781	306672	M111	5
C022	debris	4.21	6.1	0.85	2399695	302398	M130, M133	9
C023	debris	1.14	2.86	0.22	2394687	304624	M136	5
C024	debris	1.76	7.38	0.87	2399920	300797		9
C025	debris	0.91	3.34	0.39	2400087	300146	M143	9

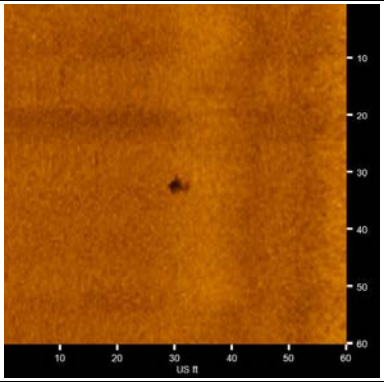
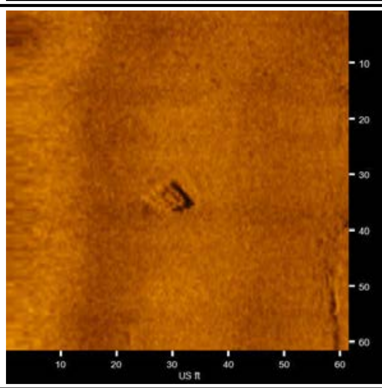
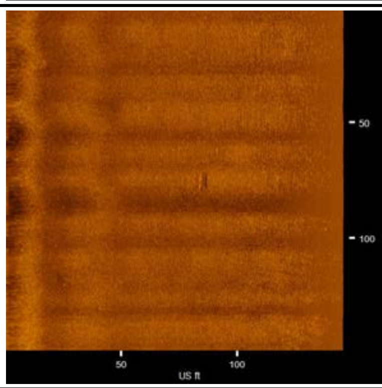
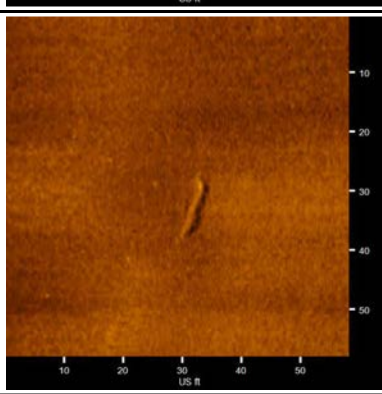
*Coordinates in NAD83 South Carolina State Plane U.S. Survey Feet.

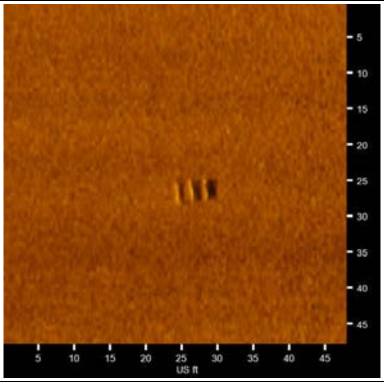
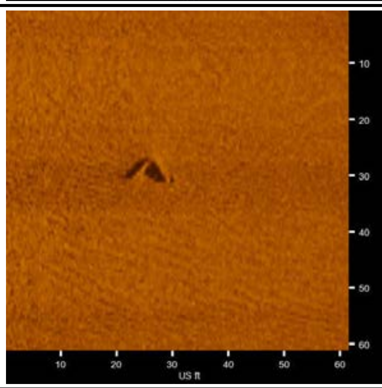
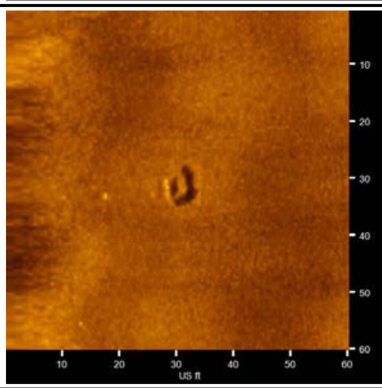
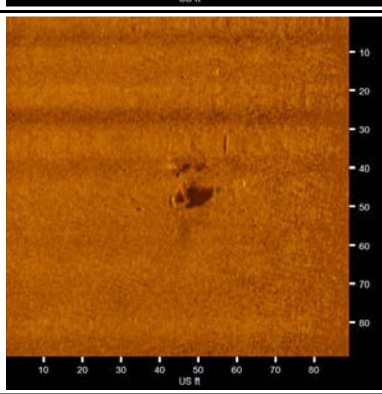
Table 4-03. Sidescan Sonar Targets in the Project Area.

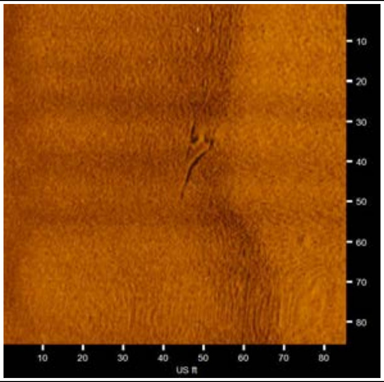
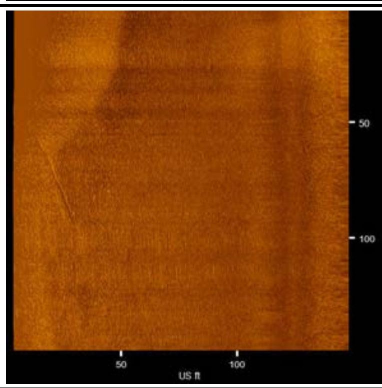
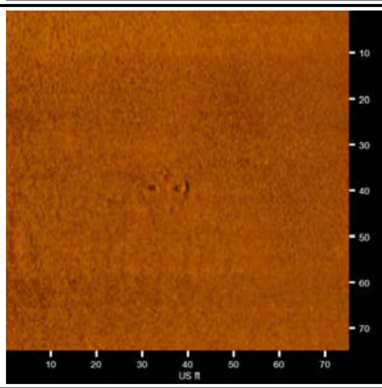
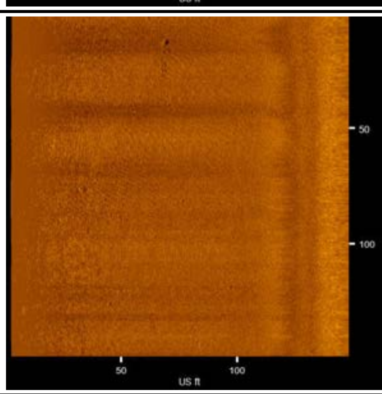
Contact Image	Contact Info	User Entered Info
	**C001** ● Sonar Time at Target: 4/25/2016 7:14:43 PM ● Click Position 32.6955136126 -79.7078329086 (WGS84) 32.6953355308 -79.7080318842 (NAD27LL) 32.6955136126 -79.7078329086 (LocalLL) (X) 2397499.92 (Y) 316191.90 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0015.sds ● Ping Number: 109876 ● Range to target: 104.05 US ft ● Fish Height: 23.87 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0015 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 3.78 US ft ● Target Height: 0.38 US ft ● Target Length: 4.10 US ft ● Target Shadow: 1.74 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris

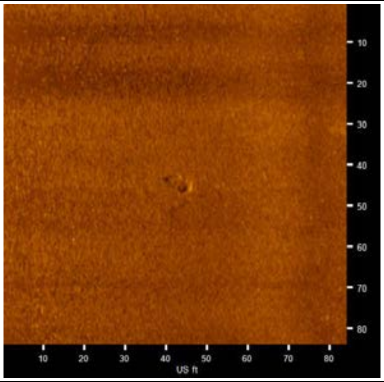
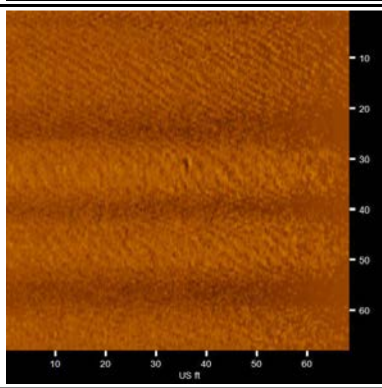
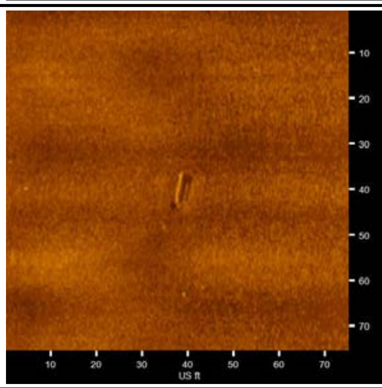
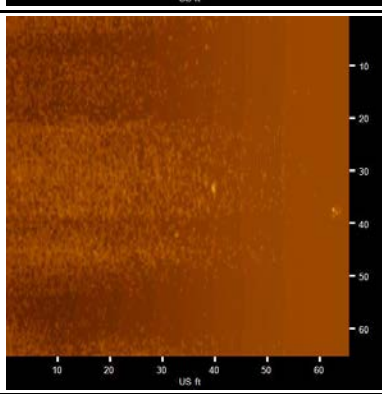
Contact Image	Contact Info	User Entered Info
	**C002** • Sonar Time at Target: 4/25/2016 9:38:12 PM • Click Position 32.6941911204 -79.7089693203 (WGS84) 32.6940129984 -79.7091682338 (NAD27LL) 32.6941911204 -79.7089693203 (LocalLL) (X) 2397156.36 (Y) 315706.42 (Projected Coordinates) • Map Projection: SC83F • Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0017.sds • Ping Number: 199593 • Range to target: 94.92 US ft • Fish Height: 26.32 US ft • Heading: 0.000 Degrees • Event Number: (-1) • Line Name: 2016FEB28_0017 • Water Depth: 0.00 US ft	**Dimensions and attributes** • Target Width: 2.31 US ft • Target Height: 0.38 US ft • Target Length: 5.47 US ft • Target Shadow: 1.44 US ft • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: debris
	**C003** • Sonar Time at Target: 4/26/2016 2:23:52 PM • Click Position 32.6962102014 -79.7145104804 (WGS84) 32.6960321159 -79.7147091145 (NAD27LL) 32.6962102014 -79.7145104804 (LocalLL) (X) 2395442.68 (Y) 316419.69 (Projected Coordinates) • Map Projection: SC83F • Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0021.sds • Ping Number: 38000 • Range to target: 80.21 US ft • Fish Height: 27.91 US ft • Heading: 0.000 Degrees • Event Number: (-1) • Line Name: 2016FEB28_0021 • Water Depth: 0.00 US ft	**Dimensions and attributes** • Target Width: 7.46 US ft • Target Height: 1.60 US ft • Target Length: 9.17 US ft • Target Shadow: 5.15 US ft • Mag Anomaly: • Avoidance Area: • Classification1: unknown • Classification2: • Area: • Block: • Description: Unknown object
	**C004** • Sonar Time at Target: 4/26/2016 9:02:51 PM • Click Position 32.6826236719 -79.6934250944 (WGS84) 32.6824452845 -79.6936247760 (NAD27LL) 32.6826236719 -79.6934250944 (LocalLL) (X) 2401991.19 (Y) 311558.40 (Projected Coordinates) • Map Projection: SC83F • Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0027.sds • Ping Number: 290089 • Range to target: 55.11 US ft • Fish Height: 27.62 US ft • Heading: 0.000 Degrees • Event Number: (-1) • Line Name: 2016FEB28_0027 • Water Depth: 0.00 US ft	**Dimensions and attributes** • Target Width: 4.01 US ft • Target Height: 1.57 US ft • Target Length: 12.30 US ft • Target Shadow: 3.72 US ft • Mag Anomaly: • Avoidance Area: • Classification1: Rectangular object • Classification2: • Area: • Block: • Description: Rectangular object; possibly geological, surrounded by debris
	**C005** • Sonar Time at Target: 4/26/2016 8:40:03 PM • Click Position 32.6920712558 -79.7132560504 (WGS84) 32.6918930612 -79.7134547378 (NAD27LL) 32.6920712558 -79.7132560504 (LocalLL) (X) 2395847.30 (Y) 314918.78 (Projected Coordinates) • Map Projection: SC83F • Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0027.sds • Ping Number: 274994 • Range to target: 105.02 US ft • Fish Height: 25.75 US ft • Heading: 0.000 Degrees • Event Number: (-1) • Line Name: 2016FEB28_0027 • Water Depth: 0.00 US ft	**Dimensions and attributes** • Target Width: 3.21 US ft • Target Height: 0.27 US ft • Target Length: 2.88 US ft • Target Shadow: 1.15 US ft • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: debris

Contact Image	Contact Info	User Entered Info
	**C006** ● Sonar Time at Target: 4/29/2016 10:24:37 PM ● Click Position 32.6812438392 -79.6927360150 (WGS84) 32.6810654161 -79.6929357283 (NAD27LL) 32.6812438392 -79.6927360150 (LocalLL) (X) 2402209.53 (Y) 311059.11 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0031.sds ● Ping Number: 66184 ● Range to target: 103.00 US ft ● Fish Height: 23.44 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0031 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 3.09 US ft ● Target Height: 0.47 US ft ● Target Length: 4.32 US ft ● Target Shadow: 2.16 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: tires ● Classification2: ● Area: ● Block: ● Description: Probable tire
	**C007** ● Sonar Time at Target: 4/29/2016 10:59:14 PM ● Click Position 32.6946983977 -79.7227866318 (WGS84) 32.6945202425 -79.7229848362 (NAD27LL) 32.6946983977 -79.7227866318 (LocalLL) (X) 2392903.67 (Y) 315838.14 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0032.sds ● Ping Number: 91664 ● Range to target: 93.77 US ft ● Fish Height: 24.30 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0032 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 1.83 US ft ● Target Height: 6.49 US ft ● Target Length: 2.20 US ft ● Target Shadow: 35.29 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris
	**C008** ● Sonar Time at Target: 4/29/2016 11:09:55 PM ● Click Position 32.6900473222 -79.7127303449 (WGS84) 32.6898690740 -79.7129290539 (NAD27LL) 32.6900473222 -79.7127303449 (LocalLL) (X) 2396018.19 (Y) 314184.51 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0032.sds ● Ping Number: 97891 ● Range to target: 70.68 US ft ● Fish Height: 20.70 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0032 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 2.87 US ft ● Target Height: 0.39 US ft ● Target Length: 26.96 US ft ● Target Shadow: 1.43 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: linear objects ● Classification2: ● Area: ● Block: ● Description: Two linear objects, possibly cables or geological features
	**C009** ● Sonar Time at Target: 4/30/2016 3:29:27 AM ● Click Position 32.6879271842 -79.7135712324 (WGS84) 32.6877488750 -79.7137698924 (NAD27LL) 32.6879271842 -79.7135712324 (LocalLL) (X) 2395769.11 (Y) 313410.00 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0036.sds ● Ping Number: 277345 ● Range to target: 100.69 US ft ● Fish Height: 33.54 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0036 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 0.91 US ft ● Target Height: 0.18 US ft ● Target Length: 84.44 US ft ● Target Shadow: 0.57 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: linear object ● Classification2: ● Area: ● Block: ● Description: possibly cable or pipe

Contact Image	Contact Info	User Entered Info
	**C010** ● Sonar Time at Target: 4/30/2016 6:41:47 AM ● Click Position 32.6872067114 -79.7152607738 (WGS84) 32.6870283768 -79.7154593451 (NAD27LL) 32.6872067114 -79.7152607738 (LocalLL) (X) 2395252.60 (Y) 313141.44 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0040.sds ● Ping Number: 412021 ● Range to target: 35.78 US ft ● Fish Height: 29.53 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0040 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 2.12 US ft ● Target Height: 1.41 US ft ● Target Length: 2.03 US ft ● Target Shadow: 2.33 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris
	**C011** ● Sonar Time at Target: 4/30/2016 8:22:13 AM ● Click Position 32.6852101009 -79.7130971776 (WGS84) 32.6850317189 -79.7132958547 (NAD27LL) 32.6852101009 -79.7130971776 (LocalLL) (X) 2395927.26 (Y) 312423.37 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0041.sds ● Ping Number: 479613 ● Range to target: 29.72 US ft ● Fish Height: 30.33 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0041 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 4.98 US ft ● Target Height: 1.57 US ft ● Target Length: 6.35 US ft ● Target Shadow: 2.32 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: Rectangular object ● Classification2: ● Area: ● Block: ● Description: Rectangular object
	**C012** ● Sonar Time at Target: 4/30/2016 8:51:15 AM ● Click Position 32.6860644718 -79.7163431925 (WGS84) 32.6858861024 -79.7165417050 (NAD27LL) 32.6860644718 -79.7163431925 (LocalLL) (X) 2394924.77 (Y) 312721.76 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0042.sds ● Ping Number: 498867 ● Range to target: 85.98 US ft ● Fish Height: 26.61 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0042 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 2.33 US ft ● Target Height: 0.42 US ft ● Target Length: 5.47 US ft ● Target Shadow: 1.44 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris
	**C013** ● Sonar Time at Target: 4/30/2016 12:21:58 PM ● Click Position 32.6789845662 -79.7049223596 (WGS84) 32.6788060407 -79.7051214402 (NAD27LL) 32.6789845662 -79.7049223596 (LocalLL) (X) 2398470.59 (Y) 310190.00 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0045.sds ● Ping Number: 649935 ● Range to target: 60.01 US ft ● Fish Height: 35.70 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0045 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 1.47 US ft ● Target Height: 0.86 US ft ● Target Length: 9.79 US ft ● Target Shadow: 1.72 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: pipe ● Classification2: ● Area: ● Block: ● Description: pipe

Contact Image	Contact Info	User Entered Info
	**C014** ● Sonar Time at Target: 4/30/2016 1:31:19 PM ● Click Position 32.6856866728 -79.7205082134 (WGS84) 32.6855082792 -79.7207065107 (NAD27LL) 32.6856866728 -79.7205082134 (LocalLL) (X) 2393645.13 (Y) 312568.43 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0046.sds ● Ping Number: 703069 ● Range to target: 74.44 US ft ● Fish Height: 24.74 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0046 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 4.71 US ft ● Target Height: 0.36 US ft ● Target Length: 3.26 US ft ● Target Shadow: 1.17 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris
	**C015** ● Sonar Time at Target: 4/30/2016 1:33:45 PM ● Click Position 32.6868194382 -79.7240272927 (WGS84) 32.6866410637 -79.7242254122 (NAD27LL) 32.6868194382 -79.7240272927 (LocalLL) (X) 2392557.42 (Y) 312967.14 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0046.sds ● Ping Number: 705055 ● Range to target: 89.21 US ft ● Fish Height: 31.52 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0046 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 4.34 US ft ● Target Height: 1.12 US ft ● Target Length: 8.40 US ft ● Target Shadow: 3.48 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: linear object ● Classification2: ● Area: ● Block: ● Description: possibly bent pipe
	**C016** ● Sonar Time at Target: 4/30/2016 1:58:04 PM ● Click Position 32.6819090647 -79.7139424806 (WGS84) 32.6817305895 -79.7141411053 (NAD27LL) 32.6819090647 -79.7139424806 (LocalLL) (X) 2395682.15 (Y) 311219.25 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\CharlestonSC\2016FEB28_0047.sds ● Ping Number: 722398 ● Range to target: 31.45 US ft ● Fish Height: 30.62 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016FEB28_0047 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 4.45 US ft ● Target Height: 1.17 US ft ● Target Length: 4.44 US ft ● Target Shadow: 1.75 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: Rectangular object ● Classification2: ● Area: ● Block: ● Description: Rectangular object
	**C017** ● Sonar Time at Target: 5/23/2016 3:58:45 PM ● Click Position 32.6735642286 -79.7187605689 (WGS84) 32.6733855093 -79.7189589235 (NAD27LL) 32.6735642286 -79.7187605689 (LocalLL) (X) 2394237.46 (Y) 308165.06 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\Charleston2\2016MAY23_0002.sds ● Ping Number: 3132 ● Range to target: 90.88 US ft ● Fish Height: 23.01 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016MAY23_0002 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 4.94 US ft ● Target Height: 1.39 US ft ● Target Length: 12.96 US ft ● Target Shadow: 6.01 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: tires ● Classification2: ● Area: ● Block: ● Description: Tire and debris

Contact Image	Contact Info	User Entered Info
	**C018** ● Sonar Time at Target: 5/23/2016 4:09:27 PM ● Click Position 32.6674763708 -79.7058769299 (WGS84) 32.6672975265 -79.7060759304 (NAD27LL) 32.6674763708 -79.7058769299 (LocalLL) (X) 2398229.32 (Y) 305999.74 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\Charleston2\2016MAY23_0002.sds ● Ping Number: 11109 ● Range to target: 81.94 US ft ● Fish Height: 21.71 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016MAY23_0002 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 0.80 US ft ● Target Height: 0.29 US ft ● Target Length: 19.50 US ft ● Target Shadow: 1.14 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: cable ● Classification2: ● Area: ● Block: ● Description: cable or wire
	**C019** ● Sonar Time at Target: 5/23/2016 6:43:59 PM ● Click Position 32.6623181687 -79.6966402839 (WGS84) 32.6621392121 -79.6968397453 (NAD27LL) 32.6623181687 -79.6966402839 (LocalLL) (X) 2401095.18 (Y) 304158.95 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\Charleston2\2016MAY23_0004.sds ● Ping Number: 125907 ● Range to target: 126.37 US ft ● Fish Height: 29.93 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016MAY23_0004 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 0.81 US ft ● Target Height: 0.33 US ft ● Target Length: 39.81 US ft ● Target Shadow: 1.44 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: pipe ● Classification2: ● Area: ● Block: ● Description: pipe
	**C020** ● Sonar Time at Target: 5/23/2016 6:48:30 PM ● Click Position 32.6651125792 -79.7022281398 (WGS84) 32.6649336816 -79.7024273215 (NAD27LL) 32.6651125792 -79.7022281398 (LocalLL) (X) 2399362.89 (Y) 305153.90 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\Charleston2\2016MAY23_0004.sds ● Ping Number: 129406 ● Range to target: 81.36 US ft ● Fish Height: 25.60 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016MAY23_0004 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 2.87 US ft ● Target Height: 0.67 US ft ● Target Length: 8.13 US ft ● Target Shadow: 2.30 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris
	**C021** ● Sonar Time at Target: 5/23/2016 7:14:19 PM ● Click Position 32.6693746155 -79.7105568377 (WGS84) 32.6691958081 -79.7107556027 (NAD27LL) 32.6693746155 -79.7105568377 (LocalLL) (X) 2396780.66 (Y) 306672.31 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\Charleston2\2016MAY23_0005.sds ● Ping Number: 149469 ● Range to target: 113.67 US ft ● Fish Height: 24.74 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016MAY23_0005 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 2.89 US ft ● Target Height: 0.36 US ft ● Target Length: 2.61 US ft ● Target Shadow: 1.73 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris

Contact Image	Contact Info	User Entered Info
	**C022** ● Sonar Time at Target: 5/25/2016 6:28:56 PM ● Click Position 32.6575268266 -79.7012625870 (WGS84) 32.6573477237 -79.7014617978 (NAD27LL) 32.6575268266 -79.7012625870 (LocalLL) (X) 2399694.68 (Y) 302398.00 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\Charleston2\2016MAY23_0022.sds ● Ping Number: 213680 ● Range to target: 66.08 US ft ● Fish Height: 37.29 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016MAY23_0022 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 4.21 US ft ● Target Height: 0.85 US ft ● Target Length: 6.10 US ft ● Target Shadow: 1.78 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris
	**C023** ● Sonar Time at Target: 5/25/2016 9:50:20 PM ● Click Position 32.6638163266 -79.7174430172 (WGS84) 32.6636373449 -79.7176414133 (NAD27LL) 32.6638163266 -79.7174430172 (LocalLL) (X) 2394686.87 (Y) 304623.88 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\Charleston2\2016MAY23_0025.sds ● Ping Number: 386311 ● Range to target: 99.24 US ft ● Fish Height: 26.47 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016MAY23_0025 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 1.14 US ft ● Target Height: 0.22 US ft ● Target Length: 2.86 US ft ● Target Shadow: 0.86 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris
	**C024** ● Sonar Time at Target: 5/26/2016 2:38:47 AM ● Click Position 32.6531196121 -79.7005963740 (WGS84) 32.6529403903 -79.7007956072 (NAD27LL) 32.6531196121 -79.7005963740 (LocalLL) (X) 2399919.87 (Y) 300797.27 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\Charleston2\2016MAY23_0030.sds ● Ping Number: 630632 ● Range to target: 71.08 US ft ● Fish Height: 42.48 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016MAY23_0030 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 1.76 US ft ● Target Height: 0.87 US ft ● Target Length: 7.38 US ft ● Target Shadow: 1.74 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris
	**C025** ● Sonar Time at Target: 5/26/2016 4:32:22 AM ● Click Position 32.6513226707 -79.7000790200 (WGS84) 32.6511434011 -79.7002782749 (NAD27LL) 32.6513226707 -79.7000790200 (LocalLL) (X) 2400087.31 (Y) 300145.56 (Projected Coordinates) ● Map Projection: SC83F ● Acoustic Source File: G:\Charleston\Charleston2\2016MAY23_0032.sds ● Ping Number: 727581 ● Range to target: 115.95 US ft ● Fish Height: 39.88 US ft ● Heading: 0.000 Degrees ● Event Number: (-1) ● Line Name: 2016MAY23_0032 ● Water Depth: 0.00 US ft	**Dimensions and attributes** ● Target Width: 0.91 US ft ● Target Height: 0.39 US ft ● Target Length: 3.34 US ft ● Target Shadow: 1.21 US ft ● Mag Anomaly: ● Avoidance Area: ● Classification1: debris ● Classification2: ● Area: ● Block: ● Description: debris

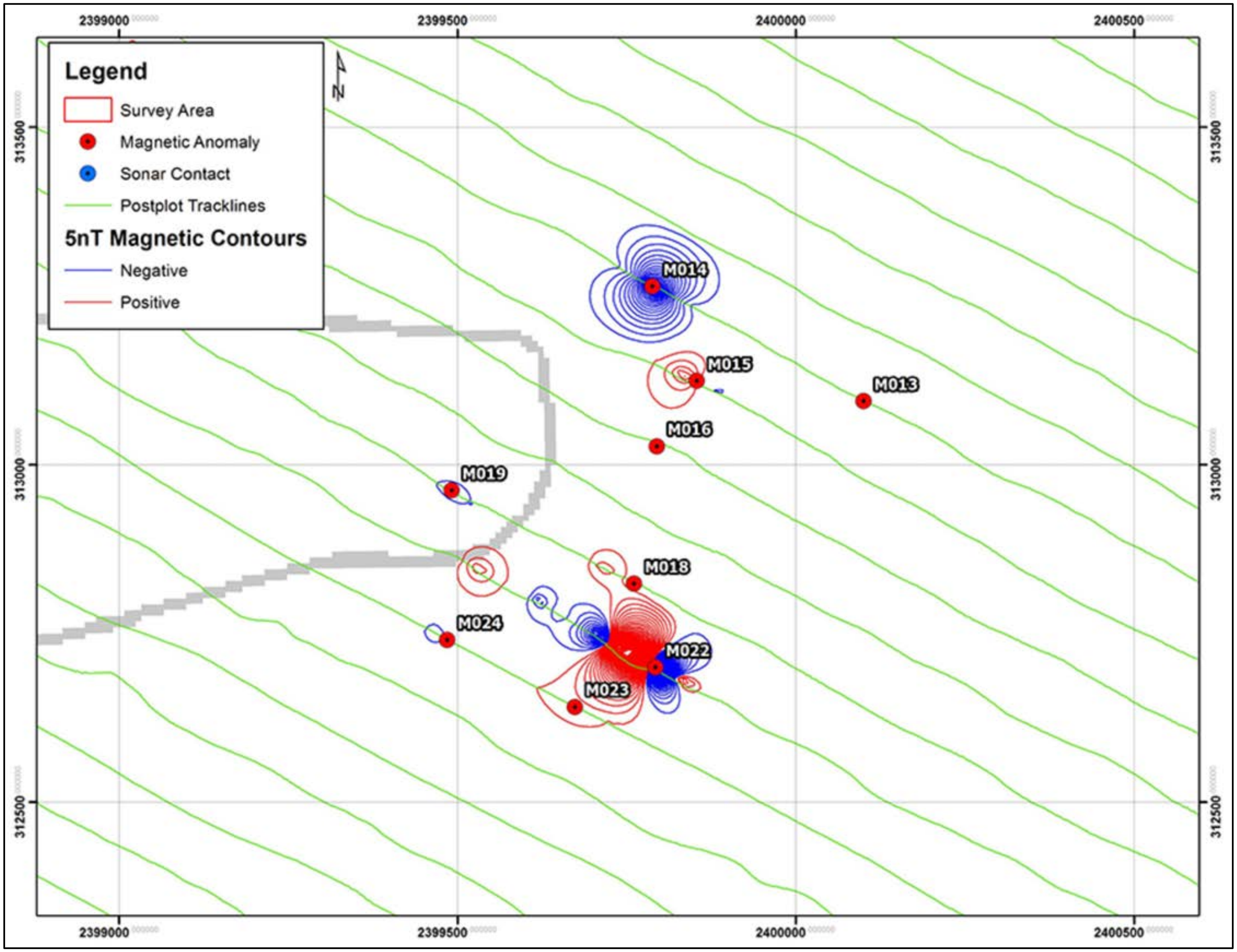


Figure 4-12. Close up of the Anomaly M022 Cluster in the Mitigation North. The main anomaly is M22 with a magnetic deviation of 519 nanoteslas; however, it appears to not influence the opposite lines, suggesting it is a single-point source that is almost linear in its duration.

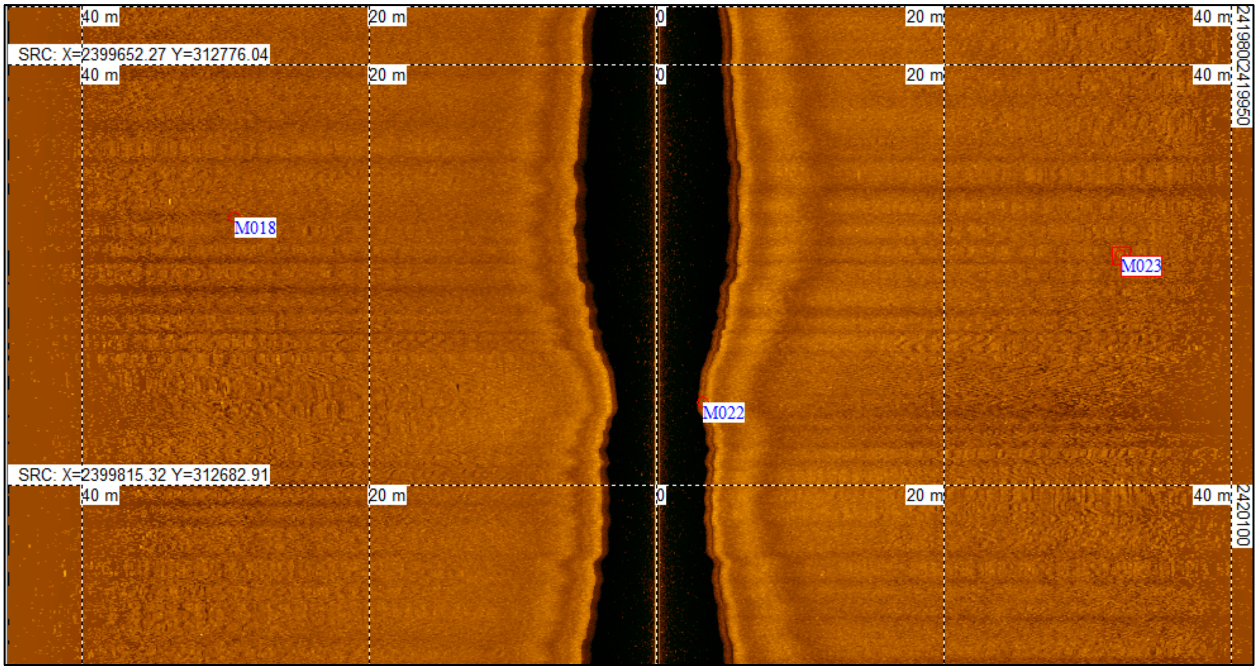


Figure 4-13. Sonar image of the Anomaly M022 Cluster location in the Mitigation North. Locations for M018, M022, and M023 are marked. Note the uniform bottom and the absence of any acoustic feature. There is, however, a rise in elevation at M022, which indicates a possible geologic source, although a magnetic deviation of 519 nanoteslas argues against this possibility.

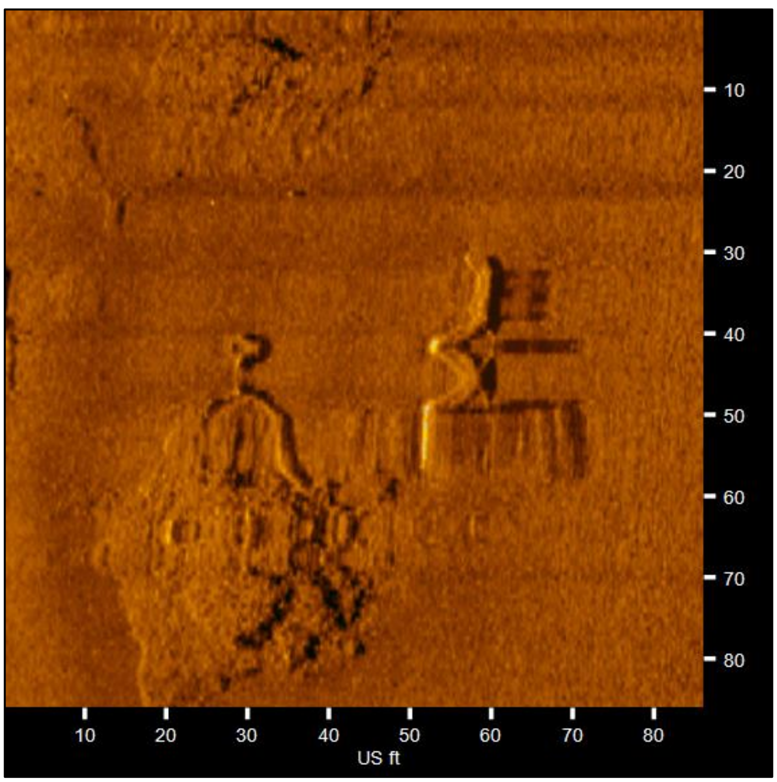


Figure 4-14. Acoustic image sonar contact C008. Lacking a magnetic signature, the image is comprised of two linear objects, possibly cables or geological features.

SUBBOTTOM PROFILER RESULTS

The subbottom remote sensing over the project area resulted in 6 Gigabytes of data divided into 46 files of Edgetech (*.JSF) data. The subbottom device was operated at the same time as the magnetometer and sidescan sonar over the planned track lines. Each subbottom data file was inspected and the first return bottom tracked in SonarWiz.MAP. The bottom tracking coverage covered all recorded lines.

Presented in Figure 4-15 is an isopach map of the paleochannel features in the Mitigation North. Attention should be brought to the bend feature in the northeastern portion of the survey area that is a large paleochannel. The other subbottom features are isolated and only carried over a few of lines; being such, they are more likely isolated areas of sediment infill rather than paleochannels. Figure 4-16 is a profile of the large paleochannel. While the side terraces would have the potential for possible prehistoric habitation, the profile shows that it is buried approximately 10 feet deep and should not be affected by artificial reef placement.

There was neither subbottom contact nor relict feature in the Mitigation South. Presented in Figure 4-17 is a typical profile in Mitigation South showing a lack of features (Line 3).

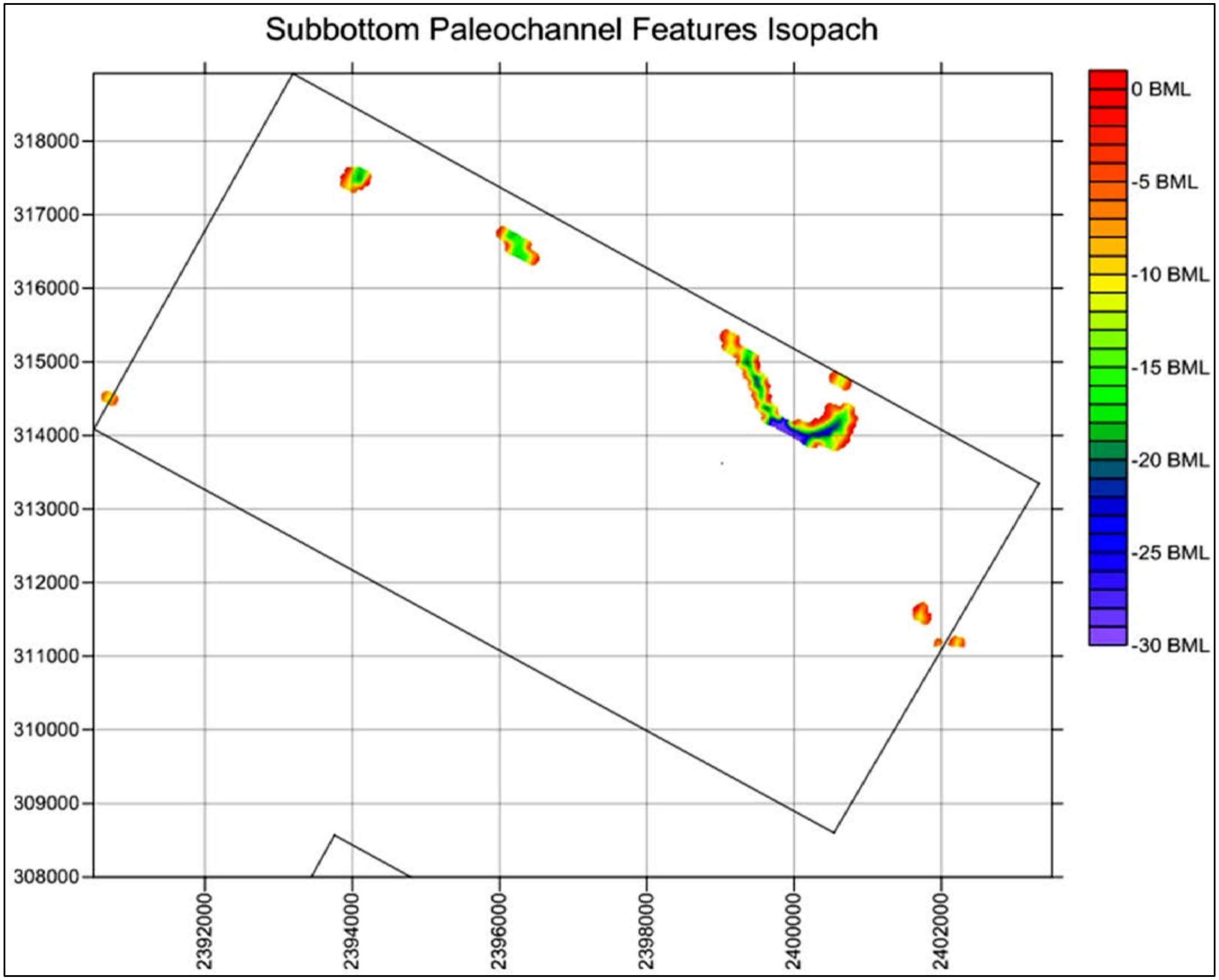


Figure 4-15. Isopach map of subbottom features in the Mitigation North, showing bend feature in the northeastern portion of the Project Area that is a large paleochannel.

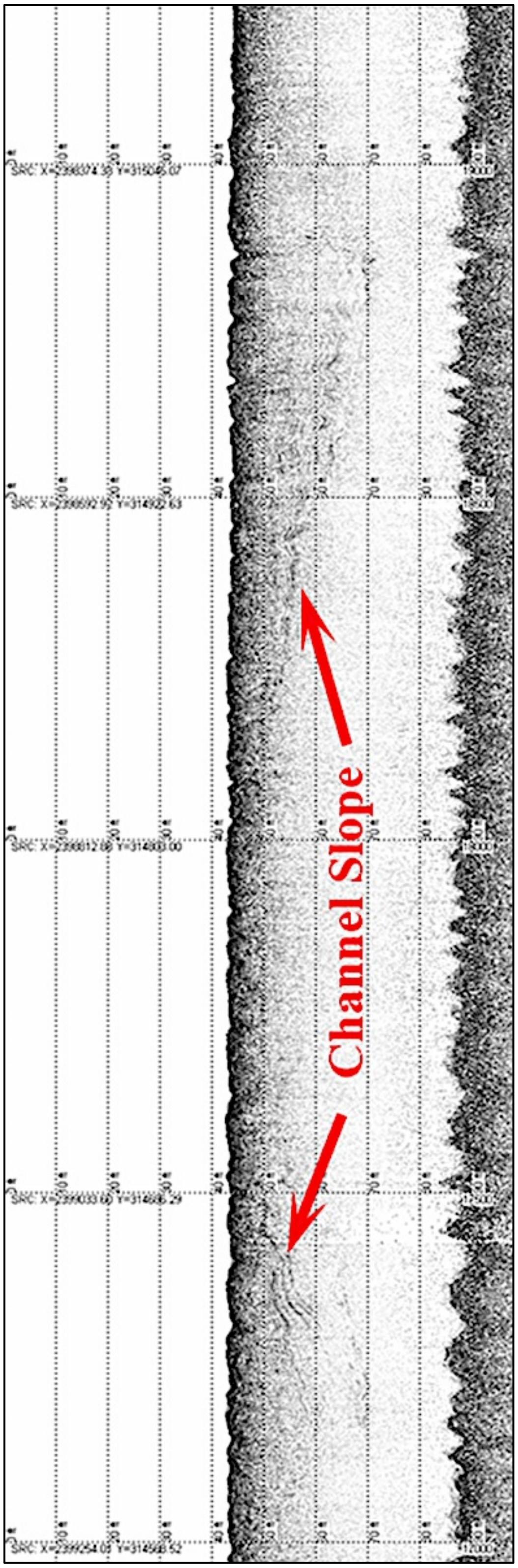


Figure 4-16. Profile of large paleochannel in the Northern Mitigation showing burial depth. The best image recorded of the large paleo channel, and as you can see the line crosses the channel twice. The upper side terrace is buried approximately 10 feet. Left is north, and it is annotated with 500 ft. distance intervals.

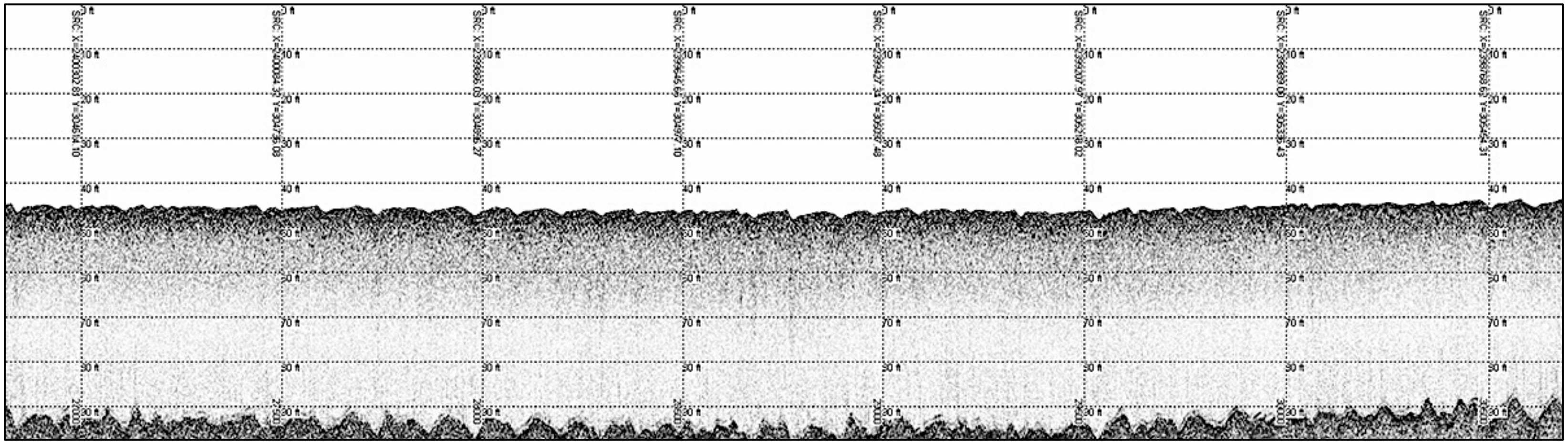


Figure 4-17. Typical profile in the southern area the Southern Mitigation Area showing a lack of features. Left is north, and it is annotated with 500 ft. distance intervals.

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V. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS AND RECOMMENDATIONS

The South Carolina State Ports Authority, in concert with the USACE, Charleston District is currently proposing to deepen the Charleston Harbor Entrance Channel from 45 feet to 52 feet in order to meet the evolving needs of the harbor and the vessels of increasing size that use it. As part of the recently completed Charleston Harbor Post 45 Integrated Feasibility Report/ Environmental Impact Statement, two mitigation areas were identified for the construction of eight 33-acre artificial reefs adjacent the entrance channel from 8 to 12 miles offshore Charleston Harbor. In order to comply with their responsibilities towards cultural resources, Panamerican, under subcontract to DC&A, conducted a comprehensive remote sensing survey of the two mitigation areas for the agencies. Performed between 19 February and 26 May 2016, the survey utilized a magnetometer, sidescan sonar, and subbottom profiler.

The Project Area consists of two survey areas: Mitigation North and Mitigation South. Within the Project Area 144 magnetic anomalies and 25 sidescan sonar contacts were recorded (see Table 4-01). In total, 104 anomalies and 16 sonar targets were recorded in the Mitigation North portion, and 40 anomalies and seven sonar targets were recorded in the Mitigation South portion. Analysis of the data indicates a lack of anomalies or sonar targets that can unequivocally be considered potentially significant; however, a single noteworthy cluster of anomalies is located in Mitigation North. Consisting of anomalies M-18, M-19, M-22, M-23, and M-24, the cluster is most likely not significant. Because of the uncertainty concerning the source of the magnetics, it is suggested that a 100-foot avoidance zone around its perimeter be implemented. In addition to this cluster, there is a single interesting sonar contact also located in Mitigation North, C008. It consists of two linear objects, possibly cables or geological features, and lacks magnetic signature. Because of the uncertainty concerning C008's identification, it is also suggested that a 100-foot avoidance buffer around its perimeter be implemented.

No additional potentially significant anomalies or targets were observed in the data. Furthermore, a review of the subbottom data did not detect any buried paleofeatures that would have the potential to contain submerged prehistoric sites in Mitigation South. The single paleofeature recorded in Mitigation North is buried approximately 10 feet and should not be affected by project activities; however, to ensure no impact to this feature a 100-foot avoidance buffer around its perimeter should be enforced. With these safeguards in place, no additional archaeological work is warranted.

PROCEDURES TO DEAL WITH UNEXPECTED DISCOVERIES

Reasonable effort has been made during this investigation to identify and evaluate possible locations of historic archaeological sites and potential prehistoric site locations within the Project Area; however, the possibility exists that evidence of prehistoric and historic resources may yet be encountered within the project limits not previously identified in the above conclusions and recommendations. Should any evidence of historic resources be discovered during project activities, it is recommended that all work in that portion of the Project Area cease immediately, and that the SHPO and SCIAA be contacted for further guidance. Evidence of historic resources includes: aboriginal or historic pottery; and prehistoric stone, bone, and/or shell tools, as well as historic shipwreck remains. Should questionable materials be uncovered during project activities, procedures contained in *ACHP 36 CFR Part 800* will take effect.

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APPENDIX A: DOCUMENTATION OF VESSEL LOSSES AS PRESENTED IN GAYES ET AL. 2013

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5.3 Documentation of Vessel Losses

Table 2. This list of ship losses reflects consultation with archaeological and historical works and individuals (Spirek & Amer eds. 2004, Watts 1986, Gaines 2008, Spirek 2012). The Stone Fleets are composed of 14 and 16 ships; Spirek (2012) has identified the First Stone Fleet, but the Second has not been located precisely.

The First Stone Fleet includes the barks AMAZON and LEONIDAS; whaling barks AMERICA, FORTUNE, AMERICAN; whalers ARCHER, COURIER, HERALD, MARIA THERESA, REBECCA SIMS, ROBIN HOOD, WILLIAM LEE; TENEDOS; merchant ship KENSINGTON; and ship L.C. RICHMOND among the 14. The Second Stone Fleet includes ships MAJESTIC, METEOR; barks MARCIA, MARGARET SCOTT; whalers MECHANIC, NEWBURYPORT, POTOMAC, NEW ENGLAND; ship PERI, whaling barks MESSENGER, NOBLE; merchant brig STEPHEN YOUNG, TIMOR, merchantman BOGOTA, and merchantman bark JUBILEE among others.

Date	Vessel name	Description	Disposition and Location
15 Dec 1733	ABIGAIL & ANN	10 guns	Wraggs Wharf
12 Sep 1742	Long boat	Lost with 4 cannon	Inside harbor from Fort Sumter
8 July 1743	William Pandridge's boat	Boat	Sunk between Ft. Sumter & Sullivan's Island
4 May 1752	BENNET GALLEY	rowed galley	Lost at Buchannan's Wharf
15 Sep 1752	Mr. Edward's pilot boat	Pilot Boat	lost at The Exchange
15 Sep 1752	POLLY	Unknown	Lost at Wappoo Creek
30 Sep 1752	VINE	Unknown	Lost off Cummings Pt.
21 Mar 1757	GOOD INTENT	Unknown	Lost between Shutes Folly and Crab Bank
4 May 1759	FRANKLAND	Snow	Lost 1/4 mile south of Fort Sumter
14 March 1760	ANNE	Unknown	Lost off Cummings Pt.
4 May 1761	DANIEL	Unknown	Lost in the Middle Ground
4 March 1769	unidentified	Unknown	Wraggs Wharf
25 Feb 1775	CHARMING SALLY	cargo vessel	79:54.20W 32:47.00N
Sep 1775	4 unidentified ships	Hulks	Hog Island Channel
28 July 1776	HMS ACTAEON	frigate (British)	Lost between Forts Sumter & Moultrie; burned

Table 2 continued

1 Nov 1777	LILANEEUR	ship (French)	Lost off Cummings Pt.
March 1780	11 vessels	includes 4 frigates	Scuttled in mouth of Cooper River
9 Mar 1780	BRICOLE	Frigate	Lost between Charleston city and Shutes Folly
9 Mar 1780	TRUITE	Frigate	Lost between Charleston city and Shutes Folly
9 Mar 1780	QUEEN OF FRANCE	Frigate	Lost between Charleston city and Shutes Folly
14 Oct 1780	FRIENDSHIP	Unknown	Lost in the Middle Ground
30 June 1781	LORD NORTH	Warship	79.53W, 32.46N
9 Aug 1781	HMS THETIS	Warship	79.55.40W, 32.47.30N
28 Dec 1781	JAMAICA	Unknown	Inside harbor from Fort Sumter
1 Feb 1785	SWIFT	Unknown	79.50.30W, 32.44N
9 Apr 1786	FRIENDSHIP	Unknown	Off Fort Johnson
5 June 1787	HOPE	Unknown	79.50.30W, 32.45N
13 May 1802	MARY	Unknown	79.53.30W, 32.45.30N
20 May 1803	SALLY	Schooner	Pritchard's Wharf
7 May 1804	BLAKE	Schooner	Lost off Cummings Pt.
7 Sep 1804	CHRISTOPHER	slave ship	Charleston Wharf
7 Sep 1804	CONCORD	Brig	Priolaeaus Wharf
7 Sep 1804	MARY	Schooner	Ham's Wharf
18 Jan 1805	unidentified	"Mr. White's sloop"	South end of Daniel's Island.
1 Feb 1806	GEORGE	Sloop	79.50.30W. 32.45N
2 Jun 1806	AURORA	Unknown	Lost off Cummings Pt.
13 Dec 1806	JOHN	slave ship	Lost off Cummings Pt.
18 Feb 1809	unidentified	SC coasting schooner	NW end of Sullivan's Island
1 Dec 1809	JOHN	Sloop	Lost off Cummings Pt.
31 Aug 1812	REGULUS	schooner (Spanish)	79.43.30W, 32.45.30N
1 April 1813	GALLATIN	Revenue cutter (U.S.A.)	Blakes Wharf
16 August 1814	ROSE	Unknown	Lost between Shutes Folly and Middle Ground
20 July 1818	MARY	Schooner	Lost between Shutes Folly and Crab Bank
16 Nov 1820	YOUNG ROMP	Sloop	Lost off Cummings Pt.

Table 2 continued

9 Mar 1822	unidentified	ferry boat	Lost between Shutes Folly and Crab Bank
28 Sep 1822	CERES	Unknown	79.55.00W, 32.46.55N
28 Sep 1822	ENTERPRISE	Sloop	Lost at SW end of Shutes Folly
28 Sep. 1822	GRAMPUS	Schooner	Lost between Shutes Folly and Crab Bank
28 Sep. 1822	MARK-TIME	Schooner	NW end of Sullivan's Island
28 Sep. 1822	PALMYRA	Brig (Spanish pirates)	Tip of Patriots Point
28 Sep. 1822	ROSALIE	schooner (Spanish)	Patriots Point, off bow of USS Yorktown
15 Sep 1824	unidentified	Sloop	79.53.40W, 32.47.10N
14 Nov 1824	S.S. COLUMBIA	Unknown	Western end of Sullivan's Island
26 Aug 1826	HELEN	Sloop	79.50.30W, 32.44N
8 Dec 1830	boat	Saylor Huffman's vessel	Western side of Drum Island, north of bridge
29 Aug 1851	MATAMORAS	Brig	Lost off Crab Bank
7 Sep 1854	ELSABELLA	Schooner	North Atlantic Wharf
7 Sep 1854	PARTIER	Schooner	Commercial Wharf
Jan 1861	4 unidentified ships	"hulks"	In channels outside harbor
19-20 Dec 1861	16 ships	First Stone Fleet*	In channels outside harbor
25/6 Jan 1862	14 ships	Second Stone Fleet**	In channels outside harbor
12 Apr 1862	SAMUEL ADAMS	wooden schooner	Western end of the Isle of Palms
20 Oct 1862	MINHO	iron screw steamer (British)	¼ mile south of Fort Moultrie
19 Mar 1863	GEORGIANA	steamer (iron blockade runner)	Lost off Isle of Palms (scavenged)
6 Apr 1863	C.S.S. ETIWAN	side-wheel steamer	79.53.30W, 32.45.00N
6 Apr 1863	C.S.S. MARION	side-wheel steamer transport (Confederate)	Mouth of Wapoo Creek
8 Apr 1863	U.S.S. KEOKUK	blockader (ironclad)	Shallows off Morris Island
11 Apr 1863	STONEWALL JACKSON (LEOPARD)	side-wheel, 2-masted steamer; British blockade runner	Off Sullivan's Island 1.5 mi from Breach Inlet Battery
19 May 1863	NORSEMAN	blockade runner	Isle of Palms (on land)
5 Jun 1863	C.S.S. STONO	Warship	Lost on breakwater near Fort Moultrie

Table 2 continued

10 Jun 1863	RUBY	side-wheel steamer; British blockade runner	West of Folly Island; Lighthouse Inlet
19 Jun 1863	RACCOON	side-wheel steamer (British)	Lost near Moultrie House; Drunken Dick Shoal East of Fort Moultrie
30 Aug 1863	C.S.S. SUMTER	Steamer	Main channel near Fort Sumter
6 Dec 1863	U.S.S. WEEHAWKEN	monitor-class iron ship	Sunk in a storm off Morris Island
2 Feb 1864	PRESTO	side wheel steamer (British)	Struck MINHO off Fort Moultrie
17 Feb 1864	H.L. HUNLEY	Submarine	Lost off Sullivan's Island (recovered)
17 Feb 1864	U.S.S. HOUSATONIC	sloop-of-war	Lost off Sullivan's Island (excavated)
28 Mar 1864	U.S.S. KINGFISHER	wooden sailing bark	Ran ashore on Combahee River bank
9 Aug 1864	PRINCE ALBERT	iron side-wheel steamer (British blockade runner)	Struck MINHO on Drunken Dick Shoal
31 Aug 1864	MARY BOWERS	sidewheel steamer (iron blockade runner)	Lost on GEORGIANA off Isle of Palms
6 Oct 1864	CONSTANCE DECIMA	sidewheel steamer (iron blockade runner)	Lost on GEORGIANA off Isle of Palms
22 Oct 1864	FLORA (ANNA)	sidewheel steamer (British, iron)	Southern bank of Maffitt's Chanel, sighted off three forts
23 Oct 1864	C.S.S. FLAMINGO	sloop-rigged sidewheel steamer	Drunken Dick Shoal east of Fort Moultrie near Battery Rutledge
27 Nov 1864	BEATRICE	iron screw steamer (iron, British)	Drunken Dick Shoal east of Fort Moultrie
4 Jan 1865	RATTLESNAKE	blockade runner	Burned between western jetty and Sullivan's Island off Breach Inlet
15 Jan 1865	U.S.S. PATAPSCO	blockader (ironclad)	Struck a mine below Fort Sumter (38CH270)
20 Jan 1865	JOHN RANDOLPH	transport (iron, Confederate)	Sullivan's Island
14 Feb 1865	CELT (COLT) (SYLPH)	blockade runner	Breakwater off Sullivan's Island (Buoy No. 2)
18 Feb 1865	C.S.S. CHARLESTON	steamer (ironclad)	Charleston Harbor; 79.55.21W, 32.47.29N
18 Feb 1865	C.S.S. CHICORA	steamer (ironclad ram)	Charleston Harbor; 79.55.21W, 32.47.29N
18 Feb 1865	C.S.S. INDIAN CHIEF	Schooner	Town Creek, Charleston Harbor

Table 2 continued

18 Feb 1865	C.S.S. PALMETTO STATE	steamer (ironclad)	South end of Drum Island
21 Feb 1874	PORDICHO	wrecking bark	South end of Daniel's Island.
13 Apr 1875	ELLA ANNA	Unknown	Between Forts Sumter and Moultrie
23 Apr 1908	STONEWALL	Sloop	Between Forts Sumter and Moultrie
?	"four hulks"	Unknown	Between the tip of Patriots Point and Castle Pickney, Shutes Folly Island
?	MAJOR BUTT	concrete wreck	Shoreline between Ravenel Bridge and USS Yorktown
?	unidentified	unknown vessel	W side Drum Island, just S of bridge
?	unidentified	unknown vessel	79.55.30W, 32.47.40N
?	unidentified	unknown vessel	Off bow of USS YORKTOWN
?	unidentified	two wrecks	S of Remely's Pt. boat ramp