Task 4 - Standardized Protocols for Assessing the Effects of Offshore Alternative Energy Development on Cultural Resources

National Oceanographic Partnership Program (NOPP)

Developing Environmental Protocols and Modeling Tools to Support Ocean Renewable Energy and Stewardship
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Executive Summary

This report completes the Cultural Resource deliverables for the National Oceanographic Partnership Program (NOPP) Project Number: M10PS00152, Developing Environmental Protocols and Modeling Tools to Support Ocean Renewable Energy and Stewardship. The report documents the work completed by the University of Rhode Island (URI) to develop standardized protocols for assessing the effects of offshore alternative energy development on cultural resources and centers around three content area tasks (tasks 1-3 below):

1) Proposing standards for geophysical survey in anticipation of offshore alternative energy development.
2) Proposing a conceptual framework for incorporating a Cultural Landscape Approach (CLA) to assessing and understanding cultural resources in areas that have been identified for potential offshore alternative energy development.
3) Proposing the use of Archaeological Sensitivity Analysis (ASA) to evaluate and assess cultural resources in potential offshore alternative energy lease blocks.

For Task 1, the report outlines a two-tier approach to geophysical survey, instrumentation and survey resolution. Tier 1 corresponds to broad baseline surveys that are appropriate for evaluating the likely general effects of offshore alternative energy development in any particular area. For Tier 1 surveys, the report contains recommended strategies and instrumentation that are commensurate with these objectives. Tier 2 surveys are more detailed and correspond with archaeological surveys required by BOEMRE prior to development, disturbance and installation. For Tier 2 surveys, the report recommends slight modifications in current BOEMRE guidelines and standards for archaeological survey.

For Task 2, the report outlines a Cultural Landscape Approach (CLA) for identifying and evaluating the potential effects of ocean renewable energy siting on marine cultural heritage resources. Pioneered and partially implemented in the Rhode Island Ocean Special Area Management Plan (SAMP), CLA advances the integrated management of cultural and environmental resources with the goal of improving the performance of NEPA and Section 106 reviews under the National Historic Preservation Act (NHPA) and to bring them into better alignment with the National Ocean Policy and its nine priority areas. The report recommends the adoption of new definitions and categories for cultural heritage resources developed under the auspices of the National Marine Protected Area Federal Advisory Committee in 2010. The basic theoretical underpinnings of CLA are described in this report and the example of Rhode Island's energy landscape is presented drawn from the Rhode Island Ocean SAMP. Basic CLA questions are provided as is a representative matrix for classifying historic shipwrecks for CLA analysis. While specific protocols for including tribal and indigenous cultural heritage are not provided here, the report strongly recommends the need for early and meaningful consultation with these groups as well as members of working maritime communities in developing landscape contexts and preservation priorities. CLA, the report states, offers a multidisciplinary and multicultural

approach to cultural heritage that operates along the full spectrum of geographic scales, from the local to the global.

For Task 3, the report details three types of models and associated techniques that have the potential to contribute to assessing the effects of offshore alternative energy development on submerged cultural resources. These are Predictive Modeling, Paleo-Archaeological Landscape Reconstruction, and Archaeological Sensitivity Analysis (ASA). Each of these models and techniques is evaluated in terms of potential effectiveness and practicality. While statistical predictive models appear to be prohibitively time consuming and expensive, irrespective of whether they are designed for prehistoric or historic sites, both preliminary Paleo-Archaeological Landscape Reconstruction and Archaeological Sensitivity Analysis (ASA) hold considerable potential. Using the Rhode Island Ocean SAMO as a case study, the report looks at ways to enhance ASA for historic site, particularly shipwreck, locations using readily available data and linear regression. While the patterns of shipwreck loss revealed by the analysis of Rhode Island data may not be applicable in every location, the methodology for revealing those patterns is likely to be broadly pertinent.

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1.0 Introduction

This project, to develop standardized protocols for assessing the effects of offshore alternative energy development on cultural resources, centered around three content area tasks (tasks 1-3 below):

1) Proposing standards for geophysical survey in anticipation of offshore alternative energy development.
2) Proposing a conceptual framework for incorporating a Cultural Landscape Approach (CLA) to assessing and understanding cultural resources in areas that have been identified for potential offshore alternative energy development.
3) Proposing the use of Archaeological Sensitivity Analysis (ASA) to evaluate and assess cultural resources in potential offshore alternative energy lease blocks.

1.1 Consultations and the Project Advisory Committee

Researchers consulted with archaeologists and cultural resources from government, academia and private industry and in particular managers from BOEMRE and NOAA. This included but was not limited to a series of meetings at the Society for Historical Archaeology conference in Austin, Texas at the beginning of January, 2011 and also a presentation to the Project Advisory Committee (PAC) on June 1, 2011.

2.0 Task 1 - Standards for Geophysical Survey

Archaeological survey has a substantial theoretical tradition and a substantial literature (see for example, Banning 2002). The scale and scope of archaeological survey is always dependent on the purposes and objectives of the work. Where the purpose is to gain a broad understanding of the number and types of sites in an area, survey strategy, instrumentation and lane spacing reflect those purposes. Alternatively, where the objective is to locate all significant cultural material in an area, the structure of the survey is different and reflective of those needs. BOEMRE, like its predecessor the Minerals Management Service, more frequently deals with the latter type of survey and has long-established guidelines for that work. (Minerals Management Service, 1999a; 1999b; 2005a; 2005b; 2005c; 2006; 2008; Bureau of Ocean Energy Management, Regulation & Enforcement, nd.) Nevertheless, broad reconnaissance-type archaeological surveys are more appropriate for baseline studies in anticipation of offshore alternative energy development. We recommend, therefore, a two-phase approach (or "two-tier" in current URI-NOPP project nomenclature). "Phase or Tier 1" would be archaeological surveys as part of broad baseline studies. "Phase or Tier 2" would be archaeological surveys of Areas of Potential Effect (APE) from offshore development (APE is the term used by BOEMRE and is common in cultural resource management). Tier 2 surveys are, in essence, similar to those already required by BOEMRE. Certainly, standards and instrumentation for these two tiers of survey could and should work in tandum, but in both conceptual and practical terms they would have to be separated to some degree.

2.1 Tier 1

We propose that Phase or Tier 1 studies, dovetail with more intensive Phase or Tier 2 studies, but that the structure, instrumentation, and perhaps survey lane spacing be somewhat different. In the first instance, most alternative energy projects establish general areas for development, rather than specific locations for wind, wave or hydrokinetic energy installations. It is for this reason that broad, reconnaissance-level studies are recommended. Reconnaissance level survey will not mitigate the needs for detailed cultural resource assessments should an Environmental Impact Statement be required (ie. Tier 2 surveys), but it will establish good baseline data about potential sites and areas of archaeological sensitivity. This in turn will help inform both Cultural Landscape and Archaeological Sensitivity Analysis.

2.1.1 Tier 1 Studies and the Selection of Survey Areas

The size of the survey area, archaeological survey theory, and the range of likely archaeological resources should help govern the kinds of studies undertaken and the selection of survey areas for Tier 1 studies. To the extent possible, Tier 1 studies should take account of results of Archaeological Sensitivity Analysis (see ASA below); Cultural Landscape Approach or studies (see CLA below); the requirements for habitat and geotechnical studies; and National Register of Historic Places criteria for significance of historic resources.

Survey Strategies should be selected on a case-by-case basis but could include:

- Random or stratified sample based on blocks, grids units or transects
- Total survey of select areas
- Total survey of entire study area

In most cases, irrespective of whether the survey instrumentation is side scan sonar or a multibeam bathymetry system, it will be inpractical to complete an acoustic geoplyiscal survey of the entire study area. Survey areas, therefore, should be divided into survey blocks or transects and a stratified sample taken. In addition, areas deemed likely, through historic and archaeological research, to contain important, known, historic properties should be surveyed. These small scale, targeted surveys would augment the statistical sample. In all cases, surveyors should achieve 100% acoustic geophysical coverage of sampled survey blocks.

It is essential that work for Tier 1, broad-based, reconnaissance-level, archaeological survey should dovetail with geophysical survey for benthic habitat analysis and geological studies. This ensures more effective use of funds and enhances synergy among scientists working in different disciplines.

2.1.2 Tier 1 Geophysical Survey Instrumentation

Recommended standards for Tier 1 geophysical survey should complement and to some extent parallel standards established by BOEMRE for more detailed archaeological work. Baseline studies should include, at a minimum, a dual-channel, dual frequency side scan sonar and high resolution multibeam bathymetry system with sufficient resolution to see objects .5 m in length along. Alternatively, side scan data and multibeam bathymetry could be achieved through the use of an interferometric sonar. Whether the archaeologists use side scan and multibeam or interferometric sonar, they should ensure that the survey is controlled using a state-of-the-art, survey-grade GPS navigation system and hydrographic software such at HYPACK. The nadir in side scan sonar surveys should be kept to a minimum.

Geophysical survey should also include the collection of sub-bottom profiler data, which should be collected at high frequency. This will provide essential near surface geology data, which in turn will help establish the extent of marine sediment deposition and possible relic surfaces. Although acoustic data should be the basis for reconnaissance-level geophysical survey for cultural resources, marine magnetometer data is also useful. Once specific areas of potential effect (APE) have been established, marine magnetometer data becomes critical for assessing potential impacts of alternative energy projects on cultural resources (ie. in Tier 2 surveys). It makes sense, therefore, to collect as much of this data as possible at the reconnaissance level bearing in mind, of course, the budgetary constraints of the project.

During post-processing, acoustic and magnetic features (or targets) and anomalies from the geophysical survey should be identified, listed and prioritized. A system should be developed that has at least a three, and preferably five, levels of potential significance, ranging from features that are certainly cultural resources to those that might conceivably be so. A qualified archaeologist, trained in geophysical survey, should identify and prioritize targets. Raw and processed geophysical survey data should be archived and cataloged.

As part of a Tier 1 baseline study, a representative sample of these features identified in the survey should be visually inspected, either by scuba equipped archaeologists or remote operated vehicle (ROV). The archaeologists should prioritize these groundtruthing studies in accordance with the overall parameters of the project. In all cases where visibility permits, a photographic and video record should be acquired, archived and cataloged. Archaeologists should determine the source and identity of each groundtruthed target or feature. In cases where the feature is determined to be potentially (or actually) a historic or prehistoric site the archaeologist should assess the extent and stability of the site, and if possible, establish its date, form and cultural origin. No artifacts should be recovered, except in exceptional circumstances and in consultation with the requisite state or federal authorities. Archaeological sites that are unstable due to natural or human impacts should be monitored. Regular visual inspection and/or site stability studies should be undertaken. In certain cases, a detailed oceanographic characterization of the immersed environment might be necessary.

2.2 Tier 2

We propose that Phase or Tier 2 studies parallel current and proposed BOEMRE standards for full-scale archaeological survey, with one principle exception. We recommend that the agency restructure its acoustic mapping studies so as to incorporate multibeam technology more fully. Currently, BOEMRE requires side scan sonar survey, single beam echo sounder surveys and encourages multibeam surveys. (Bureau of Ocean Energy Management, Regulation & Enforcement, nd.) We propose that the agency require either side scan sonar and multibeam bathymetry surveys or interferometric sonar surveys.

Irrespective of any particular lease block's location, it will remain the prerogative of cultural resource managers at BOEMRE to required full-scale archaeological survey of APE (ie. Tier 2 survey), and in many cases will recommend to the contractor that it undertake full archaeological survey of entire lease blocks. The agency has well established, but continuously evolving, standards for this kind of archaeological survey and the subsequent reporting. These standards have undergone a number of iterations as new technology has become available. The standards are divided by region, but all contain sections on determining the APE, layout of the survey, navigation and control, bathymetry, magnetometer, side scan sonar, and sub-bottom profiler. The standards also contain sections on data collection and processing, reporting of archaeological sites, and protection of data and sites. The most recent versions of the standards address and require coordination with similar surveys for habitat and geotechnical studies. (Minerals Management Service, 1999a; 1999b; 2005a; 2005b; 2005c; 2006; 2008; Bureau of Ocean Energy Management, Regulation & Enforcement, nd.)

2.2.1 Analysis of BOEMRE Survey Requirements

BOEMRE archaeological survey standards state that the scope of investigation should be sufficient to reliably cover any portion of the site that will be affected by the renewable energy project including the maximum Area of Potential Effect (APE) encompassing all seafloor/bottom-disturbing activities. The maximum APE includes but is not limited to the footprint of all seafloor/bottom-disturbing activities (including the areas in which installation vessels, barge anchorages, and/or appurtenances may be placed) associated with construction, installation, inspection, maintenance, removal of structures and/or transmission cables. (Bureau of Ocean Energy Management, Regulation & Enforcement, nd.)

In general, BOEMRE requirements for cultural resource surveys can be divided into the following sections (summarized from BOEMRE and MMS standards):

Pre-Survey Meeting and Coordination

This meeting should discuss:

- Survey logistics (proposed survey area, dates, times, weather limitations, etc.)
- Vessel characteristics (size, equipment, etc.)
- Sea floor characteristics expected based on available information (depth, slope, substrate, etc.)
- Survey plan and equipment to be utilized
- Data processing and analysis
- Formulation of a quality assurance/quality control (QA/QC) protocol for data collection and interpretation

Survey Layout

The following should be applied to the layout of the archaeological survey:

- Oriented with respect to the bathymetry, shallow geologic structure, and renewable energy structure locations whenever possible.
- The grid pattern for each survey should cover the maximum APE for all anticipated physical disturbances.
- Line spacing for all geophysical data for shallow hazards assessments (on side scan sonar/all sub-bottom profilers) should <u>not exceed</u> 150 meters throughout the APE.
- Line spacing for all geophysical data for archaeological resources assessments (on magnetometer, side scan sonar, chirp sub-bottom profiler) should <u>not exceed</u> 30 meters throughout the APE.
- Line spacing for bathymetric charting using multi-beam technique or side scan sonar mosaic construction should be suitable for the water depths encountered and provide <u>both</u> full-coverage of the seabed plus suitable overlap and resolution of small discrete targets of 0.5m - 1.0m in diameter.
- All track lines should run generally parallel to each other. Tie-lines running perpendicular to the track lines should not exceed a line spacing of 150 meters throughout the APE.
- The geophysical survey grid for proposed transmission cable route(s) should include a minimum 300 meter-wide corridor centered on the transmission cable location(s). Line spacing should be identical to that noted above.

Navigation

- Ensure that the precision of the navigation system is ± 1 meter. Continuously log position fixes digitally along the vessel track and annotate them on all records at intervals no greater than 100 meters.

Bathymetry/Depth Sounder

- Depth sounder system to record with a sweep appropriate to the range of water depths expected in the survey area.
- "BOEMRE encourages use of a multi-beam bathymetry system particularly in areas characterized by complex topography or fragile habitats."

Magnetometer

- Magnetometer sensor should be towed as near as possible to the seafloor and an altitude of greater than 6 meters above the seafloor.
- Magnetometer sensitivity to be 1 gamma or less and that the background noise level does not exceed a total of 3 gammas peak to peak.

Sea Floor Imagery/Side Scan Sonar

- Data to be corrected for slant range, lay-back and vessel speed. Use a digital dual-frequency side scan sonar system with preferred frequencies of 445 and 900 kHz and no less than 100 and 500 kHz.
- Record continuous planimetric images of the seafloor.
- Data to be mosaiced
- Provide 100 percent coverage of the APE.
- Sidescan sonar sensor towed above 10 to 20 percent of the swath width.
- Ensure that the line spacing and display range are appropriate for the water depth and that Detect seafloor objects and features 0.5m – 1m in diameter

Shallow & Medium (Seismic) Penetration Sub-bottom Profilers

- A high-resolution "chirp" sub-bottom profiler should be used to delineate near-surface geologic strata and features.
- The sub-bottom profiler system should be capable of achieving a vertical bed separation Resolution of at least 0.3 meters in the uppermost 15 meters below the mud-line.
- Contractors must be cognizant of National Marine Fisheries Service (NMFS) considers sound levels above 160 dB re 1 μPa to constitute Level B harassment under the Marine Mammal Protection Act. Sounds above 180 dB re 1 μPa are considered Level A harassment.

2.2.2 Summary of Current BOEMRE Survey Requirements and Recommendations

By way of summary, BOEMRE archaeological survey requirements call for the collection of magnetometer data (less than 1 gamma sensitivity); side scan sonar (dual frequency – 445 and 900 kHz preferred) providing 100% coverage at a resolution high enough to identify objects 0.5 – 1.0 m in diameter; single beam echo sounder; and high-resolution "chirp" sub-bottom profiler (resolution 0.3 m in uppermost 15 m).

As technological advances in geophysical survey materialize so it is possible to require higher resolution surveys or new instrumentation. BOEMRE specifically recognizes this and "encourages innovative survey and data processing technologies." We recommend slight modification to the current requirements for archaeological and geophysical survey - namely magnetometer (less than .5 gamma sensitivity); either side scan sonar and multibeam bathymetry surveys or interferometric sonar providing 100% coverage and resolving objects 0.5m in diameter and high-resolution "chirp" sub-bottom profiler (resolution 0.3 m in uppermost 15 m).

In terms of post processing of geophysical survey data, we recommend the following:

- Acoustic data mosaiced
- Side scan targets tabulated
- Magnetic anomalies tabulated
- Establish buffer zones (at least 150 m) around potential archaeological resources
- Include analysis of cores taken for geotechnical studies
- Identify paleosols and preserved landscapes, if possible.
- Mitigation negotiable

3.0 Task 2 Cultural Landscape Approach

The traditional way of assessing the impacts of coastal and offshore projects on cultural heritage resources involves focusing on the location, significance, and vulnerability of individual—physical—archaeological sites. Typically in the United States, this research has involved developing lists of the best-known shipwrecks and their possible locations with a particular project area. Frequently these lists or inventories are conjectural, as historically mentioned wrecks may or many not have actually occurred a project area, or the wreck may have been recovered through unknown salvage operations. Despite a narrow focus, historic shipwrecks, unlike many underwater cultural resources, have at least received some consideration in coastal development, offshore oil and gas, and electrical and communication projects. They represent, however, only one of many kinds of potentially significant maritime cultural heritage resources that might be adversely affected by the development of offshore renewable energy.

The discussion that follows provides the rationale and basic framework for a more holistic Cultural Landscape Approach (CLA) for assessing the effects of offshore alternative energy development on Cultural Resources. It builds directly on the research completed through the Rhode Island Ocean Special Area Management Plan (SAMP), the experience of the Cape Wind Project in Massachusetts, extensive work by the NOAA National Marine Protected Area Federal Advisory Committee's cultural heritage resources working group, and discussions at the Atlantic Wind Energy Workshop sponsored by the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) and held on July 12-14, 2011. The recommendations below respond to widespread calls for the better integration of human factors in marine resource management, and for research and management methods that are sensitive to and inclusive of tribal and indigenous people and working maritime communities (Douvre 2008; Pomeroy and Douvre 2008; Crowder and Norse 2008; St. Thomas and Hall-Arbor 2008; Elher 2008).

3.1 Defining Cultural Heritage

Historic shipwrecks have dominated the practice of marine cultural heritage resource management in the United States for several decades. The term, however, has broader definitions. For example, the UNESCO Convention on the Protection of Underwater Cultural Heritage (2001) includes "all traces of human existence having a cultural, historical, or archaeological character which have been partially or totally underwater, periodically or continuously, for at least 100 years." The Convention offers many examples of cultural heritage including sites, structures, buildings, human remains, vessels and their cargoes, including their archaeological context and objects "of a prehistoric character." The Convention excludes resources under 100 years in age and more recent industrial heritage resources such as pipelines or cables and anything "still in use on the seabed"(Forrest 2002; Smith and Couper 2003). In the United States, such categorical exclusions are not in play. The general cutoff date for historic properties under federal law is older than fifty years, and can be less than under certain circumstances. Experience with the Cape Wind Project, demonstrated that intangible cultural heritage such as sacred places and view sheds are significant maritime cultural resources vulnerable to alternative offshore energy development. Definitions of cultural heritage and protocols for assessment should thus be comprehensive, resonate with a broad range of cultures and community stakeholders, and conform to the National Ocean Policy promulgated by President Obama on July 19, 2010 in Executive Order 13547.

In order to more effectively characterize cultural heritage resources for offshore alternative energy projects, we suggest embracing definitions approved by the NOAA National Marine Protected Area Federal Advisory Committee in October 2011. These definitions were developed by a 21-member cultural heritage resources working group that included representatives from federal agencies, archaeologists, resource managers, academics, industry stakeholders, and many tribal and indigenous groups from throughout the United States, including Alaska and Hawaii.

National MPA System Definitions:

> Cultural Heritage. *The legacy of physical evidence and intangible attributes of a group or society which is inherited and maintained in the present and bestowed for the benefit of future generations*.
>
> Marine Cultural Resources. *Marine Cultural Resources, both tangible and intangible, include, but are not limited to stories, knowledge, people, places, structures, or objects that identify the nation's history or native people's lifeways and traditions, both ancestral and contemporary. The broad array of stories, knowledge, people, place, structures, objects, together with the associated environment, that contribute to the maintenance of cultural*

identity/or reveal the historic and contemporary human interactions with an ecosystem.

Although not carrying the force of law, these definitions augment existing regulation practices mandated by the National Historic Preservation Act of 1966 (NHPA) and the National Environmental Protection Act of 1969 (NEPA). They provide a bridge from the practice of treating cultural heritage resources exclusively as individual sites or relicts to one that recognizes the coasts and oceans as complex social spaces that possess diverse cultural meanings and many different types of resources. They embrace the premise that understanding cultural heritage offers important avenues for better understanding and managing the human dimensions of coastal and marine ecosystems. In that sense, these definitions are consistent with the first of the nine National Priority Objectives outlined in the President's 2010 National Ocean Policy, the adoption of ecosystem-based management "as a foundational principle for the comprehensive management of our ocean, our coasts, and the Great Lakes."

3.2 Federal Responsibility for Coastal and Maritime Cultural Heritage

The federal government has a long history of protecting certain classes of natural and cultural heritage resources associated with the oceans and Great Lakes (Elia 2000).

3.2.1 The American Antiquities Act of 1906 (AA)

The Antiquities Act initiated the modern era of federal responsibility for conserving cultural heritage. The act prohibits the appropriation, destruction, excavation, or injury of "any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the Government of the United States without the permission of the Secretary of the Deportment of the Government having jurisdiction over the lands on which said antiquities are situated." The act authorized the President of United States to establish national monuments in order to protect "historic landmarks, historic and prehistoric structures, and other objects of interest" (16 USC 431-433). From its earliest uses by Theodore Roosevelt, vast areas and countless natural and cultural resources have gained protection under the *Antiquities Act* as National Monuments. The Papahanaumokuakea Marine National Monument, for example, encompasses 140,000 square miles of the Pacific and is largest area yet designated under the act. The Antiquities Act is limited to federal lands and, in the marine environment, to areas and resources inside the United States 12-mile territorial sea boundary or within designated National Marine Sanctuaries (Zander and Varmer, 1996).

3.2.2 The Archeological Protection Act of 1979 (ARPA)

ARPA expands *Antiquities Act* protections to "archaeological resources and sites which are on public lands and Indian lands." Violators of the Act may face felony charges and substantial penalties for illegal excavation, procurement or trade of archaeological artifacts from federal and Indian lands. ARPA requires permits for research mandates and requires that federal land managers create public education and outreach programs to promote the protection of archaeological resources (McManamon 2000).

3.2.3 The National Marine Sanctuaries Act of 1972 (NMSA)

NMSA enables NOAA to regulate activities, issue permits, and assess civil penalties for those illegally excavating or destroying cultural heritage resources within sanctuaries. Significantly, cultural heritage resources within national marine sanctuaries or marine national monuments ***are not*** required to meet the historic preservation criteria established under the *National Historic Preservation Act of 1966* (NHPA). Within tightly defined geographical boundaries the NMSA supports the comprehensive and integrated management and protection of natural and cultural resources. The NMSA does not explicitly prohibit energy development, but such projects maybe subject to additional restrictions or permit requirements.

3.2.4 The Sunken Military Craft Act (SMCA)

SMCA protects sunken U.S. military craft in all national and international waters and military craft owned by foreign governments in U.S. waters up to 24 nautical miles from shore. The SMCA asserts ownership of all sunken military craft and prohibits the application of the common law of finds and the maritime law of salvage to military craft without permission from the federal government. Sunken military craft are common in particular areas along the Atlantic Coast and are an important concern in assessing cultural heritage resources offshore alternative energy siting. The pollution potential of modern military craft and merchant vessels sunk in wartime is significant and determining the presence of such vessels is highly important for protecting human and environmental health in siting.

3.2.5 The Abandoned Shipwreck Act of 1987 (ASA)

ASA protects the historic shipwrecks that exist in large numbers throughout the U.S. coastal and Great Lakes waters. The core intent of the ASA was to protect historic shipwrecks from damage or destruction by salvagers—principally “treasure hunters” seeking to find and remove artifacts of portable economic value. The ASA also promotes non-destructive multiple use of historic shipwrecks. Under the ASA, the U.S. asserted title to all abandon shipwrecks embedded on state submerged lands or in coralline formations owned by a state. ASA also applies to any wreck on submerged state lands and eligible for, or included on, the National Register of Historic Places (U.S.C. 2105). The ASA transferred the title to abandoned shipwrecks to the state or Indian tribes owning the submerged lands on which the specific wreck resides. Abandoned historic wrecks in U.S. territorial waters remain the property of the United States out to twelve miles.

3.2.6 The National Historic Preservation Act of 1966 (NHPA) 36 CFR 800

NHPA requires the meaningful consideration of the potential effects of federally assisted or permitted projects on properties included on, or eligible for inclusion on, the National

Register of Historic Places. Meaningful consideration includes consultation with all concerned parties (King 2003). Sections 110 and 106 are especially important for ocean renewable energy siting assessments.

Section 110 requires that federal agencies develop a preservation program "for the identification, evaluation, and nomination to the National Register of Historic Places, and protection of historic properties." It also reiterates the requirement that agencies consult "with other Federal, State, and local agencies, Indian Tribes, Native Hawaiian organizations carrying out historic preservation planning activities, and with the private sector."[16 U.S.C. 470h-2(a)] It requires that agencies be proactive in identifying properties that may be eligible for the National Register in its undertakings.

Section 106 of NHPA states:

> The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal of federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation established under Title II of this Act a reasonable opportunity to comment with regard to such undertaking. [16 U.S.C. 470F—Advisory Council on Historic Preservation, comment on Federal Undertaking]

Section 106 of NHPA specifies a process for "taking into account" the effects of federal undertakings such as offshore alternative energy projects. NHPA does not mandate the preservation of any cultural heritage resource. This "taking into account" requirement was showcased in Secretary of the Interior Ken Salazar's recent decision to issue permits for the Cape Wind Project despite its potential adverse effects on an area of Nantucket Sound determined eligible for inclusion to the National Register of Historic Places, the Section 106 process in Cape Wind systematically identified and considered impacts on eligible resources but overruled the recommendations of the Advisory Council on Historic Preservation in approving the project and left a legacy of mistrust among the Wampanoag tribe whose national register eligible landscape will be damaged.

The broad reach of tribal and indigenous cultural heritage combined with the legacy of Cape Wind make this an essential issue in siting—one that can be addressed in part by adopting the Cultural Landscape Approach recommended below in evaluating the potential impacts of offshore alternative energy development. No approach, however, will succeed without a meaningful process of communication. Tribal and Indigenous cultural heritage consultation and interpretation is sufficiently complex as to require separate and fuller treatment by appropriate representatives of tribal and indigenous peoples. The CLA framework requires meaningful engagement and the recommended Paleo-Archaeological

Landscape Reconstructions (see section 4.0 below) and models should serve the interests of Cultural and Indigenous Tribal Historic Preservation Offices (THPO).

Offshore alternative energy siting will require a Section 106 review. Agencies charged with completing a 106 review are required to coordinate with NEPA reviews, identify appropriate State and Tribal Historic Preservation officers, involve the public, and consult with a wide range of interested parties including Indian tribes or indigenous people, local governments, and stakeholders representing a wide variety of interests. An effective 106 process is transparent, broadly inclusive, proactive in consultation, and will integrate a wide range of interdisciplinary knowledge generated through processes such as NEPA. To often, however, the Section 106 process gets derailed through a lack of understanding and misinformation among agencies and interested parties. Conducting an archaeological survey does not, as some believe, constitute fulfillment of agency responsibilities under Section 106. (King 2008)

The National Register of Historic Places

The chief instrument of the NHPA is the National Register of Historic Places. Through appropriate research and the proper interpretation, National Register standards and guidelines may accommodate a broad array of place-based cultural heritage resources. An excellent example of this is the determination of eligibility for Nantucket Sound as a traditional cultural, historic and archaeological property issued by the Keeper of the Register on January 4, 2011. The National Register's overall history in maritime cultural heritage, however, is inconsistent. Standardized cultural heritage resource protocols through CLA should lead to improved use of the National Register and the 106 process in offshore alternative energy siting.

Categories of Significance

The *National Register* includes properties (districts, sites, buildings, structures, or objects) determined significant in American history, architecture, archeology, engineering, and culture. Properties may be eligible for the National Register under one or more of four broad categories:

> A. Association with events that have made a significant contribution to the broad patters of our history.
>
> B. Association with the lives of significant persons in the past.
>
> C. Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.
>
> D. Have yielded or may be likely to yield, information important in history or prehistory.

Furthermore a property must be at least fifty years old, unless it has a unique and important place in recent American history.

Integrity

For inclusion on the *National Register* a historically significant property must also possess integrity of location, design, setting, materials, workmanship, feeling, and association. Integrity may be broadly understood as a properties capacity of a property to convey its historical significance. Significant underwater archaeological sites are often listed under Category D. Properties nominated under D generally do not necessarily require a high degree of visible site preservation to meet integrity requirements for inclusion on the *National Register.*

Improving National Register Consistency

NHPA authority is limited to cultural resources eligible for or included on the *National Register of Historic Places.* The Section 106 process of the NHPA is triggered by the presence or likely presence of potentially eligible, eligible or listed properties that ***may*** be affected by the proposed project. Although detailed standards and guidelines exist for many types of properties, determining National Register eligibility depends as much or more on subjective cultural or professional values and the level of research undertaken, as it does objective standards (King 2008).

Large inconsistencies exist among the states in managing marine cultural heritage resources. For example, according to the Rhode Island Historical Commission, the Ocean State has an estimated 2000 shipwrecks—yet only two appear on the *National Register*. By contrast Wisconsin, a state with between 600 and 700 historic shipwrecks, has over 30 on the National Register. The research of the Rhode Island Marine Archaeology Project (RIMAP) and more recently the University of Rhode Island for the Ocean SAMP leaves no question that dozens of Rhode Island shipwrecks are eligible for inclusion on the National Register and subject to Section 106 review (Mather and Jensen 2010). The potential number of National Register eligible historic wrecks along the Atlantic Coast likely numbers in the thousands. While shipwrecks typify the challenges associated with maritime cultural heritage management, they extend to other cultural heritage resources, among them submerged structures, habitations, prehistoric landscapes, and sacred grounds.

The lack of consistency by states in applying the NHPA and National Register criteria to underwater cultural heritage properties has many sources. The historic preservation professional community has its foundations in historical architecture supplemented by degree history and terrestrial archaeology. Comparatively few historic preservation professional have knowledge of the natural and cultural marine resources and environments, and most lack access to technologies and skills required for marine archaeological research. The high cost associated with marine archaeological field research, limited professional capacities in understaffed and underfunded offices represents a heavy burden that many SHPO's choose or are forced to ignore. As a result, the majority underwater maritime cultural heritage resources in waters of most states remain undiscovered, unrecognized, or undervalued.

The fact that most ocean alternative energy siting will take place in federal waters is providing important opportunities to bring consistency and improved quality to maritime cultural heritage resource assessments. For example the Bureau of Ocean Energy Management and Research and Enforcement (BOEMRE) through the Secretary of Interior's "Smart from the Start" Atlantic OCS Offshore Wind Initiative, is taking steps to identify research priorities and best practices across many disciplines and issue areas. The Socio-Economic breakout session of the Atlantic Offshore Wind Energy Workshop organized by BOEMRE and held on July 13 and 14, 2011 identified five information area/research needs themes, two of these: "cultural landscapes" and "submerged ancient tribal sites" relate directly to the NHPA and applications of Section 106. The participants in these sessions reiterated the need to improve capacities to incorporate past and present cultural perspectives in assessing potential energy projects. The Cultural Landscape Approach is one response to that need.

NHPA Issues in Maritime Cultural Heritage Assessment

The NHPA is only one of the sources of federal regulatory responsibility over coastal and marine cultural heritage resources.

The NPHPA through Section 106 applies only to resources listed on or potentially eligible for the National Register of Historic Places.

Decisions regarding eligibility of maritime cultural heritage resources depend in large part on highly subjective judgments and the level of research undertaking in assessing resources.

Eligibility decisions and preservation priorities vary dramatically between the different states.

Section 106 compliance requires more than identifying and assessing the National Register status of cultural heritage through archaeological survey.

Section 106 mandates process and not preservation and requires early and transparent communication and consultation among interested parties

In order to meet their responsibilities under Section 106, agencies and developers should employ a comprehensive and consistent framework that takes into account the subjective as well as the objective factors associated with cultural heritage resources and that encourages appropriate transparency and genuine communication among all interested parties.

3.2.7 The National Environmental Protection Act of 1969 (NEPA)

The broadest federal law that applies to marine cultural heritage resources is the *N*ational Environmental Protection Act of 1969 (NEPA). NEPA has wide ranging authority for "managing the impacts of federal government actions on all aspects of the human environment." NEPA defines the human environment as "the natural and physical environment and the relationship of people with that environment" (King 2008). Section 101(b) of NEPA requires that the federal government "improve and coordinate federal plans, functions, programs and resources" in order to balance the use, maximum social benefits, and long term sustainability of the natural and human environments. Among its specific dictates is to "preserve important historic, cultural, and natural aspects of our national heritage, and maintain, whenever possible, an environment which supports diversity, and a variety of individual choice." Environmental and cultural factors are intertwined throughout NEPA and thus require integrated assessment is required when considering the effects of offshore alternative energy development on cultural heritage resources (Oxley 2001). To cite one example: the oil-filled wreck of a World War II T1 tanker may be at once a National Register eligible archaeological site, a memorial or grave site, a recreational and commercial resource, a site of locally significant habitat, and a looming environmental threat.

Our notions of how far the human environment extends to ocean spaces have expanded significantly since the passage of NEPA in1969, as has our knowledge of the direct influences marine environments, resources, and systems (natural and cultural) on human communities. The influences are important, but often difficult to discern on the ocean, at local scale, or over a short time period. Properly assessed tangible and intangible cultural heritage resources can make important human-environment connections visible in ways that can inform the collaborative and interdisciplinary decision-making and social values envisaged in NEPA and the NHPA.

3.2.8 Expanded Definitions for Significance in Maritime Cultural Heritage Resources

As originally approved, the Framework for NOAA's National System of Marine Protected Areas embraced National Register eligibility as the single standard for determining if an MPA qualified under its cultural heritage track. The cultural heritage resources working group established through the MPA Federal Advisory Committee (FAC), closely evaluated the framework and determined that while the National Register standards are important, they are, on their own, too limiting to serve as the exclusive definition for cultural heritage in MPAs. For example, these standards institutionalize a dependant status for federally recognized tribes that are required by law to be treated as independent nations and that have right to make their own designations, based on their own criteria. The National Register, the cultural heritage resources working group also held, provided no means of recognizing cultural heritage resources for their potential to provide important historical and contemporary biophysical information crucial for understanding historical and contemporary ecosystems. Embracing the working group's recommendations the MPA FAC voted to expand the MPA Framework's conception of a cultural heritage MPA:

Cultural Heritage MPAs must conform to the criteria included in the National Register of Historic Places, or be considered important by Indian Tribes, tribal communities, Alaska Natives, Native Hawaiians, or Pacific Islanders, or have the potential to provide information important to understanding cultural and natural heritage.

In addition to the National Register criteria previously described, cultural resources include the following for the purposes of inclusion into the national system of MPAs:

(b) Tribal and Indigenous Area Designations.
As identified by oral or written record, indigenous stories, knowledge, people, places, structures, objects, and traditional practices contribute to maintaining cultural identity and/or sustainable management of the environment. The national system will include cultural and natural marine resources that are recognized as important by tribal or indigenous peoples. Some examples are, but not limited to:

1. *Areas of cultural value or historic significance to tribes and indigenous peoples.*
2. *Traditional cultural properties, including areas of spiritual value.*
3. *Important Great Lakes and marine subsistence areas.*
4. *Important ceremonial sites and traditional activity sites.*
5. *Tribal usual and accustomed areas.*
6. *Other areas as determined important by tribal or indigenous peoples.*

(c) Other Cultural Landscapes
A place where the intersection of culture and nature leaves a distinct ecological or cultural imprint, and which is imbued with lasting meaning by a particular group through contact, experience, and activities.

3.3 The Cultural Landscape Approach (CLA)

The Cultural Landscape Approach (CLA) to maritime cultural heritage resources addresses contemporary management challenges by providing an open-ended and rigorous framework that integrates data and perspectives from the physical and social sciences, humanities, and traditional/place-based knowledge systems. CLA recognizes that places and cultural heritage resources can have different or multiple meanings and levels of significance based on how people from different cultures, times, or backgrounds have interacted with the landscape. Adopting this pluralistic approach increases the likelihood that cultural heritage resources will be found, recognized, and appropriately respected as decisions are made about the siting and potential effects of offshore alternative energy projects.

CLA offers fundamental principles about the nature of cultural heritage resources and suggests methods for identifying and characterizing interactions between human cultures and activities and coastal and marine environments. Cultural heritage resources, whether in the form of archaeological sites or living cultural practices, are records of these interactions over time. They reveal how people have used and shaped marine environments, and how these environments have shaped human cultural and history. Understanding these interactions may offer our best hope for sustainably and equitably using, maintaining, and where required restoring coastal and marine ecosystems (Crowder and Norse 2008; Douvre 2008).

3.3.1 CLA Fundamentals

The impulse for people to make sense of their relationships with nature is ancient. It is expressed in many place-based religious practices as well as in the knowledge systems of tribal and indigenous people found throughout the world. Modern western religious and scientific traditions have often served to separate in intellectual and moral senses humankind from the natural world.

In the 1920s, a rejection of geographical determinism inspired the founding of the field cultural geography in the United States, with the cultural landscape becoming one of its central concepts. Landscape architect Carl Sauer—the father of modern cultural geography—offered a definition of cultural landscape remains influential nearly a century after its articulation. Sauer explained "the cultural landscape is fashioned from the natural landscape by a cultural group. Culture is the agent, the natural area is the medium, the cultural landscape is the result" (Wilson and Groth 2003). Since Sauer's early work the idea of the cultural landscape has been embraced and reshaped by many disciplines and has given rise to enormous and complicated academic literature. Scholars and regulatory bodies worldwide have developed different definitions for cultural landscapes as well as schema for indentifying and evaluating their meaning and significance. The idea of cultural landscapes is found in geography, landscape architecture, anthropology, landscape conservation, archaeology, as well as other disciplines (Westerdahl 1992, Angelstram 1997, Farina 2000).

However adapted, the foundations of cultural landscapes remains the interplay between nature and culture. In CLA, this interplay is dialectical. Cultures are highly influenced by the physical environment and the cultures consistently reshape the malleable (or valuable) aspects of that physical environment. CLA holds that both people and the environment are agents that shape the content of cultural landscapes.

Cultural heritage resources are comprised of things that exist in the natural/physical world and shaped through human actions or human thought - or a combination of both. For example, a brilliant sunrise brings morning light to a bluff on New England's south coast. This is a physical process found in nature. The cultural significance of this event is produced through long-practiced patterns of human behavior and belief. No human hand transformed the sunrise, but human thought and practices give it a deep cultural meaning recognized in Nantucket Sound's determination of eligibility for the National Register of Historic Places. Determining meaning is essential in assessing cultural heritage resources. To site a more contemporary heritage resource, the site of the World Trade Center towers destroyed in on September 11, 2001, retains few of the material remains of the buildings where 3,000 people lost their lives in a terrorist attack. Even if every original element is removed for reasons of public health or to rebuild, the cultural meaning of the World Trade Center would remain fully intact for most Americans, and nearly all of those who live and work near Manhattan. Employing CLA requires researchers to search for and to recognize the evidence of human meaning found in sunrises, historic shipwrecks, submerged landscapes, fishing grounds, and or any other places where culture and nature come together to create substantial cultural markers.

Identified and mapped through interdisciplinary research, cultural landscapes offer a means to better understand where significant and vulnerable cultural heritage resources are more or less likely to survive. A deeper analysis of identified cultural landscapes will reveal what the contents of these landscapes mean to different cultures or groups of people. It will also help cultural resource professionals and all interested parties to collaborate in determining which resources found within the landscape, or parts of the landscape, are likely candidates for the National Register and the Section 106 process, or that merit special preservation or mitigation efforts under NEPA.

CLA places living and non-living resources with larger cultural contexts that are tied to the human uses of specific places. It identifies explicit ways that human history shaped and was shaped by important elements of the natural environment (living and non-living, natural and cultural) within a geographically defined area. CLA identifies material and intangible cultural markers found within a specified area, and assesses the patterns of human activity that underlie them across time. CLA makes visible the multiple and sometimes conflicting cultural meanings that may be associated with a specific geographic area and its resources. The approach is place-based, interdisciplinary, and adaptive. Emphasizing the potential importance of all human/ecosystem interactions, CLA is consistent with ecosystem-based approaches to management required by national policy (Arkema et, al. 2006; Curtin and Prellezo 2010; Crowder and Norse 2008);.

CLA principal features:

- Place-based and operates at multiple geographic scales from the local to the global.
- Makes visible cultural and environmental processes that are most influencing the composition and meaning of cultural heritage resources within given area.
- Requires the identification, involvement, and open representation of the views of all cultures and historically rooted groups with ties to an area under study.
- Culturally contingent, cultural landscapes and cultural heritage resources are open to multiple even conflicting interpretations by different cultures or disciplines.
- Adaptive- new landscapes may be identified within areas, or new meanings developed based on additional data or fresh perspectives.
- Consistent with ecosystem-based approaches to management.
- Supports inclusiveness and transparency in decision-making.

CLA outcomes include:

- Identifying a representative range of cultural heritage resources that are potentially eligible for the National Register of Historic Places within a project area.
- Identifying, providing and representing the connections of tribal/indigenous cultural and historically rooted stakeholder groups in an area.
- Identifying important historical and cultural forces most influential in determining the composition of cultural resources and the condition of local ecosystems in area over time.
- Identifying the natural resources and environmental factors that have consistently influenced the human uses of an area over time.

3.3.2 CLA Implementation - the Rhode Island Ocean SAMP Experience

Between 2007-2010, the University of Rhode Island in collaboration with the Rhode Island Coastal Resources Management Council produced a Special Area Management Plan (SAMP) for Rhode Island offshore waters. The Ocean SAMP is an example of coastal and marine spatial planning that employed the best available science to understand the natural, physical and cultural environment in the study area. The Ocean SAMP included a study of cultural resources in Rhode Island's offshore waters. In addition to building the usual databases of known and potential cultural resources, the researchers developed and implemented limited CLA-based research and analysis study to produce a series of landscape contexts based on historical and cartographic research, geophysical and archaeological survey, and diver reconnaissance (Rhode Island Coastal Resources Management Council, 2010)

URI researchers developed series of core CLA questions for the Ocean SAMP that guided research and identified historical processes and historical actors that most significantly shaped the region's submerged historic cultural landscape. The CLA based questions aided in interpreting geospatial databases consisting of historical, archaeological, and geological information.

CLA Questions considered by researchers in the Ocean SAMP:

- What people have used this place?
- How have they used it?
- Over what time frame have these uses taken place?
- What are the principle human practices that have altered or sustained the natural environment of the place?
- What evidence of these activities exists or might exist in the physical landscape or in living cultures?
- How can the cultural heritage of this place be linked to the recovery, preservation and conveyance of human stories and knowledge?
- In what ways has this heritage contributed to or undermined the ecological and cultural resilience of this place?

Not all of these questions were explored in the same depth—fully addressing the linkages between cultural processes and contemporary environmental conditions fell outside of the cultural heritage team's scope of work for the Ocean SAMP. The potential for applying these questions in resource assessment, however, were amply demonstrated in the development of a series of landscape contexts the representing the historical uses of the SAMP survey area that produced the largest quantity of historical archaeological materials.

Three landscape contexts: fishing, military, and energy explained the presence and potential *meaning* of the majority of likely and confirmed historical submerged cultural resources in the study area. While other contexts or broad areas of activity are represented in the archaeological record, these three areas emerged as the most important for the purposes of planning and assessment in Rhode Island Sound. While prehistoric and tribal cultural landscapes and heritage fell outside of the team's scope of work, the Ocean SAMP included of an unfiltered history based on oral traditions and memories produced by Narragansett tribe. The Narragansett history is a model for taking early steps defining a tribal landscape in a comprehensive CLA-based study.

The energy landscape

The identification of an energy landscape yielded the deepest new insights into the SAMP area's submerged maritime heritage. CLA revealed that the changing availability and demand for energy, including wood, peat, coal, petroleum oil, and wind have profoundly influenced the cultural heritage and natural environment of the SAMP area and the associated coastal zone. For understanding the formation of Rhode Island Sound's historical submerged historic shipwreck resources and principal maritime structures on land the growing use and methods for transportion coal are the most important. In the 19th century, industrialization reshaped Rhode Island's terrestrial cultural landscapes by creating factories, mills, working neighborhoods and industrial cities. Largely unrecognized is that industrialization also caused important alterations to the Rhode Island's coastal environment through the construction or improvement of harbors, dredging of shipping channels, and construction or improvements to lighthouses, docks, and lifesaving stations (Rhode Island Coastal Resources Management Council, Vol. I, Ch. 4., 2010)

Research revealed that the majority of historic shipwrecks in the SAMP area are tied to the transportation of coal to New England, principally from Virginia and New York. Most of these shipwrecks occurred between 1850 and 1918, a period when American consumption of coal grew 77-fold. Although Southern New England was at the heart of America's industrial revolution, the region lacked industrial quantities of native coal. As demand grew, the region looked to the sea to secure large, economical, and stable supplies. This demand for abundant, dependable, <u>and</u> inexpensive energy in New England led to an *ad hoc* system of transportation that relied on a motley and vulnerable armada sailing vessels, schooner barges and barges. During the peak decades, sometimes 200 vessels carrying coal day passed by Block Island in Rhode Island Sound. Poorly paid mariners (men and women) from diverse racial and ethnic backgrounds that represented the lowest strata on the regional maritime social scale provide the labor for the ships, with many losing their lives. Within this context between 1870 and 1900, the frequency of shipwrecks increased dramatically in the Northeastern U.S. and as much as six-fold in the SAMP area, with high numbers of wrecks continuing until about 1920 when major changes in technology and supply routes reduced the risks associated with shipping coal. The energy landscape associated with coal transport to New England extends from Virginia to Maine and explains the presence of hundreds of shipwrecks along the Atlantic Coast. (Rhode Island Coastal Resources Management Council, Vol. I, Ch. 4., 2010)

The energy landscape did not begin with, nor does it end with coal. Analysis of the energy landscape led to significant reassessments of the significance of known wrecks such as the iron tanker *Llewellyn Howland* that broke up on Seal Ledge near Aquidneck Island in 1924, dumping thousands of barrels of fuel oil into area waters. An early environmental disaster and well-known wreck event, the ship's historical significance as one of the first generation of purpose built oil tankers (built in 1888) remained unrecognized until viewed through the lens of energy. (Rhode Island Coastal Resources Management Council, Vol. I, Ch. 4., 2010)

In Southern New England, the continued use of the sea to transport low cost energy continues to result in significant accidents, including serious pollution events such as the oil spills associated with the grounding the barge *North Cape* in Narragansett Bay, Rhode Island in 1996, and the rupturing of *Bouchard Oil Barge 120* in Buzzards Bay, Massachusetts in 2003. The economic, geographic, and technological context of transporting energy to New England continues to influence the area's maritime cultural landscape, and the threat that it poses to the health of coastal and marine ecosystems in an age of petroleum. (Rhode Island Coastal Resources Management Council, Vol. I, Ch. 4., 2010)

In addition to identifying resources associated with the past, CLA also helps to reveal material evidence of linkages between important areas of human activity on land and at sea. Shipwreck patterns overtime reveal the influence of specific economic forces, geographic features, and climate patterns on human activity in the marine places. These influence of these long-term factors is not always obvious, and most will continue to shape human activity as the country moves offshore for clean alternative energy. Applying a Cultural Landscape Approach not only identifies important historical and cultural heritage resources that may be adversely effected through development, it goes a step further by spotlighting cultural and natural forces that have the capacity to influence positively and negatively the success of offshore energy projects in specific areas.

The energy landscape identified in the Ocean SAMP underscores the limitations of relying on standard historic preservation-based approaches to cultural heritage resources in marine environments. Transporting energy has long been and remains an important activity in Rhode Island Sound. It has resulted in a cultural landscape rich with historic archaeological resources and, in some places, evidence of alterations to the environment. Before applying CLA the energy landscape shipwrecks were largely dismissed as having little or no archaeological and historical value for Rhode Island history. CLA demonstrated that coal shipping was a central facet of the growth of industry in Rhode Island, and provided a contextual framework that will useful for determining their historical significance and integrity of historic shipwrecks under Section 106 of the NHPA. (Rhode Island Coastal Resources Management Council, Vol. I, Ch. 4., 2010)

3.3.3 Standardized Approaches to CLA

CLA is open-ended, culturally pluralistic, and adaptive. One its chief attributes is that it provides a way to capture the uniqueness of marine places. While proscribing a rigid model defeats this purpose, CLA can be implemented so as to achieve general consistency in use while preserving its capacity to capture the specific characteristics of different places. CLA works by the asking of specific types of questions, locating the appropriate types of evidence, and identifying meaningful landscape contexts to represent the major cultural patterns responsible for the material and intangible cultural resources within a specific study area. The questions, evidence, and contexts all contribute to a more culturally inclusive and interdisciplinary understanding of the human uses and their cultural legacy within an area.

One of the challenges involves determining the appropriate scale and level of generalization for characterization. A CLA study should offer a level of detail sufficient to identify major categories of human activity that resulted in the production or deposition of important cultural heritage resources in an area. Detail should not be so great as to create historical noise that can obscures important influences and layers of change within each category and add unnecessary research costs.

CLA should capture major patterns of human activity over time at a sufficient scale to identify highly important individual resources; for example, a sacred tribal place or an especially famous or individually outstanding historic shipwreck. CLA should identify the general composition and known and likely locations and distribution of cultural heritage resources. It should produce landscape contexts for evaluating resources in their own cultural terms (in the case of tribal, indigenous, or ethnic landscapes) and that identify their larger influence in history, culture, and the environment. In addition to helping to determine appropriate locations for development, these contexts provide a focus for meaningfully advancing the Section 106 process of the NHPA and in meeting NEPA requirements. This approach was most fully expressed in the energy landscape section of the Rhode Island's Ocean SAMP.

CLA Questions

The CLA questions guiding the Rhode Ocean SAMP, with the adaptations offered below provide a solid starting point for a CLA characterization of potential sites for alternative energy on the ocean:

- What major cultural groups have used this place?
- What are the most important or visible ways that each group used this places?
- Over what time frame have these groups used this place?
- What are the principle specific human practices that have most reshaped or sustained the coastal or marine natural environment of the place?
- What evidence of these activities exists or might exist in the physical landscape, the archaeological resources, or the practices and memories of living cultures?
- In what ways do specific cultural heritage resources link to human stories and knowledge of associated with this place?
- In what ways has the identified cultural heritage and landscapes and their underlying history influenced the ecological and cultural resilience of this place?

Cultures

Although the United States is a culturally diverse nation, in most instances the number of specific cultures and major categories of use found within a distinct geographic area is limited. There may be multiple tribes or indigenous groups with long human histories of an area, and a CLA study should attempt capture them all. CLA researchers should be required to consult in a deep and meaningful way with these groups. The appropriate means of consultation will depend on the specific circumstances. In all cases, tribal and indigenous people should have ownership of their own cultural heritage and its interpretation. Historical archaeological resources reflect the period after Euro-American settlement. Cultural resources for Euro-American sources are abundant and leave very pronounced archaeological signatures that cover relatively short time periods often characterized by rapid change.

Uses

CLA research involves coming to grips with general categories that operate across global, national, regional, and local geographic and historical scales and that find expression in presence, absence, composition, and meaning of material cultural resources found within a specific study area. A relatively small number of landscape context categories will usually be sufficient to classify the major types of material cultural heritage resources to be found in a specific area. These contexts may be more or less refined depending on cultural/archaeological complexity of a given area and the scope of the project. In nearly all large U.S. maritime spaces researchers will find historically significant cultural landscapes associated with fishing (including the hunting of marine birds and mammals), military activity, and maritime commerce. These are highly general categories requiring further refinement by identifying the major cultures or large scale actors (such as governments) involved, the time frame involved, and the progression of technologies associated with each group, practice, and time period. Within the context of global and United States history, there are specific events such as wars or the gold rush, or historical processes such as industrialization, of the adoption of the 200-mile U.S. exclusive economic zone that brought fundamental changes evident in the archaeological record. At a regional level in the United States, we find that distinct processes of exploration, frontier settlement, and economic expansion leave large-scale cultural landscapes comprised of underwater and coastal historical archaeological resources.

Evidence

A key to CLA is matching individual questions, cultures, and uses with the appropriate types of available evidence. For the historical period, many questions can be answered through readily available digitized and published cartographic and historical documents. Cultural landscapes that involve living cultures and certain contemporary practices, however, require researchers to engage with people today as well as with the past and move beyond historical and archaeological sources. As indicated elsewhere, documenting cultural landscapes associated with living tribal and indigenous groups is the exclusive province the appropriate representatives of these groups. CLA , however, provides a place where they may choose to express their stories and identify cultural heritage resources facing potential adverse effects. Fully understanding the complexities of fisheries landscapes likewise requires the involvement of fishing communities who possess knowledge recent history, and of specific natural features such as tides, currents, weather, that can inform research on fishing and other landscape contexts. Experience suggests that living cultures with attachments to the ocean in conducting a CLA project will enhance the consultative process envisaged in NHPA and NEPA.

While abundant historical and archaeological evidence exists to study many of the most common historical cultural heritage resources found in United States waters, it is unevenly distributed and often heavily skewed towards the years after 1850. Maritime historical materials tend to become quite abundant after the American Civil War when bureaucratic reforms brought new levels of government accountability and administrative reform. A great deal of historical evidence survives for commercial shipping, although much of the most specific material is buried in court records, archives, and private libraries. Military matters likewise have left a rich and often nearly impenetrable repository of archival and published sources. Other vital areas of activity, most notably commercial fishing, are not well represented in the historical record. While the business side and technological aspects of fishing may be well understood, the actual fishing practices often remain unknown. The losses of smaller fishing vessels often escaped recording in government or insurance shipwreck lists. The archaeological record embedded in cultural landscapes may offer the only robust means for fully assessing the cultural history of fishing as well as its impacts on coastal and marine ecosystems.

Breaking Down Categories

Determining the level of specificity and identifying categories will depend on the research design and the history of the area. We offer three examples associated with pervasive categories of human activity likely to leave material cultural heritage resources (Table 1).

Table1 - Categories of Cultural Landscape

Representative Category Breakdown for Three Principle Landscape Use Categories			
Maritime Commercial Landscape	Passenger	Sail Powered	
		Steam	
	Natural Resources	Lumber	
		Stone	
		Ore/Minerals	
		Agricultural Products	
	Energy	Coal	
		Petroleum	
		Other	
Military Landscapes	Defensive	Coastal fortifications	
		Coastal defense and utility vessels	
		Discarded equipment/dump sites	
	Operational	Combat or military support craft – lost in war or peace	Ships
			Planes
			Submarines
		Merchant vessels lost through military action	
	Experimental	Shore-based testing facilities	
		Naval testing grounds	Ordinance remains
			Aircraft
			Craft sunk for testing
Fishing Landscape	Tribal/ Indigenous	Pre-European contact	
		Post-European contact	Subsistence – non-market
			Subsistence - market
	Euro-American	Non-Motorized	Inshore
			Deepwater/Offshore
		Motorized	Inshore (minimal bottom disturbing, net, hook or trap)
			Inshore (Bottom disturbing mobile trawl, dredge)
			Offshore (minimal bottom disturbing, net, hook or trap)
			Offshore (Bottom disturbing mobile trawl, dredge)

The choice and level of specificity employed in developing landscape contexts will depend on the cultural complexity of the study area as wells its desired outcomes. Identifying resources for the purposes of avoiding adverse effects on areas with concentrations cultural heritage resources that may be eligible for the National Register of Historic Places, or that might represent a threat to human or environmental safety can likely be done by employing fairly general levels of classification. Capturing the meaning of these resources and connecting them with specific communities, cultures, or interested user groups requires more analysis. Extracting the environmental information inherent in these resources involves yet more intensive levels of geospatial and historical analysis and may include archaeological fieldwork.

Developing a more comprehensive management plan will require developing each context sufficiently so as to capture the meaningful heterogeneity of resources embedded in cultural landscapes and the relationships between them. "Meaningful" is admittedly a subjective line to draw, but it certainly involves identifying those important events or processes taking places at various geographic scales that are discernable through individual cultural heritage resources and landscapes at the local level.

3.3.4 Conclusion

The Cultural Landscape Approach (CLA) bridges traditional historic preservation-based approaches to maritime heritage resource management and the broader consideration and integration of human factors in the environment called for by EBM, Coastal and Marine Spatial Planning, and the National Ocean Policy. To summarize, we close with a quote describing CLA taken from the Rhode Island Ocean SAMP:

> Through geographical representation and spatial analysis, interdisciplinary research, and multi-cultural interpretive frameworks, CLA makes visible the multiple connections between human and the natural environment in specific places and at different times. It offers one direction for meaningfully incorporating historical change into spatial analysis and coastal and marine planning and management. More than just a method of historic preservation, CLA offers ways to analyze historical patterns and relationships that relate directly to the use of ecosystem services and their effects on the natural environment. (Rhode Island Coastal Resources Management Council, 2010)

4.0 Archaeological Sensitivity Analysis (ASA) and Predictive Modeling

The use of geospatial analysis to determine archaeological sensitivity or to create archaeological site models has increased substantially in recent years. Nowadays, archaeologists seldom consider site distribution to be random. The variables that explain site distribution, however, differ by resource type. Different sets of variables help explain pre-contact site distribution as opposed to historic site distribution.

All techniques for archaeological site modeling or sensitivity analysis aim to explain, or at least partially explain, site distribution patterns whether it be for research or resource management. Models developed and techniques used over the past 15 years or so have been almost universally GIS-based. These models and techniques are summarized below.

4.1 Predictive Modeling

A true archaeological-site predictive model is mathematical in nature and is backed by sound statistical analysis. The result is the establishment of predictive zones representing a high, medium and low probability of archaeological sites being represented in those areas. Model development is usually a multi-year process that includes extensive initial survey work to gather baseline data and address previous survey bias, model development, and finally model testing and refinement. The end product is robust enough that a high percentage of sites, ≈80%, fall within high or medium zones, while those zones themselves only account for a moderate to small part of the relevant geographic area, ≈25%. Most archaeological predictive models in the United States are GIS-based and have been focused on Indigenous site patterns. They center on creating environmental zones that are more likely to contain archaeological sites. Those zones are created by use of independent variables such as elevation, slope, soil type, and distance to fresh water. Examples of predictive models include the Minnesota Archaeological Predictive Model, (Minnesota Department of Transportation, 2005) which purports to predict pre-1837 archaeological sites in the state, and also archaeological site predictive models in Rhode Island and Massachusetts (Massachusetts Historical Commission, 1982; Mulholland, 1984; Dincause 1968; Dincause, 1974; Thorbahn, 1982; Rhode Island Historic Preservation and Heritage Commission 1982; Rhode Island Historic Preservation and Heritage Commission 1986) It is certainly possible that predictive models could be developed for underwater historic site locations – for example shipwrecks - but there have been few efforts to do so. It is more common to use a technique called Archaeological Sensitivity Analysis for historic sites (see below). As part of the work for this project, researchers experimented with enhancing ASA so as to provide something closer to a predictive model.

4.2 Paleo-Archaeological Landscape and Environmental Reconstruction

Pre-contact, archaeological site predictive modeling is enhanced considerably by paleo-archaeologicial landscape reconstruction and paleo-environmental reconstruction – both of which require the collaboration of archaeologists with earth scientists. The process starts with an archaeological understanding of the relationship between Native American sites and the environment – particularly the locational relationships between sites of human habitation and topography, natural resources and fresh water. By understanding the paleo-environment, paleo-climatic change, and the paleo-landscape it is possible to identify areas that are more likely to contain prehistoric archaeological sites. At the same time, it is also possible, through an understanding of aspects such as weathering, erosion and depositional patterns, to identify exposed or nearly exposed ancient landscapes and relic surfaces – ie. those that lie close to the modern land surface.

4.3 Archaeological Sensitivity Analysis

Archaeological Sensitivity Analysis (ASA) is a technique used by archaeologists and historians designate certain areas as more archaeologically sensitive than others. In that sense it is closely allied to predictive modeling. Those designations are based on historic, archaeological, GIS, geophysical, and site-specific studies as interpreted by an experience professional archaeologist and/or historian. In general, ASA has been used for assessments of historic rather than prehistoric site patterns and sensitivity. (Mather and Watts, 1998; Mather and Watts, 2002) All the data is geo-spatial in nature but not necessarily quantitative. ASA is not usually built upon a statistical model. More frequently, ASA is based on exploratory data analysis and is dependent on the capacity of the field professionals to see patterns, make judgments and divide an area into zones of archaeological sensitivity. Those zones tend to be 3 or 5 in number and range from *Highest Sensitivity* (areas that contain known cultural resources that are on, or have been determined eligible for inclusion in, the National Register of Historic Places) to *Lowest Sensitivity* (areas that have experienced low levels of documented human activity or that have experienced extensive disturbance. They contain no known historic or archaeological sites, a finding that has been confirmed through geophysical survey and archaeological inspection). Certainly ASA can and has been applied to submerged environments, for example by Mather and Watts in the James River and Charleston Harbor (Watts and Mather, 1996; Watts and Mather, 1997)

4.4 Predictive Modeling Discussion and Recommendations

Just as archaeologists have developed predictive models for pre-contact sites on land, it is certainly possible that similar efforts could be made underwater. Underwater pre-contact archaeology is still in its infancy, but it is clearly one of the most important new directions for the discipline. Unfortuately, underwater archaeology tends to be more costly than its land based counterpart, and the costs and time associated with developing a statistically valid pre-contact predictive model underwater would exceed similar efforts on land. Given that predictive modeling on land is already expensive and time consuming, similar efforts underwater at this time, therefore, would be impractical. The Minnesota predictive model, for example, which was a terrestrial project, took 4 years to complete. (Minnesota Department of Transportation, 2005) A similar project underwater could easily cost twice as much and take twice as long. With that said, a limited paleo-archaeological landscape reconstruction is more practical. Such an undertaking could identify areas of pre-contact archaeological sensitivity, and when combined with an enhanced version of ASA for historic sites has great potential as a tool for assessing the impacts of offshore alternative energy development.

4.5 Paleo-Archaeological Landscape Reconstruction Discussion and Recommendations

Paleo-archaeological landscape reconstruction is a critical component of any baseline study for offshore alternative energy assessments. It is particularly important in areas of the continental shelf that have experienced significant sea level rise since the last glacial maximum (LGM). In some areas this can be upwards of 70 meters. These areas of the seafloor possess significant potential for submerged pre-contact archaeological sites.

A preliminary paleo-archaeological reconstruction is achievable as part of baseline alternative energy studies. It requires, however, substantial integration of disciplines and methodologies. Using a combination of geological knowledge, sub-bottom data, side scan sonar data, and coring, it is possible to partially reconstruct the landscape prior to inundation and marine sedimentation. As a result it is possible to identify - areas that were sub-aerially exposed, relic surfaces, glacial lakes, relic riverbeds and the sedimentary regime. While this, by itself, falls short of a predictive model, it does identify areas that could contain archaeological material and, therefore, have greater archaeological sensitivity.

One significant issue is the extent of coring required for paleo-archaeological landscape reconstruction. This requirement can only be determined on a case-by-case basis, but a logical path would to be to determine overall project coring requirements with input from archaeologists, geologists and physical oceanographers and to use the data in an integrated, interdisciplinary manner. Certainly knowledge about the existence of human populations in areas that were sub-aerially exposed should be one of the driving factors in any coring decision-making process.

4.6 Archaeological Sensitivity Analysis Discussion and Recommendations

Archaeological Sensitivity Analysis holds great potential as a tool for offshore alternative energy baseline studies for submerged cultural resources. It can identify areas with greater likelihood for containing archaeological resources and can help developers and managers with assessment of time, costs and threats to cultural resources. A GIS-based ASA could also dovetail well with the results of paleo-archaeological landscape reconstruction. The question remains, however, to what extent can ASA for historic cultural resources, like shipwrecks, be expanded or enhanced so as to add rigor to the process. In an attempt to do this, we used data from the Ocean SAMP to refine and test ASA so as to better explain historic shipwreck distributions in Rhode Island waters.

4.7 Using the Ocean SAMP to Improve ASA

Between 2007-2010, a team of 60 URI researchers, policy experts, and educators from four colleges (Ocean Engineering, Graduate School of Oceanography, College of Environmental Life Sciences, and Arts and Sciences) worked to develop a Special Area Management Plan (SAMP) for Rhode Island Sound. (Rhode Island Coastal Resources Management Council, 2010) The three-year effort to describe and characterize Rhode Island's offshore resources was in response to a state mandate that 15% of Rhode Island's energy would come from renewable resources, primarily offshore wind farms. The Ocean SAMP promoted a balanced and comprehensive ecosystem-based, adaptive management approach to the development and protection of Rhode Island’s ocean-based resources, including the siting of offshore renewable energy. The final document sought to ensure that sound science and lessons learned from all over the world would strongly inform the establishment of new ocean policies for management decisions in Rhode Island waters. These policies address benthic and pelagic ecosystems, fish resources and essential fish habitat, fisheries, birds and bats, sea turtles, marine mammals, cultural and historic issues (including tribal concerns), global climate change, and human activities including offshore renewable energy. As a result of extensive mapping and multidisciplinary data gathering, the waters of Rhode Island sound provide an ideal opportunity to apply and expand ASA so as to provide an improved tool for offshore alternative energy siting as related to submerged cultural resources.

4.7.1 Introduction

The Ocean SAMP study area is located is located in the northeastern U.S., along the south shore of Rhode Island (Figure 1). The shoreline is largely oriented in an east-west direction, and includes Block Island Sound, Rhode Island Sound, and open ocean. This area has been important to maritime activities for over 400 years and represents a crossroads between multiple heavily used waterways: Narragansett Bay, Long Island Sound, Buzzards Bay, and Vineyard Sound.

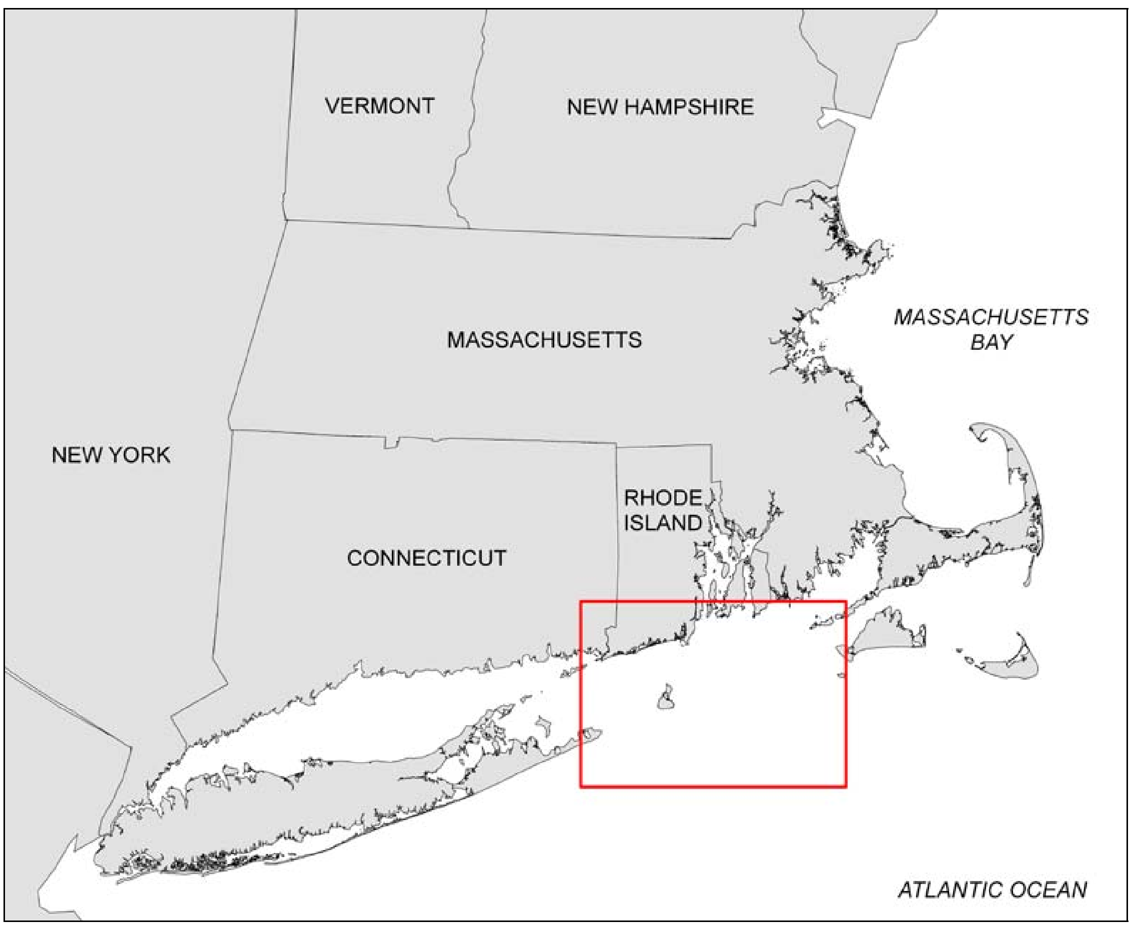

Figure 1. Rhode Island Ocean SAMP Study Area

The purpose of our work was to use SAMP data to inject more rigor into ASA, thereby improving ASA to the point that it could provide something closer to a predictive model. (Rhode Island Coastal Resources Management Council, 2010) While we use the term predictive model in the text that follows, our results cannot be considered a true archaeological predictive model in the strictest sense.

4.7.2 Source Data

The following data and their sources were used in the study.

1) Known shipwreck locations (n=119) – from a database developed by URI researchers for the Ocean SAMP.
2) Random control points (n=131) – a series of random points were generated using Arc GIS software (Environmental Systems Research Institute, Redlands CA) across the study area. To prevent random points from being coincident with known wreck locations, no random points were allowed to be within a 500' (152 m) radius of a known shipwreck.
3) Water depth
4) Seabed slope
5) Standard deviation (STD) of the seabed slope – the STD of the slope highlights areas where the slope changes abruptly and could indicate the presence of turbulent surface waters and/or currents.
6) Commercial vessel counts – vessel traffic was obtained from the Automatic Identification System (AIS) over an 8 month period from Sept. '07 – Apr. '08. A 1km grid was laid across the study area and the number of vessel points within each grid cell was summed. (U.S. Coast Guard Navigation Center)
7) Distance to shore
8) Distance to a navigation aid – as contained within the NOAA Electronic Nautical Charts (ENC).
9) Distance to a known cautionary area – obtained from the NOAA ENCs.
10) Distance to military testing areas – obtained from the NOAA ENCs.
11) Distance to closest port – port locations were obtained from the NOAA ENCs.
12) AWOIS point density – the Wrecks and Obstructions (AWOIS) database is maintained and distributed by NOAA's Office of Coast Survey. It is freely available and contains point locations for submerged wrecks and obstructions within U.S. The AWOIS points were converted into a density grid $(\frac{\#\ wrecks}{km^2})$ to minimize the effects of overlap between the Rhode Island and AWOIS datasets, and to broaden their influence over the study area. Figure 2 shows the relationship between the original AWOIS points and the calculated point density surface.

ArcGIS software was used to compute all spatial metrics. The data above represents those used in the final analyses. The original more expansive list of data used is as follows: 1. Depth; 2. Seabed slope; 3.Commercial vessel traffic counts; 4. Distance to shore; 5. Distance to another AWOIS wreck; 6. Distance to closest navigation aid; 7. Distance to shore; 8. Distance to vessel caution areas; 9. Distance to military testing areas; 10. Distance to historic fishing grounds; 11. Distance to closest port; 12. Distance to mobile gear fishing grounds, winter; 13. Distance to mobile gear fishing grounds, spring; 14. Distance to mobile gear fishing grounds, summer; 15. Distance to mobile gear fishing grounds, fall; 16. Distance to fixed gear fishing grounds, winter; 17. Distance to fixed gear fishing grounds, spring; 18. Distance to fixed gear fishing grounds, summer; 19. Distance to fixed gear fishing grounds, fall; 20. Distance to recreational fishing grounds, winter; 21. Distance to recreational fishing grounds, spring; 22. Distance to recreational fishing grounds, summer; 23. Distance to recreational fishing grounds, fall.

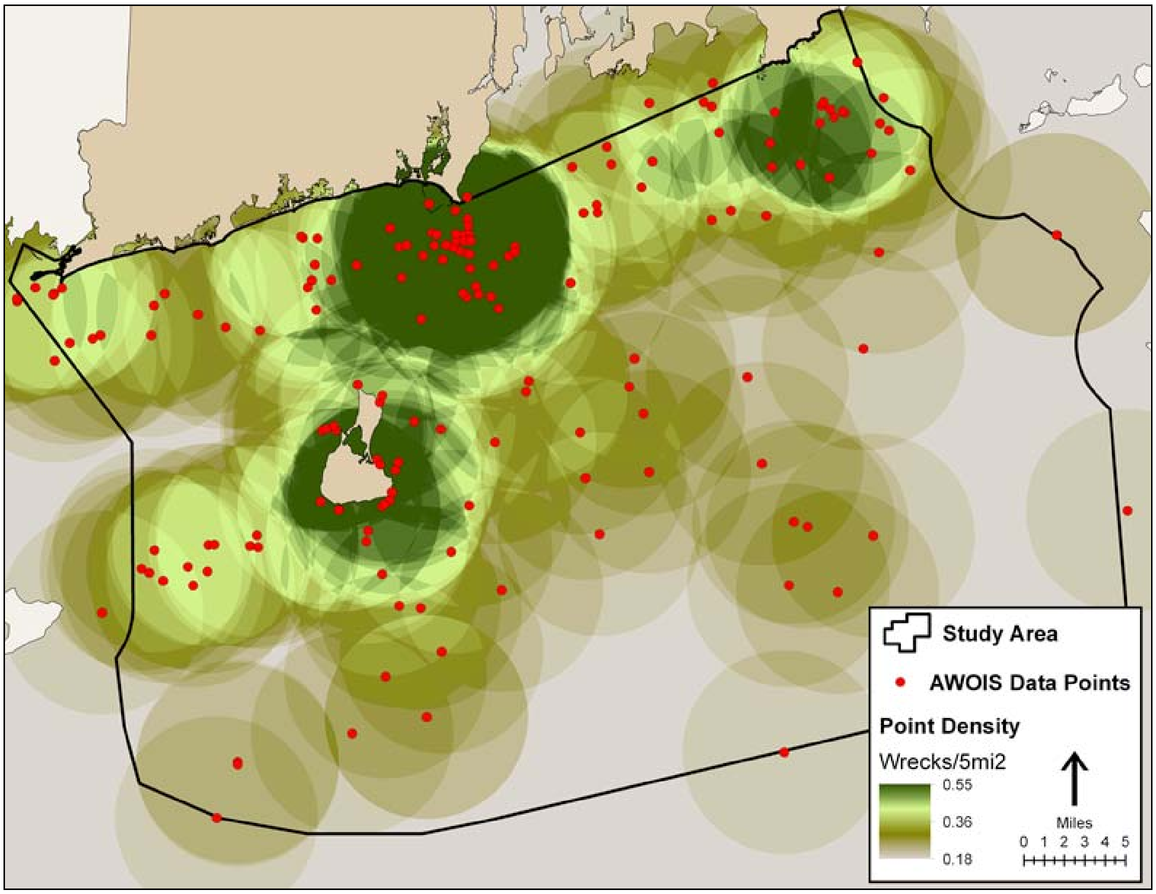

Figure 2. Original AWOIS data points with the calculated point density surface

4.7.3 Statistical Process

The known wreck locations (n=119) were merged with the random points (n=131) to create a single working dataset (N=250). At each point location, values of independent variables identified in the previous section were recorded. These variables were evaluated for their respective predictive ability in a logistic regression model implemented using PROC Logistic (SAS Institute, 1999) in the SAS software Version 9.2 of the SAS System for Windows. (Copyright © 2008 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.) Logistic regression is ideal for these data because of the model's ability to explain a single dichotomous dependent variable using multiple, continuous independent variables (Peng et. al. 2002)

A stepwise variable selection procedure was run to identify which of the variables had the greatest influence on shipwreck location. Of the original 10 predictor (independent) variables, only water depth and AWOIS point density were determined to be significant to the final model.

Using these two variables as input, a logistic regression analysis was run to calculate both the modeling coefficients and distributions for the predicted probabilities of shipwrecks versus non-shipwrecks (Figure 3). Results from the final logistic regression model are shown in Tables 2 and 3.

Table 2 - Analysis of Maximum Likelihood Estimates

Parameter	Estimate	Standard Error	Wald Chi-Square	P-value
Intercept	0.7118	0.6284	1.2831	0.2573
Depth	0.0176	0.0048	13.4892	0.0002
AwoisDensity	6.1620	1.6074	14.6951	0.0001

Table 3- Predicted Probabilities and Observed Responses

Percent Concordant	80.5
Percent Discordant	19.3
Percent Tied	0.2
Pairs	15589
Somers' D	0.612
Gamma	0.614
Tau-a	0.307
c (ROC)	0.806

The predicted probability histograms in Figure 3 show a definite separation between actual shipwreck points and the random non-wreck points. Review of the histograms indicates that probability values less than 0.36 are most likely non-wrecks, while values greater than 0.61 are more likely to be wreck locations. Predictions between these two values are somewhat muddled and could be either. In general, the model is able to distinguish wrecks from the random locations, but does a better job of predicting non-wreck locations.

"Measures of association" are used to evaluate predicted versus actual outcomes to determine if high probabilities are actually associated with events, and low probabilities non-events (Peng et. al. 2002). In this case, high probabilities indicate the presence of a shipwreck, while low probabilities indicate that no wreck is present. Goodman-Kruskal's Gamma and Somers's *D* are two such measures listed in Table 2. Both have a calculated value of 0.61 that can be interpreted as there being 61% fewer errors made in predicting a wreck location by using the estimated probabilities than by chance alone (Demaris 1992, Agresti 2007)

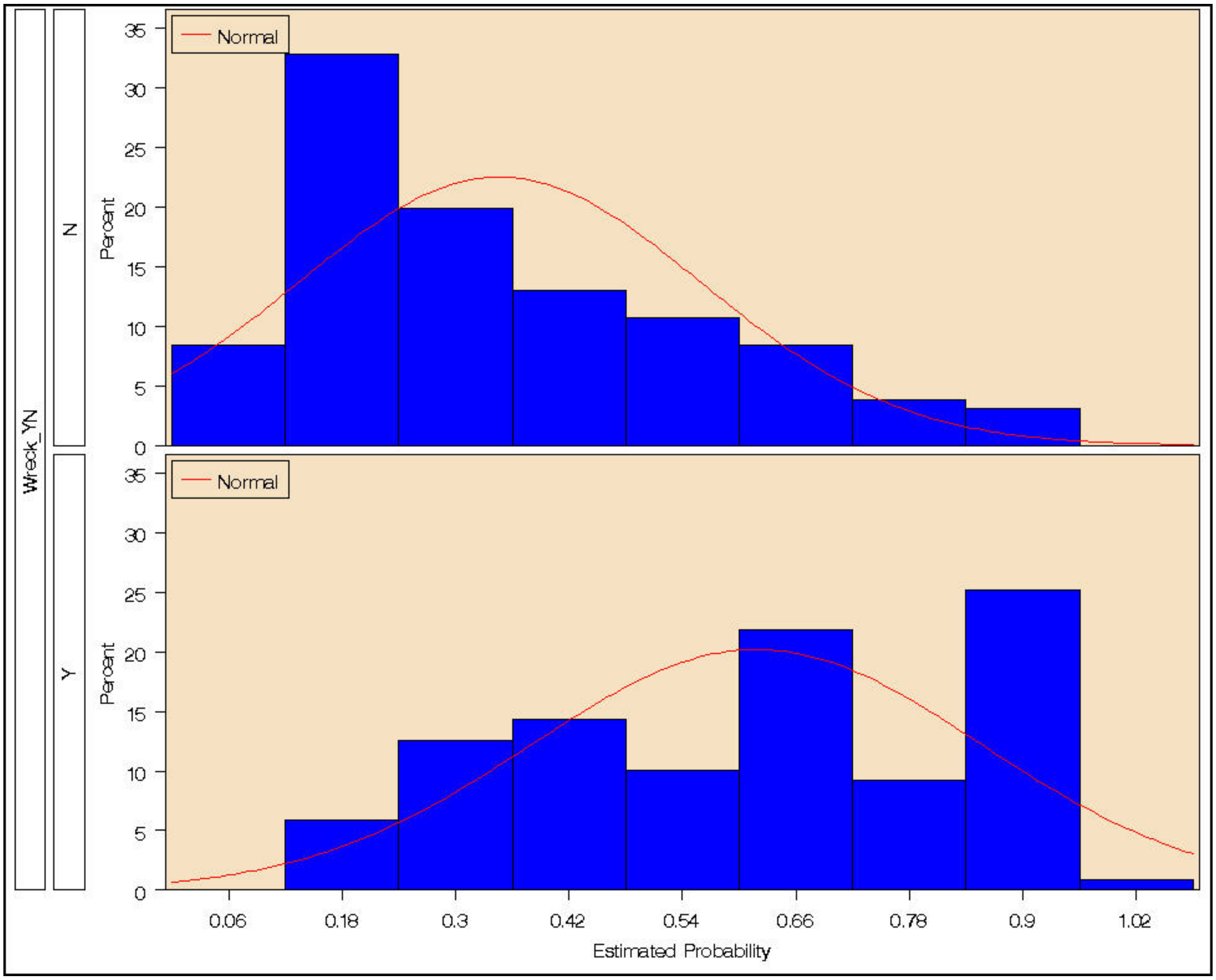

Figure 3. Distribution of predicted probability for non-wrecks (top) vs. shipwrecks (bottom).

This ability to predict wreck locations is better than random chance, with a *c* statistic value of 0.81. The *c* statistic is commonly known as the area under the Receiver Operating Curve (ROC). Output for the *c* statistic range from 0.5 to 1.0, with a value of 0.5 indicating that the model was no better than randomly assigning outcomes. This means that for all possible wreck/non-wreck point combinations, 81% of the time the model assigned a higher probability to the known wreck locations versus the non-wreck sites (Peng et. al. 2002, Agresti 2007)

4.7.4 Mapping

Using coefficients from the logit model, it was possible to calculate a probability surface for the study area using the following equations:

$$f(XB) = \frac{1}{1 + e^{-XB}}, \qquad XB = \beta_0 + \beta_1 x_1 + \beta_2 x_2$$

where x1 is recorded depth and x2 recorded AWOIS density at each of the 250 locations. *2* are coefficients associated with depth and AWOIS density respectively. f**XB** is interpreted as the estimated probability that a shipwreck is present at a given location. Figure 4 shows this estimated probability surface in conjunction with the AWOIS database points and actual shipwrecks.

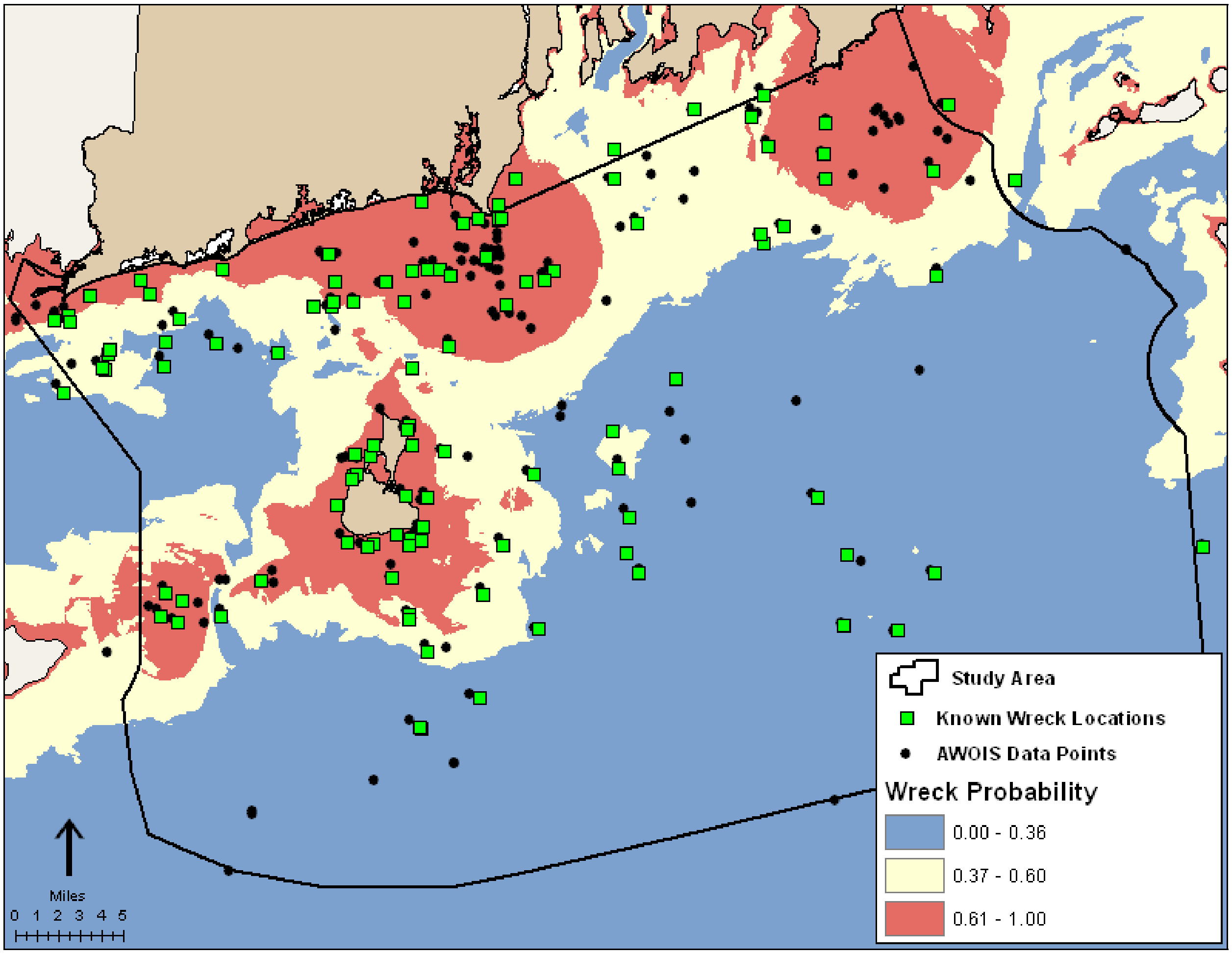

Figure 4. Probability surface displayed with both known wreck locations and AWOIS data points. Break values for the probability classes were obtained from the predicted probability histograms.

4.7.5 Discussion

Our results provided an indication for how well our method and data predict wreck locations, but it was also possible to use the probability surface to evaluate how these measures predict existing wreck locations. Our study was designed to address the following questions:

1) Using our method, what locations throughout the study area have the highest probability of containing a shipwreck?

2) How well does the predicted surface capture known wreck sites?

Figure 4 shows the distribution of known wreck locations along with the areas that pertain to low (≤ 0.36), medium (0.37-0.60), and high (≥ 0.61) probabilities of containing an actual wreck. Shallower depths and higher concentrations of AWOIS points generally yielded the highest probability areas.

The quantitative measures from the analysis are listed in Table 4. It can be seen that 56% of the known shipwreck sites fall within the highest probability area. The highest probability class encompasses only 15.7% of the total study area (230 mi^2). By focusing only on the highest probability areas, a researcher would be targeting 56% of the known wrecks while only having to survey 15.7% of the total area. This does not, of course, make any judgment as to the relative value of one shipwreck over another.

Table 4 – Quantifying Model Effectiveness

Probability of wreck	Area (mi^2)	% of Total	# wrecks (n=119)	% of Total
Low	945	64.4	22	18.5
Medium	283	19.3	28	23.5
High	230	15.7	67	56.0

4.7.6 Conclusions

This work has shown that developing a predictive statistical model to locate shipwreck locations and enhance ASA holds promise, although, at present, it falls short of the predictive models used by archaeologists on land. By accessing two freely available data sets, bathymetry and the AWOIS database, researchers can make educated determinations as to areas that are more likely to contain shipwrecks. How well this applies to areas beyond Rhode Island has yet to be determined. Nevertheless, this protocol can be considered one tool in assessing the likely impact of offshore alternative energy on submerged historic cultural resources.

Future studies might look at both refining the predictive variables and evaluating the applicability of transferring the methodology to other geographic locations.

5.0 Recommendations and Conclusions

Faced with global climate change and increasing strategic, financial and environmental issues with fossil fuels, the United States is looking to alternative forms of energy. Included in the matrix of options is offshore alternative energy. The development of wind, wave or hydrokinetic power will certainly impact and will be impacted by federal and state regulations designed to protect cultural resources. In this environment, proactive measures to understand the nature and distribution of submerged cultural resources, whether they are pre- or post contact, is critical. The difficulties experienced by the Cape Wind development off southeastern Massachusetts is ample warning of the sensitivities and issues that can arise.

In this limited study, we identify some of the tools and protocols that can assist BOEMRE in understanding the scale and scope of cultural resources in any particular area. We address the options for archaeological geophysical survey, suggest a Cultural Landscape Approach as powerful analytical and interpretive tool, and recommend an enhanced form of Archaeological Sensitivity Analysis combined with preliminary Paleo-Archaeological Landscape Reconstruction as protocols for understanding archaeological site distribution and significance.

We recommend the use of a two-tier structure for archaeological and geophysical survey. Tier 1 archaeological surveys would be deigned to assess the scale and scope of archaeological resources in an area as well as identify distribution patterns. These surveys would be conducted as part of broad baseline studies in anticipation of offshore alternative energy development and would include some selective scuba or ROV-based groundtruthing of targets. Tier 1 surveys should dovetail with geophysical survey for benthic habitat analysis and geological studies. Survey strategy should be informed by archaeological survey theory as well as the other tools and protocols proposed in this report, namely the results of the Cultural Landscape Approach and Archaeological Sensitivity Analysis.

In large areas, Tier 1 surveys should be based on a random or stratified sample of transects or blocks. The most efficient instrumentation for these studies are based on acoustics and we recommend either dual-channel, dual frequency side scan sonar and high resolution multibeam or interferometric sonar. In either case, the survey should be sufficient to resolve objects .5 m in length. Archaeological and geophysical work should be controlled by a state-of-the-art, survey-grade GPS navigation system and hydrographic software.

Geophysical survey should also include the collection of sub-bottom profiler data, which should be collected at high frequency, and if possible some magnetometer data. The latter should be considered less important for Tier 1 surveys. During post-processing, acoustic features should be identified, listed and prioritized. A categorizing system should be developed that has at least three, and preferably five, levels of potential significance. A representative sample of features identified during survey should be investigated by scuba-equipped archaeologists or ROV.

Tier 2 archaeological surveys would be designed to identify all significant cultural resources in an area and should be centered on Areas of Potential Effect (APE) from offshore development. These surveys are similar to those already required by BOEMRE. BOEMRE and its predecessor the Minerals Management Service have long established, yet continuously evolving, standards for archaeological survey of APE. We reviewed those standards for this report and recommend only a few minor changes. We recommend that BOEMRE require either either dual-channel, dual frequency side scan sonar and high resolution multibeam or interferometric sonar surveys. In either case, the survey should be sufficient to resolve objects .5 m in length and should cover 100% of the APE. We also recommend that magnetometer data be collected with an instrument capable of 0.5 gamma sensitivity. Other current BOEMRE requirements - including standards for a high-resolution chirp sub-bottom profiler, lane spacing and post-processing - we consider to be entirely appropriate.

We recommend the use of a Cultural Landscape Approach as an overarching framework for understanding, interpreting and assessing cultural resources in any area targeted for offshore renewable energy development. The questions and contexts we suggest provide a good starting point for characterizing cultural heritage resources and are transferable to multiple geographic regions. We recommend that BOEMRE adopt the MPA FAC definitions of cultural heritage.

CLA recognizes that places and cultural heritage resources can have different or multiple meanings and levels of significance based on how people from different cultures, times, or backgrounds have interacted with the landscape. Adopting this pluralistic approach increases the likelihood that cultural heritage resources will be found, recognized, and appropriately respected as decisions are made about the siting and potential effects of offshore alternative energy projects. CLA has many advantages, not least of which is that it provides a structure and place for tribal and indigenous people to developing their own landscape contexts. Although BOEMRE should facilitate this process, participation should be voluntary and the input should be evaluated in its own cultural terms. Where appropriate, a working group of tribal and indigenous representatives and cultural heritage professionals should be commissioned to produce complementary studies of any given area.

CLA bridges traditional historic preservation-based approaches to maritime heritage resource management and the broader consideration and integration of human factors in the environment called for by Ecosytem-based Management, Coastal and Marine Spatial Planning, and the National Ocean Policy.

Our final set of recommendations relate to archaeological site modeling and geospatial analysis. With sufficient information for key sets of environmental variables associated with human behavior, terrestrial archaeologists have, in some places, developed relatively robust predictive models that organize the landscape into zones of probability for the presence of archaeological resources. Although highly useful, such models are place-specific and typically involve considerable expense and years of effort. The time and costs involved make developing true predictive models for underwater cultural resources in anticipation of offshore alternative energy development not practical. We recommend, therefore, the use of enhanced Archaeological Sensitivity Analysis and Preliminary Paleo-Archaeological Landscape Reconstruction.

Paleo-archaeological landscape reconstruction is a critical component of any baseline study for offshore alternative energy assessments. It is particularly important in areas of the continental shelf that have experienced significant sea level rise since the last glacial maximum (LGM). In some areas this can be upwards of 70 meters. These areas of the seafloor possess significant potential for submerged pre-contact archaeological sites.

A preliminary paleo-archaeological reconstruction is achievable as part of baseline offshore alternative energy studies. It requires, however, substantial integration of disciplines and methodologies. Using a combination of geological knowledge, sub-bottom data, side scan sonar data, and coring, it is possible to partially reconstruct the landscape prior to inundation and marine sedimentation. As a result it is possible to identify: areas that were sub-aerially exposed, relic surfaces, glacial lakes, relic riverbeds and the sedimentary regime.

We recommend Archaeological Sensitivity Analysis as a tool for offshore alternative energy baseline studies for submerged cultural resources. ASA can help identify areas with greater likelihood for containing archaeological resources and can help developers and managers assess the time required to address cultural resources issues along with the associated costs and threats to the resources from development. In many cases, ASA relies on the experience of a professional archaeologist to interpret historic, archaeological, GIS, geophysical, and site-specific data so as to assign archaeological sensitivity zones. ASA clearly a valuable tool and has demonstrated its worth. Nevertheless, the application of statistical analysis can inject greater rigor into ASA and create more robust sensitivity zones. As a case study, we used the extensive data sets collected as part of the Rhode Island SAMP to enhance ASA. We started with 23 variables, subsequently narrowed down to 12, and used linear regression to help explain site historic shipwreck distribution. As a result , we created a probability surface with high, medium and low zones. The high probability zone encompassed 15% of the study area, but contained 56% of the known shipwrecks. While we have not been able to refine our study or test whether the variables used to create the probability surface in Rhode Island waters are transferable to other offshore areas around the United States, the methodology used here provides a promising tool for BOEMRE as the agency looks to understand the implications of offshore renewable energy development on cultural resources.

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