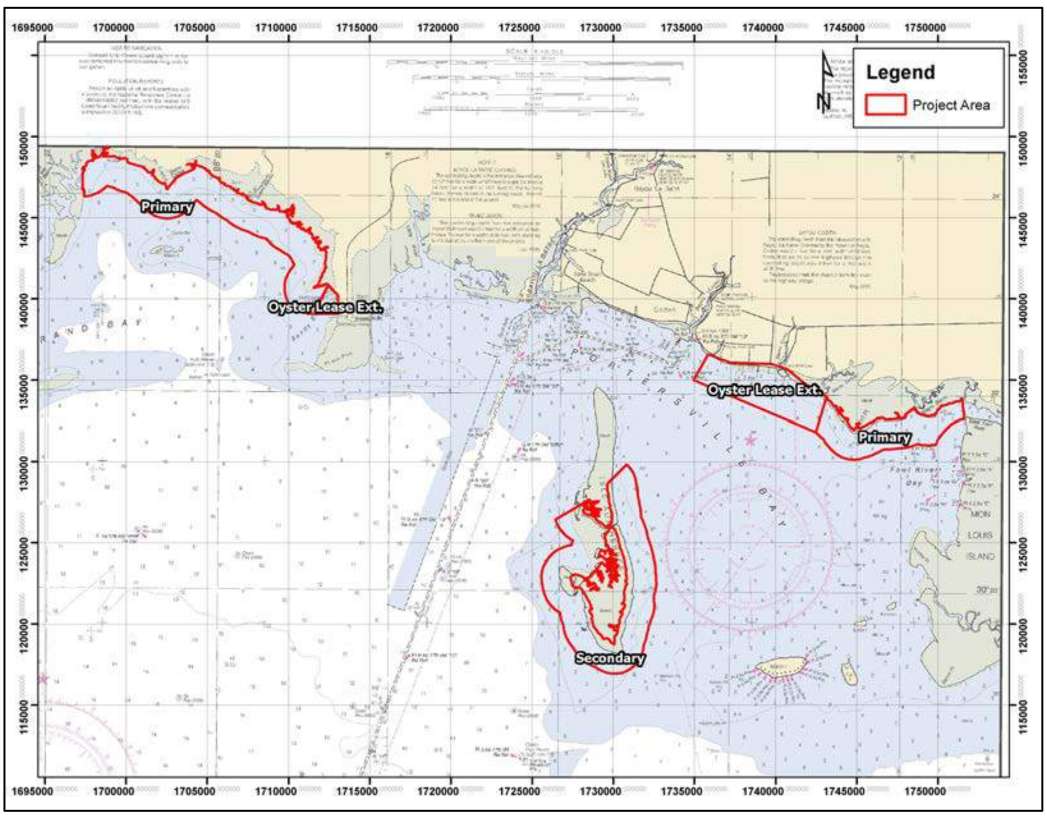
REPORT OF FINDINGS

REMOTE-SENSING SURVEY FOR PROPOSED OFF-BOTTOM OYSTER FARMS, MISSISSIPPI SOUND AND PORTERSVILLE BAY, MOBILE COUNTY, ALABAMA



PREPARED FOR:

The Mobile Bay National Estuary Program
Mobile, Alabama

PREPARED BY:

Panamerican Consultants, Inc.
Memphis, Tennessee

FINAL REPORT ♦ OCTOBER 2016

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OCTOBER ♦ 2016

Funding for this project provided by the Alabama Department of Conservation and Natural Resources, State Lands Division, Coastal Section, in part, by a grant from the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, Award #NA15NOS4190159

ABSTRACT

In August 2016, maritime archaeologists with Panamerican Consultants, Inc. conducted an intensive cultural resources remote-sensing survey of five proposed areas slated for off-bottom oyster farm leases near Bayou La Batre, Mobile County, Alabama consisting of Primary, Secondary, and Extension lease areas. To the west of Bayou La Batre is the Western Primary Area, also known as the "Grand Bay Area." On its eastern edge is the Western Lease Extension Area. To the east of Bayou La Batre is the Eastern Primary Area, also known as the "Fowl River Bay Area." To its west is the Eastern Lease Extension Area. South of Bayou La Batre is the Secondary Area that encompasses the southern half of Isle aux Herbes, also known as Coffee Island."

Comprised of a site file check, limited archival research, and an intensive remote-sensing survey of the Project Area employing a magnetometer, sidescan sonar, and subbottom profiler, the current investigation was performed under contract to the Dauphin Island Sea Lab on behalf of The Mobile Bay National Estuary Program. During the remote-sensing survey 609 magnetic anomalies and 111 sonar contacts were recorded. The great majority of anomalies and sonar contacts appear to be generated from multiple single-point sources and are considered not to have the potential to represent significant cultural resources. These include and are related to shoreline infrastructure such as docks, riprap shorelines, marker poles, and pipelines, as well as dozens of crab pots. There is, however, one cluster that should be considered to have the potential to represent significant cultural resources. Located at the far eastern end of the Eastern Primary Area (Fowl River Bay Area), it consists of anomalies M604 and M607 and is a fairly large anomaly of 577 nanoteslas and duration of 145 feet. This cluster lacks an acoustic image and is of unknown origin; therefore, it should be considered potentially significant. This potentially significant cluster should be avoided by project activities until its source is identified. Until this happens, an avoidance zone of 100 feet is recommended. The subbottom did not record any feature or landform considered potentially significant.

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I. INTRODUCTION

In August 2016, maritime archaeologists with Panamerican Consultants, Inc. (Panamerican) conducted an intensive, cultural resources, remote-sensing survey of five proposed areas slated for off-bottom oyster farm leases near Bayou La Batre, Mobile County, Alabama. The areas consist of Primary, Secondary and Extension leases areas (Figures 1-01 and 1-02). To the west of Bayou La Batre is the Western Primary Area, also known as the "Grand Bay Area." On its eastern edge is the Western Lease Extension Area. To the east of Bayou La Batre is the Eastern Primary Area, also known as the "Fowl River Bay Area." To its west is the Eastern Lease Extension Area. South of Bayou La Batre is the Secondary Area that encompasses the southern half of Isle aux Herbes, also known as Coffee Island."

Performed under contract to the Dauphin Island Sea Lab on behalf of the Mobile Bay National Estuary Program, the investigation was implemented to conform to various State and Federal statutes. These include Section 106 of the National Historic Preservation Act of 1966, as amended; 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. This investigation was also conducted in compliance with Alabama laws.

Comprised of a site file check, limited archival research, and an intensive remote-sensing survey, the focus of the investigation was to determine the presence or absence of targets within the Project Area that might represent potentially significant cultural resources in the form of shipwrecks or submerged prehistoric sites. Remote-sensing equipment employed during the survey included a magnetometer, sidescan sonar, subbottom profiler system, and Differential Global Positioning System (DGPS).

During the remote sensing survey, 609 magnetic anomalies and 111 sonar contacts were recorded. The great majority of anomalies and sonar contacts appear to be generated from multiple single-point sources and are not considered to have the potential to represent significant cultural resources. There is, however, one cluster that should be considered to have the potential to represent significant cultural resources. Discussed below, an avoidance zone of 100 feet by any project activity is recommended for this cluster. The subbottom did not record any feature or landform considered potentially significant.

Divided into chapters on natural and historical setting, field methods, results, and conclusions and recommendations, the following report presents the conduct and findings of the investigation.

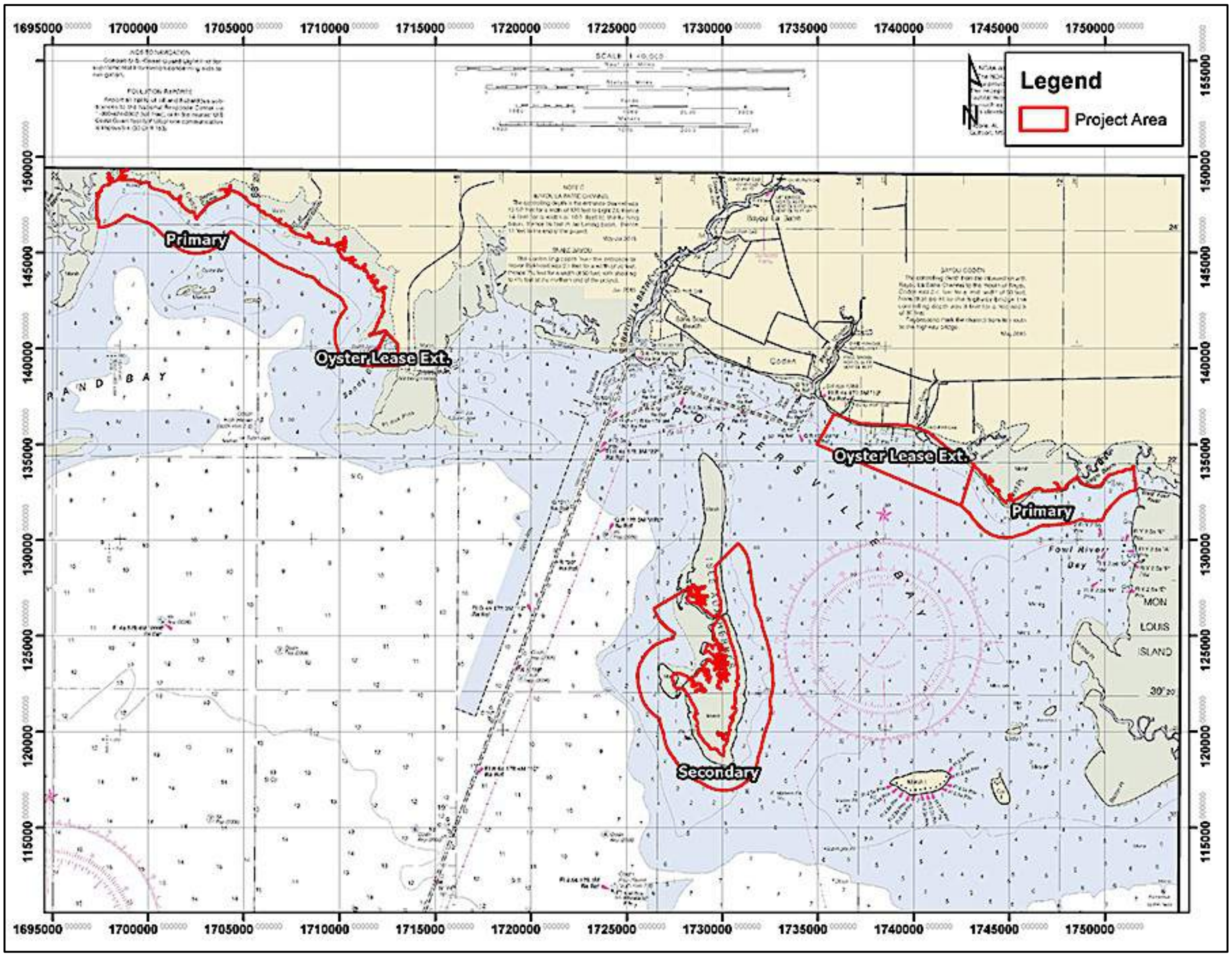

Figure 1-01. Project location map with the five off-bottom oyster survey tracts (base map National Oceanic and Atmospheric Administration Navigation Chart No. 11374, "Intracoastal Waterway Dauphin Island to Dog Keys Pass").

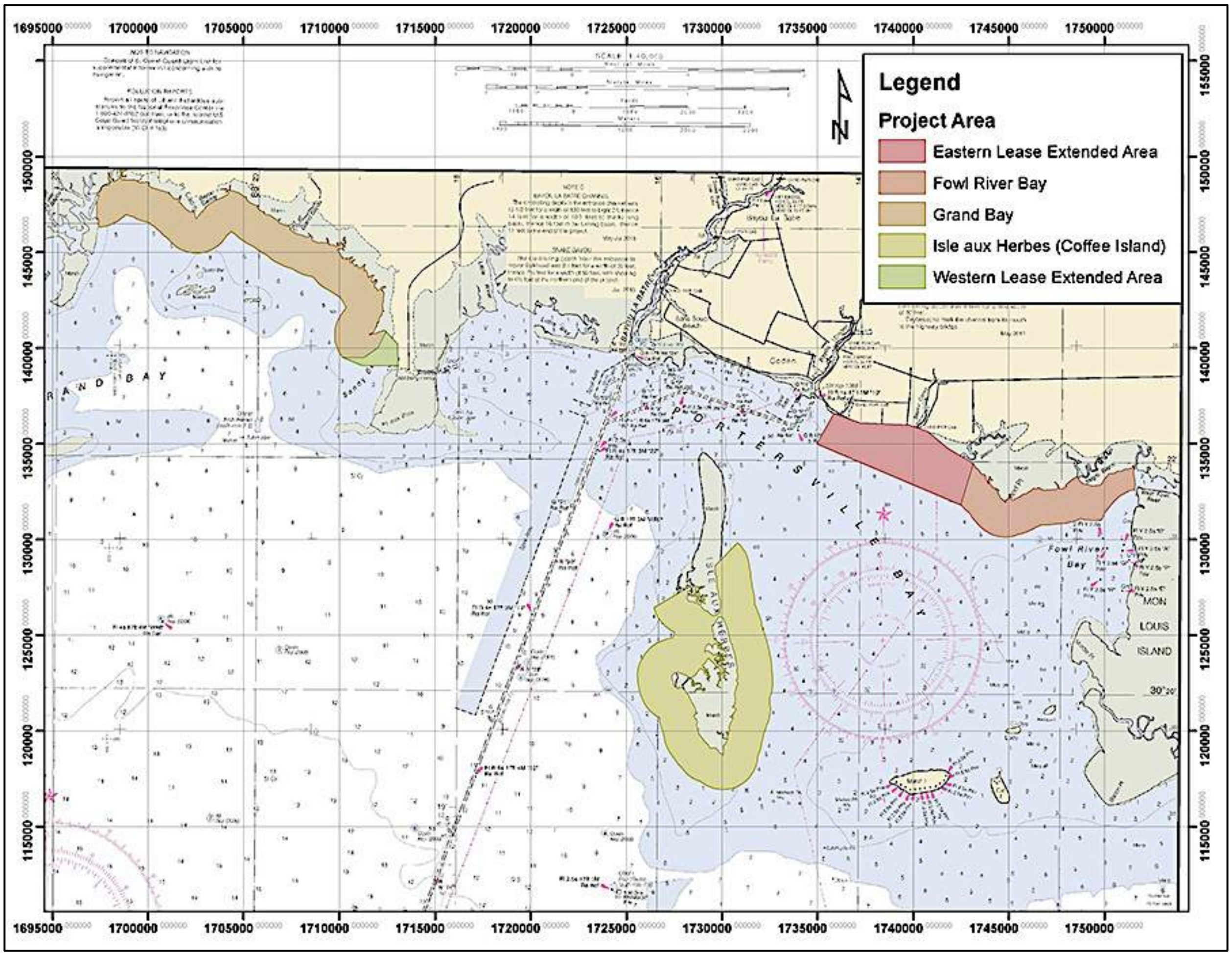

Figure 1-02. Project location map with the five off-bottom oyster survey tracts (base map National Oceanic and Atmospheric Administration Navigation Chart No. 11374, "Intracoastal Waterway Dauphin Island to Dog Keys Pass").

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II. HISTORICAL BACKGROUND

While the maritime history and potential for shipwrecks are a traditional focus of maritime cultural resource investigations such as this, the potential for submerged prehistoric sites must also be taken into account. Therefore, the background presented for the Project Area to be used to model site potentials includes brief discussions and relevant citations on the paleoenvironment, sea level rise history, and local prehistory relevant to modeling for submerged prehistoric sites; a discussion of the history of Euro-American maritime activities; and the types of vessels expected.

ENVIRONMENTAL SETTING

During the Pleistocene era (up to 1,000,000 years before present [YBP]), a series of glacial and interglacial climatic episodes occurred, causing substantial sea level fluctuations. Glacial periods brought about substantial lowering of sea levels, as glaciers encompassed seawater. During glacial periods, sea levels fell as much as 100 to 200 meters (300 to 600 feet), resulting in increased stream velocity, erosion of stream valleys, and deposition of sediments. Rapid rises in sea level were associated with interglacial periods and resulted in flooding of stream valleys and bays, greatly reducing stream velocity and filling valleys with sediments of the Citronelle Formation. Citronelle Formation sediments, which blanket the region, have continually eroded since their deposition during the Plio-Pleistocene epoch, approximately 1,200,000 YBP (Puri and Vernon 1964). Drifting sediments in the shallow waters of the Gulf of Mexico also regularly formed barrier islands during the Pleistocene interglacial periods. Each succeeding interglacial period resulted in lower sea levels, where previous peninsulas and barrier islands became incorporated into the mainland, and former sounds and bays became filled with sediments. Dauphin Island itself is a barrier island that is an existing remnant of the final period of glaciation. Illustrating the sea level fluctuations for the area, relic cypress forests recently found some 10 miles offshore Fort Morgan in 60 feet of water show that the area was at one time a fresh water swamp. Dated to between 8,000 and 14,0000 YBP, the trees and their swamp environment were covered by Gulf waters when current stands of sea levels reached approximately 4,000 to 3,500 YBP.

The climate of the Project Area is characterized as warm, temperate, and humid. Warm weather temperatures average about 82°F, while winters average about 57°F. A typical year has about 300 frost-free days, and annual precipitation, which is evenly distributed throughout the year, normally exceeds 60 in. These modern climatic conditions have existed for about 1,500 years, but during earlier prehistoric periods they did not. The terminal Pleistocene climate (15,000 to 12,000 B.C.) was much cooler and drier and was followed by warmer and drier conditions that culminated in the Altithermal period (7000 to 3000 B.C.). A period of fluctuating, but generally cooler and wetter, conditions followed the warmer, drier Altithermal, which led to the modern conditions described above (Frelund and Johnson 1993; Muto and Gunn 1982).

In terms of permanent human settlement and subsistence, the Project Area currently offers a less than ideal environment. The marine/estuarine habitat may contain a potentially rich aquatic resource base, but access to potable water, shelter, and other necessities is limited. The exposed environment found in the region would lend itself more for seasonal marine resource recovery camps than permanent settlement.

GEOLOGICAL SUMMARY

Nearby Mobile Bay, or more properly, the Mobile Bay Estuary, is a shallow north-south elongated estuarine environment, protected from the Gulf of Mexico by Dauphin Island to the west and Morgan Peninsula to the east. Mobile Bay is 46 kilometers long from north to south, and 32 kilometers wide at its widest point, which includes Bon Secour Bay. Eighty-five percent of the water from the Mobile-Tensaw delta region flows through Main Pass Inlet, directly between Dauphin and Morgan with most of the rest flowing into Mississippi Sound to the west. The northern boundary of Mobile Bay consists of the modern bay-head delta, with the western and southeastern shorelines containing low-lying topography and tidal marshes, while the northern part of the estuary has considerably steeper topography.

The continental shelf south of Alabama and Mississippi is characterized by a network of valleys that formed during the last lowstand (during the Late Glacial Maximum, approximately 29,000 YBP), also known as the Oxygen Isotope Stage 2 (Figure 2-01). Incised into the coastal plain during this time period, these channels have been extensively mapped and characterized (Bart and Anderson 2004; Bartek et al. 2004; Hummel and Parker 1995a, 1995b; Kindinger 1988; Kindinger et al. 1994; Mars et al. 1992; Roberts et al. 2004; Sager et al. 1999). These valleys differ from typical river valley systems in that they branch seaward just north of the modern shoreline, becoming more complex rather than more organized, as do other Gulf channel systems.

While previous studies differ slightly with regard to the precise location and depth of the Stage 2 Mobile valleys, they generally agree that the channel bifurcates about two-thirds of the way toward the southern end of the estuary, with the western branch passing out into the Gulf at the western end of Morgan Peninsula and the eastern branch passing through Bon Secour Bay and out under Morgan Peninsula (Figure 2-01). Estimates on the depth of this valley range from 13 to 15 meters (Davies and Hummel 1994; Hummel and Parker 1995a, 1995b) to 25 to 45 meters (Kindinger et al. 1994). According to Greene et al. (2007:141), these conclusions were reached by studying the same datasets, illustrating the difficulty of characterizing the stratigraphy of Mobile Bay. According to Greene et al. (2007), these channels, developed during the last lowstand, are reflective of older underlying topography. That is to say, channel development was somewhat guided by the morphology of the underlying sediment, and understanding the character of this underlying sediment is essential to understanding the subsequent morphologies (Greene et al. 2007:17).

In a 2007 seismic and vibracore study, Green et al. (2007) outlined four regional seismic units across Mobile Bay and Mississippi Sound, each bounded by an unconformity, referred to as Sequence Boundaries. The two shallowest Sequence Boundaries, A and B, were the only ones mapped, as seismic attenuation tended to obscure the lower units. This phenomenon was recognized in the data from the current investigation. Sequence Boundary B is present throughout Mobile Bay and characterized by broad valleys ranging in size from 0.8 to 7.7 kilometers in width, coinciding with modern La Batre, Dog, Fowl, Fish, Magnolia, and Mobile/Tensaw river systems, with thalwegs of 20 to 35 meters (Green et al. 2007:143; Figure 2-02). Between these valleys are broad interfluvial areas at 10 to 15 meters below the current sea level. Of particular note are incised valleys running through both the eastern and western portion of the bay. Depths below sea level are 25 to 33 meters for the eastern valleys and 20 to 25 meters on the west. Radiocarbon dates of material from Seismic Unit A (representing Central Basin sediments) generally indicate Holocene, although Green et al. (2007) were not able to precisely date Sequence Boundary A (i.e., the boundary between Seismic Unit A and Seismic Unit B [with B being older]). Although they indicate Seismic Unit B to be Pleistocene, with Sequence Boundary A coinciding with Oxygen Isotope Stage 2 (approximately 19,000 YBP), previous studies suggested that Sequence Boundary B coincides with Oxygen Isotope Stage 2 and Sequence Boundary A is a transgressive surface (Kindinger et al. 1994), indicating the difficulty of dating the sediment progression in Mobile Bay.

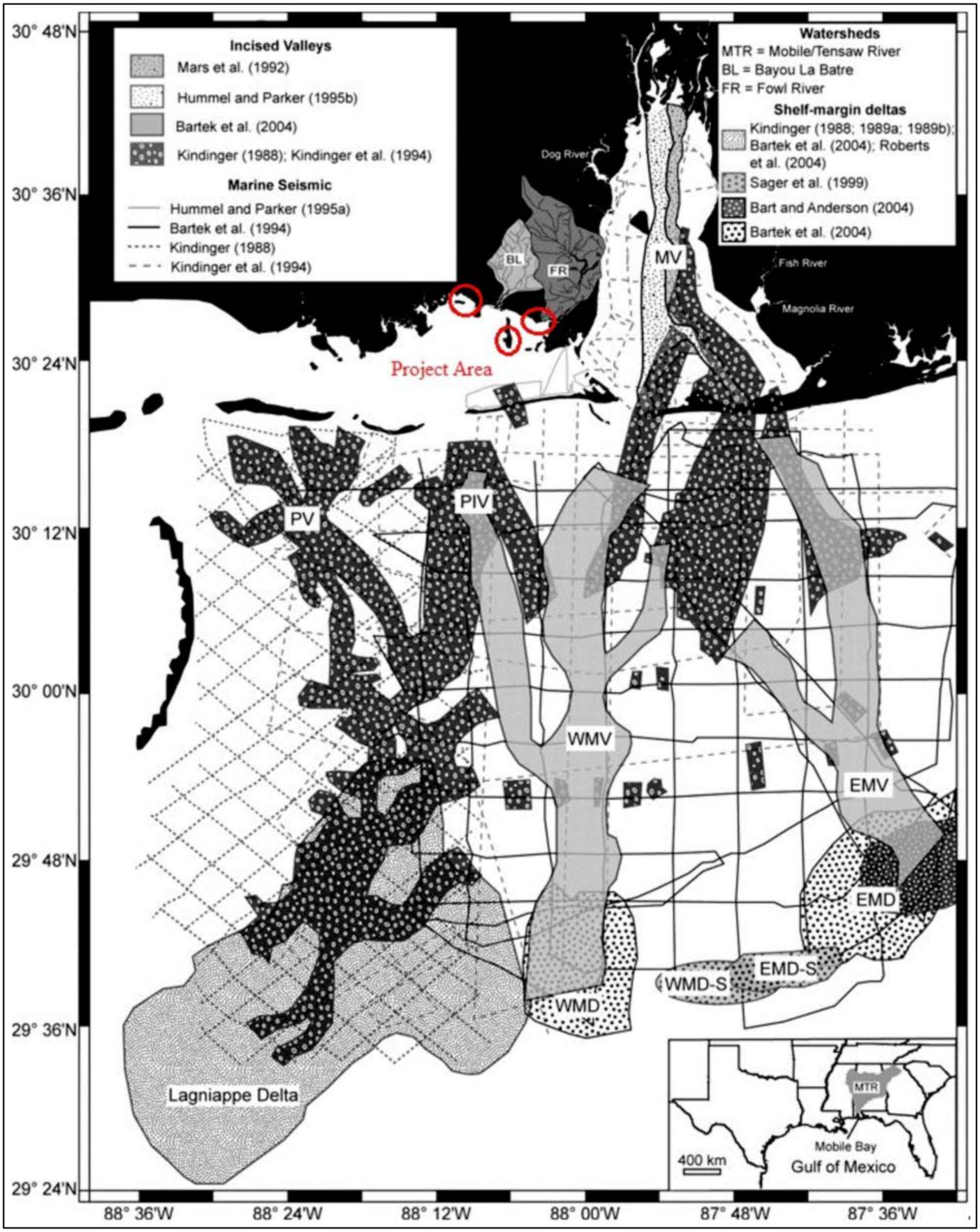

Figure 2-01. Map of valleys formed during last lowstand (as presented in Green et al. 2007:140).

Sequence Boundary A, which overlies Seismic Unit B and forms the boundary between Seismic Unit A (Central Basin marine sediments) and Seismic Unit B, is also characterized by multiple incised valleys that extend from the modern La Batre, Fowl, Dog, Fish, Magnolia, and Mobile-Tensaw rivers. The main valleys, incised into Seismic Unit A, are in the same location as the valleys in B, with thalwegs in the 10 to 25 meter range. The main difference is the lack of a bifurcation in Bon Secour Bay, instead being a broad flat interfluvial area at 10 meters below sea level that passes through the eastern portion of the Project Area (Figure 2-03).

Sequence Boundary A, which represents the boundary between Seismic Unit A and Seismic Unit B, formed in response to the Oxygen Isotope Stage 2 (Late Glacial Maximum) lowstand. It is, essentially, the last exposed Mobile Bay/Mississippi Sound surface, and dates to 17,000 to 22,000 YBP at the oldest to 9,000 YBP at inundation (Greene et al. 2007:149). Previous investigations (Bard et al. 1990; Davies and Hummel 1994; Hummel and Parker 1995a, 1995b; Kramer 1990; Mars et al. 1992; McBride et al. 1991) have produced datable organic material indicating sediments above Sequence Boundary A to be Holocene, and all dates below, Pleistocene. Greene et al. (2007) did not obtain radiocarbon datable samples from below Sequence Boundary A, and indicated previous investigations (including Grootes 1983) have demonstrated that contamination of samples with 1% modern carbon would result in a date of 37,000 YBP. The one date obtained by Greene et al. (2007) yielded 38,400 YBP, which they considered contaminated.

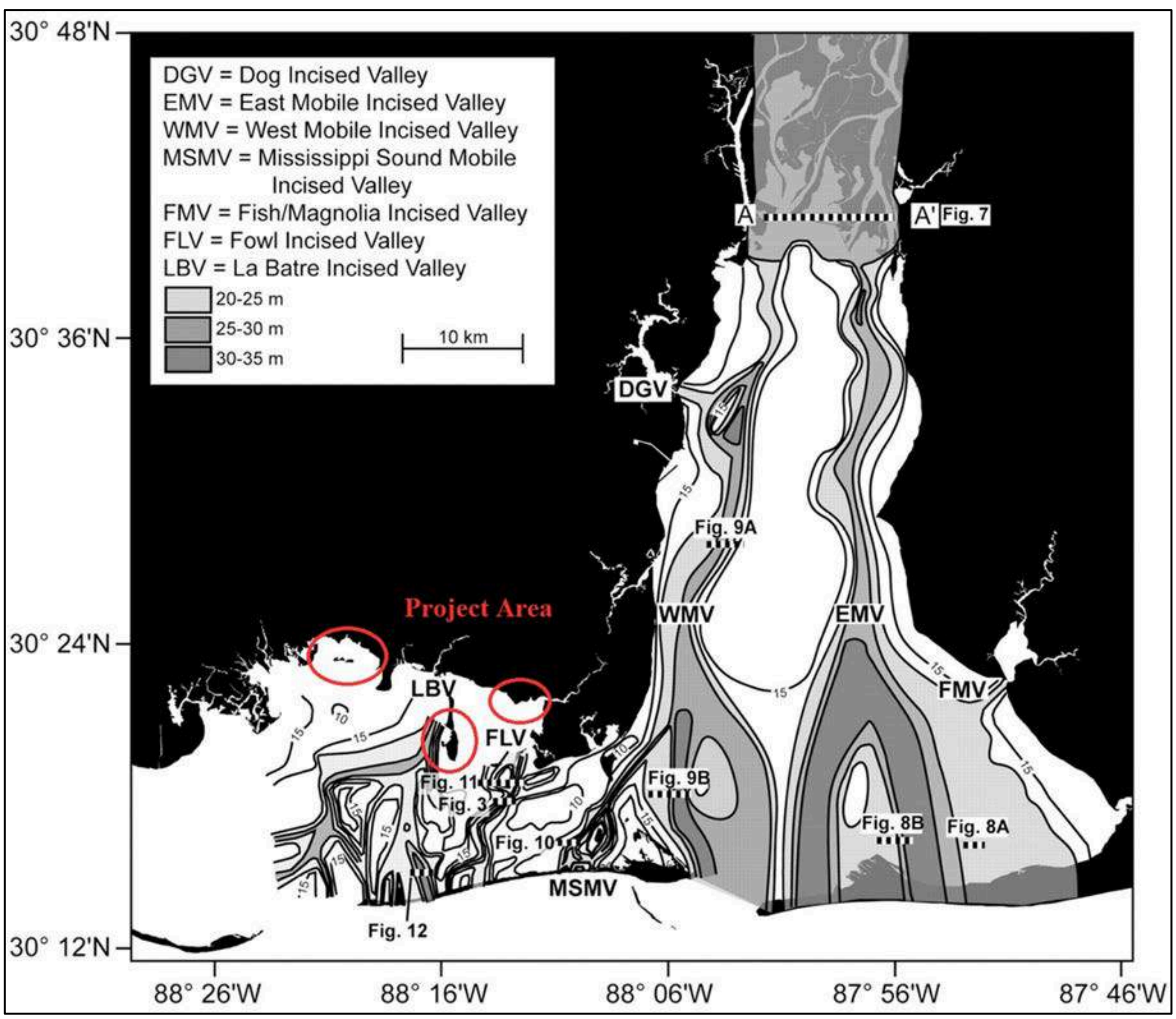

Figure 2-02. Map of channels represented by Sequence Boundary B (base map: Greene et al. 2007:145).

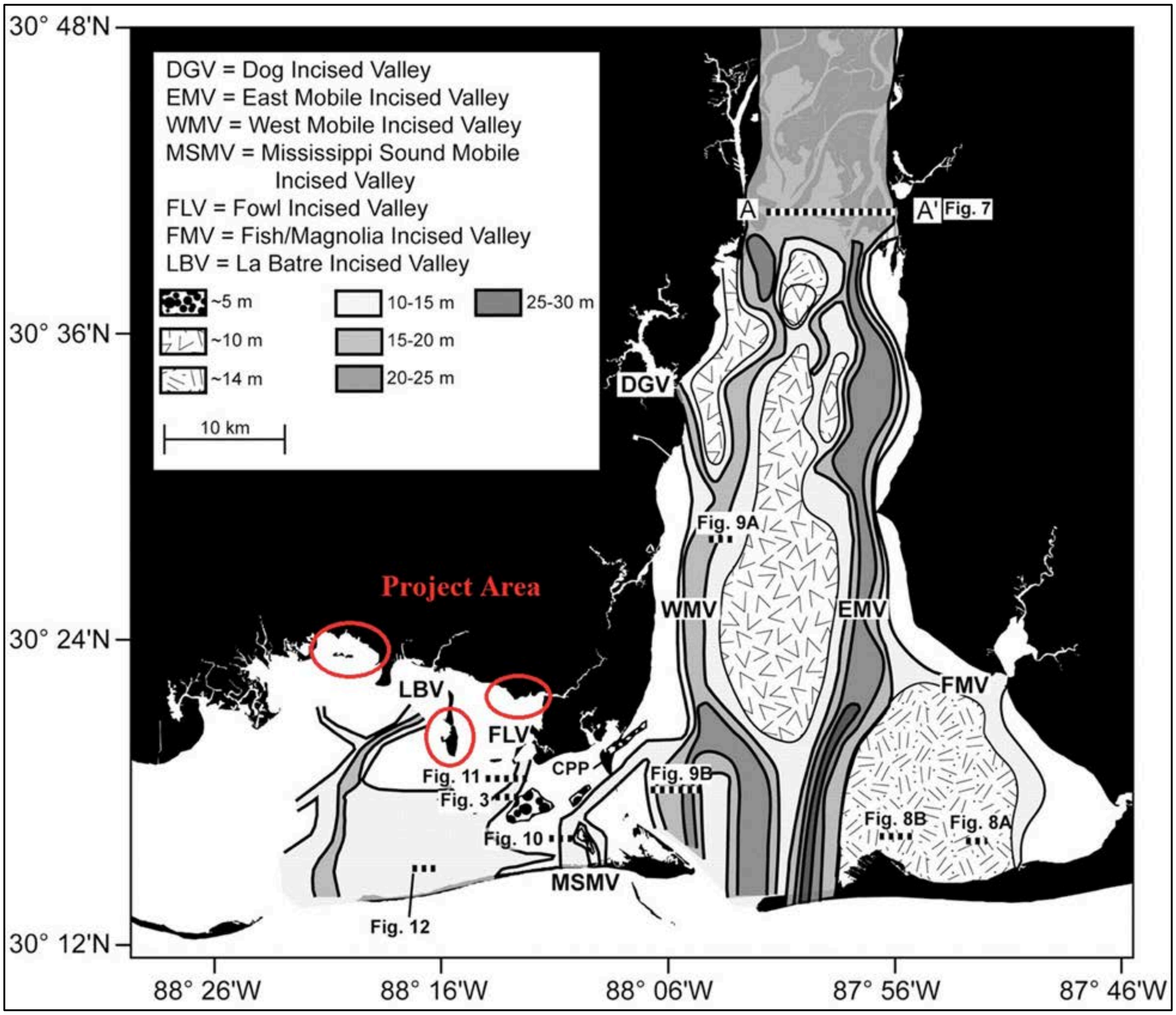

Figure 2-03. Map of incised channels in Sequence Boundary A (as presented in Greene et al. 2007:147).

Seismic Unit A, as presented in Greene et al. (2007), was sampled in nine cores, which revealed the presence of whole oysters, shell hash, and *Ophiomorpha*, *Chondrites*, and *Thalassinoides* burrows (Greene et al. 2007:145), indicating a marine environment. Greene et al. (2007), along with Kindinger et al. (1994) and Bartek et al. (2004), interpreted the sediment as Central Basin. Several cores contained peat directly above Sequence Boundary A. Radiocarbon samples from this location yielded dates of 9,000 to 9,260 YBP (Greene et al. 2007:145). These results indicate inundation of the current Project Area by 9,000 YBP.

Sediments below Sequence Boundary A, those of Seismic Unit B, consist primarily of forest beds of previous iterations of bayhead delta formed during marine regression preceding the Late Glacial Maximum lowstand. Deltaic sediments are particularly well formed in the western half of the bay and fill the previously incised valleys shown in Figure 2-02. Generally speaking, during the lowstand that is associated with Sequence Boundary B prior to Oxygen Isotope Stage 2, valleys were incised by the La Batre, Fowl, and Mobile/Tensaw river systems. During the subsequent transgression, the valleys associated with the Fowl and Mobile rivers were filled completely with alluvial sediments that now make up Seismic Unit B. During the Oxygen Isotope Stage 2 lowstand, these river systems reoccupied the same valleys.

Given the fairly firm dating of Sequence Boundary A at 9,000 YBP, and the determination that Central Basin sediments overlying Sequence Boundary A are marine in nature, Sequence Boundary A is likely to contain prehistoric archaeological sites in such high-probability landforms as channel margins, barrier islands, and back bay features, so long as the upper margins of those features are at or near Sequence Boundary A itself. As it pertains to the current Project Area, the leases lie in the western branch of the La Batre Incised Valley (Figure 2-03).

SEA LEVELS

Sea level curves for the Gulf of Mexico constructed by Balsillie and Donoghue (2004) and global eustatic estimates by Siddall et al. (2003) are shown in Figure 2-04. Post-glacial sea level rise (not shown in the figure) was rapid before 7,000 YBP and Figure 2-04 shows that it was slower thereafter. These graphs are useful to model base level changes for the Project Area, which was around 8 to 12 feet in depth. Much of the data for the Balsillie and Donoghue averaging procedure come from research conducted in southern Florida, so the curves are somewhat relevant. They show a fluctuating sea level curve (history) after 7,000 YBP, when base levels were approximately 6 meters (20 feet) below today's, when people are known to be living on the coast in this area, to 4,800 YBP, when levels were still approximately 2 meters (6 feet) below today's (Figure 2-04).

Widmer (1988), using data specific to the southwestern Florida, showed sea levels between 20 and 4 meters below today between 7,600 and 4,000 YBP. Walker et al. (1995) summarized geoarchaeological data for the southwestern Florida gulf coast and showed that some sites were formed when sea levels were lower (because their lower stratigraphic levels were flooded).

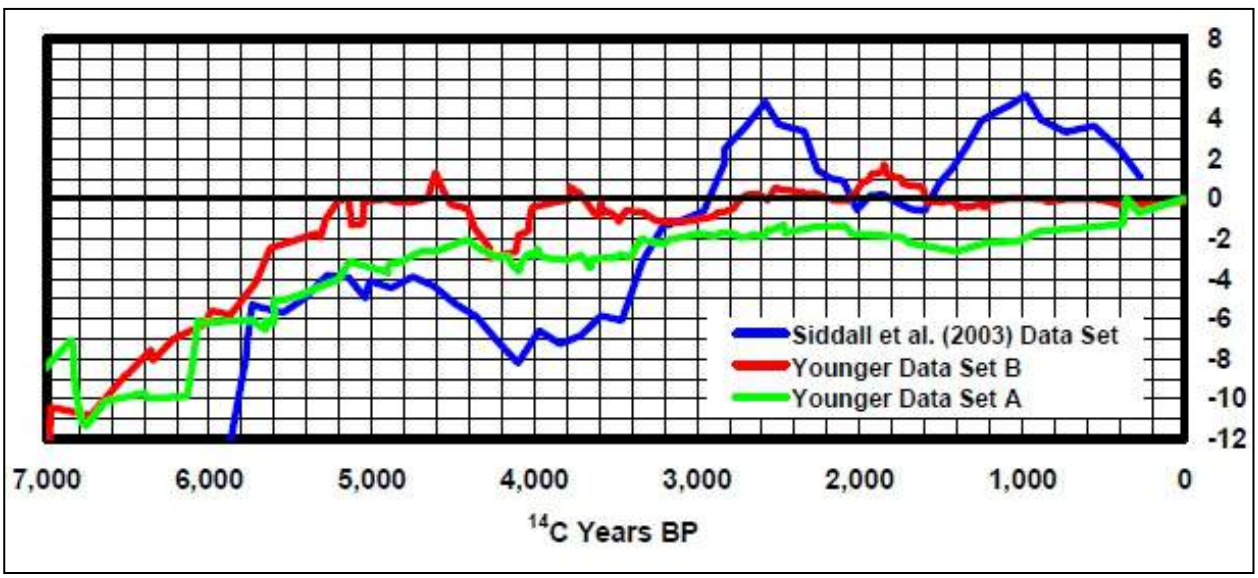

Figure 2-04. Balsillie and Donoghue's (2004:their Figure 10) "Younger Data Set," the green line represents sample sets collected offshore, the red line includes data sets collected onshore. The blue line represents a worldwide, eustatic estimate published by Siddall et al. in 2003. Areas of agreement occur at 5,800 and 3,100 YBP.

CONSIDERATIONS OF SEA LEVEL FLUCTUATION

In order to understand past landscape configurations in the Project Area, it is helpful to know the local sea level rise chronology and magnitude from the latest Pleistocene through the Holocene, but none have been published. By local, we are indicating that the local apparent sea level curve is the desired indicator for landscape reconstruction, rather than a strict eustatic sea level curve (global ice melted sea level). The latest Holocene fluctuations are of most import to this investigation. In general, and on average, global eustatic sea levels were about 20 meters below the present sea level due to a third pulse of glacial melting around 8,000 YBP. This sea level rise, that slowed between 6,000 and 7,000 YBP, resulted in sea levels somewhat lower than today's (DePratter and Howard 1981; Faught and Donoghue 1997; Hoyt et al. 1990; Siddall et al. 2003). This can be considered to be roughly true for the current Project Area, because the region is considered stable (from isostatic and tectonic forces).

PREHISTORIC BACKGROUND

Consideration of the potential for cultural resources within the Project Area focuses on two distinct types: prehistoric sites and historic shipwrecks. Although the location of shipwreck sites can be obtained through the employment of an array of remote-sensing equipment, such as that utilized within the Project Area, the location of submerged prehistoric sites with current technology is highly unlikely. Rather, the emphasis during a study of this nature is more hypothesis than reality, with the investigation basing potential submerged site locations on known above current sea level site locational parameters (i.e., land forms such as river terraces), as well as data on Pleistocene environments and resources for the area (i.e., estuaries, food types); however, it is possible to identify relict submerged landforms to some extent with the sidescan sonar, and then apply known parameters from above-sea-level sites to these landforms.

Past research indicates that portions of the reported archaeological sites in the waters of Florida are prehistoric. Several submerged prehistoric sites have been found and investigated in Florida. Most artifacts have not been found by archaeologists, but by diver/collectors. Some of the extinct faunal remains found in a submerged context show evidence of butcher cuts and other evidence of human shaping (Faught 2001); however, in general, the present Florida environment, rivers and caves, is much more benign than the conditions found off East Pass, which is exposed to sea level change and dramatic effects of the occasional hurricane.

Other coastal Atlantic regions have produced underwater prehistoric sites. To the north, over 800 submerged archaeological sites are known to be located in North Carolina waters, a vast majority being historic shipwrecks and landings. Approximately 50 (less than 7%) of these sites are from a prehistoric context. Most, if not all, of these come from a latchstring or riverine context (Richard Lawrence, personal communication 2002). Further north in Virginia there are at least 283 underwater sites on file. While 90 have prehistoric components, only three are totally submerged. The bulk is eroding out of present shorelines. Only one confirmed prehistoric site is located on the Atlantic Ocean, and that is on the eastern shore of Virginia (Blanton and Margolin 1994:ii). Thus, the presence of known marine prehistoric resources in Virginia is exceedingly rare. "It is conceivable that large portions of the home range of some Paleoindian bands are now submerged on the continental shelf, particularly for any that may have adopted a partial coastal subsistence focus" (Blanton and Margolin 1994:10).

Farther north, it is believed that past dredging activity off Sandy Hook, New Jersey may have exposed and redeposited portions of a prehistoric site. An assemblage of over 200 prehistoric artifacts was collected in an area that had been renourished by material dredged from an area approximately 1 mile offshore in depths of 35 to 40 feet below mean low water. It is believed that the artifacts came from a layer within the first 5 feet of the seabed from the Weeks 1 Borrow Area (U.S. Army Corps of Engineers, New York Memo, 21 September 1995). Other artifactual materials in the New England/Long Island Sound area were located due to dredging activity; many were assigned to the Archaic period (Stright 1990:441-442).

Thus, it is known that submerged prehistoric sites have been located or intuited through the evidence from Mississippi to New England. However, how can these sites be recognized? The equipment utilized for this project—a magnetometer—cannot positively identify prehistoric sites that are non-magnetic, nor protruding from the seabed. Alternate methods and techniques may have better results. The application of a subbottom profiler survey, with parameters to identify relict landforms, in conjunction with coring could possibly identify likely locations for submerged prehistoric sites. Rather than using these instruments in a broad survey to look for specific sites, which would be difficult, their application should be to indicate past submerged Holocene landforms with the potential to contain cultural material. Subsequent testing for prehistoric sites (i.e., coring) could concentrate on the areas of higher potential, increasing the chance to contact these materials. With that said, buried oyster or shell middens will present as a recognizable feature in the subbottom record and, if exposed, as a recognizable feature in the sidescan sonar record.

It is generally accepted that the first people to enter North America traveled overland from Asia across what is now the Bering Strait on a land bridge that formed when vast quantities of the Earth's water were concentrated in glacial masses. The warming trend that began at the end of the Pleistocene epoch and continued through the early Holocene melted glacial water, caused sea levels to rise. That rise in sea level coincided with the arrival of the earliest peoples in the Americas and possibly the earliest human arrivals to the inundated prehistoric areas that extended out onto the continental shelf in the Gulf of Mexico, south of modern shores of Alabama.

EARLIEST ARRIVALS

The arrival of prehistoric peoples to the northern Gulf Coast is considered to have occurred between 25,000 and 10,000 YBP. Within a geologic time frame, this falls within the late Pleistocene or early Holocene epochs. Sea levels fluctuated significantly during these periods, and reached sufficiently low levels to expose the continental shelf as much as 100 kilometers south of the present Gulf shoreline. All of what is now the present Project Area is considered to have been above sea level at a portion of the time when aboriginal peoples representing the Paleoindian and Archaic periods first arrived in the region.

Specific evidence of early human presence in the Project Area dates to the Early Archaic stage. This evidence is in the form of distinctive Dalton, Hardaway, and Big Sandy projectile point types recovered from upland areas (Trickey and Holmes 1971:124). The accurate dating of those projectile point types at other locations has provided a comparative date of 9,000 to 10,000 YBP for the minimum earliest arrival of man in the Mobile area. These upland sites have been interpreted as former hunting-foraging stations used on a seasonal basis by Archaic nomadic bands. By 3,000 YBP, the general geomorphology of modern Mobile Bay had formed and the lower bay area had become the focus of a somewhat sedentary aboriginal occupation with notable utilization of oysters (*Crassotrea virginica*) and/or marsh clams (*Rangia cuneata*) as a major food resource. While aboriginal material culture and society changed through time, the exploitation of rich estuarine food resources was characteristic of the Prehistoric period.

Archaeological materials pre-dating 10,000 YBP have yet to be located in the immediate offshore area, and are presumed to lie within areas now inundated by changes in sea level. Evidence such as fluted projectile points indicative of a Paleoindian presence has been located in nearby Escambia and Covington counties (Futato 1982). If Paleoindians were present in the offshore area before 10,000 YBP, the evidence of their presence may be expected near water and estuarine food resources that, at the time, were perhaps most abundant along waterways at the bottom of the now inundated valley that lies under Mobile Bay and the Mobile River Delta (Trickey and Holmes 1971:124).

At present, however, no submerged prehistoric cultural resources have been documented in the Project Area. That submerged prehistoric sites could be present in an offshore-submerged context is not argued. The archaeological community has established that prehistoric materials can be found within sites that are below sea level (Bullen 1969; Emery and Edwards 1966; Powell 1971; Salwen 1967). Indeed, the area of the continental shelf between the relict terraces bordering Desoto Canyon offshore and the current shoreline has been identified by Coastal Environments, Inc. (1977) as a high-probability zone for the presence of such sites. Of interest here, however, is the argument by Mistovich and Knight (1983) that prehistoric occupation may have occurred virtually anywhere within the present confines of near shore areas of the Gulf of Mexico off Alabama. Underscoring this statement is the fact that it is known that they did exist as evidenced by artifacts recovered during shell mining and dredging for past road construction. Artifacts have also been recovered by Mobile Bay and Mississippi Coast oystermen tonging on oyster reefs that appear to cap drowned terrestrial sites comprised of shell middens (Lewis 2000:534).

ARCHAIC PERIOD

While the presence of Paleoindian materials is theorized as possible in the Project Area, and Early Archaic materials have been documented nearby, there is a relative scarcity of Early and Middle Archaic materials that have been found in abundance in other areas of the Gulf Coastal Plain. It is uncertain whether this lack of representation is merely due to a gap in the recovered and published data, or whether there was an actual low population presence in the area (possibly related to local climate). As with the Paleoindian evidence, these sites may exist submerged and buried under Holocene sediments (Mistovich and Knight 1983:9). There have been small quantities of fiber-tempered ceramics found that may have affiliation with either the Wheeler or Norwood ceramic series that correlate with suggested dates of 1400 to 700 B.C. The significance of those ceramic finds may lie in the location of some at estuaries rather than at inland or river environments. This significance lies in the importance of estuarine food resources successfully exploited by subsequent groups.

WOODLAND PERIOD

The Early Woodland period followed the Late-Archaic and continued until about the 100 B.C. The Early Woodland is well represented in the archaeological record and is identified in the Mobile area by the Bayou La Batre ceramic series from the Bayou La Batre type-site (1MB12), which encompasses the Mobile River Delta and Mobile Bay areas (Wimberly 1960:64-74). The Bayou La Batre ceramics are characterized by coarse-grit tempers with tripodal and tetrapodal bases decorated with shell impressions and scallop shell rocker stamping (Trickey and Holmes 1971:126). The culture represented by the Bayou La Batre ceramics series is shown by extensive archaeological evidence (i.e., large shell middens) to have exploited the fish and shellfish of the Bay area; the estuarine environment was a major, if not the primary, source of subsistence. Mistovich and Knight (1983:10) point out that the archaeological evidence, both the subsistence materials recovered and the presence of Bayou La Batre materials on Dauphin Island, "strongly suggests the development at this time of a watercraft technology accompanying the estuarine economic orientation of these peoples." While there is no direct evidence for the development of prehistoric watercraft technology in the Mobile area at this time, it is strongly suggested and implies a potential for aboriginal sites at any location within the estuarine environment following its introduction.

The Middle Woodland period is characterized by Porter phase ceramic types. Present from roughly 100 B.C. to A.D. 500, it has been suggested the Middle Woodland peoples of the Mobile area had a cultural continuity with the peoples that produced the preceding Bayou La Batre ceramic series, as well as influence from the Santa Rosa culture to the east (Walthall 1980:156; Wimberly 1960). While estuarine exploitation continues in this period (i.e., shell middens), it is also characterized by the appearance of inland settlements that might be described as villages and by the presence of some burial mounds. Excavations in these mounds have shown artifacts which suggest the widespread exchange of trade goods at this time with both the Santa Rosa culture and the Marksville culture in the west, perhaps in part due to the extensive river connection with the interior (Walthall 1980:161; Wimberly 1960:12-30; Wimberly and Tourtelot 1941).

Widespread interaction between groups on the Gulf Coast during the Late Woodland period of A.D. 400 to 800 was evidenced by material from a mound excavated on the eastern shore of Mobile Bay at Starkes Wharf at the turn of the century (Moore 1905:287). Similar evidence was recovered at excavations by the Alabama Museum of Natural History at other mounds on the Fort Morgan Peninsula in 1937 (DeJarnette and Buckner 1937). The interaction between Gulf Coast peoples was shown by the similarities between the Tates-Hammock phase pottery of this time, which resemble the earlier Santa Rosa, and the Weeden Island sand tempered ceramics of Florida (Walthall 1980:171-2). Overall, the period was similar to the preceding, with mortuary and village patterns and considerable exploitation of estuarine food resources, as evidenced by substantial shell middens. That agricultural development is not yet clearly evidenced and Late Woodland society shows no clear signs of developing a social hierarchy may be due to the reliable and abundant food resources available in the Mobile Bay area.

MISSISSIPPIAN PERIOD

Significant changes occurred when Woodland culture was replaced by Mississippian ca. A.D. 900 to 1200, lasting until European influence reached the Americas. Distinctive new pottery forms were introduced, as well as major social changes evidenced by the construction of cultural centers of earthen platforms surrounding a central plaza. The Mississippian culture also introduced the bow, floodplain horticulture, ceremonialism, long distance trade, organized chiefdoms, and increased warfare (Walthall 1980:185). Walthall (1980) has suggested that the changes were gradual, supplanting existing local groups through acculturation and internal development, rather than by invasion and displacement. In the Mobile area, Mississippian culture is expressed most profoundly in the Bottle Creek site, a large ceremonial mound complex located in the very center of the Mobile River Delta, an area curiously subject to annual flooding (Curren 1976:79). The Bottle Creek site has been dated to A.D. 1250 to 1600, with the last 150 years associated with a later manifestation of the Pensacola culture identified as the Bear Point complex.

TRANSITIONAL PERIOD

The Protohistoric period for the native inhabitants of the Mobile area is poorly documented, although some collections exist from Fort Conde, as well as the site of an early French warehouse on Dauphin Island and from the D'Olive site (DeJarnette 1976; Harris and Nielsen 1972; Knight 1976). The Contact period ceramics from those sites reflect the arrival of new people who introduced non-indigenous forms with western influences (Knight 1976:145).

The thousands of years of cultural change and adaptation to the local environment abruptly ended during a relatively short period following the arrival of European colonists in the eighteenth century. The local cultures had already been affected by the shock of Spanish expeditions through the southeastern United States and had undoubtedly suffered from European diseases brought directly by the Spaniards or contracted through other indigenous peoples. When a European colony was finally established in the Mobile area, the native cultures were rapidly displaced. Eventually, the remaining communities of native tribal peoples were forcibly removed to what was once known as the Indian Territory of Oklahoma (Walthall 1980:275).

The Prehistoric period of the Mobile Bay area is acknowledged to be poorly understood by the archaeologists and anthropologists most closely associated with its study (Knight 1976). The limited knowledge about the peoples who inhabited this region for thousands of years is partly due to both the lack of systematic surveys for the area and a scarce number of detailed excavations with published reports.

HISTORIC PERIOD BACKGROUND

THE ERA OF EXPLORATION

It is possible that before any of the recorded expeditions, unknown parties explored the northern coast of the Gulf of Mexico, including Mobile Bay. The earliest period of exploration—the very late fifteenth century to the first decade of the sixteenth century—is characterized by a scarcity of documentation for perhaps a majority of those involved in the enterprise. That the area may have been explored prior to any documented expeditions is seen as possible in some of the earliest maps of the Americas. The maps of La Cosa (1500), Cantino (1502), Caniero (1502), and Waldseemuller (1507) each contain elements that illustrate knowledge of the Florida peninsula and the gulf coast to the west. It has been suggested by Summersell (1949:frontispiece) that a bay depicted by Waldseemuller represents Mobile Bay. While it is possible that unrecorded early voyages of exploration of the area did occur, it has been pointed out that in that earliest era of exploration, claims were still being made that the new lands were the fringes of the Orient, which Columbus claimed to have discovered, and that those early maps may have depicted the southwestern coast of Asia as it was known from overland journeys preceding the Columbian voyages (Fite and Freeman 1926:16, 26, 34).

Regardless of whether the early maps depicted geographic knowledge brought back from the New World or were merely misplaced representations of old knowledge, there is evidence for the unrecorded presence of early voyages on the Gulf Coast. The first European known to explore the Gulf of Mexico was Ponce De Leon. With permission from the King of Spain to find new lands, De Leon left Puerto Rico in 1513 to search for land, wealth, and the Fountain of Youth. After exploring portions of the eastern coast of the modern state of Florida, De Leon coasted approximately one-third of the way up the Gulf coast of the peninsula. After being rather savagely attacked by the local inhabitants, who had no knowledge of the Fountain of Youth, De Leon decided to leave Florida in mid-June after six weeks of exploration (Morison 1974:507-511). Three years later Diego Miruelo, who had sailed with De Leon, explored far enough north into the Gulf to find what most likely would be named Pensacola Bay. In 1521, De Leon attempted to set a colony in the gulf, but after receiving a fatal wound from the natives died (Morison 1974:515). Thus began the Spanish exploration of the North American mainland.

Spanish persistence in the Gulf kept explorers busy. In 1519, an expedition under the command of Alonso Alvarez De Pineda again entered the Gulf of Mexico. Landing in southwestern Florida the explorers made contact with the natives. Hostile to this European encroachment, they protested with violence. The Spaniards sailed northwest and were the first to sail the coast of the Gulf and must have passed Mobile Bay as they encountered the mouth of the Mississippi on their travels. The Historic era for the Mobile Bay region began with the exploratory voyage of the Spaniard Alonso Alvarez de Pineda in 1519. Sailing from Jamaica with four ships, Pineda became the first recorded European to enter *Bahia del Espiritu Santo* (or *Spirito Sancto*), the name given to Mobile Bay by Pineda. The Pineda expedition, ordered by the Spanish Governor Garay of Jamaica, mapped the bay and described its inhabitants. This expedition is accepted as the first thoroughly documented exploration of that body of water (Scaife 1892:149). Other Spanish voyagers are known to have sailed the Gulf Coast west of Florida in the second and third decades of the sixteenth century, including Juan Ponce de Leon and Diego Miruelo.

Following the Pineda expedition of 1519, the next two Spanish groups to visit the Mobile Bay area were the Pánfilo de Narvaez and Francisco Maldonado expeditions. Pánfilo de Narvaez apparently stopped at Mobile Bay in October of 1528 while navigating toward Mexico on makeshift boats, following an ill-fated expedition to the east. Narvaez was met by a force of natives who may have retained two of the expedition members as captives following an aborted effort by the Spaniards to obtain water (Smith 1967:242). The Narvaez visit to Mobile Bay was brief, and it appears that the two lost members of the expedition may have been the only ones to go ashore. In 1540, Maldonado also may have stopped at Mobile Bay with several brigantines during an effort to meet and resupply the expedition of Hernando De Soto. The failure of these early expeditions to locate any easily obtainable wealth contributed to a general lack of activity in the area by Spaniards who were more profitably occupied elsewhere.

There was a delay of 18 years before further interest in the area brought another Spanish expedition. In 1558, Guido de Las Bazares was sent from Vera Cruz, Mexico with three small vessels on an expedition to examine the northern Gulf coastline for the purpose of locating an appropriate site for the establishment of a colony. Bazares explored Mobile Bay and wrote a favorable account of it. From his description, it is clear that the group had explored Mobile Bay (Hudson et al. 1989:124). The Bazares account gave considerable attention to navigational advantages, noting details concerning the entrance to the bay, water depths within the bay, and a favorable anchorage. Additionally, the Bazares account of the land emphasized the abundance of specific tree species suitable for the building of ships. Among observations recorded concerning the native inhabitants, Bazares noted that the Indians were on the bay in large canoes and that they used fish traps (Nuzum 1969:29).

Despite the glowing account given to the Mobile Bay area by Bazares, the colonization fleet that set out the following year selected another location. The Tristan de Luna y Arellano expedition of 1559 set sail with 11 vessels, 1,000 colonists and servants, 500 soldiers, and 240 horses (Hudson et al. 1989:124). Missing their intended destination, the de Luna fleet did, temporarily, put into Mobile Bay where they remained from 17 July to 14 August while a vessel was sent in search of the bay intended for the location of the colony. This was to be the largest group of Europeans to enter the bay for some decades. Archival evidence indicates that the de Luna colony was established on Pensacola Bay, although the actual site has not yet been discovered (Hudson et al. 1989:126). When the expedition departed Mobile Bay, some men were left on the eastern shore to travel overland with all of the surviving horses. Following an early loss of vessels and supplies to a hurricane, unprofitable excursions into the interior, and periods of starvation, the colony at Pensacola Bay failed, and the colony was all but abandoned by 1561.

For more than a century following the de Luna colonization attempt, the central Gulf Coast and the Mobile area were virtually ignored by the Spanish. Content with possessions in Florida and the western Gulf, the Spanish maintained nominal possession of the central Gulf Coast, but failed to explore further or attempt colonization until foreign competition sparked renewed interest more than a century after the failure of the de Luna colony. That the Spanish had little contact with the Mobile Bay area during this period is reflected in the paucity of archaeological evidence for sixteenth-century contact which, at present, is limited to a single mid-sixteenth-century coin of Mexican origin found at the Shellbanks Bayou site (Lazarus 1965).

French Period

The French attempt to secure control of the southern terminus of the Mississippi River system came in 1698, with an expedition under the command of Pierre Le Moyne. This expedition was to begin another colony to secure access through the Gulf of Mexico to the vast French territory of Louisiana. Finding that the Spanish had recently established a new foothold at Pensacola, Le Moyne then sailed west, explored Mobile Bay, and proceeded to continue on to establish a base at Biloxi.

Permanent European settlement of the Mobile area began as a result of the efforts of Iberville's younger brother, Jean Baptiste Le Moyne, to move the colony to Mobile Bay, a location considered by Bienville to have conditions better suited to maritime trade. French colonization efforts on Mobile Bay began in 1702 with the establishment of Port Dauphin, on Dauphin Island near the entrance to Mobile Bay, and with the founding of the colony's capitol on relatively high ground, known as "27-Mile Bluff" on the Mobile River. The French built a wooden stockade near the river and named it "*Fort Louis de la Louisiane*" in honor of King Louis XIV. From an early point, the settlement was popularly given the more geographically specific name of "*Fort Louis de la Mobile*" after the name of a local Indian tribe (Foscue 1989:94).

At the time the colony was established, the entrance to Mobile Bay had a depth of over 10 feet at low tide and could accommodate all but the largest vessels. These found an anchorage in the protected waters of a main harbor established at Pelican Bay, an anchorage protected by barrier islands on the Gulf side of Dauphin Island near the mouth of the Bay (McWilliams 1981:40; Surrey 1916:40). From there, passengers and supplies were offloaded to Port Dauphin and carried aboard smaller vessels to Fort Louis 60 miles through the bay and up the Mobile River. The products of the colony were similarly lightered down to Port Dauphin for export. Coastal trade in small vessels, often locally built, expanded the commerce (Surrey 1916:55-81). The early maritime trade of the French colony included the immigration of colonists and slaves, the importation of supplies and trade goods, and the exportation of natural resources and agricultural products (Surrey 1916:164).

The settlement on Dauphin Island was abandoned by the French in 1719, after being devastated by a hurricane and by shoaling at the entrances of both Pelican and Mobile bays that forced larger vessels to anchor in the open water of the Gulf in order to discharge or receive cargoes (Summersell 1949:2). The French capital was moved to Biloxi in 1720 and then again to New Orleans in 1722. Mobile continued to export the natural resources of the region throughout the remainder of the French period in Alabama, but without remarkable commercial success.

During the French period, navigation on the rivers, the bay, and along the coast was developed and expanded. Inland commerce of this period, largely carried on with the local Indian population, relied on small vessels that could be rowed, punted, or towed and included open flat boats (*pirogues* or *bateaux*) and small-decked vessels (*galere*). Bay navigation and coastal trade was carried on in sailing vessels (*barques* and *brigantines*) that generally carried less than 50 tons of cargo. These coasting vessels made voyages to ports as distant as Cuba and Mexico. The ships that brought supplies from France and carried away the exports were not much larger than the coasting vessels during the first few years of the colony. By 1720, vessels over 100 tons burden were standard, and by the end of the French period, ships of as much as 700 tons were involved in the Mobile trade (Surrey 1916:70, 78). Exports were largely restricted to furs traded from the Indians during the first few years of the French period, but gradually grew to include salted beef, cattle, hides, tallow, ship masts and lumber, tar and pitch, corn, rice, tobacco, indigo, sassafras, cotton, and quinine (Hamilton 1976:290; Surrey 1916:164-166).

Bayou La Batre got its name from a battery the French maintained there; a Frenchmen by the name of Joseph Bousage founded it in the 1780s. By that time France had lost control of the area to the British, but the French/Cajun culture persisted. Many of the place names of the area today are of French origin, such as Coden and San Souci.

British Period

When Mobile was taken over by the British with the Treaty of Paris in 1763, it was incorporated into the administrative district of West Florida. Maritime commerce expanded under British rule. Better charting and increased knowledge of the entrance to Mobile Bay allowed a return of deep draft vessels to a protected anchorage, now in the lower bay rather than south of Pelican

Island. The return of major shipping allowed the commerce of the city to flourish; however, access to the lower bay required lightering of the cargoes of larger vessels to and from the city due to the shallowness of the upper bay (Delaney 1962:43).

Commerce focused on the export of products obtained in trade with the local Indian tribes, primarily hides and pelts as during the French period. Most of the Indian trade materials came from the interior, which, north of the district border, was closed to colonists and reserved by the British for the indigenous population. While animal skins remained the dominant export product, a greater emphasis was placed on the production of timber, naval stores, indigo, and a growing interest in cotton. During the French period, trade had been a government monopoly; while under British rule, trade was conducted by private enterprise with a resultant increase in capital for local expenditure, investment, and development (Delaney 1962:41).

SECOND SPANISH PERIOD

During the American Revolution, both Spain and France were allied with the Americans against the British. At the instigation of American revolutionaries, the Spanish governor of Louisiana, Don Bernardo de Galvez, sailed in the winter of 1780 with a force of 2,000 soldiers to attack the British garrison at Mobile. Following a siege of 14 days, the British surrendered the city to the Spanish forces. Galvez then spent a year at Mobile in preparation for an assault on Pensacola, the British capitol of West Florida. During this period of preparation, a fort was constructed next to the Blakeley River east of the Mobile River Delta. The British launched an unsuccessful attack against the fort in January of 1781 and retreated back to Pensacola. In May 1781, Galvez captured Pensacola, returning to the Spanish crown control of the Gulf Coast from Mexico to Florida (Harris 1977:50-51).

Although the commerce of Spanish Florida and the Gulf Coast port of Mobile suffered under a return to a restrictive system similar to that which had existed under the French, the colony was now nearly self-sufficient (Mistovich and Knight 1983:17). Trade with the native Indian tribes continued, and the exportation of furs and hides remained a dominant part of trade. Much of that trade was in the hands of a British trading firm that maintained a virtual monopoly with several tribes and imported vast quantities of British goods to exchange for the Indian furs and deer hides (Hamilton 1910:352-353). It was during this period of Spanish rule that the cotton gin was invented and introduced to the area.

During the second Spanish period, Americans began settling in Spanish western Florida and in the new U.S. territory to the north. By necessity, these settlers exported produce and received supplies through Mobile as the port city at the terminus of the Tombigbee, Alabama, and Mobile rivers. Resentment by the American settlers of heavy Spanish import duties may have been a contributing factor to the U.S. annexation of western Florida during the War of 1812.

AMERICAN ERA

The city of Mobile became part of the U.S. on the pretense that Spain was then a military ally of England, with which the U.S. was at war. It was, however, almost a year after the annexation before American forces actually occupied Mobile. The American presence in Mobile was soon threatened by British military actions. In 1814 American forces at Fort Bowyer, established on Mobile Point in 1813, were involved in combat with a British naval expedition. The American forces repulsed the attack and received credit for the destruction of the HMS *Hermes* at the entrance to the bay. The British returned in 1815, following the Battle of New Orleans, with 38 warships and 5,000 troops. This second British assault captured the fort, but the forces were withdrawn after it was learned that the Treaty of Ghent, which ended the war, had been signed before Fort Bowyer had been taken. Construction of present-day Fort Morgan was begun in 1818 on Mobile Point at a location immediately northeast of Fort Bowyer.

Following the War of 1812, the American era for Mobile was the start of a half-century of economic prosperity. The dissolution of the international border north of Mobile opened the second largest watershed in the southeast to free trade under one nation. Substantial numbers of new settlers arrived from the Atlantic states. The government obtained land through Indian treaties, and this opened most of the state of Alabama for settlement (Royce 1899).

The arrival of steamboats in 1819 opened the vast inland waterways to practical two-way navigation. When Alabama was granted statehood in 1819, Mobile grew rapidly as an international port, soon to rival New Orleans for supremacy as a center of Gulf Coast commerce.

The influx of settlers opened new land to the cultivation of export crops and led to the establishment of many new towns. Less than five years after the American annexation of Spanish West Florida, the town that was to become Tuscaloosa was founded on the Black Warrior River. Demopolis was established near the confluence of the Tombigbee and Black Warrior rivers, and Montgomery, Selma, and Claiborne were settled on the Alabama River. Each of these towns took advantage of the transportation opportunities that placement on a navigable river provided (Summersell 1949:16).

Steamboats steadily increased in capacity, speed, and reliability, although the formative years of the trade were filled with disasters such as boiler explosions, fires, and sinkings that resulted in considerable loss of life and property. Many of the early disasters were due to negligence or incompetence. The Alabama General Assembly was able to pass a law as early as 1826 requiring the annual inspection and certification of steamers by the harbormaster and port wardens of Mobile.

The ascendancy of cotton as a profitable export product provided revenues that helped to finance the development of steam navigation. Steam navigation, in turn, provided the means for a genuine reciprocal trade between Mobile and the interior of the state (Mistovich and Knight 1983:18). Cotton, while the most significant export in the antebellum era, was not the sole product of the interior or the only export from Mobile; lumber and naval stores were also exported in some quantity (Summersell 1949:23). Overseas trade from Mobile, however, continued to suffer from the shallowness of the waterways between the city and the Gulf. Larger oceangoing vessels were still required to anchor in the lower bay and transfer imports and exports via smaller vessels.

CIVIL WAR

Following the secession of Alabama from the Union on 11 January 1861, the outbreak of the Civil War severely affected the maritime commerce of the port of Mobile. Commerce remained largely unchanged in the first few months of the war, but in April of 1861, Lincoln declared a naval blockade of the Confederacy to slow or stop both export of Confederate goods and import of materials that might aid the Confederate war effort. Union warships patrolled off the mouth of Mobile Bay in an increasingly effective effort to intercept, destroy, or deter vessels attempting to run the blockade.

Outbound blockade-runners carried valuable cargoes of cotton that provided the revenue to pay for medicines, munitions, and a multitude of other goods, including a considerable proportion of luxury goods, of which the South was in short supply. The goods were brought on inbound runs from Europe, the Bahamas, or Cuba. Following the 1862 capture of New Orleans and Pensacola, Mobile remained the only major port open to the Confederacy on the eastern Gulf Coast.

The Confederate defenders established an extensive series of obstructions and fortifications and built up naval and land forces in an attempt to protect the city from Union assault. The protection of Mobile was given a high priority by the Confederate government and considerable expense and effort were devoted to that cause.

These defenses proved to be an effective deterrent until the summer of 1864, when on 5 August a Union fleet fought its way past Fort Morgan and through the torpedoes at the entrance to Mobile Bay. During the forced entry past Fort Morgan, the *USS Tecumseh*, a turreted ironclad, struck a torpedo and quickly sank with most of its officers and crew. After entering the bay, the Union fleet defeated the four Confederate warships that challenged it. Complete control of the lower bay was not achieved until combined naval and shore bombardment forced the surrender of Fort Morgan on 23 August.

Following the Union capture of the lower bay, the Confederate defenses in the upper Mobile Bay area remained stubbornly effective, slowing the Union advance against the city until the very end of the war. During the Civil War, the salty water of Portersville Bay was selected as a site for a Confederate salt works (Holt 1909:10).

From Reconstruction to the Twentieth Century

During the period of Reconstruction that followed the war, Mobile continued to be an important port city. Both the city itself as well as the interior of the state suffered considerably less damage than many other areas of the South. Shipping soon returned (Pearson et al. 1994:5.54-55). There was, however, a general decline in the commercial traffic of the port in comparison to the pre-war era due, in part, to war efforts that left the entire Bay area less accessible to commercial navigation. The extensive series of obstructions that had been established in order to prevent the passage of warships was still in place, and shoaling had built up during the war years. The U.S. Army Corps of Engineers (USACE) began a program of dredging that has continued harbor improvement to the present.

Following the Civil War, there was a considerable increase in vessel traffic on the waters of the Mobile area, particularly by local steamers and small boats involved in transportation and the collection of seafood. The development of resorts and summer homes on the eastern shore led to a number of cross-bay ferries and excursion steamers that became a major part of life for the people of Mobile and the Mobile Bay area. This is also true for the Portersville Bay portion of the current Project Area.

Historically, areas of southern Alabama have held the names Hancockville and Portersville. The latter area once included present-day Coden, Bayou La Batre, and Sans Souci Beach. Coden was then a summer resort community for residents of New Orleans, Mobile, and other areas of the Cotton Belt. Large-scale resort hotels such as the Hotel Joullian, Villa Alba, and the Rolston Hotel were constructed along Portersville Bay. By 1909, the dirt road from Mobile down the Bay Shore had been improved for automobile use. During the winter season, Coden and other areas in the Gulf Coast offered hunting. The streams, bays, and inlets of the area served as winter nesting grounds for wild ducks and other waterfowl, and in the uplands quail and dove shooting was ample. In less populated areas, deer hunting was available, as well as limited access to bear.

Located in the Gulf Coast of Mobile County, Portersville Bay was renowned for its oyster beds, where there was no closed season (Holt 1909:1). The Portersville, Mobile, and Montgomery stage line connected steamboats from New Orleans with Bayou La Batre (Longiaru and Griffin 2005).

The bay ferries and excursion boats, known locally as "bay boats," developed a substantial and regular service until a rapid decline following the opening of Cochrane Bridge across the lower Mobile River Delta in 1927 (Anthony 1991:part 4). At the same time cross-bay traffic was developing, private yachts and sailing clubs were being introduced to the bay area, which continue to exist there today. The bay waters also saw the development of a seafood industry involved in fishing, oystering, and shrimping. By the early twentieth century, substantial fleets of locally built small schooners and sloops were active on the bay. In the off seasons, these vessels were commonly involved in charter service and transporting farm produce and timber (Mistovich and Knight 1983:22).

Oystering developed into an export industry and thrived until the early twentieth century, when siltation brought about a decline in the oyster population. It was, however, also early in this century that the development of the otter trawl brought about the shrimping industry that continues to work out of Mobile Bay today.

VESSEL TYPE POTENTIAL FOR THE AREA

With the advent of the Colonial era, the maritime character of the area witnessed an increasing influx of watercraft types and numbers. Vessel types present during the Colonial era were all powered by sail and/or current, and included small coastal merchant vessels rigged as sloops and schooners, large merchantmen and warships, small local fishing craft, and early river craft, which brought commodities by river to Pascagoula. During the nineteenth and early twentieth centuries other vessel types emerged in use in the area including: river and coastal steamers; sailing craft such as lugers, sloops, schooners, ships, and barks; unpowered river craft of the flatboat family; Civil War vessels such as monitors and rams; small vernacular craft and fishing vessels such as bateaux, oyster boats, and bay shrimpers; and harbor craft like steam tugs, barges, and dry-docks. Potential vessel loss types for this area include scuttled or storm-driven vessels that have been buried and reworked, of which vernacular craft would be the most predictable kind of vessel (Figure 2-05).

Figure 2-05. Early twentieth-century photograph of small vernacular craft in the Mobile Bay area (courtesy of University of South Alabama Archives).

Though less romanticized than the steamboats that plied the bay and rivers, one of the most prolific classes of vessels found in the area's waters were schooners. These included large blue-water schooners, coastal schooners, and locally built fishing schooners. These large schooners played a significant role in the local economy, as lumber and lumber products such as staves and shingles were one of the main exports from the area.

In 1937, offshore shrimp grounds were discovered and vessels called "shrimp trawlers" began to be fabricated. Initially built of wood, after 1945 the trawlers were made of steel. Pearson et al. In the late 1930s, Florida fishermen:

> "…introduced the "South Atlantic Trawler" when the potential for offshore shrimping in the Gulf was discovered. Begun as a variation of a powered vessel originally derived from the design of Greek sponge boats used on the west coast of Florida, the South Atlantic Shrimp trawler generally measured between 50 and 65 ft. long. The shrimp boat reached its present characteristic form and style in the very short period of time between the end of World War II and about 1950. Possibly as a result of the need for maximum rear deck working space, it was among the first powered fishing craft to have a forward-located pilot house. The hull, however, retained characteristics of the old Greek sponge boats with its full body, sweeping sheer line, and fine entrance" [Pearson et al. 1993:114].

These kinds of vessels are abundant in Bayou La Batre today. Small versions of this type, commonly called shrimp trawlers, commonly called "bay shrimpers" or "shrimp boats," can still be found fishing the surrounding bays and in and adjacent to the Project Area. These vessels, because of their relatively recent age, would not generally be considered historically significant if their remains were encountered in the Project Area; however, the earliest examples of this vessel type might be considered significant relative to National Register of Historic Places (NRHP) criteria, based on their evolving, yet distinctive, construction characteristics (Figure 2-06).

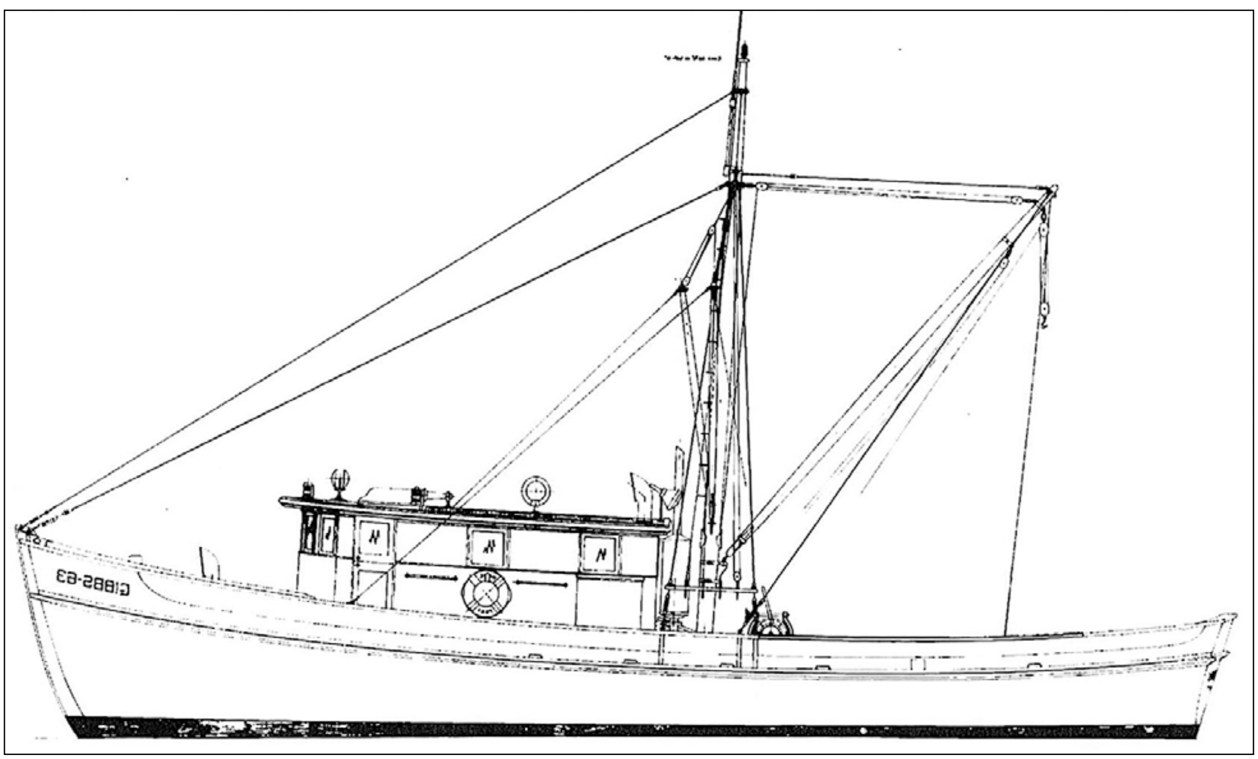

Figure 2-06. Profile of a Greek-type shrimper of the late 1920's and 1930s (as presented in Fleetwood 1995:199).

PREVIOUS INVESTIGATIONS

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 that have been completed in or near the Project Area. Varying in degree of applicability to the current research, these studies allow for the identification of potentially significant resources, and the studies aid in the recognition of specific problems or aspects inherent in the assessment of the present survey data and in the identification of potential resources. At the commencement of the project, archival investigations were conducted that compiled and utilized both primary and secondary sources. References mainly included previous cultural resources survey reports. Six previous maritime underwater projects were found and no previous shipwreck has been recorded.

In 2009, Panamerican conducted a similar remote-sensing survey of a proposed fish and shellfish habitat project just to the west of the Bayou La Batre Channel and just south of Little Bay (James and Faught 2009). Performed under contract to Volkert Environmental Group, Inc. of Mobile, Alabama for the Alabama Department of Conservation and Natural Resources Post-Katrina Shellfish & Fish Recovery Project, the survey was negative for the presence of submerged cultural resources (James and Faught 2009). The survey was negative for the presence of submerged cultural resources.

Another earlier study in the Project Area vicinity conducted by Panamerican was the intensive remote-sensing survey of a construction corridor for a proposed out-flow pipe for a wastewater treatment plant on the bay side of the Bayou La Batre coming out in Portersville Bay in 2007. Performed under contract to Goodwyn, Mills and Cawood, Inc., of Montgomery, Alabama, the remote-sensing survey recorded 26 magnetic anomalies in the project corridor (James and Faught 2007). Based on signal characteristics, these anomalies appeared to be generated from multiple single-point sources and were not considered to have the potential to represent significant cultural resources (James and Faught 2007).

In the summer of 2014, Panamerican examined the proposed Marsh Island Restoration project area for Portersville Bay (James 2014). The project was performed under contract to Thompson Engineering, Inc. of Mobile, Alabama for the Alabama Department of Conservation and Natural Resources. Located in the Mississippi Sound southeast of Bayou La Batre and to the east of Isle Aux Herbes, the project entailed the construction of a short breakwater on the southern face of Marsh Island totaling approximately 3,000 feet in length, and the dredging of both a temporary construction access and construction channel. Twelve magnetic anomalies were recorded with an anomaly cluster at the northeastern end of the Marsh Island survey corridor recommended as potentially significant. In addition to this cluster, there were paleochannel margins buried at least 10 feet below the bay floor throughout the project area.

In May 2016, maritime archaeologists with Panamerican conducted a remote-sensing survey of four proposed off-bottom oyster farm tracts near Bayou La Batre, Mobile County, Alabama (James et al. 2016a). Located just to the east of Bayou La Batre in West Portersville Bay, and between Coden Bayou and Grand Point, the four areas included from west to east the 18.5-acre Landry Tract, the 3-acre P. Shashy Tract, the 3-acre W.M. Shashy Tract, and the 33-acre Duval Tract (Figure 2-07). During the remote-sensing survey, 46 magnetic anomalies were recorded and identified during the analysis of the data, nine in the Landry Tract, four in the P. Shashy Tract, three in the W.M. Shashy Tract, and 30 in the Duval Tract. Ten sonar contacts were present in the Duval Tract, but none was recorded in any of the other tracts. All of the anomalies appeared to be generated from multiple single-point sources and were not considered to have the potential to represent significant cultural resources. In addition to an absence of potentially significant anomalies, the subbottom did not record any feature or landform considered potentially significant; therefore no further cultural resources work was recommended.

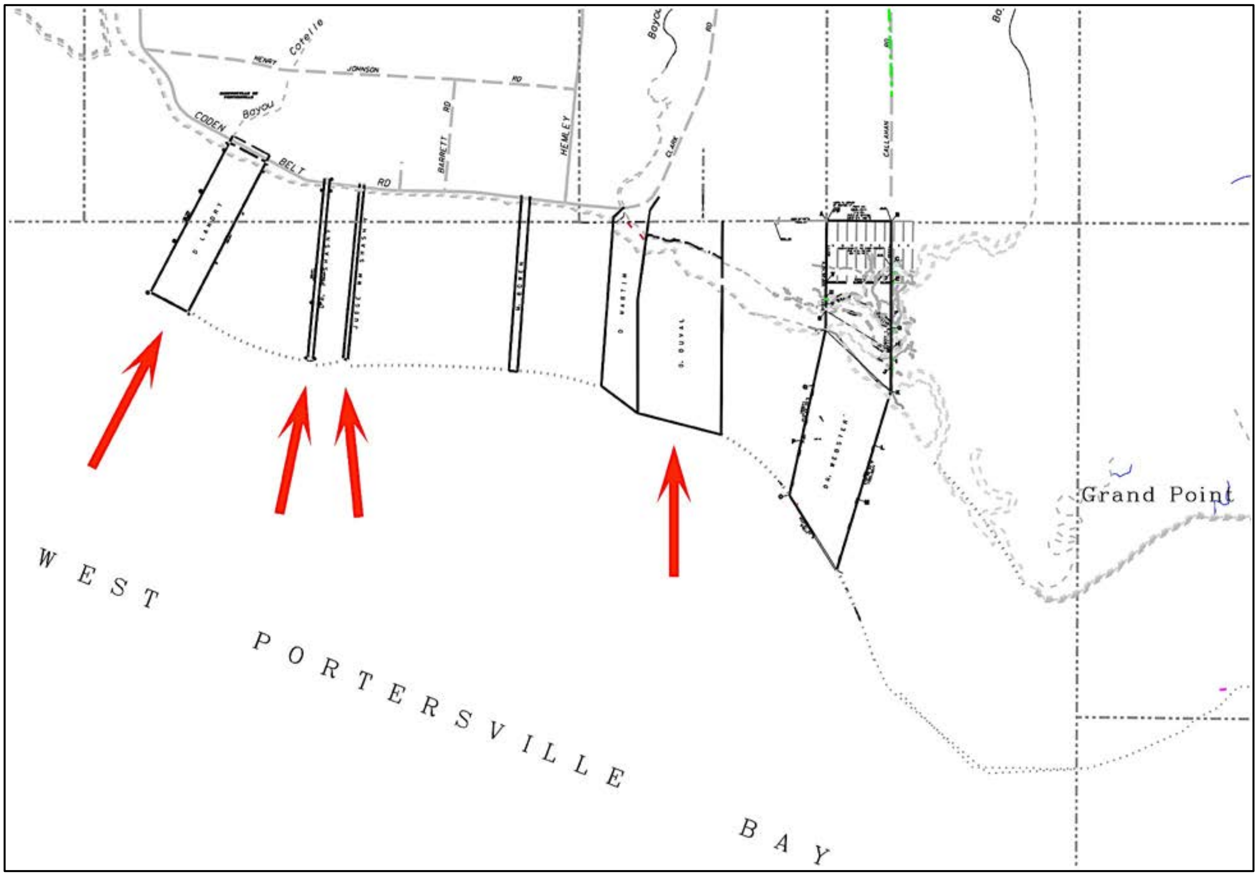

Figure 2-07. Marked with red arrows, project location map showing from left to right, the Landry, the P. Shashy, the W. M. Shashy, and the Duval Oyster Farm survey tracts of Panamerican's 2016 remote-sensing survey (James et al. 2016a:2).

Also in May 2016, Panamerican conducted another intensive cultural resources remote-sensing survey of two proposed off-bottom oyster farm tracts near Bayou La Batre, Mobile County, Alabama (James et al. 2016b). Located just to the west of Bayou La Batre on the southwestern side of Point Aux Pins in Sandy Bay is the 73-acre Stewart Tract. To the east of Bayou La Batre in Portersville Bay is the 57-acre Webster Tract. The investigation was performed under contract to Auburn University School of Fisheries (Shellfish Lab). During the remote-sensing survey, 33 magnetic anomalies were recorded: seven in the Webster Tract; and 26 in the Stewart Tract. With no associated acoustic image and based on signal characteristics, the majority of the anomalies appears to be generated from multiple single-point sources and are not considered to have the potential to represent significant cultural resources. In addition to an absence of potentially significant anomalies, the subbottom did not record any features or landforms considered potentially significant; therefore no further cultural resources work was recommended.

In June 2016, Panamerican conducted a remote-sensing survey for a proposed Artificial Reef Site in Mobile County, Alabama, in the nearby Mississippi Sound (James et al. 2016c). Specifically, the 300-foot square site was situated approximately 7 miles due south of Bayou La Batre and north of Dauphin Island. The investigation was comprised of a site file check, limited archival research, and an intensive remote-sensing survey of the project area employing a magnetometer, sidescan sonar, and subbottom profiler. During the remote-sensing survey, 52 magnetic anomalies were recorded in the project area. Based on signal characteristics, the anomalies appeared to be generated from buried and abandoned pipeline and well infrastructure. Due to their material nature and since they have no associated acoustic image, the magnetic anomalies were considered to have no potential to represent significant cultural resources. In addition to an absence of potentially significant anomalies, the two subbottom features recorded were not considered potentially significant and no further investigation was recommended.

Documented Vessel Losses

To aid in the determination of the potential for shipwrecks within the current survey corridor, various navigation charts, as well as the Automated Wreck and Obstruction Information System (AWOIS) list were reviewed. The current online edition of the National Oceanic and Atmospheric Administration's (NOAA's) Automated Wreck and Obstruction Information System (AWOIS) and NOAA's Electronic Navigational Charts (ENCs) was consulted relative to known wreck sites or obstructions within or near the current survey corridor. The AWOIS database contains information on over 10,000 wreck sites and obstructions/hangs in the coastal waters of the United States. Information within the database includes a latitude and longitude of each feature along with any known historic and/or descriptive details. The AWOIS website, which may be accessed at http://historicals.ncd.noaa.gov/awois/awoisdbsearch.asp, allows researchers to search for wrecks based on Latitude/Longitude coordinates for a given area. An Access Database file, it has been projected here into Google Earth to allow the researcher to view what wrecks or obstructions are within a given area.

For the purposes of this survey, a review of the AWOIS did not indicate any wrecks or obstructions immediately within the Project Area. It must be stated that position accuracy of AWOIS wrecks and/or obstructions is highly variable and usually poor. It also appears the AWOIS program routinely includes wrecks, obstruction, and unknowns located outside the prescribed coordinates or chart. Of the three survey areas, the ENC database notes three shipwrecks within or nearby the Isle aux Herbes survey area. No wreck or obstruction is identified at the Grand Bay survey area, and one shipwreck is found outside and west of the Grand Point survey area. A review of the ENC records identified two wrecks immediately within the Project Area (Table 2-01 and Figure 2-08).

Table 2-01. Vessels Within/Near the Project Area.*†

Record	Latitude (Dec Degrees)	Longitude (Dec Degrees)	Description	Comment
Kml_4011	30.3333333	-88.25	Unknown, Shipwreck	Within Project Area; always under water/submerged
Kml_4012	30.3335691	-88.2750092	Unknown, Shipwreck	Outside of Project Area; always underwater/submerged
Kml_4013	30.32666	-88.26166	Unknown, Shipwreck	Within Project Area; always dry

*Source: NOAA Electronic Navigational Charts.
†Coordinates presented in WGS84 meters.

Figure 2-08. Electronic Navigational Chart wreck data plotted for the three survey areas (identified by red outlines).

Local accounts note the presence of a shipwreck off the southern beach of Isle aux Herbes (also known as Coffee Island). The remains of a burnt shrimp boat is a known fishing spot. This shipwreck may represent the above record of Kml_4013, which is described as dry and on nautical charts as having superstructure or a mast visible. A fishing article notes, the "rigging of this burnt shrimp boat is clearly visible as it rises from about 2.5 feet of water" (Dute 2009).

Additionally, just off the east coast of Coffee Island a submerged breakwater reef is visible on Google Earth. The reefs are made up of three acres of bags of oyster shells as a part of a $2,900,000 reef restoration project funded by NOAA for The Nature Conservancy to protect 18 acres of habitat from erosion. The project was temporarily halted by the 2010 British Petroleum oil spill and oil-collecting booms were laid in the area to protect the island and work area (National Oceanic and Atmospheric Administration 2010).

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 web sites. The NOAA website allows the researcher to specify the area or region of interest and then review all available maps for the survey areas (Figures 2-09 through 2-14). Another valuable utility provided by this site is the virtual magnification feature, which allows the researcher to zoom in and out of specific areas.

Illustrated in Figure 2-09, is one of the earliest navigation charts available with a detailed view of most of the Project Area (from the NOAA website) date to 1877. Close examination of the chart includes hydrographic data for the area. No cultural feature (i.e., shipwreck or obstruction) is represented at or near the Project Area on the map. Examination of an 1892 chart (Chart No. 188; not shown) presents the same information. Nautical charts showing detailed hydrographic data for Grand Bay from 1877 to 1905 could not be found in the database.

The next available navigation chart from the NOAA website dates to 1905 (Figure 2-10). Similar to the 1877 and 1892 charts, no cultural feature (i.e., shipwreck or obstruction) is represented at or near the Project Area on the map.

The next available navigation charts from the NOAA website date to 1933 (Figures 2-11 and 2-12). The Figure 2-11 chart excerpt focuses on the survey areas east of Bayou Coden. Figure 2-12 features the survey areas west of Isle aux Herbes. No cultural feature (i.e., shipwreck or obstruction) is represented at or near the Project Area on either chart.

The 1968 nautical chart (Figure 2-13) shows the same hydrography and land structure. One shipwreck is noted as dangerous with an unknown depth just outside the Isle aux Herbes survey area. This shipwreck is not found on the 1958 chart (Chart No. 1267), but is located on the 1966 chart (also Chart No. 1267). No other shipwreck is found in the other survey areas including the survey area of Grand Point (not shown, but seen on Chart No. 1266).

The most recent navigation chart from the NOAA website dates to 2015 (Figure 2-14). All three survey areas are exhibited on this chart along with a number of shipwrecks in the Mississippi Sound and near the entrances of Bayou La Batre and Bayou Coden. On this chart excerpt, only two shipwrecks are inside the survey area for Isle aux Herbes. One wreck is noted as having a mast or superstructure showing at the island's shore and the other is dangerous with an unknown depth (noted by red arrows). The wreck with visible structure is first illustrated on the 1998 nautical chart (Chart No. 11373) and the other wreck is noted first on the 2014 chart (Chart No. 11376). No other shipwreck is found in the other Project Area; however, "Ruins" are noted in the Grand Bay survey area appearing first on the 2012 chart (Chart No. 11374). Examination of the area with Google Earth reveals the remains of a pier.

Figure 2-09. 1877 nautical chart of the Project Area showing the Mississippi Sound and the majority of the survey areas (Chart No. LC00188 from National Oceanic and Atmospheric Administration's Office of Coast Survey's Historical Map and Chart Collection).

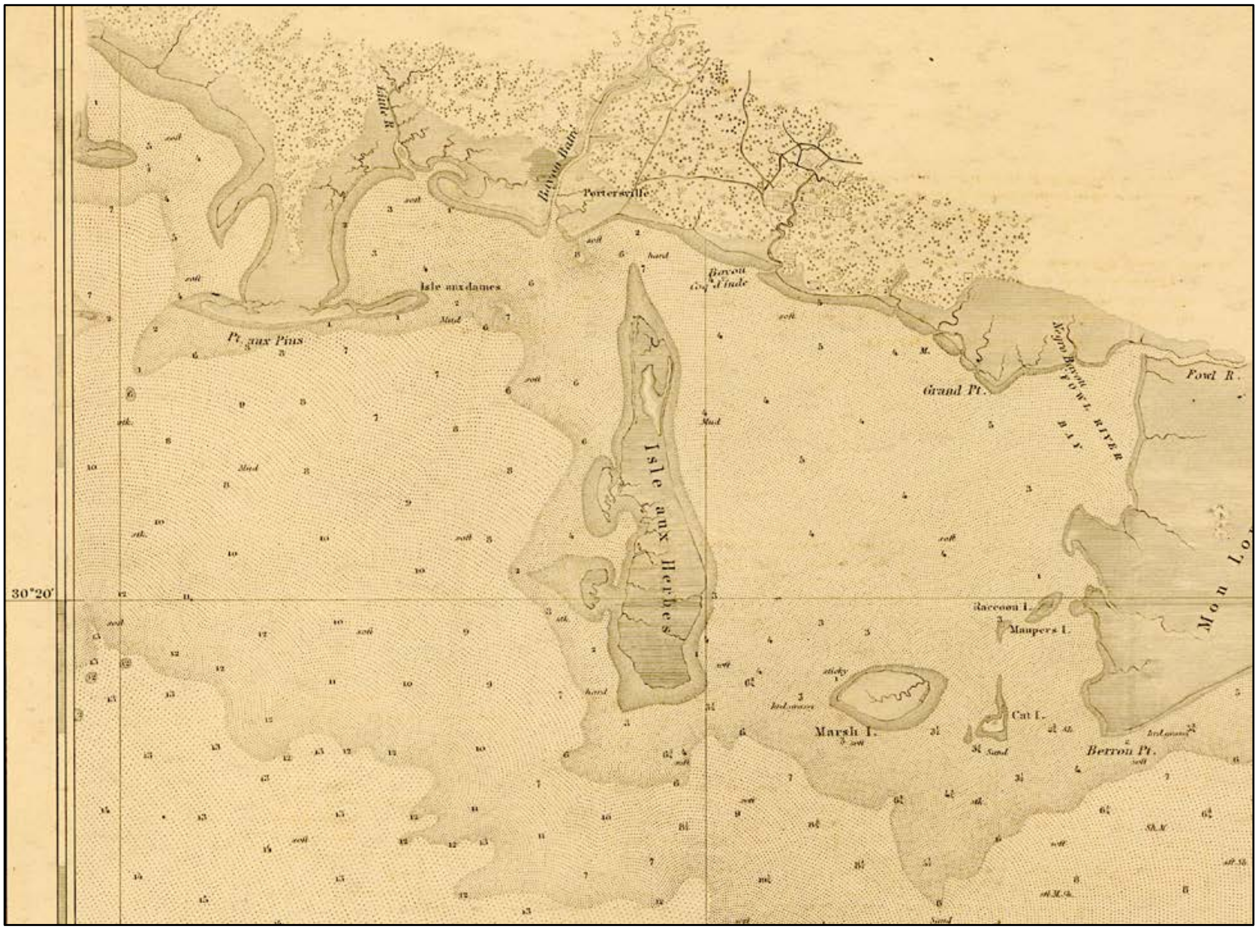

Figure 2-10. 1905 nautical chart excerpt of the Project Area showing the hydrography of the Mississippi Sound (Chart No. LC00188 from National Oceanic and Atmospheric Administration's Office of Coast Survey's Historical Map and Chart Collection).

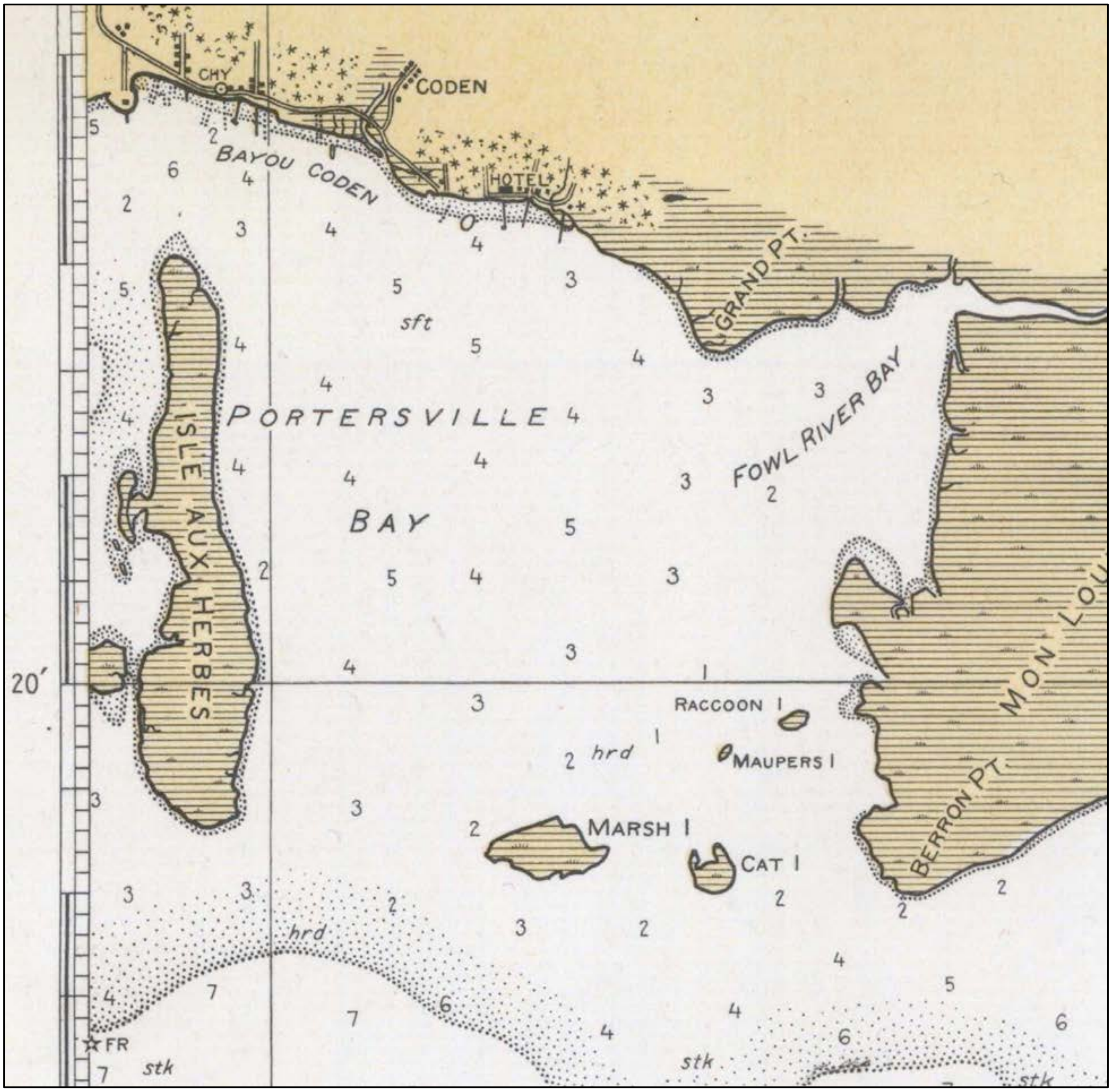

Figure 2-11. 1933 nautical chart excerpt of the Project Area east of Bayou Coden (Chart LC01266 from National Oceanic and Atmospheric Administration's Office of Coast Survey's Historical Map and Chart Collection).

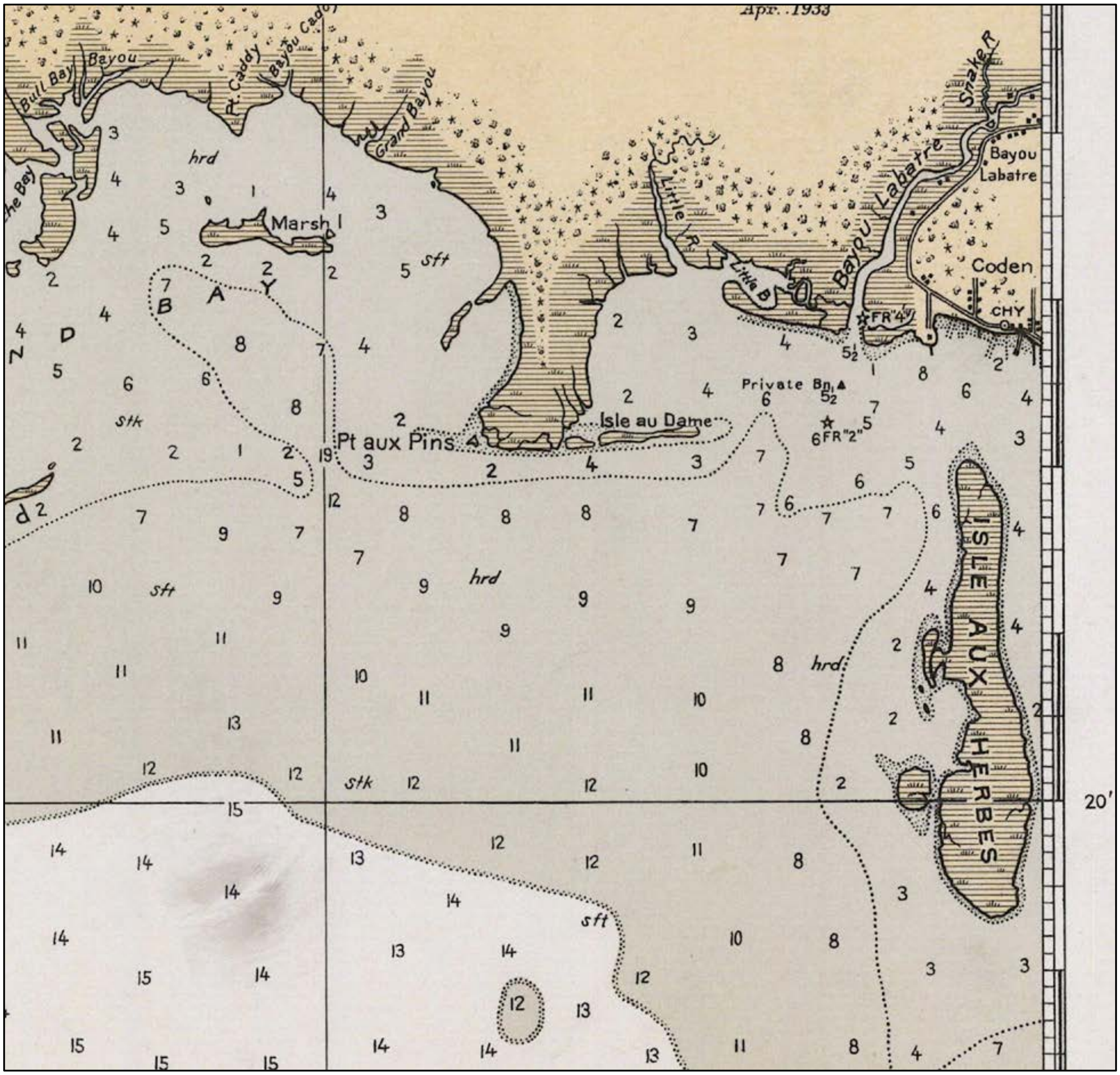

Figure 2-12. 1933 nautical chart excerpt of the Project Area west of *Isle aux Herbes* (Chart LC01267 from National Oceanic and Atmospheric Administration's Office of Coast Survey's Historical Map and Chart Collection).

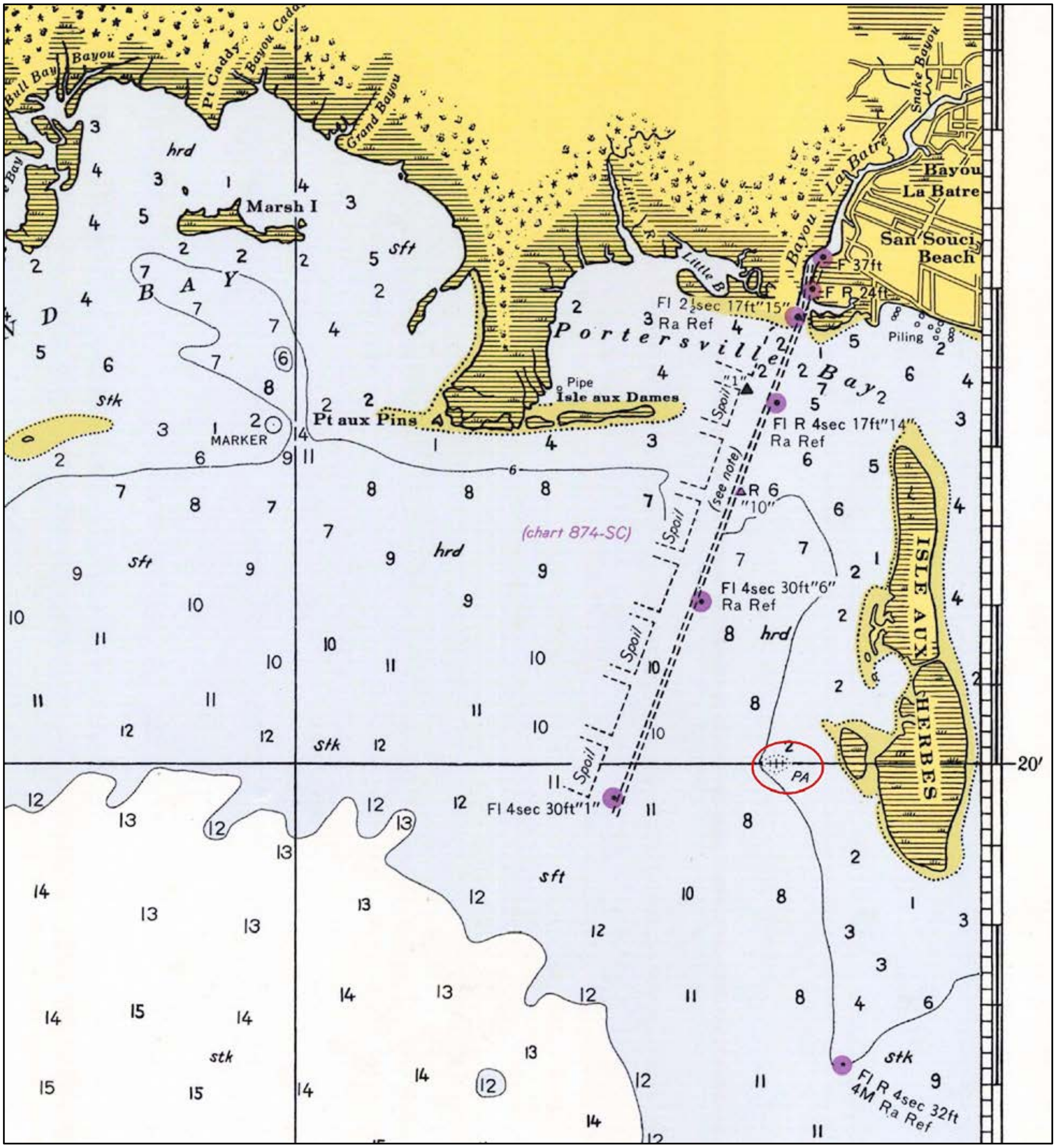

Figure 2-13. 1968 nautical chart excerpt of the Project Area showing one shipwreck nearby the *Isle aux Herbes* survey area (Chart 1267 from National Oceanic and Atmospheric Administration's Office of Coast Survey's Historical Map and Chart Collection).

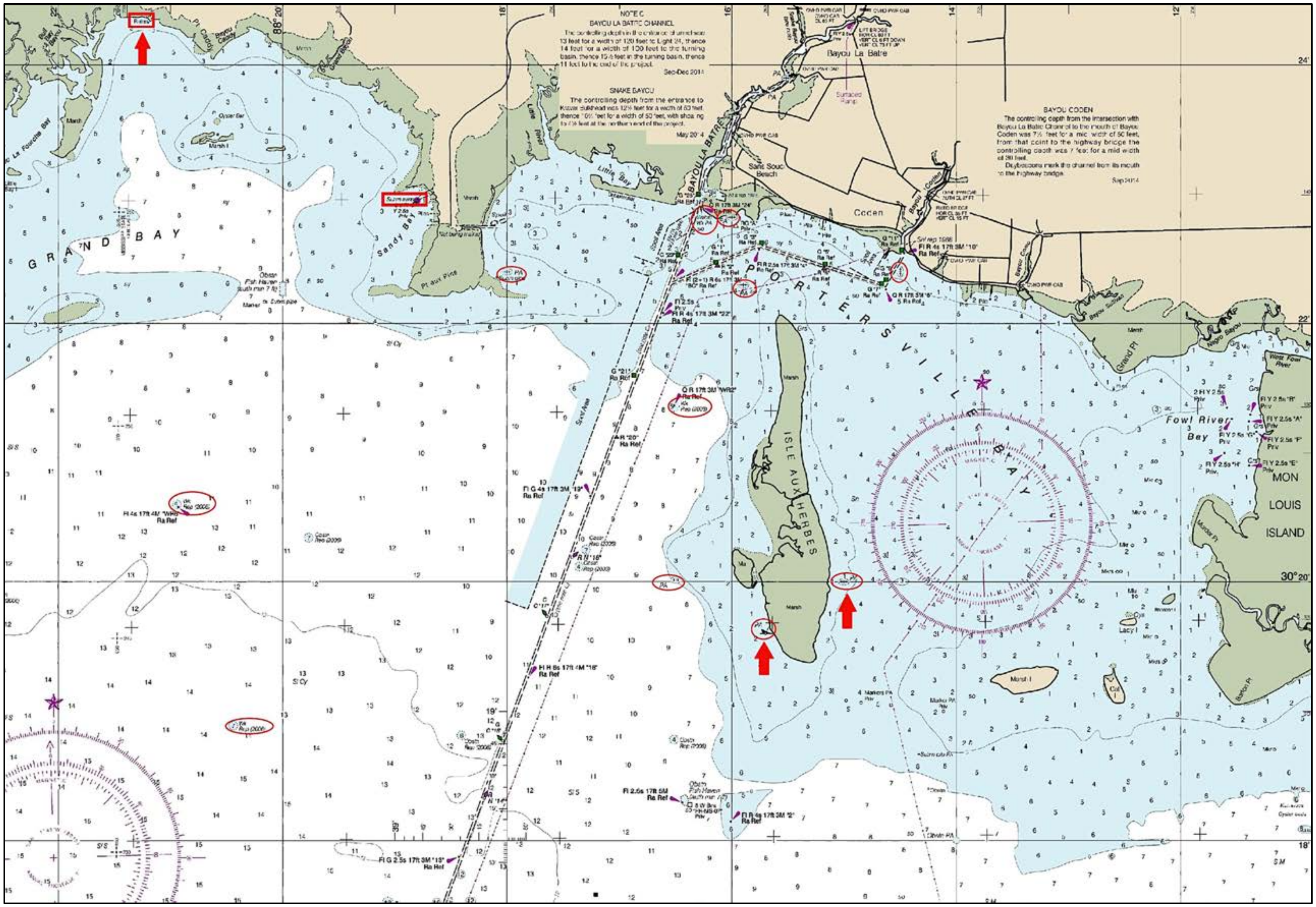

Figure 2-14. 2015 nautical chart excerpt showing all three survey areas with two shipwrecks in the Isle aux Herbes survey area and "Ruins" in the Grand Bay survey area (all noted by red arrows; Chart 11374 from National Oceanic and Atmospheric Administration's Office of Coast Survey's Historical Map and Chart Collection).

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SURVEY AREA ENVIRONMENT

The five proposed areas slated for off-bottom oyster farm leases near Bayou La Batre, Mobile County, Alabama consisted of Primary, Secondary and Extension leases areas. To the west of Bayou La Batre is the Western Primary Area, also known as the "Grand Bay Area." On its eastern edge is the Western Lease Extension Area. To the east of Bayou La Batre is the Eastern Primary Area, also known as the "Fowl River Bay Area." To its west is the Eastern Lease Extension Area. South of Bayou La Batre is the Secondary Area that encompasses the southern half of Isle aux Herbes, also known as Coffee Island." Figures 3-01 to 3-03 show an existing off-bottom oyster farm and convey the environment of the survey areas.

The survey was conducted throughout the month of August. The weather was generally favorable, although the first two weeks of the month saw unusually active thunderstorm activity that dictated numerous shortened or no survey days altogether.

Figure 3-01. Off-bottom oyster farm at the southern end of the Western Lease Extension Area; view east.

Figure 3-02. Eastern side of the Secondary Area (Isle aux Herbes/Coffee Island Area) survey area; view north.

Figure 3-03. Numerous breakwaters were located on the eastern side of the Secondary Area (Isle aux Herbes/Coffee Island Area) survey area; view west.

PERSONNEL

All personnel involved with the remote-sensing survey had the requisite experience to effectively and safely complete the project as proposed. Mr. Stephen R. James, Jr. served as the Project Manager and Principal Investigator, and Mr. Andrew D.W. Lydecker and Jeff Pardee served as Remote-Sensing Specialists, and Mr. James Duff served as Remote-Sensing Technician.

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 in returning to recorded locations for remote-sensing refinement or diver investigations. Positioning was accomplished using two Trimble DSM12/212 GPS and antennae; one was used for the subbottom, and one split to the navigation/mag computer and to the sidescan (Figure 3-04).

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 at which the magnetic data were recorded (Trimble Navigation Limited 1998:1-2).

The project was planned in NAD83 Alabama West State Plane, U.S. survey feet, and all sidescan, subbottom, and magnetometer target data have been converted to this datum and projection. The 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 Dell PC computer, using the 2015 version of Hypack Max for navigation, which was written and developed by Hypack, 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 3-05). This layback information is critical for accurate positioning of targets in the data analysis phase and to relocate any targets for additional investigations.

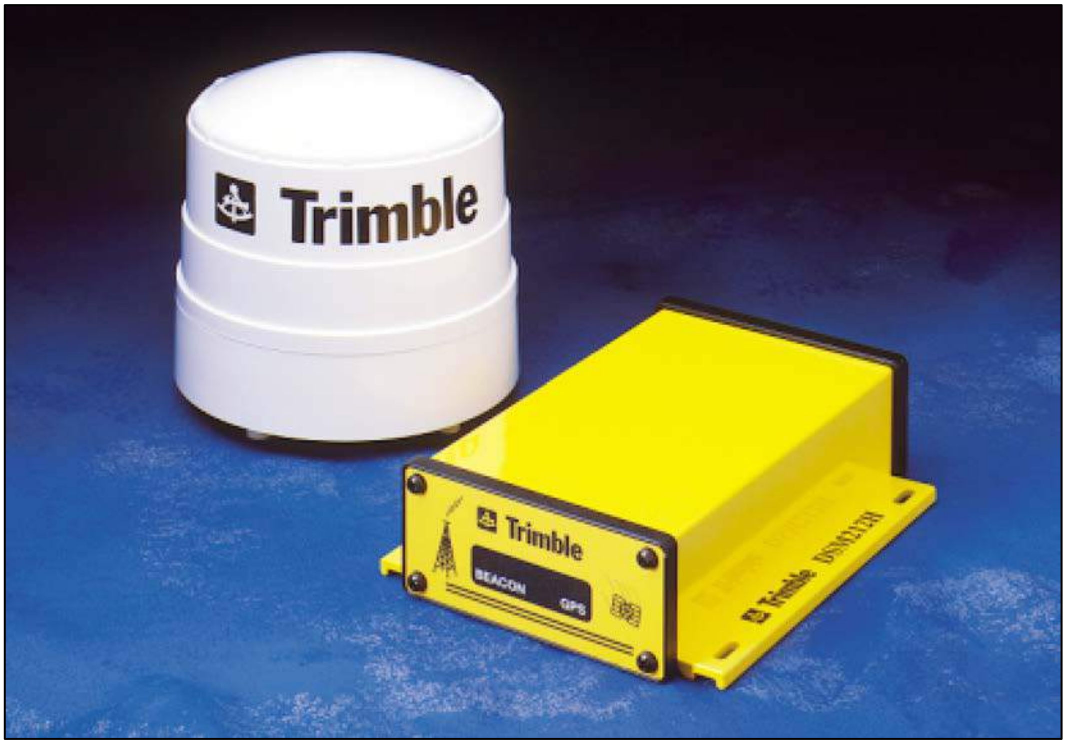


Figure 3-04. Trimble Navigation DSM 12/212 Global Positioning System used during the investigation.

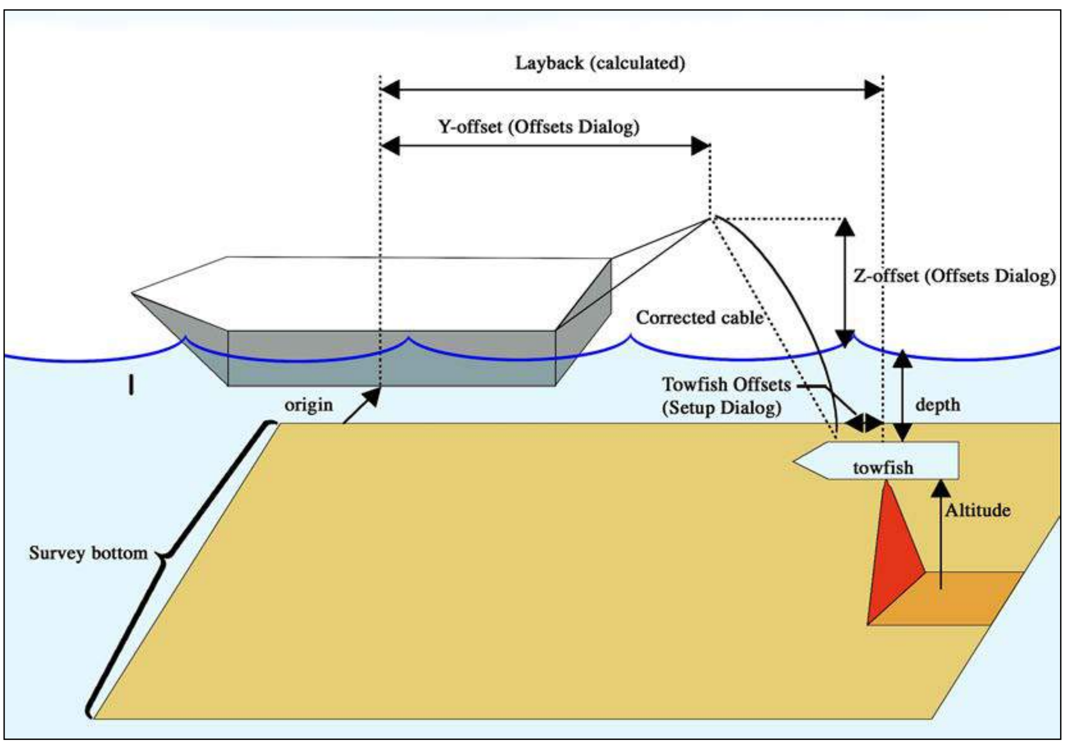


Figure 3-05. Equipment schematic illustrating layback (based on image from Coastal Oceanographics, Inc.).

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 other sources 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 Explorer Overhauser magnetometer is the most stable and precise magnetometer available, and therefore, it is the magnetometer used for this survey (Figure 3-06). A 110-volt gasoline-powered generator fueled the system. The magnetometer towfish was activated without a float to allow it to sink in the water column, depending on vessel speed and tidal currents. The towfish was never more than 20 feet off the bottom (generally half that distance) and less in the shallower portions of the Project Area. The Explorer 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. Data were stored in the navigation computer and archived.

Figure 3-06. Marine Magnetics Explorer magnetometer used 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 EdgeTech kilohertz towfish was operated from the bow of the vessel to keep vessel and motor noises to a minimum.

Target characteristics, such as height above bottom, linearity, and structural form are recorded. Additionally, potential acoustic targets are checked for any locational match with the data derived from the simultaneous magnetometer survey.

The remote-sensing instrument used to search for physical features on or above the ocean floor was a Marine Sonic Technology (MST) Sea Scan HDS sidescan sonar system (Figure 3-07). 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.

Figure 3-07. Marine Sonic Technology sidescan sonar system.

The Sea Scan HDS 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 fixed or target points on the digital printout. Sidescan sonar data are useful in searching for the physical features indicative of submerged historic 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 Sea Scan HDS sidescan sonar was linked to a towfish that employed a 600/ 1,200-kilohertz power setting and a variable side range of 20 meters-per-channel (65-foot beam width) on each of the survey lines. The 20-meters-per-channel setting was chosen to provide detail and 100% overlapping coverage with the 100-foot line spacing to ensure full coverage of the survey area. The power setting was selected in order to provide maximum possible detail on the record generated; 600 kilohertz was the preferred frequency.

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 (Figure 3-08). The device was operated at a setting of 4 to 16 kilohertz, the lowest setting of the device, for maximum penetration.

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

Remote-sensing survey operations were conducted from Panamerican's 17-foot johnboat equipped with a 30-horsepower outboard motor (Figure 3-09). The vessel conforms to all U.S. Coast Guard specifications according to class and had a full compliment of safety equipment as well. They also carry all appropriate emergency supplies, including lifejackets, a spare parts kit, a tool kit, first-aid supplies, a flare gun, and air horns.

Figure 3-08. The EdgeTech SB-424 towfish employed during the survey.

Figure 3-09. The johnboat employed for the remote-sensing survey.

SURVEY PROCEDURES

The five survey areas (see Figures 1-01 and 1-02) were covered with survey lines spaced at 75-foot intervals and a total of 363 survey line miles were programmed into the navigation computer to effectively cover the survey areas. The Western Primary Area (Grand Bay Area) covered 103.5 survey line miles along with 6.6 line miles of the Western Lease Extension Area (Figure 3-10). The Eastern Primary Area (Fowl River Bay Area) covered 55.6 survey line miles along with 49.5 line miles of the Eastern Lease Extension Area (Figure 3-11). In total, 147.6 survey line miles were required for the Secondary Area (Isle aux Herbes/Coffee Island Area; Figure 3-12). 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 magnetic, sonar, and subbottom data were also stored digitally.

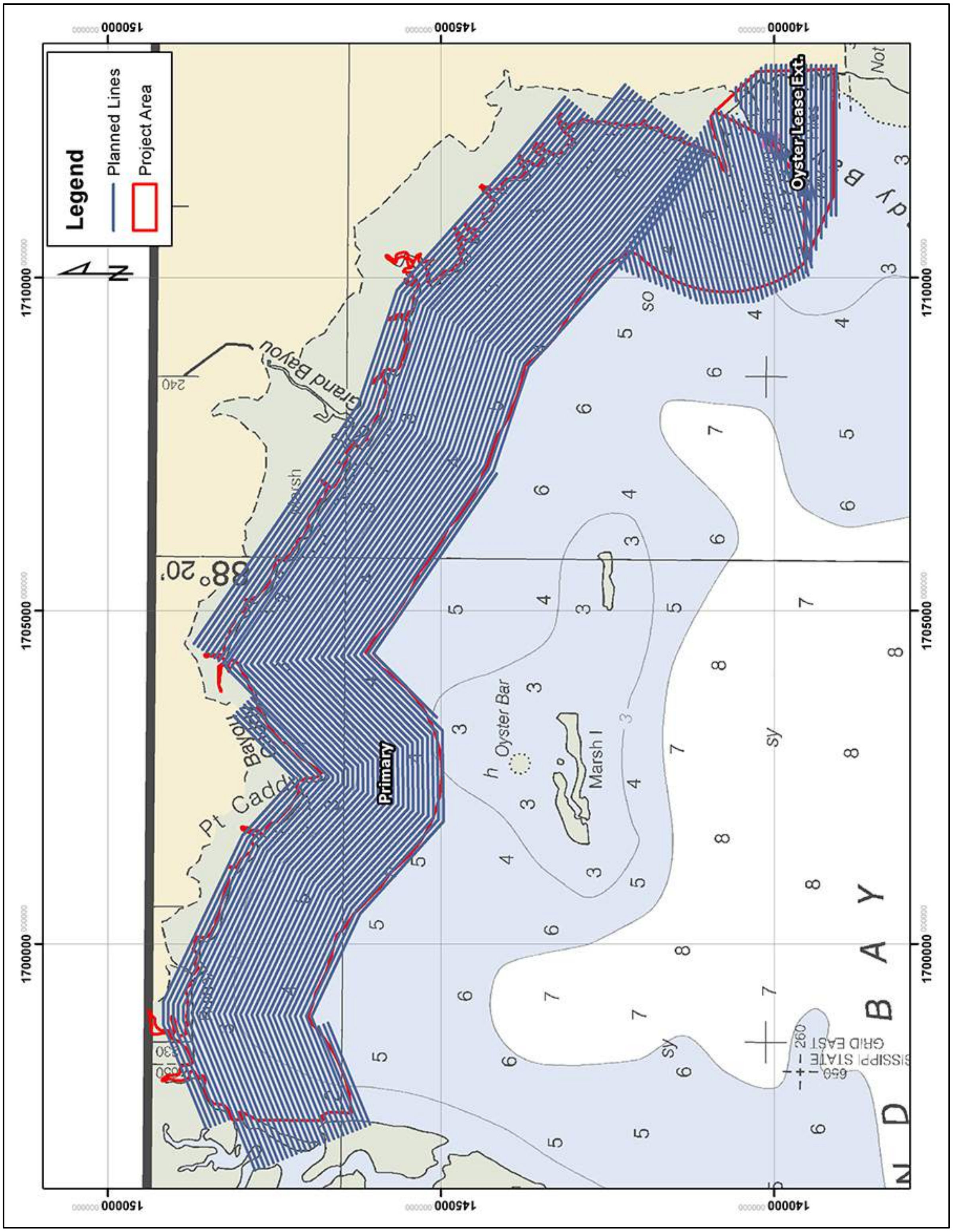


Figure 3-10. Planned survey lines for the Western Primary Area (Grand Bay Area) along with the Western Lease Extension Area.

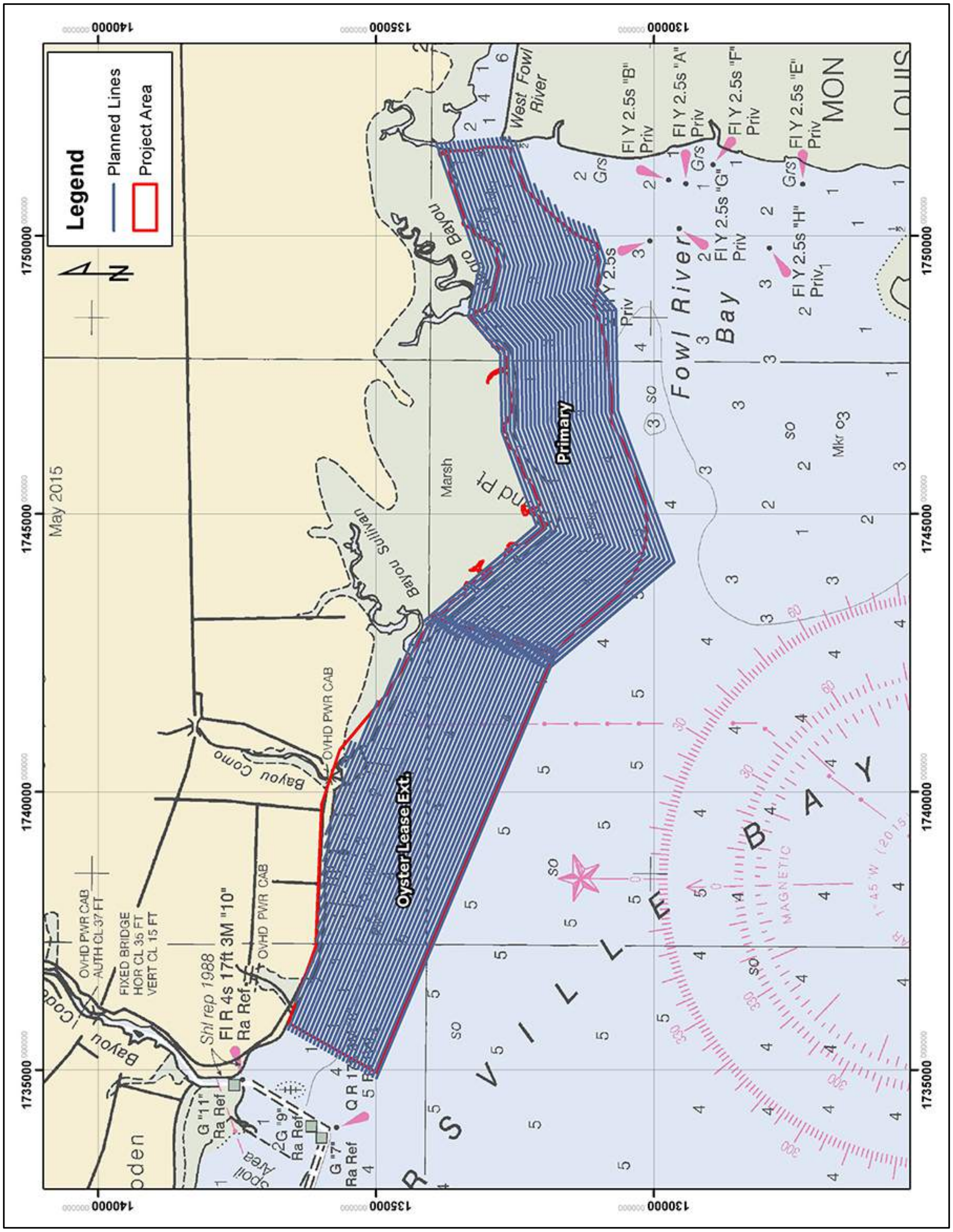


Figure 3-11. Planned survey lines for the Eastern Primary Area (Fowl River Bay Area) along with the Eastern Lease Extension Area.

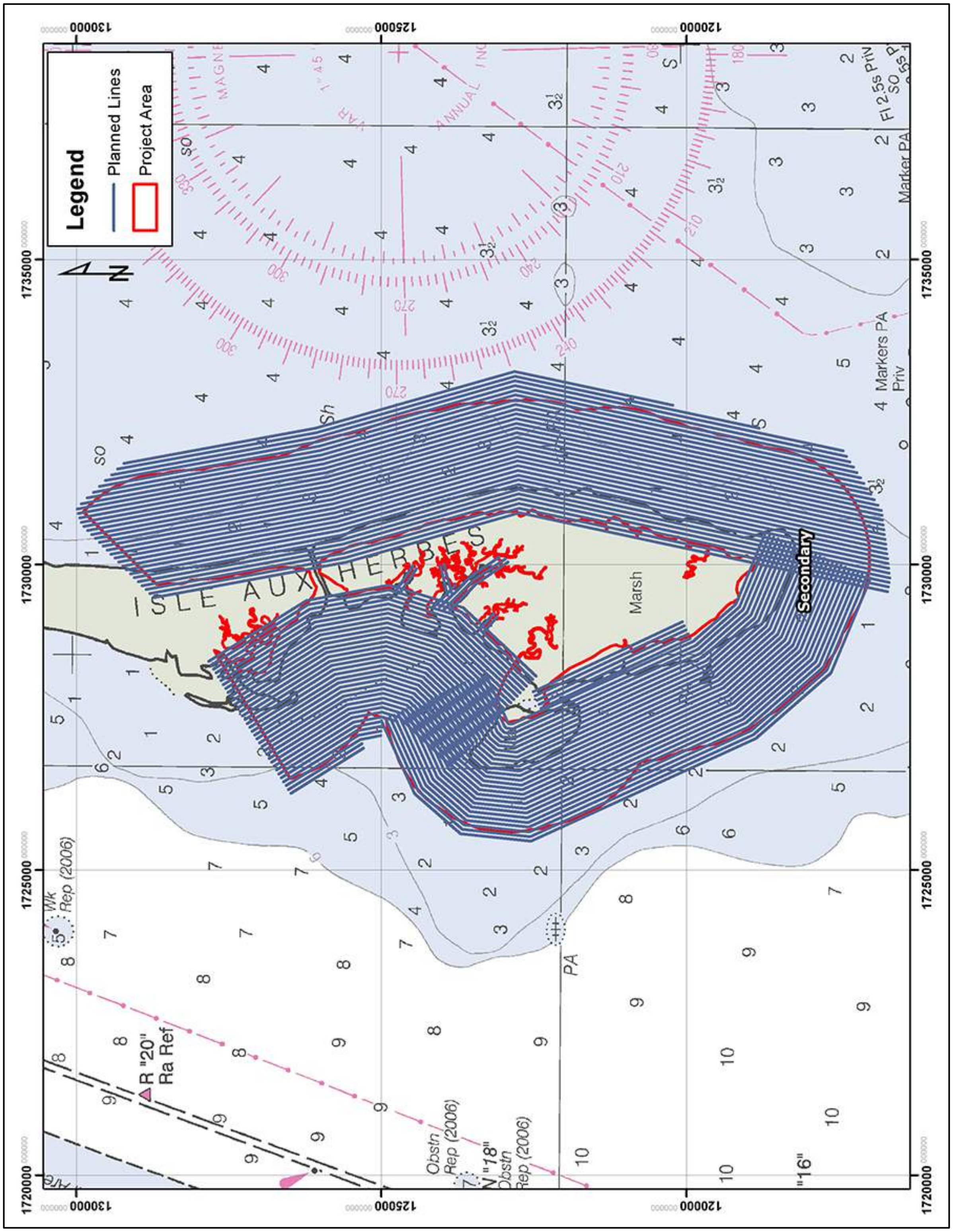


Figure 3-12. Planned survey lines for the Secondary Area (Isle aux Herbes/Coffee Island Area).

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 3-13) and the location, strength, duration, and type of anomaly are transcribed to a spreadsheet along with comments.

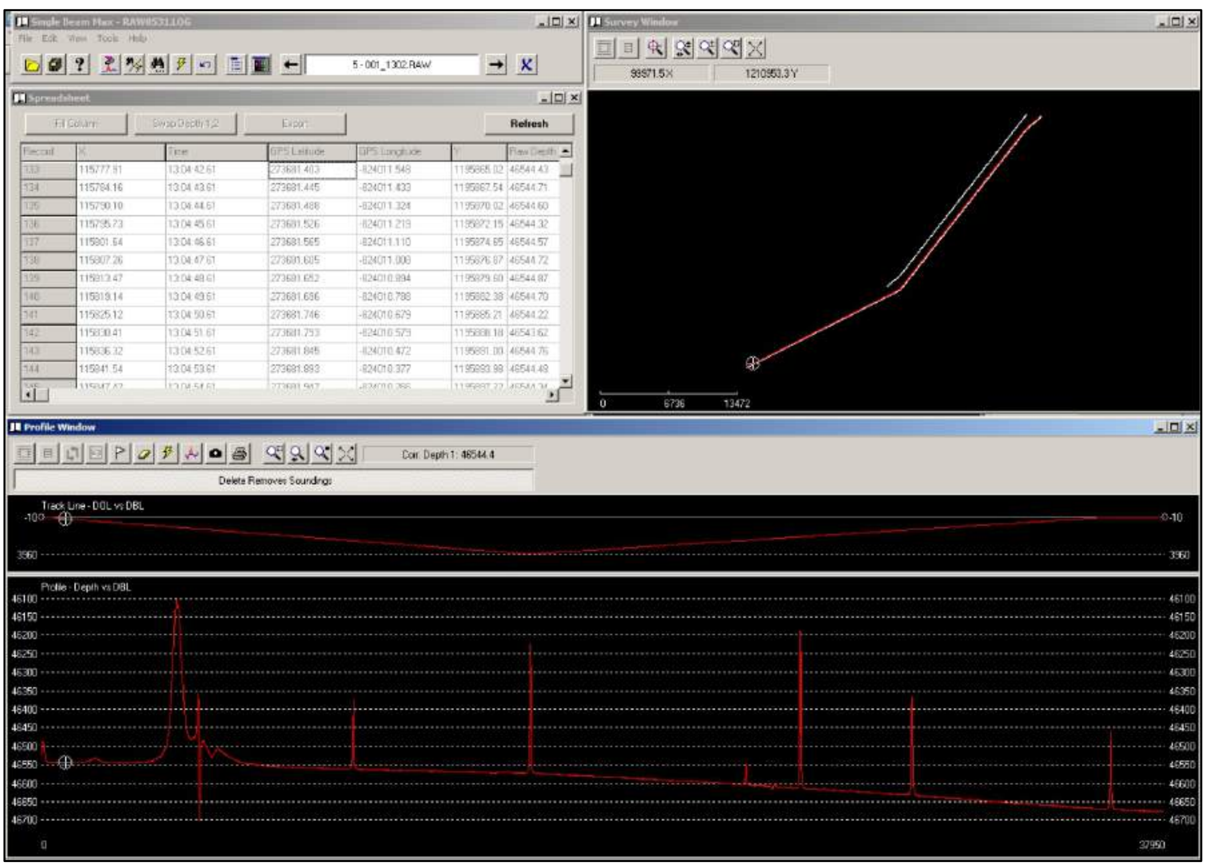


Figure 3-13. Hypack Single Beam Editor magnetic data display of a section of a survey line. Using these windows, one can analyze anomaly position, strength, duration, and type. The peaks of these variations are the locations of target coordinates; their width is the duration.

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. 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 3-14). 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. Sonar mosaics showing 100% coverage for each of the three areas is shown in Figures 3-15 to 3-17.

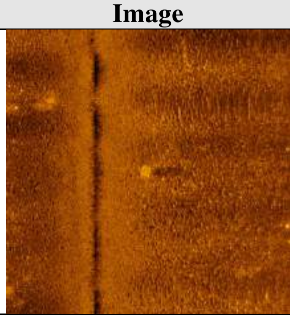
Image	Target	X	Y	Description	Length	Width	Height
	C001	1749216	132752.6	crab pot	3.19 ft.	3.24 ft.	1.37 ft.

Figure 3-14. SonarWiz.MAP sonar contact tabular format, automatically generated. The target pictured is Contact 0001 and represents a crab pot.

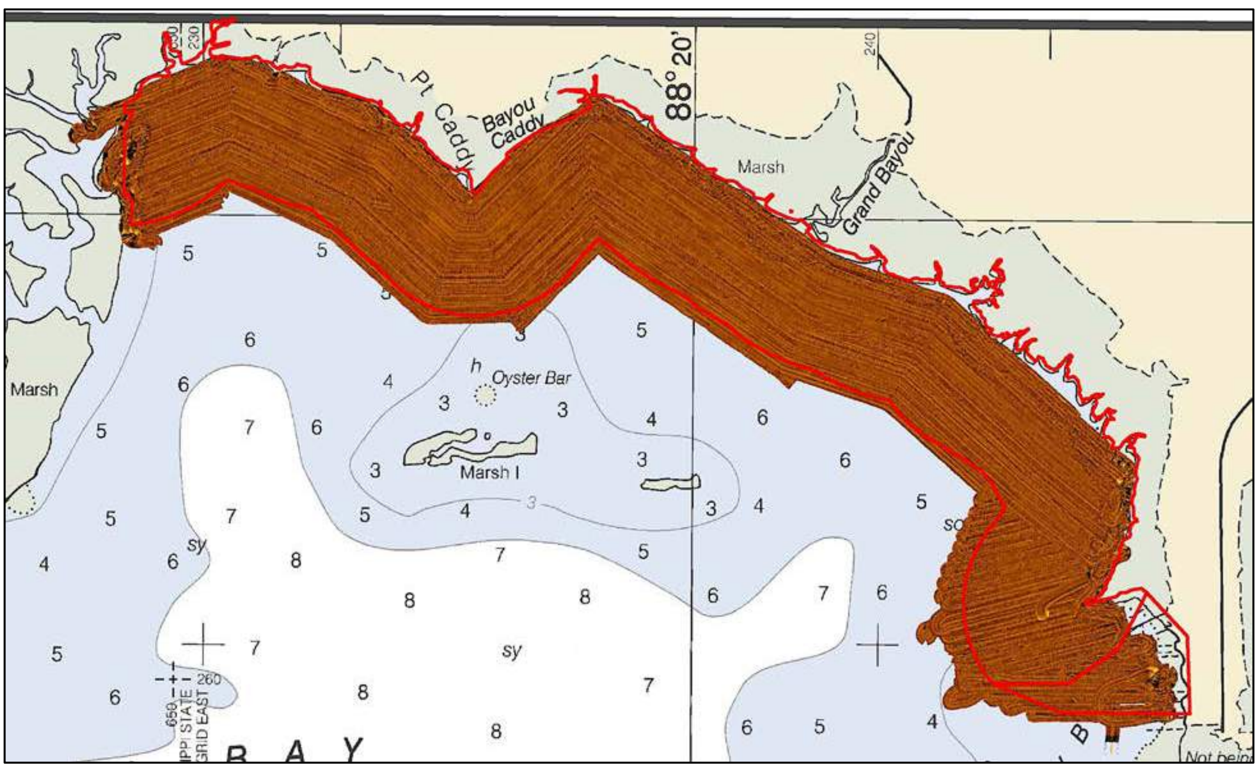


Figure 3-15. Sidescan mosaic produced with SonarWiz.MAP software showing full coverage of the Western Primary Area (Grand Bay Area) along with the Western Lease Extension Area.

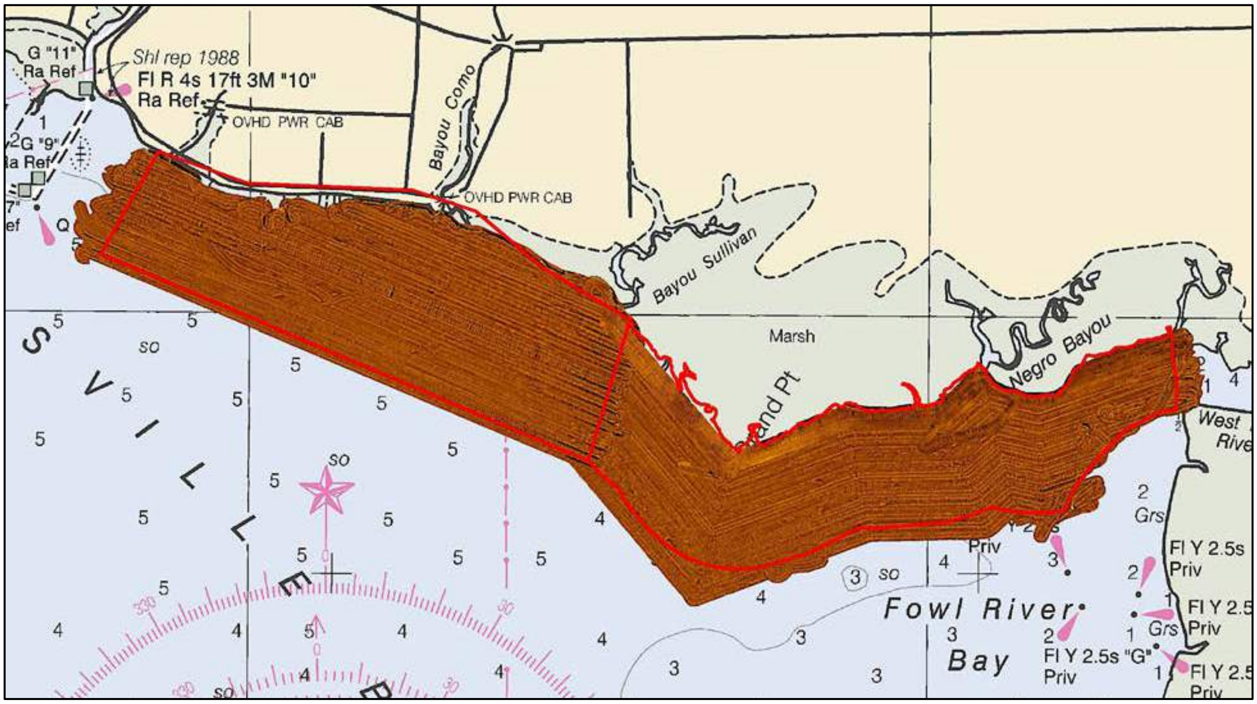


Figure 3-16. Sidescan mosaic produced with SonarWiz.MAP software showing full coverage of the Eastern Primary Area (Fowl River Bay Area) along with the Eastern Lease Extension Area.

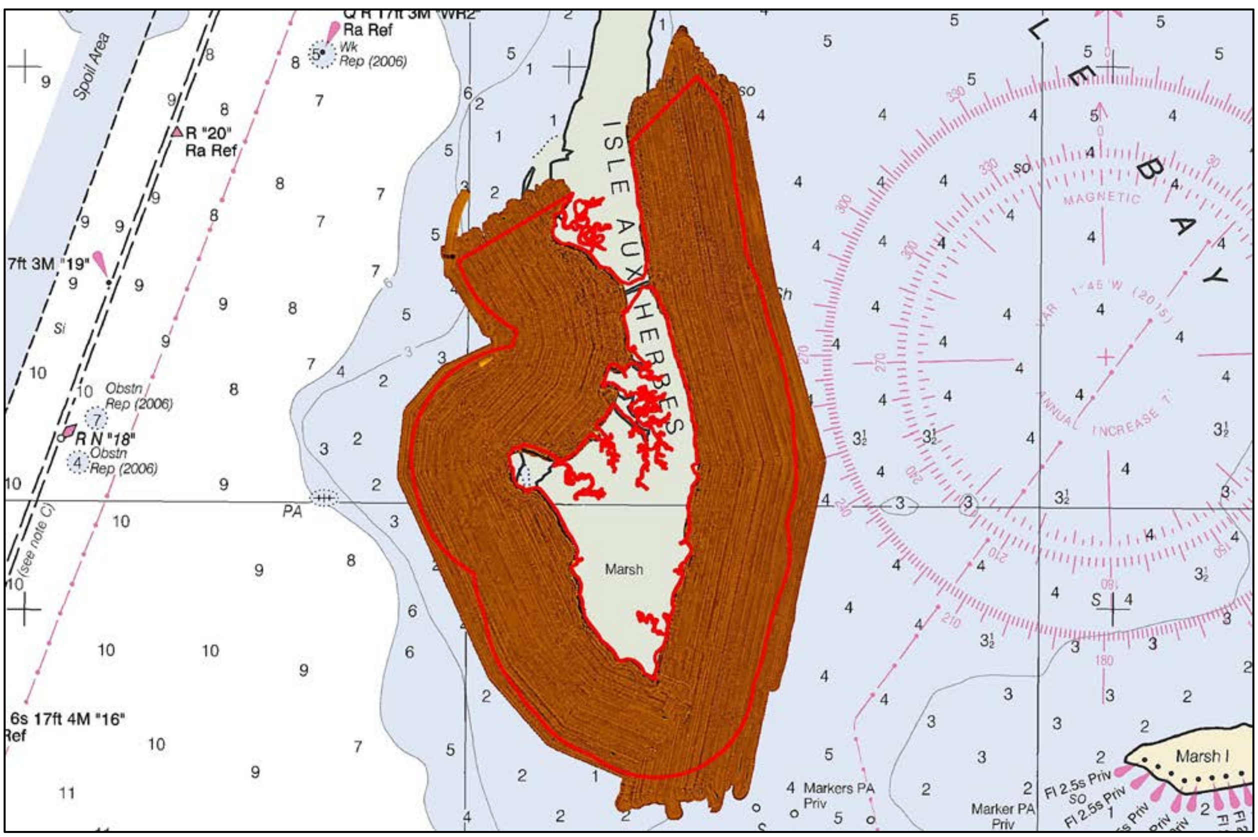


Figure 3-17. Sidescan mosaic produced with SonarWiz.MAP software showing full coverage of the Secondary Area (Isle aux Herbes/Coffee Island Area) survey area.

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 3-18). SonarWiz.MAP batch processes waterfall images to *.JPG formats in order to generate figures (Figure 3-19). 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 survey areas.

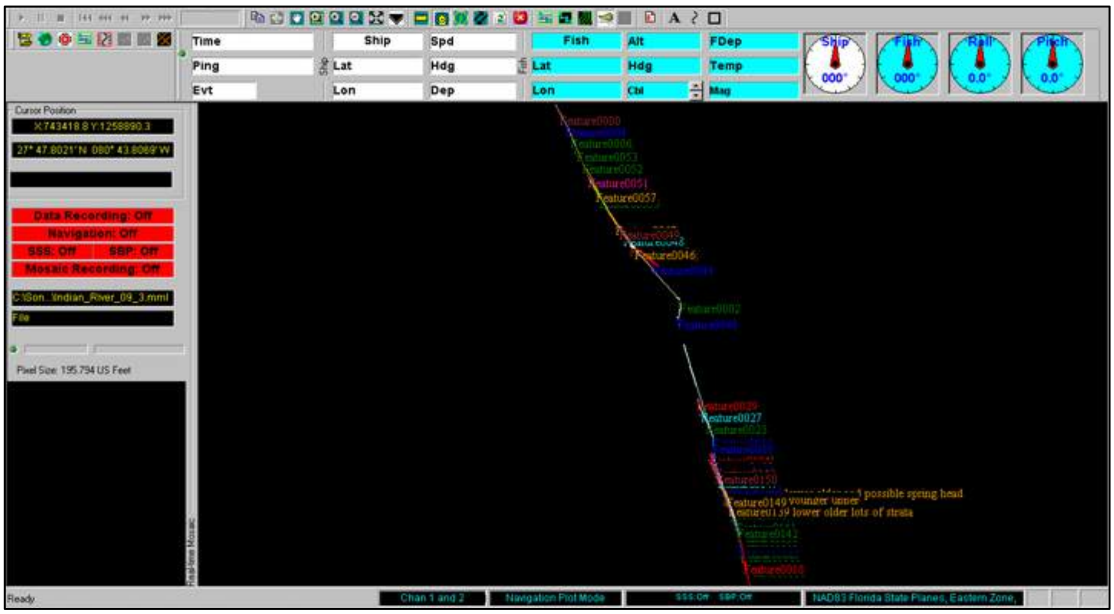


Figure 3-18. Trackline configuration and various "reflector" features digitized.

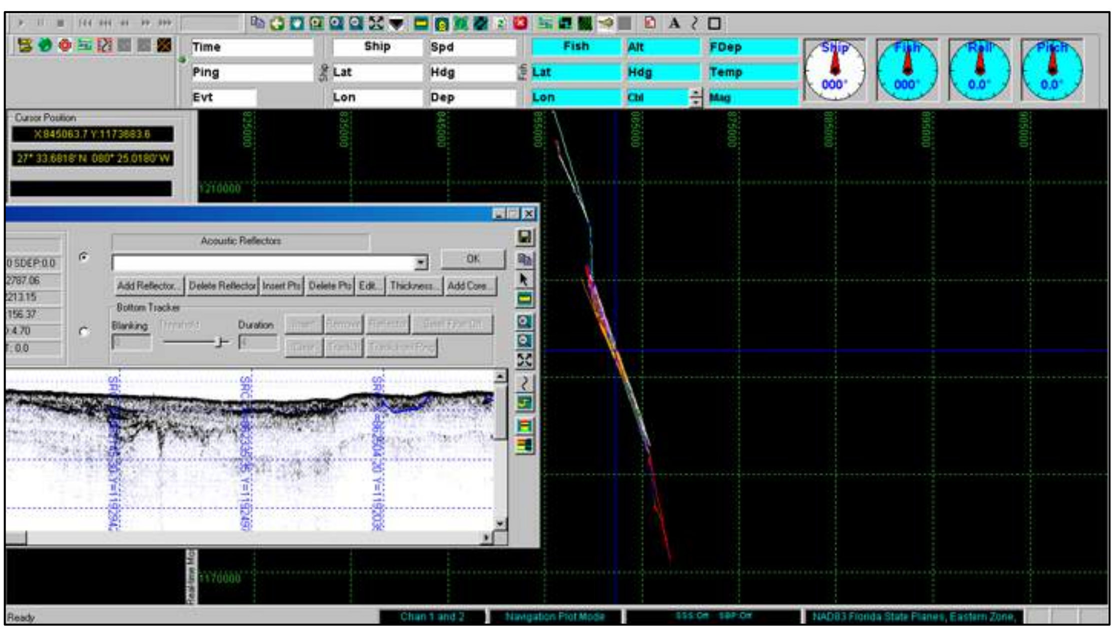


Figure 3-19. SonarWiz.MAP subbottom waterfall image showing the seismic profile-digitizing window. The blue cross hairs in the background chart show the location of the cursor, which at the time of the image was directly over the peak of the positive relief feature shown.

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 (Figure 3-20). 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. Second, 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.

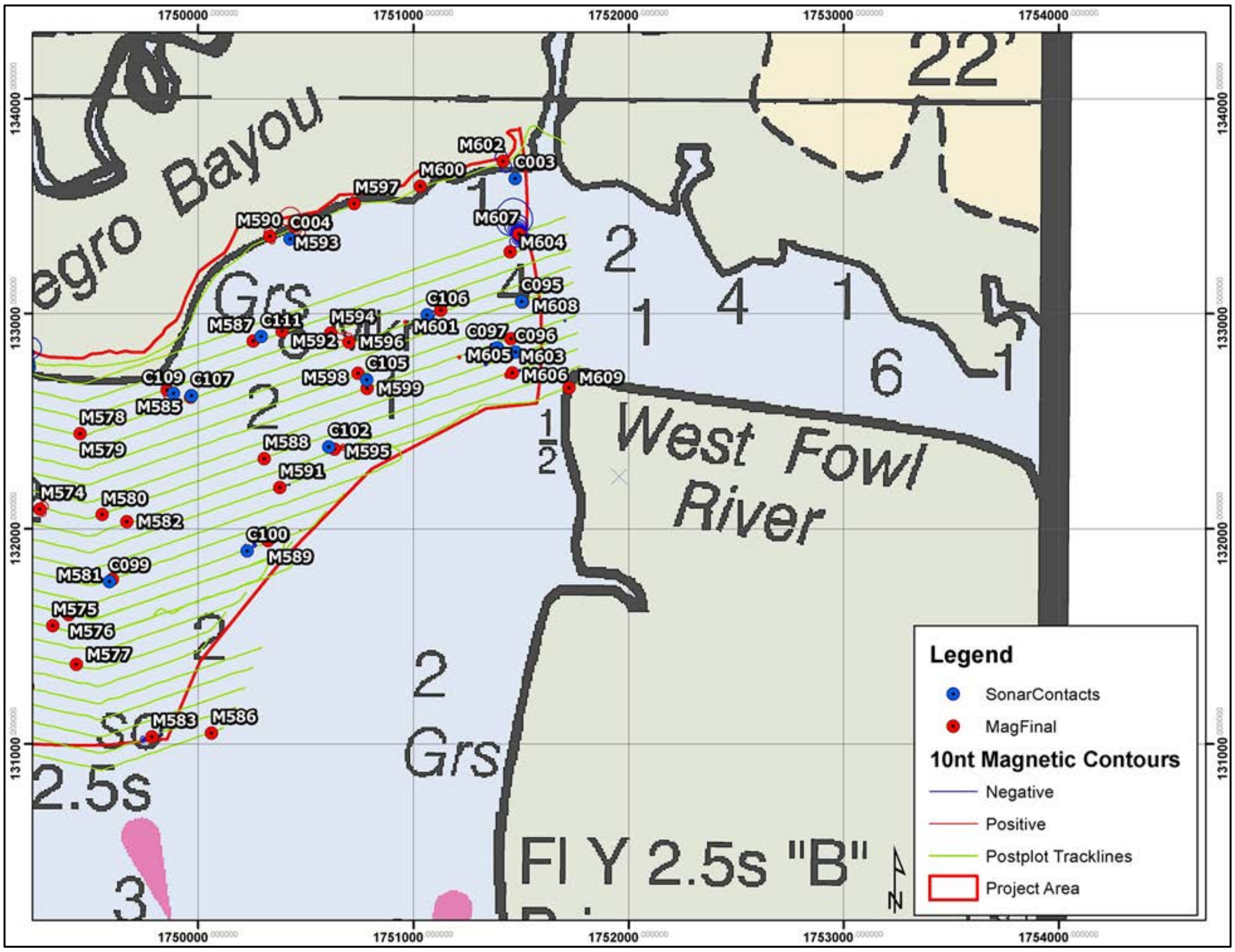


Figure 3-20. A section of the Geographic Information System database of the eastern side of the Eastern Primary Area (Fowl River Bay Area) survey area showing magnetic anomalies, sonar contacts, and magnetic contour map.

DATA ANALYSIS CRITERIA, THEORY, AND COMMENTARY

The remote-sensing survey of portions of the survey area intended to locate and identify the presence or absence of potentially significant submerged historic 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.

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				
J.D. Hinde	129-ft. wooden sternwheeler	573	110	Gearhart and Hoyt 1990
Mary	234-ft. iron-hulled sidewheeler	1180	200	Hoyt 1990
Confederate Obstructions	numerous vessels with machinery removed and filled with construction rubble	110	long duration	Irion and Bond 1984
Utina	267-ft. wooden freighter	690	150	James and Pearson 1991; Pearson and Simmons 1995
Gen C.B. Comstock	177-ft. wooden hopper dredge	200	200	James et al. 1991
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
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
modern shrimp boat	segment 27-x-5 ft.	350	90	Pearson et al. 1991
Mary Somers	iron-hulled sidewheeler	5000	400	Pearson et al. 1993
Homer	148-ft. wooden side-wheeler	810	200	Pearson and Saltus 1990
Shrimp Boat	modern	162	110	Watts 2000
Single Objects				
pipeline	18-in. diameter	1570	200	Duff 1996
Pipe	3 in. by 10 ft.	55	352	Krivor 2005
Pipe/mast/davit	18 in. by 26 ft.	475	104	Lydecker 2007
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				
cable and chain	5 ft.	30	50	Pearson et al. 1991
scattered ferrous metal	14-x-3 ft.	100	110	Pearson et al. 1991
anchor/wire rope	8-ft. modern stockless/large coil	910	140	Rogers et al. 1990

While the data indicate 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 is present, such as the current survey areas, the presence of a 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, such as an entrance channel, similar to 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 historic 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 paleofeatures 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 historic 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.

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IV. INVESTIGATIVE FINDINGS

In total, 609 magnetic anomalies and 111 sidescan sonar targets were recorded during the current survey. Employing the previous 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), 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 contacts. Sidescan sonar contacts, as visual images, were assessed for linearity, height off bottom, size, associated magnetics, backscatter characteristics, and visual surface associations (i.e., jetties, buoys, etc.). Subbottom features in all survey areas include four relict paleofeatures in the form of buried channels and a bayou, as well as a buried surface corresponding to Sequence Boundary A, which forms the boundary between Seismic Unit B and Seismic Unit A (which itself consists entirely of marine sediments) and represents the last exposed surface in this area dating to between 9,000 and 22,000 YBP.

MAGNETOMETER RESULTS

As listed in *Appendix A: Recorded Magnetic Anomalies*, 609 magnetic anomalies were recorded and identified during the analysis of the data, 117 in the Western Primary Area (Grand Bay Area), 13 in the Western Lease Extension Area, 203 in the Secondary Area (Isle aux Herbes/Coffee Island Area), 99 in the Eastern Primary Area (Fowl River Bay), and 176 in the Eastern Lease Extension Area. The table includes target location, type (i.e., Monopole, Dipole, or Complex), anomaly deviation in nanoteslas, duration in feet, and association with other targets (both magnetic and sidescan). The five survey areas with all data contacts are presented in Figures 4-01 to 4-18. The magnetic contour maps are presented at a 10-nanotesla contour with the positive magnetic deviation denoted in red and the negative deviation in blue.

The 609 anomalies consist largely of single-point source anomalies normally consistent with small nonsignificant debris. As described previously, examination of both the contour map and the strip-chart for these anomalies indicates that each target was recorded on only a single transect and they were not recorded (i.e., did not influence the ambient magnetic background) on adjacent lines. Some of the single-point source anomaly readings had large deviations, yet were recorded on only one line, or had very short durations, which indicates the source for these targets must be small discrete objects. The magnetometer sensor must have passed closely by or directly over the object to generate the large readings on the survey line, yet not be recorded or have had an influence on an adjacent transect line. Many of the single-point source anomaly type generally is not considered representative of potentially significant submerged historic resources. Additionally, many of the anomalies appear to be related to shoreline infrastructure such as docks, riprap shorelines, marker poles, and pipelines, as well as having acoustic images showing crab pots.

While the vast majority of the anomalies were nonsignificant, there were several interesting anomalies seen in the data; their descriptions follow.

There is a large anomaly cluster on the western side of the Secondary Area (Isle aux Herbes/Coffee Island Area) comprised of Anomalies M138 and M141. It is in the center of what was once an island (Figure 4-08). The cluster lacks an acoustic target and it was most likely on land at one time; therefore, it is not considered potentially significant.

To the south is Anomaly M155, which has an interesting acoustic image, C060 (see Figure 4-08). With a deviation of 65 nanoteslas and duration of 145 feet, the sonar contact shows an interesting debris scatter 60 feet in length (Appendix C; Figure 4-19). Initially of unknown origin and considered potentially significant, it has since been identified as the remains of a modern shrimp boat as seen in Figure 4-20 that sank approximately six years ago (Carl Ferraro ADCNR-State Lands Division, personal communication, October 2016).

To the north, on the western end of the Eastern Lease Extension Survey Area is a large anomaly cluster comprised of Anomalies M341, M342, M343, and M345 (Figure 4-14). It lacks an acoustic image and is located along an armored shoreline at the mouth of a small bayou. Although unknown, it is likely that the anomaly is a result of shoreline armoring.

The last interesting cluster observed in the magnetometer data is located at the far eastern end of the Eastern Primary Area (Fowl River Bay Area). Consisting of Anomalies M604 and M607 (Figure 4-18), it is a fairly large anomaly of 577 nanoteslas and duration of 145 feet. Lacking an acoustic image and of unknown origin, this target should be considered potentially significant.

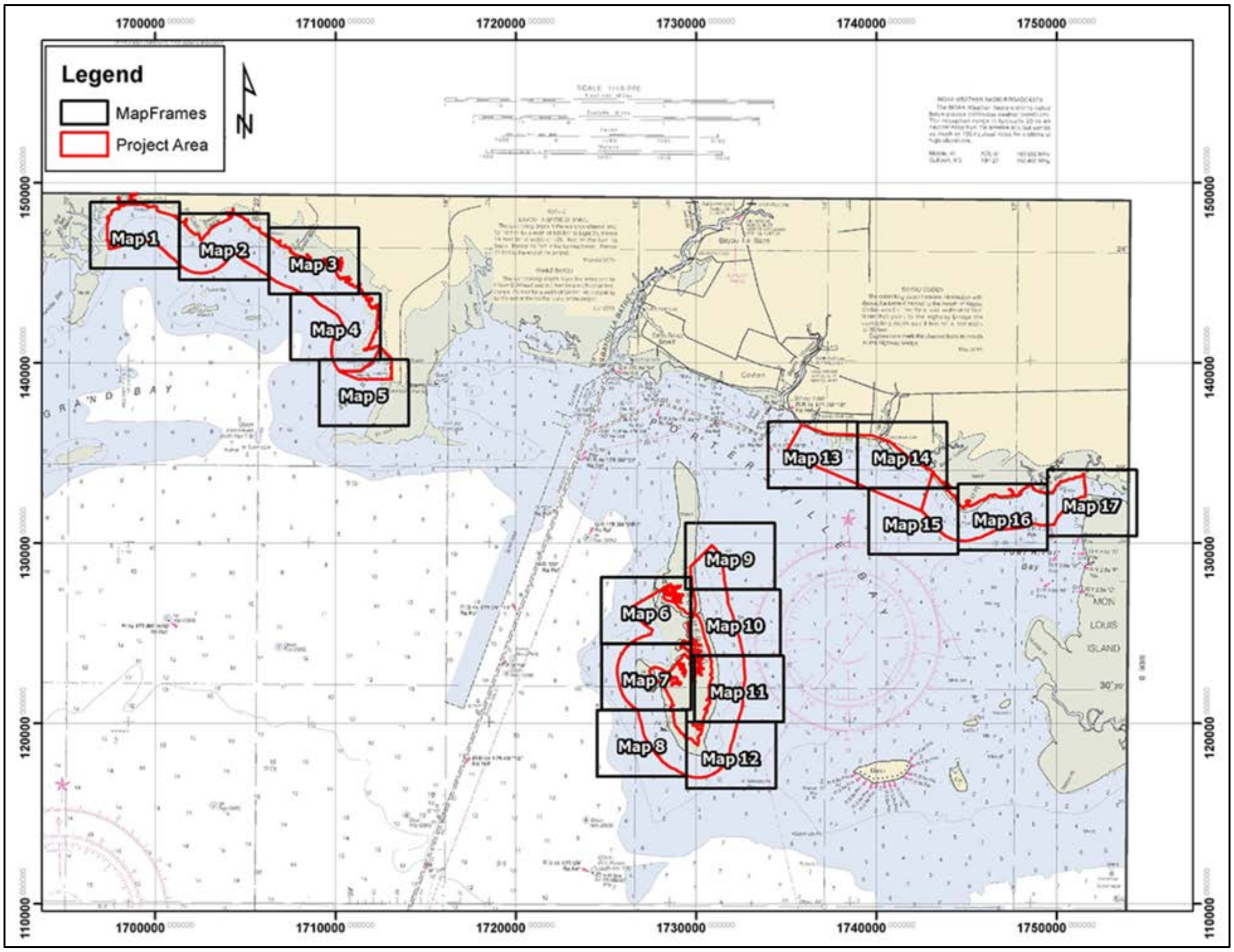

Figure 4-01. Map Key for the survey areas.

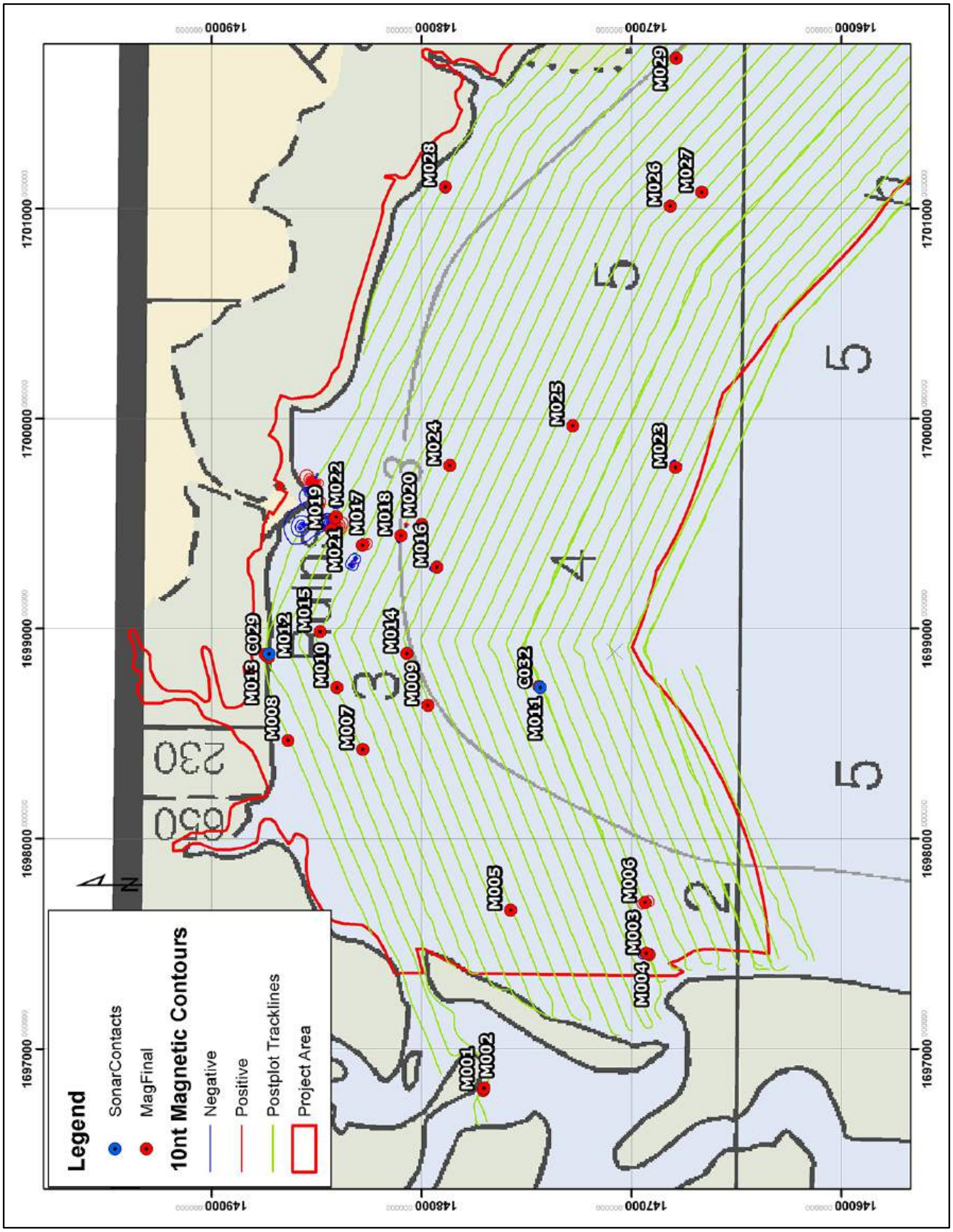

Figure 4-02. Map 1 Magnetic Contour Map for the Western Primary Area (Grand Bay Area).

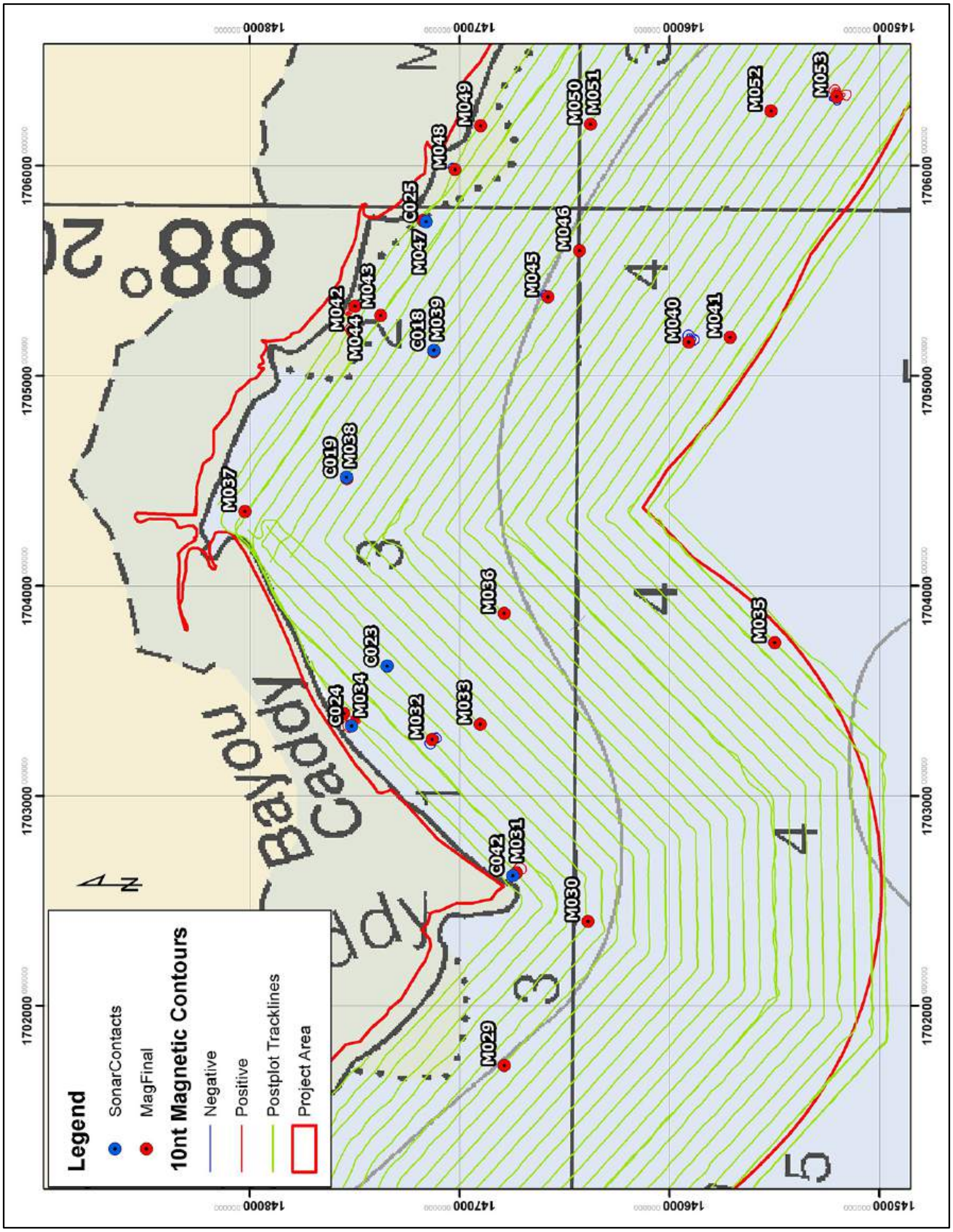

Figure 4-03. Map 2 Magnetic Contour Map for the Western Primary Area (Grand Bay Area).

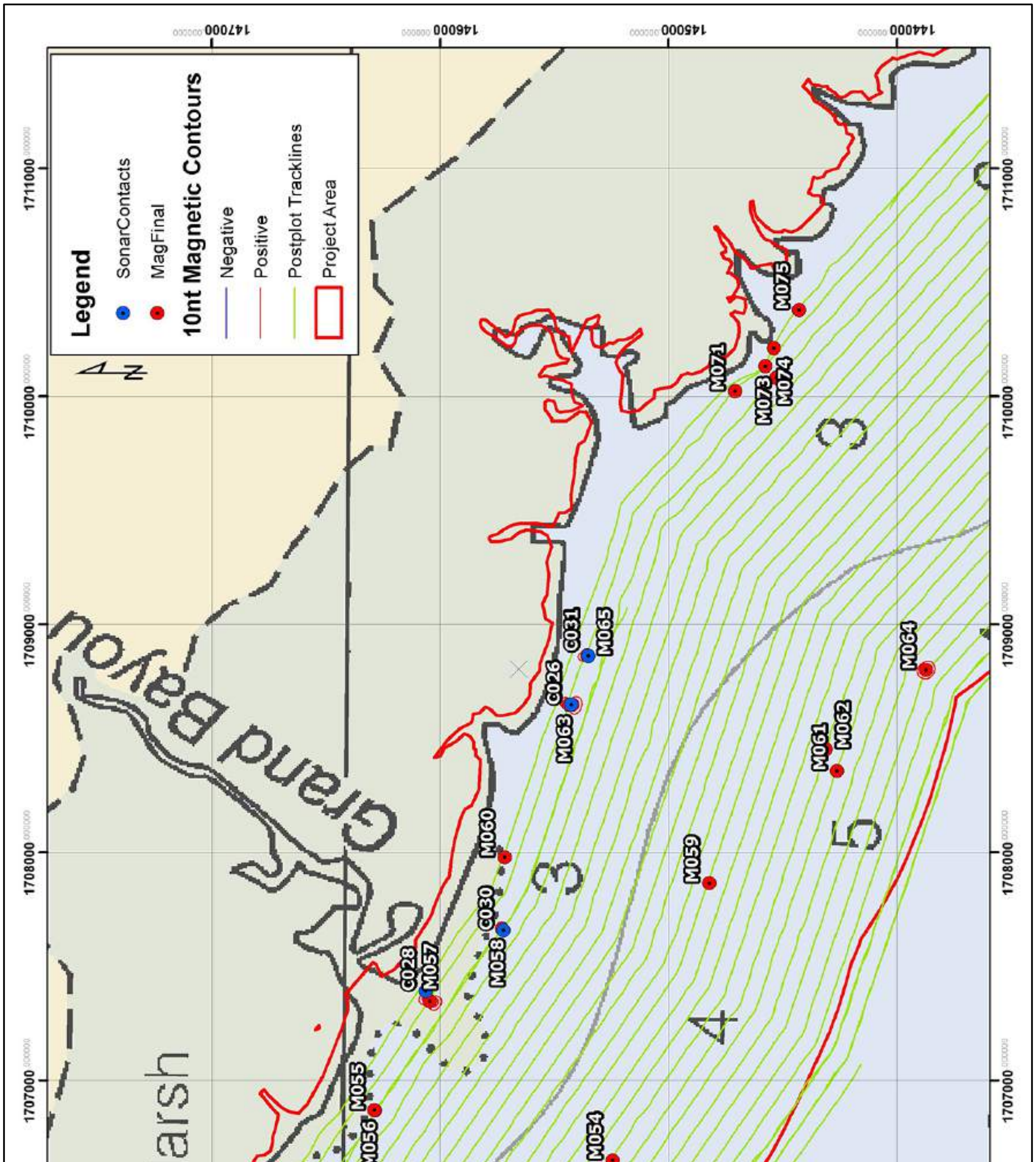

Figure 4-04. Map 3, Magnetic Contour Map for the Western Primary Area (Grand Bay Area).

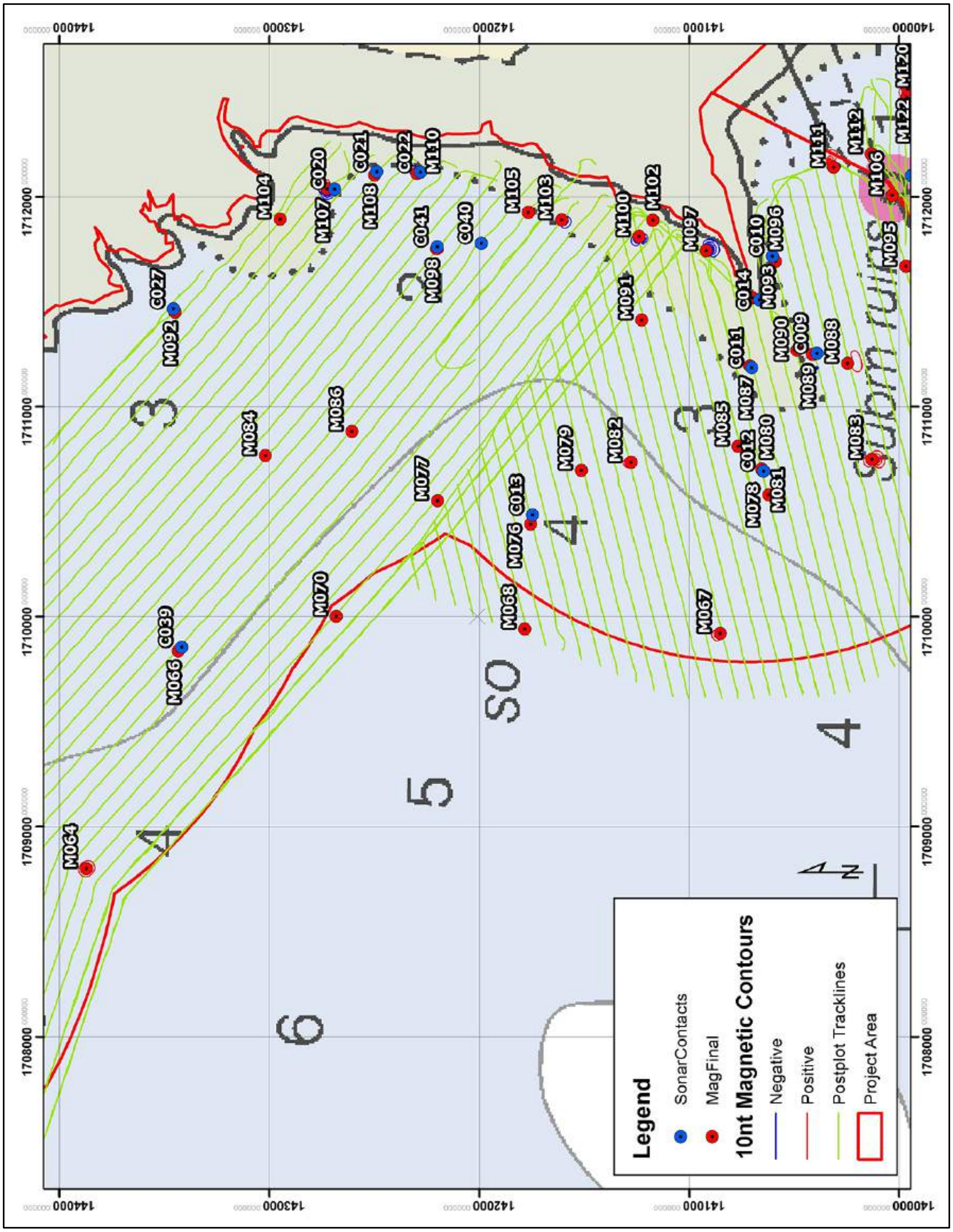

Figure 4-05. Map 4, Magnetic Contour Map for the Western Primary Area (Grand Bay Area).

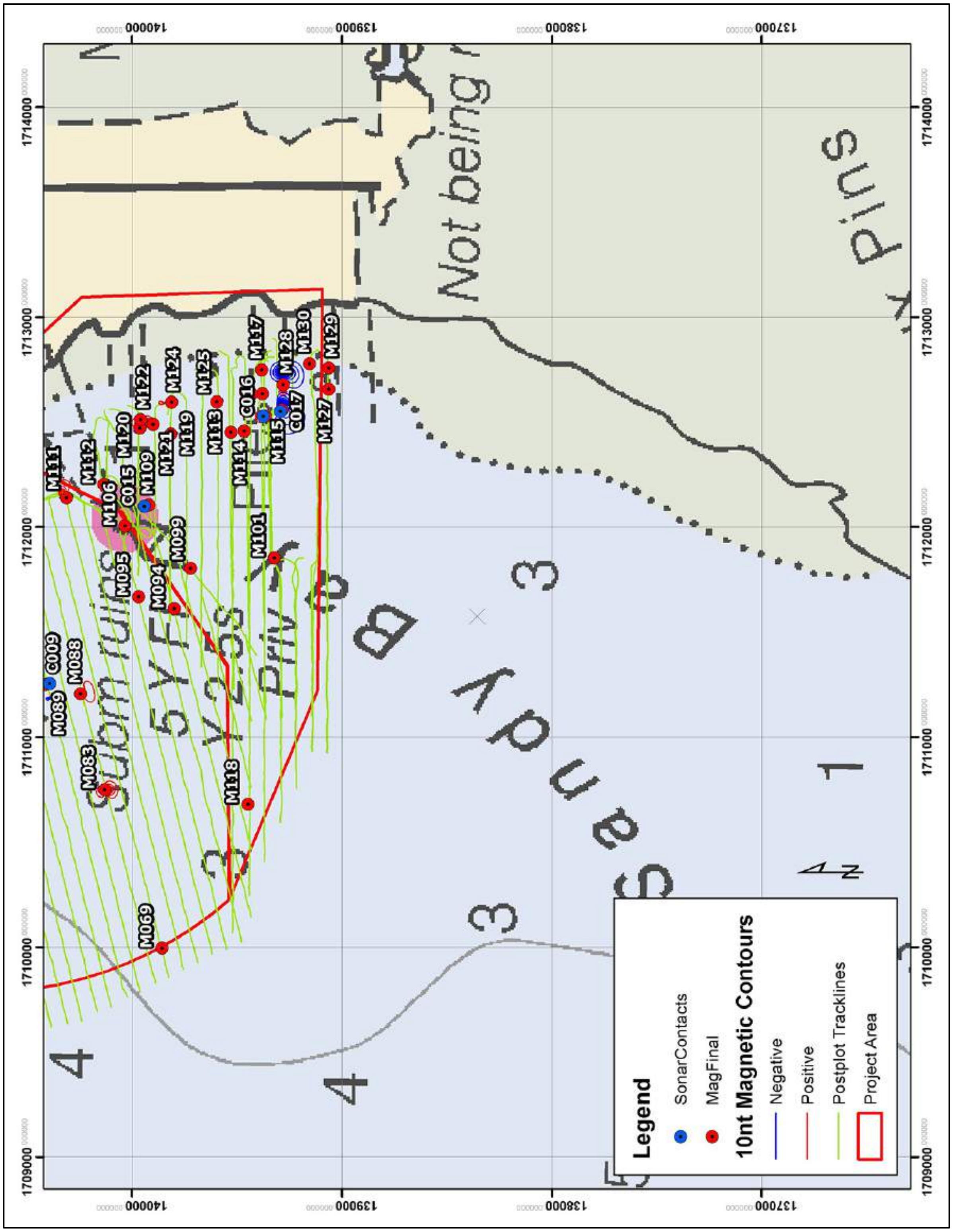

Figure 4-06. Map 5, Magnetic Contour Map for the Western Primary Area (Grand Bay Area) and Western Lease Extension Area.

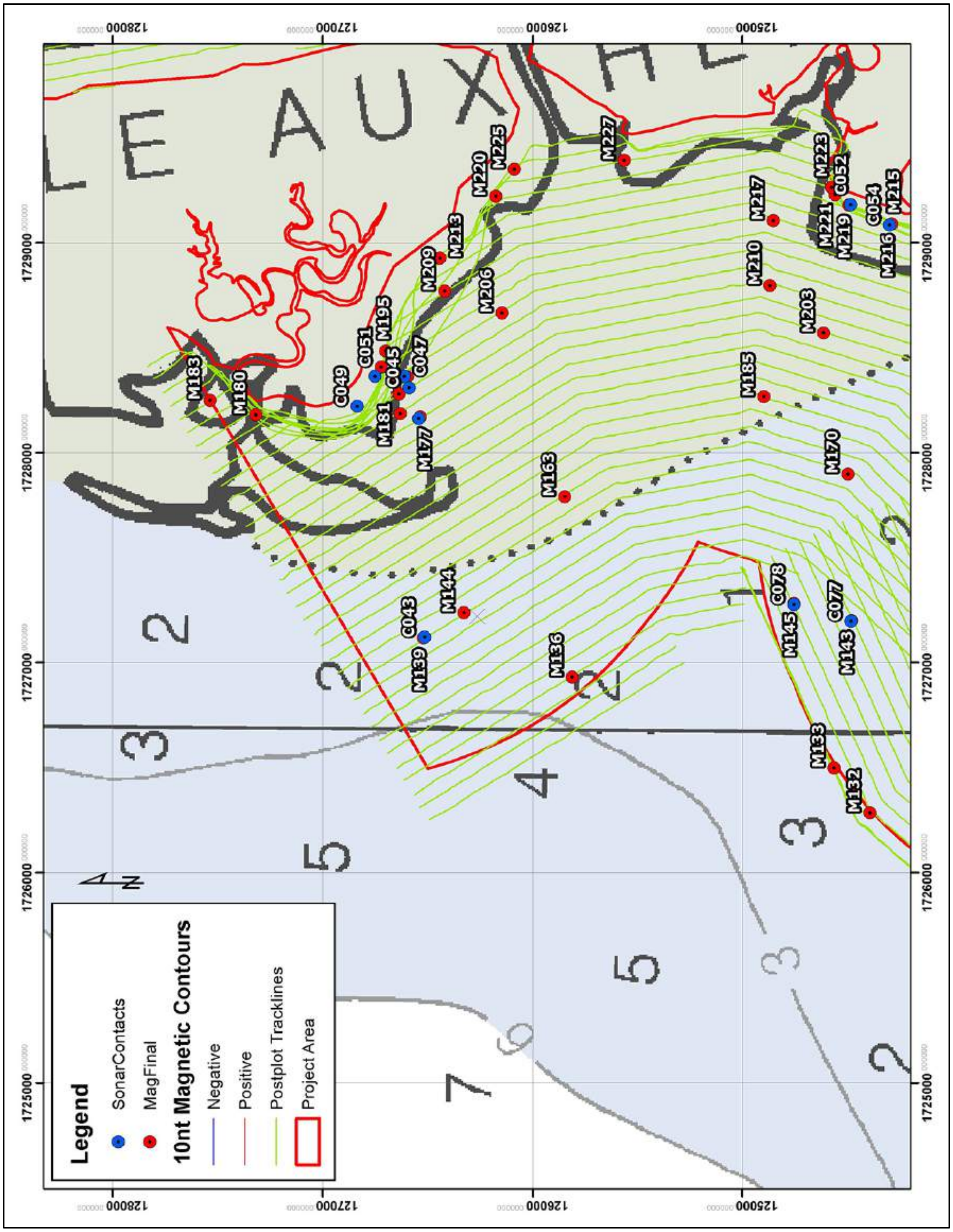

Figure 4-07. Map 6, Magnetic Contour Map for the Secondary Area (Isle aux Herbes/Coffee Island Area).

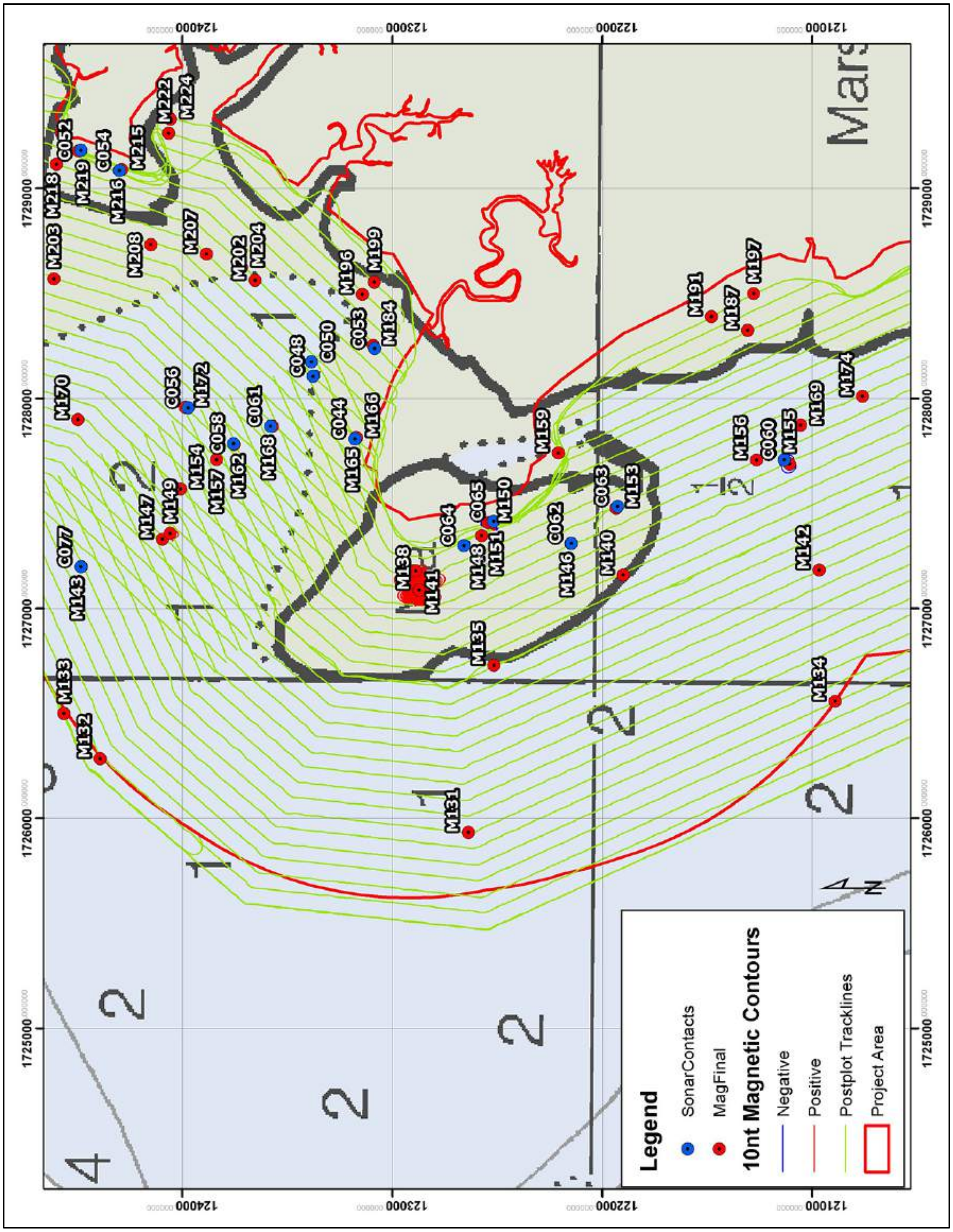

Figure 4-08. Map 7, Magnetic Contour Map for the Secondary Area (Isle aux Herbes/Coffee Island Area).

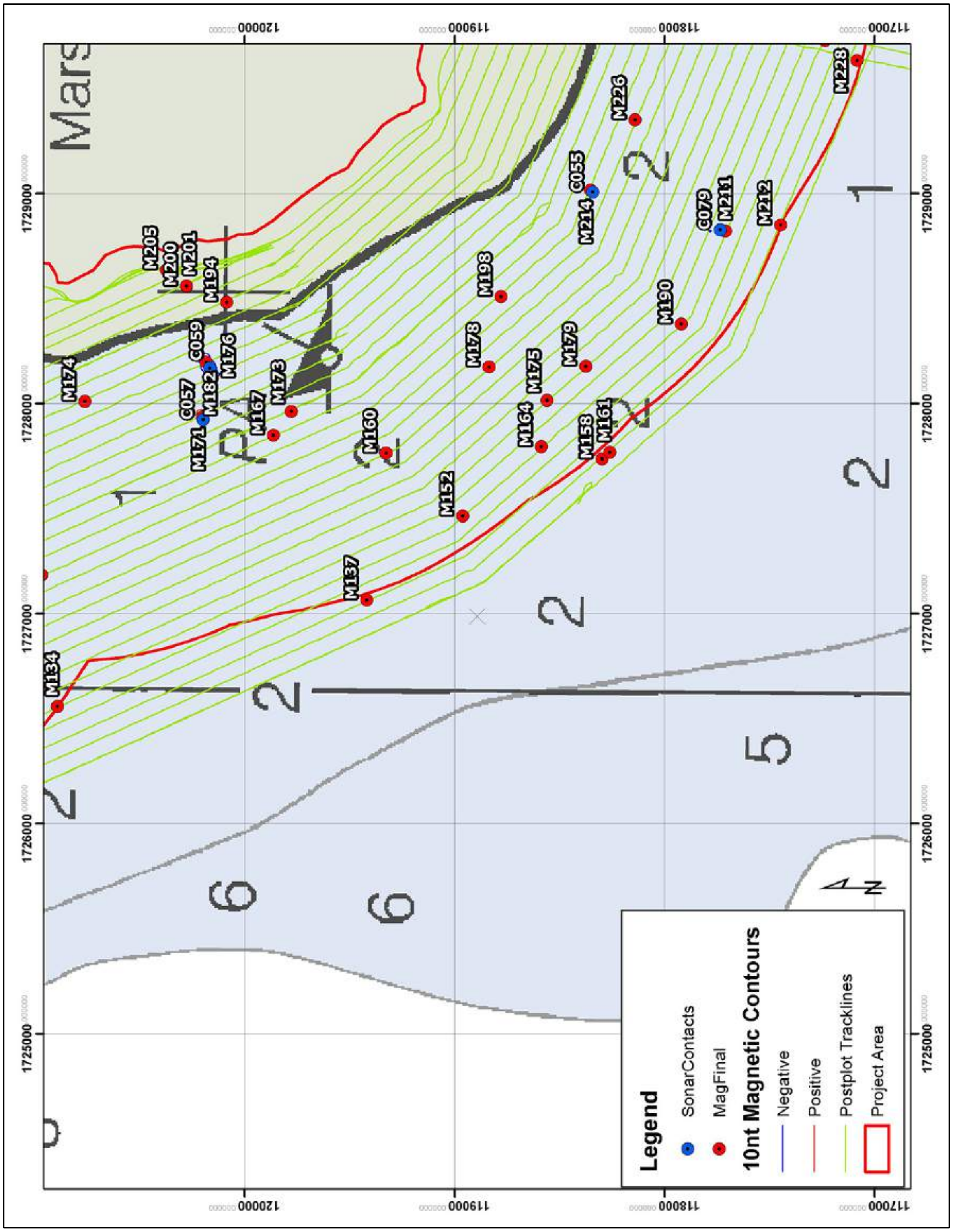

Figure 4-09. Map 8, Magnetic Contour Map for the Secondary Area (Isle aux Herbes/Coffee Island Area).

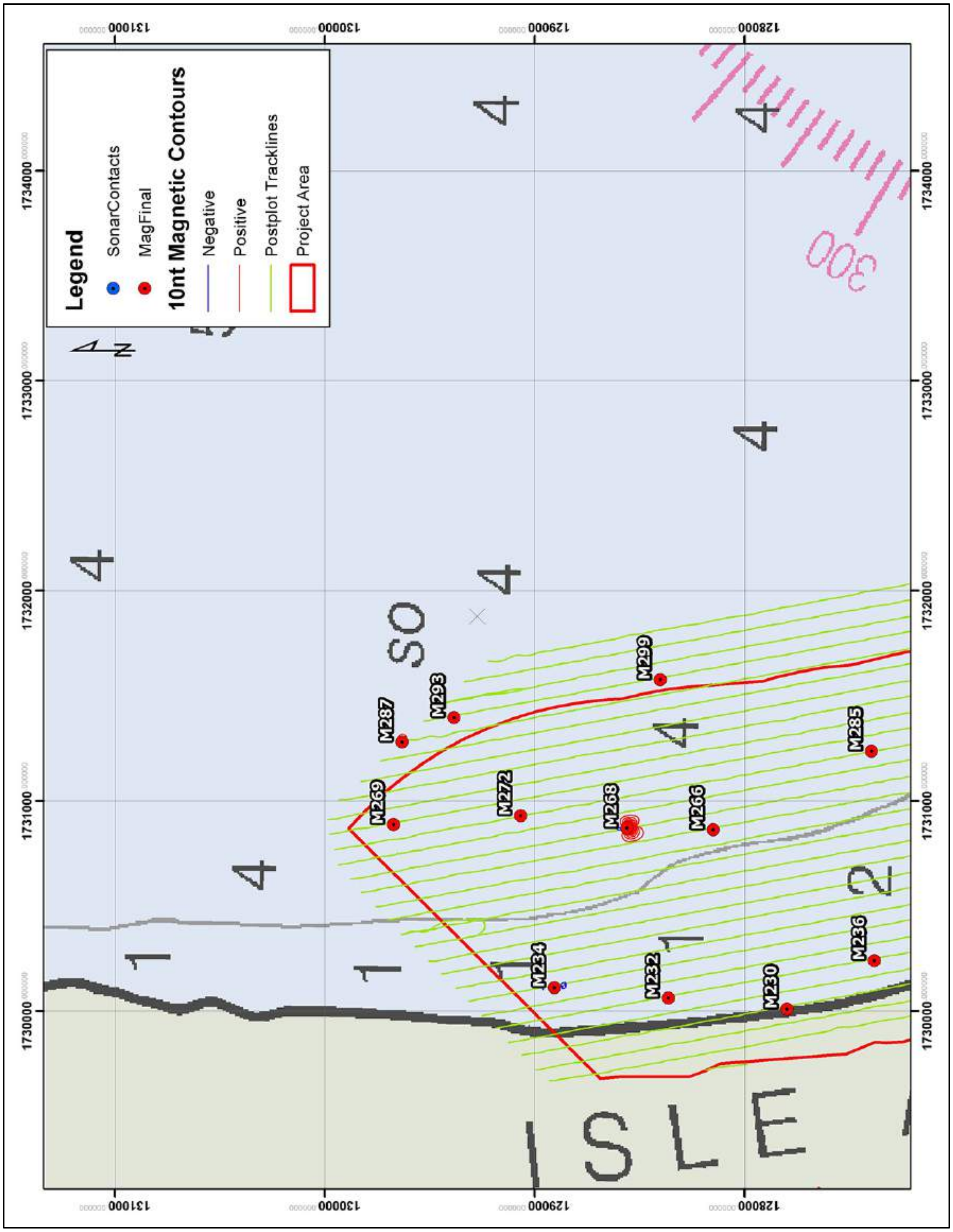

Figure 4-10. Map 9, Magnetic Contour Map for the Secondary Area (Isle aux Herbes/Coffee Island Area).

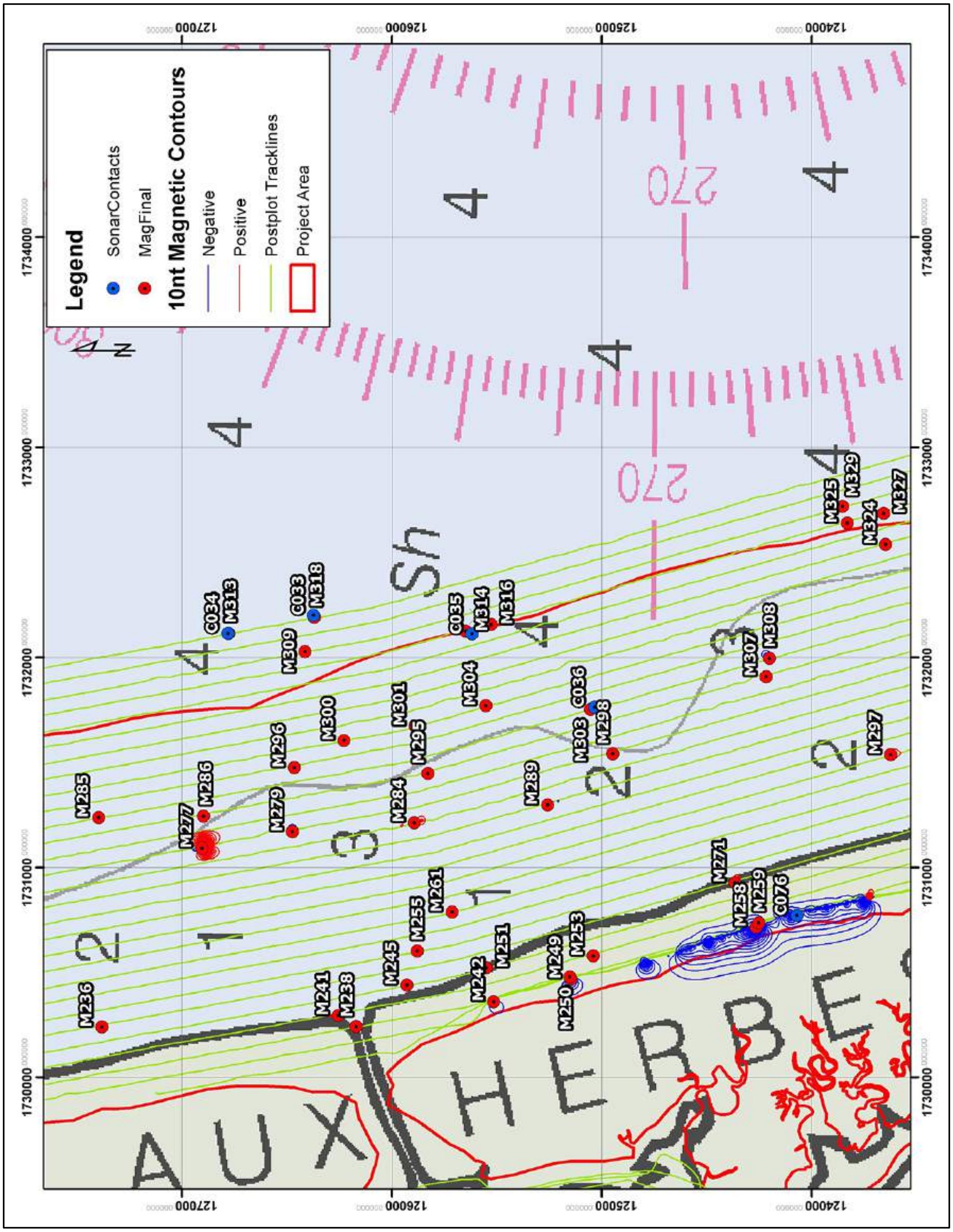

Figure 4-11. Map 10, Magnetic Contour Map for the Secondary Area (Isle aux Herbes/Coffee Island Area).

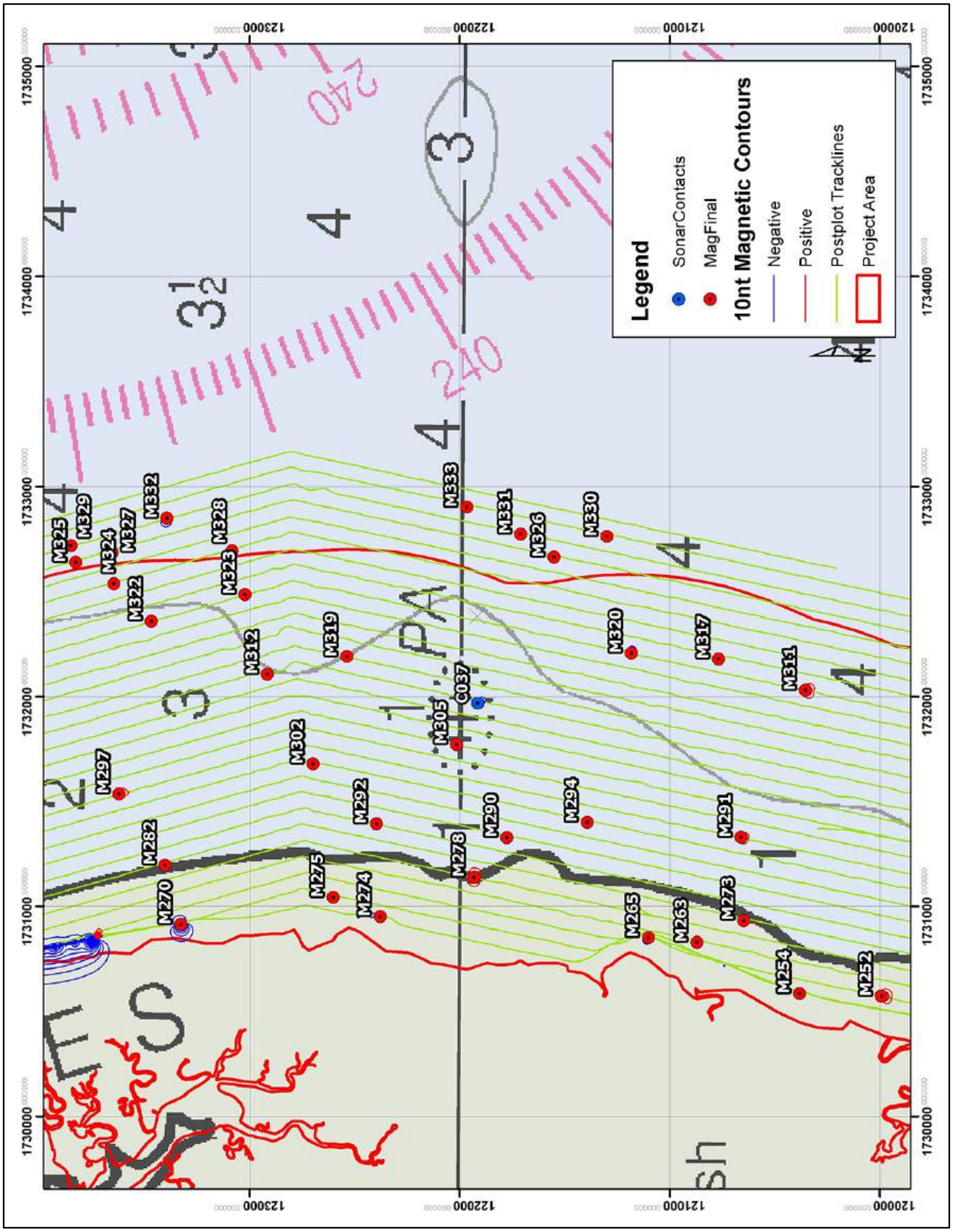

Figure 4-12. Map 11, Magnetic Contour Map for the Secondary Area (Isle aux Herbes/Coffee Island Area).

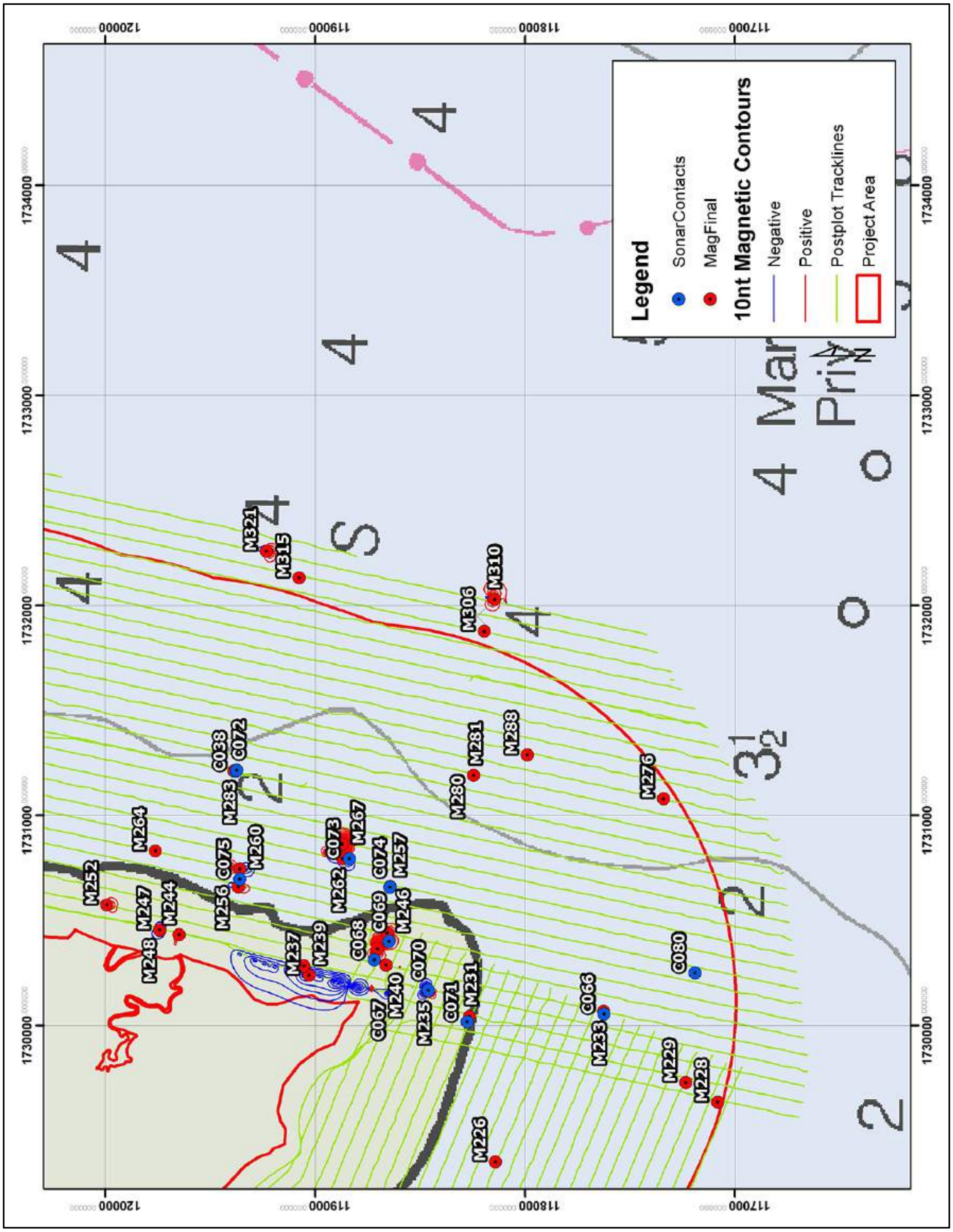

Figure 4-13. Map 12, Magnetic Contour Map for the Secondary Area (Isle aux Herbes/Coffee Island Area).

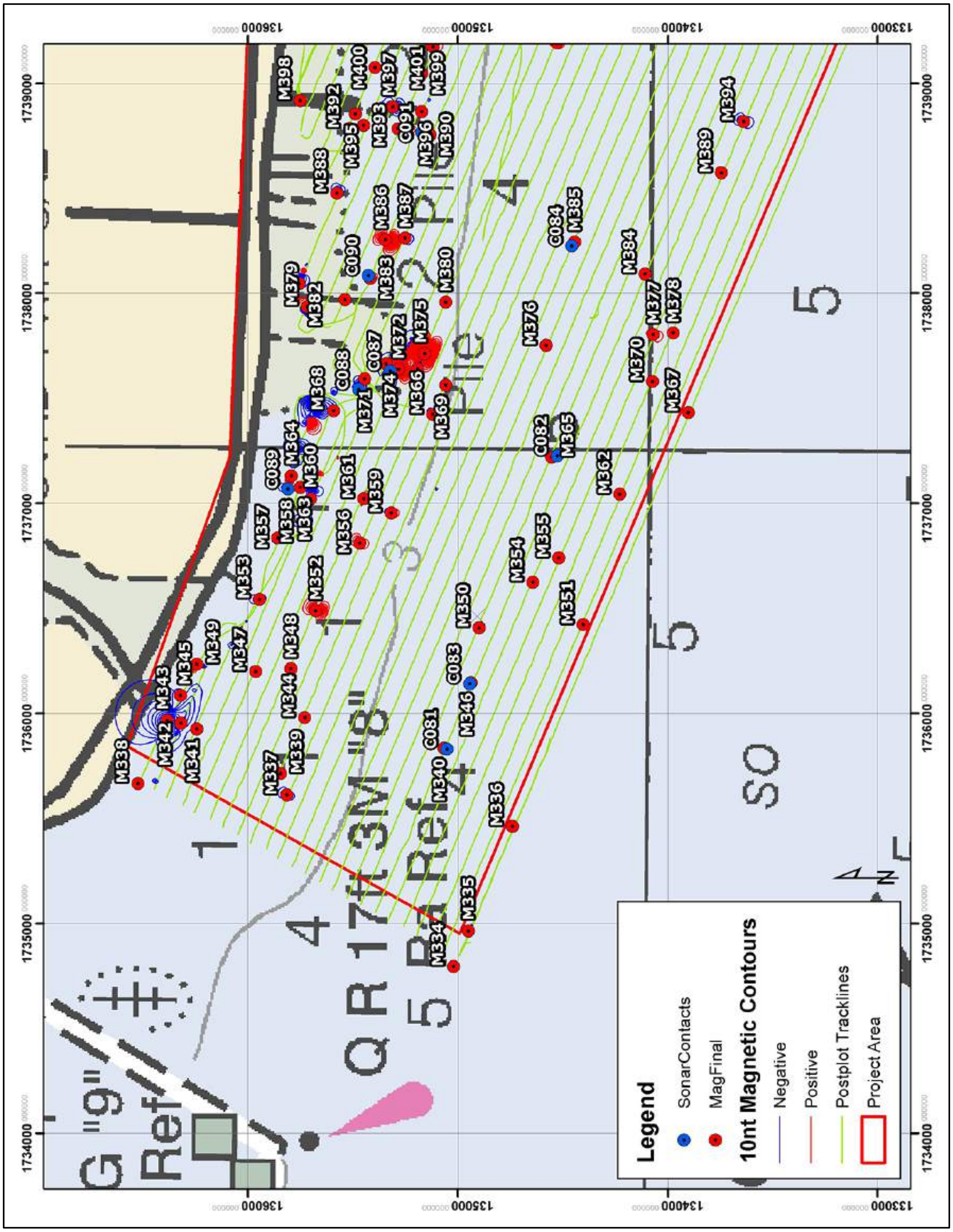

Figure 4-14. Map 13, Magnetic Contour Map for the Eastern Lease Extension Area.

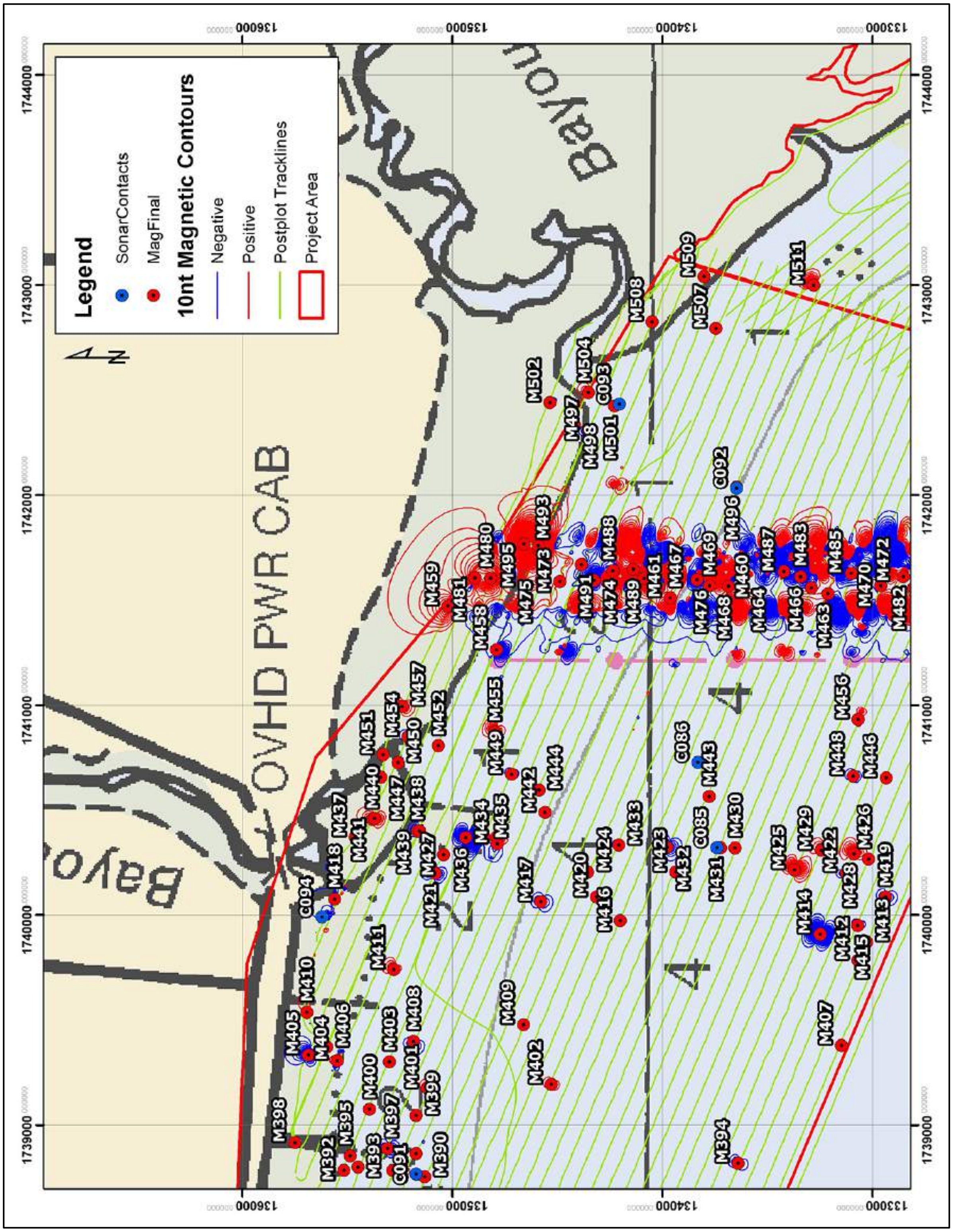

Figure 4-15. Map 14, Magnetic Contour Map for the Eastern Lease Extension Area.

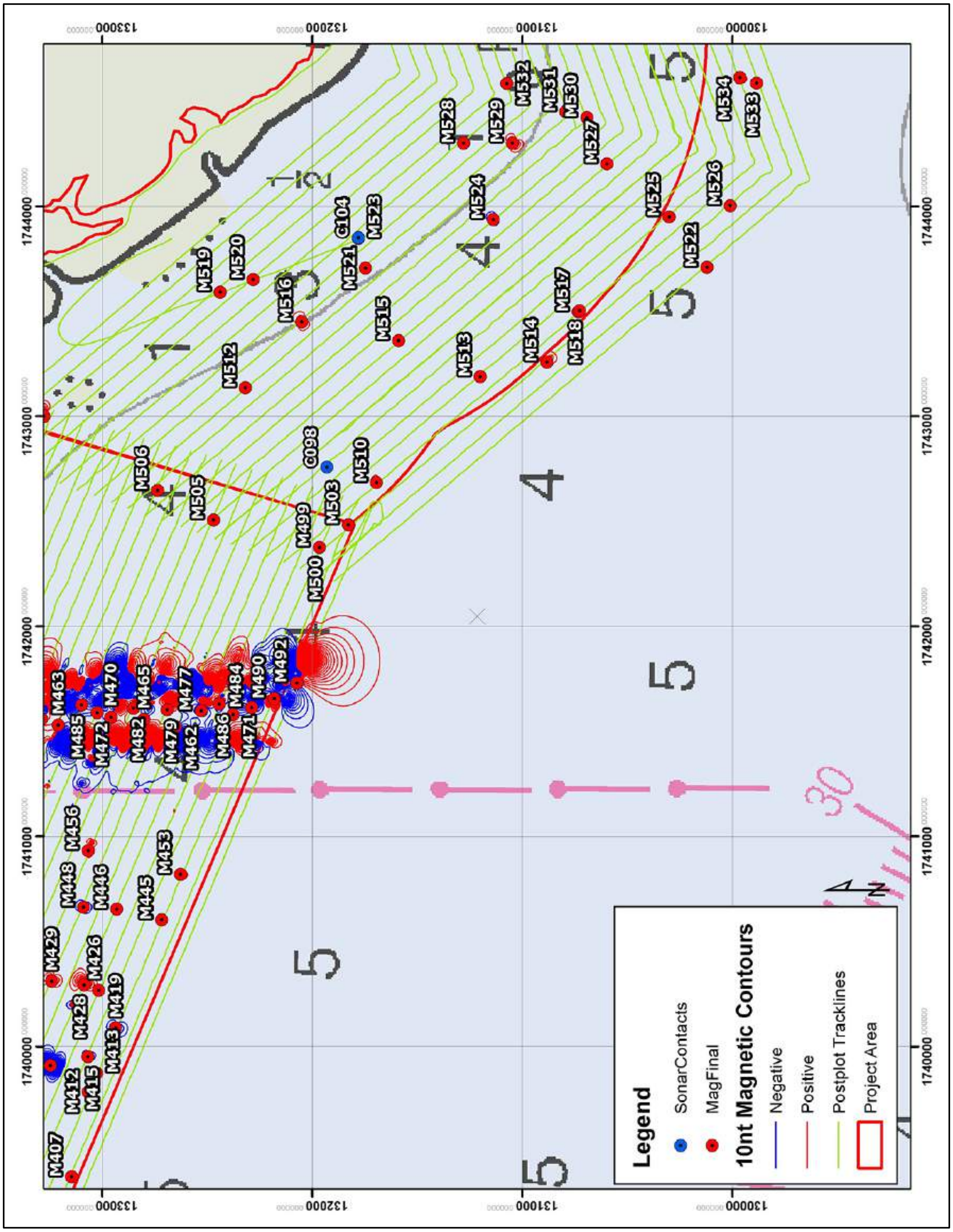

Figure 4-16. Map 15, Magnetic Contour Map for the Eastern Lease Extension Area and Eastern Primary Area (Fowl River Bay Area).

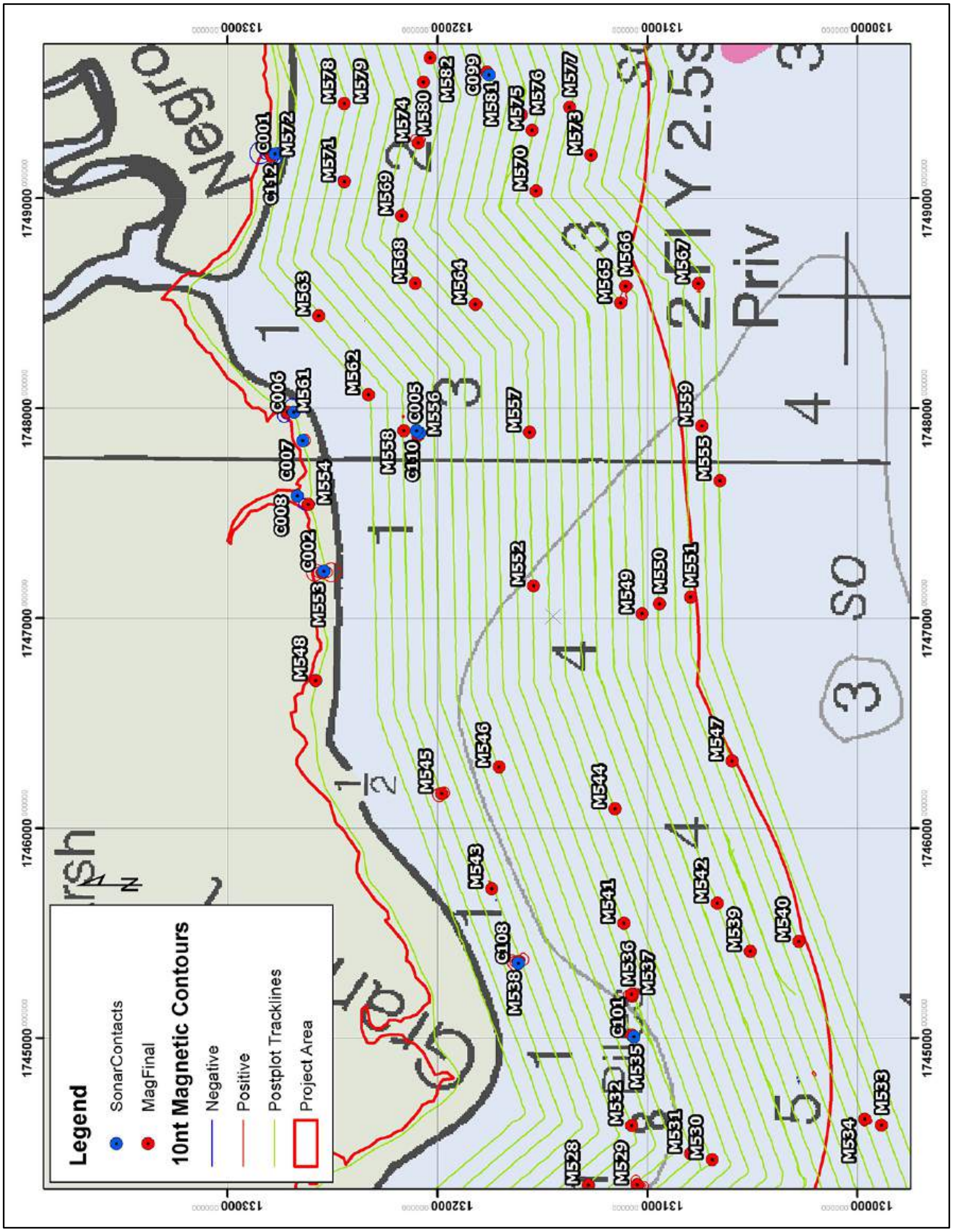

Figure 4-17. Map 16, Magnetic Contour Map for the Eastern Primary Area (Fowl River Bay Area).

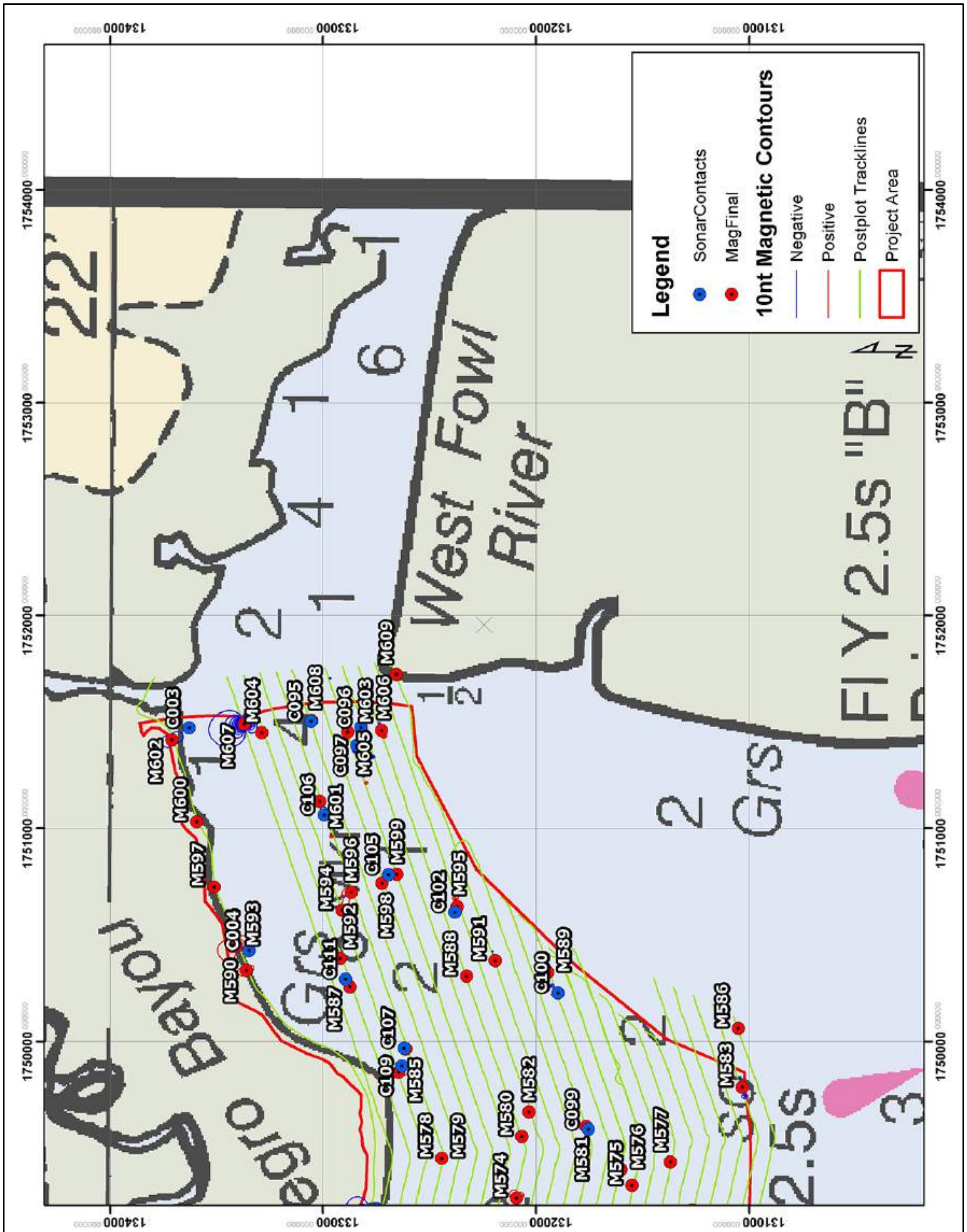

Figure 4-18. Map 17, Magnetic Contour Map for the Eastern Primary Area (Fowl River Bay Area).

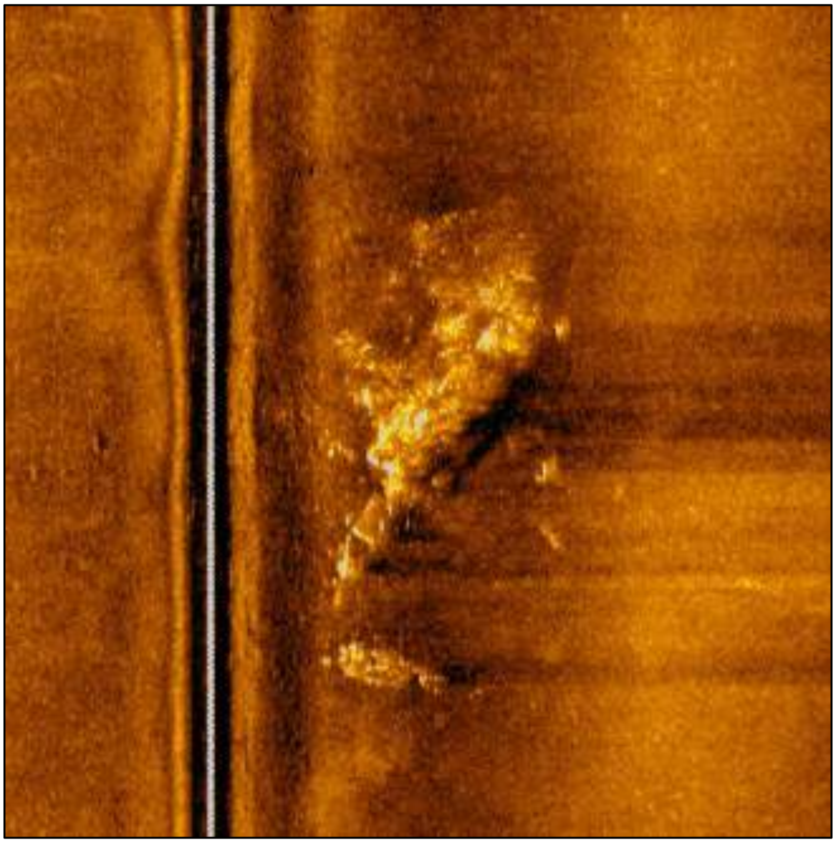

Figure 4-19. Sonar Contact C060, which corresponds to Anomaly M155. With a deviation of 65 nanoteslas and a duration of 145 feet, the sonar contact shows an interesting debris scatter 60 feet in length.

Figure 4-20. Circled in red, Anomaly M155/Contact C060 has since been identified as the remains of a modern shrimp boat that sank approximately six years ago (Carl Ferraro ADCNR-State Lands Division, personal communication, October 2016; base map courtesy of Google Earth).

SIDESCAN SONAR RESULTS

As listed in *Appendix B: Sonar Contacts Data* and *Appendix C: Sonar Contact Images*, 111 sidescan sonar contacts were recorded and identified during the analysis of the data, 25 in the Western Primary Area (Grand Bay Area), three in the Western Lease Extension Area, 44 in the Secondary Area (Isle aux Herbes/Coffee Island Area), 25 in the Eastern Primary Area (Fowl River Bay Area), and 14 in the Eastern Lease Extension Area. These contacts include any object or anomalous bottom return that appeared to be of human origin. They consist of miscellaneous small debris, mostly comprising crab pots, docks, breakwaters, and several unknown objects.

As indicated above, Contact C060 is a modern shrimp boat. Shown in Figures 4-19 and 4-20 above, it has interesting debris scatter 60 feet in length and is associated with Anomaly M155; however, it has been identified as the remains of a modern shrimp boat. Other than this target, a review of the sonar data indicates no additional contact worthy of consideration.

SUBBOTTOM RESULTS

Subbottom profiler data were processed in Sonarwiz.MAP to aid in the analysis and mapping of features relevant to reconstructing paleolandscape features, including those having the potential to contain submerged prehistoric archaeological sites. Penetration was particularly good in the marine sediments of the Project Area. In general, the stratigraphy consists of a first reflector surface layer consisting largely of small-grain marine sediment (silt and clay) with a shift to a more highly reflective surface.

Subbottom features include four relict paleofeatures in the form of buried channels and a bayou, as well as a buried surface corresponding to Sequence Boundary A, which forms the boundary between Seismic Unit B and Seismic Unit A (which itself consists entirely of marine sediments) and represents the last exposed surface in this area (dating to between 9,000 and 22,000 YBP; see *Chapter II: Historical Background*). The relict channel features, incised into Sequence Boundary A, are likely related to the La Batre Incised Channel (see Chapter II).

There are two relict channels in the Western Primary Area (Grand Bay Area; Figures 4-21 to 4-23). Both very shallow, the channel terraces or margins should not be considered to have the possibility for prehistoric site potential, as it appears the channel is incised into marine sediments and well above Sequence Boundary A.

There are two relict features, a channel, and a possible bayou in the middle of the Eastern Primary Area (Fowl River Bay Area; Figures 4-24 to 4-26). Possibly associated with a buried portion of the Fowl River system, the channel should not be considered to have the possibility for prehistoric site potential, as it appears the channel is incised into marine sediments and well above Sequence Boundary A.

As illustrated in Figures 4-27 and 4-28, there was no relict feature recorded in the Secondary Area (Isle aux Herbes/Coffee Island Area).

Given the subbottom record it can be stated that the proposed project activities associated with these areas would not be sufficient to impact any sites that might be present. If present, they would be associated with Sequence Boundary A, which is at a burial depth of approximately 20 feet (7 meters), well below any potential impact.

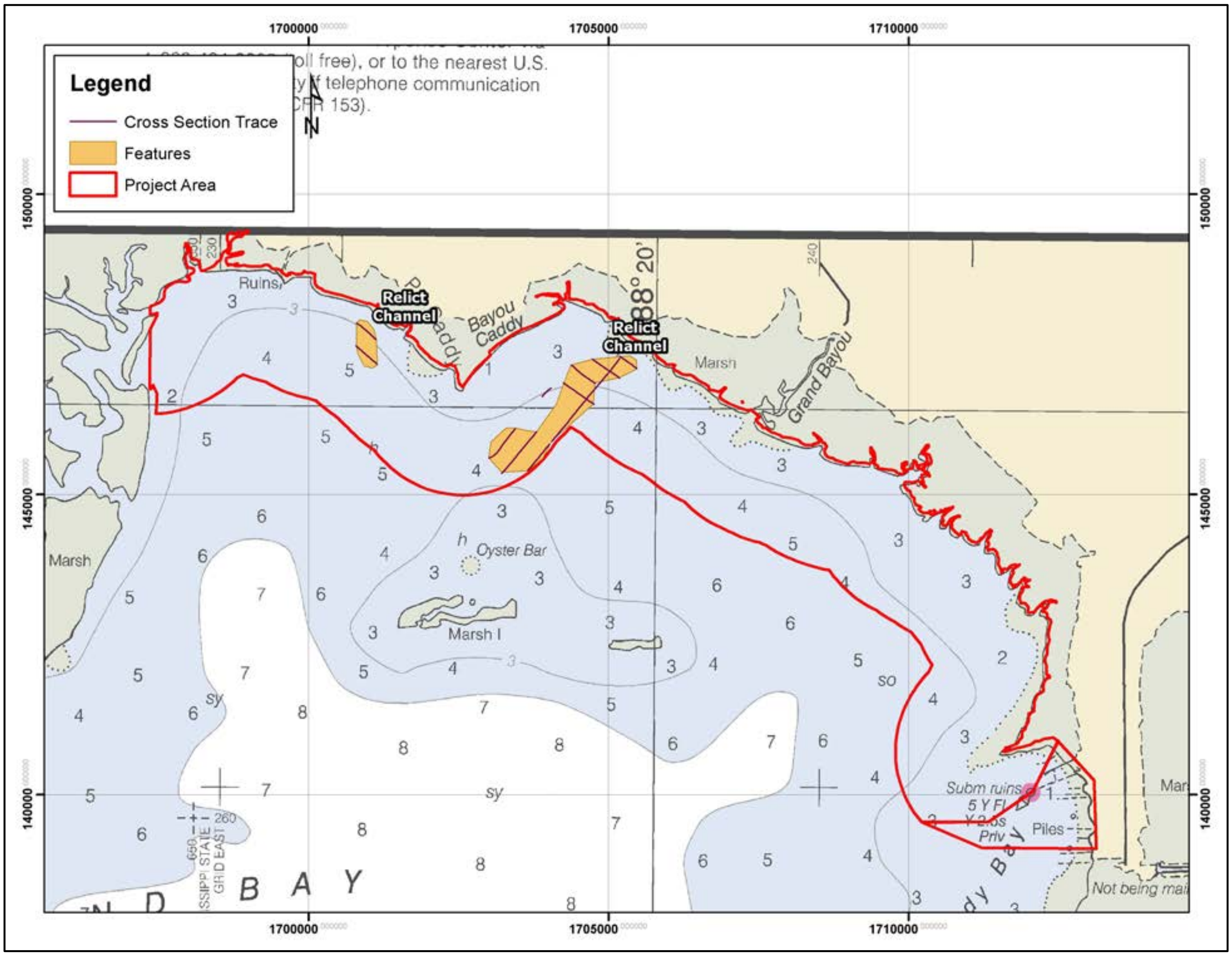

Figure 4-21. Mapped relict channel locations in the Western Primary Area (Grand Bay Area).

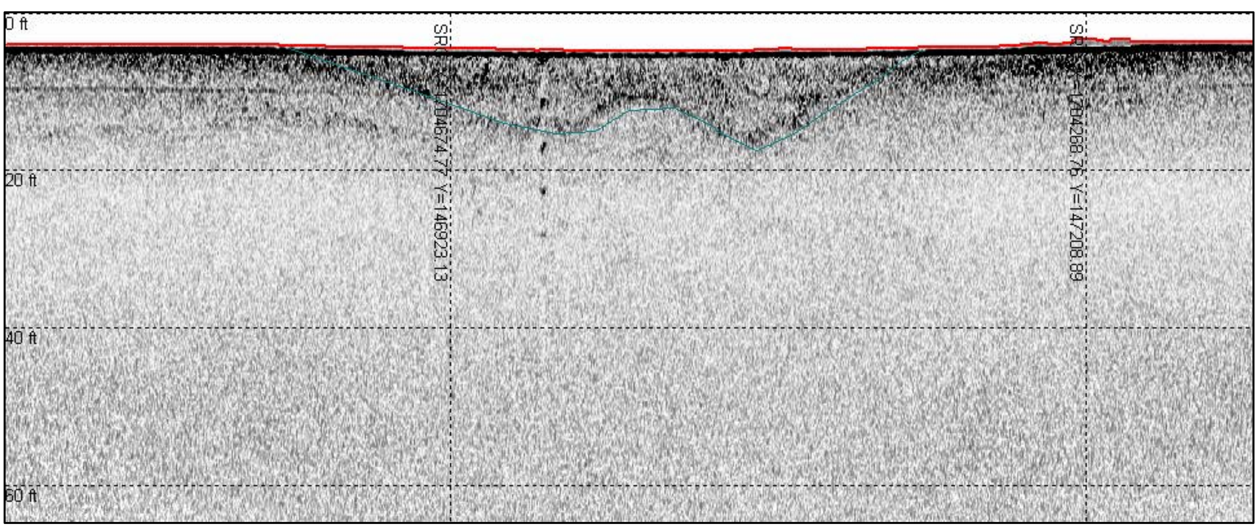

Figure 4-22. Relict channel in the Western Primary Area (Grand Bay Area; note that it is not deeply buried). The channel terraces or margins should not be considered to have the possibility for prehistoric site potential, as it appears the channel is incised into marine sediments.

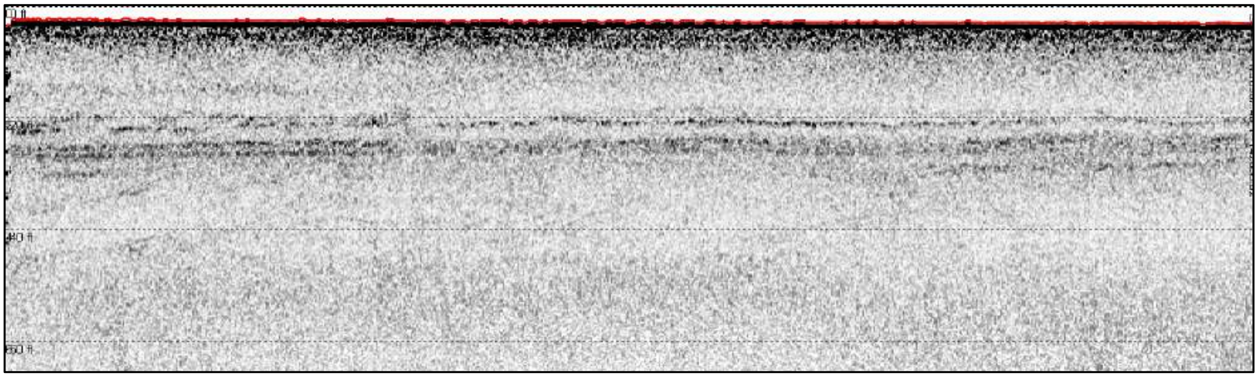

Figure 4-23. Representative data example from Western Primary Area (Grand Bay Area; 500 feet east [left] to west [right]; 20-ft vertical annotations). The representative data show parallel strata, including the stratum around 20 feet (7 meters) that most likely represents Sequence Boundary A.

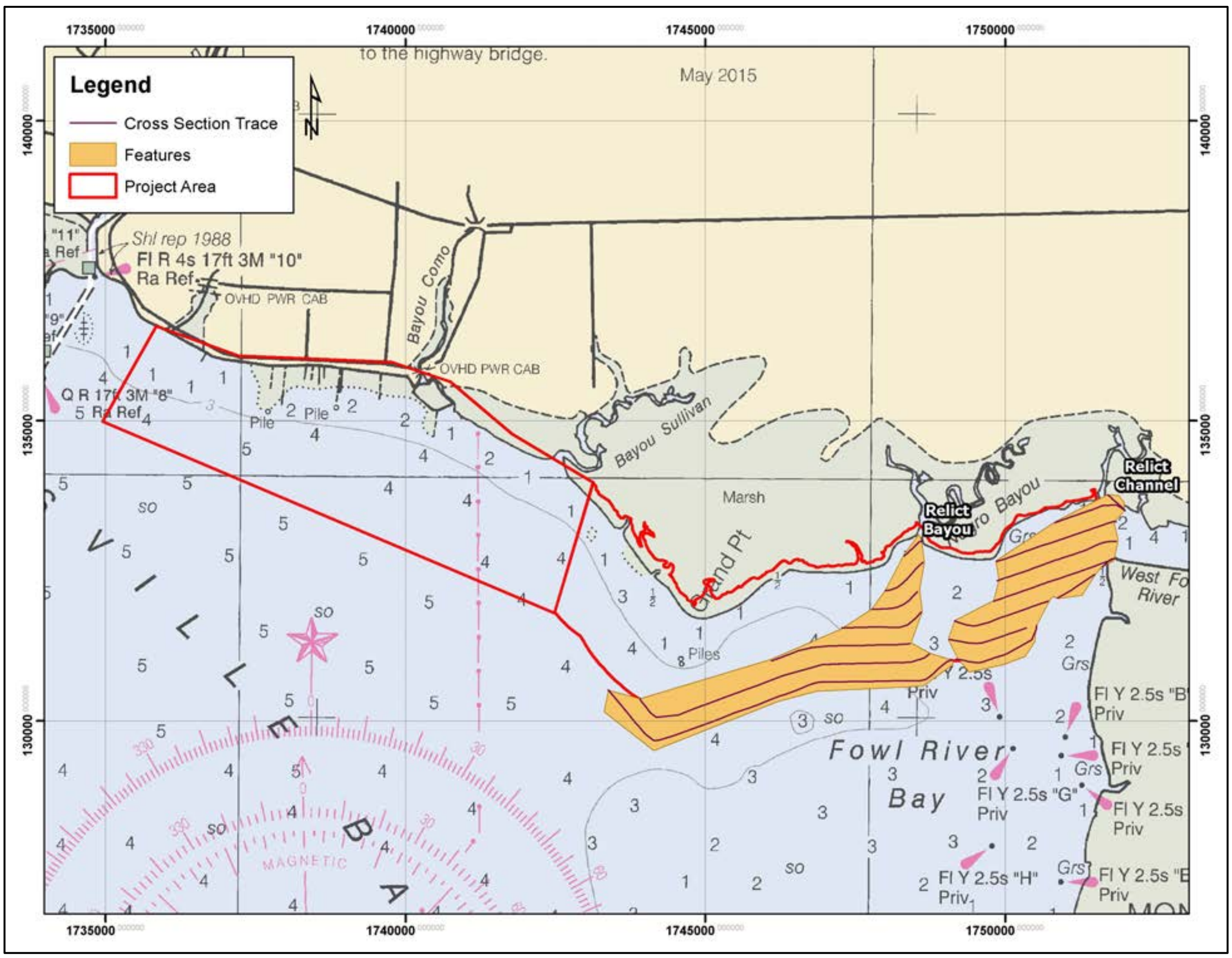

Figure 4-24. Mapped feature locations in the Eastern Primary Area (Fowl River Bay Area).

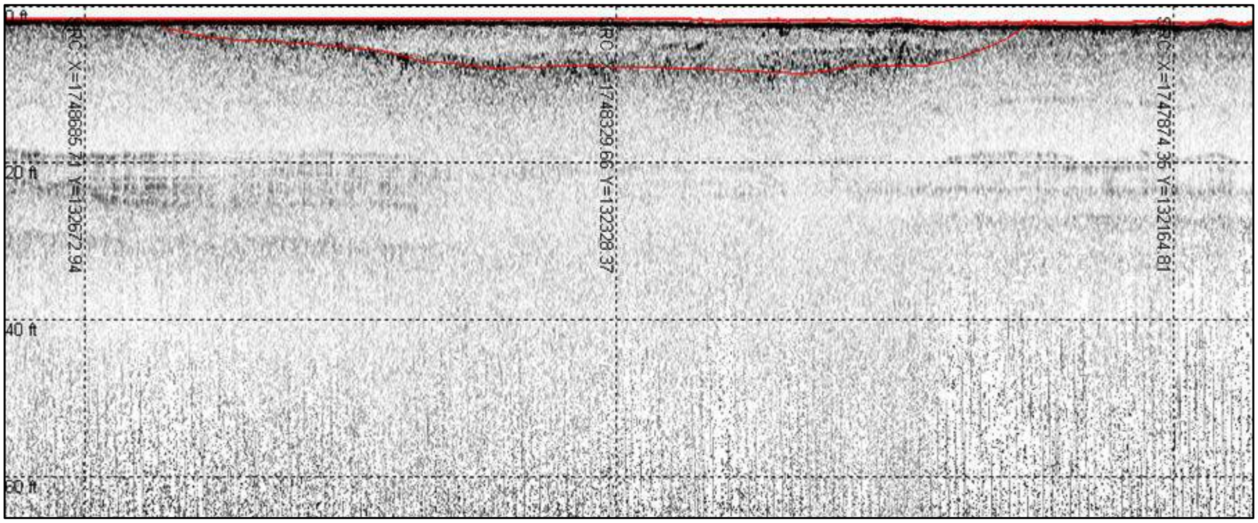

Figure 4-25. Relict channel in the middle of the Eastern Primary Area (Fowl River Bay Area). This may represent a buried portion of the Fowl River system (note that it is not deeply buried). The channel terraces or margins should not be considered to have the possibility for prehistoric site potential, as it appears the channel is incised into marine sediments (note the stratum around 20 feet [7 meters] that most likely represents Sequence Boundary A).

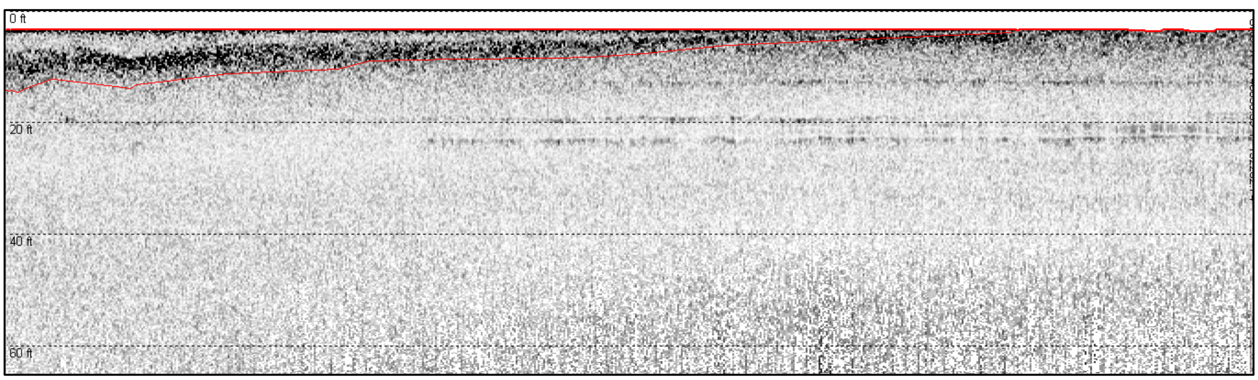

Figure 4-26. Possible relict portion of a bayou in the middle of the Eastern Primary Area (Fowl River Bay Area). This may also represent a buried portion of the Fowl River system (note that it is not deeply buried). It should not be considered to have the possibility for prehistoric site potential (note the stratum around 20 feet [7 meters] that most likely represents Sequence Boundary A).

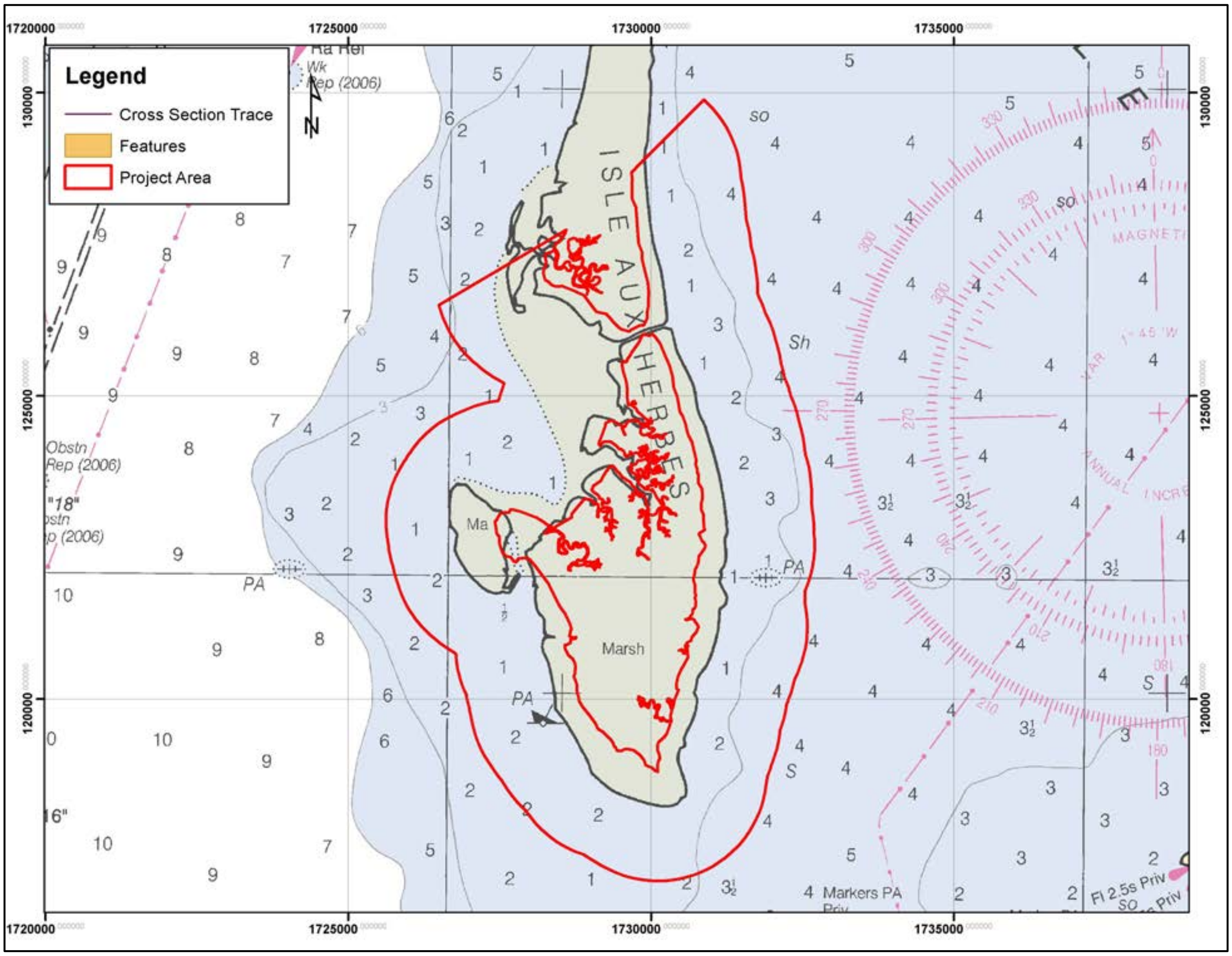

Figure 4-27. Absence of relict feature locations in the Secondary Area (Isle aux Herbes/Coffee Island Area).

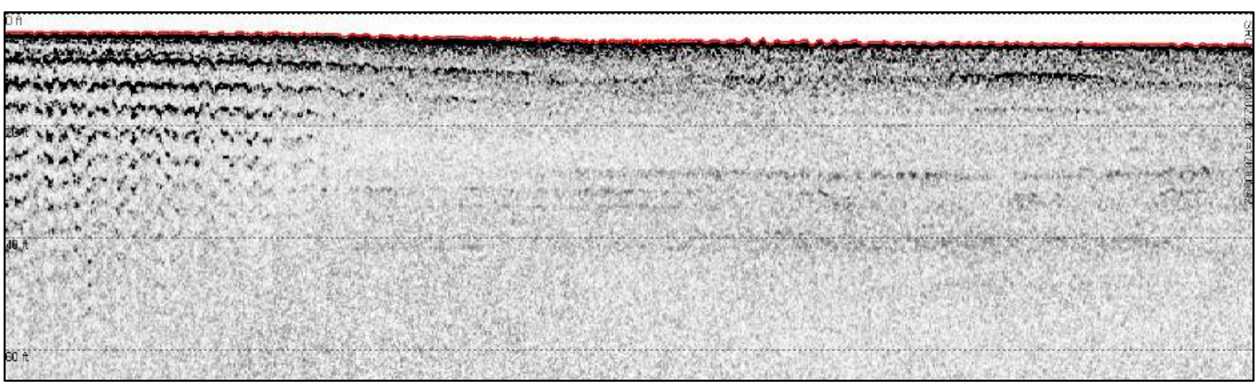

Figure 4-28. Representative subbottom data example from the western side of the Secondary Area (Isle aux Herbes/Coffee Island Area; 500 feet east [left] to west [right]; 20-ft vertical annotations). The multiple reflections of the first-reflector surface layer on left of image indicates a highly reflective surface that creates reflections, likely sand.

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V. CONCLUSIONS

In August 2016, maritime archaeologists with Panamerican Consultants, Inc. conducted an intensive cultural resources remote-sensing survey of five proposed areas slated for off-bottom oyster farm leases near Bayou La Batre, Mobile County, Alabama consisting of Primary, Secondary, and Extension lease areas. To the west of Bayou La Batre is the Western Primary Area, also known as the "Grand Bay Area." On its eastern edge is the Western Lease Extension Area. To the east of Bayou La Batre is the Eastern Primary Area, also known as the "Fowl River Bay Area." To its west is the Eastern Lease Extension Area. South of Bayou La Batre is the Secondary Area that encompasses the southern half of Isle aux Herbes, also known as Coffee Island."

Comprised of a site file check, limited archival research, and an intensive remote-sensing survey of the Project Area employing a magnetometer, sidescan sonar, and subbottom profiler, the current investigation was performed under contract to the Dauphin Island Sea Lab on behalf of The Mobile Bay National Estuary Program. During the remote-sensing survey, 609 magnetic anomalies and 111 sonar contacts were recorded. The great majority of anomalies and sonar contacts appear to be generated from multiple single-point sources and are considered not to have the potential to represent significant cultural resources. These include and are related to shoreline infrastructure such as docks, riprap shorelines, marker poles, and pipelines, as well as dozens of crab pots. There is, however, one cluster that should be considered to have the potential to represent significant cultural resources. Located at the far eastern end of the Eastern Primary Area (Fowl River Bay Area), it consists of anomalies M604 and M607 and is a fairly large anomaly of 577 nanoteslas and duration of 145 feet. This cluster lacks an acoustic image and is of unknown origin; therefore, it should be considered potentially significant.

This potentially significant cluster should be avoided by project activities until its source is identified. Until this happens, an avoidance zone of 100 feet is recommended. The subbottom did not record any feature or landform considered potentially significant.

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. 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: RECORDED MAGNETIC ANOMALIES

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Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
Western Primary Area								
M001	1696803	147706	142	145	C	M001, M002	1	unknown
M002	1696814	147704	138	170	C	M001, M002	1	unknown
M003	1697450	146917	226	60	D	M003, M004	1	unknown
M004	1697457	146931	224	45	M	M003, M004	1	unknown
M005	1697661	147577	27	55	M		1	SPS
M006	1697698	146936	198	55	D		1	SPS
M007	1698427	148281	428397	75	D		1	SPS
M008	1698470	148637	197	40	D		1	SPS
M009	1698636	147970	37	50	D		1	SPS
M010	1698722	148403	90	55	D		1	SPS
M011	1698726	147440	51	60	M	M011, C032	1	debris
M012	1698865	148730	67	80	D	M012, M013, C029	1	debris
M013	1698880	148747	316	45	D	M012, M013, C029	1	debris
M014	1698885	148071	108	90	D		1	SPS
M015	1698988	148484	95	60	D		1	SPS
M016	1699295	147928	98	105	D		1	SPS
M017	1699400	148283	253	410	C		1	SPS
M018	1699445	148098	142	190	C		1	SPS
M019	1699474	148430	339	160	C	M019, M021, M022	1	Old fish camp, charted as "Ruins"
M020	1699498	147999	97	90	D		1	SPS
M021	1699529	148414	602	175	C	M019, M021, M022	1	Old fish camp, charted as "Ruins"
M022	1699535	148407	1510	370	C	M019, M021, M022	1	Old fish camp, charted as "Ruins"
M023	1699770	146792	162	110	D		1	SPS
M024	1699779	147865	27	110	D		1	SPS
M025	1699967	147281	51	90	D		1	SPS
M026	1701014	146815	120	70	D		1	SPS
M027	1701081	146665	21	70	D		1	SPS
M028	1701106	147887	30	65	D		1	SPS
M029	1701718	146788	104	60	D		2	SPS
M030	1702404	146389	33	75	M		2	SPS
M031	1702635	146729	94	70	M	M031, C042	2	linear debris
M032	1703272	147132	219	175	D		2	SPS
M033	1703343	146902	51	55	D		2	SPS
M034	1703394	147551	589	280	C		2	SPS
M035	1703732	145499	64	60	D		2	SPS
M036	1703871	146788	25	70	D		2	SPS
M037	1704357	148022	88	30	D		2	SPS
M038	1704514	147537	50	65	D	M038, C019	2	crab pot
M039	1705118	147123	34	95	M	M039, C018	2	crab pot
M040	1705163	145908	115	180	D		2	SPS
M041	1705185	145710	37	70	D		2	SPS
M042	1705216	147511	193	40	M	M042, M043, M044	2	unknown
M043	1705290	147378	117	45	D	M042, M043, M044	2	unknown
M044	1705333	147499	90	110	C	M042, M043, M044	2	unknown
M045	1705378	146580	76	55	M		2	SPS
M046	1705598	146429	21	80	D		2	SPS

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M047	1705742	147173	37	75	D	M047, C025	2	crab pot
M048	1705985	147022	105	45	M		2	SPS
M049	1706193	146900	31	45	D		2	SPS
M050	1706200	146377	36	60	D	M050, M051	2	unknown
M051	1706200	146377	36	65	D	M050, M051	2	unknown
M052	1706263	145516	117	60	M		2	SPS
M053	1706330	145205	1186	85	D		2	SPS
M054	1706652	145245	106	40	M		3	SPS
M055	1706870	146286	37	55	D	M055, M056	3	unknown
M056	1706872	146290	29	40	D	M055, M056	3	unknown
M057	1707348	146045	633	55	D	M057, C028	3	crab pot
M058	1707668	145730	58	81	D	M058, C030	3	debris
M059	1707868	144822	51	45	M		3	SPS
M060	1707981	145718	24	100	C		3	SPS
M061	1708360	144262	27	85	D		3	SPS
M062	1708455	144312	69	45	M		3	SPS
M063	1708651	145438	258	50	M	M063, C026	3	crab pot
M064	1708802	143873	28	250	M		3	SPS
M065	1708865	145357	427	40	D	M065, C031	3	debris
M066	1709840	143434	161	50	D	C039, M066	4	crab pot
M067	1709922	140853	206	35	D		4	SPS
M068	1709943	141784	42	70	D		4	SPS
M069	1709997	139857	171	40	D		5	SPS
M070	1710003	142682	32	150	D		4	SPS
M071	1710026	144708	32	60	D		3	SPS
M072	1710084	144529	37	70	M	M072, M073, M074	3	unknown
M073	1710134	144577	22	45	D	M072, M073, M074	3	unknown
M074	1710215	144539	58	40	D	M072, M073, M074	3	unknown
M075	1710382	144427	144	50	D		3	SPS
M076	1710443	141756	31	35	M	M076, C013	4	debris
M077	1710554	142200	40	40	D		4	SPS
M078	1710582	140622	27	40	D		4	SPS
M079	1710699	141514	40	80	D		4	SPS
M080	1710701	140653	708	40	D	M080, M081, C012	4	crab pot
M081	1710706	140655	63	60	M	M080, M081, C012	4	crab pot
M082	1710737	141279	122	40	M		4	SPS
M083	1710751	140132	297	70	C		5	SPS
M084	1710769	143020	23	125	C		4	SPS
M085	1710814	140767	55	45	D		4	SPS
M086	1710885	142607	39	80	D		4	SPS
M087	1711196	140711	126	45	D	M087, C011	4	debris
M088	1711208	140246	710	55	D		4	SPS
M089	1711252	140413	77	50	C	M089, M090, C009	4	crab pot
M090	1711270	140487	20	50	M	M089, M090, C009	4	crab pot
M091	1711416	141227	284	40	D		4	SPS
M092	1711453	143451	364	70	D	M092, C027	4	crab pot
M093	1711521	140701	19	150	M	M093, C014	4	debris
M094	1711613	139799	30	65	M		5	SPS
M095	1711671	139969	65	50	D		5	SPS
M096	1711695	140590	23	110	C	M096, C010	4	crab pot

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M097	1711744	140920	407	65	M		4	SPS
M098	1711754	142205	215	50	D	M098, C041	4	crab pot
M099	1711806	139721	382	65	C		5	SPS
M100	1711813	141240	295	75	C	M100, M102	4	unknown
M101	1711856	139323	245	30	D		5	SPS
M102	1711891	141174	592	80	D	M100, M102	4	unknown
M103	1711892	141608	223	40	M		4	SPS
M104	1711896	142949	64	65	D		4	SPS
M105	1711927	141767	46	95	D		4	SPS
M106	1712008	140033	19	70	D		5	SPS
M107	1712040	142727	854	100	D	M107, C020	4	crab pot
M108	1712106	142500	26	165	D	M108, C021	4	crab pot
M109	1712106	139922	23	40	M	M109, C015	5	crab pot
M110	1712113	142299	579	30	D	M110, C022	4	tire
M111	1712142	140314	781	100	C		4	SPS
M112	1712206	140134	624	65	M		5	SPS
M113	1712454	139529	25	120	C	M113-M117, M023, M025-M030	5	dock and pilings
M114	1712459	139467	45	60	D	M113-M117, M023, M025-M030	5	dock and pilings
M115	1712560	139287	1723	25	D	M113-M117, M023, M025-M030	5	dock and pilings
M116	1712637	139380	1003	25	D	M113-M117, M023, M025-M030	5	dock and pilings
M117	1712751	139383	49	30	D	M113-M117, M023, M025-M030	5	dock and pilings
Western Lease Extension Area								
M118	1710683	139448	31	50	M		5	SPS
M119	1712446	139815	132	25	M	M119-M122, M124	5	dock
M120	1712473	139963	1357	35	D	M119-M122, M124	5	dock
M121	1712491	139899	218	75	C	M119-M122, M124	5	dock
M122	1712514	139961	161	30	D	M119-M122, M124	5	dock
M123	1712530	139366	391	40	M	M113-M117, M023, M025-M030	5	dock and pilings
M124	1712597	139811	193	30	D	M119-M122, M124	5	dock
M125	1712600	139596	120	35	M	M113-M117, M023, M025-M030	5	dock and pilings
M126	1712635	139431	530	55	D	M113-M117, M023, M025-M030	5	dock and pilings
M127	1712659	139063	49	60	C	M113-M117, M023, M025-M030	5	dock and pilings
M128	1712680	139281	688	140	C	M113-M117, M023, M025-M030	5	dock and pilings
M129	1712760	139063	61	25	M	M113-M117, M023, M025-M030	5	dock and pilings
M130	1712781	139154	19	45	C	M113-M117, M023, M025-M030	5	dock and pilings
Secondary Area								
M131	1725935	122639	45	35	D		7	SPS
M132	1726287	124393	56	125	D		6	SPS
M133	1726501	124564	19	120	D		6	SPS

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M134	1726560	120891	25	95	D		7	SPS
M135	1726731	122516	75	75	D		7	SPS
M136	1726933	125811	22	75	M		6	SPS
M137	1727067	119418	129	105	D		8	SPS
M138	1727089	122873	4521	80	D	M138, M141	7	unknown
M139	1727119	126520	128	50	D	M139, C043	6	crab pot
M140	1727162	121901	30	75	D		7	SPS
M141	1727181	122888	207	130	C	M138, M141	7	unknown
M142	1727186	120967	85	65	D		7	SPS
M143	1727201	124482	45	75	D	M143, C077	6	crab pot
M144	1727239	126328	32	80	D		6	SPS
M145	1727284	124755	96	55	M	M145, C078	6	crab pot
M146	1727313	122149	38	75	M	M146, C062	7	debris
M147	1727332	124096	69	80	D	M147, M149	7	unknown
M148	1727349	122574	124	65	M	M148, M150, M151, C065	7	debris scatter
M149	1727360	124058	170	95	D	M147, M149	7	unknown
M150	1727411	122544	99	95	C	M148, M150, M151, C065	7	debris scatter
M151	1727412	122526	49	55	D	M148, M150, M151, C065	7	debris scatter
M152	1727467	118961	144	35	D		8	SPS
M153	1727480	121933	31	55	D	M153, C063	7	crab pot
M154	1727571	124009	51	70	D		7	SPS
M155	1727690	121109	63	145	M	M155, C060	7	debris scatter
M156	1727710	121265	37	45	M		7	SPS
M157	1727710	123839	43	70	D		7	SPS
M158	1727739	118298	17	40	D	M158, M161	8	unknown
M159	1727743	122209	46	45	D		7	SPS
M160	1727767	119327	37	105	D		8	SPS
M161	1727771	118260	21	50	D	M158, M161	8	unknown
M162	1727782	123753	48	85	M	M162, C058	7	crab pot
M163	1727793	125848	131	95	D		6	SPS
M164	1727796	118588	46	60	D		8	SPS
M165	1727814	123171	68	80	D	M165, M166, C044	7	crab pot
M166	1727816	123172	47	85	D	M165, M166, C044	7	crab pot
M167	1727852	119863	36	105	D		8	SPS
M168	1727869	123572	168	60	M	M168, C061	7	crab pot
M169	1727874	121055	56	65	D		7	SPS
M170	1727900	124498	25	60	M		6	SPS
M171	1727937	120201	147	70	D	M171, C057	8	crab pot
M172	1727960	123986	34	70	M	M172, C056	7	crab pot
M173	1727965	119779	125	60	D		8	SPS
M174	1728013	120761	45	75	D		7	SPS
M175	1728017	118561	82	100	D		8	SPS
M176	1728125	120155	14	175	M	M176, M182, C059	8	debris scatter
M177	1728171	126535	89	100	D	M177, C046	6	crab pot
M178	1728177	118836	43	65	D		8	SPS
M179	1728181	118376	171	60	D		8	SPS
M180	1728182	127319	180	65	D		6	SPS

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M181	1728188	126632	181	45	M		6	SPS
M182	1728200	120184	62	125	M	M176, M182, C059	8	debris scatter
M183	1728252	127536	162	65	M		6	SPS
M184	1728254	123092	117	75	D	M184, C053	7	crab pot
M185	1728269	124898	41	50	M		6	SPS
M186	1728281	126636	82	140	C	M186, M188, M189	6	debris
M187	1728327	121308	25	120	D		7	SPS
M188	1728358	126642	187	90	D	M186, M188, M189	6	debris
M189	1728362	126597	418	120	D	M186, M188, M189	6	debris
M190	1728381	117920	91	80	D		8	SPS
M191	1728392	121480	56	45	D		7	SPS
M192	1728408	126720	110	125	D	M192, M193	6	unknown
M193	1728410	126722	84	90	D	M192, M193	6	unknown
M194	1728486	120086	35	60	D		8	SPS
M195	1728486	126700	86	45	M		6	SPS
M196	1728497	123143	32	40	M	M196, M199	7	unknown
M197	1728502	121280	52	50	M		7	SPS
M198	1728512	118780	33	70	D		8	SPS
M199	1728555	123086	52	50	D	M196, M199	7	unknown
M200	1728561	120278	40	50	M		8	SPS
M201	1728562	120277	27	45	M		8	SPS
M202	1728565	123655	35	60	M		7	SPS
M203	1728572	124613	35	90	D		6	SPS
M204	1728627	123718	163	65	D		7	SPS
M205	1728638	120373	28	55	D		8	SPS
M206	1728668	126145	46	85	D		6	SPS
M207	1728691	123886	45	65	D		7	SPS
M208	1728735	124150	34	45	M		7	SPS
M209	1728771	126420	41	90	D		6	SPS
M210	1728799	124869	25	105	D		6	SPS
M211	1728825	117711	65	75	M	M211, C079	8	crab pot
M212	1728852	117447	34	95	D		8	SPS
M213	1728929	126442	155	40	D		6	SPS
M214	1729019	118353	41	85	D	M214, C055	8	crab pot
M215	1729091	124291	37	80	M	M215, M216, C054	7	tire
M216	1729092	124290	195	55	M	M215, M216, C054	7	tire
M217	1729108	124854	176	65	M		6	SPS
M218	1729118	124600	23	85	D		6	SPS
M219	1729181	124495	264	60	M	M219, C052	6	crab pot
M220	1729223	126176	38	75	D		6	SPS
M221	1729230	124559	118	175	D	M221, M223	6	unknown
M222	1729265	124065	32	75	M	M222, M224	7	unknown
M223	1729266	124577	43	115	M	M221, M223	6	unknown
M224	1729333	124057	409	75	D	M222, M224	7	unknown
M225	1729352	126088	47	95	M		6	SPS
M226	1729353	118141	59	115	D		8	SPS
M227	1729394	125564	110	135	C		6	SPS
M228	1729636	117083	50	50	D		12	SPS
M229	1729731	117235	26	85	D		12	SPS
M230	1730011	127799	23	115	D		9	SPS

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M231	1730045	118266	24	105	M	M231, C071	12	debris
M232	1730062	128364	48	85	D		9	SPS
M233	1730068	117626	39	100	D	M233, C066	12	crab pot
M234	1730113	128906	35	240	C		9	SPS
M235	1730163	118461	98	110	D	M235, C070	12	linear debris
M236	1730241	127382	48	90	D		10	SPS
M237	1730242	119030	241	935	C	M237, M239	12	living shoreline
M238	1730243	126170	54	80	M	M238, M241	10	unknown
M239	1730287	119053	11	855	M	M237, M239	12	living shoreline
M240	1730290	118663	28	370	C	M240, M243, C068	12	living shoreline
M241	1730296	126255	33	160	C	M238, M241	10	unknown
M242	1730363	125515	109	125	M		10	living shoreline
M243	1730366	118704	758	95	M	M240, M243, C068	12	living shoreline
M244	1730434	119649	642	50	D	M244, M247, M248	12	living shoreline
M245	1730441	125930	82	60	D		10	SPS
M246	1730442	118657	481	75	D	M246, C069	12	unknown object
M247	1730454	119740	165	185	M	M244, M247, M248	12	living shoreline
M248	1730457	119743	66	165	M	M244, M247, M248	12	living shoreline
M249	1730470	125147	212	135	M		10	living shoreline
M250	1730481	125153	19	140	M		10	living shoreline
M251	1730524	125551	30	155	D		10	SPS
M252	1730575	119992	253	185	D		12	SPS
M253	1730581	125041	28	150	D		10	SPS
M254	1730587	120383	44	200	M		11	SPS
M255	1730603	125880	20	205	C		10	SPS
M256	1730662	119367	48	305	D	M256, M260, C075	12	linear debris
M257	1730663	118643	41	80	M	M257, C074	12	crab pot
M258	1730718	124265	474	1345	C		10	living shoreline
M259	1730737	124252	56	1225	C		10	living shoreline
M260	1730746	119359	141	290	D	M256, M260, C075	12	linear debris
M261	1730789	125714	26	105	D		10	SPS
M262	1730795	118868	432	255	C	M262, M267, C073	12	debris
M263	1730831	120872	103	75	M		11	SPS
M264	1730832	119762	16	105	D		12	SPS
M265	1730855	121103	58	115	M		11	SPS
M266	1730864	128150	127	50	M		9	SPS
M267	1730864	118873	952	195	D	M262, M267, C073	12	debris
M268	1730873	128561	342	190	D		9	SPS
M269	1730889	129674	20	120	D		9	SPS
M270	1730917	123328	236	180	M		11	living shoreline
M271	1730928	124366	204	80	D		10	SPS
M272	1730931	129068	26	70	D		9	SPS
M273	1730936	120649	31	160	C		11	SPS
M274	1730955	122380	98	125	C		11	SPS
M275	1731046	122604	148	120	D		11	SPS
M276	1731082	117341	31	70	D		12	SPS
M277	1731093	126904	649	210	D		10	SPS
M278	1731142	121933	95	205	D		11	SPS
M279	1731171	126473	72	90	M		10	SPS
M280	1731192	118246	111	55	D	M280, M281	12	unknown

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M281	1731192	118246	111	65	D	M280, M281	12	unknown
M282	1731201	123404	34	65	M		11	SPS
M283	1731214	119388	109	100	C	M283, C038, C072	12	crab pot
M284	1731215	125894	37	250	C		10	SPS
M285	1731239	127397	54	90	D		9	SPS
M286	1731246	126898	34	100	D		10	SPS
M287	1731282	129632	91	70	D		9	SPS
M288	1731290	117990	79	55	M		12	SPS
M289	1731299	125259	29	255	C		10	SPS
M290	1731331	121776	22	85	D		11	SPS
M291	1731331	120661	45	260	D		11	SPS
M292	1731396	122398	105	115	D		11	SPS
M293	1731399	129385	38	65	M		9	SPS
M294	1731403	121394	73	95	D		11	SPS
M295	1731449	125829	32	80	D		10	SPS
M296	1731477	126465	47	185	D		10	SPS
M297	1731539	123625	32	190	D		11	SPS
M298	1731543	124948	35	70	D		10	SPS
M299	1731579	128403	18	80	D		9	SPS
M300	1731606	126229	146	120	D		10	SPS
M301	1731675	125890	75	105	D		10	SPS
M302	1731681	122700	66	115	D		11	SPS
M303	1731754	125054	45	80	D	M303, C036	10	crab pot
M304	1731772	125554	34	55	M		10	SPS
M305	1731774	122017	15	195	M		11	SPS
M306	1731878	118194	30	120	D		12	SPS
M307	1731910	124218	33	130	D	M307, M308	10	unknown
M308	1731999	124201	361	90	D	M307, M308	10	unknown
M309	1732029	126414	32	100	D		10	SPS
M310	1732031	118145	256	165	C		12	SPS
M311	1732033	120354	67	255	D		11	SPS
M312	1732108	122917	31	120	D		11	SPS
M313	1732116	126778	30	85	D	M313, C034	10	debris
M314	1732126	125649	75	70	D	M314, C035	10	debris
M315	1732133	119078	29	60	D		12	SPS
M316	1732158	125528	193	95	D		10	SPS
M317	1732182	120768	21	115	D		11	SPS
M318	1732192	126370	37	115	D	M318, C033	10	debris
M319	1732193	122539	98	75	D		11	SPS
M320	1732209	121183	95	70	M		11	SPS
M321	1732260	119232	131	210	D		12	SPS
M322	1732361	123470	36	95	D		11	SPS
M323	1732488	123024	52	115	D		11	SPS
M324	1732539	123648	24	100	D		11	SPS
M325	1732641	123830	48	80	M	M325, M329	10	unknown
M326	1732665	121552	65	65	D		11	SPS
M327	1732688	123658	61	60	D		11	SPS
M328	1732696	123085	63	80	D		11	SPS
M329	1732721	123854	78	80	D	M325, M329	10	unknown
M330	1732765	121300	27	105	D		11	SPS

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M331	1732776	121711	34	80	D		11	SPS
M332	1732851	123395	222	95	D		11	SPS
M333	1732904	121966	49	120	D		11	SPS
Eastern Lease Extension Area								
M334	1734797	135021	85	35	M		13	SPS
M335	1734966	134951	64	80	C		13	SPS
M336	1735463	134740	24	50	D		13	SPS
M337	1735613	135815	212	35	M		13	SPS
M338	1735668	136524	94	40	D		13	SPS
M339	1735715	135845	57	45	D		13	SPS
M340	1735836	135067	29	65	D	M340, C081	13	debris
M341	1735927	136244	23	55	M	M341, M342, M343, M345	13	unknown
M342	1735956	136320	172	685	C	M341, M342, M343, M345	13	unknown
M343	1735969	136386	153	210	M	M341, M342, M343, M345	13	unknown
M344	1735981	135730	38	55	M		13	SPS
M345	1736088	136322	140	55	D	M341, M342, M343, M345	13	unknown
M346	1736148	134938	121	100	D	M346, C083	13	debris
M347	1736201	135964	75	65	M		13	SPS
M348	1736214	135795	26	110	D		13	SPS
M349	1736236	136243	131	95	D		13	SPS
M350	1736409	134899	30	175	C		13	SPS
M351	1736425	134403	31	55	M		13	SPS
M352	1736490	135677	604	145	D		13	SPS
M353	1736545	135946	107	75	M		13	SPS
M354	1736627	134644	72	100	M		13	SPS
M355	1736742	134520	47	80	D		13	SPS
M356	1736813	135468	518	85	D		13	SPS
M357	1736838	135857	31	230	C		13	SPS
M358	1736915	135741	89	80	M		13	SPS
M359	1736955	135318	219	75	D		13	SPS
M360	1737024	135702	362	350	C	M360, M363, M364, C089	13	dock and tire dump
M361	1737024	135448	39	130	C		13	SPS
M362	1737046	134228	67	90	D		13	SPS
M363	1737078	135751	140	65	M	M360, M363, M364, C089	13	dock and tire dump
M364	1737133	135793	625	325	C	M360, M363, M364, C089	13	dock and tire dump
M365	1737222	134553	28	190	D	M365, C082	13	crab pot
M366	1737426	135120	270	80	D		13	SPS
M367	1737434	133902	19	45	D		13	SPS
M368	1737444	135593	116	85	D	M368, M371-M375, C087, C088	13	dock
M369	1737565	135058	30	40	D		13	SPS
M370	1737582	134074	54	80	M		13	SPS
M371	1737596	135445	165	80	D	M368, M371-M375, C087, C088	13	dock

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M372	1737641	135282	2333	220	C	M368, M371-M375, C087, C088	13	dock
M373	1737643	135192	368	340	D	M368, M371-M375, C087, C088	13	dock
M374	1737667	135342	46	545	C	M368, M371-M375, C087, C088	13	dock
M375	1737715	135158	4573	120	C	M368, M371-M375, C087, C088	13	dock
M376	1737754	134580	59	125	D		13	SPS
M377	1737806	134070	171	95	M	M377, M378	13	unknown
M378	1737814	133975	68	70	M	M377, M378	13	unknown
M379	1737939	135717	186	160	D	M379, M382	13	unknown
M380	1737960	135058	28	110	D		13	SPS
M381	1737973	135537	343	40	M		13	SPS
M382	1738049	135757	125	205	C	M379, M382	13	unknown
M383	1738073	135417	73	155	D	M383, C090	13	debris scatter
M384	1738095	134108	27	115	M		13	SPS
M385	1738247	134444	71	115	D	M385, C084	13	crab pot
M386	1738256	135345	1517	120	D	M386, M387	13	pilings
M387	1738265	135251	109	100	M	M386, M387	13	pilings
M388	1738479	135577	69	95	D		13	SPS
M389	1738575	133745	131	60	M		13	SPS
M390	1738757	135132	64	150	C		13	dock
M391	1738787	135285	50	80	D		13	dock
M392	1738787	135517	168	80	D		13	dock
M393	1738802	135450	110	65	M		13	dock
M394	1738820	133640	217	85	M		13	SPS
M395	1738856	135488	87	40	M		13	dock
M396	1738866	135173	30	300	C		13	dock
M397	1738891	135310	231	75	M		13	dock
M398	1738919	135751	93	70	D		13	SPS
M399	1739049	135172	25	75	M		14	SPS
M400	1739077	135395	76	85	D		14	SPS
M401	1739176	135118	248	120	D		14	SPS
M402	1739195	134529	126	90	M		14	SPS
M403	1739304	135299	42	80	D		14	dock
M404	1739309	135549	185	145	C		14	dock
M405	1739336	135687	570	130	M		14	dock
M406	1739374	135598	81	50	M		14	dock
M407	1739381	133148	33	115	D		14	SPS
M408	1739402	135185	356	95	D		14	dock
M409	1739481	134662	42	100	M		14	SPS
M410	1739540	135694	90	135	C		14	dock
M411	1739744	135278	347	80	D		14	SPS
M412	1739787	133067	87	85	M		14	SPS
M413	1739874	133028	32	75	D		14	SPS
M414	1739911	133248	1013	245	M		14	SPS
M415	1739953	133069	136	85	D		14	SPS
M416	1739976	134200	43	120	D		14	SPS
M417	1740066	134578	122	190	M		14	SPS

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M418	1740079	135561	299	515	C	M418, C090	14	linear debris
M419	1740089	132938	187	90	M		15	SPS
M420	1740089	134313	51	95	D		14	SPS
M421	1740201	135082	1588	95	D		14	SPS
M422	1740204	133124	625	75	D	M422, M426, M428	14	unknown
M423	1740207	133936	55	75	D		14	SPS
M424	1740208	134355	38	90	D		14	SPS
M425	1740218	133371	771	80	D		14	SPS
M426	1740269	133018	44	90	D	M422, M426, M428	15	unknown
M427	1740290	135042	31	60	D		14	SPS
M428	1740293	133087	579	85	D	M422, M426, M428	14	unknown
M429	1740311	133242	269	135	D		14	SPS
M430	1740323	133653	19	160	D	M430, M431, C085	14	linear debris
M431	1740324	133724	130	105	M	M430, M431, C085	14	linear debris
M432	1740325	133978	243	185	M		14	SPS
M433	1740336	134208	42	150	M		14	SPS
M434	1740341	134786	571	390	C	M434, M435, M436	14	unknown
M435	1740367	134846	78	150	M	M434, M435, M436	14	unknown
M436	1740371	134937	1908	95	M	M434, M435, M436	14	unknown
M437	1740373	135463	29	140	M		14	SPS
M438	1740402	135167	116	95	M	M438, M439	14	unknown
M439	1740403	135157	548	110	D	M438, M439	14	unknown
M440	1740457	135382	524	60	D	M440, M441	14	unknown
M441	1740463	135371	422	85	M	M440, M441	14	unknown
M442	1740492	134559	23	65	D		14	SPS
M443	1740568	133777	30	45	M		14	SPS
M444	1740598	134587	49	80	M		14	SPS
M445	1740605	132719	33	45	M		15	SPS
M446	1740655	132933	81	90	D		15	SPS
M447	1740659	135341	35	60	D		14	SPS
M448	1740665	133090	74	115	M		14	SPS
M449	1740672	134718	55	85	M		14	SPS
M450	1740727	135260	61	65	M	M450, M451	14	unknown
M451	1740766	135330	33	60	D	M450, M451	14	unknown
M452	1740808	135066	119	105	C		14	SPS
M453	1740821	132628	75	80	M		15	SPS
M454	1740852	135212	192	80	D		14	SPS
M455	1740874	134798	986	80	D		14	SPS
M456	1740935	133068	121	150	D		14	SPS
M457	1740997	135240	269	80	M		14	SPS
M458	1741266	134790	955	125	M		14	SPS
M459	1741473	135022	135	255	M	M459-M495	14	pipeline
M460	1741511	133544	1938	825	C	M459-M495	14	pipeline
M461	1741514	133962	689	960	C	M459-M495	14	pipeline
M462	1741524	132653	587	1415	C	M459-M495	15	pipeline
M463	1741533	133211	1514	735	C	M459-M495	14	pipeline
M464	1741558	133616	1398	605	C	M459-M495	14	pipeline
M465	1741559	132803	1532	900	C	M459-M495	15	pipeline
M466	1741561	133290	1051	780	C	M459-M495	14	pipeline
M467	1741561	134015	1675	525	C	M459-M495	14	pipeline

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M468	1741567	133685	691	710	C	M459-M495	14	pipeline
M469	1741570	133775	1924	1065	C	M459-M495	14	pipeline
M470	1741570	132960	1272	850	C	M459-M495	15	pipeline
M471	1741581	132378	941	1070	C	M459-M495	15	pipeline
M472	1741590	133025	1276	730	C	M459-M495	15	pipeline
M473	1741590	134489	90	800	C	M459-M495	14	pipeline
M474	1741596	134325	1330	820	C	M459-M495	14	pipeline
M475	1741596	134576	113	1130	C	M459-M495	14	pipeline
M476	1741599	133836	1224	465	C	M459-M495	14	pipeline
M477	1741600	132530	422023	530	C	M459-M495	15	pipeline
M478	1741604	134088	1784	610	C	M459-M495	14	pipeline
M479	1741606	132693	1369	735	C	M459-M495	15	pipeline
M480	1741607	134819	235	985	C	M459-M495	14	pipeline
M481	1741608	134892	226	645	C	M459-M495	14	pipeline
M482	1741613	132852	1034	700	C	M459-M495	15	pipeline
M483	1741614	133342	1715	650	C	M459-M495	14	pipeline
M484	1741615	132289	580	1120	C	M459-M495	15	pipeline
M485	1741629	133099	1463	670	C	M459-M495	14	pipeline
M486	1741632	132446	938	955	C	M459-M495	15	pipeline
M487	1741638	133421	685	695	C	M459-M495	14	pipeline
M488	1741642	134236	741	1240	C	M459-M495	14	pipeline
M489	1741648	134140	941	570	C	M459-M495	14	pipeline
M490	1741657	132181	992	730	C	M459-M495	15	pipeline
M491	1741673	134385	207	1135	C	M459-M495	14	pipeline
M492	1741733	132075	714	695	C	M459-M495	15	pipeline
M493	1741741	134590	433	815	C	M459-M495	14	pipeline
M494	1741762	134590	476	1355	C	M459-M495	14	pipeline
M495	1741769	134659	591	1120	C	M459-M495	14	pipeline
M496	1742041	133647	76	75	D	M496, C092	14	debris
M497	1742314	134356	395	110	D	M497, M498	14	unknown
M498	1742335	134420	53	70	D	M497, M498	14	unknown
M499	1742378	131967	45	70	D		15	SPS
M500	1742378	131967	45	125	D		15	SPS
M501	1742426	134227	130	85	D	M501, C093	14	crab pot
M502	1742444	134535	134	75	D		14	SPS
M503	1742486	131830	25	80	M		15	SPS
M504	1742491	134353	214	55	M		14	SPS
M505	1742509	132472	30	85	D		15	SPS
M506	1742649	132738	33	80	D		15	SPS
M507	1742796	133745	13	55	M		14	SPS
M508	1742828	134049	24	95	D		14	SPS
M509	1743042	133803	57	50	D		14	SPS
Eastern Primary Area								
M510	1742687	131694	139	60	D		15	SPS
M511	1743003	133280	583	65	M		14	SPS
M512	1743138	132319	49	65	M		15	SPS
M513	1743191	131201	41	75	M		15	SPS
M514	1743261	130884	44	200	D		15	SPS
M515	1743362	131590	46	80	M		15	SPS
M516	1743453	132052	160	120	M		15	SPS

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M517	1743500	130734	39	70	D		15	SPS
M518	1743505	130728	39	75	D		15	SPS
M519	1743594	132439	27	60	M		15	SPS
M520	1743654	132283	57	60	M		15	SPS
M521	1743709	131749	37	75	M		15	SPS
M522	1743711	130121	19	155	D		15	SPS
M523	1743849	131782	31	90	D		51	SPS
M524	1743940	131140	84	115	M		15	SPS
M525	1743952	130301	45	100	M		15	SPS
M526	1744006	130010	24	135	D		15	SPS
M527	1744205	130597	26	95	D		15	SPS
M528	1744302	131281	33	110	D		15	SPS
M529	1744304	131048	287	110	D		15	SPS
M530	1744424	130692	46	60	M		15	SPS
M531	1744453	130794	24	75	D		15	SPS
M532	1744586	131074	40	100	M		16	SPS
M533	1744588	129885	48	140	D	M533, M534	16	unknown
M534	1744616	129965	51	245	D	M533, M534	16	unknown
M535	1745017	131074	39	90	M	M535, C101	16	crab pot
M536	1745203	131073	129	60	D	M536, M537	16	unknown
M537	1745210	131076	147	135	M	M536, M537	16	unknown
M538	1745368	131614	321	60	M	M538, C108	16	linear debris
M539	1745415	130511	39	95	M		16	SPS
M540	1745462	130279	101	80	D		16	SPS
M541	1745549	131112	56	100	D		16	SPS
M542	1745645	130667	52	90	D		16	SPS
M543	1745714	131741	24	215	C		16	SPS
M544	1746095	131154	31	100	D		16	SPS
M545	1746167	131981	72	150	M		16	SPS
M546	1746294	131707	51	75	D		16	SPS
M547	1746322	130597	22	120	D		16	SPS
M548	1746705	132580	354	75	D		16	SPS
M549	1747023	131025	32	85	M	M549, M550	16	unknown
M550	1747071	130943	43	80	D	M549, M550	16	unknown
M551	1747103	130795	41	75	D		16	SPS
M552	1747155	131542	21	110	D		16	SPS
M553	1747218	132547	405	75	M	M553, C002	16	debris
M554	1747544	132615	78	155	M	M554, C008	16	debris
M555	1747657	130655	59	105	M		16	SPS
M556	1747872	132094	31	95	M	M556, M558, C005, C110	16	crab pot
M557	1747888	131561	24	125	D		16	SPS
M558	1747895	132160	36	205	C	M556, M558, C005, C110	16	crab pot
M559	1747918	130741	27	75	D		16	SPS
M560	1747983	132715	301	50	M	M560, M561, C006	16	crab pot
M561	1747983	132715	301	95	M	M560, M561, C006	16	crab pot
M562	1748065	132329	33	105	C		16	SPS
M563	1748441	132565	105	75	D		16	SPS
M564	1748497	131820	140	85	D		16	SPS

Target	Easting*	Northing*	nTs	Duration	Type	Association	Map	Notes
M565	1748504	131128	91	85	D	M565, M566	16	unknown
M566	1748582	131105	148	85	D	M565, M566	16	unknown
M567	1748595	130758	75	120	D		16	SPS
M568	1748598	132106	34	150	C		16	SPS
M569	1748918	132171	53	165	C		16	SPS
M570	1749037	131531	21	70	M		16	SPS
M571	1749080	132444	70	115	M		16	SPS
M572	1749202	132793	410	95	M	M572, C001, C112	16	crab pots
M573	1749208	131268	44	75	D		16	SPS
M574	1749267	132092	101	120	D		16	SPS
M575	1749326	131550	36	80	D		16	SPS
M576	1749401	131601	37	80	M		16	SPS
M577	1749436	131371	70	100	D		16	SPS
M578	1749454	132444	22	75	D		16	SPS
M579	1749454	132444	22	90	D		16	SPS
M580	1749556	132067	43	100	D		17	SPS
M581	1749602	131765	22	110	D	M581, C099	17	crab pot
M582	1749669	132034	39	85	D		17	SPS
M583	1749787	131033	51	180	C		17	SPS
M584	1749857	132647	199	110	D	M584, C109	17	crab pot
M585	1749967	132614	47	45	M	M585, C107	17	crab pot
M586	1750064	131052	19	80	M		17	SPS
M587	1750257	132873	141	125	C		17	SPS
M588	1750309	132327	25	70	D		17	SPS
M589	1750326	131945	70	385	C	M589, C100	17	crab pots
M590	1750335	133360	114	50	M	M590, M593, C004	17	crab pot
M591	1750381	132193	29	135	D		17	SPS
M592	1750391	132920	63	90	M		17	SPS
M593	1750450	133407	217	85	M	M590, M593, C004	17	crab pot
M594	1750617	132911	151	125	C	M594, M596	17	unknown
M595	1750636	132371	60	125	D	M595, C102	17	crab pot
M596	1750702	132869	195	170	C	M594, M596	17	unknown
M597	1750727	133513	54	45	M		17	SPS
M598	1750744	132724	75	120	D	M598, M599, C105	17	crab pots
M599	1750787	132653	73	105	D	M598, M599, C105	17	crab pots
M600	1751034	133594	33	70	M		17	SPS
M601	1751130	133017	97	495	C	M601, C106	17	two crab pots
M602	1751419	133710	107	85	M	M602, C003	17	linear debris
M603	1751447	132811	66	365	C	M603, M605, M606, C096, C097	17	crab pots
M604	1751452	133288	51	160	C	M607, M604	17	unknown
M605	1751456	132884	90	610	C	M603, M605, M606, C096, C097	17	crab pots
M606	1751463	132725	77	175	D	M603, M605, M606, C096, C097	17	crab pots
M607	1751492	133371	577	120	M	M607, M604	17	unknown
M608	1751510	133056	44	165	D		17	SPS
M609	1751726	132657	47	120	D		17	SPS

*Coordinates in NAD83 Alabama State Plane West U.S. Survey Feet.
Key: D = Dipole, M = Monopole, C = Complex

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APPENDIX B: SONAR CONTACTS DATA

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Target	Easting*	Northing*	Description	Length (ft.)	Width (ft.)	Height (ft.)	Map
C001	1749216	132753	crab pot	3.19	3.24	1.37	16
C002	1747226	132541	debris	2.47	1.02	0.39	16
C003	1751475	133629	linear debris	29.18	1.78	0.40	17
C004	1750429	133348	crab pot	3.34	3.37	1.66	17
C005	1747884	132087	crab pot	3.61	12.38	1.05	16
C006	1747983	132684	crab pot	2.75	3.03	2.11	16
C007	1747847	132642	linear debris	8.65	2.01	0.42	16
C008	1747584	132668	debris	5.77	2.54	0.02	16
C009	1711257	140392	crab pot	3.26	2.99	1.03	4
C010	1711719	140604	crab pot	3.54	3.93	0.44	4
C011	1711188	140702	debris	3.23	2.03	0.27	4
C012	1710696	140647	crab pot	4.60	3.23	2.19	4
C013	1710487	141747	debris	3.66	2.55	0.45	4
C014	1711510	140666	debris	22.11	8.88	0.35	4
C015	1712102	139942	crab pot	2.90	4.06	0.60	5
C016	1712530	139376	crab pot	3.26	2.99	1.46	5
C017	1712553	139293	sign/marker	1.88	2.04	1.22	5
C018	1705124	147123	crab pot	3.15	2.36	1.07	2
C019	1704520	147539	crab pot	3.22	3.22	0.49	2
C020	1712038	142690	crab pot	2.35	2.35	0.32	4
C021	1712122	142489	crab pot	2.31	2.90	0.46	4
C022	1712119	142281	probable tire	3.91	3.21	0.16	4
C023	1703620	147344	unknown object	4.93	7.13	0.73	2
C024	1703334	147514	crab pot	3.28	3.24	1.50	2
C025	1705736	147160	crab pot	3.11	2.79	0.43	2
C026	1708650	145427	crab pot	2.96	2.62	0.31	3
C027	1711468	143457	crab pot	3.67	5.03	0.66	4
C028	1707395	146064	crab pot	3.66	2.77	0.68	3
C029	1698882	148727	debris	1.44	1.88	1.84	1
C030	1707661	145723	debris	1.76	0.98	0.68	3
C031	1708865	145351	debris	2.96	2.77	0.03	3
C032	1698721	147434	debris	3.05	1.80	0.09	1
C033	1732203	126373	debris	4.58	3.04	0.35	10
C034	1732116	126782	debris	4.73	3.35	0.06	10
C035	1732114	125619	crab pot	5.48	2.44	0.36	10
C036	1731765	125034	crab pot	2.73	3.20	0.44	10
C037	1731971	121915	linear debris	22.91	2.38	0.53	11
C038	1731213	119379	crab pot	3.77	2.97	1.86	12
C039	1709858	143419	crab pot	3.48	3.00	0.28	4
C040	1711781	141992	debris	21.19	13.40	0.37	4
C041	1711765	142202	crab pot	3.63	2.74	0.51	4
C042	1702622	146748	linear debris	12.79	0.72	0.21	2
C043	1727123	126515	crab pot	3.10	2.22	1.47	6
C044	1727810	123178	crab pot	3.12	3.40	0.56	7
C045	1728312	126589	debris	11.18	8.50	0.05	6
C046	1728165	126542	crab pot	3.53	2.58	0.58	6
C047	1728366	126612	linear debris	9.19	1.23	0.10	6
C048	1728108	123377	unknown object	20.37	10.75	0.35	7
C049	1728223	126836	possible oyster bed	27.79	16.69	1.10	6
C050	1728177	123386	linear debris	9.59	1.60	0.04	7

Target	Easting*	Northing*	Description	Length (ft.)	Width (ft.)	Height (ft.)	Map
C051	1728366	126751	possible oyster bed	22.96	10.91	1.70	6
C052	1729184	124484	crab pot	3.20	3.23	0.43	6
C053	1728239	123085	crab pot	2.90	2.68	0.52	7
C054	1729087	124300	tire	2.47	2.35	0.05	7
C055	1729010	118342	crab pot	2.81	2.98	0.51	8
C056	1727959	123972	crab pot	2.91	2.95	0.44	7
C057	1727926	120198	crab pot	3.70	3.71	0.50	8
C058	1727787	123757	crab pot	4.34	3.66	0.74	7
C059	1728172	120167	debris scatter	30.52	21.37	0.04	8
C060	1727711	121133	debris scatter	59.70	27.53	1.37	7
C061	1727869	123580	crab pot	3.00	2.98	1.36	7
C062	1727311	122147	debris	8.00	3.79	1.41	7
C063	1727488	121927	crab pot	2.99	3.96	1.01	7
C064	1727301	122660	crab pot	3.07	3.15	1.45	7
C065	1727418	122518	debris scatter	89.18	45.37	0.02	7
C066	1730056	117624	crab pot	2.86	2.95	0.31	12
C067	1730121	118624	portion of living shoreline	0.00	0.00	0.00	12
C068	1730314	118719	portion of living shoreline	7.46	5.45	2.77	12
C069	1730402	118649	unknown object	33.14	8.93	0.00	12
C070	1730170	118461	linear debris	10.11	5.26	0.38	12
C071	1730020	118275	debris	6.43	6.74	0.01	12
C072	1731218	119373	crab pot	2.97	3.33	0.61	12
C073	1730796	118837	crab pot	3.79	5.61	1.03	12
C074	1730659	118645	crab pot	3.20	2.59	1.10	12
C075	1730699	119359	linear debris	14.79	1.80	0.03	12
C076	1730773	124071	portion of living shoreline	0.00	0.00	0.00	10
C077	1727200	124484	crab pot	3.75	2.97	1.11	6
C078	1727279	124756	crab pot	3.50	2.92	1.04	6
C079	1728830	117735	crab pot	3.03	3.36	1.35	8
C080	1730252	117190	rectangular object	14.07	3.41	2.12	12
C081	1735832	135053	debris	2.37	1.78	0.23	13
C082	1737227	134528	crab pot	3.38	2.75	0.71	13
C083	1736142	134943	debris	3.29	1.76	0.11	13
C084	1738228	134458	crab pot	5.00	2.62	1.62	13
C085	1740324	133741	linear debris	13.33	1.45	0.19	14
C086	1740730	133830	linear feature	55.68	4.24	0.39	14
C087	1737632	135323	debris scatter	25.60	11.11	0.08	13
C088	1737543	135472	dock	78.30	11.62	1.16	13
C089	1737071	135809	tire dump	42.60	22.54	0.10	13
C090	1738087	135427	debris scatter	30.16	12.32	1.30	13
C091	1738769	135173	pilings	87.60	17.72	1.05	13
C092	1742036	133646	crab pot	2.88	2.48	0.07	14
C093	1742436	134204	crab pot	2.56	3.11	1.36	14
C094	1739993	135621	linear debris	12.52	1.18	0.51	14
C095	1751504	133057	two crab pots	3.82	4.56	0.67	17
C096	1751476	132822	crab pots	3.22	4.23	0.32	17
C097	1751391	132842	crab pots	4.56	1.83	0.51	17

Target	Easting*	Northing*	Description	Length (ft.)	Width (ft.)	Height (ft.)	Map
C098	1742760	131931	crab pot	18.42	14.50	0.81	15
C099	1749588	131755	crab pot	3.77	3.64	0.65	17
C100	1750230	131898	two crab pots	2.76	3.53	1.71	17
C101	1745007	131064	crab pot	3.37	2.51	1.27	16
C102	1750609	132381	crab pot	3.79	3.17	1.30	17
C104	1743853	131782	crab pot	3.74	1.43	1.29	15
C105	1750785	132694	crab pots	2.68	3.65	0.97	17
C106	1751066	132995	two crab pots	2.57	3.31	1.11	17
C107	1749970	132620	crab pot	3.21	2.99	0.41	17
C108	1745359	131616	linear debris	19.78	4.09	0.30	16
C109	1749887	132629	crab pot	3.06	3.20	0.62	17
C110	1747894	132100	crab pot	3.56	3.73	0.72	16
C111	1750294	132894	crab pot	3.22	0.00	0.59	17
C112	1749213	132773	two crab pots	2.76	3.03	0.30	16

*Coordinates in NAD83 Alabama State Plane West U.S. Survey Feet.

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APPENDIX C: SONAR CONTACT IMAGES

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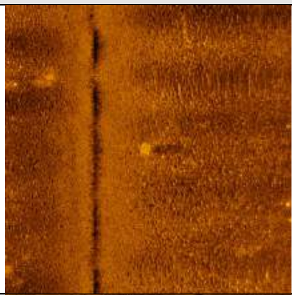
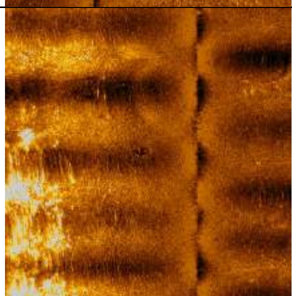
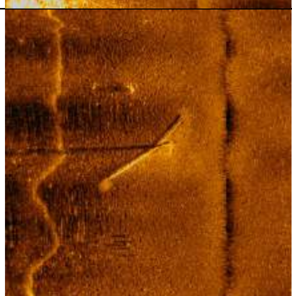
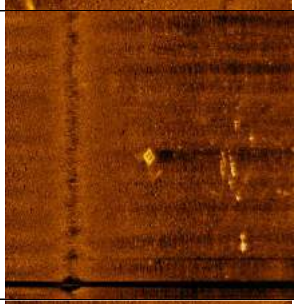
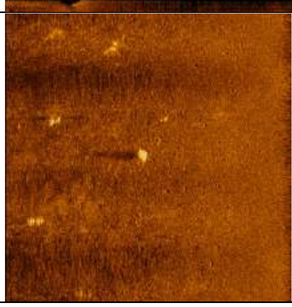
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C001	1749216	132752.6	crab pot	3.19	3.24	1.37
	C002	1747226	132540.5	debris	2.47	1.02	0.39
	C003	1751475	133629.4	linear debris	29.18	1.78	0.40
	C004	1750429	133348.1	crab pot	3.34	3.37	1.66
	C005	1747884	132086.7	crab pot	3.61	12.38	1.05

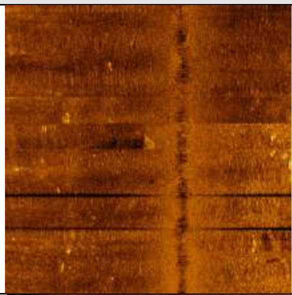
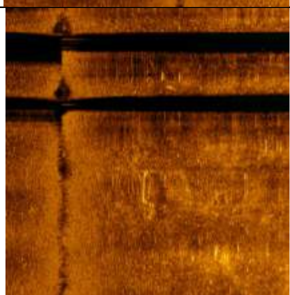
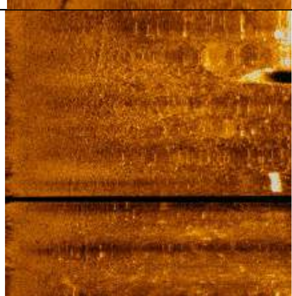
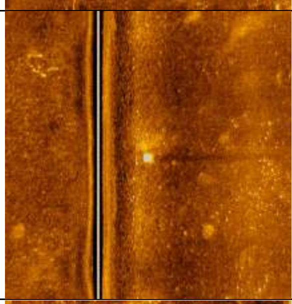
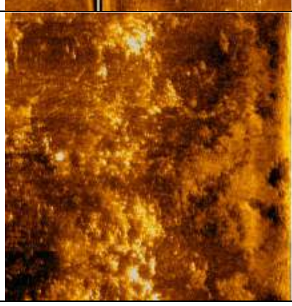
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C006	1747983	132683.8	crab pot	2.75	3.03	2.11
	C007	1747847	132642.1	linear debris	8.65	2.01	0.42
	C008	1747584	132668.2	debris	5.77	2.54	0.02
	C009	1711257	140392.2	crab pot	3.26	2.99	1.03
	C010	1711719	140603.7	crab pot	3.54	3.93	0.44

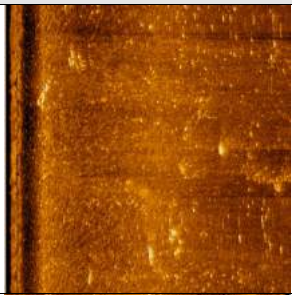
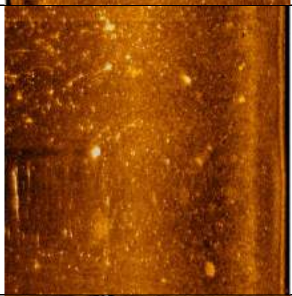
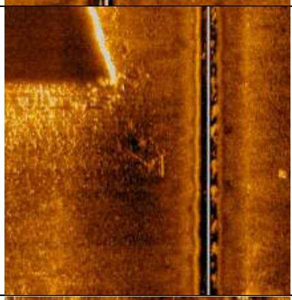
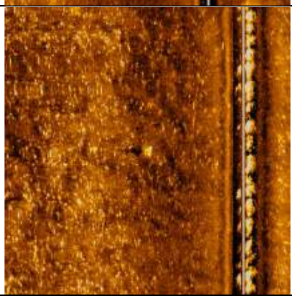
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C011	1711188	140702	debris	3.23	2.03	0.27
	C012	1710696	140646.9	crab pot	4.60	3.23	2.19
	C013	1710487	141746.9	debris	3.66	2.55	0.45
	C014	1711510	140666.2	debris	22.11	8.88	0.35
	C015	1712102	139941.7	crab pot	2.90	4.06	0.60

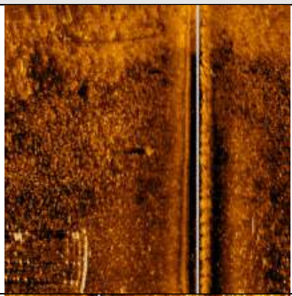
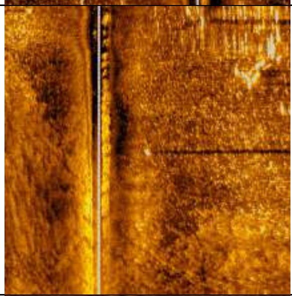
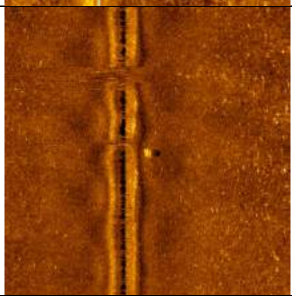
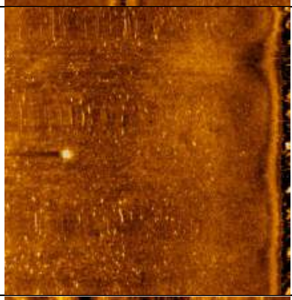
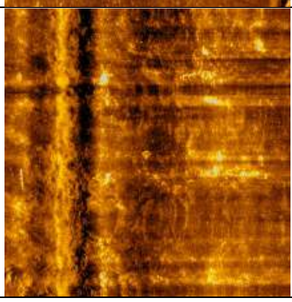
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C016	1712530	139375.6	crab pot	3.26	2.99	1.46
	C017	1712553	139293.1	sign/marker	1.88	2.04	1.22
	C018	1705124	147123	crab pot	3.15	2.36	1.07
	C019	1704520	147538.6	crab pot	3.22	3.22	0.49
	C020	1712038	142690.2	crab pot	2.35	2.35	0.32

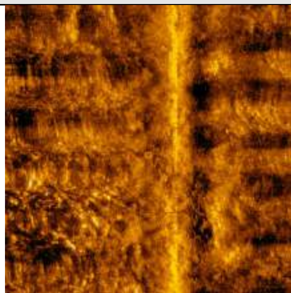
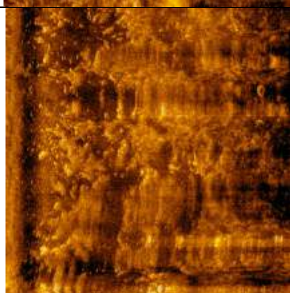
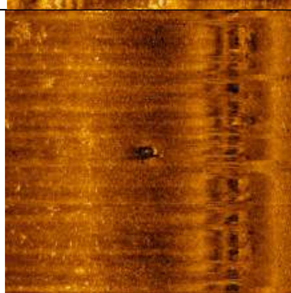
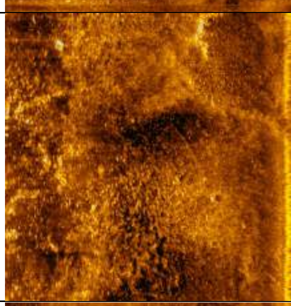
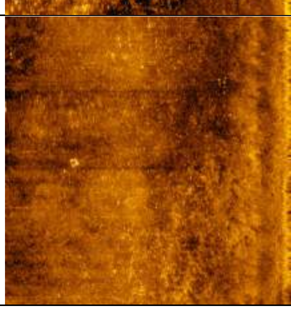
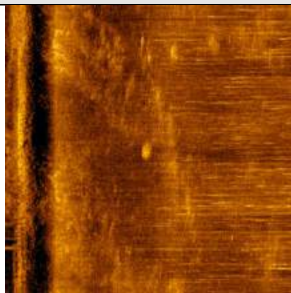
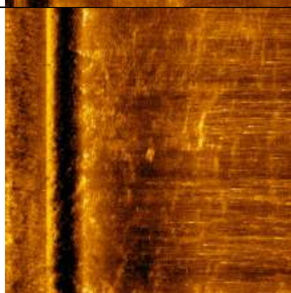
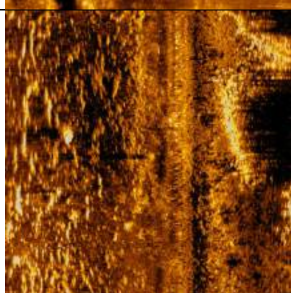
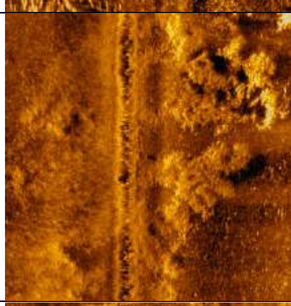
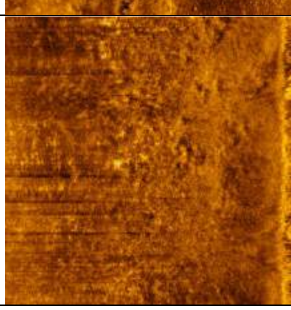
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C021	1712122	142489.1	crab pot	2.31	2.90	0.46
	C022	1712119	142280.5	probable tire	3.91	3.21	0.16
	C023	1703620	147344.4	unknown object	4.93	7.13	0.73
	C025	1705736	147160.4	crab pot	3.11	2.79	0.43
	C026	1708650	145426.9	crab pot	2.96	2.62	0.31

Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C027	1711468	143457.4	crab pot	3.67	5.03	0.66
	C028	1707395	146064.2	crab pot	3.66	2.77	0.68
	C029	1698882	148727.4	debris	1.44	1.88	1.84
	C030	1707661	145723.3	debris	1.76	0.98	0.68
	C031	1708865	145351.2	debris	2.96	2.77	0.03

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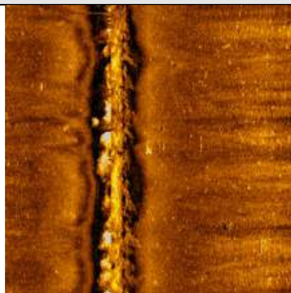
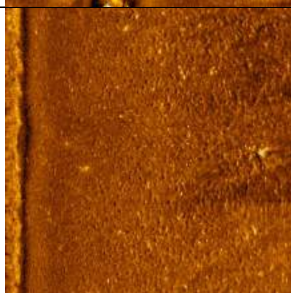
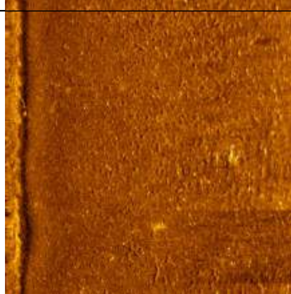
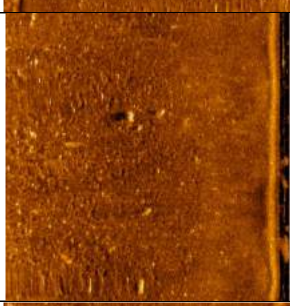
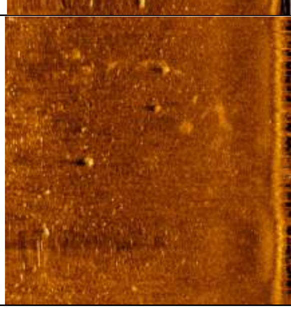
	C032	1698721	147434.4	debris	3.05	1.80	0.09
	C033	1732203	126372.9	debris	4.58	3.04	0.35
	C034	1732116	126782.1	debris	4.73	3.35	0.06
	C035	1732114	125619.1	crab pot	5.48	2.44	0.36
	C036	1731765	125034	crab pot	2.73	3.20	0.44

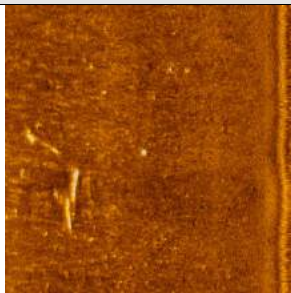
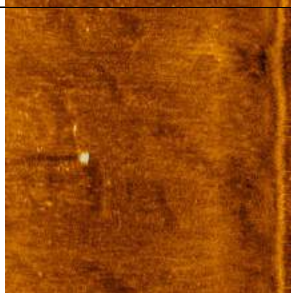
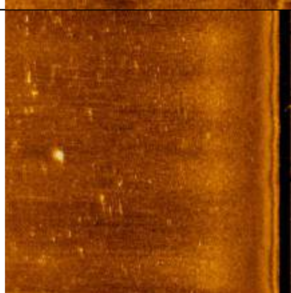
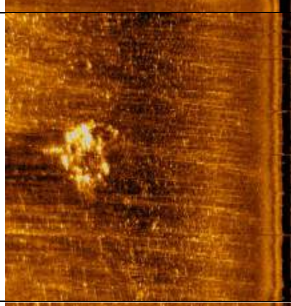
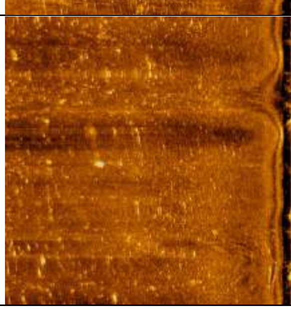
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C037	1731971	121914.9	linear debris	22.91	2.38	0.53
	C038	1731213	119379.3	crab pot	3.77	2.97	1.86
	C039	1709858	143418.9	crab pot	3.48	3.00	0.28
	C040	1711781	141991.7	debris	21.19	13.40	0.37
	C041	1711765	142201.8	crab pot	3.63	2.74	0.51

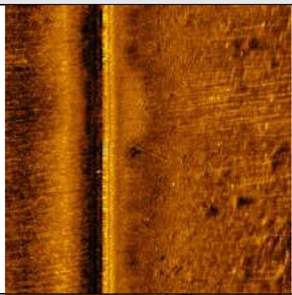
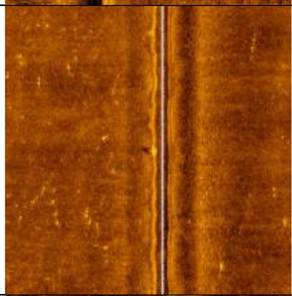
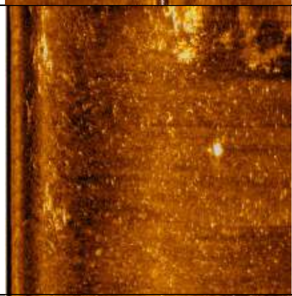
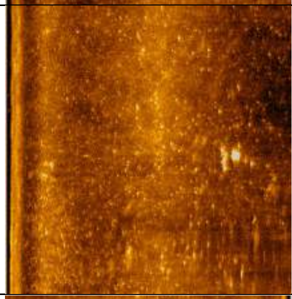
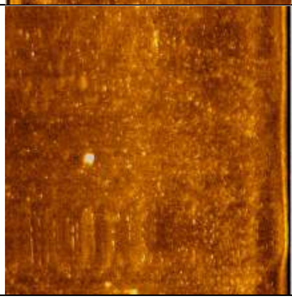
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C042	1702622	146747.6	linear debris	12.79	0.72	0.21
	C043	1727123	126515.1	crab pot	3.10	2.22	1.47
	C044	1727810	123177.6	crab pot	3.12	3.40	0.56
	C045	1728312	126589.1	debris	11.18	8.50	0.05
	C046	1728165	126542.1	crab pot	3.53	2.58	0.58

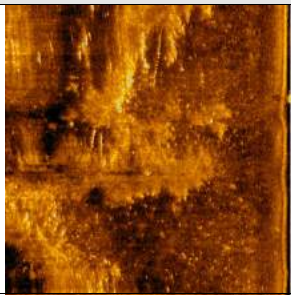
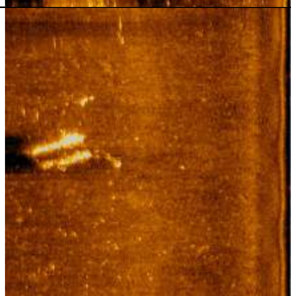
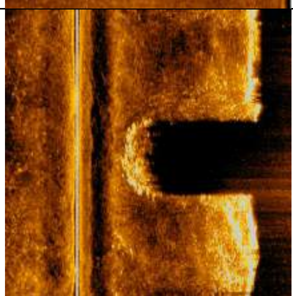
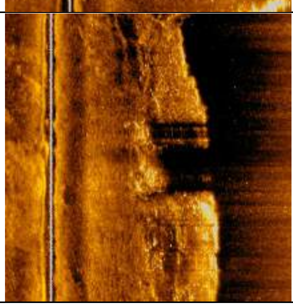
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C047	1728366	126612.3	linear debris	9.19	1.23	0.10
	C048	1728108	123377	unknown object	20.37	10.75	0.35
	C049	1728223	126836	possible oyster bed	27.79	16.69	1.10
	C050	1728177	123385.6	linear debris	9.59	1.60	0.04
	C051	1728366	126750.6	possible oyster bed	22.96	10.91	1.70

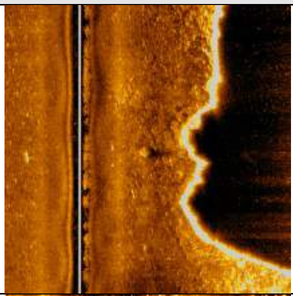
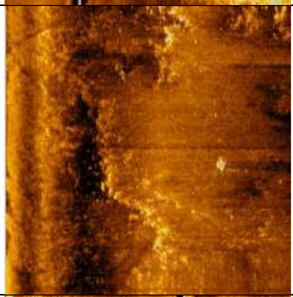
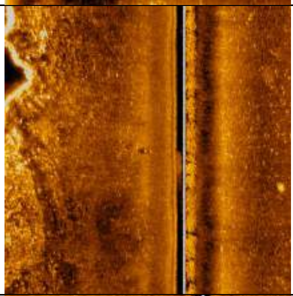
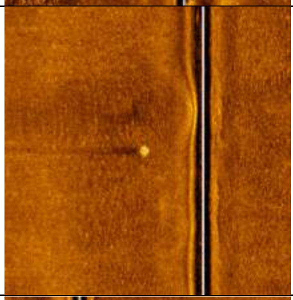
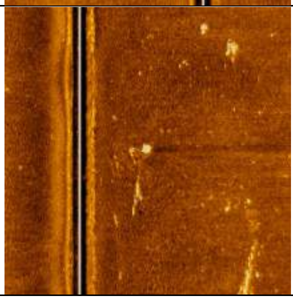
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C052	1729184	124484.5	crab pot	3.20	3.23	0.43
	C053	1728239	123084.7	crab pot	2.90	2.68	0.52
	C054	1729087	124299.8	tire	2.47	2.35	0.05
	C055	1729010	118342.5	crab pot	2.81	2.98	0.51
	C056	1727959	123971.8	crab pot	2.91	2.95	0.44

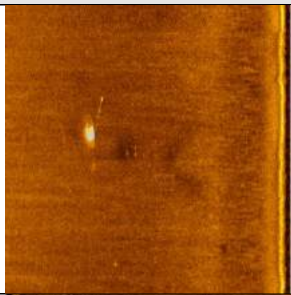
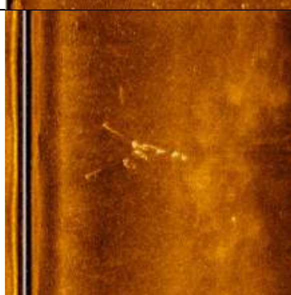
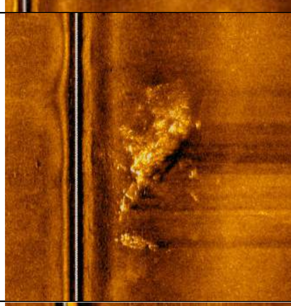
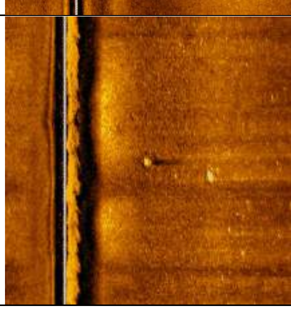
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C057	1727926	120198.2	crab pot	3.70	3.71	0.50
	C058	1727787	123757.3	crab pot	4.34	3.66	0.74
	C059	1728172	120166.7	debris scatter	30.52	21.37	0.04
	C060	1727711	121133.2	debris scatter	59.70	27.53	1.37
	C061	1727869	123580.4	crab pot	3.00	2.98	1.36

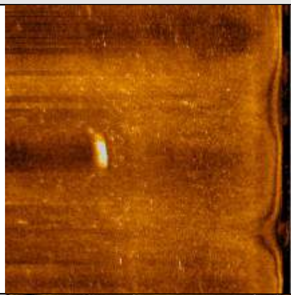
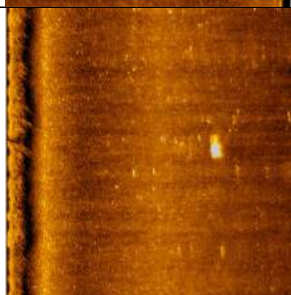
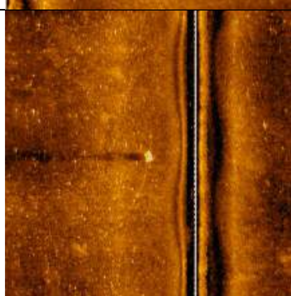
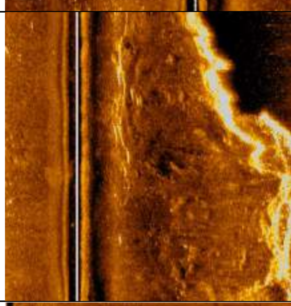
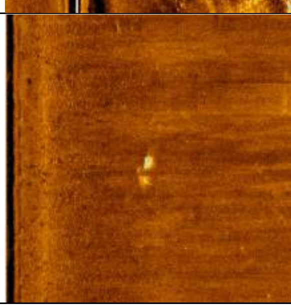
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C062	1727311	122147.2	debris	8.00	3.79	1.41
	C063	1727488	121926.7	crab pot	2.99	3.96	1.01
	C064	1727301	122659.5	crab pot	3.07	3.15	1.45
	C065	1727418	122518.2	debris scatter	89.18	45.37	0.02
	C066	1730056	117624.1	crab pot	2.86	2.95	0.31

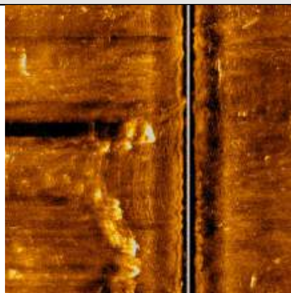
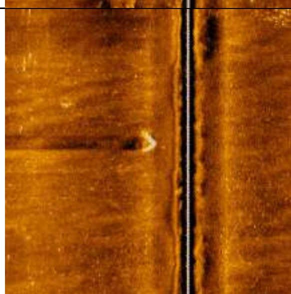
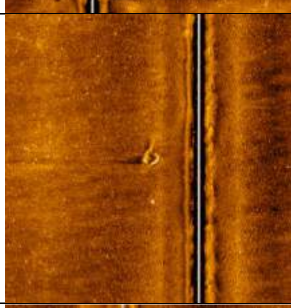
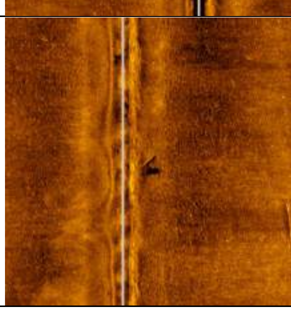
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C067	1730121	118624.3	portion of living shoreline	0.00	0.00	0.00
	C068	1730314	118719.2	portion of living shoreline	7.46	5.45	2.77
	C069	1730402	118648.5	unknown object	33.14	8.93	0.00
	C070	1730170	118460.9	linear debris	10.11	5.26	0.38
	C071	1730020	118275.4	debris	6.43	6.74	0.01

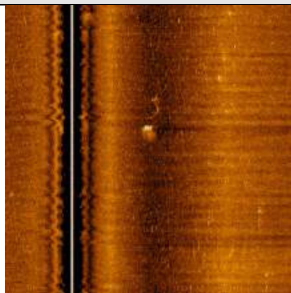
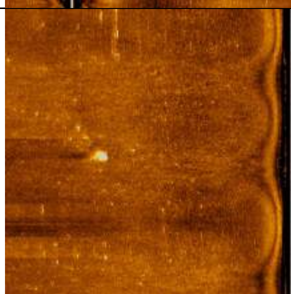
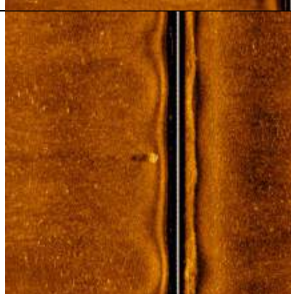
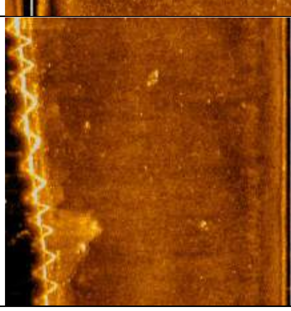
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C072	1731218	119373.3	crab pot	2.97	3.33	0.61
	C073	1730796	118837.1	Crab pot	3.79	5.61	1.03
	C074	1730659	118645.4	crab pot	3.20	2.59	1.10
	C075	1730699	119359	linear debris	14.79	1.80	0.03
	C076	1730773	124070.6	portion of living shoreline	0.00	0.00	0.00

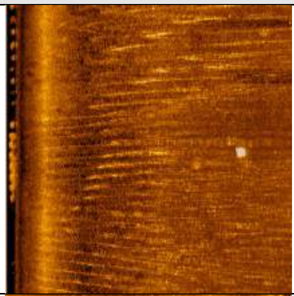
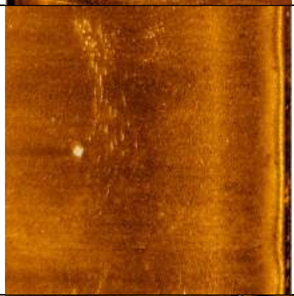
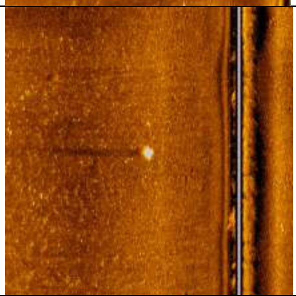
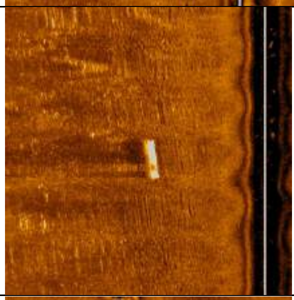
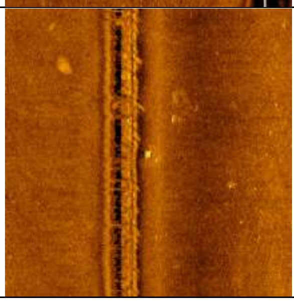
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C077	1727200	124483.7	crab pot	3.75	2.97	1.11
	C078	1727279	124755.7	crab pot	3.50	2.92	1.04
	C079	1728830	117734.7	crab pot	3.03	3.36	1.35
	C080	1730252	117190.1	rectangular object	14.07	3.41	2.12
	C081	1735832	135053.3	debris	2.37	1.78	0.23

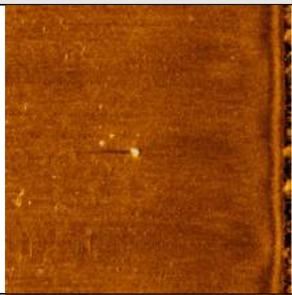
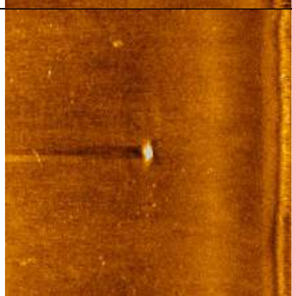
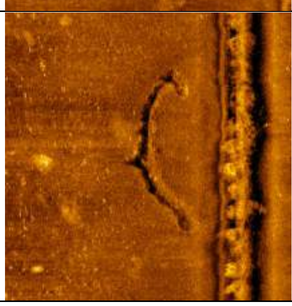
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C082	1737227	134527.6	crab pot	3.38	2.75	0.71
	C083	1736142	134943.4	debris	3.29	1.76	0.11
	C084	1738228	134457.8	crab pot	5.00	2.62	1.62
	C085	1740324	133741	linear debris	13.33	1.45	0.19
	C086	1740730	133830.5	linear feature	55.68	4.24	0.39

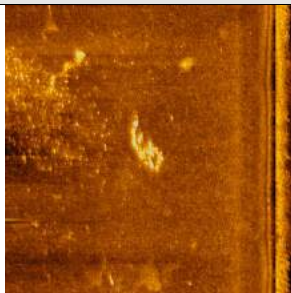
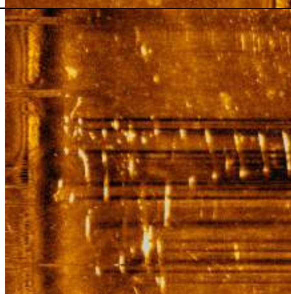
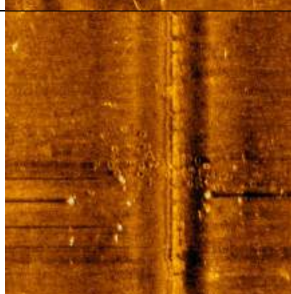
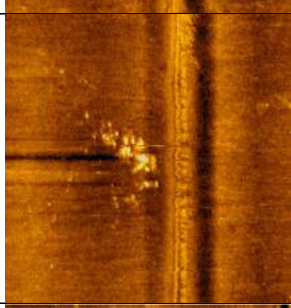
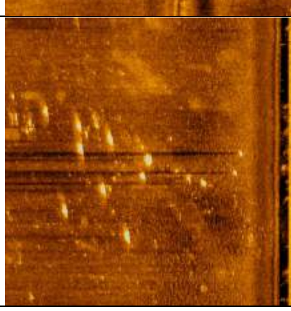
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C087	1737632	135323.3	debris scatter	25.60	11.11	0.08
	C088	1737543	135472.4	dock	78.30	11.62	1.16
	C089	1737071	135808.9	tire dump	42.60	22.54	0.10
	C090	1738087	135426.5	debris scatter	30.16	12.32	1.30
	C091	1738769	135172.9	pilings	87.60	17.72	1.05

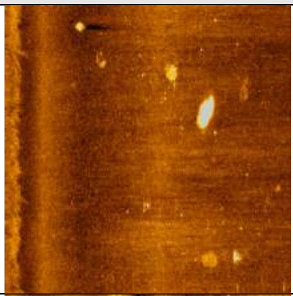
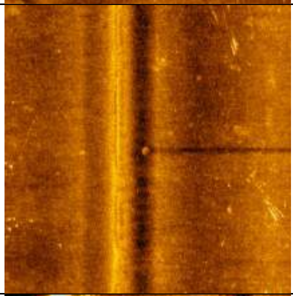
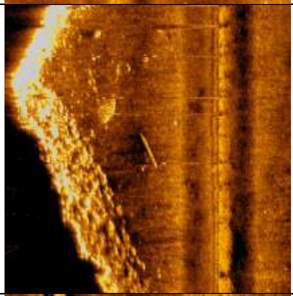
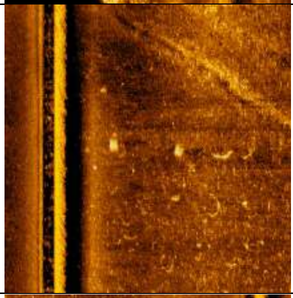
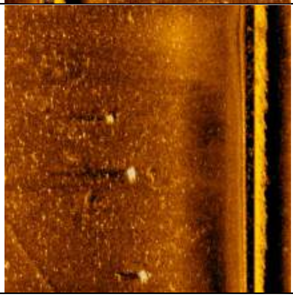
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C092	1742036	133646.2	crab pot	2.88	2.48	0.07
	C093	1742436	134204.1	crab pot	2.56	3.11	1.36
	C094	1739993	135621	linear debris	12.52	1.18	0.51
	C095	1751504	133056.9	two crab pots	3.82	4.56	0.67
	C096	1751476	132822.1	crab pots	3.22	4.23	0.32

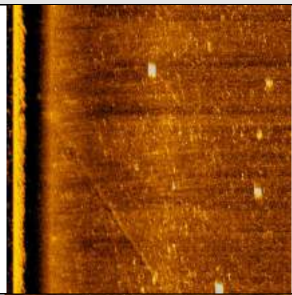
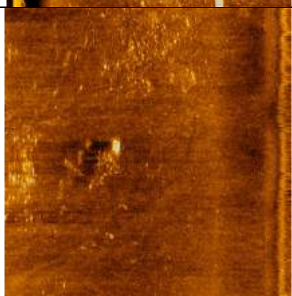
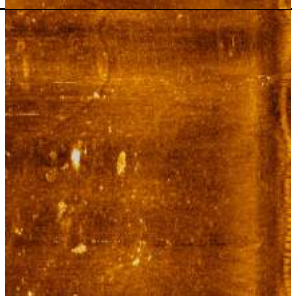
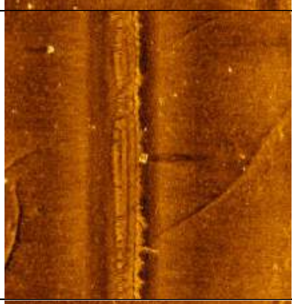
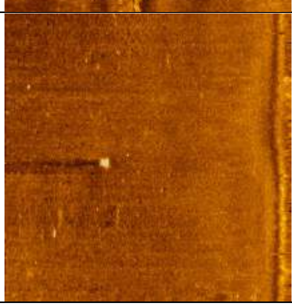
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C097	1751391	132841.8	crab pots	4.56	1.83	0.51
	C098	1742760	131930.9	crab pot	18.42	14.50	0.81
	C099	1749588	131754.5	crab pot	3.77	3.64	0.65
	C100	1750230	131898.2	two crab pots	2.76	3.53	1.71
	C101	1745007	131064.4	crab pot	3.37	2.51	1.27

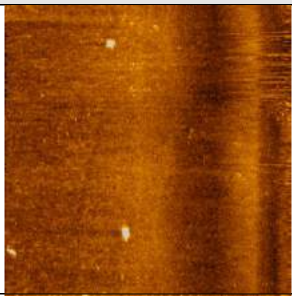
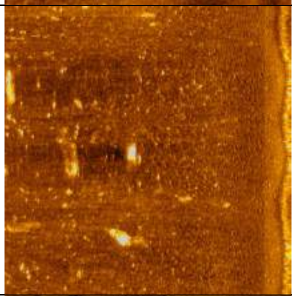
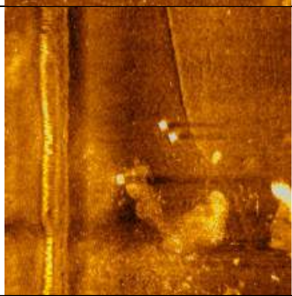
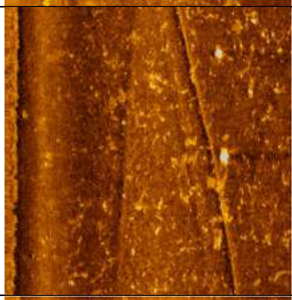
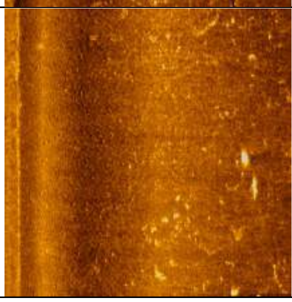
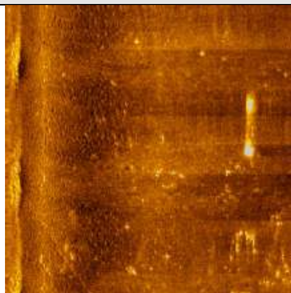
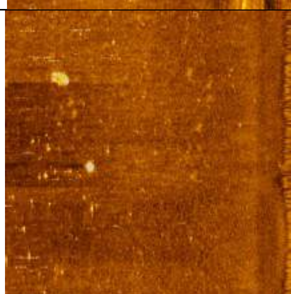
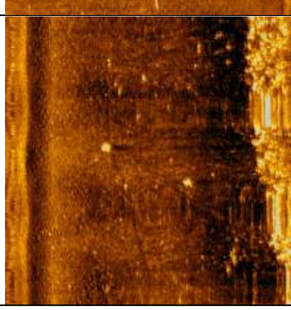
Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C102	1750609	132381.4	crab pot	3.79	3.17	1.30
	C104	1743853	131781.8	crab pot	3.74	1.43	1.29
	C105	1750785	132694.3	crab pots	2.68	3.65	0.97
	C106	1751066	132994.9	two crab pots	2.57	3.31	1.11
	C107	1749970	132620.4	crab pot	3.21	2.99	0.41

Image	Target	X	Y	Description	Length (ft.)	Width (ft.)	Height (ft.)
	C108	1745359	131615.8	linear debris	19.78	4.09	0.30
	C109	1749887	132629.4	crab pot	3.06	3.20	0.62
	C110	1747894	132100.4	crab pot	3.56	3.73	0.72
	C111	1750294	132894.2	crab pot	3.22	0.00	0.59
	C112	1749213	132773.5	two crab pots	2.76	3.03	0.30

*Coordinates in NAD83 Alabama State Plane West U.S. Survey Feet.