PORTSMOUTH HARBOR AND PISCATAQUA RIVER
NEW HAMPSHIRE AND MAINE
NAVIGATION IMPROVEMENT STUDY
FEASIBILITY REPORT

APPENDIX I
CULTURAL RESOURCE INVESTIGATIONS
AND COORDINATION

TECHNICAL REPORT

MARINE ARCHAEOLOGICAL SURVEY
PISCATAQUA RIVER

Eliot, Maine

CONTRACT NO. DACW33-03-D-0002 IDIQ
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PAL, under contract with the U.S. Army Corps of Engineers, New England District, conducted a remote sensing archaeological survey of the proposed navigation improvement project area in the Piscataqua River, Eliot, Maine. The archaeological work was conducted to identify and document remote sensing target areas with potential to be significant archaeological deposits (i.e., shipwecks) or intact paleosols with archaeological sensitivity for containing pre-contact sites within the project area. The survey consisted of archival research and field investigation using differential GPS, side scan sonar, a marine magnetometer, and sub-bottom profiler to acquire 100 percent coverage within the project area along a series of parallel surveyed track lines spaced 50 feet apart.

Systematic, multidisciplinary archival research, remote sensing archaeological field survey, and geotechnical data analysis of the Piscataqua River navigation improvement project area documented no targets with potential to be National Register-eligible post-contact archaeological deposits and no areas of buried paleosols with archaeological sensitivity for potentially containing pre-contact period archaeological deposits. Based on the results of this study, no additional archaeological investigations within the project area are recommended.

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MANAGEMENT ABSTRACT

PAL has completed a remote sensing archaeological survey of the proposed navigation improvement project area in the Piscataqua River, Eliot, Maine. The archaeological work was conducted to identify and document any remote sensing target areas with potential to be significant archaeological deposits (i.e., shipwrecks) or intact paleosols with archaeological sensitivity for containing pre-contact sites within the project area. The survey was authorized and conducted under contract with the U.S. Army Corps of Engineers, New England District to comply with Section 106 of the National Historic Preservation Act of 1966 (16 USC 470f), as amended (1976, 1980, 1992, 1999), and implementing regulations of the Advisory Council on Historic Preservation (36 CFR 800).

The remote sensing survey consisted of archival research and field investigation using differential GPS, high frequency side-scan sonar, a cesium-vapor marine magnetometer, and a seismic sub-bottom profiler to acquire 100 percent coverage within the proposed navigation improvement area along a series of parallel surveyed track lines spaced 50 feet apart.

Systematic, multidisciplinary archival research, remote sensing archaeological field survey, and geotechnical data analysis of the Piscataqua River navigation improvement project area documented no targets with potential to be National Register-eligible post-contact archaeological deposits and no areas of buried paleosols with archaeological sensitivity for potentially containing pre-contact period archaeological deposits.

Based on the results of this study, no additional archaeological investigations are recommended within the Piscataqua River navigation improvement project area.

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CHAPTER ONE

INTRODUCTION

This report presents the results of a remote sensing marine archaeological survey of the U.S. Army Corps of Engineers, New England District's (NAE) proposed navigation improvement project area in the Piscataqua River, Eliot, Maine (Figures 1-1 and 1-2). The NAE is preparing to expand a turning basin in the River to provide improved access to piers located east of Newington Station, Newington, New Hampshire. The archaeological work was conducted to identify and document any remote sensing target areas with potential to be contact or post-contact period archaeological deposits (i.e., shipwrecks) or intact paleosols with archaeological sensitivity for containing pre-contact archaeological deposits. The survey was conducted under contract with the NAE, in accordance with approved work and safety plans for the investigation.

Scope

As a federal undertaking, the NAE turning basin expansion project is subject to review under Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended (36 CFR 800). Section 106 requires that all federal agencies take into account the effect of their undertaking on cultural resources listed or eligible for listing in the National Register of Historic Places (National Register) (36 CFR 60). The agency must also afford the Advisory Council on Historic Preservation the opportunity to comment on the undertaking. The Section 106 process is coordinated at the state level by the State Historic Preservation Office (SHPO), which in Maine operates within the office of the Maine Historic Preservation Commission (MHPC).

The scope of the archaeological investigations (Appendix A) included archival research and fieldwork consisting of a marine geophysical survey utilizing a magnetometer, side-scan sonar, and a sub-bottom profiler. The fieldwork and report will assist NAE in complying with Section 106 of the NHPA of 1966, as amended (1976, 1980, 1992, 1999), for the proposed channel deepening project. The report will also be a scholarly document that fulfills the mandated legal requirements, and serves as a scientific reference and planning tool for future professional studies.

Authority

The survey was authorized by NAE to comply with the National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915) as amended (16 U.S.C. 470 et seq.); the National Environmental Policy Act of 1969 (P.L. 91-190; 83 Stat. 852; 42 U.S.C. 4321 et seq.); the Archaeological Resources Protection Act of 1979 (P.L. 96-95; 93 Stat. 721; 16 U.S.C. 470 et seq.); the Abandoned Shipwreck Act of 1987 (P.L. 100-298; 102 Stat. 432; 43 U.S.C. 2102); the National Maritime Heritage Act of 1994 (P.L. 103-451; 108 Stat. 4769; 16 U.S.C. 5401); the Advisory Council on Historic Preservation, Protection of Historic Properties (36 CFR 800); the National Register of Historic Places, Nominations by States and Federal Agencies (36 CFR Part 60); the

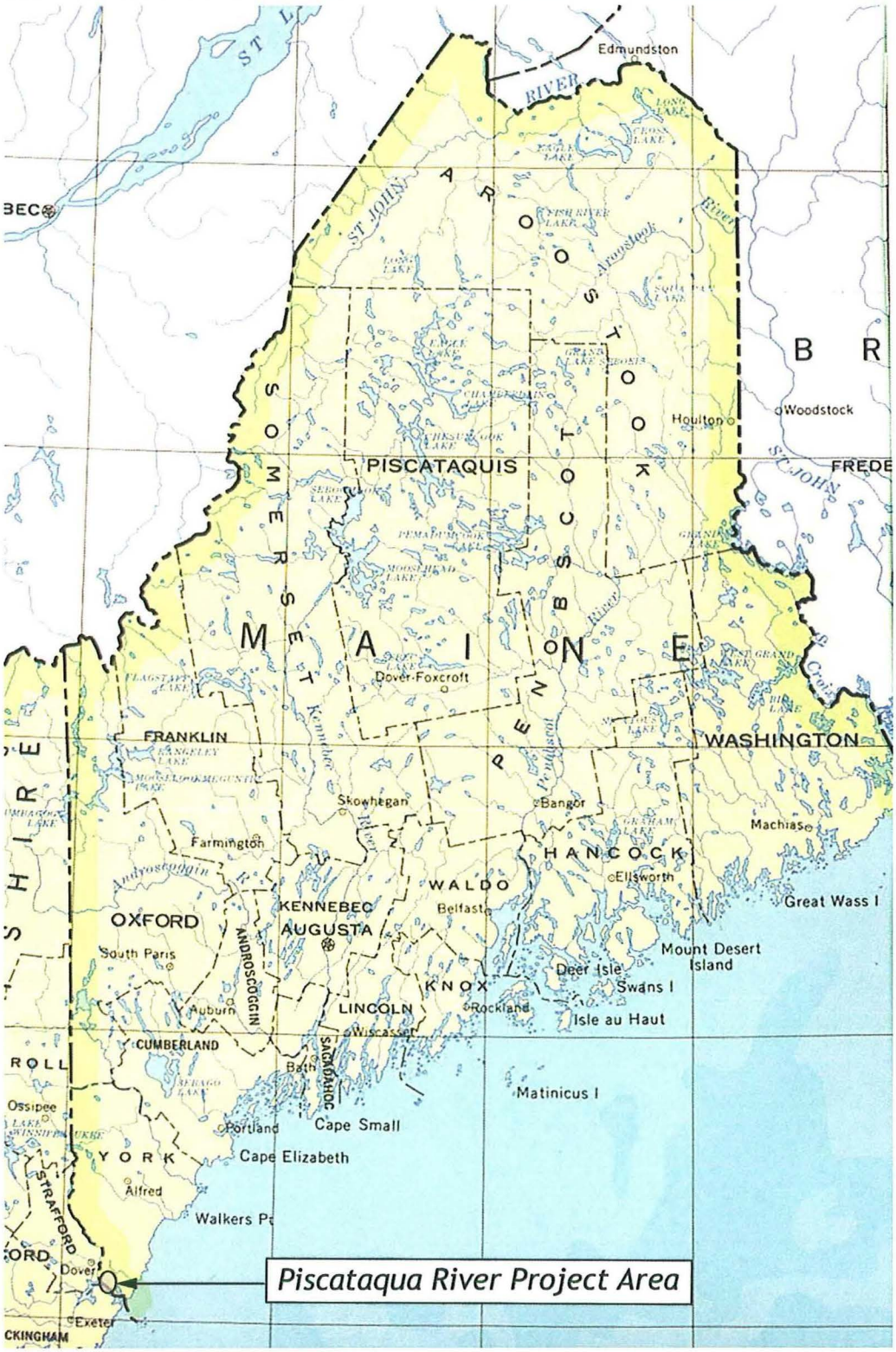


Figure 1-1. 1972 (rev. 1990) USGS Maine state map (1:2,500,000 scale) showing the general location of the Piscataqua River project study area in York County.

Marine Archaeological Survey, Piscataqua River, December 2008

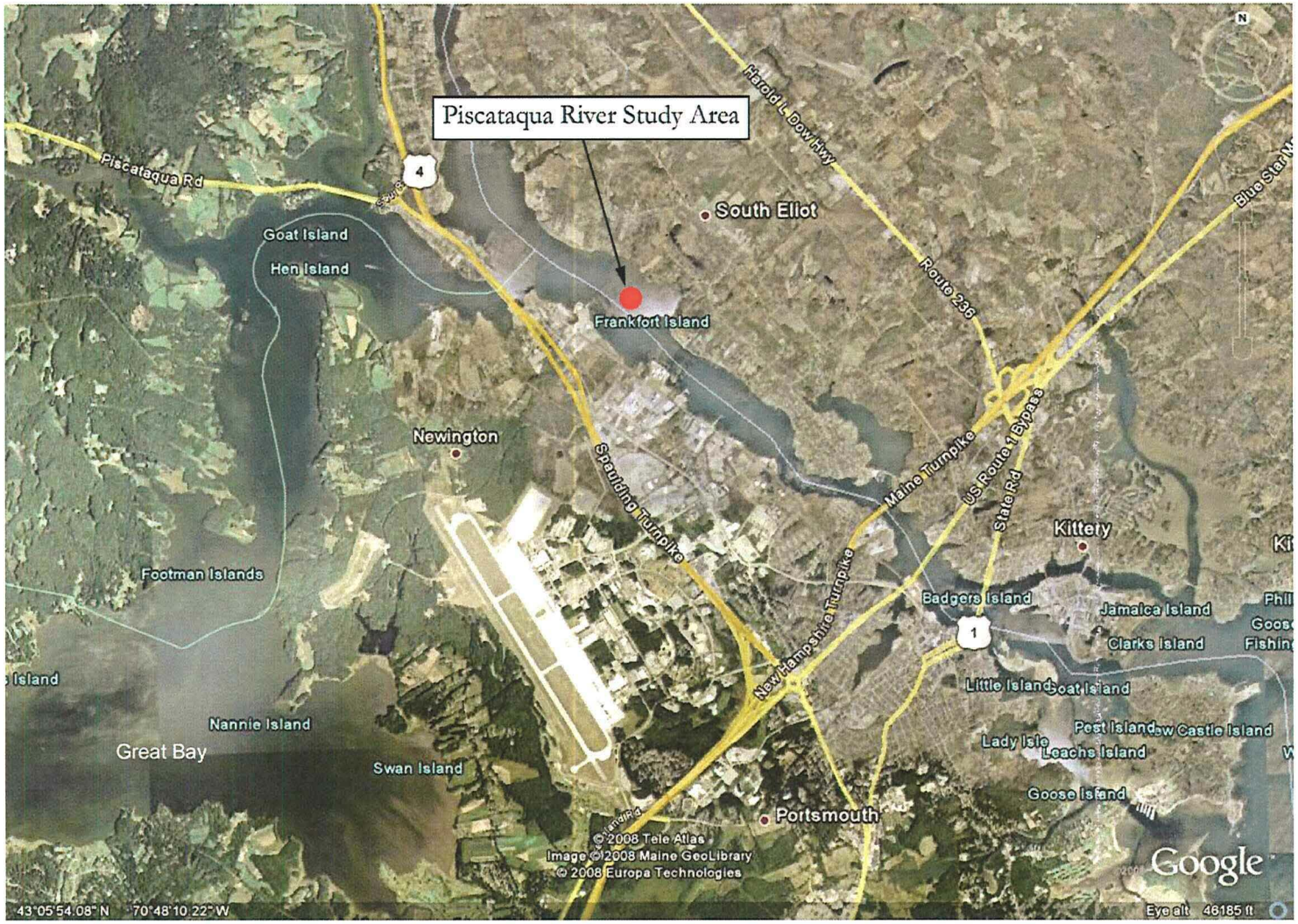


Figure 1-2. Map showing the location of the Piscataqua River project study area in relation to Eliot and Kittery, Maine, Newington and Portsmouth, New Hampshire, Frankfort Island, and Great Bay (source: Google Earth 2008).

U.S. Army Corps of Engineers' Regulations ER 1105-2-50, Planning, Environmental Resources, Chapter 3, Historic Preservation; the Secretary of the Interior's Standards and Guidelines for Identification (1983); the MHPC's Contract Archaeology Guidelines; and the Maine Department of Educational and Cultural Services State Historic Preservation Officer's Standards for Archaeological Work in Maine (27 MRSA S.509).

The remote sensing archaeological survey was approved by the NAE district archaeologist, and performed in consultation with the state archaeologist at the MHPC. No state permit was required to conduct the non-disturbance remote sensing survey.

All fieldwork was conducted in accordance with the Accident Prevention Plan (APP) and the Activity Hazards Analyses (AHAs) prepared by PAL, and their marine survey subcontractor, Ocean Surveys, Inc. (OSI), for the project. Both the APP and AHAs were approved in writing by the NAE Safety Office prior to commencement of field activities.

Project Description

One of the closest US ports to Europe, the deep water port of Portsmouth Harbor and the Piscataqua River are used by domestic and international commercial vessels throughout the year (http://www.des.state.nh.us/Coastal/documents/PiscataquaRiverUses.pdf). The River's 400 foot (ft)-wide (122 meter [m]) navigation channel and approximately 750 ft-wide (229 m) turning basin at the channel's northern end are federally maintained at a charted authorized depth of 28 ft (8.5 m) below Mean Low Low Water (MLLW). The present size of the turning basin impedes the maneuverability of commercial vessels using the River Road Sprague Energy terminal in Newington Station. Therefore, the NAE is currently considering the feasibility of removing sediments from the river bed to expand the turning basin from approximately 750 to 1,250 ft (229 to 381 m) and dredging the area to a maximum depth of 45 ft (14 m) below MLLW, as outlined in the USACE's project scope-of-work dated November 6, 2006 (Figure 1-3).

Nature of Study

This marine archaeological study was conducted as part of a larger investigation designed to assess the proposed project's effects on submerged archaeological deposits as well as to evaluate geologic conditions in the depth of interest for the project. To record the data necessary for this archaeological assessment and evaluation, PAL and its sub-consultant, Ocean Surveys, Inc. (OSI), performed a vessel-based non-disturbance survey using a towed array of remote sensing instruments to document geological and potential cultural features on the seafloor, in accordance with the field methodology approved in advance by NAE. Archival research of primary and secondary sources and informal informant interviews were also performed as part of the archaeological task to obtain the necessary information for preparing environmental and historical context narratives of the survey area, and to preliminarily assess the potential National Register eligibility of identified resources.

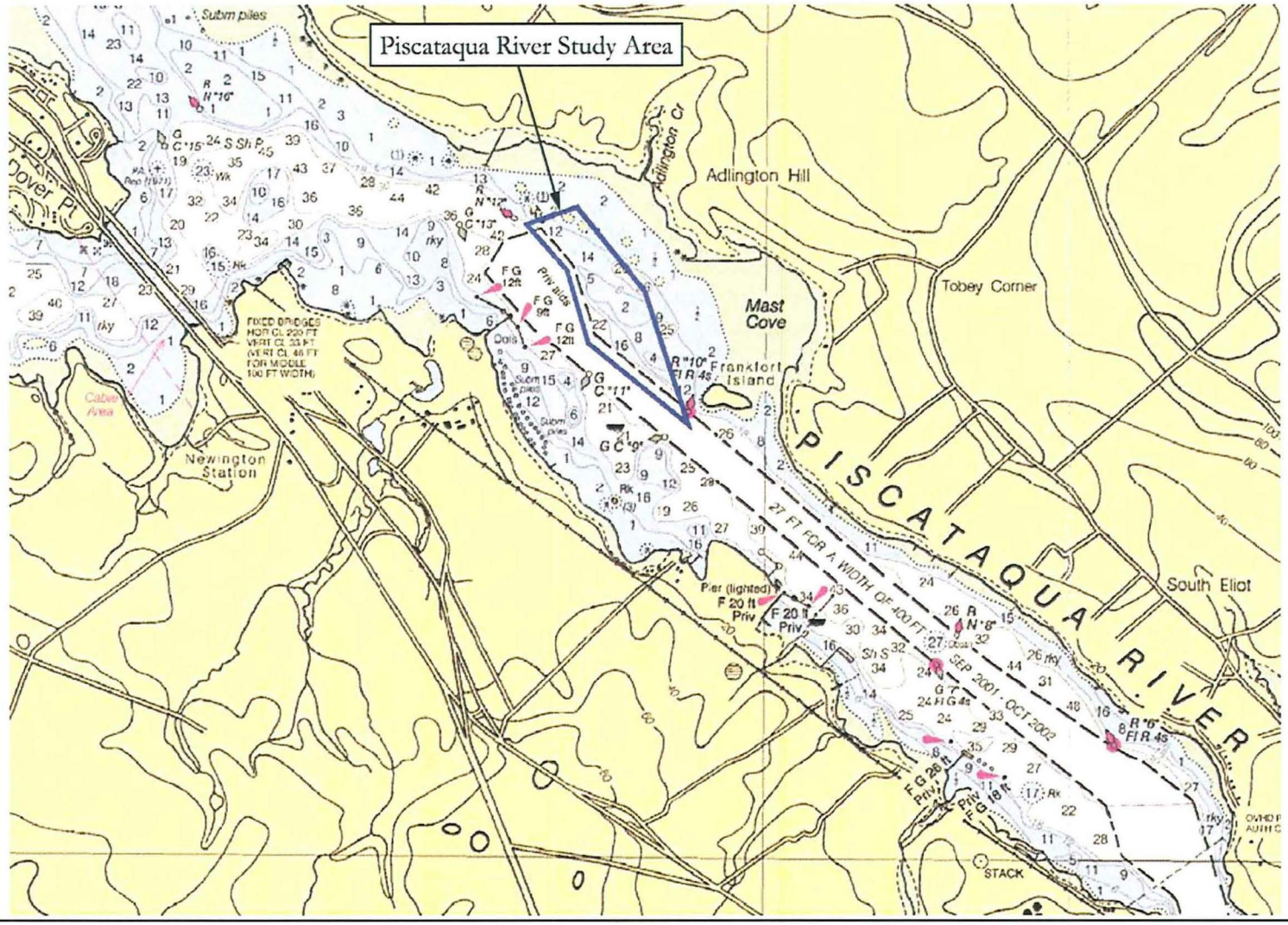


Figure 1-3. Excerpt of NOAA Chart No. 13285 showing the limits of the project study area within the Piscataqua River, Eliot, Maine (map courtesy of NAE).

Project Personnel

PAL staff involved in the project included David S. Robinson (project manager/principal investigator/site safety and health officer), and Suzanne Cherau (corporate safety and health officer). OSI project staff included Thaddeus A. Nowak (general manager), John D. Sullivan (geophysical surveys program manager), Jeffrey D. Gardner (senior geophysical scientist/project manager), and Greg Schulmeister (marine electronics technician/boat operator).

Disposition of Project Materials

All project information is currently on file at PAL, 210 Lonsdale Avenue, Pawtucket, Rhode Island. PAL serves as a temporary curation facility for these materials until such time as the U.S. government designates a permanent repository that meets the requirements under 36 CFR 79.

CHAPTER TWO

METHODOLOGY

The systematic, interdisciplinary research methodologies employed in this investigation followed those outlined in the NAE project scope-of-work (SOW) (see Appendix A) and did not deviate from the project work plan. The two principal goals of this investigation were:

1) assess the archaeological sensitivity of the Piscataqua River project area and;

2) determine the presence or absence of archaeological properties within it.

These goals were met through a combination of archival research and remote sensing archaeological field survey.

Archaeological sensitivity is defined as the likelihood for archaeological sites to be present within a particular area based on different categories of information. In the case of the Piscataqua River project area, such sites could potentially include submerged pre-contact period Native American settlement sites, fishing gear, and watercraft, as well as contact and post-contact period Native and Euro-American fishing gear and watercraft.

Assessment of the Piscataqua River project area's archaeological sensitivity involved conducting archival research to identify and consider previously documented offshore archaeological resources, the environmental and geomorphological history and sedimentary environment of the Piscataqua River within the context of regional/local pre-contact through post-contact period settlement, subsistence, and maritime activity patterns. For this aspect of the investigation, a review of the following sources was completed

- National and State Registers for any archaeological properties in the proposed Piscataqua River project area that have been listed on or are potentially eligible for nomination to be listed;

- National Oceanic and Atmospheric Administration's (NOAA) on-line Automated Wreck and Obstruction Information System (AWOIS);

- Northern Maritime Research's Northern Shipwreck Database (NSWDB) (Version 2002);

- Paul Sherman's Collection of Shipwreck Notes and Information on file at the Massachusetts Board of Underwater Archaeology;

- Environmental studies providing information about the geomorphological history of coastal Maine and the effects of the Holocene marine transgression;

- Published and unpublished primary and secondary sources held in the Maine State Library, and in the research library at PAL; and

- Informal informant interviews with: Maine State Archaeologist, Arthur Spiess; University of Maine Darling Marine Center Research Associate Professor, Warren Riess; and Massachusetts Board of Underwater Archaeological Resources Deputy Director, David Trubey.

In addition to the archival research that was performed, a marine archaeological reconnaissance field survey was completed December 20 and 21, 2006. The field investigation methodology followed the specifications outlined in the NAE's project SOW and consisted of non-disturbance marine remote sensing survey performed by PAL and its subcontractor (OSI) to aid in determining the presence/absence of potential archaeological properties within the Piscataqua River project area.

Survey operations were conducted from OSI's research vessel (R/V *Ready II*), a 26-ft (8 m) motorboat equipped with dual outboard engines, a fully enclosed cabin, and an array of survey and support equipment (Figure 2-1). A differential satellite global positioning system (DGPS) interfaced with an onboard computer was used to precisely navigate the vessel throughout the survey area and record positioning data. Differential satellite corrections transmitted to the survey vessel via a radio link at a frequency and rate of 288 kilohertz (kHz)/100 bits per second (bps) from the U.S. Coast Guard DGPS beacon at Portsmouth, New Hampshire provided reliable survey control of the vessel throughout the survey area. The computer navigation software utilized onboard the survey vessel converted the geodetic coordinates (latitude-longitude) to State Plane coordinates (easting-northing) for navigation while logging these position data at one-second intervals along survey track lines. The survey was conducted in the Maine State Plane Coordinate System - West Zone 1802, referencing the North American Datum of 1983 (NAD 83) with all coordinates in feet. The accuracy of the positioning system was verified by performance of navigation checks at the start and end of each survey day at a horizontal check point ("Great Bay Marina Slip 1A") established at the Great Bay Marina dock. The recorded position of this check point was N 103845 / E 2774061 (Maine State Plane Coordinate System - West Zone 1802, referencing the NAD 83). According to Trimble, this DGPS configuration typically provides repeatable position accuracies of less than 3 ft (1 m).

Prior to beginning field investigations, coordinates were obtained from the NAE for the boundaries of the Piscataqua River project area (Table 2-1).

Figure 2-1. Piscataqua River Project survey vessel R/V *Ready II*.

Table 2-1. Piscataqua River Survey Area Limits

Point	Easting (feet)*	Northing (feet)*
1	2781542.5	105206.7
2	2782299.3	104257.0
3	2782784.7	102743.9
4	2781666.7	103670.2
5	2781430.9	104492.0
6	2780980.4	105009.4

*Coordinates for survey area limits are in the Maine State Plane Coordinate System - West Zone 1802, referencing the NAD 83.

Survey equipment used to complete the field investigation included:

- Trimble 4000 and ProBeacon Differential GPS;
- HYPACK MAX Navigation Software;
- Klein 3000 Dual Frequency Side-Scan Sonar System (Figure 2-2);
- Geometrics G-882 Marine Cesium Magnetometer (see Figure 2-2);
- Applied Acoustics Engineering "Boomer" Seismic Reflection System (see Figure 2-2).

The side-scan sonar towfish and magnetometer sensor were deployed off the sides of the vessel and each towed off a davit and winch to allow modification of sensor height along tracklines. The side-scan sonar system was set at a 164 ft (50 meter) sweep range to obtain high resolution data with more than 200 percent overlapping coverage of the bottom. Side-scan sonar data were collected on parallel lines spaced 150 ft (46 m) apart. The altitude of the side-scan sonar towfish above the riverbed was maintained at 10 to 15 percent of the range where water depth and operational safety parameters allowed.

To ensure detection of even the smallest targets of potential archaeological interest, the magnetometer sensor was towed at a nominal altitude above the riverbed of not more than 20 ft (6 m) and measurements of the Earth's magnetic field were recorded along every one of the survey track lines, which were offset at a 50 ft (15.25 m) interval (Figure 2-3).

The "boomer" sound source (catamaran with boomer plate) and receiver (hydrophone array or "eel") were towed off the vessel's stern outside the boat propeller wash to minimize acoustic noise. Sub-bottom profile data were recorded along every third track line, at the same 150 ft (46 m) interval as the side-scan sonar. The "boomer" seismic system recorded data at a 100 millisecond scan rate to record a total depth profile (water and stratigraphic column) of

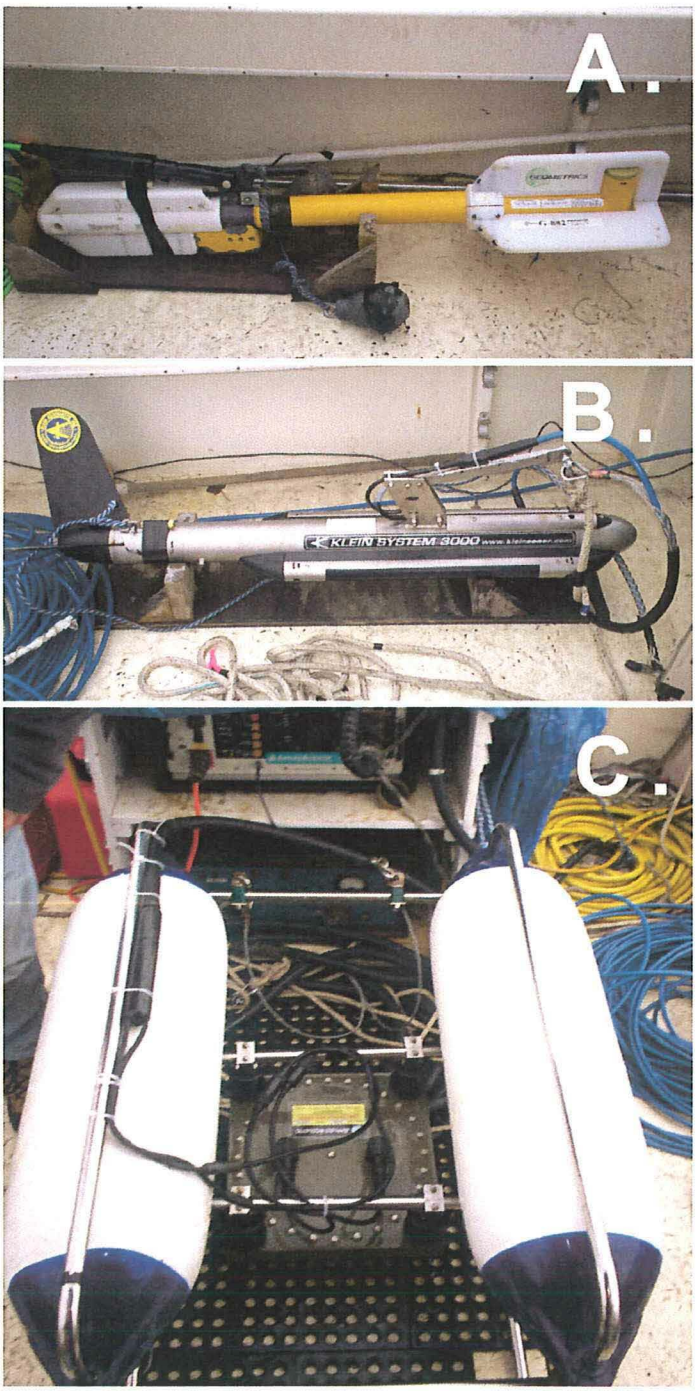


Figure 2-2. Piscataqua River Project survey instrumentation: A) Geometrics 882 cesium-vapor marine magnetometer sensor; B) Klein 3000 dual frequency digital side-scan sonar towfish; and C) Applied Acoustics Engineering seismic reflection system (power supply and catamaran with boomer plate – hydrophone array not shown).

Marine Archaeological Survey, Piscataqua River, December 2008

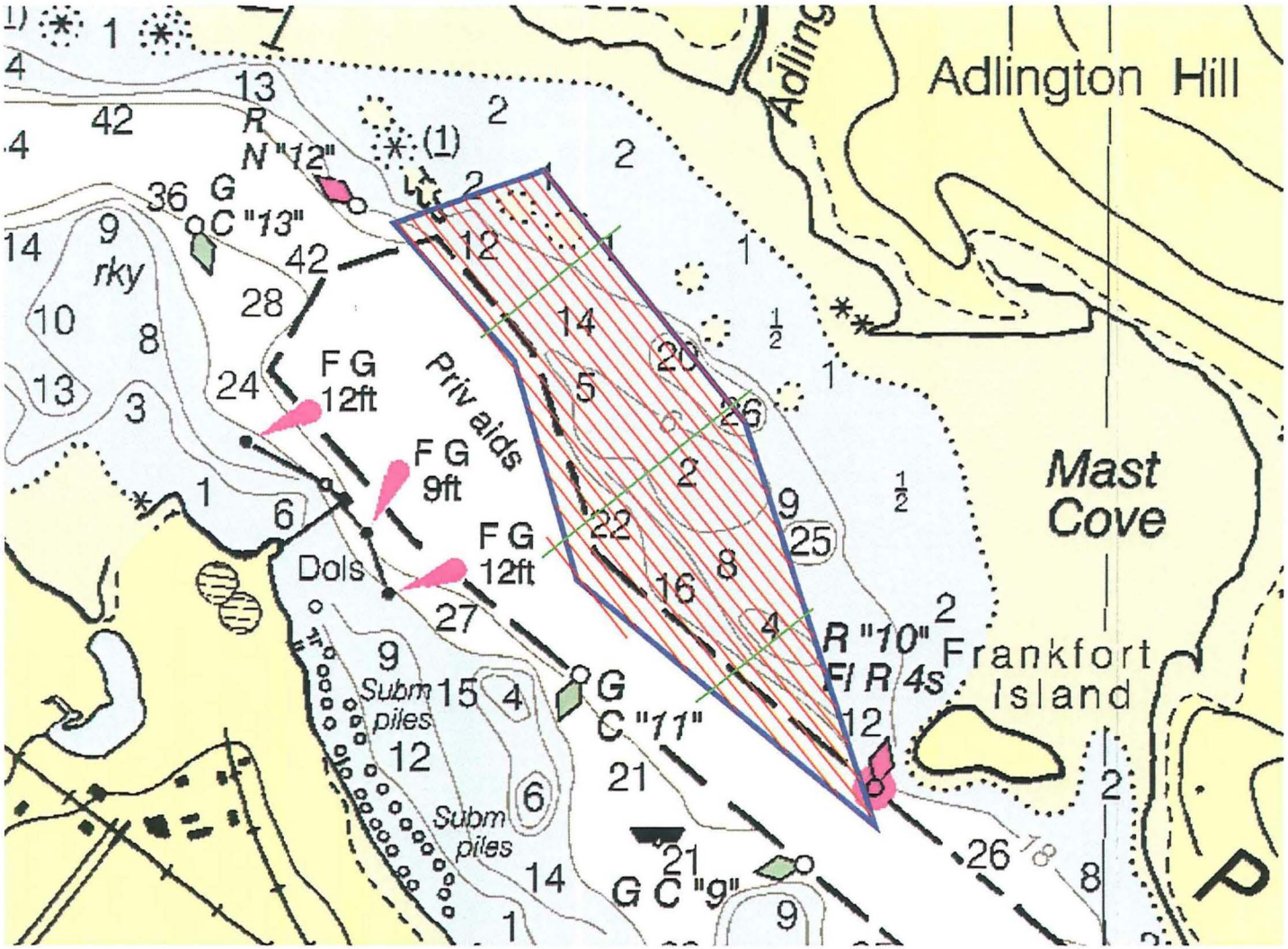


Figure 2-3. Piscataqua River Project planned survey track lines and tie-lines (magnetometer line interval - 50 ft [15.25 m]; side-scan sonar and sub-bottom profiler line interval – 150 ft [46 m]) (plot courtesy of OSI).

approximately 250 ft (76 m) (assuming 5,000 ft (1,524 m) per second sound velocity in sediments). The system collects raw seismic signals in the 0 to 10 kHz range, with filtered frequencies of 0.08 to 4 kHz used for final display and interpretation. Laybacks and offsets to sensors were recorded in the field for application during post-survey processing.

Lines were numbered and identified to allow ease of use. As an additional means of providing data quality control, three "tie lines" (i.e., track lines running perpendicular to the primary track lines) were also surveyed. Data generated by the survey were reviewed by the project archaeologist, both as they were recorded in the field and after post-processing. Post-processing of the data involved reconstructing survey track lines to include adjustments for sensor layback and offset, and plotting the x/y coordinates logged at each "fix" point along each track by the HYPACK MAX software package.

Criteria utilized for interpreting the various types of survey data (both during and after the survey) and selecting anomalies as targets of potential archaeological interest, either individually or collectively with other anomalies, relied on a combination of factors. These factors included the type of data being considered, environmental conditions, predicted types of resources likely to be encountered, survey-design parameters employed, and the scientific knowledge and practical experience of the project archaeologist.

Consideration and interpretation of acoustic data produced by the side-scan sonar and sub-bottom profiler is relatively straightforward. Acoustic targets appear as visual anomalies in the ambient visual field of the riverbed in either plan view (as in the case of a side-scan sonar record) or in profile (as in the cases of sub-bottom profiler and fathometer records). Side-scan sonar targets are selected as possible archaeological targets based on their appearances, that is, whether or not they appear to be a shipwreck or cannot otherwise be eliminated as a possible shipwreck. The sizes of targets, their relief above the riverbed, and the relative density of their constituent parts are all obtainable from the sonar record.

Sub-bottom profiler targets generally fall into two categories of archaeological interest: those that appear to be shallowly buried, discrete, anthropogenic deposits, and those that appear to be buried geological features. The former can be associated with shipwrecks, and if so, often have corresponding anomalies within the magnetometer data and side-scan sonar data (e.g., low to moderate intensity and moderate duration magnetic signatures and subtle, yet distinct, changes in bottom composition). The latter are sometimes associated with anomalies in the magnetic data and/or changes in riverbed that are visible in the acoustic data sets. Sub-bottom reflectors that are geological in nature and buried beneath the surface of the riverbed result from changes in sediment density caused by post-inundation marine sedimentation processes, inundation sequences, pre-submergence depositional events, or older geological processes. Some reflectors have characteristics that are readily identifiable as relict elements of the pre-submergence paleolandscape, such as paleochannel features, beach/shoreline features, upland terraces, etc. However, conclusive determination of the nature of a reflector requires physical evidence obtained through geotechnical surveying (i.e., vibratory cores or deep borings).

Interpretation of magnetic data is less straightforward. Anomalies of archaeological interest can range from several to thousands of gammas in intensity, and extend tens or hundreds of feet or meters in duration, depending on the characteristics of the source and its distance from the point of measurement (i.e., the magnetometer sensor). Even though a considerable body of magnetic signature data for shipwrecks is now available, it is impossible to positively associate any specific magnetic signature with a particular type or age of shipwreck or any other feature (Pearson and Saltus, Jr. 1991:49). Variations in iron content, condition, and distribution of a ship's wrecked remains, as well as the survey's design parameters (particularly track line interval and sensor tow depth) combine to influence the intensity and configuration of the anomaly.

Marine remote sensing archaeological surveys conducted at a tight survey track line interval (e.g., 50 ft [15.25 m] or less, as in the case of this survey) provide magnetic data that is comprehensive in its coverage and of adequate resolution to differentiate patterns in the data that are indicative of potential shipwrecks, geological deposits, or isolated modern debris. Since shipwreck sites commonly consist of a centrally concentrated area of large (possibly buried) debris associated with primary hull remains trailed or surrounded by a more diffuse distribution of relatively smaller debris (e.g., displaced secondary hull components, cargo, armament, etc.), such deposits are generally detectable as "complex" anomalies (i.e., a cluster of magnetic anomalies with signatures consisting of dipolar and/or monopolar anomalies) occurring on multiple adjacent survey track lines. Magnetic targets associated with shipwrecks are also often accompanied by correlating side-scan sonar and/or sub-bottom profiler anomalies, although there are circumstances when such correlating anomalies are absent or difficult to detect. By comparison, magnetic anomalies associated with geological deposits are often distributed in regular patterns extending over broad areas of the riverbed, while those associated with modern isolated debris can exhibit high intensity magnetic signatures, but typically are detected for only brief durations and/or on just a single track line.

By contrast, in instances when a survey is conducted at track line interval wider than 50 ft (15.25 m) and the magnetometer sensor is more likely to be farther away from a magnetized source, anomalies associated with shipwrecks are typically lower in intensity, less complex in signature, and may be detectable on just a single line or missed altogether between lines. The reasons for these differences, the magnetometer's limited range of detection, and its implications for archaeological surveys are discussed fully by Aneskiewicz (1986), Bell and Nowak (1993), and Breiner (1973).

In all cases, interpretation and the target selection process are significantly enhanced by the ability to cross-correlate data collected simultaneously from multiple instruments with different detection capabilities and data gathered from adjacent track lines. Rather than select potential cultural targets from a single data set or individual track lines, all of the data are examined simultaneously as they are recorded in the field and after post-processing for the presence of any correlations between data sets and across multiple track lines that provide clues regarding the possible identity of a particular target. Additionally, data associated with modern and/or spurious sources can be recorded as such in the field and eliminated from further consideration as a target of potential archaeological interest.

The remote sensing data recorded during this survey were used in conjunction with the results from the study's archival research component to determine the presence/absence of targets potentially representing archaeological deposits (e.g., shipwrecks) or archaeologically sensitive areas (i.e., contextually intact elements of the inundated paleolandscape or "paleosols") within the Piscataqua River study area. The data were also used to formulate preliminary statements of resource significance and project impacts that should be avoided regarding these deposits, and provide recommendations regarding further archaeological investigation of these deposits.

CHAPTER THREE

ENVIRONMENTAL CONTEXT

The project area is located in the Seaboard Lowland section of the New England Province, within Maine State waters of the Piscataqua River, between Eliot, Maine and Newington Station, New Hampshire, at the northern end of the federally maintained navigation channel west of Adlington Creek and Mast Cove (see Figure 1-3). The Piscataqua River is a 12 mile- (19.3 kilometer [km]) long, ocean-dominated system that extends from the Gulf of Maine at Portsmouth Harbor and forms a portion of the border of New Hampshire and Maine to the fork of its tributaries, the Salmon Falls and Cocheco rivers. The Piscatagua River provides a fairly narrow channel to the ocean for six different rivers as well as one of the largest estuaries on the Atlantic Coast formed by Great and Little Bays, which join the river less than 3 miles (4.8 km) upstream from and northwest of the project area.

The tidal Piscataqua is the third fastest moving navigable river in the world with tidal currents in the vicinity of the project area averaging 4 knots (kts) (2 m per second [mps]). Together with its tributaries (the Winnicut, Swamscott, Lamprey, Oyster, Bellamy, Cocheco, and Salmon Falls rivers), the Piscataqua River drainage and region occupy an approximately 120 square (sq) mile (311 sq km) area. Charted MLLW depths in the study area range from 0 ft (0 m) in places along its northeast corner to a minimum maintained depth of approximately 28 ft (8.5 m) within the navigation channel situated along the survey area's western limit. The maximum tidal range within the Project area is approximately 9.4 ft (2.9 m). The area's varied topography, fresh and salt water resources, and abundant floral and faunal species together comprise a wide range of onshore ecozones, some of which actually would have extended into the project area when it was sub-aerially exposed at around 9500 B.P., prior to inundation by postglacial sea level rise (Belknap et al. 1989:31–32; Crock et al. 1993:182).

Bedrock in the project area is composed primarily of Eliot Formation ("Sze" on the Maine Bedrock Geology map) of the Merrimack Group, which covers much of southeastern New Hampshire and the southern end of Maine (Anderson 1985; Billings 1980). Rock comprising the Eliot Formation is characterized as a system of belts and sub-belts, consisting of variably metamorphosed, argillaceous, sedimentary rocks with thin-bedded alternations between medium-gray buff-weathering calcareous and ankeritic quartz-mica phyllite and dark gray phyllite that are Silurian-Pre-Cambrian in age. Quartzose and calcareous slates are among the least metamorphosed elements of the Eliot Formation, while the more metamorphosed rock in the formation includes biotite, biotite schist, quartz-mica schist, biotite-actinolite schist, and green-gray actinolite granulite (Billings 1980). Approximately 15 percent of the Eliot Formation consists of quartzites (Freedman 1950).

The uppermost section of the Eliot Formation consists of the Calef Member, which is primarily recognized as a black phyllite with some green quartz-chlorite phyllite. Maximum thickness of the Calef Member is estimated at 800 ft (m), while maximum thickness of the entire Eliot Formation in the vicinity of the project area is believed to extend as much as 6,500 ft (m) deep

(Freedman 1950). Outcrops of the Eliot Formation consist of a mix of the rock types described above in alternating beds that are a few inches (cm) to a few ft (m) thick.

The composition of the surficial sediments on the bottom of the Piscataqua River within the project area encompasses an extremely wide range of material types. These different materials include everything from fine-grained sediments (e.g., silt is present in the nearshore portion of the project area, outside the reach of the channel's stronger current flow) to coarse glacial till (including gravel, cobbles, and, possibly, boulders). The extreme tidal velocity in the project area generates strong currents that inhibit deposition of finer materials and leaves only coarser deposits on the riverbed.

Colonization of the region by flora during and after deglaciation is characterized by continuous changes, particularly between 14,000 and 9,000 years ago. This time frame is considered to be a marker of a transition from an open tundra-like environment to a woodland environment, and eventually a closed forest environment across much of the New England region (Davis and Jacobson 1985). Pollen and macrofossil studies from regional lake cores suggest species responded individually to climatic changes over time as the ice front retreated northward. Woodland vegetation, dominated by poplar and spruce, is believed to have spread along the coastal lowlands up to New Brunswick by ca. 12,000 years ago, and pushed into interior portions of the region by 11,000 years ago. As archaeologist Bruce Bourque notes, "An observer in Maine 11,000 years ago would have seen a mosaic environment of tundra, shrubs, and trees arranged in patterns determined by latitude, elevation, local soil conditions, drainage, and exposure" (Bourque 2001:16).

The transition from woodlands to closed forests initially began in southern Maine around 12,000 years ago, and then developed rapidly over the region between 11,000 and 10,000 years ago. The closed forests were initially dominated by spruce, balsam fir, birch, and poplar, but pine emerged as the dominant species approximately 1,000 years after closure of the forests. The simultaneous emergence of pine and the demise of spruce signaled a warming trend that reached its peak sometime around 5,000 years ago. Studies from lake cores suggest this warming trend was characterized by a drier climate and lower water levels, particularly between 8,000 and 6,000 years ago (Almquist et al. 2001). Cooler, wetter conditions prevailed after about 4,500 years ago, resulting in an increase in birch, followed by a return of spruce after around 2,000 years ago (Almquist-Jacobson and Sanger 1995).

Past archaeological research in northern New England has provided some indication regarding the range of environmental variables that most often correlate with human settlement and land use patterns during both the pre-contact and post-contact periods. Contemporary modeling of pre-contact archaeological site locations has considered several environmental variables (e.g., proximity to water, topographic setting, soil type, and availability of natural resources), of which proximity to water ranks among the highest for predicting site location. To date, more than 95 percent of the recorded pre-contact sites in Maine have been identified along the margins of water bodies (Spiess 1992). Evidence for pre-contact human activity in the interior of Maine has commonly been found on level, moderately well-drained land surfaces near the shores of rivers,

lakes, streams, and sometimes overlooking marshes and wetlands. These bodies of water would likely have represented important resource areas and transportation routes for pre-contact peoples. Along the coast, hundreds of pre-contact sites have been identified in Maine. Typically, these sites are located on southern or protected exposures adjacent to both fresh water and resource-rich areas, such as mud flats. The location of the proposed Piscataqua River project fits the model for high potential pre-contact land use, because of its location in a resource-rich, protected estuarine setting near the confluence of multiple rivers, embayments, and the open ocean. The strong tidal river currents that regularly sweep across most of the project area are likely to have destroyed through erosion any vestiges of a contextually intact, formerly exposed, relict landscape.

Many of the same environmental factors that were attractive to pre-contact inhabitants were also attractive to Euro-American people visiting and settling in the area during the post-contact period. Early in the contact period, the area was favored as an excellent place to log, hunt, fish, trap, and trade with local Native populations. Rich fishing opportunities afforded by the convergence of fresh and salt waters near the mouth of the Piscataqua River encouraged Euro-American exploration and exploitation of that resource as early as the 1500s. Seemingly limitless forests of pine, spruce, oak, and tamarack, and the region's vast system of lakes, rivers, and streams that provided easily obtainable sources of power for the milling and transportation of lumber to deep water ports and shipyards along the coast, provided the necessary ingredients for the extensive shipping and shipbuilding industries that fueled Portsmouth and Eliot's early economies and supported their resident human populations.

CHAPTER FOUR

CULTURAL CONTEXT

An understanding of regional long-term human settlement and subsistence practices is critical to assessing and interpreting the archaeological sensitivity and record of any project study area. The following chapter provides a brief summary overview of the pre- through post-contact culture history of the Piscataqua River project area. This review is by no means exhaustive, but provides a general framework from which to predict and interpret archaeological deposits encountered during the marine archaeological survey of the project study area. The information for this context has been drawn from the review and synthesis of pre- through post-contact culture histories and previous archaeological investigations completed in the area.

Pre-Contact Period Culture History

The current inventory of known pre-contact sites documents a lengthy sequence of Native American settlement in coastal Maine and the nearby Maritime Provinces of Canada. The region is part of the larger Maritime Peninsula, a geographic formation and culture area stretching from the border between Maine and New Hampshire across southeastern Quebec and the Maritime Provinces to Cape Breton Island that has been home to human populations for more than 10,500 years, and whose unique, supposedly isolating, ecology of mountains and sea helped shape the cultures of pre-contact human groups who lived there (Bourque 2001:xvi, xvii). Maine's archaeological record suggests a regional cultural history that is both complex and dynamic, which is strongly linked to the resource-rich sea and the region's major rivers, including the Piscataqua (Bourque 2001). This is particularly true of the Native groups that lived on Maine's coasts beginning about 7,000 years ago (Bourque 2001:xvi). The importance of the sea to Maine's Native peoples continued even long after the initial contact period, as Native mariners were quick to adopt European nautical technologies and use sailing vessels for conducting trade and warfare far from their home territories (Bourque 2001:xvi; Duncan 1992:129–130; 144–147). Far from presenting an obstacle to significant cultural contacts with other regions, the sea, and Maine's coastlines in particular, actually appear to have facilitated inter-regional interaction among Native peoples (Bourque 2001:xvii).

There is a considerable degree of consensus among archaeologists regarding broad patterns of regional cultural history throughout the Northeast, although debates continue about how and to what extent these patterns are related to each other over space and time. As a result of this consensus, the archaeological record of Maine has been organized into three major cultural periods: the PaleoIndian Period (11,500–9500 B.P.); the Archaic Period (9500–3000 B.P.); and the Ceramic Period (3000–450 B.P.). These periods are further subdivided based on similarities in artifact forms and cultural adaptations over broad regions (Table 4-1) (Spiess 1990).

Table 4-1. Maine's Comprehensive Planning Pre-Contact Period Archaeological Study Units (after Spiess 1990).

Time Period	Study Unit
11,500 - 10,200 B.P.	Fluted Point Paleoindian Tradition
10,200 – 9,500 B.P.	Late Paleoindian Tradition
10,000 – 6,000 B.P.	Early and Middle Archaic Traditions
6,000 – 4,200 B.P.	Late Archaic: Laurentian Tradition
6,000 – 2,000 B.P.	Late Archaic: Small-Stemmed Point Tradition
4,500 – 3,700 B.P.	Late Archaic: Moorehead Phase
3,900 – 3,000 B.P.	Late Archaic: Susquehanna Tradition
3,000 – 450 B.P.	Ceramic Period

The PaleoIndian Period in Maine corresponds with a time when much of the landscape was vegetated in a mosaic environment of tundra, shrubs, and trees, the locations of which were patterned by latitude, elevation, local soil conditions, drainage, and exposure (Bourque 2001:16, 17). As the Piscataqua River project area became free from its ice and water overburden, tundra vegetation (mosses, lichen, grasses, and sedge) appeared, followed by thickets of willow and alder, then stands of hardier trees, such as poplar and spruce. By about 12,000 B.P., an intermediate woodland environment consisting of a mix of open areas of tundra and stands of closed-canopy poplar, spruce, and birch forest would have likely prevailed in the area (Bourque 2001:15).

Although much of Maine's late Pleistocene environment was generally similar to today's subarctic taiga (i.e., near tree line) or arctic tundra zones, it was probably biologically richer (Bourque 2001:17). In addition to its vegetation, Maine and the rest of the Northeast at this time supported a large and varied population of late Pleistocene mammal species that included mammoth, mastodon, horse, musk ox, moose, caribou, and whitetail deer, as well as walrus, bearded seal, and cold-water species of shellfish, suggestive of a marine environment that was similar to that of the southern Labrador coast today (Bourque 2001:16).

Understanding of subsistence and settlement patterns of PaleoIndians in Maine is growing and becoming more refined, although some of the even basic aspects, such as diet, geographic range, and dating of sites remain unclear (Bourque 2001:20). Part of the reason for this may be attributed to the poor preservation of organic remains in most terrestrial contexts in the Northeast, which has left a frustratingly small archaeological record, consisting of just stone, wood charcoal, and calcined bone cultural materials available for interpretation. As Petersen et al. (2000:131) conclude in their discussion of the Late PaleoIndian period, ". . . we sorely need more . . . sites in the Northeast to elucidate further details and refine our attendant

reconstructions." Another part of the reason may also lie in the paucity of marine archaeological research conducted to date focusing on the inundated paleolandscape and the pre-contact period submerged archaeological deposits it contains. Ironically, it is the least-studied landscape – the intact elements of the coastal environment of the PaleoIndian and Early to Middle Archaic periods - that now lies offshore of the present Maine coast, and which, because of the submerged environment's uniquely preservative qualities, may hold some of the best evidence of Maine's earliest inhabitants.

Based on the currently available archaeological data recovered solely from the terrestrial context, archaeologists have characterized PaleoIndians as highly mobile hunter-gatherers who were largely reliant on caribou that were presumably abundant at that time (Spiess et al. 1998). While caribou would have been a principal focus for Maine's PaleoIndian population, they also invariably would have exploited a broad range of other resources that would have been available to them at the time (e.g., small mammals, fish, birds, and plants) (Bourque 2001:36).

Generally speaking, PaleoIndian Period peoples crafted tools from very fine lithic materials obtained from a limited number of sources scattered widely throughout the region. An abundance of exotic lithic materials at early PaleoIndian sites suggests frequent long-distance movement and/or broad-ranging exchange networks. Most PaleoIndian site locations that have been documented to date are quite different from those of later time periods, and are typically removed from present-day water bodies (Spiess et al. 1998). However, some of the more studied PaleoIndian archaeological deposits (e.g., the Munsungan Lake, Michaud, and Varney Farm sites), as well as the Magalloway Valley PaleoIndian Complex (the Vail and Adkins sites), described by archaeologist Bruce Bourque as one of the "richest clusters of PaleoIndian sites known anywhere in the Northeast" (Bourque 2001:27), are all proximal to areas with (or that once held) lakes, rivers, streams, brooks, or bogs.

Previous research suggests PaleoIndian Period peoples preferred locating their settlements on sandy soils. Such locations may have been chosen simply because they were relatively dry and well-drained, as compared to the otherwise wet early postglacial terrain (Bourque 2001:35), or may have been based on reasons more directly associated with the logistics of resource procurement. Site locations seem to be strategically located at points above low-lying terrain that may have been suitable habitat for caribou and other game animals. Maine's PaleoIndian archaeological deposits are typically indicative of short-term habitations by small groups of people, perhaps in some cases by even a single extended family. While smaller sites prevail, a handful of larger PaleoIndian sites are known to exist in the region as well, such as the Magalloway Valley PaleoIndian Complex (Vail and Adkins sites) in northwestern Maine (Gramly 1982, 1988), the Debert Site in Nova Scotia (MacDonald 1968), and the Bull Brook Site in Massachusetts (Grimes 1979; Grimes et al. 1984). It is hypothesized that these sites possibly represent seasonal gathering places for larger groups, which were an integral part of the PaleoIndian cultural system's highly structured migration and colonization behaviors (Spiess et al. 1998).

The end of the PaleoIndian Period and subsequent transition into the Early Archaic is poorly understood, although increasing perceptions of subtle cultural changes during the transition have led some archaeologists to suggest a three-phase PaleoIndian occupation in Maine that may help explain some of these differences (Bourque 2001:34–36; Wilson and Spiess 1990). Archaeological evidence indicates that during the later PaleoIndian Period, fluted spear points were replaced by smaller, unfluted points. Other point styles also emerge in the region, most notable of which are long, slender lanceolate points with a distinctive parallel flaking technology (Cox and Petersen 1997; Doyle et al. 1985; Will and Moore 2002). These technological changes coincide with the transformation of the environment from relatively open woodlands to more closed forests. By the Early Archaic Period, the archaeological record contains a dramatically different material culture than that recovered from sites dating to the PaleoIndian Period (e.g., abundant use of quartz, barbed bone spears, and a new range of implements [i.e., adzes, gouges, and whetstones] created by pecking and grinding less-brittle granular rock types) (Bourque 2001:37–74).

No PaleoIndian Period sites have been reported within the Piscataqua River study area. However, the presence of an important PaleoIndian site (the Debert Site) off the Bay of Fundy coast in Nova Scotia (MacDonald 1968), suggests that PaleoIndians were present and familiar with the coastal Maritimes region. If such sites existed within the Project study area, rising sea levels have long since drowned them, or, the river's strong tidal currents have very likely eroded them.

Archaic Period (9500–3000 B.P.)

Spanning around 6,500 years, the Archaic Period represents the longest archaeologically defined cultural period in the region, and is divided into three sub-periods (Early [10,000–8000 B.P.), Middle [8000–6000 B.P.], and Late [6000–3500 BP]). Based on inferences from artifact assemblages, the Archaic Period consists of a complex mosaic of cultures with varied lifestyles and wide reaching external relations (Bourque 2001:74). In general, the period is characterized by archaeologists as one in which there are important elements that remain continuous, but also sharp discontinuities as well, with evidence of arrivals and departures of distinct groups, and important changes in subsistence, mortuary practices, technology, and other patterns that are still being identified in the archaeological record.

In addition to the cultural changes that occurred during the Archaic Period, there were also dramatic changes in Maine's flora and fauna during this time. Paleontological studies indicate a time of global warming accompanied by a drop in precipitation known as the "Hypsithermal" period, which occurred between about 9000 and 5500 B.P. (McWeeney 1999:8). During the Archaic Period, woodlands replaced tundra over large parts of Maine, and boreal tree species (spruce, poplar, and birch), which declined, were followed by oak and eastern hemlock. Animal species that had sustained PaleoIndian hunters diminished and then disappeared altogether, to be replaced by fauna from areas south and west of the region (e.g., moose, deer, bear, and other smaller mammals) that were deglaciated at earlier times (Bourque 2001:37).

Marine conditions in the Gulf of Maine also became increasingly favorable for biological productivity during the middle of the Archaic Period, as lower sea levels and shifts in the Gulf Stream and Labrador currents probably increased water temperatures, while decreasing tidal amplitudes, making them lower than today's (Bourque 2001:45). Paleontological evidence recovered from the eastern Gulf of Maine indicates that marine animal communities of the Middle Archaic were significantly different than today's, with warm-water species, such as oysters and quahogs, present in abundance (Bourque 2001:45).

The Gulf of Maine region may contain the largest number of radiocarbon-dated Early and Middle Archaic archaeological sites in New England, among the most diverse eighth millennium ground-stone technologies in North America, and a well-established mortuary tradition of elaboration dating from as early as 8000 to 7000 B.P. (Robinson and Petersen 1993:61). Subsistence and settlement patterns and the assemblages they produced were different from those of the PaleoIndian Period. Many sites dating from the Early Archaic occur along present-day water bodies and inland waterways, suggesting waterborne travel and fishing, with an apparent spring seasonal emphasis on spawning runs, important activities of Archaic Period peoples (Bourque 2001:42). Such sites include evidence of fishing for perch, sucker and eels, some hunting of large mammals, hunting or trapping of beaver, muskrat, woodchuck, various birds, and turtles, and the collection of a variety of plant resources, as evidenced by charred nutshells and seeds. The lithic tool assemblages include quartz cores and unifaces, ground-stone tools, such as abraders, choppers, stone rods, full channeled gouges, and low numbers of bifacially flaked lithic tools.

Unlike the prevalence of exotic lithic materials found in PaleoIndian assemblages, tools of the subsequent Archaic Period were typically produced from local stone, often collected in cobble form, and lack the finely crafted, chipped-stone spear points that characterize the PaleoIndian Period. Instead, scrapers, flake tools, and minimally modified unifacial tools made from quartz dominate the assemblages. Projectile points resembling forms common in the Carolinas, where they may have originated, appear during the Early Archaic, and include "bifurcate" points with notched bases as well as small amounts of the Kirk Corner Notched type (Bourque 2001:41). Additionally, a new stone tool technology (i.e., adzes, gouges, and stone rods used for whetstones) manufactured from less-brittle granular rock types through pecking and grinding techniques appears for the first time in Maine's archaeological record during the Early Archaic. This pecking and grinding technology becomes increasingly elaborate through the period (Bourque 2001:42; Robinson 1992). Given that these stone tools are intended for woodworking, it may be inferred that their appearance and increased presence in the archaeological record reflects an expansion of wood technology that would presumably have included dugout log boats, food vessels, and fish weirs (Bourque 2001:42). In addition to tools manufactured from stone, tools made from bone and antler, including barbed spears, have also been found in small numbers from Early Archaic sites in Maine (Bourque 2001:41).

Mortuary practices first appear in the archaeological record of the Maritime Peninsula region during the Early Archaic Period, with three mortuary sites dating from ca. 8500 B.P. found in northern New England: 1) the Tableland Site on the Merrimack River, Manchester, NH; 2) the

Morrill's Point Site at the mouth of the Merrimack River, Salisbury, MA, and 3) the Ormsby Site on the Androscoggin River, Brunswick, ME. All three sites contained cremation burials, although grave furnishings (i.e., red ocher and stone tools) were present just at the Tableland and Morrill's Point sites (Bourque 2001:43).

By the Middle Archaic Period, chipped-stone spear points, bifurcate projectile points, and heavy woodworking tools (occasionally supplemented by a southern type of grooved axe), all of which were present during the Early Archaic, become increasingly more abundant. Finely ground and polished winged spear-throwing weights, and stylistically local ground slate lance points and "ulus," which are a semi-lunar stone knife, also appear.

Middle Archaic sites occur in Maine's interior as well as along its coast, but even then are nearly always associated with bodies of water, suggesting a continued or growing dependence on fishing as an important subsistence strategy and a strong maritime focus. Most sites from the period are small and represent brief seasonal encampments of 25–50 individuals. Archaeological evidence of a coastal focus during the Middle Archaic is concentrated along the central Maine coast, where even islands were occupied — another clear indication for manufacture and use of reliable watercraft.

Mortuary practices of Middle Archaic peoples are poorly represented in the archaeological record of Maine and in New England in general, with only about five such sites identified (three of which are in Maine). The use of red ocher and inclusion of burial furniture (i.e., projectile points, spear-thrower weights, adzes, gouges, and stone rods) in Early Archaic burials continues in the Middle Archaic, as well. Taken together, these various technological and mortuary attributes of the central Gulf of Maine's Early and Middle Archaic cultures form a core of cultural traits that are distinct from cultural assemblages to the north and south. This distinctive nature has led archaeologists to label this Early and Middle Archaic pattern as the "Gulf of Maine Archaic Tradition" (Robinson and Petersen 1993:68).

The archaeological record of the Late Archaic Period in Maine is sparse for the sixth and fifth millennia B.P.; however, archaeological evidence of human occupation dating from about 5000 B.P. is much more abundant in the form of two distinct cultures from this period in Maine's pre-contact history: 1) the Vergennes phase, and; 2) the Small Stemmed Point tradition.
Vergennes phase culture sites are fairly common at interior locations between the Kennebec River and St. John drainages, and a few typical artifacts have been found as far northeast as Nova Scotia. The relative scarcity of Vergennes sites in New Hampshire, western Maine, and along Maine's coast, suggest that this culture's influence came primarily from the St. Lawrence Valley, and had an insignificant impact on the White Mountains region and coastal New England (Bourque 2001:46–49).

The robust Otter Creek spear point typifies the phase, and suggests reliance upon large terrestrial game, which is supported by the fact that Vergennes sites are confined to interior sections of the Northeast. Additional artifacts typically found on Vergennes sites include plummets, gouges, ulus, and flat rocks expediently chipped around their edges to create what archaeologists have

termed "choppers." The significance of the Vergennes phase and its influence in Maine archaeology is debated, with some archaeologists seeing it as an intrusive culture of small, mobile hunting population that originated in the St. Lawrence River valley, while others equate the culture's less formal tool styles and beautifully polished ulus as a technological continuation of those of Maine's coastal and near coastal Middle Archaic sites (Bourque 2001:46–49).

While Vergennes phase people mainly occupied Maine's interior upland areas and focused on terrestrial game, the Small Stemmed Point or narrow point tradition peoples mainly occupied the Gulf of Maine coast, where they practiced a mixed economy that included pursuit of large fish, such as cod and swordfish. The Small Stemmed tradition is characterized by archaeological deposits that have yielded thousands of small, narrow-stemmed projectile points, often found along with triangular points, both of which are generally made of quartz. Other associated stone artifacts include adzes, gouges, plummets, spear-thrower weights, and fully-grooved net weights. All of these artifact forms appear to have origins in the Middle Archaic. Small Stemmed sites found east of the Kennebec River pre-date by about 1,000 years the same types of sites located in southern New England. The earliest dated Small Stemmed sites in Maine occur in the central coastal region of the state. The oldest coastal archaeological site in Maine (the ± 5290 B.P. Occupation 1 deposit at the important Turner Farm Site) is located in Penobscot Bay, on North Haven Island, approximately 120 miles (190 km) northeast of the Piscataqua River Project area (Sanger and Kellogg 1989:119).

Available archaeological evidence indicates that between 5000 and 4500 B.P., the Small Stemmed tradition produced a striking new culture named for the pioneering Maine archaeologist, Warren K. Moorehead, who worked extensively on sites of this period. Termed the "Moorehead Phase," the most extensively studied site produced by this culture is the second component of the Turner Farm Site (Occupation 2), the contents of which were subjected to intensive analysis by Spiess and Lewis (2001) and provide a detailed record of coastal subsistence activities during the centuries between ca. 4500 and 4000 B.P. The most striking element of the faunal assemblage from Occupation 2 is the abundance of swordfish remains, which although present on other sites, were first found at Turner Farm, and thereby provided the original indication of this formidable prey's importance. Other major food resources present at Occupation 2 included cod, deer, and shellfish – both the soft-shelled clam and the locally extinct quahog or hardshell variety. Noticeably absent from the assemblage were shallow-water fish species and sea mammals, such as seals and porpoise, which apparently were little used. Together, the evidence examined at Occupation 2 indicates the presence of a substantial year-round population at the site, who used it as a home base. Generally speaking, Moorehead Phase sites are only found east of the Kennebec River.

In addition to its distinctively coastal settlement pattern, the Moorehead phase is primarily known for its mortuary practices, which included the lavish use of red ocher, giving rise to the term "the Red Paint People," and the offering of grave goods, such as gouges, slate spear points, and stone rods (Moorehead 1922; Robinson 1992; Willoughby 1898). Present understanding of how the Moorehead phase culture may have developed focuses on its relationship to the marine environment. Sometime between 6000 and 4000 B.P., as the biological productivity of the Gulf

of Maine reached high levels, a local population settled along the coast of central and eastern Maine to exploit the region's rich resources and growing stocks of cod and swordfishes, developing a highly distinctive material culture and unprecedented mortuary ceremonialism along the way (Bourque 2001:51–61). The innovative and highly successful Moorhead phase maritime hunting peoples disappear abruptly from the archaeological record at around 3800 B.P., and don't appear to leave any vestiges of their culture in those that succeeded them locally.

The Moorehead phase was replaced at the close of the Late Archaic Period by another distinct cultural tradition, known as the Susquehanna tradition. Susquehanna tradition sites appear in Maine's archaeological record between 3700 and 3400 B.P. (Bourque 1995, 2001; Sanger 1979). Initially recognized by archaeologists working in the Susquehanna River valley region of southern New York and eastern Pennsylvania, Susquehanna tradition sites are widespread throughout eastern North America and are common in Maine, occurring as far east as the St. John River in New Brunswick, with a few Susquehanna tradition artifacts recently recognized from sites across the Bay of Fundy in southern Nova Scotia (Bourque 2001:62).

Once again, the Turner Farm Site proves to be the best source of data about this distinctive culture, with the largest and richest Susquehanna archaeological deposit in Maine comprising Occupation 3 (Bourque 2001:62). The Susquehanna tradition's technology, subsistence practices, and mortuary rituals are striking in their uniformity and marked difference from those of preceding cultures. Diagnostic tool forms of the Susquehanna tradition are the largest and most skillfully manufactured stone artifacts of the pre-contact period. Susquehanna artisans excelled not only in their production of chipped-stone tools, but also worked bone by grinding, as opposed to scraping with a stone tool, as was done during the Moorehead phase. Susquehanna craftspeople also produced ground- and pecked-stone tools such as adzes and gouges, which were functionally similar to those of earlier cultures, but were different in their detail and in their use of different lithic materials, and lithic bowls sculpted from steatite, a soft, easily worked, metamorphic stone.

The Susquehanna culture was also distinctly different from the Moorehead phase in its diet, preferring terrestrial game and "mast" resources (i.e., nuts: acorns, beech nuts, butternuts, hickory nuts, and walnuts) to maritime resources. This difference is evident in the faunal refuse remains and diet indicators resulting from isotopic analysis of the site's human skeletal population from the Turner Site Occupation 3 (Bourque 2001:62–66).

The Susquehanna tradition's elaborate mortuary rituals differed dramatically from those of the Moorehead phase's Red Paint People. Despite a very large number of Susquehanna habitation sites throughout Maine, only a half-dozen or so Susquehanna cemeteries have been identified in the state, as compared to the 44 known cemeteries associated with the Moorehead phase culture. This difference may be attributed to two factors: Susquehanna occupation of the region was too brief to generate a larger number of burials, and/or, unlike the Moorehead cemeteries which included all members of their populations, the Susquehanna tradition's burial practices were more exclusive; however, age and sex do not appear to have been a basis for burial in the Susquehanna cemetery at Turner Farm. Other major distinctly different elements of the

Susquehanna tradition burials are the "ritualized manipulation of the dead," consisting of the removal of whole or partial human remains from their place of initial interment to combine them with the remains of other individuals for ceremonial use in bundle burials or commitment to cremation pyres along with rich arrays of grave furnishings (Bourque 2001:62–66).

Archaeological evidence of the Susquehanna tradition disappears from the archaeological record in Maine by about 3400 B.P. This disappearance coincides with a "Little Ice Age" (McWeeney 1999:10) and a transition in the temperate southern character of Maine's woods back to northern hardwoods and hemlock of a colder climate, which may have resulted in a southward territorial contraction of Maine's Susquehanna tradition population.

The relationships between the various Late Archaic traditions continue to be a source of debate among Maine archaeologists. At the root of the discussion is whether the various archaeological assemblages of the Late Archaic reflect local, long-term cultural adaptations, or movement of people into the region with different cultures. Whatever the origins of the cultural changes observed, they again roughly coincide with increasing changes in the environment that provided more favorable habitat for deer and possibly other modern species of fauna as well.

No Archaic Period archaeological sites are documented within the Project study area. As in the case of PaleoIndian Period sites, rising sea levels and the river's extremely strong tidal currents have very likely drowned and eroded whatever sites may have been present within the study area.

Ceramic Period (3000–450 B.P.)

The introduction of pottery manufacture and use in Maine defines the onset of what Maine archaeologists call the Ceramic Period (Sanger 1979). In other parts of the Northeast, this cultural period is referred to as the Woodland Period. The differences between the two terms is mainly that hunting and gathering for food remained the primary means of subsistence throughout much of Maine and the Maritimes, while a reliance on horticulture and a tendency toward larger, more permanent settlement patterns developed in other regions during the same time period. Ceramics first appear in the archaeological record of Maine around 3,000 years ago and they persist until contact with Europeans when clay pots were replaced in favor of iron and copper kettles that were traded for beaver pelts and other animal furs. Bourque's report of archaeological evidence and Samuel de Champlain's documented observations of the Maine coast indicate maize was being cultivated in western Maine as early as 1000 B.P., and along the Maine coast as far east as Saco by the first decade of the seventeenth century (Bourque 2001:87).

The picture that emerges from Ceramic Period sites is one showing long-standing cultural adaptation to the diversified use of local resources. In addition, the nature of artifact forms and certain types of stone recovered from Ceramic Period sites indicate broad trade and communication networks with peoples located far to the north, south, and west. By the end of the period, historical and archaeological evidence suggests horticulture was practiced in southern Maine. The Ceramic Period ends with European contact around 450 years ago. At this time,

most of the artifacts attributable to pre-contact inhabitants of Maine disappear from the archaeological record.

During the Ceramic Period and at the time of European contact, New England and the Maritime provinces were populated by Eastern Algonquian speakers. Maine's major river drainages north of the Piscataqua River, including the upper Saco and many smaller coastal drainages, were occupied by the Eastern Abenaki (Snow 1978a:67). The name of the Eastern Abenaki derives from *wapanahki*, their own name for themselves, which means "dawn land people" or "easterners" (Snow 1978b:137). The territory of the Eastern Abenakis was covered by a mixed white pine, hemlock, and hardwood forest along the coast, transitioning to a spruce and fir forest in the interior. Neither the soil nor the climate was adequately warm enough to allow for cultivation of the available domesticates within most of Maine (Snow 1978b:138). Consequently, the subsistence pattern of the period primarily involved a seasonal round of hunting and gathering with summer residences based along the coast and winter residences in the interior.

Ceramic Period archaeological evidence indicates a strong maritime focus over much of the Maine coast, which did not exist during the preceding Susquehanna tradition (Bourque 2001:84). Native peoples living along the coast were heavily reliant on marine resources and exploited springtime runs of alewives, salmon, shad, eel, smelt, and other fish with hooks, leisters, purse-nets, and weirs. Some fishing was done with harpoons, particularly for sturgeon, which were attracted to the surface by torches at night. Harpoons were also used to hunt harbor seals, porpoise and various water fowl. Lobsters and crabs were caught in shallow water using spears. Shellfish, particularly clams, were a staple of native coastal inhabitants (Snow 1978b:139). Cod was taken, but in insignificant numbers relative to the amount of smaller fish that were sought, such as winter flounder and longhorn sculpin (Bourque 2001:84). Swordfish are markedly absent from Ceramic Period faunal assemblages, possibly as a result of becoming locally extinct due to cooling water temperatures in the Gulf of Maine (Bourque 2001:84). Two extinct species of animal were also exploited by Ceramic Period People – the great auk, a flightless, penguin-like relative of the puffin, and the sea mink, both of which were hunted into extinction during the nineteenth century (Bourque 2001:85).

Coastal peoples were quite mobile as compared to other Eastern Algonquians, and utilized watercraft for travel, hunting, and fishing. The first Europeans to arrive in the Northeast recorded three basic types of watercraft: dugout canoes, birch bark canoes, and hide-covered kayaks. Throughout northern New England and the Maritime Peninsula, birch bark canoes were used exclusively for interior travel, while dugouts made from large trees were used in coastal waters.

Ceramic Period sites are abundant in Maine, along both the coast and in the Maine interior (Sanger 1979). Along the coast, they are most visible in the form of shell middens, which have attracted the attention of professional and amateur archaeologists since the late nineteenth century (Wyman 1868). Shell midden sites contain discarded shells of clams, oysters, mussels, and quahogs, bones of both terrestrial and marine animals, as well as broken pottery sherds and

discarded stone and bone tools. Sites in the interior are most common along waterways, ponds, and lakes. Assemblages from the interior differ from coastal sites in that bone assemblages are poorly represented because of differences in preservation.

No Ceramic Period archaeological sites are documented within the project study area. Sites from this period would be maritime, rather than terrestrial, in nature, as sea level rise would have inundated most or all of the project study area prior to the start of the Ceramic Period.

Contact/Post-Contact Period Culture History

The project study area lies on the eastern (Maine) side of the Piscataqua River adjacent to the town of Eliot. Eliot is situated in the southwestern corner of York County and along with the Berwicks, was a part of Kittery, Maine's oldest town, which was settled in 1623 and incorporated in 1647. Located opposite Portsmouth, New Hampshire, Kittery and Elliot developed into a center for trade and shipbuilding. Originally called Sturgeon Creek in the 1630s and 1640s, Elliot remained a part of Kittery up until 1810, when it was incorporated, and, like the rest of Maine, was part of the Commonwealth of Massachusetts until 1820.

The initial documented European incursions up the Piscataqua were those of Englishmen Martin Pring in 1603 and John Smith in 1614 (Aldrich 1917:1–3). Before English settlers arrived to the shores of the Piscataqua, there were active fishing communities on the abutting offshore islands, particularly the Isle of Shoals. On this cluster of islands 10 miles (16 km) outside of the mouth of the Piscataqua, English west-country fishermen set up temporary bases to fish the rich coastal waters during the spring and fall fishing seasons (Heffernan and Stecker 1986:19). European settlement of Eliot was initiated in the 1630s through a series of land grants stemming from a charter by King James to John Mason and Sir Ferdinand Gorges, for properties comprising part of the Piscataqua Plantation (i.e., a land area that was later named Kittery), situated along the riverfront on the town's western edge. Mason and Gorges began issuing land grants through their agent, Walter Neal, around 1632 (Varney 1886). By 1636, this large Plantation (encompassing today's Eliot, as well as the Berwicks and Kittery), was populated by approximately 200 people. One of the area's earliest settlers was Nicholas Frost, who arrived at Sturgeon Creek (i.e., Elliot) about 1636. Other early settlers were Anthony Emery (about 1652), the Hills (1670s), James Tobey (about 1675), John Heard (no date), and Nathan Bartlett and his brother (1713). Reportedly, the first settlers were allowed to take up as much land as they could fence, on the condition that they paid 2 to 2½ shillings per acre for 100 years (Varney 1886).

While much of the colony's energy in the seventeenth century focused on achieving permanent, stable, and governable settlements, the natural advantages and attractions of the Piscataqua region began to be developed and exploited – initially in the fur and fishing trades, and then in the timber trade (Heffernan and Stecker 1986:29). The area's early settlers established riverfront farms on 10- to 200-acre tracts of land and extracted timber from the surrounding area's heavily forested interior. Plentiful land, timber, and fish resources, a deepwater river harbor providing access to the interior and the sea, as well as riverine waterpower, attracted shipbuilders, sailors, and fishermen alike to York County, and the area's agrarian, maritime-based, and early industrial

economies and population both began to flourish and grow (Macpherson et al. 1997). Eliot's fledgling timber industry became a lucrative one following the establishment of the town's first sawmill in 1650. By the end of the seventeenth century, the export of timber on the Piscataqua had increased four-fold from the mid-century total (Heffernan and Stecker 1986:31).

One of the principal consumers of the region's timber was the British navy, who facing shortages from Baltic sources, relied increasingly on the more abundant North American timber. The region's stands of giant first-growth white pine, in particular, were appealing to the navy for use as masts in its warships. The first cargo of masts was shipped from the Piscataqua River in 1634 (Duncan 1992:180).

To ensure a dependable supply of mast timber, the Royal Navy Board inserted clauses in colonial charters restricting the cutting of pine and appointed Surveyors of His Majesty's Woods and Forests to police and control the resource. Trees were reserved for purchase by the Crown with a "Broad Arrow" mark, an old symbol of naval property, cut into them by the Surveyors. Trees were sought by the Royal Navy for use as warships' masts, by merchants for conversion into lumber for the lucrative West Indies trade, and local settlers for use as building material and home heating fuel. As the number of suitable pine trees decreased, competition for them intensified, and the resource took on more focused political and economic significance. Ultimately, the tension between English timber imperialism and the colonial settlers' desire to turn a profit affected every level of the social, political, and economic life of the Piscataqua frontier and contributed to the region's participation in the American Revolution. In 1775, with the beginning of the American Revolution, the Colonies refused to ship more masts to Britain (Duncan 1992:187).

As settlement increased, dams and mills were built at strategic points along the river to harness and control its power. Abundant clay deposits along the river's banks were also utilized for brick-making during this early period. Brick served as the primary material used in the foundations of buildings constructed in Eliot and elsewhere locally during this period. While most early farms were subsistence farms, raising food for personal consumption, Eliot's larger farms produced crops of wheat, oats, corn, hay, grass, malt, peas, and apples for milling and export to colonial and European ports.

A map of "The Middle Parrish of Kittery (Now Elliot)," depicts the town between 1632 and 1700, and shows that the land north of and adjacent to the project area was among Elliot's first to be settled (Figure 4-1). Among the town's earliest settlers was James Tobey, mentioned above, who came to own a property in 1675 described as being "near Frank's Fort" (named after Francis "Frank" Williams, overseer of a company doing experimental work in the salt industry), a small island located in the Piscataqua River at the southern end of the Project study area (now called "Frankfort Island"). A string of properties depicted on the map east of the Project area is labeled as belonging to James's eldest son, Stephen Tobey, as well as David Libby, Matthew Libby, Daniel Fogg, and Joseph Hammond. This land, called the "Bay Land," extended from Frank's Fort to Watt's Fort along the river and east to Marsh Hill. Stephen Tobey reportedly built ships on the waterfront of his property in what is called "Mast Cove" (Stearns 1908:1331).

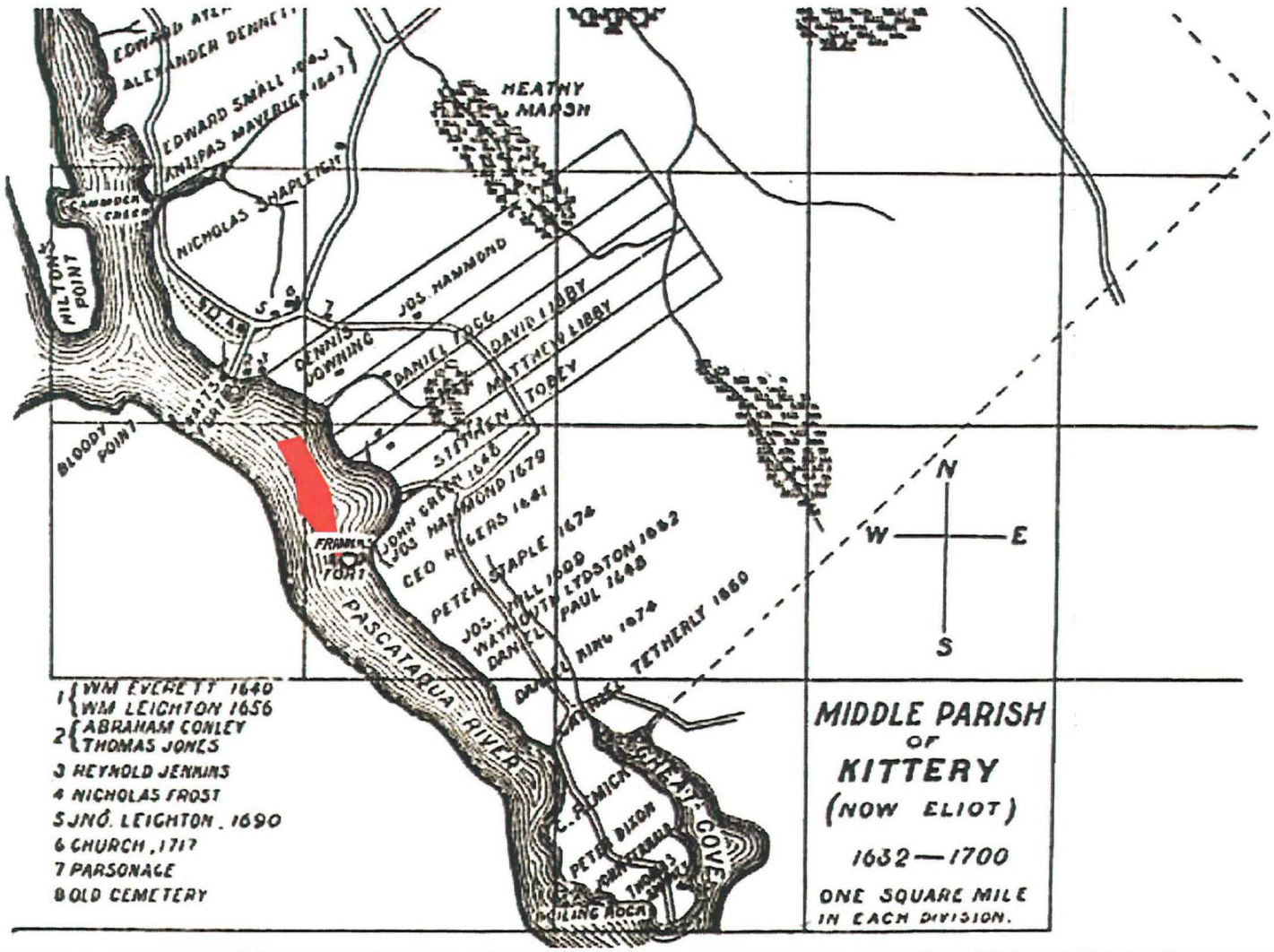


Figure 4-1. Map of the Middle Parish of Kittery (Now Eliot) 1632-1700 (source: Stackpole 1903:106).

While the 1713 Treaty of Utrecht ceased open hostilities between England and France, sporadic attacks on Maine's English settlers by Indians and the French continued. These attacks, however, were not enough to stem the tide of English settlement into the vast lands opened to them in Maine and elsewhere by France's ceding of their North American holdings in Acadia, the Maritimes, and Hudson Bay. Existing villages in Maine grew rapidly during the period. By 1750, Kittery's three parishes contained 270 dwellings and six grist- and sawmills (Macpherson et al. 1997). Shipbuilding got its start during this period, as well, as coastal vessel types such as "shallops," "ketches," and "pinkies" needed by local fishermen were produced in considerable numbers. By the end of the period, Eliot's population (1,457) comprised nearly half of Kittery's total population.

Over the course of the Federal Period, Kittery's three parishes began to take on distinctive socioeconomic characteristics. Eliot, Kittery's Second Parish, was inhabited primarily by farmers, and, thus, retained a distinctly agrarian character as the "Garden of Kittery." The other two parishes west and east of Eliot, however, were populated more by mechanics, traders, seamen, and fishermen, and had more of an industrial character.

During the Revolutionary War, Kittery organized a militia composed of six companies that were commanded by Colonel John Frost of Eliot, and served in the Second Regiment of Infantry of York County. Frank's Fort Island, at the southern end of the project area, was the scene of war-related activity at the start of the Revolution. Guns and powder from Fort William and Mary in New Castle, New Hampshire were seized by a group of men from Durham and Portsmouth and shipped to Frank's Fort Island where they were buried to hide them. The arms and powder were subsequently uncovered and sent to Charlestown, Massachusetts for use by Continental forces during the Battle of Bunker Hill (Macpherson et al. 1997).

Adjustment of the Piscataqua's maritime economy to the war resulted in a shift away from the international timber trade to internal transportation and shipbuilding. Recognized for their skill at building fishing vessels and larger cargo ships, the region's carpenters would become a major force in the Revolutionary War. Between 1775 and 1783, the region contributed more than 100 vessels and several thousand men to the "marine militia" of Continental privateers, and produced the first warships of the U.S. Navy at Portsmouth, New Hampshire, site of the nation's first federal navy yard (established in 1800 on Fernald's Island). These vessels included the 32-gun *Raleigh*, the 18-gun *Ranger*, and the 74-gun *America*, all of which saw considerable and successful naval action and greatly impressed their rivals (Heffernan and Stecker 1986:70).

In addition to their successes building and refitting ships for both a private and the Continental ocean-going navy during the war, the region's farmers and jacks-of-all-trades could claim success in developing and perfecting yet another essential, but unassuming coastal watercraft – the "gundalow" (Figure 4-2). The gundalow was a crudely designed, quick-to-build, broad-beamed nautical workhorse particularly well-suited to carry heavy loads in shallow waters along narrow river banks, although nimble and fast enough to negotiate the swift-moving, river and open-water tidal currents that prevailed on the Piscataqua. Gundalows provided a crucial link in

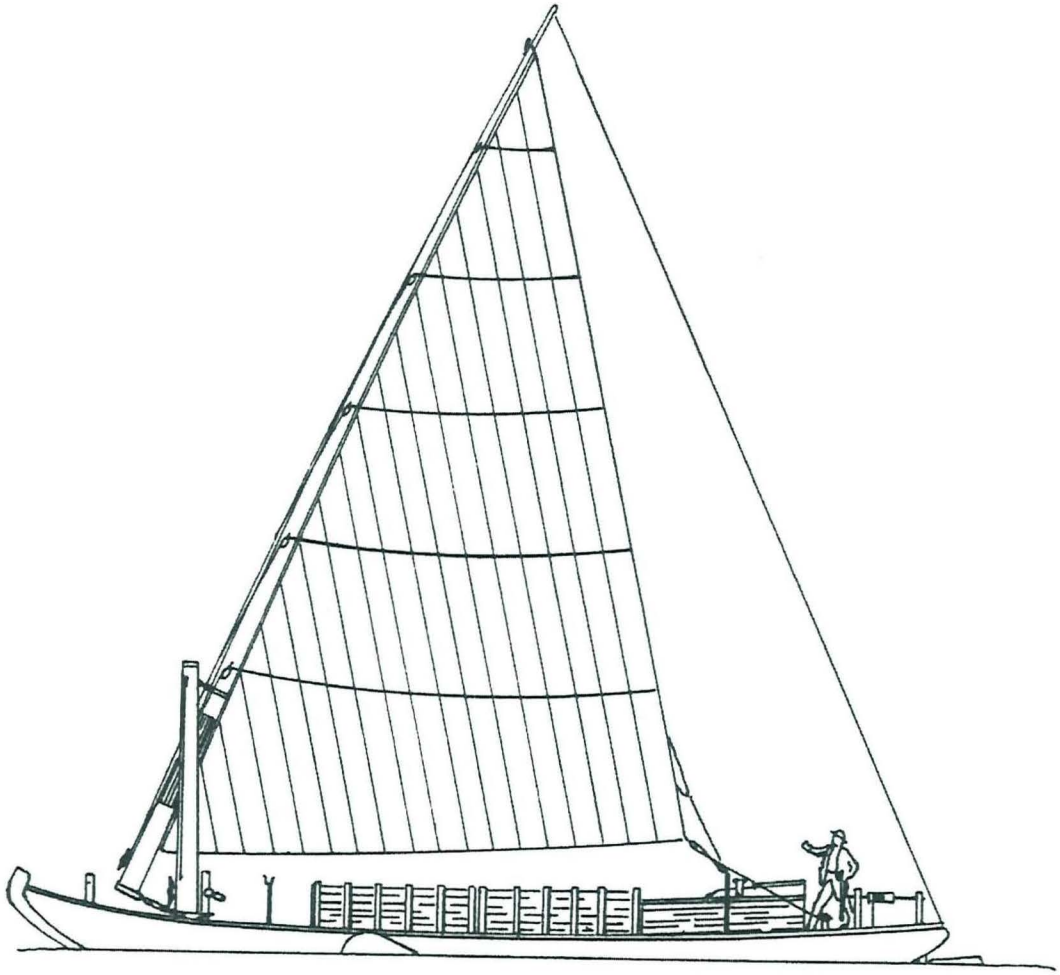


Figure 4-2. Drawing showing the 1886 Piscataqua River "gundalow" *Fannie M.* in profile while under sail. (The Piscataqua River gundalows used a modified Mediterranean-derived lateen sail rig from the nineteenth century onward to make passing under the area's bridges faster and easier.) (source: Grimwood 1942:Plate II).

the regional transportation system for more than 200 years hauling cargoes of local bricks and granite, cord wood, coal, cotton and other raw materials for the area's mills, and marsh hay and grass cleared from the area's fields between Piscataqua towns (Heffernan and Stecker 1986:70–72). Well adapted to the Piscataqua's geography and economy, it was the last of the region's commercial sailing vessels to ply the river's waters into the twentieth century.

Following the war, increasing differences in livelihoods, economics, and politics, led residents of Kittery's Second Parish to establish Eliot as an independent township, resulting in its incorporation in 1810. Maine itself gained independence from Massachusetts 10 years afterward in 1820. In the absence of British restraints, old overseas trade patterns revived and expanded, and Piscataqua's commerce and shipbuilding thrived for a 30-year period following the American Revolution. The early years of the nineteenth century witnessed more lumber and fish exports, more ships launched, and more fortunes made than in any preceding period in the Piscataqua region's history. The Piscataqua's docks were jammed with schooners and other types of ships loading and unloading pine lumber, barrel staves, dried fish, cattle, sheep, horses, bricks, cider, flaxseed, molasses, rum, sugar, cocoa, coffee, cheese, and salt (Heffernan and Stecker 1986:109).

The Embargo Act of 1807 and the War of 1812 disrupted the surge in prosperity; however, engagement in privateering (at a smaller scale than during the Revolutionary War) cushioned some of the trade losses. Ironically, it was in the peacetime that followed the War of 1812 that overseas trade declined significantly, as most of the foreign goods brought into the Piscataqua during the 1830s and 1840s supplied the growing railroad industry (Heffernan and Stecker 1986:109). Historically successful enterprises such as fishing and shipbuilding continued to be important, as the region returned its focus on local and coastal markets to compensate for the loss of foreign markets. Piscataqua's clipper ships, built in the decade before the Civil War, were the last "stars" of the region's shipyards. Although competition with the ascendant shipyards and merchants in the ports of Boston and New York led eventually to the decline of those on the Piscataqua, which generally didn't have deep enough harbors or large enough facilities to build bigger craft that were increasingly in demand. At least four clipper ships were built in the Kittery area, although registered in Portsmouth. The 1,060-ton clipper *Nightingale*, designed and built by Samuel Hanscom, Jr., was launched in Eliot in 1851 and towed to Portsmouth for outfitting (Duncan 1992:296) (Figure 4-3).

Farming also went into decline in the nineteenth century, because the region's small farmsteads could not compete with the growing agribusinesses of the Midwest and West. Fishing remained the principal business of coastal Maine and the Piscataqua. By the late nineteenth century, tourism began to replace most traditional economic activities in the area, as summer visitors were drawn to the coast for its cool climate, beaches, scenic shores, and relative lack of development. While Kittery has the Portsmouth Naval Shipyard, York its tourism and sandy beaches, Portsmouth its rich history, Eliot remains largely rural in character and has retained its identity as one of coastal Maine's quiet, residential communities.

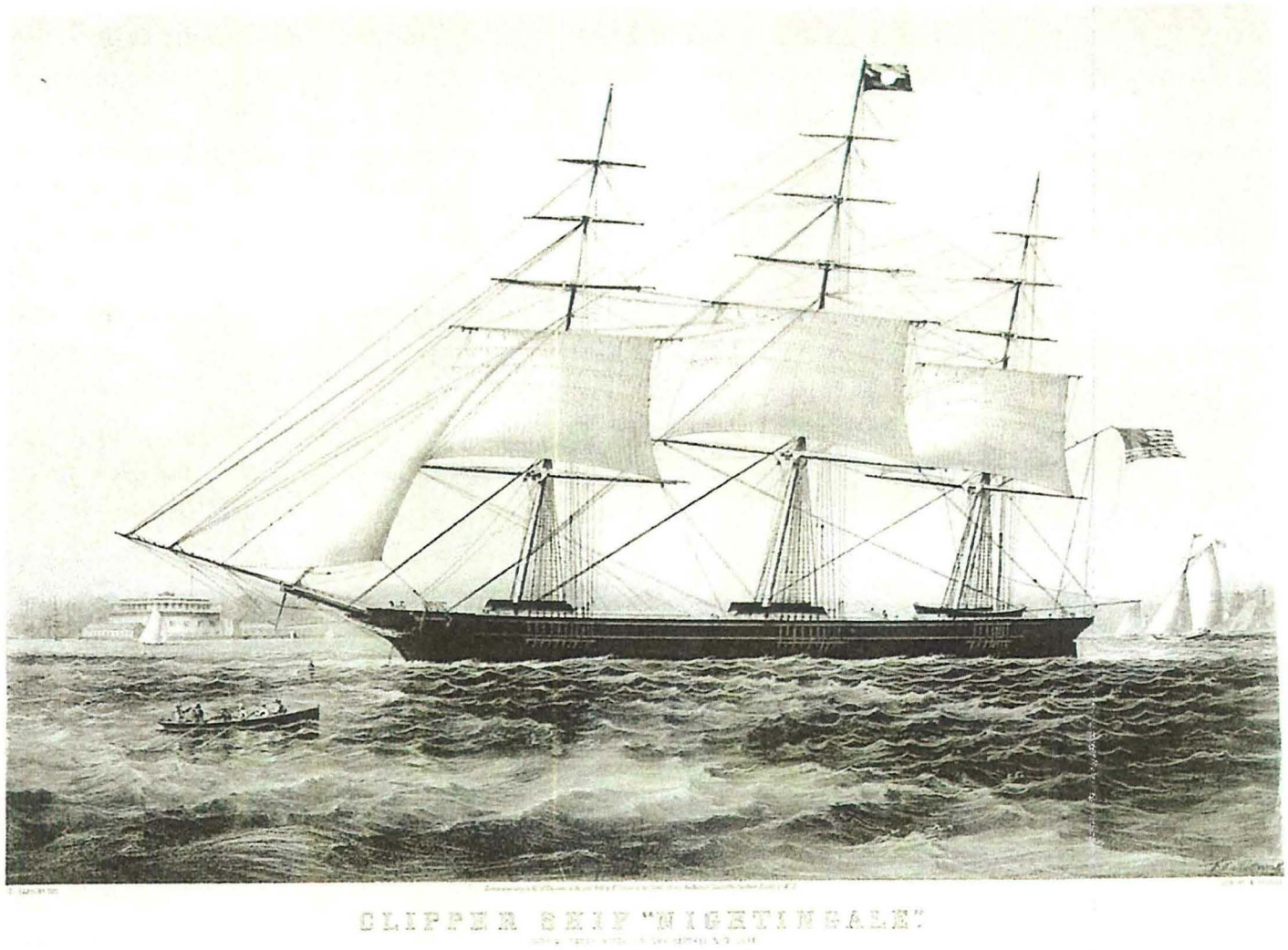


Figure 4-3. Eliot, Maine-built clipper ship *Nightingale* (1851) (source: Svardskog 2005:6).

CHAPTER FIVE

RESULTS AND RECOMMENDATIONS

Archival research conducted for this investigation recorded data useful for predicting the locations and types of pre- through post-contact period underwater archaeological deposits possibly present in the Piscataqua River project area. The field investigations conducted for this study produced geophysical (i.e., remote sensing) data used for the dual purposes of assessing the area's geology and potential hazards to the proposed navigation improvements within the project study area, and for identifying and inventorying anomalous targets with the potential to be National Register-eligible shipwrecks or areas of potential archaeological sensitivity. This chapter presents the results of this study's research and field survey tasks, and provides recommendations regarding the need for any additional archaeological investigations.

Archival Research Results

Archaeological Sensitivity - Submerged Pre-Contact Archaeological Deposits

The Piscataqua River Project study area is situated on the coastal plain within a resource-rich, protected estuarine setting, between Great Bay (one of the largest estuaries in the Northeast) and the Gulf of Maine/Atlantic Ocean. The project study area is located on the submerged eastern margin of the drowned Piscataqua River valley, which was inundated by rising sea level and coastal subsidence. Prior to its submergence, this environmental setting would have been a particularly attractive area for Native American resource-procurement and settlement during the pre-contact period.

Review of the available environmental data and sea level rise curves for the western Gulf of Maine indicate that the Piscataqua River study area was exposed land available for human habitation from the beginning of the Fluted Point PaleoIndian Period (11,500 B.P.) until some time during the Middle Archaic Period (circa [ca.] 7500–5000 B.P.), at which point the area would likely have been inundated by rising sea level. Available literature produced by archaeological research conducted to date on the pre-contact period for the southwestern Maine coastal area (i.e., from the New Hampshire border to Cape Elizabeth at the western end of Casco Bay) indicates that this section of the coast was occupied at least as early as the Late Archaic period (ca. 5000 B.P.) (Sanger and Kellogg 1989:113).

The Piscataqua River project area and its surrounding environs fit the prevailing predictive model as a productive ecological zone that would have been highly attractive for pre-contact land use from the Archaic Period through the contact period. No National Register or National Register-eligible archaeological properties or Maine site survey file archaeological sites are recorded in the project's underwater study area or on the shores directly adjacent to it. This absence is probably as much attributable to the negligible amount of underwater archaeological

research on the pre-contact period that has been conducted to date in Maine and throughout the Northeast, as it is the low probability that the former subaerially exposed soils in which pre-contact archaeological deposits could be present are unlikely to remain or be undisturbed within the limits of the rapidly flowing river. For stratified archaeological deposits preserved in meaningful contexts to exist within the Piscataqua River Project study area, intact elements of the paleo-landsurface in which they were deposited must be present. Such deposits would need to have survived the postglacial marine transgression of the Piscataqua River valley and the subsequent disturbances from the river's fluvial processes and/or human activities.

Preservation of any inundated pre-contact archaeological deposits that potentially exist in the study area is dependent upon their location and depth of burial relative to natural and human impacts on sediments. Recognizing the erosional effects of the river's extremely strong tidal flow, the Piscataqua River study area is considered to possess a low potential for containing formerly terrestrial archaeological deposits of the pre-contact period. Instead, it would be more probable that pre-contact Native American archaeological deposits present in the study area would be of a maritime nature (e.g., watercraft or fishing weirs) and date to the later pre-contact period.

Archaeological Sensitivity - Submerged Contact/Post-Contact Archaeological Deposits

Available information for the Piscataqua River contact/post-contact period history (i.e., National and State registers of archaeological properties; vessel casualties in NOAA's AWOIS and the NSDB; previous CRM investigations, secondary sources, and local informant interviews) documents an extensive 400-year history of native and non-native fishing, shipbuilding, and maritime commerce in the lower Piscatacqua River. As noted above, the towns of Eliot, Maine and Newington, New Hampshire, as well as nearby Portsmouth, New Hampshire, reached their commercial zenith during the nineteenth century, as Maine became the "foremost builder of wooden ships in the country" (Allin 1995).

The relatively broad, straight section of the Piscataqua where the study area is located is north of an area known among mariners as, "Long Reach." Research conducted for this study produced no record of vessel casualties, nor any charted shipwrecks or submerged structures or obstructions within the project study area. Recognizing these facts, plus the protected inland nature of the study area and its proximity to the river's shore, the project study area is considered to have a moderate archaeological sensitivity for containing the remains of contact/post-contact period vessels and/or coastal structures that would be associated with the brief, early-seventeenth-century British establishment and occupation (ca. 1631–1634) of "Frank's Fort" Island (Frankfort Island), and lumber extraction activities presumably conducted in "Mast Cove," as part of the significant masting industry carried out on the Piscataqua from ca. 1640 to 1815.

Field Survey Results

Geophysical remote sensing survey performed by OSI and PAL recorded side-scan sonar, magnetometer, and sub-bottom profile data covering the entire Piscataqua River project study area. The recorded data was reviewed after post-processing to identify and inventory areas with potential to be archaeologically sensitive paleosols or targets likely to be associated with contact/post-contact period National Register-eligible archaeological deposits (e.g., shipwrecks and coastal infrastructure). Data sets reviewed by PAL included:

- Post-plot drawings of surveyed track lines and anomalies;
- All-inclusive anomaly inventories produced for the geological characterization and hazards survey;
- Sub-bottom profiles of each surveyed track line; and
- Side-scan sonar mosaic of the entire study area.

A total of 18 track lines spaced 50 ft (m) apart, plus three cross-tie lines (surveyed with just the sub-bottom profiler), were surveyed across the study area (Figure 5-1).

Pre-Contact Submerged Archaeological Deposits

The side-scan sonar and sub-bottom profiler produced a clear visual record from which to interpret and estimate the nature of the Piscataqua River project area's geomorphology. No geotechnical data (i.e., grab samples, vibratory cores, or borings) were obtained as part of this study for ground-truthing the geophysical data, so the surficial and subsurface sediment types described below are necessarily estimates based on the interpretation of the geophysical data alone (OSI 2007:12). The side-scan sonar and sub-bottom profiler records contain acoustic evidence suggestive of bedrock, coarse glacial till, and Holocene silts and gravel. A large percentage of the riverbed within the Piscataqua River study area appears to consist of coarse glacial till and bedrock outcrops (OSI 2007:12). Sand and gravel is the suspected material infilling depressions between outcrops, and covering the steeply sloped margin of the navigation channel on the study area's western edge. Sediments interpreted as silt appear to be present in deeper areas close to the river's Maine shoreline. A shoal in the central portion of the study area appears to be composed primarily of coarse glacial till and bedrock. The side-scan sonar and sub-bottom profiler data suggest that the Piscataqua River's extremely strong tidal currents have removed or redistributed any silt that may have been associated with formerly exposed paleolandforms in the study area; thus, it appears from the recorded data that there is virtually no potential for contextually intact archaeological deposits to be present within the Piscataqua River study area.

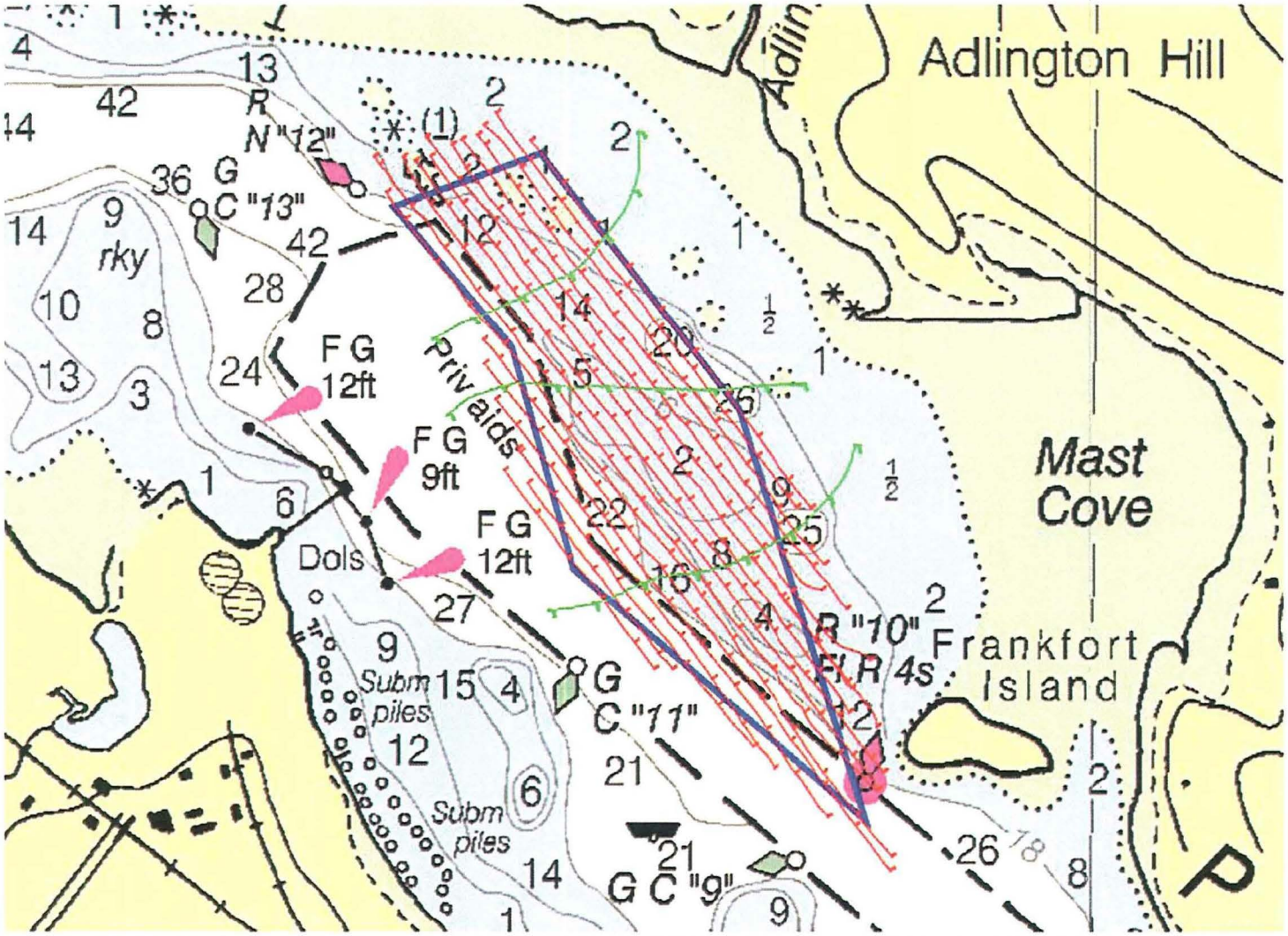


Figure 5-1. Location of surveyed track lines and anomalies within the Piscataqua River study area (plot courtesy of OSI).

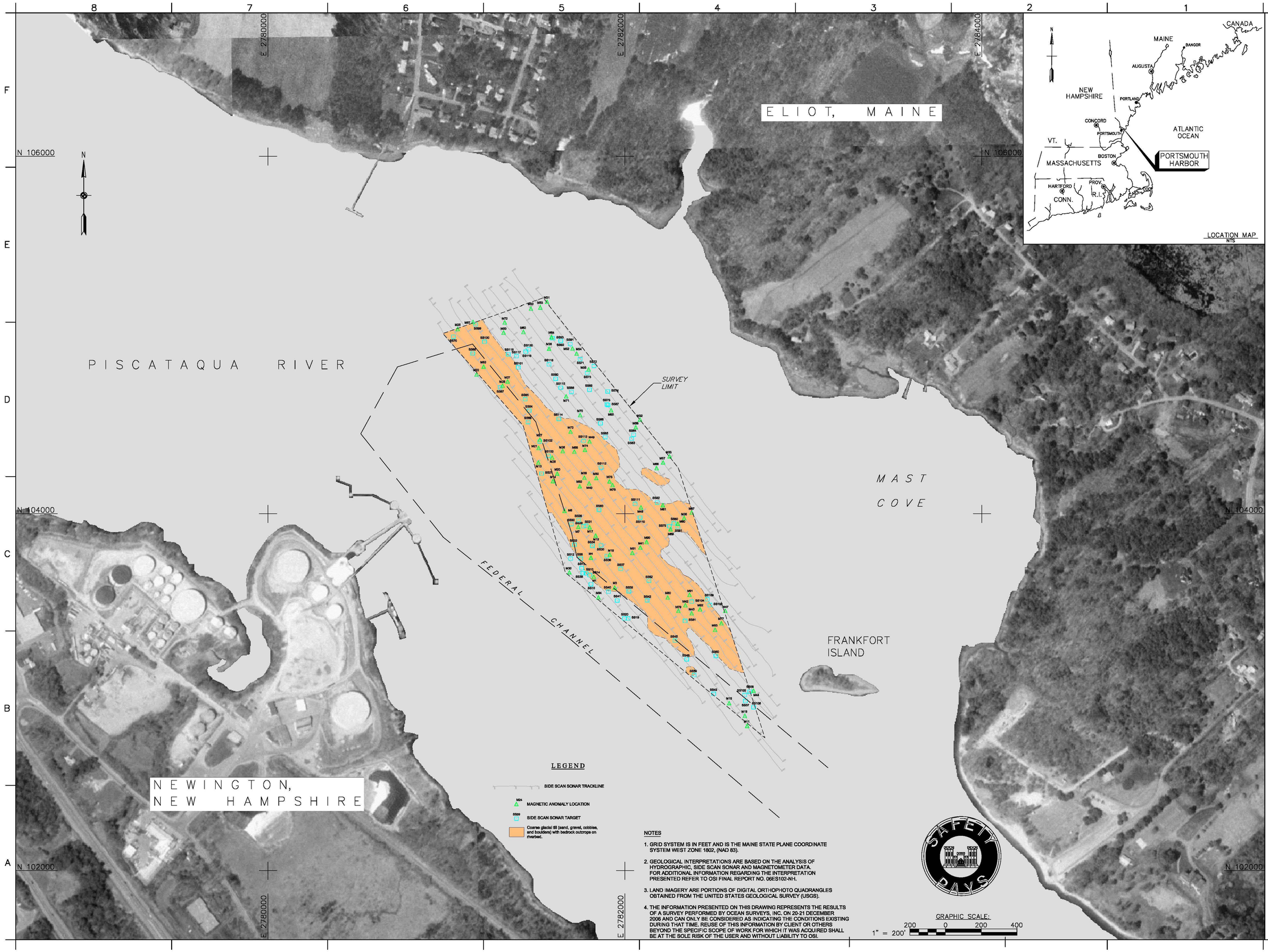
Marine Archaeological Survey, Piscataqua River, December 2008

Contact/Post-Contact Period Submerged Archaeological Deposits

Analysis of the remote sensing data recorded along these track lines documented 80 side-scan sonar anomalies (Appendix D) and 74 magnetic anomalies (Appendix E). The inventoried magnetic anomalies ranged in amplitude from 2 to 250 gammas and from 7 to 225 ft (2 to 69 m) in detected duration. The inventoried side-scan sonar anomalies ranged between 4 to 36 ft (1 to 11 m) in length, less than 1 to 27 ft (0.3 to 8 m) in width, and up to 6 ft (2 m) in elevation. Ten of the side-scan sonar anomalies (SS-14, -36, -58, -67, -73, -79, -80, -93, -99, and -102) were associated with magnetic anomalies. All of the detected side-scan sonar and magnetic anomalies appear to derive from geological sources (mafic and non-mafic bedrock and coarse glacial till) or widely scattered isolated occurrences of modern debris (Figure 5-2, Back Pocket) that are typical for a heavily utilized industrial waterway. Results from the remote sensing archaeological survey produced no indication of there being any potentially National Register-eligible post-contact period cultural targets on or embedded in the surface of the riverbed within the Piscataqua River project study area. A detailed description of the field survey's geological results is provided in the project's marine geophysical report prepared by PAL's sub-consultant, OSI (OSI 2007).

Recommendations

The region surrounding the Piscataqua River study area has a long history of intensive maritime activity spanning the pre- and post-contact periods. However, combined archival research and a systematic remote sensing archaeological field survey of the study area documented no listed submerged archaeological properties or any potentially National Register-eligible cultural targets on the surface of the riverbed. In addition, no sub-bottom profiler reflectors indicative of intact elements of an archaeologically sensitive paleolandscape were recorded within the survey area. Based on the results of this study, no additional archaeological investigations within the Piscataqua River project study area are recommended.



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Symbol	Description	Date	Appr.	Symbol	Description	Date	Appr.

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Rev.
Design file:
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Plot date: 09/10/08
Plot scale: 1" = 200'

Surveyed By: J.D. GARDINER
Plotted By: P.J. LACKEY
Asst. Chief, Survey Section
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V-2
Sheet 1 of 1

Figure 5-2. Plot showing locations of magnetic and side-scan sonar anomalies detected within the Piscataqua River study area (plot courtesy of OSI).

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APPENDIX A
PROJECT SCOPE OF WORK

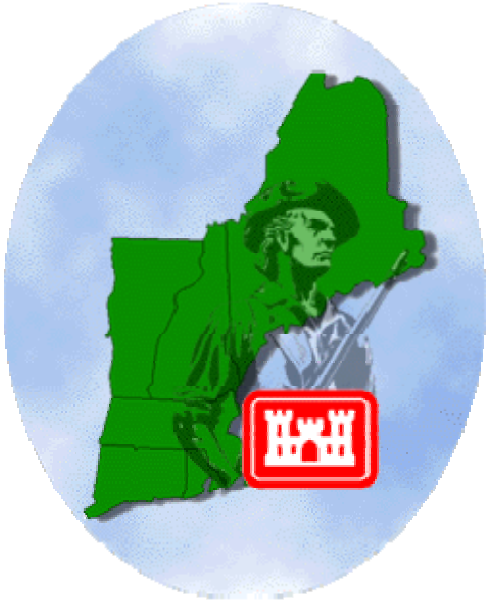
US Army Corps of Engineers®

STATEMENT OF WORK
MARINE ARCHEOLOGY AND MARINE GEOPHYSICS
SEARSPORT HARBOR MAINE
AND
PORTSMOUTH HARBOR, PISCATAQUA RIVER, NEW HAMPSHIRE AND MAINE

Prepared for

Planning Branch

by



Geo-Environmental Branch
New England District
Concord MA

6 November 2006

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LIST OF ACRONYMS

AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
DQO	Data Quality Objective
EM	Engineer Manual
ft	Feet
GDA	Government Designated Authority
MLLW	Mean Lower Low Water
MLW	Mean Low Water
NAD	North American Datum
NOAA	National Oceanographic and Atmospheric Administration
THFZ	Turtle Head Fault Zone
USACE	United States Army Corps of Engineers

1.0 INTRODUCTION

1.1 Project Description

The United States Army Corps of Engineers New England District (USACE) is preparing to undertake a channel deepening project at Searsport Harbor in Maine (Figure 1). As part of this effort, a marine archaeological and geophysical survey will be conducted to assess site conditions.

An optional effort is additional marine archaeological and geophysical survey on a portion of the Piscataqua River (Figure 2) during the same mobilization.

1.2 Task Overview

Services to be performed under this scope of work are described in this document. This is a firm fixed-price contract. Costs shall be priced on a per task/option basis. Contractor effort shall include reasonable time for delay due to coordination with navigation traffic and Harbor Master, logistics, set-up, etc. Contractor shall sequence executable work to minimize potential for downtime or delay**.**

1.2.1 Base Tasks

TASK 1 - Preparation of Work Management Plan, Health and Safety Plan, and Activity Hazard Analysis

TO BE COMPLETED BEFORE MOBILIZATION

Prepare draft and final Health and Safety Plan and Activity Hazard Analysis for tasked and optional fieldwork, and mobilization and demobilization with the exception of Task 9 where the Health and Safety Plan and Activity Hazard Analysis will be included as part of the Task 9 deliverables. See Section 6.0 for details.

Prepare draft and final work management plan to cover field tasks at Searsport Harbor and Optional field tasks on the Piscataqua River. See Section 8.2 for details.

TASK 2 - Searsport Harbor Marine Geophysical and Remote Sensing Archaeological Survey

Perform marine geophysical and remote sensing archaeological survey, consisting of seafloor imaging (sidescan sonar and magnetometer), and subbottom profiling (seismic reflection) within the areas being studied in/along the Searsport Harbor Navigation Channel.

See Section 4.0 MARINE GEOPHYSICS, of this Statement of Work for general requirements for magnetometer, sidescan sonar, and subbottom profiling (seismic reflection). For this task , magnetometer line spacing not exceeding 50 feet would result in a total of approximately 73 nautical miles of linear magnetometer data. Cross lines for subbottom profiling shall be run where they can intersect existing boring data, and shall not exceed 6 lines total.

Bottom elevations within the study area range between -10 and -53 ft below MLLW (Figure 1).

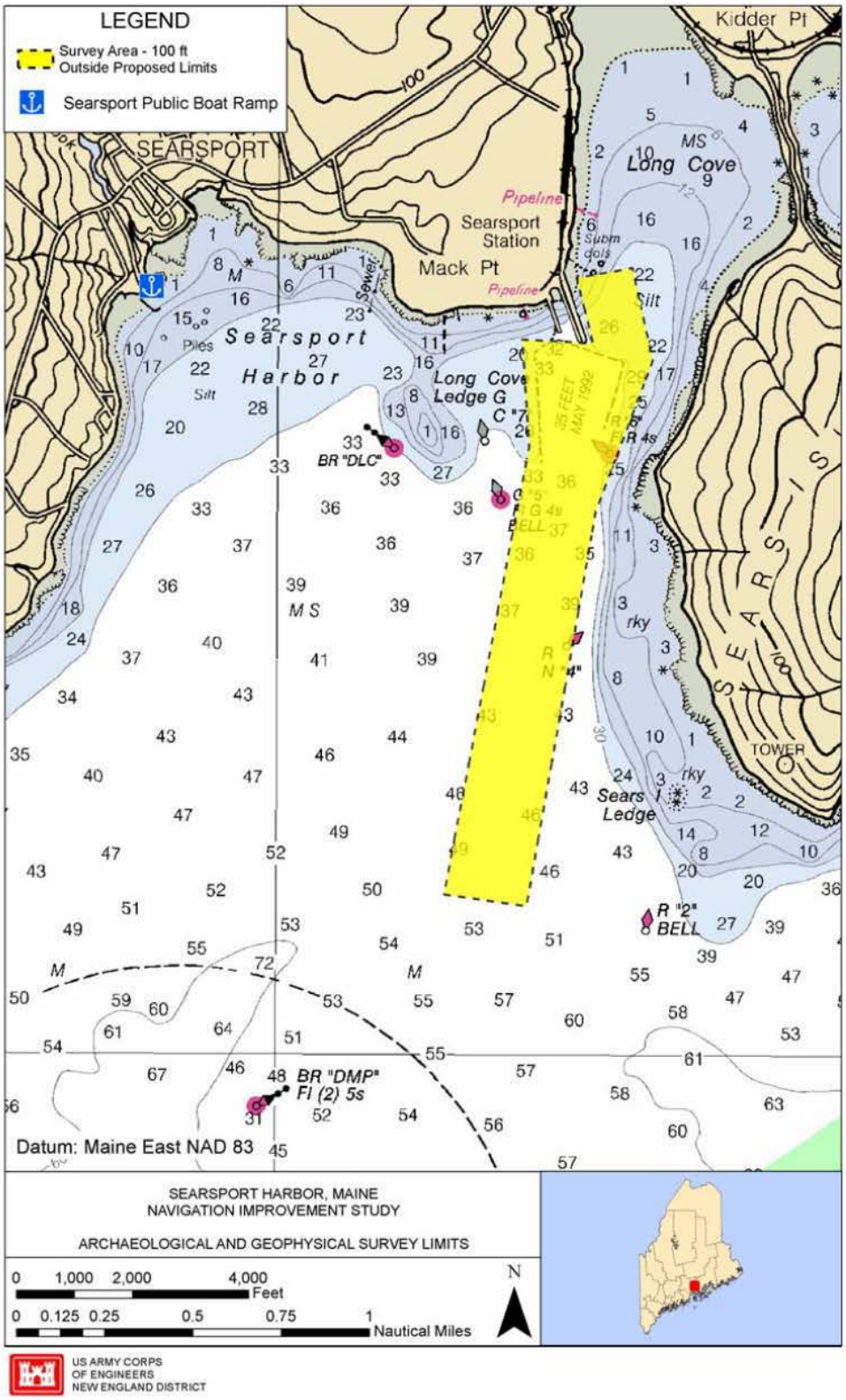

Figure 1. Searsport Harbor Maine study area and nearby public dock (soundings are ft below MLLW).

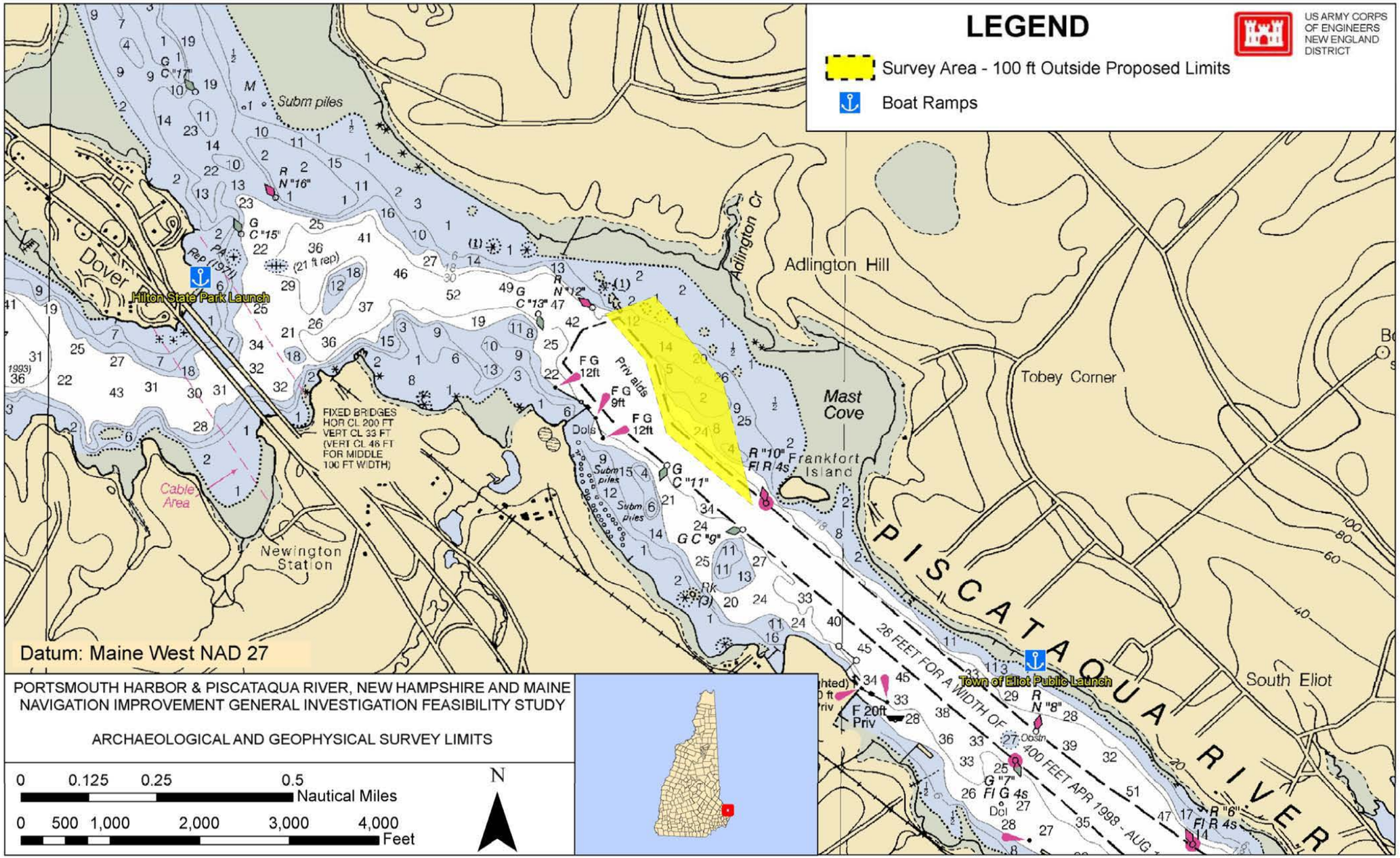

Figure 2. Location of the Piscataqua study area and nearest public boat ramps (soundings are ft below MLLW).

1.2.2 Optional Tasks – To Be Completed At USACE Direction

OPTIONAL TASK 3 - Piscataqua River Marine Geophysics and Remote Sensing Archaeological Survey

Perform marine geophysics and remote sensing archaeological survey, consisting of seafloor imaging (side scan sonar and magnetometer), and subbottom profiling (seismic reflection) within the areas being studied in/along the Piscataqua River Navigation Channel.

See Section 4.0 MARINE GEOPHYSICS, of this Statement of Work for general requirements for magnetometer, sidescan sonar, and subbottom profiling (seismic reflection). For this task, magnetometer line spacing not exceeding 50 feet would result in a total of approximately 7 nautical miles of linear magnetometer data. Cross lines for subbottom profiling shall be run where they can intersect existing boring data, and shall not exceed 3 lines total.

Bottom elevations range between -2 and -24 ft below MLLW (Figure 2).

OPTIONAL TASK 4 - Searsport Harbor Marine Archeology Report (Technical Evaluation, Literature Review and Assessment, Data Processing and Post Processing)

Prepare and submit report, including (1) discussion of field work and presentation of results (field reports, magnetometer results, side scan sonar images, profiles, electronic data files, discussion of equipment and methods, etc.), (2) and archaeological assessment and survey findings, including resources identified, magnetic anomalies encountered, and, if necessary, recommendations for further investigations.

Work includes preliminary interpretation of geophysical data, technical evaluation of results with respect to project objectives, tabulated locations of wrecks, suspected wrecks, debris and debris fields. Any significant archaeological findings shall be presented, including an assessment of the current project area, preliminary statements of resource significance and the identification of anomalies requiring additional evaluation. A qualified archaeologist familiar with the area and underwater prehistoric resources shall provide an assessment of the prehistoric potential of the study area.

General research guidelines for literature review and assessment (archaeological and historic resources):

a. A literature search shall be conducted of the project area not to exceed 1 man day. This should be geared toward obtaining information pertaining to the cultural resources in the area and/or the potential of their existence. Information and data for the literature search shall be obtained but not be limited to the following sources:

(1) Published and unpublished reports such as books, journals, theses, manuscripts and dissertations.

(2) Maritime archaeological site files at local universities, the State Historic Preservation Offices, and local historical societies and museums.

(3) Consultation with qualified professionals familiar with the underwater cultural resources in the area, as well as consultation with professionals in associated areas such as history or geology, as deemed necessary.

b. Information should be included concerning any cultural resources in the proposed area that have been listed on or are potentially eligible for nomination to the National Register of Historic Places. Information gathered during the literature review may be tailored to meet the needs of the presentation required above, however, the bulk of the data shall be included in the report.

OPTIONAL TASK 5 - Searsport Harbor Marine Seismic Report (Technical Evaluation, Literature Review and Assessment, Data Processing and Post Processing)

Prepare and submit report, including (1) discussion of fieldwork and presentation of results (field reports, magnetometer results, seismic reflection profiles, electronic data files, discussion of equipment and methods, etc.), (2) finalized geologic interpretation of geophysical data and technical evaluation of results with respect to project objectives, including bedrock topographic maps and recommendations for future subsurface investigations, and (3) table of proposed boring locations, estimated total depth, and rationale (verify interpretation, investigate anomalous bedrock zone, fill in area where bedrock data is missing due to gas-bearing sediments).

Work includes preliminary interpretation of geophysical data, technical evaluation of results with respect to project objectives, identification of areas considered questionable or likely to have hard material (bedrock, cobbles, etc.) within the dredge limits and recommend actions for future subsurface investigations. Other items of interest include areas having large expanses of mud/fines (greater potential for contamination), and areas where depth to bedrock would preclude excavation.

General research guidelines for literature review and assessment:

a. A literature search shall be conducted of the project area not to exceed 1 man day. This should be geared toward obtaining information pertaining to the geology of the area and/or past geophysical surveys. Information and data for the literature search shall be obtained but not be limited to the following sources:

(1) Published and unpublished reports such as books, journals, theses, manuscripts and dissertations.

(2) United States and Maine Geological Surveys, and files at local universities.

(3) Consultation with qualified professionals familiar with the underwater and shore geology, as deemed necessary.

OPTIONAL TASK 6 - Piscataqua River Marine Archeology Report (Technical Evaluation, Literature Review and Assessment, Data Processing and Post Processing)

Prepare and submit report, including (1) discussion of field work and presentation of results (field reports, magnetometer results, side scan sonar images, profiles, electronic data files, discussion of equipment and methods, etc.), (2) and archaeological assessment and survey findings, including resources identified, magnetic anomalies encountered, and recommendations for further investigations.

Work includes preliminary interpretation of geophysical data, technical evaluation of results with respect to project objectives, tabulated locations of wrecks, suspected wrecks, debris and debris fields. Any significant archaeological findings shall be presented, including an assessment of the current project area, preliminary statements of resource significance and the identification of anomalies requiring additional evaluation. A qualified archaeologist familiar with the area and underwater prehistoric resources shall provide an assessment of the prehistoric potential of the study area.

General research guidelines for literature review and assessment (archaeological and historic resources):

a. A literature search shall be conducted of the project area, and not exceed 1 man day. This should be geared toward obtaining information pertaining to the cultural resources in the area and/or the potential of their existence. Information and data for the literature search shall be obtained but not be limited to the following sources:

(1) Published and unpublished reports such as books, journals, theses, manuscripts and dissertations.

(2) Maritime archaeological site files at local universities, the State Historic Preservation Offices, and local historical societies and museums.

(3) Consultation with qualified professionals familiar with the underwater cultural resources in the area, as well as consultation with professionals in associated areas such as history or geology, as deemed necessary.

b. Information should be included concerning any cultural resources in the proposed area that have been listed on or are potentially eligible for nomination to the National Register of Historic Places. Information gathered during the literature review may be tailored to meet the needs of the presentation required above, however, the bulk of the data shall be included in the report.

OPTIONAL TASK 7 - Piscataqua River Marine Seismic Report (Technical Evaluation, Literature Review and Assessment, Data Processing and Post Processing)

Prepare and submit report, including (1) discussion of field work and presentation of results (field reports, magnetometer results, seismic reflection profiles, electronic data files, discussion of equipment and methods, etc.), (2) finalized geologic interpretation of geophysical data and technical evaluation of results with respect to project objectives, including bedrock topographic maps and recommendations for future subsurface investigations, and (3) table of proposed boring locations, estimated total depth, and rationale (verify interpretation, investigate anomalous bedrock zone, fill in area where bedrock data is missing due to gas-bearing sediments).

Work includes preliminary interpretation of geophysical data, technical evaluation of results with respect to project objectives, identification of areas considered questionable or likely to have hard material (bedrock, cobbles, etc.) within the dredge limits and recommend actions for future subsurface investigations. Other items of interest include areas having large expanses of mud/fines (greater potential for contamination), and areas where depth to bedrock would preclude excavation.

General research guidelines for literature review and assessment:

a. A literature search shall be conducted of the project area, and not exceed 1 man day. This should be geared toward obtaining information pertaining to the geology of the area and/or past geophysical surveys. Information and data for the literature search shall be obtained but not be limited to the following sources:

(1) Published and unpublished reports such as books, journals, theses, manuscripts and dissertations.

(2) United States and Maine Geological Surveys, and files at local universities.

(3) Consultation with qualified professionals familiar with the underwater and shore geology, as deemed necessary.

OPTIONAL TASK 8 - Weather Day

TO BE EXERCISED DURING FIELD PROGRAM IF NEEDED.

Item shall include costs incurred due to one down day due to weather, with vessel and equipment idle, and crew not working.

OPTIONAL TASK 9 - Searsport Harbor Wreck Assessment

Field Work

a. All sites are to be drawn, photographed, videotaped or documented by any other means, as is common archaeological practice for the identification and evaluation of submerged cultural resources. The purpose of this fieldwork is to provide a preliminary assessment of submerged cultural resources; no formal National Register eligibility documentation or field survey will be required at this time. Any sites of potential significance are to be recorded, documented and left in-situ for purposes of further coordination and consultation.

Inspection of the wreck site will include the dropping of an anchored buoy followed by the diving to the area to conduct a systematic search and recording of the target. This work should be undertaken with the use of an archaeological diving crew, as opposed to a commercial diving unit, although commercial divers may assist under the supervision of the Underwater Archaeologist. **The minimum dive team is a four-person crew. This may not include the boat operator, unless the operator is part of the normal dive team and precautions are in place.**

b. All work to be accomplished will be in accordance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716, September 29, 1983) and the Advisory Council on Historic Preservation's Handbook "Treatment of Archaeological Properties" (1980). The qualifications for leading an historic shipwrecks project must be met, as specified by the National Park Service in the “Abandoned Shipwreck Guidelines” published in the Federal Register, Volume 50, Number 233, on December 4, 1990.

c. The Contractor will be responsible for the obtaining of a permit for the performing of underwater archaeological explorations as required by the Maine Historic Preservation Commission, prior to the implementation of fieldwork. No subsurface excavation will be conducted.

d. An accident prevention plan (APP) and site-specific detailed diving plan should be prepared and be available for review and approval by the Government prior to the initiation of fieldwork. Special attention shall be focused on the requirements of the US Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1 (dated 3 September 1996), and particularly Appendix A, (Minimum Basic Outline for Accident Prevention Plan), and Section 30 (Contract Diving Operations). A copy of the Appendix A requirements and Section 30 will be provided by Corps upon request. Work **shall not** proceed until the APP has been reviewed by the Corps and accepted by the Contracting Officer Representative. **Diving may not take place unless a USACE Certified Diving Inspector is present on-site.**

Report and Graphics Production

a. Draft Report. The Contractor shall prepare, within 30 days of completion of fieldwork, a draft report of the wreck inspection survey results and recommendations for further research and evaluation, if necessary. Upon completion of the draft report, the Contractor shall submit 10 copies to the Government for review and comment. The review of the report will focus on format, method of preparation and compliance with applicable contract requirements. The Government will provide the Contractor consolidated review comments within 20 days of the submittal of the draft report. Upon receipt of the review comments, the Contractor shall make all necessary changes or corrections and develop a Final report within twenty (20) calendar days.

b. Final Report. The Contractor shall submit ten (10) copies of the Final report version, including one unbound copy, a copy of the electronic files in Microsoft Office format, original black and white photographs and/or a copy of the DVD, no later than twenty (20) days after the receipt of any Government review comments from the draft report. Comments should be addressed within the final version of the report; otherwise reference to other resolution should be included.

All data, reports, and related materials obtained as a result of this contract shall become the property of the U.S. Government and shall be turned over to the Contracting Officer, upon completion of the contract, **with the exception of any cultural remains or artifacts recovered as a result of the study**. **These resources are the property of the State of Maine, except in cases stipulated within the Standards and Guidelines for Abandoned Shipwrecks Investigations.**

1.3 Background Geology

1.3.1 Searsport Harbor

Bedrock underlying the study area consists of thick-bedded biotite, quartzites, schists, massive meta-graywacke or andesite tuffs of the Penobscot Formation (Kasuba and Simpson, 1989). The northeast-southwest trending Turtle Head Fault Zone (THFZ), located southeast of Sears Island (Figure 1), separates the Penobscot Formation to the north from the Ellsworth Formation and coastal volcanics to the south (Hogan and Sinha, 1989). The Ellsworth Formation and coastal volcanics units consist of bedded, buff-weathered quartzite; some metamorphosed mafic volcanics, as well as some rusty weathering pellites and minor limestones. The bedrock surface about 1.5 nautical miles south of Sears Island contains bedrock pinnacles exceeding 60 feet in amplitude (Belknap, Kelley and Gontz, 2002).

Till sequences overly most of the bedrock, except where bedrock pinnacles reach 60 feet or more above the bedrock base. The Waldoboro moraine runs along the north-western coastline of Penobscot Bay. End moraine deposits are found running east to west. The southern part of Sears Island (Figure 1) contains various types of till and outwash sand deposits (Gerber, 1976), which are likely present in the harbor sediments west of the island.

The Presumpscot Formation overlies the till units, and consists of mostly glaciomarine mud with sand layers and gravel dropstones (Belknap, Kelley and Gontz, 2002). Fine grained sediment eroded from glaciomarine and till bluffs north of the study area are carried by the Passagassawakeag River and deposited in Penobscot Bay. Sediment cores south of Sears Island show thick Quaternary sediment beds of sand, gravel and estuarine mud. Detrital organic material (wood, bark and grass fragments) was retrieved from 1 vibracore south of Sears Island (Belknap, Kelley and Gontz, 2002).

Numerous large pits are present in the Belfast Harbor sediments about five miles west of Sears Island, and have a typical size of 500-foot diameter by 50-feet deep. Sidescan sonar shows these pits to be present as far east as the midpoint between Sears Island and the mainland to the west (NOAA, 1999). It is not known if source of decaying organic matter is related to peat in glacial till or sawmill waste materials (Caldwell, 1998). Marine seismic reflection data suggest the uppermost unit of the harbor sediment sequence is natural gas-rich, and can negatively affect marine seismic data (Belknap, Kelley and Gontz, 2002).

1.3.2 Piscataqua River

The Piscataqua River is underlain by several Precambrian – Silurian sedimentary rocks (Caldwell, 1998). The oldest is the Rye Formation, which consists of deformed metasedimentary and felsic igneous rocks (blastomylonitic granite to granodioritic gneiss). The Eliot Formation, described as calcareous pellite, is comprised of a buff-colored, quartz-plagioclase-biotite phyllite and is strongly sheared throughout. Abundant carbonate at the lowest grades and calc-silicate minerals at higher grades are found. The Kittery Formation, calcareous feldspathic sandstone, is most commonly seen with variation in bedding thickness of tan quartzite alternating with phyllite. Grain size ranges from coarse sand at depth to fine mud closer to surface (Anderson, 1985a). Both the Eliot and Kittery Formations fall largely within the green schist facies as well as small

portions of the epidote-amphibolite and low rank amphibolite facies. The Rye Formation, schists, phyllites and amphibolites, overlies sections of the Kittery and Eliot Formations (VanDiver, 1984).

The Norumbega fault, a strike-slip fault running NNE, is shown on the Maine Bedrock Geology map running North of the area (Caldwell, 1998).

The Piscataqua Riverbed is comprised mainly of glaciomarine sediment (fine grained facies) of silt, clay and sand with trace amounts of gravel, deposited by Wisconsinan glacial ice. It is not until farther upstream that coarser grained glaciomarine deposits are found. Some areas of till are present.

No references to organics gas-rich sediments were found.

1.4 Site Specific Data Acquisition and Analysis Problems

Cargo and fishing vessels actively use both areas.

Pre-glacial valley or valleys may underlie Searsport Harbor, potentially yielding a complex bedrock surface. Glacial till is likely present in the harbor, and may interfere with interpreting the bedrock surface.

Side scan sonar in Belfast Harbor and marine seismic data south of Sears Island indicate organics and gas are likely present in the sediments immediately west of Sears Island.

Mafic igneous intrusions, such as dikes, may be present in both study areas and create strong magnetic anomalies.

Limited boring data near the Piscataqua River study area suggest bedrock may be shallow.

2.0 PROJECT GOAL, OBJECTIVES, AND ASSUMPTIONS

2.1 Project Goal and Data Quality Objectives

The overall project goal is to collect archeological and design data for the Searsport Harbor channel deepening project and Piscataqua River navigation channel improvement project. The data quality objectives (DQOs) for this Marine Geophysics SOW are:

a) Assess subsurface conditions to –70 ft below MLLW
b) Locate objects or magnetic anomalies representing historic period and/or prehistoric archaeological resources and evidence of sunken vessels
c) Make recommendations for future archaeological studies based upon survey data and literature review to include inspection of identified anomalies at the intensive survey level and for the potential for submerged prehistoric resources,
d) Identify areas suspected of having material that is not easily dredged (bedrock, cobbles, dense till, hard pan, etc.) within the proposed dredge limits
e) Identifying pinnacles and large glacial erratics
f) Recommend areas for subsurface explorations (borings/probes) to verify presence of such material
g) Assess depth to bottom of water column
h) Discriminate between silt, sand, and till overburden units where geophysical contrasts permit
i) Locate potential buried utilities

This work effort will be accomplished by performing geophysical and remote sensing archaeological explorations (seismic, magnetometer, sidescan sonar, and subbottom profiling) in the areas being studied for potential navigation improvement. The data gathered from the exploration program will be used to scope intensive archaeological survey work (if warranted) and subsurface investigations in the future.

All work shall be done in accordance with USACE guidance (USACE, 2003, 2002, 2001a, 2001b, 1995).

2.2 Project Assumptions

- Searsport horizontal data shall be referenced to the Maine East State Plane NAD83 coordinate system.
- Piscataqua River horizontal data shall be referenced to the Maine West State Plane NAD83 coordinate system.
- All vertical data shall be referenced to mean lower low water (MLLW) as determined by the USACE tide gage.
- Searsport Harbor study area bedrock is deeper than 40 feet below MLLW, based on boring and probe data.
- Profiles will pass over or near existing borings to aid in the data interpretation.
- Organic-rich sediments are present in the Searsport Harbor area.
- The Contractor shall notify and brief the Harbor Master and Coast Guard prior to commencing field operations.

- The contractor will identify geophysical signatures suggesting utilities or other manmade features (charted and uncharted), but these interpretations shall not constitute a utility survey, which is beyond the scope of this effort.
- Preliminary draft and draft data plots and a brief write-up describing identified features, and are due 21 and 45 calendar days from the completion of fieldwork, respectively.
- The Contractor shall follow USACE safety requirement as spelled out in the Accident Prevention Plan.
- USACE shall provide:
    - The most recent condition survey plans (full-size) for the areas being studied in/along the navigation channel.
    - Description of Survey control points used for each hydrographic study
    - HYPACK electronic files containing the bathymetric data for the study areas compatible with Microstation.

3.0 PROJECT REQUIREMENTS

a. General. The Contractor shall provide all necessary labor, materials, and equipment necessary to complete the specified marine geophysics and remote sensing archaeological survey. The Contractor shall provide well-maintained and calibrated equipment, and a qualified crew experienced in all phases of marine geophysical and remote sensing archaeological explorations.

b. Qualifications. **Geophysical**: The lead geophysicist shall have at least five years experience conducting and interpreting results of marine geophysical explorations in New England. **Archaeological**: All work to be accomplished will be in accordance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716, September 29, 1983), and the Advisory Council on Historic Preservation's Handbook "Treatment of Archaeological Properties" (1980). The qualifications for leading an historic shipwrecks project must be met, as specified by the National Park Service in the “Abandoned Shipwreck Guidelines” published in the Federal Register, Volume 50, Number 233, on December 4, 1990.

c. Coordination. All details presented in this document are subject to change by USACE as the work progresses. Close coordination with the USACE point-of-contact listed is required during the operations to determine final details.

d. Utilities. Prior to starting any field work, Contractor shall contact the necessary agencies (DIG-SAFE) and/or utility companies to identify any utilities or other features in the areas to be explored, so they can be avoided and protected from damage by any invasive activities that may be taken during the explorations (setting anchors, etc.).

4.0 MARINE GEOPHYSICS

4.1 General Requirements

4.1.1 Density of Coverage

The distance between remote sensing transects should be determined by background research and an expectation of the kinds of wrecks likely to be encountered. Parallel line spacing for the magnetometer should not exceed 50 feet. Parallel line spacing for marine seismic data acquisition shall not exceed 150 feet. The number of lines should be sufficient to acquire 100% sidescan sonar coverage of proposed dredge area, including some overlap along the edges, to generate a bedrock contour map and identify potential archeological targets. It is anticipated that geophysical lines will be run roughly parallel to the channel, with cross lines (perpendicular) approximately every 500 to 1,500 feet of channel length, as needed to aid in interpretation of the data. Lines should provide adequate coverage, extending slightly beyond the channel limits, to ensure that significant masses of bedrock, cobbles, etc. are not missed along the edges of the channel. Contractor shall propose geophysical track line array, because selection may be influenced by weather, logistics, geology, field findings, etc. Lines will be numbered and identified in a fashion that will allow ease of use, and will avoid mistaking lines made in different areas. Contractor shall propose nomenclature for identifying lines.

4.1.2 Vessel, Navigation, and Positioning

Vessel shall be sufficiently sized and equipped to conduct the required explorations, providing for protection of instrumentation and electronics, and able to accommodate the crew, captain, as well as visitors (1 to 2 Corps personnel). A Safe Boater certified captain shall captain the vessel. Contractor is responsible for making all Notices to Mariners, the Harbor Master, and other vessels operating in the area. The vessel shall be equipped with a Differential Global Positioning System (DGPS) with navigation software (HYPACK or equivalent) to enable the vessel captain to steer-to navigate, to stay on course and run straight and accurate data collection lines. Lines should be run as straight and on-course as conditions will allow. DGPS shall be accurate to within 5 feet horizontally, and 1 foot vertically. Geophysical instruments shall be integrated with the DGPS so that the data can be tagged with position and time information at regular intervals during data collection. All horizontal data shall be referenced to the site specific horizontal datums, and vertical data shall be referenced to Mean Lower Low Water (MLLW) to match datum currently being used in USACE drawings. Position and dimension results shall be provided in English units, to be consistent with existing USACE plans. Geophysical units shall be metric.

4.1.3 Marine Magnetometer

Magnetometer data (Geometrics G-881 or other suitable equipment) will be considered as part of this evaluation to identify any metallic features on the bottom that could represent cultural resources and/or could affect the navigation improvement dredging being considered.

4.1.4 Seafloor Imaging

An appropriate side scan sonar (Klein Model 540, EG&G Model 260 with Model 272-T towfish, EG&G Model DF-1000 in-water towfish, or equivalent) and data collection and processing system will be used to generate images of bottom conditions. Images will be interpreted by an experienced side scan sonar operator, to identify geologic material types present at the surface (mud, bedrock, etc.), and aid in identifying potential cultural resources that warrant further investigation and other features that could impact a dredging operation (utilities, pipes, debris, obstructions, shipwrecks, etc.).

4.1.5 Subbottom Profiling

Contractor shall mobilize to the site the appropriate seismic reflection equipment necessary to perform subbottom profiling of the Areas. Contractor shall select the most appropriate equipment to provide the appropriate balance between depth penetration and resolution for the conditions within each portion of the study area. Lower frequency equipment has greater depth penetration, but lower resolution (EG&G Uniboom, ORE Geopulse, Edgetech X-Star System with low frequency towfish, etc.), while higher frequency equipment gives higher resolution, but does not penetrate as deep (DataSonics 6600 Chirp System, Raytheon RTT 1000a, Edgetech X-Star System with high-frequency towfish, etc.). The maximum dredge depth being considered is –45-ft MLLW (-47-ft MLLW including 2 feet overdredge), but the exploration program should be geared to acquire high-quality data to –52-ft MLLW. If acoustically opaque gas (entrapped in mud) is encountered, the Contractor need not propose any extraordinary measures to penetrate the mud acoustically, but these areas should be identified and noted.

4.1.6 Interpretation

An experienced, qualified marine geophysicist shall interpret the geophysical data collected, and make best judgment assessments of the presence and limits (horizontally and vertically) of hard material within the dredging limits of the study area. The geophysicist shall also note the places in the geophysical data where there is greater uncertainty in the interpretation, and other places where subsurface investigations could add the most value (at cross-points of the geophysical lines, for example). See Section 2.1 for data interpretation and presentation requirements.

The project archaeologist shall evaluate both magnetometer and sidescan sonar results in tandem, as well as subbottom profiling, when identifying potential cultural resources.

4.2 Base and Optional Study Areas

4.2.1 Contract Base – Searsport Harbor

Coordinates for the entire study area shown in Figure 1 are listed in Table 1.

Table 1. Points defining the Searsport Harbor study area are listed below (Maine State Plane, NAD83).

Point	Northing	Easting
1	287375	881678
2	286177	882106
3	283650	881159
4	277663	880108
5	277860	878712
6	283611	879806
7	285984	879651
8	285896	880773
9	286921	880407

Figure 3 shows a portion of the Searsport study area and location of available boring and probe data. Boring and probe data is summarized in Table 2.

Table 2. Searsport Harbor boring data (coordinates in Maine State Plane NAD83).

Boring	Northing	Easting	Surface Depth (ft below MLW)	Total Depth of Boring (ft below MLW)	Details (depth units are in feet)
H-3	286015.161	880514.789	-22.5	-52	-22.5' to -35.5 (Mud); -35.5' to -43.5' (Gravel, rocks, clay); -43.5' to -52' (Loose sand and gravel with boulder obstruction on bottom)
M-4	285965.162	880652.789	-23.5	-60	-23.5' to -38.5' (Mud); -38.5' to -44' (Hard Clay); -44' to -60' (Sand and gravel with little clay)
W-5	286027.164	880839.786	-22	-64	-22' to - 32.5' (Mud); -32.5' to -52' (Hard Clay); -52' to -64' (Clay, sand & gravel)
FD-1	284477.17	879976.81	-30.1	-40.1	-30.1 to -40.1' (Organic SILT with occasional shells)
FD-2	284965.17	880514.8	-30.5	-40.5	-30.5' to -40.5' (Organic SILT with occasional shells)
FD-3	285615.17	881326.79	-30.9	-40.9	-30.9' to -38.9' (Organic SILT with occasional shells to organic SILT with occasional shells a trace of sand); -38.9' to -40.9' (CLAY in laminated layers)
FD-4	286040.16	880126.79	-23.2	-43.2	-23.2' to -31.8' (Organic SILT); -31.8' to -33.2' (CLAY); -33.2' to -35.2' (Organic SILT); -35.2' to -43.2' (CLAY)

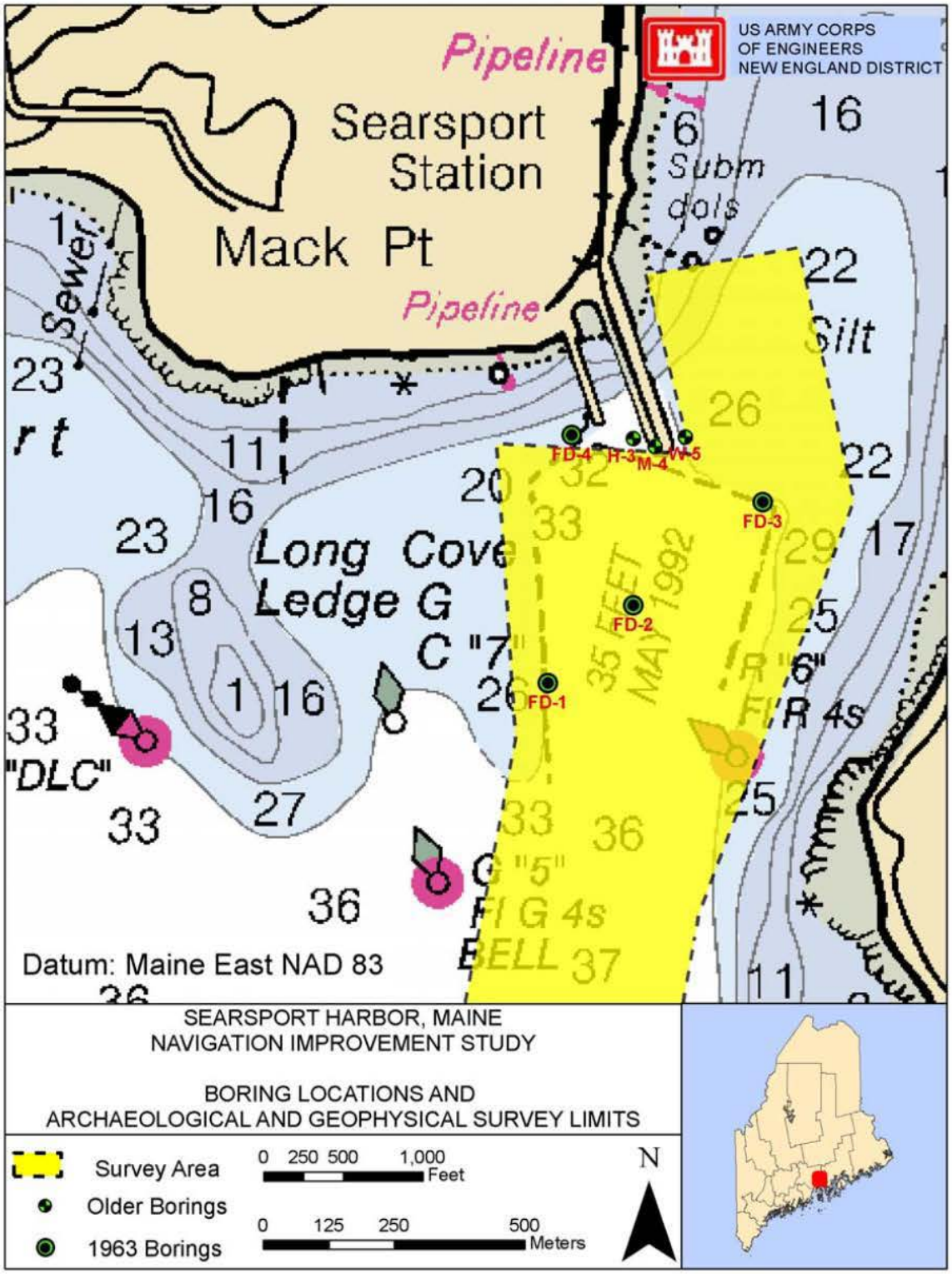

Figure 3. Northern portion of the Searsport study area and borings (see Table 2) (soundings are ft below MLLW).

4.2.2 Contract Option – Piscataqua River Turning Basin

Figure 4 shows the Piscataqua study area and location of available boring and probe data. Coordinates for the study area polygon are in Table 3.

Table 3. Points defining the Piscataqua River study area are listed below (Maine West State Plane, NAD27).

Point	Northing	Easting
1	105174.757	328653.9
2	104225.074	329410.631
3	102712	329896
4	103638.256	328777.994
5	104460.107	328542.193
6	104977.482	328091.73

Two probes completed near the proposed turning basin show mud, sand and loose stone in retrieved samples (Table 4, Figure 4). Probe Number 11 went to a depth of 37.4-ft below MLW and penetrated 6.1-ft before hitting refusal. Depth of water was 31.5-ft. Probe Number 18 went to a depth of 32.7-ft below MLW before hitting refusal after 8.9 feet. Depth of water was 29.4-ft. These probes were taken with a pointed ¾" iron pipe forced into the sediment by two men in a skiff. They were taken between August 31 and September 2, 1960 (USACE File No. 1505 D-8-3).

Table 4. Historic probe data near the proposed Piscataqua River turning basin shown in Figure 4 (Maine West State Plane NAD27).

Probe	Northing	Easting	Depth of Water (ft below MLW)	Depth of Probe (ft below MLW)	Penetration (ft)	Material
P-11	102879	329093	-31.5	-37.4	6.1	Mud & sand, Refusal
P-18	102800	329179	-29.8	-32.7	8.9	Loose stone - Gravel – Refusal

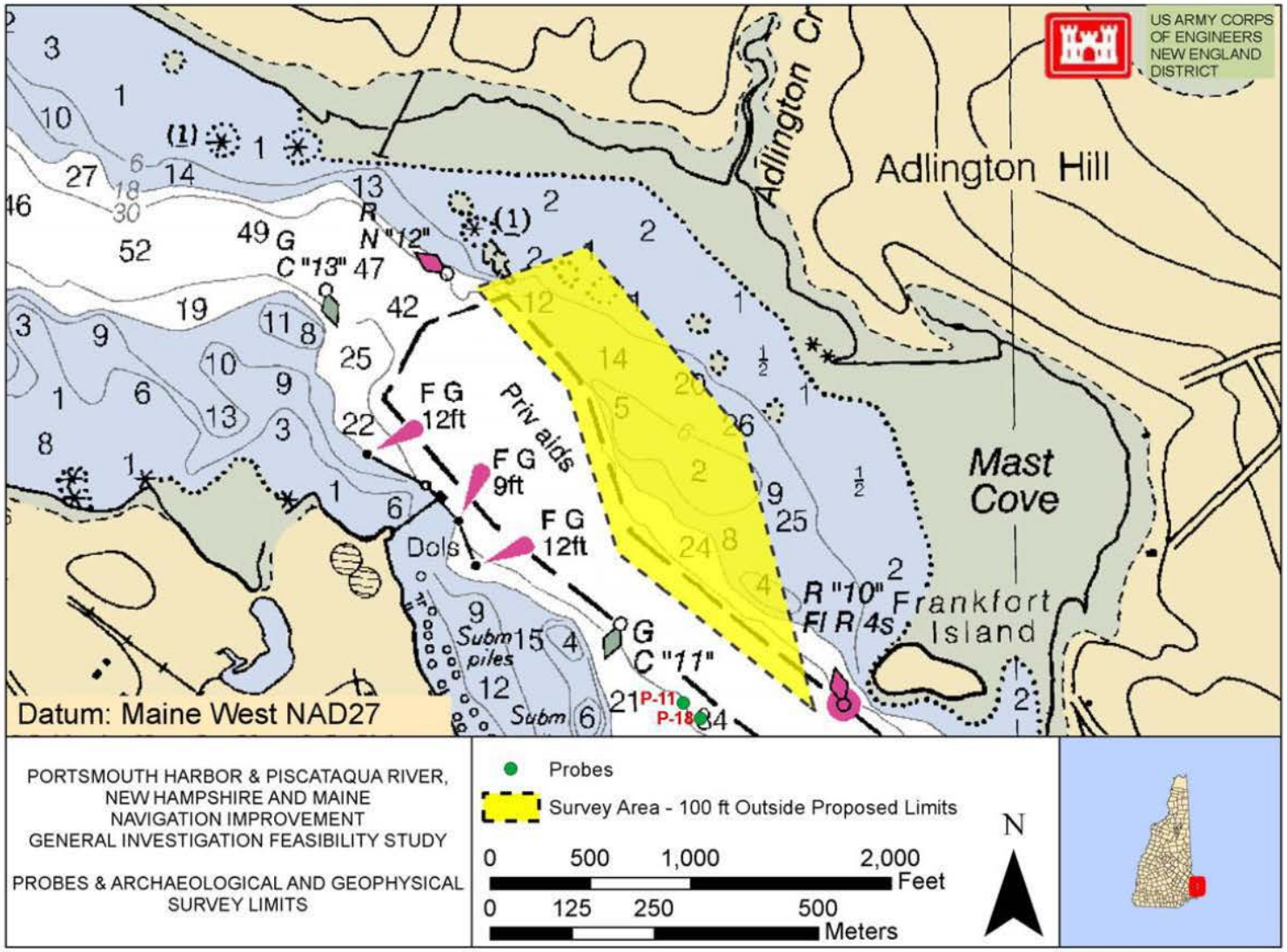

Figure 4. Location of existing probes near the proposed Piscataqua River turning basin (soundings are ft below MLLW).

5.0 REMOTE SENSING ARCHAEOLOGY

The Contractor shall utilize a systematic, interdisciplinary, synergistic approach to conducting the study. Specialized knowledge and skills will be used during the course of the study to include expertise in the disciplines of maritime archaeology, geology, history, marine architecture, and any other discipline as required. Techniques and methodologies used for the study shall be representative of the state of current professional knowledge and development.

Preliminary statements of resource significance and project impacts should be provided. A qualified archaeologist familiar with the area and underwater prehistoric resources should also provide an assessment of the prehistoric potential of the study area. Preliminary assessments of significance should be formulated.

Prepare a report describing the results of the survey, including archaeological resources identified, magnetic anomalies encountered and recommendations for further investigations. Recommendations should be made as to whether archaeological subsurface testing (i.e. vibracores) is warranted to determine the presence of submerged prehistoric deposits. Recommended locations shall be summarized in a table of prioritized proposed vibracore locations, estimated total depths, and rationales shall be included.

The report will serve several functions. It will assist USACE in fulfilling legal obligations under Section 106 of the National Historic Preservation Act of 1966 as amended and 36 CFR 800. It is also a scholarly document that not only fulfills the mandated legal requirements but serves as a scientific reference for future professional studies as well.

6.0 SAFETY AND HEALTH REQUIREMENTS

6.1 Accident Prevention Plan

The Contractor shall prepare an Accident Prevention Plan (APP) specific to the activities being performed (see Appendix A). It shall include an Activity Hazard Analysis (AHA) as described in 6.2 below. All work shall be conducted in accordance with the APP, the U.S. Army Corps of Engineers Safety and Health requirements Manual (USACE, 2003), and all applicable federal, state, and local safety and health requirements. A copy of EM 385-1-1 can be accessed electronically at www.usace.army.mil/inet/usace-docs/eng-manuals/em385-1-1.

The APP shall detail how safety and health will be managed during the project. The APP shall address the requirements of applicable Federal, State and local safety and health laws, rules, and regulations. The Contractor shall comply with Federal Acquisition Regulation Clause No. 52.236-13 for Accident Prevention, which is added by reference. Special attention shall focus on the requirements of EM 385-1-1, specifically Section 01.A.11 through 01.A.18, Figure 1-1 AHA, and Appendix A, (Minimum Basic Outline for Accident Prevention Plan). The APP shall be developed by a qualified person. The contractor shall be responsible for documenting the qualified person's credentials. Work shall not proceed until the APP has been reviewed and approved by the Government Designated Authority (GDA) Sheila Winston (978-318-8159; sheila.m.winston@nae02.usace.army.mil) and deemed acceptable for use on the project.

The APP shall interface with the Contractor's overall safety and health program. Any portions of the Contractor's overall safety and health program referenced in the APP shall be included in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract, the penalties for noncompliance, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.

The Contractor shall conduct a safety meeting at the project site on the first day of work, whenever a new activity or phase of work begins, or at least weekly during the progress of work. All safety meetings shall be documented (See Figure 5 for an example). The attached safety meeting form or a similar contractor-prepared form shall be used. Records of the safety briefings shall be submitted to the GDA weekly.

WEEKLY SAFETY MEETING

Date Held: _____

Time: _____

CONTRACTOR: _____ Contract No. DACW33-

PERSONNEL PRESENT (check): Contractor ____ Sub. ____ Government ____

SUBJECTS DISCUSSED (check items that were discussed during meeting):

USACE EM385-1-1 _____ (Specific sections: _____)
On-site Accident Prevention Plan (or Site Safety and Health Plan) _____
Individual protective equipment (steel-toed boots, safety glasses, etc..) _____
Prevention of slips/falls _____
Back injury/safe lifting techniques _____
Fire prevention _____
First aid _____
Tripping hazards _____
Equipment inspection and maintenance _____
Hoisting equipment, winch and crane safety _____
Ropes, hooks, chains, and slings _____
Water safety _____
Boat safety _____
HAZMAT, Toxic hazards, MSDS, respiratory, ventilation _____
Staging, ladders, concrete forms, safety nets, handrails ____
Hand tools, power tools, machinery, chain saws _____
Vehicle operation safety _____
Electrical grounding, temporary wiring, GFCI _____
Lockouts/safe clearance procedures _____
Welding, cutting _____
Excavation hazards/rescue _____
Loose rock/steep slopes _____
Explosives _____
Sanitation and waste disposal _____
Clean-up, trash _____

Other safety issues of concern specific to contract that was discussed during meeting:

All persons attending meeting the meeting must sign below or on the back of the form.

Contractor Representative Signature _____ Date: _____
CE Inspector/QA (if present at meeting) _____ Date: _____

Figure 5. Example of weekly safety meeting form.

6.2 Activity Hazard Assessment

An AHA shall be submitted for each major phase of work. A major phase of work is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform the work. The analysis shall define all activities to be performed, identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. Work shall not proceed on a phase of work until the AHA has been accepted by the GDA. A preparatory meeting shall be conducted by the contractor to discuss the AHA contents with all engaged in the activity. The preparatory meeting shall be conducted by the prime contractor and shall include all subcontractors and Government on-site representatives. The AHA shall be continuously reviewed and revised to address changing site conditions or operations as appropriate.

6.3 Accident Reporting

All accidents and near misses shall be investigated by the Contractor. All work-related recordable injuries, illnesses and property damage accidents (excluding on-the-road vehicle accidents), in which the property damage exceeds $2,000.00, shall be verbally reported to the GDA within 24 hours of the incident. Serious accidents as described in EM 385-1-1 Section 01.D.02 shall be immediately reported to the GDA. ENG Form 3394 shall be completed and submitted to the GDA within five working days of the incident.

The Contractor shall complete the "USACE Contractor Monthly Summary Record of Injuries/Illness and Work Hour Exposure" (for prime and its subcontractors) shown in Figure 6, and forward the completed form to the GDA no later than close of business on the 10th calendar day of the following month. The method of transmission by the prime contractor to the GDA shall be electronically.

US Army Corps of Engineers

USACE PRIME CONTRACTOR
Monthly Record of Work-Related Injuries/Illnesses & Exposure

Month _____
Year _____

In accordance with the provisions of EM 385-1-1, Section 01 Program Management, Paragraph 01.D Accident Reporting and Recording, sub-paragraphs 01.D.05, you (the Prime Contractor) shall provide a monthly record of all exposure and accident experience incidental to the work (this includes exposure and accident experience of the Prime Contractor and its sub-contractor(s). As a minimum , these records shall include exposure work hours and a record of occupational injuries and illnesses that include the data elements listed below. Definitional criteria for each data element is found in 29 CFR Part 1904. If the maintenance of OSHA 300 Logs are required by OSHA, most of this information can be obtained from those logs. If data on log provided below is revised after it is submitted to USACE, Contractor shall provide a revised report to the GDA. You must complete the USACE ENG Form 3394, Report of Accident Investigation Report for all recordable accidents. If you're not sure whether a case is recordable, call your local Safety and Occupational Health Office for help.

USACE Command _____
Contractor Name _____
Contract Number _____
Project Title _____
City _____ State _____
USACE Office Overseeing Work:

Identify the person							Describe The Case		Classify the case												
									Using these categories, check ONLY the most serious result for each case:				Enter the number of days the injured or ill worker was:		Check the "Injury" column or choose one type of illness:						
															(M)						
(A)		(B1)	(B2)	(B3)	(C)	(D)	(E)	(F)	Death	Days away from work	Remained at work		On job transfer or restriction (days)	Away from work (days)	Injury	Skin Disorder	Respiratory Condition	Poisoning	Hearing Loss	All other Illnesses	
Company Name	Prime or Sub (P or S)	Age	Gender	Date Employee Began Work on Job Covered by Contract	Job Title (e.g., Welder)	Date of Injury or onset of Illness (mo./day)	Where the event occurred (e.g. Loading dock north end)	Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)			Job transfer or restriction	Other record-able cases									
									(G)	(H)	(I)	(J)	(K)	(L)	(1)	(2)	(3)	(4)	(5)	(6)	
									0	0	0	0	0	0	0	0	0	0	0	0	

For Government Use Only

TYPE OF WORK ACTIVITY (Choose One):

Construction		Environmental Remed.	
Opn & Main.		Superfund	
Eng. Services		FUDS	
Dredging		IRP	
Rsch. & Dev.		FUSRAP	
Emerg. Opns.		Ordinance/Expl. Cleanup	
Other		Environmental Other	

Type of Contract (Choose One):

Civil Works	
Military Programs	
Other	

Exposure Hours	
Month	
Year to Date	

Certification of Record	
Name of Person Submit. Record	
Signature	
Date	

Page ___ of ___

Figure 6. USACE Monthly Accident Reporting Form

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

The contractor will be held responsible for the quality of their submittals and for all damages caused to the Government because of his/her negligence in the performance of any services furnished under this task order.

Although the Government reviews submissions required under this task order, it is emphasized that work must be scrutinized using proper internal controls and review procedures to meet USACE (2002, 2001a, 2001b, 1995) and company requirements. The letter of transmittal for each submission must indicate that the submission has been subjected to review and coordination procedures to ensure

a) Completeness for each discipline commensurate with the level of effort required for that submission.
b) Compliance with this SOW and USACE Guidance (USACE 2006, 2003, 2002, 2001a, 2001b, 1995)
c) Reviewed by an experienced technical writer or editor for grammar, punctuation, subject-verb agreement, paragraph organization, agreement between tables, text, figures, and plates.
d) Elimination of conflicts, errors, and omissions.
e) The overall professional and technical accuracy of the submission.

Documents, which are significantly deficient in any of these areas, will be returned to the contractor for correction and/or upgrading prior to Government review. Contracted submission due dates will not be extended if a resubmission of draft material is required for this reason. It is requested that the Contractor indicate in writing in the fee proposal letter their cognizance of this requirement and the contractor firm and its associates have the professional competency and technical expertise necessary to accomplish this project in a satisfactory manner. Reports and information, raw data and modeled results, generated under this task order shall become the property of the Government and distribution to any other source by the Contractor is prohibited.

8.0 SCHEDULE AND DELIVERABLES

8.1 Draft and Final APP, AHA, and Work Plan

The Contractor shall develop a written Work Plan describing the equipment and procedures to be used to collect geophysical data, and the Accident Prevention Plan (APP) and Activity Hazard Analysis (AHA). The intent of this work plan is to document to an audience with science and engineering backgrounds how data collection will occur, how data will be processed, and how it will be interpreted using existing Standard Operating Procedures, ASTM guides, etc. The work management plan shall included:

- Completing coordination tasks before, during, and after execution of fieldwork
- How geophysical data will be collected and managed in the field, including backups
- How positional data will be collected and managed in the field, including backups and minimum number of satellites needed for positional precision and accuracy
- Procedures and equations for data reduction and evaluation

This Work Plan shall be submitted to USACE for approval within seven days of receipt of the Notice to Proceed. Approval of this plan shall be received by the Contractor from USACE prior to the start of on-site work. USACE will provide a review response within five (5) days of receipt of this work plan. **All fieldwork shall be completed by 31 December 2006.**

8.2 Reporting Requirements

8.2.1 General Requirements

The report shall also contain the following items:

Discussion of equipment and methods used during field program, and explanation for any deviations from the Work Plan.

The daily narratives of field operations as written in the field, including any additional field notes produced, and any records from the weekly safety meetings.

Full-size plans for the study areas investigated showing bathymetry, locations of lines, areas suspected of having hard material within dredging limits, locations of potential cultural resources and/or objects/obstructions identified by magnetometer and/or side scan sonar, etc. Plans shall be of a quality and at a scale suitable for use in scoping future subsurface investigations, during design, and for incorporation in dredging plans and specifications. Additional figures shall be prepared as needed, and other figures deemed necessary and appropriate for summarizing results (dense till extent and thickness map, for example, if encountered).

Draft and final bedrock maps (boat chart format) shall be in the project coordinate system, identify areas of uncertainty, or areas where coverage could not be obtained (holiday areas)..

Final seismic deliverables **for each QA profile** shall include:

- Portion of the processed seismic profile encompassing a boring

- Mud line identified
- All depths relative to MLLW in feet
- Compass quadrant assigned to each end of the profile
- Nearby boring results extrapolated onto the interpretation
- An Excel file containing location and elevation data for all bedrock picks

The Contractor shall prepare a transmittal cover letter when furnishing the final submittal for this project. The letter shall include a statement that all comments have been addressed and incorporated and all requirements have been met.

All data, reports, and related materials obtained as a result of this contract shall become the property of the U.S. Government and shall be turned over to the Contracting Officer, USACE Office, upon completion of the contract, **with the exception of any cultural remains or artifacts recovered as a result of the study**. **These resources are the property of the State of Maine, except in cases stipulated within the Standards and Guidelines for Abandoned Shipwrecks Investigations.**

All marine geophysics submittals to the Government shall be directed to the U. S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751, Attn: Mr. Drew M. Clemens.

All marine archeology submittals to the Government shall be directed to the U. S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751, Attn: Mr. Marcos Paiva.

8.2.2 Preliminary Draft Data Deliverables

Preliminary estimated top-of-bedrock interpretations are due to USACE within 28 calendar days following completion of field work for internal, USACE-only use (Table 5). All vertical and horizontal dimensions shall be in US feet. Data will be relative to the project horizontal and vertical datums specified in the USACE hydrographic surveys.

Table 5. Report deliverables and distribution of electronic and paper copies.

Deliverables	CD/FTP*	Paper*
Preliminary Draft Plots	FTP	0
Draft Plots and Report	FTP	12
Final Report	FTP	12 w/ Data CDs

* Documents shall not be sent to regulatory agencies by USACE or its team members until comments have been received and incorporated from internal USACE review or until the USACE has directed the team to do so.

8.2.3 Draft Report Deliverables

Draft QA profiles and maps shall be presented to USACE for internal review and discussion 45 calendar days after completion of the fieldwork phase (Table 5). These profiles shall have the borings plotted onto the panels along with the pertinent results (refusal, bedrock, sediment type), and presented with the draft map plots. Vertical and horizontal scales shall be in US feet. Profile intersections shall be noted on each profile.

Draft bedrock picks shall be submitted electronically in an Excel file format. Location and elevation shall be in the project datums. All data shall be qualified using a system selected by the contractor and explained in each data table.

Draft bedrock maps shall be submitted in PDF, AutoCAD, and Microstation compatible file formats. Holiday areas and areas where penetration was limited due to organics shall be identified. Basemap shall be the USACE 2005 conditions survey. Process the seismic data and make static corrections for delays, offsets, and velocities. Pick the acoustic basement (potential bedrock) reflector at a suitable spacing to depict the slope/shape of the surface. Export the picks to an ASCII file. Cross check the data output, and verify the data match up at cross lines or tie lines. Convert the ASCII XYZ file to the site's horizontal datum. **Submit the ASCII XYZ file (NAD 27) of the acoustic basement (CD or DVD).**

Contour the ASCII XYZ data file, where the acoustic basement, with a one-foot contour interval, using appropriate contouring software. Also use geologic background and professional judgment to correct for artifacts of the contouring program. Export the contoured surface to an ASCII XYZ file. **Submit the ASCII XYZ file in the site's horizontal datum of the contoured surface (CD or DVD).**

8.2.4 Final Report Deliverables

Final plots and an integrated interpretation incorporating USACE review comments shall be submitted in accordance with Table 5. All dimension units shall be in feet, and geophysics units shall be metric. Those profiles passing near existing borings shall have the borings plotted onto the panels along with the pertinent results (refusal, bedrock, sediment type), and presented with the final map plots and report text as supporting figures. The report shall include electronic copies of all seismograms, seismic and magnetic data, and scanned field notes. The final report is due 40 calendar days after receipt of USACE comments.

The professionally labeled CD or DVD accompanying the final report shall contain PDF files of all interpreted profiles and report text. Data files in each site's DVD shall be categorized using clearly labeled sub-folders. The DVD accompanying the final report shall contain raw seismogram data files in the SEG-2 standard established by the Society of Exploration Geophysicists (Pullan, 1990), travel-time arrival picks and shot-receiver geometry information in ASCII format. Data files will be categorized using clearly labeled sub-folders. A README file shall accompany the data, explaining positional and geophysical data integration steps used. Scanned copies of field notes taken in conjunction, or in lieu of, field forms shall also be included. A README file shall accompany the data, explaining positional and geophysical data integration.

9.0 COORDINATION

All field activities and site visits as appropriate for this project shall be coordinated by telephone at least five days prior to actual commencement of work with both Mr. Drew Clemens (978-318-8861) and Mr. Marc Paiva (978-318-8796) of the Engineering/Planning Division, New England District (NAE). At a minimum, during the progress of the fieldwork, the Contractor's inspector shall coordinate with NAE upon completion of work each day (phone call), and when any difficulties or questions arise requiring NAE input.

10.0 CLEANING AND WASTE HANDLING PROCEDURES

All solid and liquid wastes shall be containerized and properly disposed of on shore in accordance with harbor requirements.

11.0 REFERENCES

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USACE, 2001a. EM 200-1-3 Requirements for the Preparation of Sampling and Analysis Plans.

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APPENDIX A - MINIMUM BASIC OUTLINE FOR ACCIDENT PREVENTION PLAN

An accident prevention plan is a dynamic project specific safety and health policy and program document. The following areas are typically addressed in an accident prevention plan, but a plan will be **job-specific** and shall address any unusual or unique aspects of the project or activity for which it is written. The accident prevention plan shall interface with the employer's overall written safety and health program. Referenced sections of the employer's company General Safety Program, shall be included as appropriate.

1. SIGNATURE SHEET. Title, signature, and phone number of the following:
a. plan preparer (corporate safety staff person, QC);
plan approval, e.g. Certified Safety Professional or Certified Industrial Hygienist;
plan concurrence (provide concurrence of other applicable corporate and project personnel (contractor), e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional, project QC as warranted.

2. BACKGROUND INFORMATION. List the following:
a. contractor;
b. contract number;
c. project name;
d. brief project description, description of work to be performed, and location (map);
e. contractor accident experience (provide information such as EMR, OSHA 300 Forms, corporate safety trend analyses);
f. listing of phases of work and hazardous activities requiring activity hazards analyses.

3. STATEMENT OF SAFETY AND HEALTH POLICY. (In addition to the corporate policy statement, a copy of the corporate safety program may provide a significant portion of the information required by the accident prevention plan).

4. RESPONSIBILITIES AND LINES OF AUTHORITIES.
a. identification and accountability of personnel responsible for safety-at both corporate and project level (contracts specifically requiring safety or industrial hygiene personnel should include a copy of their resume - the District Safety and Occupational Health Office will review the qualifications for acceptance).
b. lines of authority

5. SUBCONTRACTORS AND SUPPLIERS. Provide the following: .
a. identification of subcontractors and suppliers (if known);
b. means for controlling and coordinating subcontractors and suppliers;
c. safety responsibilities of subcontractors and suppliers. It should be noted that the Prime Contractor is responsible for ensuring that all subcontractors have the necessary written health and safety programs in place, have provided their employees with the necessary training, and subcontractors conduct their work in accordance with all relevant Occupational Health and Safety Standards which includes OSHA, USACE and ANSI at a minimum.

6. TRAINING.
a. list subjects to be discussed with employees in the safety indoctrination.
b. list mandatory training and certifications which are applicable to this project (e. g., U.S. Coast Guard Licensed Captain etc. and any requirements for periodic retraining/recertification.
c. identify requirements for emergency response training.

d. outline requirements (who attends, when given, and who will conduct etc,) for supervisory and employee safety meetings.

7. SAFETY AND HEALTH INSPECTION. Provide details on:
a. who will conduct safety inspections (e.g., project manager, safety professional, QC, supervisors, employees, etc.), when inspections will be conducted, how the inspections will be recorded, deficiency tracking system, follow-up procedures, etc;
b. any external inspections/certifications which may be required (e.g., Coast Guard).

8. SAFETY AND HEALTH EXPECTATIONS, INCENTIVE PROGRAMS, AND COMPLIANCE.
a. the company's written safety program goals, objectives, and accident experience goals for this contract should be provided.
b. a brief description of the company's safety incentive programs (if any) should be provided.
c. policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified.
d. provide written company procedures for holding managers and supervisors accountable for safety.

9. ACCIDENT REPORTING. The contractor shall identify who shall complete the following, how, and when:
a. exposure data (man-hours worked);
b. accident investigation, reports and logs;
c. immediate notification of major accidents.

10. MEDICAL SUPPORT. Outline on-site medical support and off-site medical arrangements.

11. PERSONAL PROTECTIVE EQUIPMENT. Outline procedures (who, when, how) for conducting hazard assessments and written certifications for use of personal protective equipment.

PLANS (PROGRAMS, PROCEDURES) REQUIRED BY THE SAFETY MANUAL (as applicable). Written plans and/or procedures addressing the following project specific items shall be included in the Contractor's Accident Prevention Plan. It is the Contractor's responsibility to review the entire list and provide the appropriate information. If an item is not applicable to the project then the Contractor shall note it as such with a statement of: "not applicable." For those items which are applicable to the project, the Contractor shall ensure that the information and standard operating procedures are applicable to the work which will be performed.

hazard communication program (01.B.04);
emergency response plans:
- procedures and tests (01E.01)
- spill plans (01.E.01, 06.A.02)
- firefighting plan (01.E.01, 19.A.04)
- posting of emergency telephone numbers (01.E.04)

health hazard control program (06.A.02);
hazardous energy control plan (12.A.07);
contingency plan for severe weather (19.A.03);
floating plant and marine activities (section 19)
personal protection equipment (section 5, especially 05.I).

plan for prevention of alcohol and drug abuse (Defense Federal Acquisition Regulation Supplement Subpart 252.223-7004, Drug-Free Work Force);

13. OTHER. The contractor shall also provide information on how he will meet the requirements of other major sections of EM 385-1-1, not identified in a-h above, in the accident prevention plan. Particular attention shall be paid to medical and first aid requirements, sanitation, personal protective equipment, fire prevention, machinery and mechanized equipment and thermal extremes as they may apply to this project. Detailed site-specific hazards and controls shall be identified in the activity hazard analysis for each phase of the operation.

APPENDIX B

FIELD NOTES

FIELDNOTES

Prepared by
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Prepared for
Department of the Army
New England District, Coprs of Engineers
Contract No. DACW33-03-D-002 IDIQ

Searsport Harbor, ME and Portsmouth Harbor, Piscataqua River, NH and Maine Marine Archaeology and Geophysics

December 13, 2006 (Wednesday)
Travel day: PAL to Searsport, ME

December 14, 2006 (Thursday)
0615: meet OSI and leave hotel for boat

0700: arrive at boat and perform inspection

0730: conduct & document project safety meeting;
Note: OSI is using a different make of boat than that specified in the Float Plan – a 25-ft Parker 25 w/twin 150-horse o.b. engines - CT Reg. # 8934 AX
conduct nav check at dock and prepare boat/survey equipment for in-water on-site testing & tuning
Weather conditions: Temp: 40F+; Wind: none; Seas: calm; Sky: overcast

Survey Equipment:
Hypack Hydrographic Survey Software
Side Scan Sonar (SSS) - Klein 3000
Sub-bottom Profiler (SBP) - Applied Acoustics/OSI "Boomer"
Marine Magnetometer (Mag) - Geometrics 882 (with altimeter)
Global Positioning System (GPS) - Trimble 4000 with Leica MX-52 Differential Receiver using the Brunswick, ME USCG beacon (transmitting at 316 kHz/100 BPS)

0755: arrive in PA; deploy instruments to begin on-site testing/tuning; have trouble with SBP; will survey with mag only while trouble-shooting SBP to identify & fix problem

Settings:
Events/Fixes: every 200 ft
20-gamma scale on mag readout
approx. 25 ft scale on SBP readout
SSS range set at 50 m (165 ft)

1330: running mag (only) in-fill lines because having trouble with SSS and SBP

1630: end surveying for the day; return to dock; call Barbara Blumeris @ USACE-NAE to give status report; OSI continues working on SBP problem; order new boomer plate and power supply as back-up in case problem can't be fixed
1700: leave boat for hotel

December 15, 2006 (Friday)

0600: leave hotel for boat

0630: arrive at boat and prep to get underway
Weather conditions: Temp: 33-35 F; Wind: none; Seas: calm; Sky: foggy, but can see across Searsport Harbor

0700: leave dock for project area

0715: arrive at PA and prep to survey – problems with SSS creating noise in mag data; note that water color is amber-brown color with underwater visibility appearing to be just 3 to 5-ft

0845: begin surveying – could not eliminate SSS noise in mag data, so continuing with mag (only) in-fill track lines;

1615: end surveying for day; return to dock

1630: call USACE-NAE with project status update; leave dock for hotel

December 16, 2006 (Saturday)

0600: leave hotel for boat

0630: leave dock for project area
Weather conditions: Temp: 35F; Wind: none; Seas: calm; Sky: partly cloudy

0645: begin surveying
Plan for today is to finish remaining mag (only) in-fill track lines and then start surveying the SSS/SBP/mag lines tomorrow

1145: note floating boom is in NE section of PA and will need to be moved prior to surveying; OSI contacts Wayne Hamilton (Searsport Harbormaster) for assistance in getting it moved; Hamilton directs OSI to contact Dwayne Seekings @ Sprague Energy (207) 548-2531 to get removed; Seekings directs OSI to contact Charles @ Clean Harbors (207) 852-9265, ext. 0100) to have the boom moved; Charles reports that only boom, not boom anchors & buoys can be moved and will call back to coordinate further

1205: mag re-rigged for surface tow to survey shallow NW section of PA

1310: Wade Henry from Clean Harbors calls; boom will be moved out of our way first thing Monday a.m.

1445: end surveying for the day
All of mag (only) infill track lines are essentially done in long section of PA as well as in nearly all of the NE section of the PA; OSI setting up new SBP to run tomorrow

1500: return to dock; transcribe fieldnotes & preliminary anomaly inventory to computer

1800: call USACE-NAE and leave project status update message on Barbara Blumeris's VM

1700: finish transcribing fieldnotes & preliminary anomaly inventory

December 17, 2006 (Sunday)

0600: leave hotel for boat

0630: leave dock for project area
Weather Conditions: temp: 30 F; wind: SW 5 kts; sky: partly cloudy

0700: arrive at PA; deploy & tune survey instruments
Plan for today is to run track lines with SBP, SSS & mag on every 3rd line, as all mag (only) in-fill lines are essentially done. Hopefully we can get everything done in the longer section of the PA and then do some of the shorter section track lines, leaving little to do tomorrow

0930: start surveying; have to run track lines with just SBP (only) due to noise & cross-talk between the mag , SBP, and SSS; this is unfortunate, as it now means we now have to re-run these lines with just SSS & mag

1200: Weather conditions change – Wind: SW 15-18 kts with maximum fetch across Penobscot Bay, Searsport Harbor and PA; Seas: 2-4 ft – too rough to continue surveying with SBP due to data drop-outs

1245: switched instrument configuration to just SSS and mag; continue surveying short lines in in more protected NE section of PA

1600: end surveying for the day

1630: return to dock; call USACE-NAE and speak with Barbara Blumeris re: project status update; continue transcribing fieldnotes and preliminary anomaly inventory to computer

December 18, 2006 (Monday)

0600: leave hotel for boat

0645: leave dock for PA
Weather conditions: Temp: 25F; Wind: light W-NW; Seas: 1 ft; Sky: overcast
Plan for day is to start with SBP (only) track lines in shallow northern end of PA because tide is high and seas are relatively calm

0730: Clean Harbors crew on-site to remove boom from NE section of PA

0745: Second (back-up) SBP power-supply fails and needs to be replaced; switch instrument configuration to continue surveying with just mag and SSS

1430: snagged SSS and mag tow cables in line attached to “ghost trap” (i.e., unmarked lobster trap); mag cable damaged and needs replacement

1500: mag cable replaced and tested; surveying continues; we “see” charted wreck – appears to be a larger (100-ft+) wooden-hulled sailing vessel

1630: end of surveying; retrieve instruments and return to dock
OSI has ordered another (#3) SBP power supply; earliest we can get it in Searsport is by 1500 hrs tomorrow, or at 1000 at the Fedex center in Bangor; I decide to drive to Bangor in the a.m. to pick up the power supply so we can survey with the SBP later in the day, while OSI is going to survey remaining mag & SSS lines, any “holidays” that need to be covered, and get more refined SSS images of the wreck to assist with planning of future diving/mapping task (i.e., Optional Task 9 of the USACE-NAE’s SOW).
Call USACE-NAE with project status update – given SBP problems, it’s going to be very difficult to complete Searsport and Portsmouth surveys during this deployment.

December 19, 2006 (Tuesday)

0600: meet with OSI; leave for Fedex center in Bangor

0930: get SBP power supply from Fedex; OSI completes all remaining mag and SSS surveying and gets great SSS images of wreck from multiple angles; need to get run, line, and events data from OSI and review data from these track lines

1035: arrive back in Searsport and meet boat at dock

1100: arrive at PA and prep to begin surveying with SBP
Conditions: Temp: 33F; Wind: W-NW 15 kts; Seas: 1-2 ft; Sky: clear-partly sunny

1645: end of surveying for day; retrieve instruments and return to dock; call USACE-NAE with project status update – barring any unforeseen problems, should finish survey at Searsport tomorrow a.m. and be on site in Portsmouth tomorrow afternoon ready to begin surveying following day (December 20 – Thursday)
Email SSS images of wreck to USACE-NAE and PAL Project PM Deborah Cox

December 20, 2006 (Wednesday)

0600: check out & leave hotel for boat

0630: leave dock for PA

0655: arrive in PA; equipment deployed; ready to survey

0915: Searsport survey complete; retrieve equipment and return to dock; prep. and haul boat for travel to Portsmouth, NH for USACE-NAE Piscataqua River survey; call USACE-NAE re: project status update; meet with Penobscot Marine Museum Executive Director, Niles Parker, re: assistance conducting research @ museum and knowledge re: the charted Searsport Harbor wreck in the PA that we imaged with the SSS; he says talk with the museum's archivist, Ben Fuller (bfuller@penobscotmarinemuseum.org)

1345: call PAL President and overall Project PM Deborah Cox with project status update

1415: arrive at marina in Portsmouth (Great Bay Marine); boat launched

1500: transit to PA to assess environmental conditions to assist in formulating strategy for tomorrow's surveying operations; site conditions present several challenges (large tidal differential, strong tidal currents, variable underwater topography (1-50 ft deep with steep rock ledge), vessel traffic, etc. and potential safety hazards that were not present in the Searsport PA – discuss with OSI

1645: arrive back at dock; call USACE-NAE with project status update; report results of reconnaissance assessment of PA and challenges it presents to completing survey in single day

1700: meet with OSI to formulate explicit survey plan to ensure greatest likelihood of success for completing survey tomorrow
Plan is to run all lines with just a single instrument deployed for enhanced safety; tide will be nearly dead low in the a.m., so we're going to survey deep water track lines that are in the navigation channel with SSS first to get a better sense of the "lay of the land" underwater and identify and assess and potential submerged hazards on the river bed; then we're running the mag lines in deep water, followed by the SBP deep water lines; tide should be high by the time we get done with the deep water work – so, we'll move

into the shallow water portion of the PA and run all the remaining lines with SBP and then SSS and mag

December 21, 2006 (Thursday)

0600: leave hotel for boat

0645: conduct weekly safety meeting; review general and site specific hazards; stress that safety is the foremost concern

0700: leave dock for Piscataqua River PA

0715: arrive at PA; deploy and tune SSS; prepare to survey

1000: deep water SSS and mag done; SBP deployed

1415: complete Pisctaqua River survey operations; retrieve instruments; return to dock to prep and haul boat for return travel to Old Saybrook, CT; fieldwork wrap-up meeting with OSI;

1700: call USACE-NAE and PAL Project Manager to report project field work complete; travel from Portsmouth, NH to RI

APPENDIX C

SIDE SCAN SONAR ANOMAY INVENTORY

Piscataqua River / Navigation Channel Improvement Project											
Side Scan Sonar Targets											
Date	***Run***	***Line***	***Event***	***Target ID #***	***Easting***	***Northing***	***Length***	***Width***	***Height or Relief***	***Comment***	***Associated Magnetic Anomaly***
					feet	feet	feet	feet	feet		
21-Dec	2	18	419.8	SS8	2781753	103748	3.6	1.6	1.3	curved	
			420.3	SS10	2781783	103665	3.0	2.3	1.0	rectangular, possible lobster pot	
			419.6	SS12	2781697	103749	40.0	0.3	<0.5	linear	
			420.1	SS13	2781759	103695	2.0	1.6	1.6	triangular	
			420.3	SS14	2781803	103656	35.4	2.3	1.0	broken linear	M1
			420.5	SS15	2781810	103605	4.9	3.6	1.3	rounded	
			422.0	SS19	2782018	103413	n/a	0.3	<0.5	long linear end	
			421.9	SS20	2781998	103413	2.3	1.0	0.7	small	
21-Dec	4	15	435.1	SS27	2781534	104225	13.1	6.6	5.2	possible angular, at edge of boulder field	
			436.7	SS28	2781741	103965	3.0	1.3	0.7	oval	
			436.9	SS29	2781769	103930	2.6	0.7	0.7	rectangular	
			436.7	SS30	2781701	103941	n/a	0.3	<0.5	long linear begin	
			437.0	SS31	2781784	103933	n/a	0.3	<0.5	long linear2 begin	
			437.3	SS33	2781717	103826	2.3	2.0	1.3	curved	
			437.6	SS34	2781818	103820	3.0	1.6	1.6	curved object	
			437.7	SS35	2781867	103823	n/a	0.3	<0.5	long linear2 end	
			438.0	SS36	2781900	103763	n/a	0.3	<0.5	begin long linear4	M16
			438.6	SS37	2781977	103691	13.1	2.0	0.3	wide linear	
			438.0	SS38	2781765	103667	5.6	3.9	0.7	curved	
			439.2	SS39	2782023	103565	4.6	3.0	3.9	angled, alonglong linear4 object	
			438.8	SS40	2781909	103563	5.9	0.7	0.7	2 linear approimately same size	
			439.2	SS41	2781958	103513	n/a	0.3	<0.5	approximate end of long linear3	
			439.7	SS42	2782126	103515	4.6	1.3	1.6	2 parallel rectangular	
			441.1	SS45	2782281	103289	7.2	4.6	1.3	rectangular	
			441.7	SS46	2782347	103184	1.3	1.0	1.0	small	
			447.7	SS49	2782498	102991	n/a	0.7	<0.5	end long linear4	
21-Dec	5	12	447.0	SS57	2782676	102950	n/a	0.3	<0.5	approximate beginning long linear	
			447.2	SS58	2782700	103003	5.6	1.0	1.0	2 objects, one oblong, one oval	M44

Piscataqua River / Navigation Channel Improvement Project											
Side Scan Sonar Targets											
Date	***Run***	***Line***	***Event***	***Target ID #***	***Easting***	***Northing***	***Length***	***Width***	***Height or Relief***	***Comment***	***Associated Magnetic Anomaly***
					feet	feet	feet	feet	feet		
			448.4	SS59	2782388	103096	8.5	0.7	0.3	linear	
			448.5	SS60	2782510	103203	3.3	1.3	1.3	small	
			449.8	SS61	2782338	103400	7.2	4.6	0.7	rectangular	
			451.3	SS62	2782135	103625	4.3	3.3	2.3	rounded	
			453.7	SS63	2781855	104021	n/a	0.7	<0.5	approximate end long linear	
			457.2	SS64	2781464	104578	6.2	4.6	5.2	angular, in boulder field	
			457.5	SS65	2781442	104642	5.6	7.5	<0.5	angular, in boulder field	
			456.9	SS66	2781458	104513	12.8	3.0	2.6	possible angular, in boulder field	
			458.2	SS67	2781301	104707	5.2	6.2	6.2	curved angular	M26
			459.4	SS68	2781148	104898	5.2	2.3	<0.5	rectangular	
			460.3	SS70	2781040	104992	4.9	2.6	5.9	oval	
21-Dec	24	1	663.4	SS71	2781750	104865	4.6	2.0	0.7	rectangular	
			663.7	SS72	2781827	104828	6.2	2.3	1.0	2 adjacent curved	
			663.7	SS73	2781789	104788	11.5	4.3	0.7	possible partially buried rectangular object	M55
			664.6	SS74	2781904	104685	17.4	<0.5	<0.5	linear depression	
			664.8	SS75	2781899	104613	5.2	2.0	1.0	3 oblong shapes	
21-Dec	25	4	674.0	SS79	2782249	103930	3.0	2.3	1.0	roughly rectangular	M69
			674.0	SS80	2782275	103946	3.9	3.9	1.0	square	M60
			673.8	SS81	2782298	103926	4.6	3.0	1.3	curved/round	
			674.7	SS82	2782181	104063	4.9	2.3	1.6	curved-angular	
			676.6	SS83	2782038	104420	3.3	2.6	1.0	oval	
			676.7	SS84	2782050	104443	3.9	1.6	1.0	linear	
			677.1	SS85	2781890	104429	4.9	1.3	0.7	2 objects approximate same size, oblong	
			677.5	SS86	2781864	104507	4.3	3.6	1.6	1 linear, 1 oblong	
			677.7	SS87	2781905	104608	8.2	5.6	3.3	curved	
			678.7	SS88	2781700	104682	4.6	3.6	1.0	angled	
			678.4	SS89	2781802	104694	12.1	3.0	1.0	curved angluar	
			679.3	SS90	2781613	104756	18.0	3.3	0.3	somewhat pointed	
			679.8	SS91	2781694	104951	18.4	3.6	<0.5	2 parallel linear	
			680.0	SS92	2781641	104968	3.6	4.6	0.7	rounded	
			680.2	SS93	2781596	104983	35.4	2.0	1.0	partially buried linear	M64
21-Dec	26	10	685.0	SS99	2781164	105060	6.2	0.3	<0.5	possible linear object	M87
			685.5	SS100	2781214	104964	4.3	1.0	1.3	curved next to round	

Piscataqua River / Navigation Channel Improvement Project

Side Scan Sonar Targets

Date	*Run*	*Line*	*Event*	*Target ID #*	*Easting*	*Northing*	*Length*	*Width*	*Height or Relief*	*Comment*	*Associated Magnetic Anomaly*
					feet	feet	feet	feet	feet		
			686.7	SS101	2781403	104821	8.5	1.3	1.3	possible curved-linear	
			688.7	SS102	2781524	104404	n/a	0.7	<0.5	begin linear	M27
			689.2	SS103	2781572	104324	n/a	0.7	<0.5	end linear	
			694.8	SS104	2782375	103507	5.6	2.6	1.3	oblong	
			697.8	SS105	2782672	102984	11.2	8.5	<0.5	area with curved and linear features	
			698.4	SS106	2782722	102915	<0.5	<0.5	<0.5	approximately 20m long striations with one rounded target	
21-Dec	28	7	706.7	SS108	2782477	103488	12.5	3.9	1.0	possibly partially buried object	
			706.9	SS109	2782462	103521	3.9	1.6	2.3	oblong	
			709.9	SS110	2782085	103978	17.4	27.2	3.6	oblong and curved-angular objects	
			710.3	SS111	2782058	104055	6.6	1.3	2.3	wide linear	
			711.7	SS112	2781867	104259	4.6	0.7	2.0	linear	
			712.6	SS113	2781769	104408	5.6	3.0	4.3	oval	
			713.5	SS114	2781631	104531	8.9	3.0	3.6	crescent-shape	
			714.2	SS115	2781641	104706	21.7	3.6	1.3	somewhat linear	
			714.8	SS116	2781575	104837	13.5	6.6	3.3	roughly rectangular	
			715.7	SS117	2781393	104883	5.9	2.6	1.0	oblong	
			715.8	SS118	2781347	104893	35.8	3.0	2.3	linear, possible partially buried object	
			715.6	SS119	2781445	104908	8.5	1.6	1.3	curved and linear	
			715.6	SS120	2781462	104922	8.9	2.0	3.0	possibly partially buried object	

NOTES:

1. Coordinates are referenced to the Maine State Plane system, West Zone 1802, NAD83, in feet.
2. Target sizes and dimensions are based on acoustic measurements only and have not been verified directly.
3. The side scan sonar method only identifies features located on (not below) the bottom.
4. Only targets evident on more than one side scan sonar image / trackline were mapped; targets located outside the survey areas were not mapped.
5. Target identification numbers are not sequential, as mutliple targets on overlapping images were removed from the data set.

APPENDIX D

MAGNETIC ANOMALY INVENTORY

Piscataqua River / Navigation Channel Improvement Project

Magnetic Anomalies

Date	Run	Line	Event	Anomaly ID#	Easting	Northing	Size	Type	Duration	Sensor Altitude	Dipolar ferrous mass (lbs)	Monopolar ferrous mass (lbs)	Associated Side Scan Target
					feet	feet	gammas		feet	feet	pounds	pounds	
21-Dec	7	16	472.0	M1	2781826	103643	12	D	67	45.7	1189.3	26.0	SS014
21-Dec	8	15	481.0	M3	2781944	103583	10	M+	25	45.5	978.2	21.5	
			482.0	M4	2781810	103750	15	M+	100	51.7	2152.5	41.6	
21-Dec	9	14	494.4	M7	2781739	103923	200	M+	60	29.9	5551.6	185.7	
			494.9	M8	2781662	104013	250	M-	25	35.6	11712.9	329.0	
21-Dec	10	13	500.4	M11	2782686	102808	110	M+	150	50.5	14710.9	291.3	
			507.3	M12	2781836	103874	190	M+	67	35.0	24514.8	491.3	
			509.9	M13	2781516	104283	50	M+	133	44.6	4606.3	103.3	
			509.3	M14	2781597	104180	20	M+	100	42.4	1583.1	37.3	
			501.3	M15	2782585	102936	18	M+	67	49.9	2322.5	46.5	
			506.6	M16	2781916	103768	20	M+	133	32.3	699.9	21.7	SS036
			507.6	M17	2781803	103921	20	M+	50	34.0	816.3	24.0	
21-Dec	11	12	514.5	M19	2782673	102864	150	D	225	47.8	17011.7	355.9	
			523.2	M20	2781621	104222	150	D	67	47.7	16905.2	354.4	
			524.0	M21	2781517	104365	40	M-	150	43.8	3490.2	79.7	
			526.8	M22	2781169	104777	140g	M+	133	47.7	15778.2	330.8	
21-Dec	38	11	825.4	M25	2781063	105032	8g	M-	40	27.1	165.3	6.1	
			827.4	M26	2781315	104715	75g	M+	200	39.8	4910.0	123.4	SS067
			829.2	M27	2781524	104412	10g	M+	33	42.9	819.9	19.1	SS102
			829.8	M28	2781593	104311	53g	D	100	38.9	3239.7	83.3	
20-Dec	1	18	413.3	M30	2781690	103669	100g	M+	225	18.6	668.2	35.9	
21-Dec	24	1	661.7	M31	2781565	105182	32g	D	133	7.3	12.9	1.8	
			665.8	M32	2782085	104524	20g	M-	133	26.0	365.0	14.0	
			667.2	M33	2782250	104319	35g	M+	133	28.4	832.5	29.3	
21-Dec	25	4	674.1	M35	2782332	103973	75g	M+	200	18.3	477.3	26.1	
			680.2	M36	2781576	104922	10g	M+	15	11.4	15.4	1.3	
21-Dec	26	10	686.9	M37	2781343	104738	40g	M+	200	21.5	412.8	19.2	
			689.4	M38	2781652	104348	5g	M+	18	10.1	5.3	0.5	
			690.4	M39	2781774	104199	12g	M+	29	6.8	4.8	0.7	
			690.6	M40	2781800	104167	10g	M+	33	7.3	4.0	0.6	
			692.9	M41	2782087	103807	30	M+	133	18.0	181.7	10.1	
			694.9	M42	2782339	103484	5	M+	67	8.6	3.3	0.4	
			695.3	M43	2782374	103439	15	M+	67	8.6	9.9	1.2	

Piscataqua River / Navigation Channel Improvement Project													
Magnetic Anomalies													
Date	***Run***	***Line***	***Event***	***Anomaly ID#***	***Easting***	***Northing***	***Size***	***Type***	***Duration***	***Sensor Altitude***	***Dipolar ferrous mass (lbs)***	***Monopolar ferrous mass (lbs)***	***Associated Side Scan Target***
					feet	feet	gammas		feet	feet	pounds	pounds	
			633.7	M44	879695	285016	33.9	M+	50	15.37	127.8	8.3	SS171
21-Dec	28	7	706.5	M47	2782563	103453	38	D	225	17.2	200.8	11.7	
			710.3	M48	2782091	104033	8	D	13	6.6	2.4	0.4	
			712.6	M49	2781802	104402	8	M+	33	5.9	1.7	0.3	
			716.5	M50	2781321	105012	15	D	100	30.2	429.0	14.2	
21-Dec	31	2	730.8	M52	2781707	104922	5	M+	20	6.6	1.5	0.2	
			729.3	M53	2781527	105153	10	M+	67	8.1	5.5	0.7	
			731.0	M54	2781730	104894	4	M+	20	6.8	1.3	0.2	
			731.6	M55	2781797	104806	20	M+	200	15.1	71.5	4.7	SS073
			733.7	M56	2782062	104482	30	M-	171	23.1	384.0	16.6	
			734.9	M57	2782215	104285	30	M+	133	24.0	430.7	17.9	
21-Dec	32	5	741.5	M60	2782297	103941	50	M+	200	24.8	792.0	31.9	SS080
			742.2	M61	2782213	104044	10	M+	67	14.4	31.0	2.2	
			748.4	M62	2781432	105016	18	M+	100	6.7	5.6	0.8	
21-Dec	33	3	752.3	M63	2781474	105146	35	M+	50	7.8	17.2	2.2	
			753.3	M64	2781590	104986	5	M+	17	6.8	1.6	0.2	SS093
			755.8	M65	2781923	104577	12	M+	100	22.7	145.8	6.4	
			757.9	M66	2782178	104252	15	M+	100	20.3	130.3	6.4	
			759.5	M67	2782375	104003	80	M+	175	11.0	110.6	10.1	
21-Dec	34	6	767.2	M69	2782256	103910	25	M+	200	21.9	272.7	12.5	SS079
			771.3	M70	2781749	104550	12	M+	150	19.9	98.2	4.9	
			771.8	M71	2781672	104655	25	M+	50	14.7	82.5	5.6	
			774.6	M72	2781327	105068	20	M-	125	6.3	5.2	0.8	
21-Dec	35	8	781.8	M73	2781696	104457	10	M+	50	7.4	4.2	0.6	
			782.5	M74	2781777	104355	5	M+	50	9.0	3.8	0.4	
			783.5	M75	2781914	104178	3	M+	25	7.3	1.2	0.2	
			783.7	M76	2781931	104157	5	M+	25	6.8	1.6	0.2	
			788.6	M77	2782541	103383	25	M+	200	14.8	84.2	5.7	
21-Dec	36	11	796.2	M79	2782300	103453	10	D	50	11.7	16.6	1.4	
			796.6	M80	2782240	103528	10	M+	67	12.4	19.8	1.6	
			798.2	M81	2782042	103778	20	M+	175	20.4	176.3	8.6	
			800.6	M82	2781748	104151	100	M-	50	6.1	23.6	3.9	
			804.9	M83	2781209	104821	50	M-	100	34.0	2040.7	60.0	
21-Dec	37	9	809.8	M87	2781149	105071	20	M+	50	6.1	4.7	0.8	SS099

Piscataqua River / Navigation Channel Improvement Project

Magnetic Anomalies

Date	*Run*	*Line*	*Event*	*Anomaly ID#*	*Easting*	*Northing*	*Size*	*Type*	*Duration*	*Sensor Altitude*	*Dipolar ferrous mass (lbs)*	*Monopolar ferrous mass (lbs)*	*Associated Side Scan Target*
					feet	feet	gammas		feet	feet	pounds	pounds	
			814.4	M88	2781717	104345	2	M+	7	8.4	1.2	0.1	
			815.4	M89	2781840	104197	15	M+	40	5.7	2.9	0.5	
			817.7	M90	2782122	103838	30	M+	100	12.5	60.8	4.9	
			819.5	M91	2782363	103543	10	M+	50	12.7	21.3	1.7	
			820.0	M92	2782422	103461	25	D	100	8.4	15.4	1.8	
			820.8	M93	2782506	103346	30	M+	175	11.3	45.0	4.0	
21-Dec	6	17	464.7	M94	2781852	103528	8	M+	29	20.2	68.5	3.4	

NOTES

1. Positions are referenced to the Maine State Plane Coordinate System, West Zone 1802, NAD83, in feet.
2. Estimated ferrous masses calculated using the following formulas:

   $W = T r^2 / 963$ for monopoles

   $W = T r^3 / 963$ for dipoles

   where W = weight of ferrous object, T = anomaly amplitude, r = distance between magnetic sensor and object

   *Magnetic moment is assumed at a median value of 963, but may vary by an order of magnitude between 175 and 1750.
3. Anomaly types: M+ = positive monopole, M- = negative monopole, D = dipole, CD = complex dipole
4. Anomaly identification numbers are not sequential, as those positioned outside the site limits were removed from the listing.

APPENDIX E

SUB-BOTTOM PROFILES & GEOTECHNICAL SAMPLING DATA

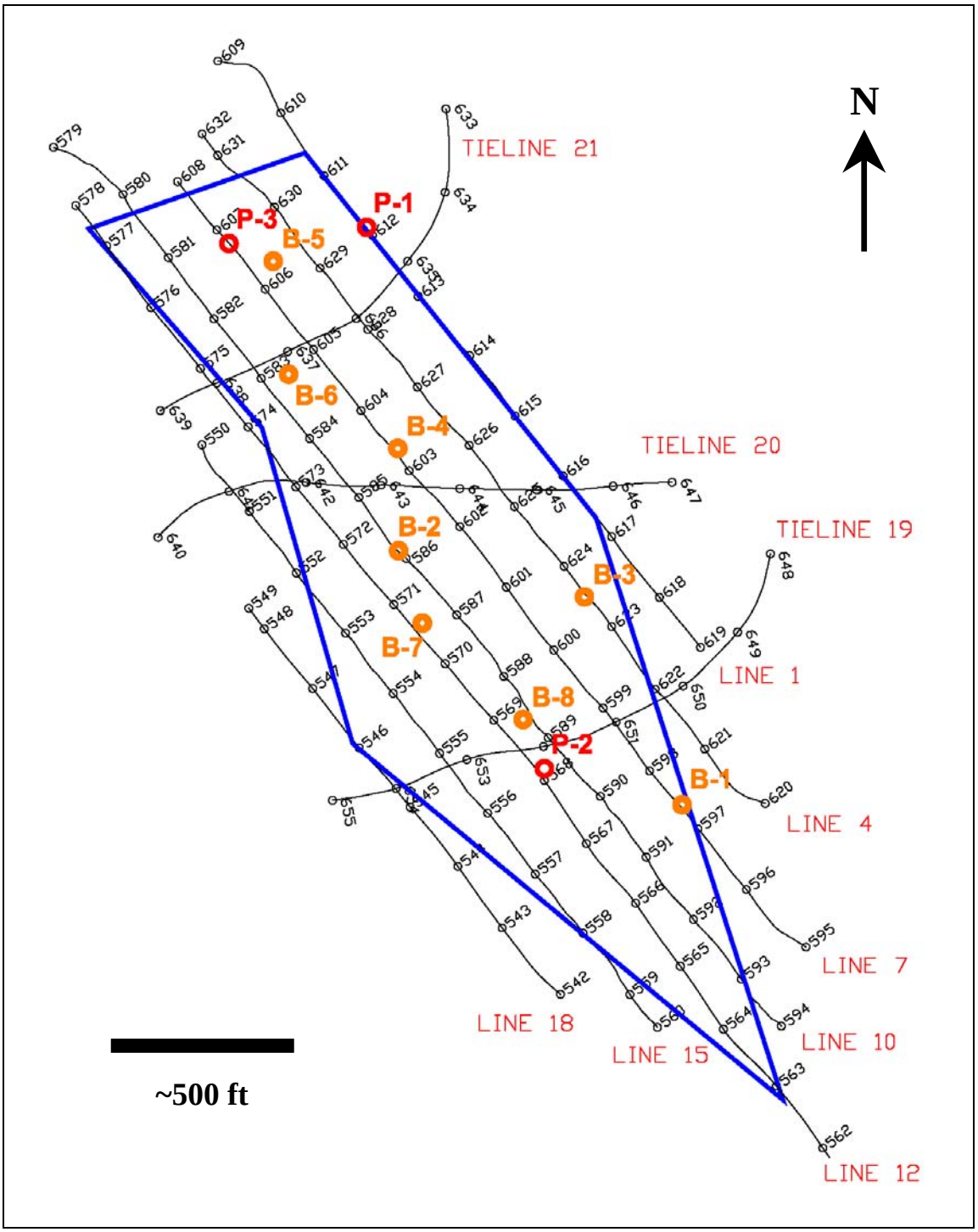
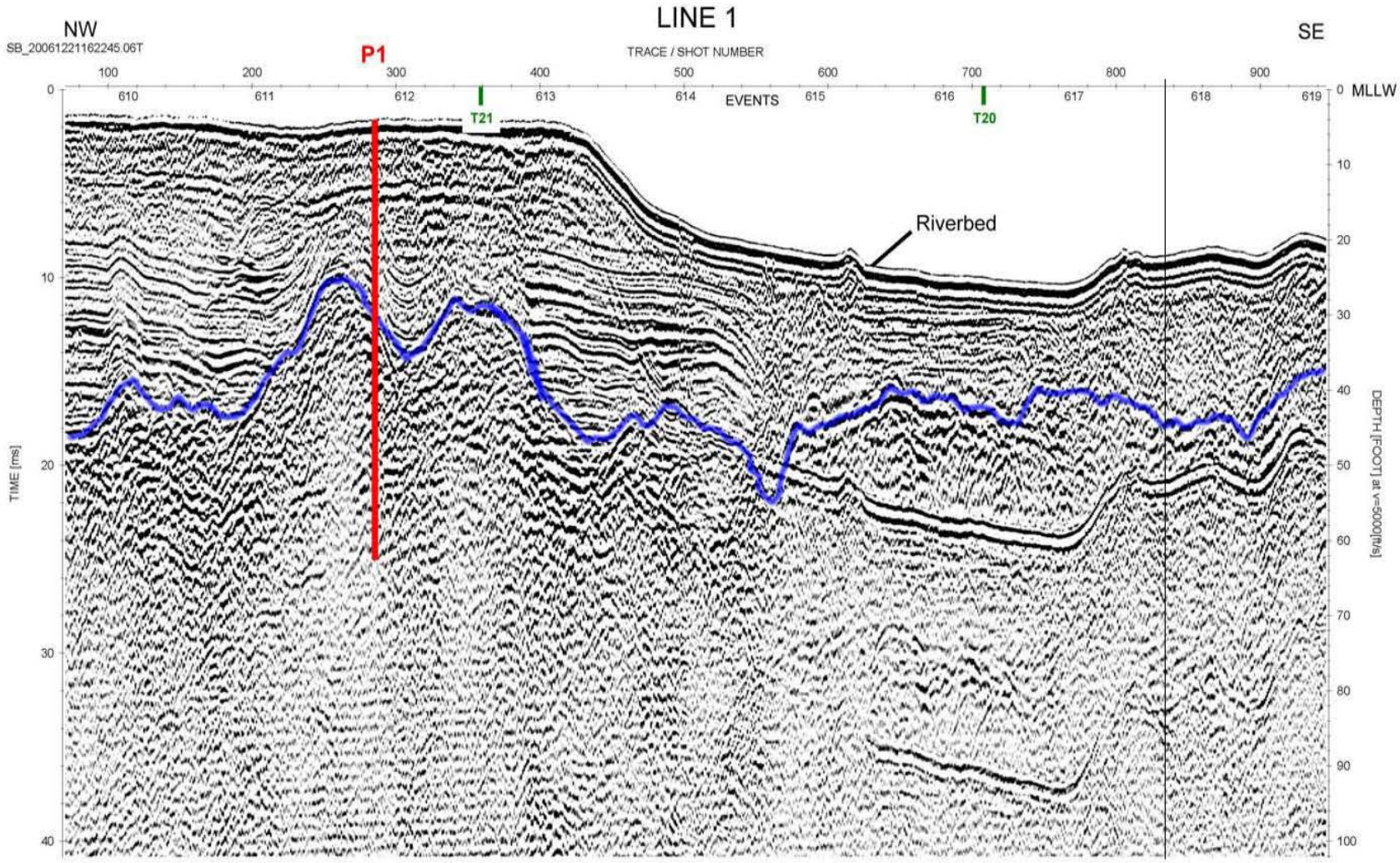


Figure showing the location of subbottom "boomer" profile lines and borings in the site.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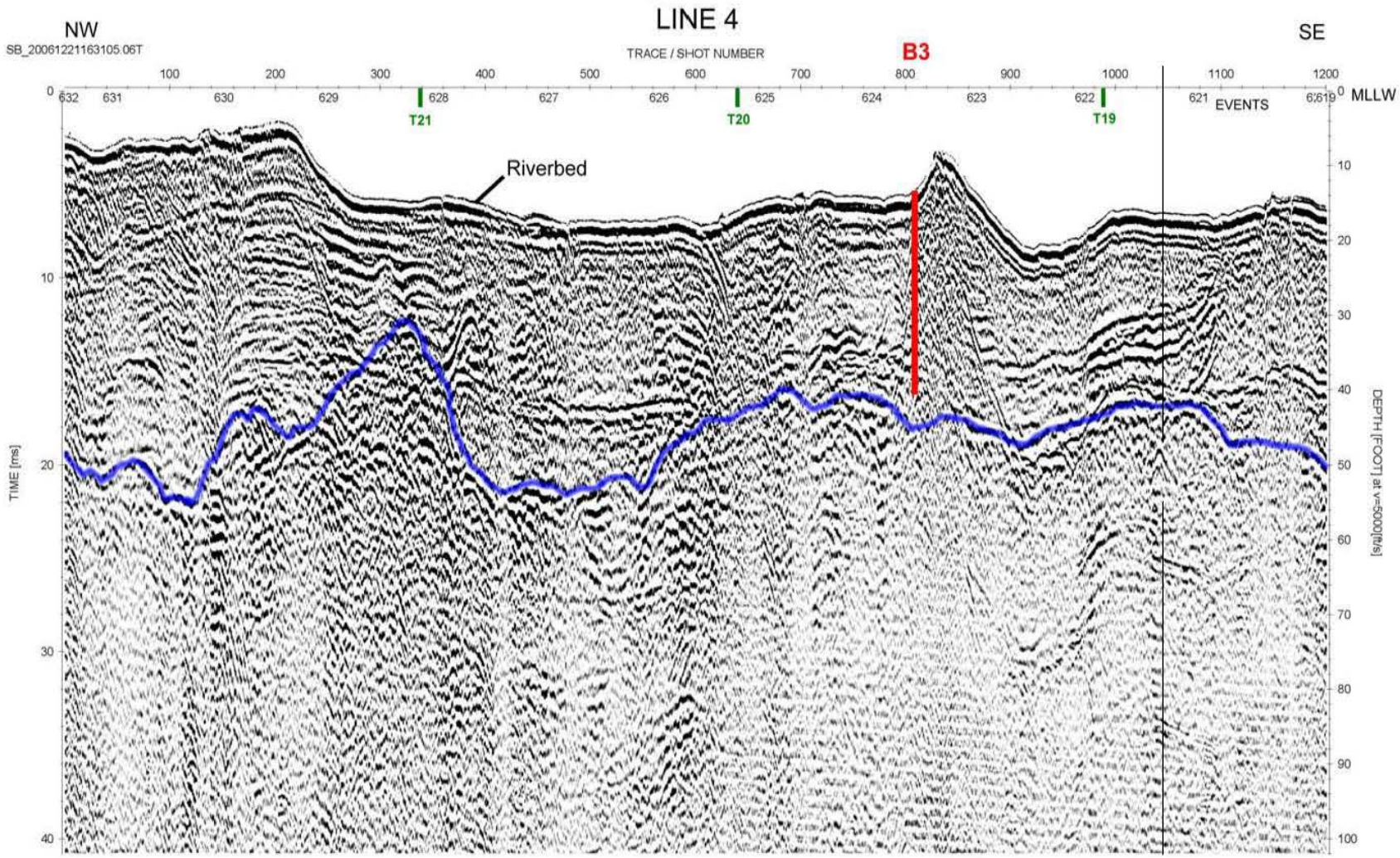
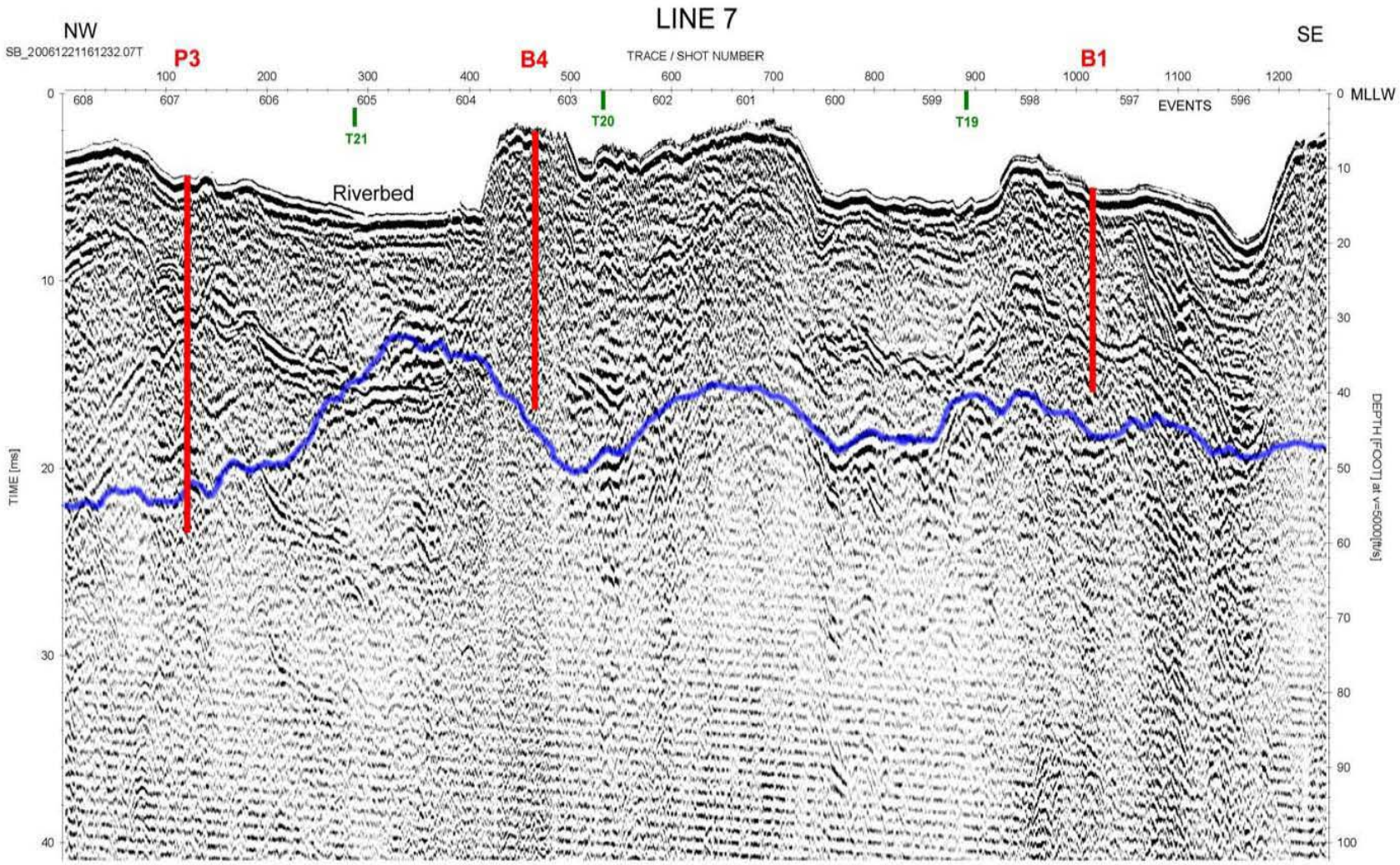
NW
SE
SB_20061221162245.06T
P1
TRACE / SHOT NUMBER
100
200
300
400
500
600
700
800
900
610
611
612
613
614
615
616
617
618
619
EVENTS
T21
T20
Riverbed
TIME [ms]
0
10
20
30
40
MLLW
DEPTH [FOOT] at v=5000ft/s]
50
60
70
80
90
100


LINE 4
NW
SE
SB_20061221163105.06T
TRACE / SHOT NUMBER
B3
T21
T20
T19
EVENTS
MLLW
Riverbed
TIME [ms]
DEPTH [FOOT] at v=5000[ft/s]


LINE 7
NW
SE
SB_20061221161232.07T
P3
B4
B1
TRACE / SHOT NUMBER
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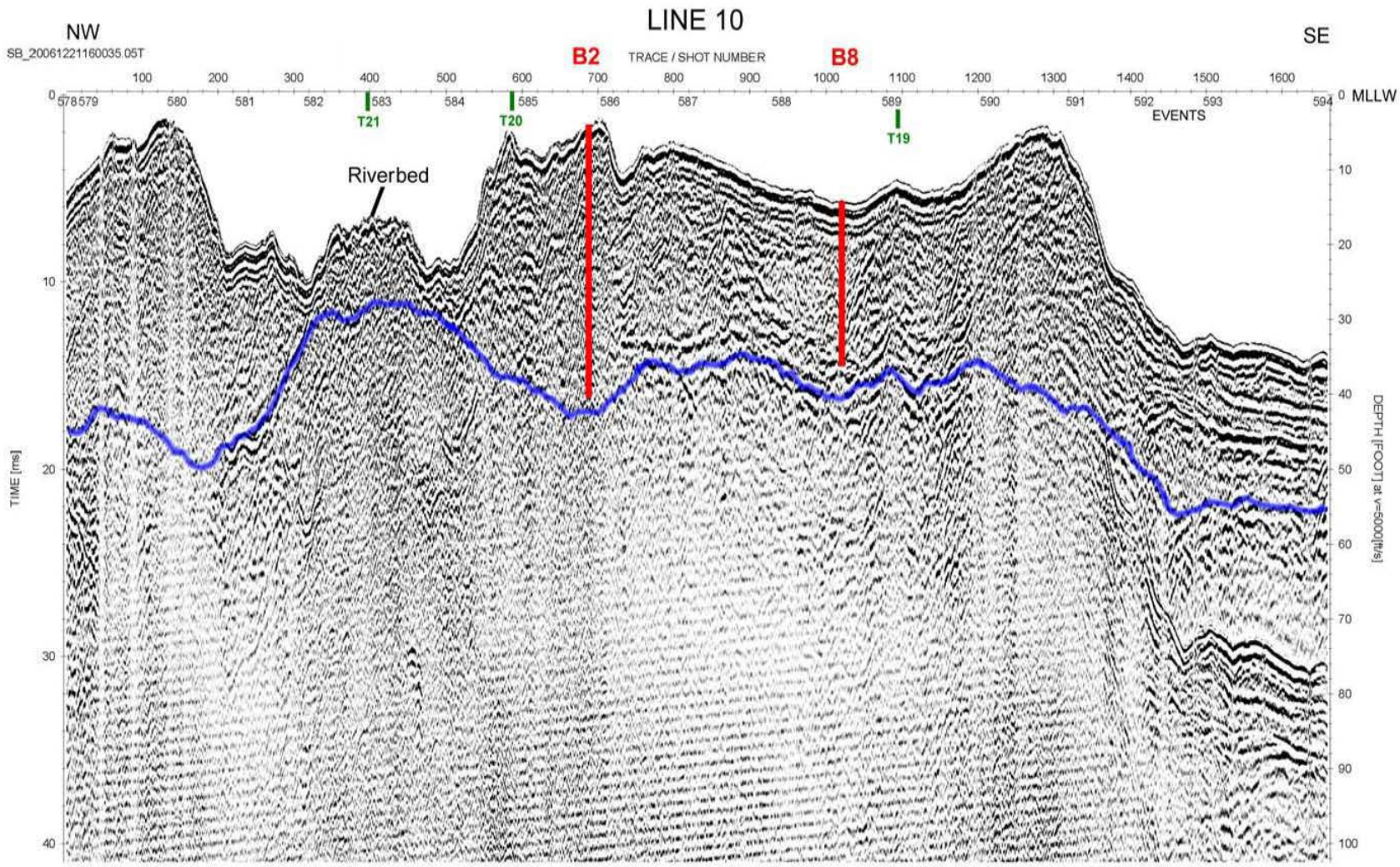
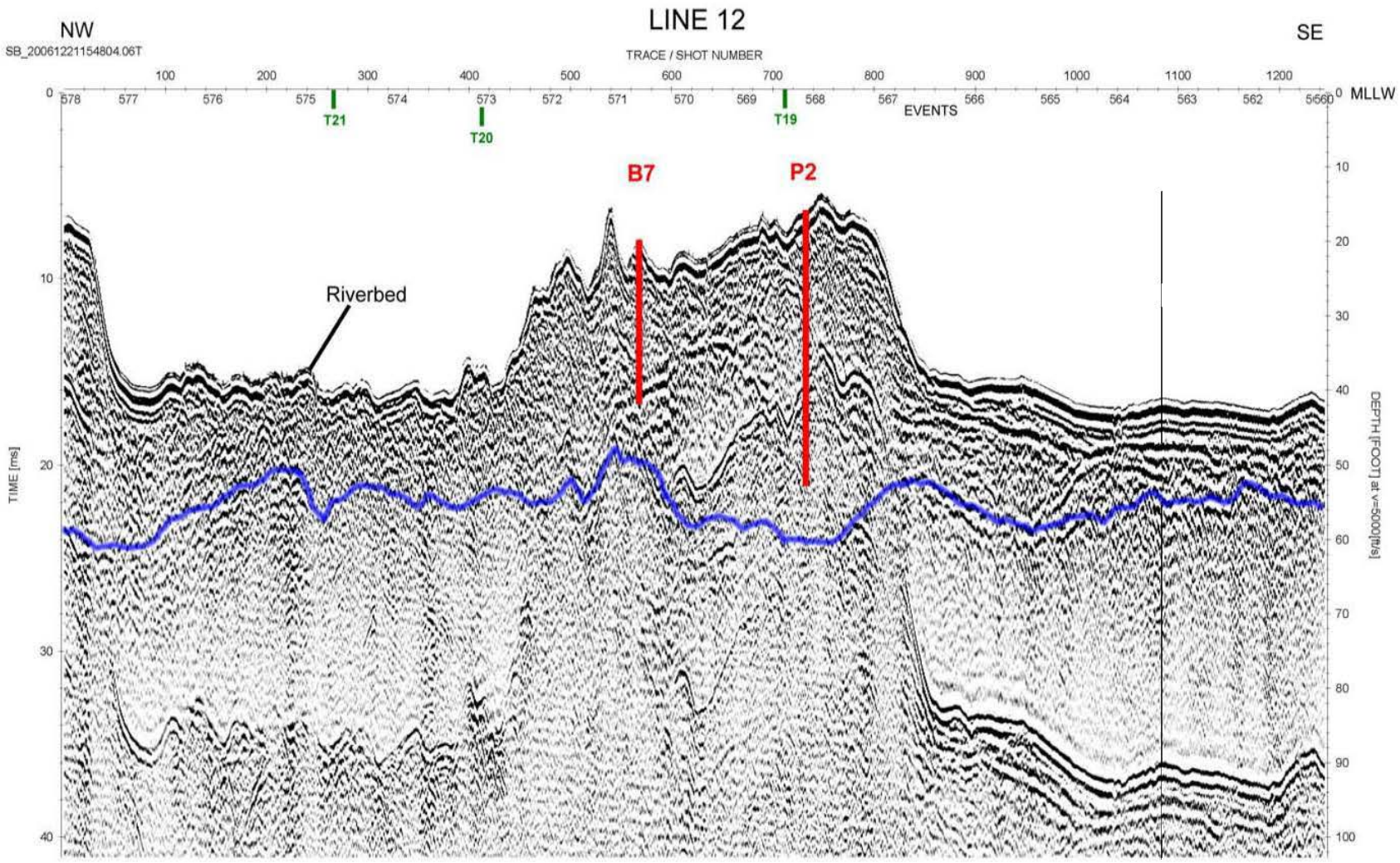
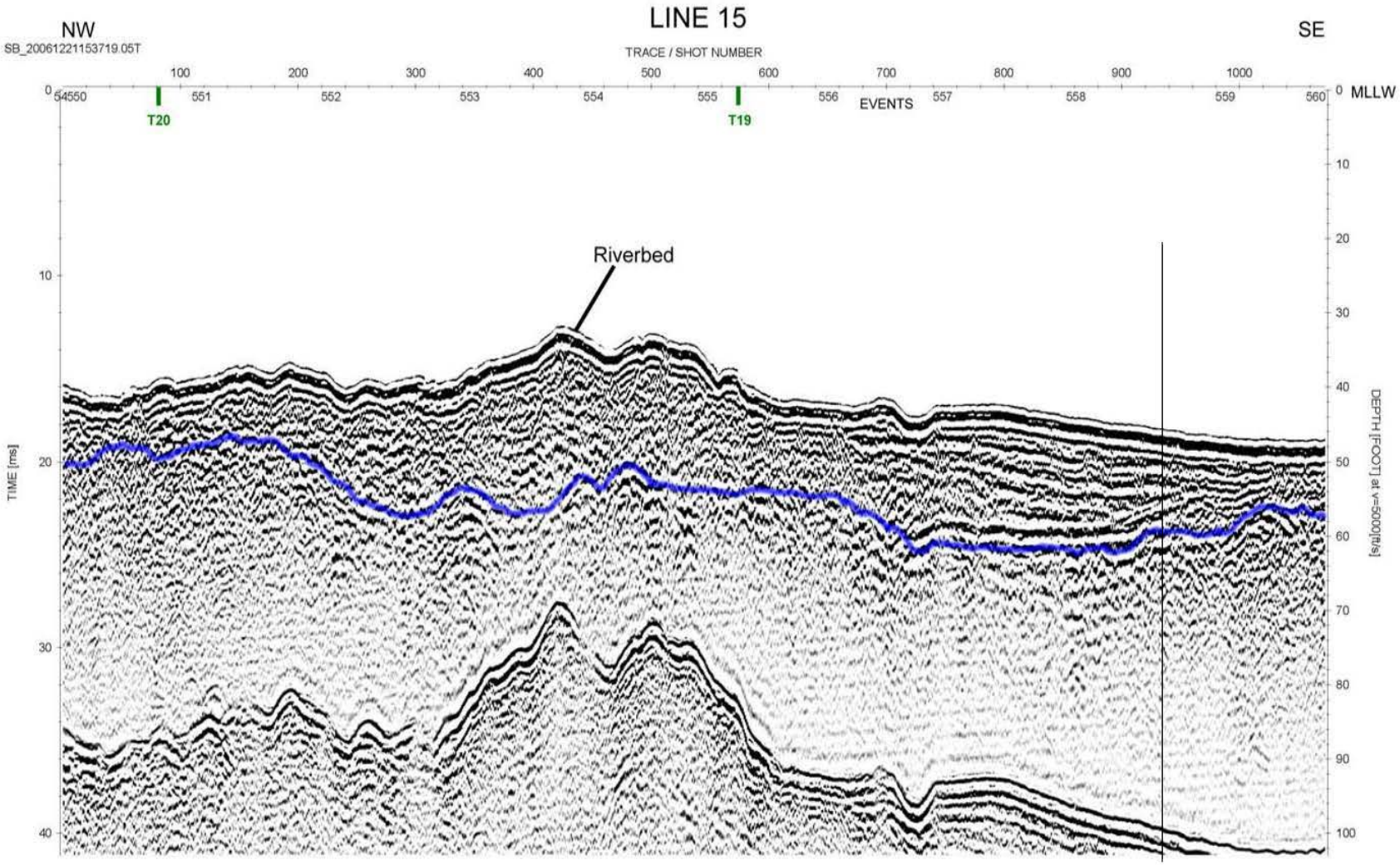
200
300
400
500
600
700
800
900
1000
1100
1200
608
607
606
605
604
603
602
601
600
599
598
597
596
EVENTS
T21
T20
T19
Riverbed
TIME [ms]
0
10
20
30
40
0 MLLW
10
20
30
40
50
60
70
80
90
100
DEPTH [FOOT] at v=5000[ft/s]


LINE 10
NW
SE
SB_20061221160035.05T
B2
TRACE / SHOT NUMBER
B8
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600
578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594
T21
T20
T19
EVENTS
0 MLLW
Riverbed
TIME [ms]
0 10 20 30 40
DEPTH [FOOT] at v=5000[ft/s]
10 20 30 40 50 60 70 80 90 100


LINE 12
NW
SE
SB_20061221154804.06T
TRACE / SHOT NUMBER
EVENTS
T21
T20
T19
B7
P2
Riverbed
TIME [ms]
MLLW
DEPTH [FOOT] at v=5000[ft/s]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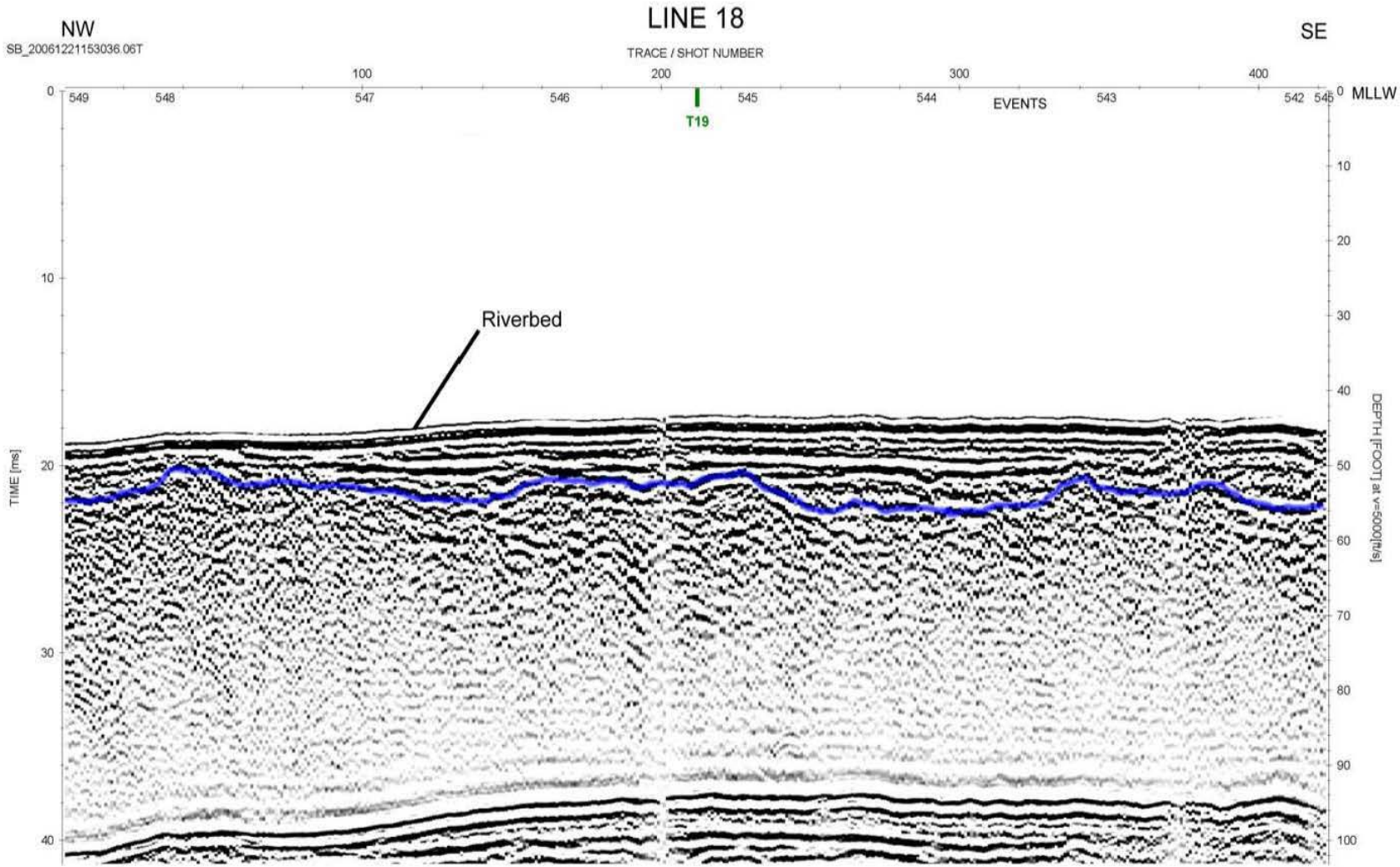
NW
SE
SB_20061221153719.05T
TRACE / SHOT NUMBER
100
200
300
400
500
600
700
800
900
1000
54550
551
552
553
554
555
556
557
558
559
560
EVENTS
T20
T19
MLLW
Riverbed
TIME [ms]
DEPTH [FOOT] at v=5000[ft/s]
0
10
20
30
40
50
60
70
80
90
100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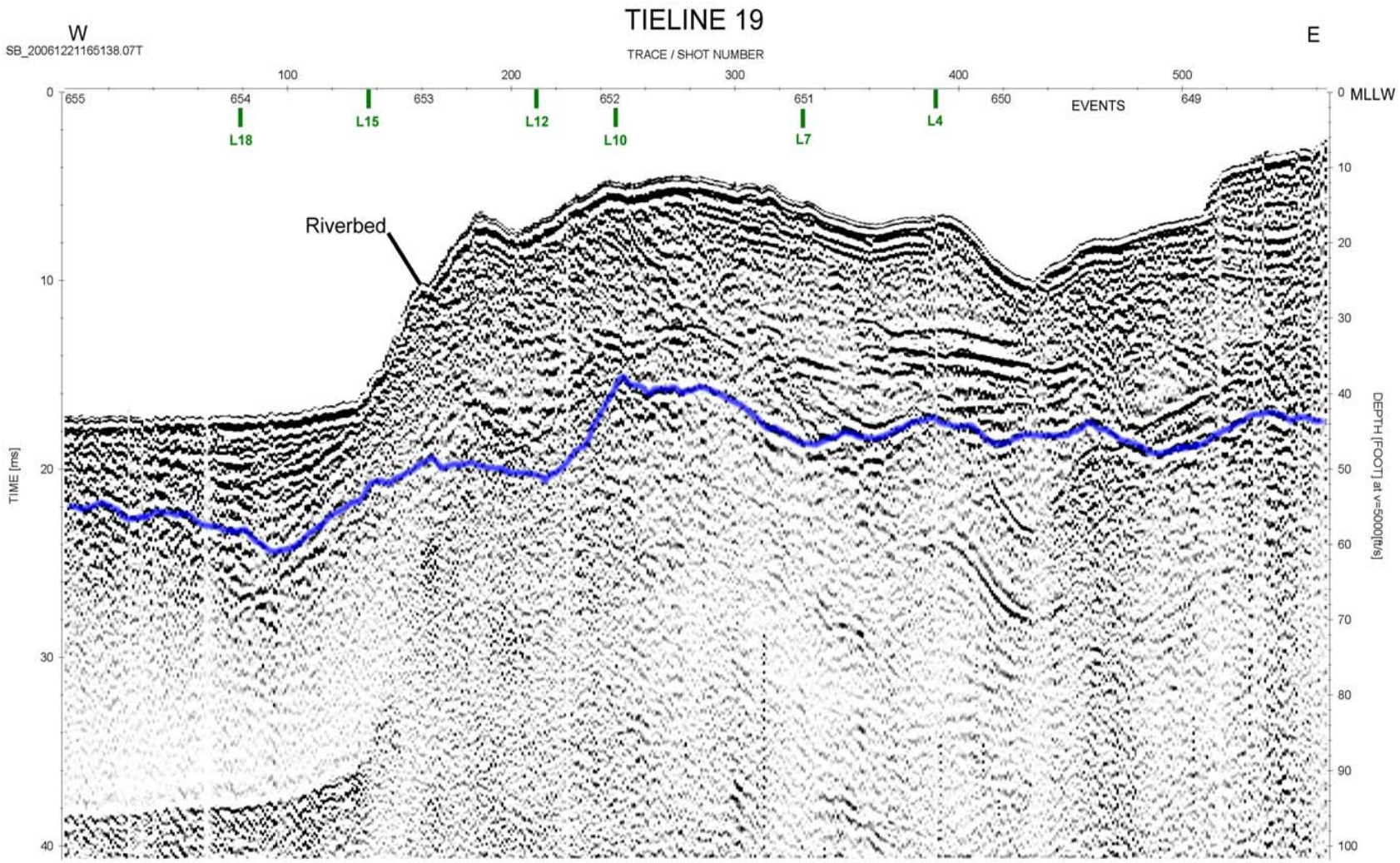
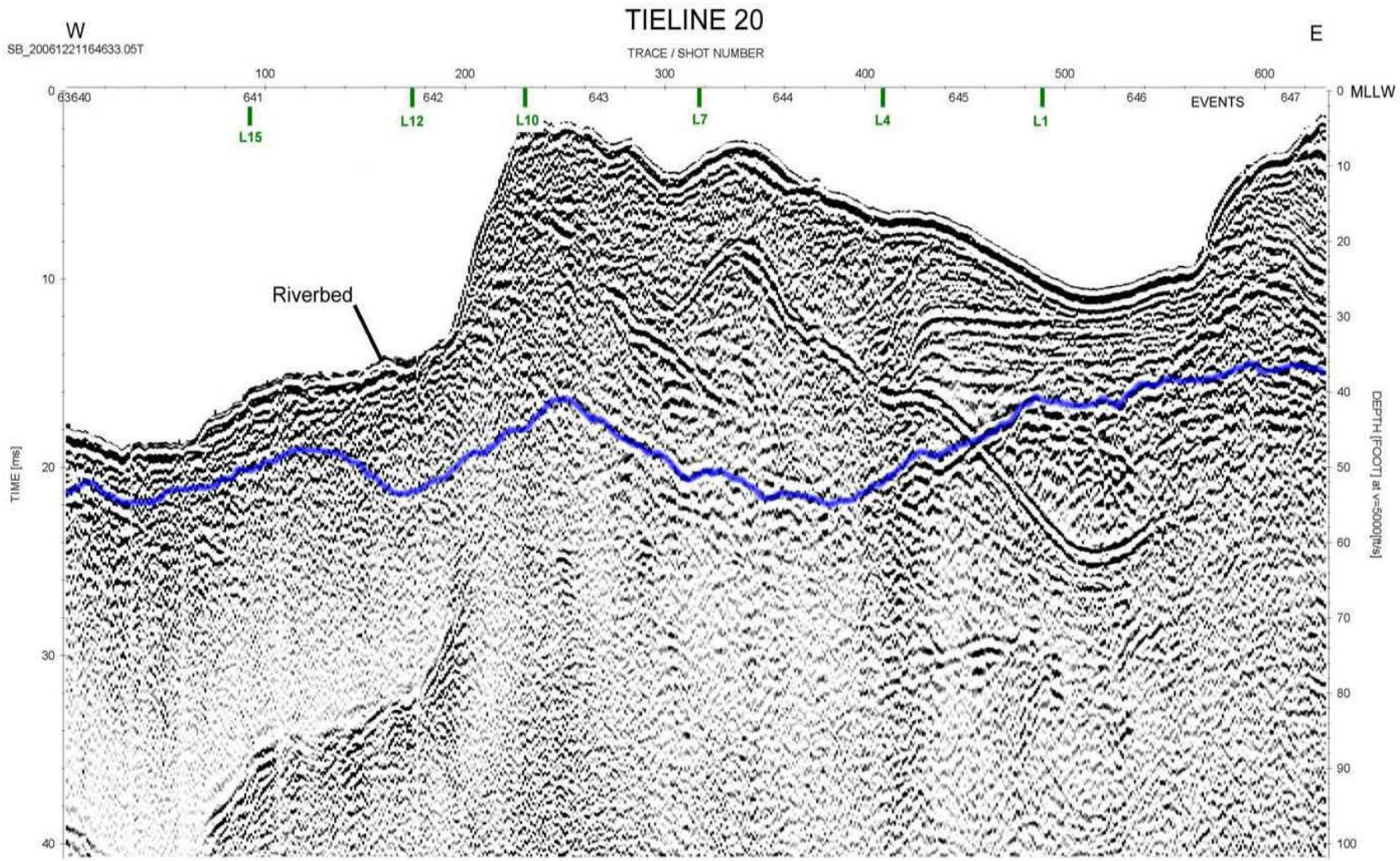
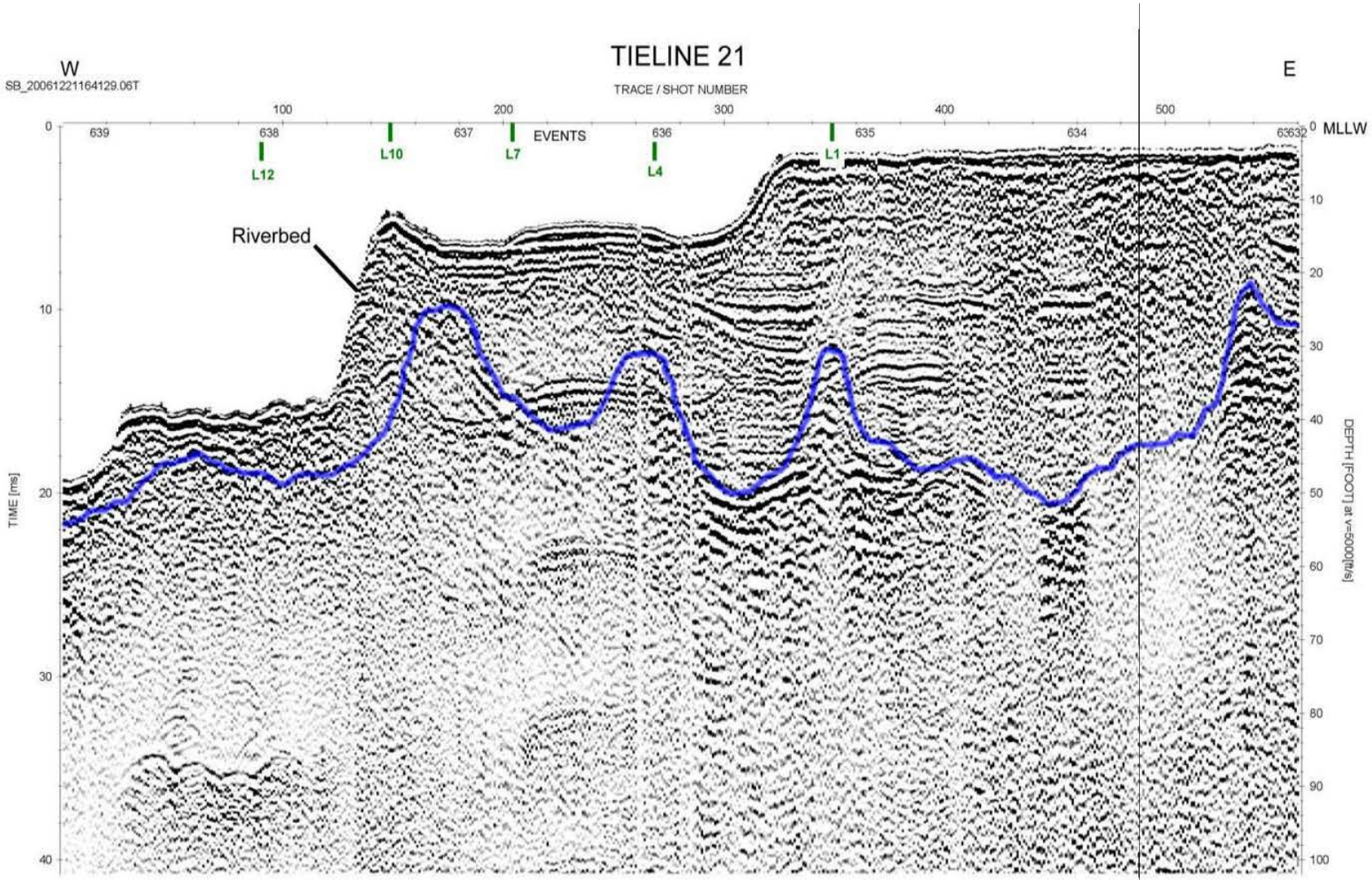
SE
SB_20061221153036.06T
TRACE / SHOT NUMBER
100
200
300
400
549
548
547
546
545
544
EVENTS
543
542
545
T19
MLLW
Riverbed
TIME [ms]
DEPTH [FOOT] at v=5000[ft/s]
0
10
20
30
40
50
60
70
80
90
100


TIELINE 19
W
E
SB_20061221165138.07T
TRACE / SHOT NUMBER
100
200
300
400
500
655
654
653
652
651
650
649
EVENTS
L18
L15
L12
L10
L7
L4
Riverbed
TIME [ms]
0
10
20
30
40
0 MLLW
10
20
30
40
50
60
70
80
90
100
DEPTH [FOOT] at v=5000[ft/s]


TIELINE 20
W
E
SB_20061221164633.05T
TRACE / SHOT NUMBER
100
200
300
400
500
600
63640
641
642
643
644
645
646
647
EVENTS
L15
L12
L10
L7
L4
L1
0 MLLW
Riverbed
TIME [ms]
DEPTH [FOOT] at v=5000[ft/s]
0
10
20
30
40
50
60
70
80
90
100


TIELINE 21
W
E
SB_20061221164129.06T
TRACE / SHOT NUMBER
100
200
300
400
500
639
638
637
636
635
634
633
632
EVENTS
L12
L10
L7
L4
L1
Riverbed
TIME [ms]
0
10
20
30
40
MLLW
DEPTH [FOOT] at v=5000[ft/s]
0
10
20
30
40
50
60
70
80
90
100

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 2 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 103,511.5 E 2,782,522.9
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Manlea "Bub" Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	27.00 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	27.00 ft
10. SIZE AND TYPE OF BIT	4" roller bit
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 6 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	▽ ft / ▼ ft / ▼ ft
16. DATE/TIME	STARTED 9/10/07 0945 / COMPLETED 9/10/07 1200
17. ELEVATION TOP OF HOLE	-13.00 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-13.00 / -15.00	0.00 / 2.00		0.0-2.0 Silty fine, SAND and gravel, wet, brown	J-1	SPT	2-2-17-21		0.7	35%		
-18.00	5.00		2.0-5.0 ROLLERBITTED.								
-20.00	7.00		5.0-7.0 Medium to coarse, SAND and gravel, wet, brown	J-2	SPT	16-11-11-11		0.5	25%		
-23.00	10.00		7.0-10.0 ROLLERBITTED.								
-25.00	12.00		10.0-12.0 Medium to coarse, SAND and gravel, wet, brown, with one larger angular piece of gravel.	J-3	SPT	13-14-13-8		0.3	15%		
-28.00	15.00		12.0-15.0 ROLLERBITTED.								
-30.00	17.00		15.0-17.0 Medium to coarse, SAND and gravel, wet, brown, with one larger piece of gravel.	J-4	SPT	5-7-8-8		0.4	20%		
-33.00	20.00		17.0-20.0 ROLLERBITTED.								

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -13.00 ft

Hole No. B-1

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-35.00	22.00		20.0-22.0 Fine, SAND little gravel, wet, brown	J-5	SPT	3-3-7-9		1	50%		
-38.00	25.00		22.0-25.0 ROLLERBITTED.								
-40.00	27.00		25.0-27.0 Fine, SAND some gravel, wet, brown BOTTOM OF HOLE	J-6	SPT	4-5-8-14		0.9	45%		

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Classification System
2. Sampled using a standard 1 3/8" split spoon driven manually by a 140 lb. hammer dropped 30".
3. Water depth at start of drilling from top of water to mudline was 16.5'
4. Drill rods periodically ran rough for short periods of time during drilling, especially while drilling through sands and gravels.
5. The majority of SPT samples did not have sample in shoe, most likely due to wash out.
6. Boring were advanced using 4" casing and 4" rollerbit.
7. Roundness of gravel was subangular.
8. GPS coordinates were determined through data processing.

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 3 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 104,172.3 E 2,781,786.4
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Manlea "Bub" Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	37.00 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	37.00 ft
10. SIZE AND TYPE OF BIT	4" roller bit
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 8 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	▽ ft / ▼ ft / ▼ ft
16. DATE/TIME	STARTED 9/10/07 1322 / COMPLETED 9/11/07 0855
17. ELEVATION TOP OF HOLE	-3.00 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-3.00 / -5.00	0.00 / 2.00		0.0-2.0 Medium to coarse, SAND and gravel, wet, brown	J-1	SPT	9-11-5-2		0.5	25%		
-8.00	5.00		2.0-5.0 ROLLERBITTED.								
-10.00	7.00		5.0-7.0 Medium, SAND little gravel, wet, brown	J-2	SPT	6-5-4-5		0.6	30%		
-13.00	10.00		7.0-10.0 ROLLERBITTED.								
-15.00	12.00		10.0-12.0 Fine to medium, SAND little gravel, wet, brown	J-3	SPT	4-4-6-8		1	50%		
-18.00	15.00		12.0-15.0 ROLLERBITTED.								
-20.00	17.00		15.0-17.0 Fine to medium, SAND little gravel, wet, brown, Bottom 0.3 medium to coarse sand and gravel.	J-4	SPT	4-8-12-12		0.8	40%		
-23.00	20.00		17.0-20.0 ROLLERBITTED.								

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -3.00 ft

Hole No. B-2

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-25.00	22.00		20.0-22.0 Medium to coarse, SAND and gravel, wet, brown	J-5	SPT	9-12-17-17		0.6	30%		
-28.00	25.00		22.0-25.0 ROLLERBITTED.								
-30.00	27.00		25.0-27.0 Medium to coarse, SAND and gravel, wet, brown	J-6	SPT	6-8-11-14		0.7	35%		
-33.00	30.00		27.0-30.0 ROLLERBITTED								
-35.00	32.00		30.0-32.0 Medium to coarse, SAND and gravel, wet, brown	J-7	SPT	11-12-14-18		0.8	40%		
-38.00	35.00		32.0-35.0 ROLLERBITTED								
-40.00	37.00		35.0-37.0 GRAVEL with medium to coarse sand, wet, brown, In tip of SPT the color changed to gray BOTTOM OF HOLE	J-8	SPT	7-31-30-27		0.8	40%		

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Classification System
2. Sampled using a standard 1 3/8" split spoon driven manually by a 140 lb. hammer dropped 30".
3. Water depth at start of drilling from top of water to mudline was 9.0'
4. Drill rods running rough between 20.0' - 27.0'.
5. Drill rods periodically ran rough for short periods of time during drilling, especially while drilling through sands and gravels.
6. The majority of SPT samples did not have sample in shoe, most likely due to wash out.
7. Boring were advanced using 4" casing and 4" rollerbit.
8. Roundness of gravel was subangular.

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: -3.00 ft

Hole No. B-2

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 3 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)		SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
			9. GPS coordinates were determined through data processing.									

NAB 1836 LETTER PORTSMOUTH NAB ALL BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 2 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 104,052.6 E 2,782,268.9
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Manlea "Bub" Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	27.00 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	27.00 ft
10. SIZE AND TYPE OF BIT	4" roller bit
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 6 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	▽ ft / ▼ ft / ▼ ft
16. DATE/TIME	STARTED 9/11/07 1000 / COMPLETED 9/11/07 1310
17. ELEVATION TOP OF HOLE	-15.00 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-15.00	0.00		0.0-2.0 Fine to medium, SAND contains shells, little gravel, wet, black and brown	J-1	SPT	3-3-3-2		0.4	20%		
-17.00	2.00		2.0-5.0 ROLLERBITTED.								
-20.00	5.00										
-20.60	5.60		5.0-5.6 Fine to medium, SAND little gravel, wet, brown	J-2	SPT	31-120/0.1		0.6	100%		
-25.00	10.00		7.0-10.0 ROLLERBITTED.								
-27.00	12.00		10.0-12.0 Sandy fine, SILT with gravel, wet, brown	J-3	SPT	2-5-22-37		1.2	60%		
-30.00	15.00		12.0-15.0 ROLLERBITTED.								
-32.00	17.00		15.0-17.0 Fine, SAND with two interbedded silt layers, wet, brown	J-4	SPT	4-5-5-6		0.7	35%		
-35.00	20.00		17.0-20.0 ROLLERBITTED.								

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

▽ DURING DRILLING ▼ AT COMPLETION ▼ AFTER DRILLING

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -15.00 ft

Hole No. B-3

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-37.00	22.00		20.0-22.0 Fine, SAND wet, brown	J-5	SPT	8-2-6-8		0.4	20%		
-40.00	25.00		22.0-25.0 ROLLERBITTED.								
-42.00	27.00		25.0-27.0 Fine to medium, SAND wet, brown BOTTOM OF HOLE	J-6	SPT	8-6-4-6		0.9	45%		

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Classification System
2. Sampled using a standard 1 3/8" split spoon driven manually by a 140 lb. hammer dropped 30".
3. Water depth at start of drilling from top of water to mudline was 18.5'
4. Casing dropped 0.5' while setting up to sample J-2, potentially due to washed out sand and gravel.
5. Drill rods running rough between 5.6' to 10.0' - sounded like grinding on gravel.
6. Drilling for B-3 was rougher for longer periods of time than B-1 and B-2.
7. The majority of SPT samples did not have sample in shoe, most likely due to wash out.
8. Boring were advanced using 4" casing and 4" rollerbit.
9. Roundness of gravel was subangular.
10. GPS coordinates were determined through data processing.

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 2 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 104,438.4 E 2,781,783.8
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Manlea "Bub" Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	37.00 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	37.00 ft
10. SIZE AND TYPE OF BIT	4" roller bit
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	▽ ft / ▼ ft / ▼ ft
16. DATE/TIME	STARTED 9/13/07 1230 / COMPLETED 9/13/07 1230
17. ELEVATION TOP OF HOLE	-3.00 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-3.00	0.00		0.0-2.0 Silty medium to coarse, SAND and gravel, wet, brown, rock stuck in tip of SPT	J-1	SPT	8-12-21-18		0.6	30%		
-5.00	2.00		2.0-5.0 ROLLERBITTED.								
-8.00	5.00		5.0-7.0 Fine to medium, SAND little gravel, wet, brown	J-2	SPT	4-6-9-11		0.9	45%		
-10.00	7.00		7.0-15.0 ROLLERBITTED.								
-18.00	15.00		15.0-17.0 Fine to medium, SAND little gravel, wet, brown, Bottom 0.2 fine sandy silt	J-3	SPT	4-6-10-12		1.3	65%		
-20.00	17.00		17.0-25.0 ROLLERBITTED.								

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

▽ DURING DRILLING ▼ AT COMPLETION ▼ AFTER DRILLING

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -3.00 ft

Hole No. B-4

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-28.00	25.00										
-30.00	27.00		25.0-27.0 Fine to medium, SAND little gravel, wet, brown	J-4	SPT	7-13-30-42		1.1	55%		
-38.00	35.00		27.0-35.0 ROLLERBITTED.								
-40.00	37.00		35.0-37.0 Fine to medium, SAND wet, brown BOTTOM OF HOLE	J-5	SPT	10-12-38-81		1.4	70%		

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Classification System
2. Sampled using a standard 1 3/8" split spoon driven manually by a 140 lb. hammer dropped 30".
3. Water depth at start of drilling from top of water to mudline was 8.0'
4. Drill rods running rough between 2.0' to 5.0', 7.0' to 10.0', and 25.0' to 37.0'.
5. The majority of SPT samples did not have sample in shoe, most likely due to wash out.
6. Boring was advanced using 4" casing and 4" rollerbit.
7. Roundness of gravel was subangular.
8. GPS coordinates were not processed and the raw utilized.

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 2 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 104,925.0 E 2,781,460.3
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Dave Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	27.00 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	27.00 ft
10. SIZE AND TYPE OF BIT	4" roller bit
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 6 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	ft
16. DATE/TIME	STARTED 11/27/07 0945 / COMPLETED 11/27/07 1245
17. ELEVATION TOP OF HOLE	-14.50 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-14.50	0.00		0.0-2.0 Sandy fine, SILT wet, brown, Upper 0.3 black fine sand with shells	J-1	SPT	1-1-3-3		1.4	70%		
-16.50	2.00		2.0-5.0 ROLLERBITTED.								
-19.50	5.00		5.0-7.0 Sandy fine, SILT wet, brown	J-2	SPT	3-3-5-5		0.6	30%		
-21.50	7.00		7.0-10.0 ROLLERBITTED.								
-24.50	10.00		10.0-11.8 Silty fine, SAND with gravel, wet, brown, One large piece of gravel approx 0.1'	J-3	SPT	30-50-96-100/0.3		1.2	67%		
-26.30	11.80		11.8-15.0 ROLLERBITTED.								
-29.50	15.00		15.0-17.0 Fine, SAND wet, brown, Bottom 0.2 gravel and coarse sand.	J-4	SPT	20-17-18-21		1.1	55%		
-31.50	17.00		17.0-20.0 ROLLERBITTED.								
-34.50	20.00										

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -14.50 ft

Hole No. B-5

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-36.50	22.00		20.0-22.0 Fine, SAND little gravel, wet, brown	J-5	SPT	9-20-21-24		1.2	60%		
-39.50	25.00		22.0-25.0 ROLLERBITTED.								
-41.50	27.00		25.0-27.0 Fine to medium, SAND little gravel, wet, brown BOTTOM OF HOLE	J-6	SPT	12-29-40-48		1.3	65%		

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Classification System
2. Sampled using a standard 1 3/8" split spoon driven manually by a 140 lb. hammer dropped 30".
3. Water depth at start of drilling from top of water to mudline was 23.5'
4. Boring was advanced using 4" casing and 4" rollerbit.
5. Roundness of gravel was subangular.
6. Drill rods running rough between 7.0' to 15.0'.
7. GPS coordinates were not processed and the raw utilized.

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 2 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 104,631.0 E 2,781,500.2
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Dave Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	12.00 ft
8. DEPTH DRILLED INTO ROCK	10.00 ft
9. TOTAL DEPTH OF HOLE	28.00 ft
10. SIZE AND TYPE OF BIT	4" roller bit
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 3 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	2
15. ELEVATION GROUND WATER	▽ ft / ▼ ft / ▼ ft
16. DATE/TIME	STARTED 11/28/07 0800 / COMPLETED 11/28/07 1305
17. ELEVATION TOP OF HOLE	-15.00 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	100 %
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-15.00 / -17.00	0.00 / 2.00		0.0-2.0 Fine to medium, SAND with gravel, wet, brown	J-1	SPT	7-8-9-10		0.6	30%		
-17.00 / -20.00	2.00 / 5.00		2.0-5.0 ROLLERBITTED.								
-20.00 / -22.00	5.00 / 7.00		5.0-7.0 Silty fine, SAND with gravel, wet, brown	J-2	SPT	18-28-40-43		0.5	25%		
-22.00 / -25.00	7.00 / 10.00		7.0-10.0 ROLLERBITTED.								
-25.00 / -27.00	10.00 / 12.00		10.0-12.0 Silty fine, SAMD with gravel, wet, brown, Upper 0.2 black gravel and coarse sand	J-3	SPT	76-88-63-72		1	50%		
-27.00 / -33.00	12.00 / 18.00		12.0-15.0 ROLLERBITTED. 15.0-18.0 SPT refusal @ 15' (0.0/100). ROLLERBITTED to 18.0'. Wash water from tailings was cloudy gray, and tailings appeared to be crushed rock. Began coring at 18.0.'								
-33.00	18.00		18.0-23.0 Gneiss gray, slightly weathered, fine, medium hard, Rock contained pitted voids from 18.0 to 19.0'. One apparent fracture at 19.9'. Fracture was slightly stained, rough, narrow, dipping at approx 50 degrees								

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -15.00 ft

Hole No. B-6

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
			Mechanical breaks occurred at 18.2', 18.9', 20.1', 20.5' and 22.2'.		CR Run 1			5	100%	0.92	55.2
-38.00	23.00										
			23.0-28.0 Gneiss gray, slightly weathered, fine, medium hard, One apparent fracture at 23.7'. Fracture was slightly stained, rough, narrow, dipping at approx 60 degrees. Mechanical breaks occurred at 24.6', 25.3', 25.7', and 26.5'. Mechanical break angles ranged from 40 to 70 degrees.		CR Run 2			5	100%	0.94	56.4
-43.00	28.00		BOTTOM OF HOLE								

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Classification System
2. Sampled using a standard 1 3/8" split spoon driven manually by a 140 lb. hammer dropped 30".
3. Water depth at start of drilling from top of water to mudline was 15.0'
4. Boring was advanced using 4" casing and 4" rollerbit.
5. Roundness of gravel was subangular.
6. Run Times (ft/min) for Run #1: 3-4-4-4-4, and Run#2: 4-3-3-3-3.
7. Poor recovery for J-2 due to rock in catcher.
8. Drill rods running rough between 7.0' to 10.0'.
9. GPS coordinates were determined through data processing.

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 2 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 103,983.5 E 2,781,847.7
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Dave Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	22.00 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	22.00 ft
10. SIZE AND TYPE OF BIT	4" roller bit
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	▽ ft / ▼ ft / ▼ ft
16. DATE/TIME	STARTED 11/29/07 0830 / COMPLETED 11/28/07 1100
17. ELEVATION TOP OF HOLE	-19.00 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-19.00	0.00		0.0-2.0 Fine, SAND little gravel, wet, brown	J-1	SPT	11-4-3-2		1	50%		
-21.00	2.00		2.0-5.0 ROLLERBITTED.								
-24.00	5.00		5.0-7.0 Fine to medium, SAND little gravel, wet, brown	J-2	SPT	5-5-3-5		1.3	65%		
-26.00	7.00		7.0-10.0 ROLLERBITTED.								
-29.00	10.00		10.0-12.0 Fine to coarse, SAND with gravel, wet, brown	J-3	SPT	4-4-4-6		1.2	60%		
-31.00	12.00		12.0-15.0 ROLLERBITTED.								
-34.00	15.00		15.0-17.0 Medium to coarse, SAND with gravel, wet, brown	J-4	SPT	7-8-12-31		0.9	45%		
-36.00	17.00		17.0-20.0 ROLLERBITTED.								
-39.00	20.00										

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -19.00 ft

Hole No. B-7

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
			20.0-22.0 Medium to coarse, SAND with gravel, wet, brown	J-5	SPT	13-78-39-26		1.4	70%		
-41.00	22.00		BOTTOM OF HOLE								

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Classification System
2. Sampled using a standard 1 3/8" split spoon driven manually by a 140 lb. hammer dropped 30".
3. Water depth at start of drilling from top of water to mudline was 25.0'
4. Boring was advanced using 4" casing and 4" rollerbit.
5. Roundness of gravel was subangular.
6. Drill rods running rough between 17.0' to 20.0'.
7. The current was very strong in this location.
8. For samples J-1, J-3, and J-5, the 3" spoon was used to retrieve a greater amount of sample.
9. GPS coordinates were determined through data processing.

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 2 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 103,732.7 E 2,782,109.8
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Dave Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	22.00 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	22.00 ft
10. SIZE AND TYPE OF BIT	4" roller bit
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	▽ ft / ▼ ft / ▼ ft
16. DATE/TIME	STARTED 11/29/07 1237 / COMPLETED 11/30/07 1000
17. ELEVATION TOP OF HOLE	-18.00 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-18.00 / -20.00	0.00 / 2.00		0.0-2.0 Fine to medium, SAND wet, brown, One large piece of gravel approx 0.3'	J-1	SPT	19-6-2-2		0.7	35%		
-23.00	5.00		2.0-5.0 ROLLERBITTED.								
-25.00	7.00		5.0-7.0 Coarse, SAND AND GRAVEL wet, brown	J-2	SPT	5-5-7-9		1	50%		
-28.00	10.00		7.0-10.0 ROLLERBITTED.								
-30.00	12.00		10.0-12.0 Fine to medium, SAND AND GRAVEL little gravel, wet, brown	J-3	SPT	14-19-23-30		0.9	45%		
-33.00	15.00		12.0-15.0 ROLLERBITTED.								
-35.00	17.00		15.0-17.0 Medium to coarse, SAND AND GRAVEL wet, brown	J-4	SPT	12-30-31-40		2	100%		
-38.00	20.00		17.0-20.0 ROLLERBITTED.								

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -18.00 ft

Hole No. B-8

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
			20.0-22.0 Coarse, SAND AND GRAVEL wet, brown	J-5	SPT	13-15-17-14		1	50%		
-40.00	22.00		BOTTOM OF HOLE								

Notes:

1. Soils are field visually classified in accordance with the Unified Soils Classification System
2. Sampled using a standard 1 3/8" split spoon driven manually by a 140 lb. hammer dropped 30".
3. Water depth at start of drilling from top of water to mudline was 25.0'
4. Boring was advanced using 4" casing and 4" rollerbit.
5. Roundness of gravel was subangular.
6. For samples J-1, J-2, J-4, and J-5, the 3" spoon was used to retrieve a greater amount of sample.
7. GPS coordinates were determined through data processing.

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 3 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 105,013.1 E 2,781,703.1
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Manlea "Bub" Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	58.90 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	58.90 ft
10. SIZE AND TYPE OF BIT	
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 0 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	ft
16. DATE/TIME	STARTED 9/13/07 0740 / COMPLETED 9/13/07 0915
▽	ft
▼	ft
▼	ft
17. ELEVATION TOP OF HOLE	-2.00 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)		SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-2.00	0.00		0.0-58.9									
			19.0-24.0 Casing blows per foot: 26-24-22-24-21									

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: -2.00 ft

Hole No. P-1

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)		SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
			24.0-29.0 Casing blows per foot: 23-21-22-21-21									
			29.0-34.0 Casing blows per foot: 21-21-20-21-22									
			34.0-39.0 Casing blows per foot: 26-25-25-22-20									
			39.0-44.0 Casing blows per foot: 23-27-24-23-22									
			44.0-49.0 Casing blows per foot: 21-21-18-21-27									

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: -2.00 ft

Hole No. P-1

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 3 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
			49.0-54.0 Casing blows per foot: 26-26-29-34-42								
			54.0-58.9 Casing blows per foot: 40-42-48-56-49								
-60.90	58.90		BOTTOM OF HOLE								

Notes:

1. Water depth at start of drilling from top of water to mudline was 2.5'
2. Probe holes were advanced using a 300 lb hammer to pound NW rods into the sediment. An A-rod center plug that was ground into a 60 degree point was used to advance the NW rods.
3. Top of rock was determined by a bouncing refusal.
4. Casing blows were only recorded for P-1.
5. GPS coordinates were determined through data processing.

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 2 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 103,605.5 E 2,782,165.0
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Manlea "Bub" Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	37.00 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	37.00 ft
10. SIZE AND TYPE OF BIT	
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 0 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	ft
16. DATE/TIME	STARTED 9/12/07 0130 / COMPLETED 9/12/07 1453
▽ ft / ▼ ft / ▼ ft	
17. ELEVATION TOP OF HOLE	-15.50 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)		SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-15.50	0.00		0.0-37.0									

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: -15.50 ft

Hole No. P-2

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-52.50	37.00		BOTTOM OF HOLE								

Notes:

1. Water depth at start of drilling from top of water to mudline was 15.5'
2. Hard driving rods near bottom of probe hole.
3. At completion of probe hole, the final rod that was pulled was bent.
4. Probe holes were advanced using a 300 lb hammer to pound NW rods into the sediment. An A-rod center plug that was ground into a 60 degree point was used to advance the NW rods.
5. Top of rock was determined by a bouncing refusal.
6. GPS coordinates were not processed and the raw utilized.

DRILLING LOG

DIVISION	North Atlantic Division
INSTALLATION	Baltimore District
SHEET	1 OF 3 SHEETS
1. PROJECT	FS for Navigational Improvement, Portsmouth, NH
2. BORING LOCATION (Coordinates or Station)	N 104,971.2 E 2,781,345.4
3. DRILLING AGENCY	New Hampshire Boring
4. NAME OF DRILLER	Manlea "Bub" Thompson
5. NAME OF INSPECTOR	Maria Orosz
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	49.00 ft
8. DEPTH DRILLED INTO ROCK	ft
9. TOTAL DEPTH OF HOLE	49.00 ft
10. SIZE AND TYPE OF BIT	
11a. VERTICAL DATUM	MLLW
11b. HORIZONTAL DATUM	State Plane, NAD 83 Maine West
12. MANUFACTURER'S DESIGNATION OF DRILL	Detrich D-50
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 0 / UNDISTURBED 0
14. TOTAL # OF ROCK SAMPLES	0
15. ELEVATION GROUND WATER	ft
16. DATE/TIME	STARTED 9/12/07 0840 / COMPLETED 9/12/07 1132
▽ ft / ▼ ft / ▼ ft	
17. ELEVATION TOP OF HOLE	-12.00 ft
18. TOTAL ROCK CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	Maria Orosz

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)		SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-12.00	0.00		0.0-49.0									

NAB 1836 LETTER PORTSMOUTH_NAB_ALL_BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE
-12.00 ft

Hole No. P-3

PROJECT
FS for Navigational Improvement

INSTALLATION
Baltimore District

SHEET 2 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)		SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD

NAB 1836 LETTER PORTSMOUTH NAB ALL BORINGS.GPJ USACE BALTIMORE.GDT 12/7/07

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE -12.00 ft

Hole No. P-3

PROJECT: FS for Navigational Improvement

INSTALLATION: Baltimore District

SHEET 3 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	SAMPLE	SPT/ AB/ CR	BLOWS / 0.5 ft	PP/ TOR	Length REC.	% REC.	RQD	Length RQD
-61.00	49.00		BOTTOM OF HOLE								

Notes:

1. Water depth at start of drilling from top of water to mudline was 11.5'

2. Probe holes were advanced using a 300 lb hammer to pound NW rods into the sediment. An A-rod center plug that was ground into a 60 degree point was used to advance the NW rods.
3. Top of rock was determined by a bouncing refusal.
4. GPS coordinates were determined through data processing.