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POLICY GUIDANCE ON ARCHAEOLOGICAL INVESTIGATIONS AND RELATED SURVEY STANDARDS FOR THE DISCOVERY OF UNDERWATER ARCHAEOLOGICAL RESOURCES

Introduction

The Massachusetts Board of Underwater Archaeological Resources (BUAR) is the state agency charged with the identification, preservation and protection of the Commonwealth's underwater archaeological resources. The purpose of archaeological investigations is (1) to determine the presence or absence of culturally related materials and resources within an area or region of interest, (2) interpret these resources for the benefit of the public, and (3) determine or assess their eligibility for listing in the State and National Register of Historic Places (National Register). Such work is undertaken pursuant to the applicable laws and regulations pertaining to the cultural resources of Massachusetts. Generally, these archaeological investigations are conducted to comply with the National Environmental Policy Act of 1969 (NEPA) and Section 106 of the National Historic Preservation Act of 1966, as amended (1976, 1980, 1992, 1999), and implementing regulations of the Advisory Council on Historic Preservation (Advisory Council) as well as pursuant to Massachusetts General Laws concerning the BUAR and the Massachusetts Historical Commission (MHC).

As our knowledge of the natural and cultural resources in our region has developed, it has become necessary to establish a set of survey standards and parameters that those who chose to work within Massachusetts waters must adhere to. Given the high variability of the marine environment and the nature of submerged cultural deposits alterations may be made to these standards on a case by case basis, such as instances where adherence may not be safe or feasible. But barring any such alterations, adherence to the procedures laid out in this document is required of any permittee and project proponent's technical service consultant (i.e. archaeologist).

Past experiences have proven the cost-effectiveness and efficiency of having the archaeologist's direct involvement as early as possible in the project, especially during geophysical survey planning and data acquisition. This should ensure that the concerns of the BUAR and review agencies will be adequately addressed.

Standards for Archaeological Investigations

The methodology for archaeological investigation described herein is intended to establish the minimally acceptable standards for the discovery of potential underwater archaeological resources in the waters of the Commonwealth of Massachusetts. BUAR and other state or federal review and compliance agencies may set more (or less) stringent standards depending on location, sensitivity, and potential impacts. Furthermore, this guidance is not intended to supersede the techniques and methods employed by other bodies in the course of archaeological investigations, only to ensure that the minimum standards required by the BUAR are met.

Coordination and consultation with BUAR and other state or federal review and compliance agencies is an integral component of project planning. For those projects subject to Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), you are directed to consult with, provide their proposed research design and methodology to, and obtain the approval of the State Historic Preservation Office/MHC and the lead federal agency in accordance with 36 CFR 800.4, prior to conducting the field investigation. Additionally, for intertidal survey activities above mean low water, coordination with MHC as State Archaeologist's permits may be required as well as a BUAR permit.

All archaeological survey and data collection activities should be undertaken in consultation with and/or under the supervision of a qualified archaeologist (see Appendix A).

1. Desk Based Assessment:

Background research and pre-survey sensitivity evaluation

The purpose for undertaking background research is to determine general locations within the permit or study area where there is a likelihood for encountering cultural materials. This information provides the contextual framework for evaluation of those resources.

- i. **Perform a comprehensive literature review** of textual sources, documents, photographs, maps and charts, site reports and files that pertain to the area of interest with special reference to known or potential sites within the project area.
- ii. **Consult the MHC and BUAR** to determine if there are any sites within or near the proposed work area that are currently under review for addition to the National Register of Historic Places (NR). BUAR maintains an inventory and permit files. MHC maintains NR nominations, an inventory, CRM bibliography and collector files.
- iii. **Consult with local experts** and persons possessing expert knowledge about the environment, history, and prehistory of the area of interest.
- iv. **Perform an Artifact and Material Review.** This can be a detailed analysis of previously recovered cultural materials from within, or within the immediate vicinity of, the project area. Artifacts can be found in private or museum collections. Knowledge of previously recovered materials will provide insight into the cultural affiliation, possible function, and significant characteristics of the area.
- v. **Review environmental reports** so as to describe the nature of the site in terms of geology, ecology, climate, and other natural conditions surrounding the project area. This is necessary to the understanding of the function and condition of the site and expected remains.
- vi. **Provide a Pre-survey Sensitivity Evaluation and Predictive Models** concerning anticipated site locations and find types. The criteria and justifications set forth in establishing these predictions should be a clear summary of the results of each phase of the Desk Based Assessments.

2. Field Survey:

a) Remote Sensing and Geophysical Survey:

A remote sensing/geophysical field survey is required following the Desk-Based Assessment. This allows for a non-invasive inspection of the project area focused on characterizing the nature of the site and locating objects, vessels, or sites of potential prehistoric or historic significance. There is a

suite of tools and technologies available for use in archaeological investigations, each providing a different function with their own operational costs and constraints.

The following is a list of geophysical survey techniques required and recommended (Swath) by the BUAR:

○ **Magnetometer:**

Magnetometers work by detecting variations in the earth's magnetic field resulting from the presence of ferrous materials. They are often capable of penetrating multiple sediment layers and assisting in the location of ferrous objects that may not be visible on the surface. However high concentrations of metallic debris in the survey area can render the magnetometer results unusable.

Requirements:

- i. A cesium vapor type magnetometer capable of outputting data digitally
- ii. Trackline intervals should be spaced at 15m (50 feet) above the 100 foot contour, and may not exceed 30m (100 feet) below the 100 foot contour.
- iii. The Magnetometer should be towed at a height of $6m \pm 1m$ (18 - 23 feet) and far enough from the vessel to minimize interference from the hull.
- iv. Magnetometer sensitivity should be one gamma (γ) or one nanoTesla (nT) or less.
- v. The data sampling interval may not exceed one (1) second.

○ **Side Scan Sonar:**

Side scan sonar refers to a category of sonar employed to acoustically image the seafloor. These systems work by emitting sound pulses into the water and then plotting the returning signals based on the time and intensity of the return. The resulting monochromatic imagery allows for the discernment of different features on the seafloor (bed forms, surface geology, natural or man-made obstructions, the extent of the site) composed of varying density and materials. Harder materials (rock or metal) are better acoustic reflectors than softer materials (mud or organics).

Requirements:

- i. A dual channel 100/500 kHz side scan sonar that records data digitally
- ii. Line spacing should be such so as to provide a minimum of 100% coverage of the project area (ideally a 30m interval at a 50m range scale), with 200% being the desired coverage.
- iii. Surveys should be conducted in a manner that allows for the detection of objects on the seafloor with minimum dimensions 1m x 1m x 1m (obtained from shadow length measurements) regardless of depth.
- iv. Towfish height should be 10% to 20% of the range scale in use.
- v. Survey speed should be sufficient to adequately ensonify all features.

○ **Sub-Bottom Profilers:**

The term sub-bottom profiler may refer to any marine survey instrument that utilizes sound pulses sent through the water column and into the seafloor for the purpose of imaging the stratigraphic layers and sub-surface features. Penetrative power and resolution depend on the system used (i.e. Chirp or Boomer) and the composition of the seafloor. In terms of archaeological applications, high frequency profilers may be used to directly survey buried sites (submerged landscapes or anthropogenic materials) or to study the geologic and sedimentological nature of a site.

Requirements:

- i. A high-frequency system with an operational bandwidth between 1.5 and 4.5 kHz must be used to provide high resolution digital images on near surface features.

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- ii. The profiler must be capable of achieving a vertical resolution of 1 foot in the upper 15m (50 feet) of sediment
 - iii. Sediment penetration must exceed the depth of the feature being surveyed
- **Swath/Multi-Beam Bathymetry: (*Recommended but not required*)**
- Swath Bathymetric surveys use numerous directed sound pulses to ensonify the seafloor. Unlike Side Scan Sonar which produces imagery based on intensity plots, bathymetric surveys provide depth and position data derived from the two-way travel time of the sound emitted. The depth and position data can be used to create high resolution topographic models of the sea floor. While SSS ensonifies only the areas to the left and right of the system, but not directly beneath, Swath systems survey directly beneath the sonar transducer and outwards at a predetermined angle, with the least reliable data being collected in the outer beams of the swath. The use of swath systems require highly skilled operators, careful measurements of the properties of the water the system is to be used in, and extensive data processing and interpretation.

Requirements:

- i. Any swath bathymetric survey conducted for the purpose of archaeological inspection must be capable of distinguishing an object with dimensions 1m x 1m x 1m from the seafloor in waters less than 20m (65 feet) in depth.
- ii. In waters 20m (65 feet) in depth or greater the survey must be conducted in a manner capable of detecting a cube measuring 5% of the depth, with finer resolutions desirable.
- iii. Line spacing must be such so as to provide 100% seafloor coverage. (Less than 100% coverage is acceptable if paired with 200% side scan sonar coverage)
- iv. Grid resolution must be 0.5m or less at depths above 20m, and not less than 5% of the water depth in waters 20m and deeper.
- v. CTD (conductivity, temperature, depth) casts should be made at the start and end of the final transect, and every 2 hours to adjust for variations in the speed of sound as it penetrates the water column
- vi. The use of Heave, Pitch, and Roll sensors is desired to mitigate errors caused by ship movement
- vii. Data should be tide corrected before being submitted (recommended).

General requirements for all Geophysical Field Surveys:

In addition to the instrument specific requirements listed above, the following represents the requirements for all geophysical field surveys regardless of method.

- i. All survey data is to be positioned by use of a Differential Global Positioning System (DGPS) with a precision error not to exceed $\pm 5m$ in water depths less than 200 meters and $\pm 15m$ in waters 200m and deeper.
- ii. Depths are to be tracked digitally using a single beam or multi-beam echosounder.
- iii. Surveys should be conducted in Universal, or Zulu, Time.
- iv. Data sets must all correlate and be referenced to the North American Datum of 1983 (NAD 83). Coring samples must match sub-bottom data.
- v. All equipment must be operated by and data interpreted by a qualified and experienced geophysical survey technician. Final interpretation and report preparation is to be handled by a qualified maritime archaeologist.
- vi. In the event that an anomaly is located in the project area a sufficient number of lines are to be run to ensure that the anomaly is fully defined, with lines to be spaced at intervals not to exceed 10m.

- vii. All anomalies (including any object producing a stronger return than that of the surrounding area) should be targeted digitally within the survey data directly (where applicable) and positions noted on a separate document in 'X' 'Y' format with accompanying screen grabs, descriptions, and locations charted at an appropriate scale. Seafloor features that represent either known or potential archaeological remains, should likewise be plotted on a map and listed in a table that includes height above bottom, a central 'X' and 'Y' coordinate, a screen grab and description of the feature.
- viii. The position of any shore features such as landmarks, anomalies, and/or GPS base stations should also be included on a separate document with accompanying descriptions.
- ix. Locations of any natural geomorphic features having sediment traps (submerged river, stream, creek channels, sinkholes, etc.) that are identified through evaluation of sub-bottom data should be plotted to show their extent. Cross section maps showing definable strata should be prepared for each of these targets.
- x. For CRM-type surveys, the BUAR typically requires that the remote sensing suite be comprised of magnetometer, side scan sonar, and sub-bottom profiler that meet the specifications previously set forth in this section.

b) Visual Survey:

The visual survey and documentation of the project area provides in situ inspections to characterize conditions, validate assessments, and identify potential cultural targets. As with geophysics, the steps outlined here are intended to be non-invasive.

○ **Walkover/Swimover:**

A quick inspection from the surface of the project area to characterize conditions and assess either potential hazards to the survey or any potential remains.

○ **Diving:**

In cases where the site is wholly submerged at all tides and it is safe to do so, SCUBA may be employed so that the inspecting body may view the site directly characterizing the conditions of any materials as well as the project area.

○ **Remotely Operated Vehicle (ROV)/Autonomous Underwater Vehicle (AUV):**

Under the supervision of an archaeologist and operation of a qualified ROV/AUV Pilot, visual inspections using ROVs and AUVs may be used to provide an effective alternative to diving for the purpose of identifying, characterizing, and assessing potential cultural targets.

Requirements:

- i. Digital Video and Photography is required for collection and submittal during ROV/AUV surveys.
- ii. Submitted media must be of sufficient quality for reviewers to draw reasonable conclusions about the project area.
- iii. Media must include, date, time, orientation, and GPS coordinates for reference to survey track lines, field maps, and plans.

○ **Submarine:**

Under the supervision of an archaeologist, visual inspections using submarines can provide an effective alternative means to diving for the purpose of identifying, characterizing, and assessing potential cultural targets, especially in deep water.

General requirements for all Visual Field Surveys:

While (with the exception of ROV/AUV surveys) there are no specific requirements for the individual methods of visually surveying an area of interest, the following represents general requirements and recommendations

- i. Visual inspections must be conducted in a safe and effective manner, especially those in which divers or other individuals are in the water.
- ii. Visual inspections must be conducted during times of optimum visibility and the inspecting/reviewing body should be able to draw reasonable conclusions about the site based on those inspections.
- iii. Visual surveys are non-invasive and tampering with or damaging any materials is to be avoided.
- iv. Digital video or other photographic evidence is required for submittal in the case of ROV/AUV surveys, and is desirable in all other cases but not required.

c) Potentially Intrusive and Direct Data Collection Activities:

A number of invasive data collections techniques have valuable application to archaeological assessments and investigations when used appropriately.

o Grab Sample Survey:

Grab samples (bottom samples) are collected to characterize the seabed sediments. This method should not be used for direct archaeological data collection, but as a means to characterize the sea bed surrounding a site. However, under certain conditions it is possible for recovered samples to (unintentionally) contain archaeological materials.

Requirements:

- i. A sufficient number of diffuse samples should be recovered to accurately characterize the sea floor within the project area.
- ii. Samples must be described based on visual inspection noting such elements as color, texture, inclusions, and general grain size.
- iii. Samples should be photographed for submission with final reports.

o Vibracore or Borehole Survey:

Vibracore/borehole surveys are undertaken to provide a detailed profile of the local stratigraphy. The samples provide direct analysis of conditions viewed using sub-bottom profilers. The cores give insight into the past and present geologic, sedimentological, and climatological conditions of the project area as well as in determining the presence and integrity of paleosols. Samples may contain archaeological materials though steps should be taken to avoid coring directly through cultural remains.

Requirements:

- i. Cores should be collected in conjunction with sub-bottom profile data to identify distinct acoustic reflectors in the strata.
- ii. Vibracore locations should be spread throughout the survey area ideally in a pattern that crosses the prevailing trend of the offshore geology.
- iii. Cores should be spaced no more than 1000 feet apart.
- iv. The minimum accepted recovery of each core is 80% and at least three attempts (recommended).
- v. Cores should be split in half longitudinally with one half archived while the other is submitted for analysis. Each half must be labeled with the collection location and date of collection.

- vi. Individual cores samples may be substituted for individual bottom samples where applicable.

- o **Benthic Survey:**

Benthic surveys allow for the characterization of marine flora and fauna within the project area. This information is relevant as it may affect the manner in which latter stages of the investigation are conducted as well as give insight into the condition of materials and dynamics of the site. As with coring and grab sampling, steps should be taken to avoid damaging any remains.

General requirements for all Potentially Intrusive and Direct Data Collection Activities:

- i. All survey results should be reviewed by a qualified archaeologist.
- ii. All surveys must be conducted in a safe and effective manner
- iii. Care must be taken not to damage any cultural remains within the survey area
- iv. Photographic evidence is to be included in reports discussing survey results
- v. Sampling location areas should be depicted on plans and/or survey maps at appropriate scales.
- vi. Care must be taken to cause no unnecessary harm to the marine life within or adjacent to the survey area.

3) Artifact Recovery, Excavation, Preservation

The results gathered from the non-invasive and sediment sampling surveys must be reported to the BUAR prior to moving forward on the initial project. Only on the basis of those reports will decisions be made regarding artifact retrieval, site excavation, conservation, and material preservation if any cultural materials are present. Artifacts should not be collected during the survey phase of the investigation. Decisions regarding object recovery and/or excavations will be made through consultations with the BUAR. Methods and approach will be established at that time.

In the event of an unexpected recovery, see the BUAR's *Policy on the Unexpected Recovery of Archaeological Materials*.

4) Summary and Additional Recommendations:

The goal of these surveys is to identify areas of archaeological sensitivity based on reasonable expectations of site occurrence, frequency, and preservation within the region. Prior to the start of any field work the Desk Based Assessments should have formed the basis of any expectations for the encounter of cultural deposits in the project area. In addition to evaluating the possibility of locating archaeological remains, the impact of the proposed activity (e.g. dredging) on those remains needs to be considered. The nature of the proposed activity may be taken into consideration for the alteration of the survey guidelines.

In regions with such a high degree of human activity as Massachusetts State waters, contemporary debris will certainly be encountered during the course of an archaeological survey. By identifying such objects during the initial survey using high-resolution survey methods, cost and effort will be reduced as those objects deemed insignificant will not require further (and costly) investigation.

By instituting these survey standards, it is hoped that the maritime cultural history and pre-history of Massachusetts will best be served. Archaeologically significant materials can be identified, avoided, and preserved. Through experience and review of accepted archaeological survey protocols, we have found the criteria established in this document should in many cases ensure adequate coverage for the detection of surficial and buried cultural resources in the waters of the northeastern United States.

Applicable State and Federal Laws

MGL Chapter 9, § 26-27C - MHC review of state projects, State Archaeologist's Permits

MGL Chapter 91, §63 – Underwater Archaeological Resources Permits

312 CMR 2.00: Board of Underwater Archaeological Resources

950 CMR 70.00: Massachusetts Historical Commission

Section 106 of the National Historic Preservation Act of 1966 (16 USC 470f), as amended (1976, 1980, 1992, 1999)

National Environmental Policy Act of 1969 (“NEPA”)

APPENDIX A - Qualified Archaeologist

BUAR minimum qualifications (312 CMR 2.09(4)(d))

<https://www.mass.gov/files/documents/2017/10/30/312cmr2.pdf>

U.S. Secretary of Interior minimum qualifications

https://www.nps.gov/history/local-law/arch_stnds_9.htm