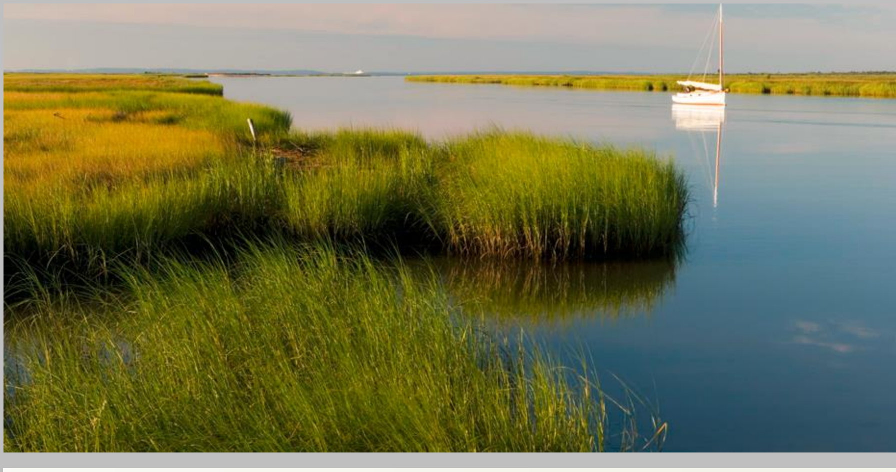
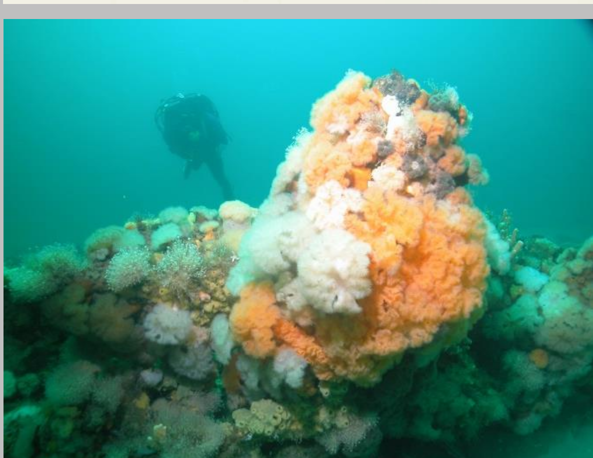


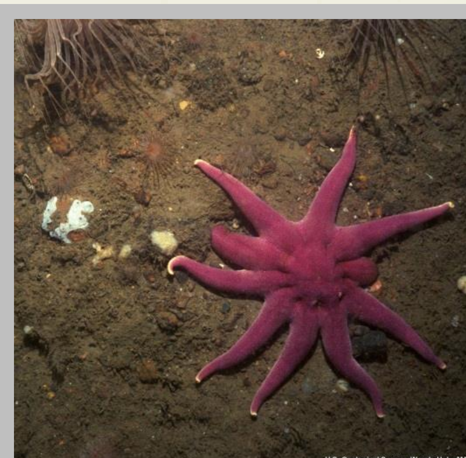
Application of the Coastal and Marine Ecological Classification Standard (CMECS) to the Northwest Atlantic

Katherine J. Weaver, Jennifer K. Greene, and Mark G. Anderson
The Nature Conservancy, Eastern Division Conservation Science

Emily J. Shumchenia and John W. King
University of Rhode Island, Graduate School of Oceanography

Kathryn H. Ford and Mark A. Rousseau
Massachusetts Department of Fish and Game, Division of Marine Fisheries





Katherine J. Weaver (kweaver@tnc.org), Jennifer K. Greene (jgreene@tnc.org), and Mark G. Anderson (manderson@tnc.org)

The Nature Conservancy
Eastern Division Conservation Science
99 Bedford St, 5th Floor
Boston, MA 02111

Emily J. Shumchenia (emily.shumchenia@gmail.com) and John W. King (jking@gso.uri.edu)

University of Rhode Island
Graduate School of Oceanography
South Ferry Road
Narragansett, RI 02882

Kathryn H. Ford (kathryn.ford@state.ma.us) and Mark A. Rousseau (mark.rousseau@state.ma.us)

Massachusetts Department of Fish and Game
Division of Marine Fisheries
1213 Purchase Street, 3rd Floor
New Bedford, MA 02740

Please cite as:
Weaver, K.J., E.J. Shumchenia, K.H. Ford, M.A. Rousseau, J.K. Greene, M.G. Anderson and J.W. King. 2013. Application of the Coastal and Marine Ecological Classification Standard (CMECS) to the Northwest Atlantic. The Nature Conservancy, Eastern Division Conservation Science, Eastern Regional Office. Boston, MA. http://nature.ly/EDcmecs

"Partial funding for this program is supported by a grant/cooperative agreement from the U.S. Department of the Interior, Fish and Wildlife Service."

North Atlantic LCC

North Atlantic Landscape Conservation Cooperative

Cover photo credits:
Top Row (left to right): © 2006 Jerry and Marcy Monkman (EcoPhotography.com), © U.S. Fish and Wildlife Service
Middle Row (left to right): © Matthew Lawrence (NOAA), © 2006 Jerry and Marcy Monkman (EcoPhotography.com), © Page Valentine and Dan Blackwood (USGS)
Bottom Row (left to right): © Dave Spier, © 2009 Daniel White (The Nature Conservancy)

Acknowledgements

The authors gratefully acknowledge guidance with crosswalking and CMECS from Mark Finkbeiner (NOAA) and Kathy Goodin (NatureServe), and we thank Mark Finkbeiner for providing the National Estuarine Research Reserve System (NERRS) crosswalk. We would like to thank the Northeast Regional Ocean Council (NROC) Habitat Working Group for providing suggestions, edits and comments for our work throughout the project. Funding from North Atlantic Landscape Conservation Cooperative (NALCC) was gratefully appreciated.

Table of Contents

List of Figures

List of Tables

Executive Summary

In the Northeast United States region, efforts are underway to better organize and integrate marine ecosystem data to support ocean planning and management efforts. An important step in this process is translating existing data to a common language so that heterogeneous data can be viewed in a common framework region-wide to better facilitate decision-making.

In September 2013, the Northeast Regional Ocean Council Habitat Working Group agreed that crosswalking (i.e., translating) existing seafloor habitat data to the Federal Geographic Data Committee (FGDC)-approved United States Coastal and Marine Ecological Classification Standard (CMECS) should be a priority. At that time, the work presented here was already well underway. The fact that multiple entities have recognized the need for such crosswalking efforts underscores the value of the work presented here. We hope that the results of our work provide the essential first steps towards an extensive and eventually complete crosswalking effort in the Northeast United States.

The purpose of this report is to document the process of crosswalking existing classified benthic habitat data at three scales – local, subregional and regional. In addition, we mapped the newly crosswalked data and compared the results with maps of the original classification scheme/data. From these steps we were able to demonstrate:

1. It is possible to crosswalk existing classified benthic habitat data at multiple scales to CMECS in the Northwest Atlantic (Northeast United States).

2. There are common challenges and pitfalls to crosswalking existing data regardless of scale or data type, but there are precautions as well as corrective measures that can address these challenges.

3. We were able to construct a working list of Northwest Atlantic United States CMECS Habitats that was representative of a wide range of marine environments throughout the region.

4. Inconsistencies in some of the source data/schemes caused complications in both the processes of crosswalking and mapping, suggesting that time spent conducting initial data curation or reinterpretation specifically for habitat mapping purposes could save time in crosswalking and/or mapping.

5. Some crosswalked CMECS maps did not significantly differ from original source maps whereas others did.

6. There is value in both original source scheme maps and to CMECS maps. Original maps were often “fit” or “calibrated” to the methodology or modeling conducted with the source data. CMECS maps would allow all data across the region to be represented with a common legend.

1. Introduction and Background

Mapping estuarine and marine habitats in the Northeast United States is essential for identifying conservation needs and restoration priorities, addressing mandates under the Clean Water Act for protection of certain habitats, and for facilitating marine spatial planning activities aimed at minimizing use conflict, protecting vulnerable and important habitats, and maximizing resource use. Consequently, a variety of classification schemes have been developed to map coastal and marine ecosystems, all with varying purposes, data sources, methodologies, and optimal scales of application (see Kostylev et al., 2001; Greene et al., 2005; Valentine et al., 2005; Kutcher 2006; Auster 2006; World Wildlife Fund 2006; Todd and Greene 2008; and see reviews in National Estuarine Research Reserve System 2000 and Lund and Wilbur 2007). Depending on its focus, each classification scheme differs in its choice of variables, thresholds, and hierarchical structure. However, marine habitat classification schemes are often based on common physical factors such as such as bathymetry, sediment texture, salinity, bottom temperature, and seabed features. The need for an inclusive and standardized approach to classifying marine habitats throughout the United States resulted in the development of the Coastal Marine and Ecological Classification Standard (CMECS, FGDC 2012) by National Oceanic and Atmospheric Administration (NOAA) and NatureServe. This standard has been in development for approximately ten years and was endorsed as a federal standard by the Federal Geographic Data Committee (FGDC) in 2012 (CMECS Manual and CMECS Catalog; FGDC 2012). CMECS is informed by several existing classification schemes that are local or regional in scale. Recently, the Bureau of Ocean Energy Management (BOEM) designated CMECS as the standard classification system for classifying offshore marine environments. Furthermore, the FGDC adoption of CMECS requires that all federally funded coastal and marine habitat mapping projects must report CMECS units with submitted classification schemes (CMECS FAQ).

CMECS provides a common language in which the terminology of existing schemes can be consistently crosswalked to a common schema. The CMECS domain ranges from the tidal splash zone to the deep water ocean. The scheme is organized by two “Settings” and four “Components.” Detailed “Modifiers” can be applied to all units to convey more information about the source unit. “Biotopes” are species and abiotic assemblages that form the finest level of the classification (**Figure 1**). CMECS consists of the following main components:

Settings:

- Biogeographic Setting (extent and/or location)
- Aquatic Setting (e.g. Marine Nearshore Subtidal)

Components:

- Water Column Component (the structures, patterns and processes of the water column)
- Geoform Component (the major geomorphic or structural characteristics at various scales)
- Substrate Component (the composition of the upper few centimeters of substrate)
- Biotic Component (the biological composition and cover of the benthos)

- Biotopes (repeating combination of abiotic and biotic features)
- Modifiers (unit descriptors)

While it is important to note that CMECS was not developed to solely support marine habitat mapping projects, CMECS does have the capacity to incorporate a variety of datasets into common units regardless of mapped scale. The ability to incorporate multiple datasets using a common language is a valuable trait in a management landscape where the interpretation of marine habitat data is hindered by the use of multiple mapping methodologies and classification schemes depending on the collecting agency/institution or type of dataset. The use of common units can assist regulators and policy makers with important habitat and ecosystem decisions by establishing a consistent habitat framework that includes biological, geological, physical, and chemical information. In the Northeast United States, there is a particularly high concentration of habitat classification schemes in use at various scales, but there have not yet been any attempts to align these schemes to a common framework across the region. In 2007, the Massachusetts Office of Coastal Zone Management commissioned a study of habitat data and four candidate classification schemes for its coastal and marine environment mapping, which included an examination of a previous version of CMECS (Valente et al., 2007). This multi-scale study was an important test of CMECS in the Northeast region because it provided valuable feedback to the CMECS development team and guidance for applying CMECS to raw datasets. However, an examination of CMECS across the wider region is still needed, as well as an evaluation of the process of crosswalking existing classified habitat data to CMECS.

This project tests the utility of CMECS in crosswalking and mapping legacy classified benthic habitat data at the local, subregional and regional scales. The results of this project will be helpful in understanding how CMECS can be used to maximize the utility of existing data and in developing methods to aid in crosswalking mapping projects to CMECS.

In conducting this project, we recognized the need to preserve source habitat classification schemes and the data they were built upon. The process of crosswalking to CMECS was anticipated to potentially alter existing maps and interpretations of these data due to the relationships between source schemes and CMECS expressed in the crosswalking process. By completing these crosswalks, we are not advocating for the deletion or discontinued use of existing source schemes, and in no way did we find that CMECS crosswalks unequivocally represent "improvements" to regional habitat data. Nevertheless, the crosswalking and mapping exercise can be useful for providing consistency across varying source schemes, and addressing certain regional habitat management and ocean planning needs. We also acknowledge that there are undoubtedly several management and planning applications that may be better served by the source schemes as well. These ideas were echoed by and agreed upon by the members of the Northeast Regional Ocean Council (NROC) Habitat Working Group at the NROC Habitat Classification Workshop that was held in September 2013.

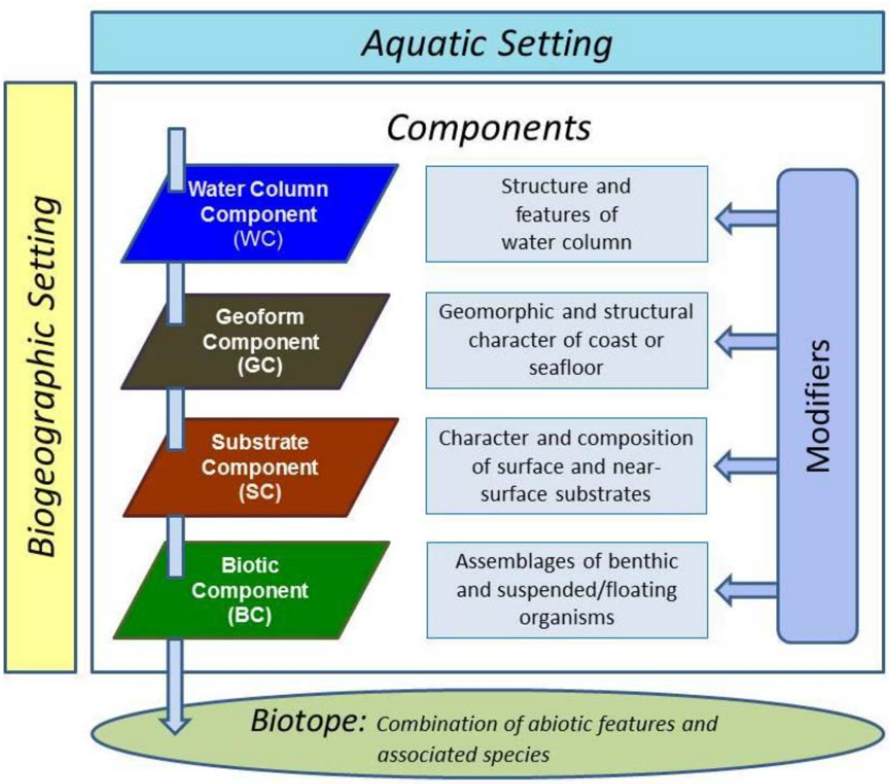


Figure 1: CMECS Framework (Settings, Components, Modifiers, and Biotopes (*Image courtesy of FGDC 2012 CMECS manual. Figure 2.2 in CMECS document*)

1.1 Project Overview

The goal of this project was to apply and map existing, classified benthic habitats in the Northwest Atlantic using CMECS at three scales – local, subregional, and regional. The resulting maps of marine systems at different scales demonstrate the value of CMECS using source data with varying resolutions. The lessons learned in creating the maps identify needed improvements to CMECS. We had three teams, each tackling a different scale. At the local scale (small scale estuary-specific: 1:5,000) we investigated high-resolution benthic information for the Boston Harbor including state maps of wetlands, shellfish resources, and artificial reefs. At the subregional scale (1:250,000) we used datasets assembled for marine spatial planning efforts in Rhode Island and adjacent federal waters as well as representative schemes from Maine, New Hampshire and Connecticut. At the regional scale (1:5,000,000), we applied the classification to The Nature Conservancy's Benthic Habitat Model (Anderson et al., 2010) from the Northwest Atlantic Marine Ecoregional Assessment (NAMERA; Greene et al., 2010) and The National Estuarine Research Reserve System Classification (NERRSC; Kutcher et al., 2008) scheme. Crosswalking and applying the CMECS classification in these three pilot areas allowed us to assess the ability of CMECS to convey consistent ecological information across several relevant scales using existing datasets.

The project was completed in two phases. In phase one, scale-relevant biological, geological and oceanographic data sources and classification schemes were identified. These data sources and classification schemes were crosswalked to the standard CMECS classification scheme, and notes were made on problems, inconsistencies, and the appropriateness of the crosswalk. A complete and quantitative crosswalk follows Appendix H in the CMECS documentation (FGDC 2012) and contains relationship and confidence classes for each crosswalked unit. Each of the three teams (scale dependent) approached the task independently, starting with their existing classification units, discussing, assigning and justifying the criteria for the proposed crosswalk to the corresponding CMECS classification for the Northwest Atlantic. Each team independently established methods to create a consistent crosswalk appropriate to their data. Calibration across the teams was completed by coordinating progress as well as discussing roadblocks via regular conference calls and presentations, as well as with members of the CMECS Implementation Group. The end results of phase one consisted of a list of existing habitats for all scales (in their native classification terminology), individual tables crosswalking each native source scheme to CMECS (**Appendices 9.1-9.3.3**) and CMECS-style space-time diagrams for each scale. A list of the Northwest Atlantic CMECS habitats (i.e. all mappable units in the Northwest Atlantic relevant to each scale) was created from the compiled list of existing habitats and crosswalk tables. Recommendations for modifications to CMECS were also generated (**Appendix 9.4**). At the completion of phase one, the working group presented these results to the NROC Habitat work group which is comprised of scientists from state and federal agencies, academic institutions and other non-governmental organizations in the Northeast United States.

In the second phase of the project we tested the crosswalks by mapping subsets of the data at each of the three scales. At the local scale we used existing data sources and classification schemes in the Boston Harbor to develop "best" CMECS maps for the Substrate, Biotic and Geoforms components. At the subregional scale we used the Rhode Island Ocean Special Area Management Plan datasets (Geological Forms, Geological Facies and Biotopes) to create maps consisting of CMECS Biotic, Geoform and Substrate components (LaFrance et al., 2010). At the regional scale we used datasets from The Nature Conservancy's NAMERA Benthic Habitat Model (Anderson et al., 2010). The marine NAMERA ecoregions, bathymetry, substrate, seabed form and depth, and benthic invertebrate communities were crosswalked to CMECS Biogeographic Setting, Benthic Depth Zones Modifier, Substrate, Geoform, and Biotopes.

This document provides descriptions of the data sources, crosswalking methodology, mapping and crosswalking challenges, recommendations for refinements to CMECS from a Northeast perspective, and evaluates the information conveyed by the CMECS maps at each scale for use in planning and conservation efforts. Results from both phases (e.g. crosswalks, list of Northwest Atlantic United States CMECS Habitats, maps, and recommendations) are contained in this report. The crosswalks have not been reviewed by the experts associated with each dataset. We hope that the results presented here will contribute to future improvement and refinement of the CMECS classification and CMECS mapping guidance by offering insight into multi-scale issues and solutions to mapping challenges.

2. Geographic Extent and Data Sources

2.1 Local

The first step in the local scale crosswalking process was to identify existing data sources in Massachusetts and more specifically around Boston Harbor (1:5,000 scale). This scale is particularly relevant for coastal and natural resource managers in addressing local and state-wide priorities such as beach nourishment, coastal infrastructure management, habitat impacts from construction, habitat restoration, and protection and conservation measures for specific habitats of interest such as shellfish, intertidal flats, and eelgrass beds. Some of these sources were comprehensive classification schemes, and others were single unit data sources (for example, the eelgrass map in Massachusetts only maps a single habitat type). Certain classifications and data sources were then selected for crosswalking based on their coincidence with the CMECS domain. For example, the BioMap2 (Natural Heritage and Endangered Species Program, 2011) classification is terrestrially oriented, so it was not crosswalked. A total of twelve classification schemes and eighteen single unit data sources (totaling 346 source units) were crosswalked to CMECS at the local scale. In phase two, twelve of these crosswalked datasets were selected for mapping. The datasets were selected for mapping based on how closely they matched the target 1:5,000 scale, the availability of GIS-ready data in Boston Harbor (e.g. USGS charts were only available as images and we did not have data for the CZM substrate classification in Boston Harbor), and a lack of overlap with other datasets (e.g. we had multiple substrate and wetlands datasets and we selected a single one for mapping). The mapping decisions are more fully explained in Section 4.1. **Table 1** outlines the existing datasets that were collected for the local scale extent denoting which classification schemes and single unit datasets were used in the final crosswalks and mapping exercises at the local scale.

Table 1: Classifications and data sources available in Massachusetts; those crosswalked are indicated by a star (*) and those used in mapping are indicated by a cross (†). ***Links valid as of December 2013***

Classifications	Extent	Source
USGS Topographic Maps*	National	USGS http://mapserver.mytopo.com/mapserver/topographic_symbols/USGS_top.html
NOAA Charts*	National	NOAA http://www.nauticalcharts.noaa.gov/mcd/chartno1.htm
The Nature Conservancy Northwest Atlantic Marine Ecoregional Assessment (Coastal Habitats)*	Virginia-Maine	Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg, eds. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/marine/namera/Pages/default.aspx
Natural Heritage and Endangered Species Program, Division of Fish and Wildlife	Massachusetts	Swain, P.C. and J.B. Kearsley. 2011. Classification of the Natural Communities of Massachusetts. Version 1.4. Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA. URL: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/natural-communities/classification-of-natural-communities.html#
BioMap2	Massachusetts	Natural Heritage and Endangered Species Program. 2011. BioMap2 Technical Report – Building a Better BioMap: A supplement to BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife, Westborough, MA. http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/land-protection-and-management/biomap2/biomap2-technical-report.html
Massachusetts DEP, Wetlands Conservancy Program*†	Massachusetts	Department of Environmental Protection Wetlands Conservancy Program, wetlands datalayer, 2009. http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/depwetlands112000.html
National Wetlands Inventory	National	Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/wetlands/classwet/index.htm (Version 04DEC1998).
National Estuarine Research Reserves Classification	National	Kutcher, T. E. 2008. Habitat and Land Cover Classification Scheme for the National Estuarine Research Reserve System. http://www.nerrs.noaa.gov/Doc/PDF/Stewardship/NERRClassificationSchemeDoc.pdf
NOAA Environmental Sensitivity Index*	Massachusetts	NOAA http://response.restoration.noaa.gov/maps-and-spatial-

		data/environmental-sensitivity-index-esi-maps.html AND http://response.restoration.noaa.gov/maps-and-spatial-data/download-esi-maps-and-gis-data.html#Massachusetts
NRCS SSURGO-Certified Soils	National	MassGIShttp://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/soi.html
Surficial Geology (Knebel, Ackerman, Massachusetts, USFWS†, TNC)*	Massachusetts, Gulf of Maine	1. Knebel, H.J., and R.C. Circe. 1995. Seafloor environments within the Boston Harbor-Massachusetts Bay sedimentary system: A regional synthesis. Journal of Coastal Research. 11: 230-251. 2. Ackerman, S.D., B. Butman, W.A. Barnhardt, W.W. Danforth and J.M. Crocker. 2006. High-Resolution Geologic Mapping of the Inner Continental Shelf: Boston Harbor and Approaches, Massachusetts. USGS Open-File Report 2006-1008. http://woodshole.er.usgs.gov/pubs/of2006-1008/ 3. Ford, K.H. and S. Voss. 2010. Seafloor sediment composition in Massachusetts determined using point data. http://www.mass.gov/eea/docs/dfg/dmf/publications/tr-45.pdf 4. Banner, A. and S. Schaller. 2001. USFWS Gulf of Maine Watershed Habitat Analysis. http://www.fws.gov/r5gomp/gom/habitatstudy/Gulf_of_Maine_Watershed_Habitat_Analysis.htm 5. Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg, eds. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/marine/namera/Pages/default.aspx
CZM Application of Marine Classifications in Massachusetts*	Massachusetts	Valente, R. M., D. A. Carey, M. E. Esten, C. R. Woods, G. A. Berman. 2007. Application of Four Candidate Habitat Classification Schemes for Coastal and Marine Environments in Massachusetts. Submitted by CoastalVision to the Massachusetts Office of Coastal Zone Management, Boston, MA, 173 pp.+appendices.
DMF Habitat*	Massachusetts	Ford, K.H. pers comm.
Data sources		
DMF Artificial reef locations*†	Massachusetts	Mass. Ocean Resources Information System (MORIS)http://maps.massgis.state.ma.us/map_ol/moris.php
DEP Eelgrass locations*†	Massachusetts	MassGIShttp://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/massdep-eelgrass-project.html
ACE Dredge boundaries*†	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
CZM Marina boundaries*†	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
CZM Mooring field boundaries*†	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
NOAA Wreck database*†	National	NOAA, MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
Outfalls*†	Massachusetts	Environmental Protection Agency http://oaspub.epa.gov/enviro/pcsicisquery.list?pSearch=Map%20Recentered&minx=-71.272430&miny=42.187829&maxx=-70.791779&maxy=42.431566&ve=10,42.310069,-71.032104
CZM Pipelines*†	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
DMF Shellfish suitability layers (9 species)* †	Massachusetts	MassGIShttp://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/shlfshsuit.html
DOT Dams*†	Massachusetts	MassGIShttp://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/dams.html
CZM private seawall and coastal structures inventory*	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php

2.2 Subregional

Managers from the state coastal programs most often look for habitat data at the subregional scale (1:250,000) for general, pro-active ocean planning (e.g., state marine spatial plans). It is at this scale that state coastal managers seek to examine the linkages between marine resources and human activities. Eight subregional classification schemes pertained to the New England states' coastal mapping and assessment programs. Because of the quantity, variety and breadth of these schemes, it was not possible to conduct complete, quantitative crosswalks for all eight schemes. The CMECS Implementation Group had previously crosswalked The Habitat Classification Scheme for the Long Island Sound Region (Auster et al., 2009). We reviewed the Auster scheme crosswalk and offered minor additional comments. We also excluded habitat classification schemes in Massachusetts because these were documented under the local scale portion of this project (see Section 2.1). For the detailed crosswalking and mapping exercise, we selected the Rhode Island Ocean Special Area Management Plan seafloor maps because they were developed based on previous versions of CMECS (LaFrance et al., 2010) and represent a recent map tied directly to an ocean planning/management activity. The remaining seven crosswalks were conducted as drafts, representing important first steps toward more detailed and quantitative crosswalking processes. The seven draft crosswalks provided sufficient information to fully represent the range of habitats in the Northeast region for inclusion in the list of Northwest Atlantic CMECS Habitats. Below are brief descriptions of all of the classification schemes that were examined at the subregional scale.

Maine

The Maine Geological Survey mapped and classified "Maine coastal marine geologic environments" in the 1980s-1990s (Kelley et al., 2005). This classification scheme is primarily of surficial geologic features, but contains some biological information on habitats ranging from the intertidal to subtidal zones for the entire coast of Maine. The classification scheme "Marine and estuarine habitats in Maine: An ecosystem approach to habitats; Part 1: Benthic habitats" (Brown 1993) represents a more integrated approach for classifying biological and geological attributes. The Brown scheme describes habitats in terms of biome, tidal regime, substrate, energy level, and by diagnostic and common species. Biomes show particular promise for a detailed crosswalk to CMECS Biotopes. It is unknown whether or not Maine coastal management agencies still embrace the Brown scheme.

New Hampshire

The habitat classification used in "A technical characterization of estuarine and coastal New Hampshire" was the sole source scheme for New Hampshire (Jones 2000) is primarily biological in focus. This scheme was focused geographically on the Great Bay, Hampton and Seabrook estuaries. Classification units for native bivalves and seagrass are at the core of this scheme, as are nuisance and invasive species.

Rhode Island

Two classification schemes in Rhode Island address coastal habitats and two others extend into offshore habitats. The "Mapcoast subaqueous soils classification" addresses very shallow (less than 5 meters deep) intertidal and subtidal habitats in Narragansett Bay and along the south coast of Rhode Island (www.mapcoast.org). This scheme applies a soils classification approach to estuarine sediments and contains mostly soil terminology with landscape-level geological information. Estuarine benthic habitats of Narragansett Bay are the focus of the Narragansett Bay Project scheme that was assembled in the late 1980s (French et al., 1992). The Narragansett Bay scheme contains geological and biological information that is integrated for some habitat units or separate for others. Habitats that are visually dominated by organisms (e.g., mussel beds) are named as biological units whereas soft bottom habitats are named as geological units. The two schemes that extend offshore are the "Sediments of Narragansett Bay and Rhode Island Sound (McMaster 1960) and the benthic habitat classification used in the Rhode Island Ocean Special Area Management Plan or "Ocean SAMP" (LaFrance et al., 2010). The McMaster scheme is solely geological whereas the Ocean SAMP scheme contains geological and biological information. The Ocean SAMP scheme applies to benthic habitats within the Rhode Island offshore management area. Because it was the most current and was designed to fit benthic habitats in offshore Rhode Island and neighboring Massachusetts waters, we chose to test the Ocean SAMP-CMECS crosswalk by comparing maps that used the source scheme with maps using CMECS.

Connecticut

The "Habitat classification scheme for the Long Island Sound region" for the states of Connecticut and New York (Auster et al., 2009) is a hierarchical system that addresses geological and biological habitat elements including large- and small-scale geomorphology, chemical processes, biological processes, anthropogenic processes and disturbance regime in intertidal and subtidal environments. The Long Island Sound scheme is unique in that it encourages mapping of both habitat features and processes. It was originally crosswalked by Mark Finkbeiner (NOAA) of the CMECS Implementation Group. Therefore, the crosswalk table for this scheme is a full, detailed table following

Appendix H of the CMECS documentation. We added an additional comment field to the existing crosswalk table and offered minor comments to this draft crosswalk.

2.3 Regional

This portion of the project focuses on crosswalking and mapping regional scale (1:5,000,000) datasets to the CMECS scheme in the Northwest Atlantic region (Gulf of Maine, Southern New England, Mid-Atlantic Bight ecoregions) using The Nature Conservancy's NAMERA Benthic Habitat Model (Anderson et al., 2010) and the National Estuarine Research Reserve System Classification Scheme (Kutcher et al., 2008).

The NAMERA Benthic Habitat Model provides a baseline of scientific information on the distribution of benthic habitats and invertebrate species across the Northwest Atlantic from the Bay of Fundy to its most southern point of Cape Hatteras, North Carolina extending past the continental shelf/slope break. This comprehensive mapping and assessment was part of a larger conservation assessment focused on the identification of the species, habitats and ecological processes that represent the biodiversity of the region (Greene et al., 2010). A key product of the assessment was a map of 72 estimated nearshore and deep water benthic habitats based on sediment grain size (silts to pebbles), seafloor topography (e.g. very shallow depressions, steeps, slopes), bathymetry (0 to 2,400 meters below sea level), and habitat complexity, informed by the distribution of benthic invertebrates (Anderson et al., 2010; **Figure 2**). The benthic map and classification was intended to represent how physical features such as sediment, bathymetry and topography corresponded with species' habitats. This model was developed using a bottom-up classification approach, where benthic communities were classified based on species composition and then linked to physical environmental data. Continuous datasets of bathymetry, sediment grain size, topographic position and slope were subdivided into classes of depth zones, grain size, and seabed forms based on thresholds that corresponded with changes in biotic community composition. The three components and their classes were combined into 2,518 features called Ecological Marine Units (EMUs; e.g. deep sandy depression, shallow gravel flat). The EMU map represents all three-way combinations of depth, sediment grain size, and seabed form based on the ecological thresholds revealed by the benthic-organism relationships. Thus, the EMU dataset is the most comparable to the CMECS classification, and was the one used as the basis for the CMECS crosswalk.

In the NAMERA, the EMUs were simplified into Benthic Habitats, defined as sets of EMUs that shared a similar species assemblage. For instances, if the two EMUs: very shallow sand flat, and shallow sand flat, shared the same biota, they would be considered one Benthic Habitat. Although the authors reviewed a variety of proposed marine classification systems, no particular scheme was endorsed or adopted; rather the information and distribution patterns were mapped directly from the data using statistical analysis, allowing the information to be crosswalked and fit into various classification schemes such as CMECS.

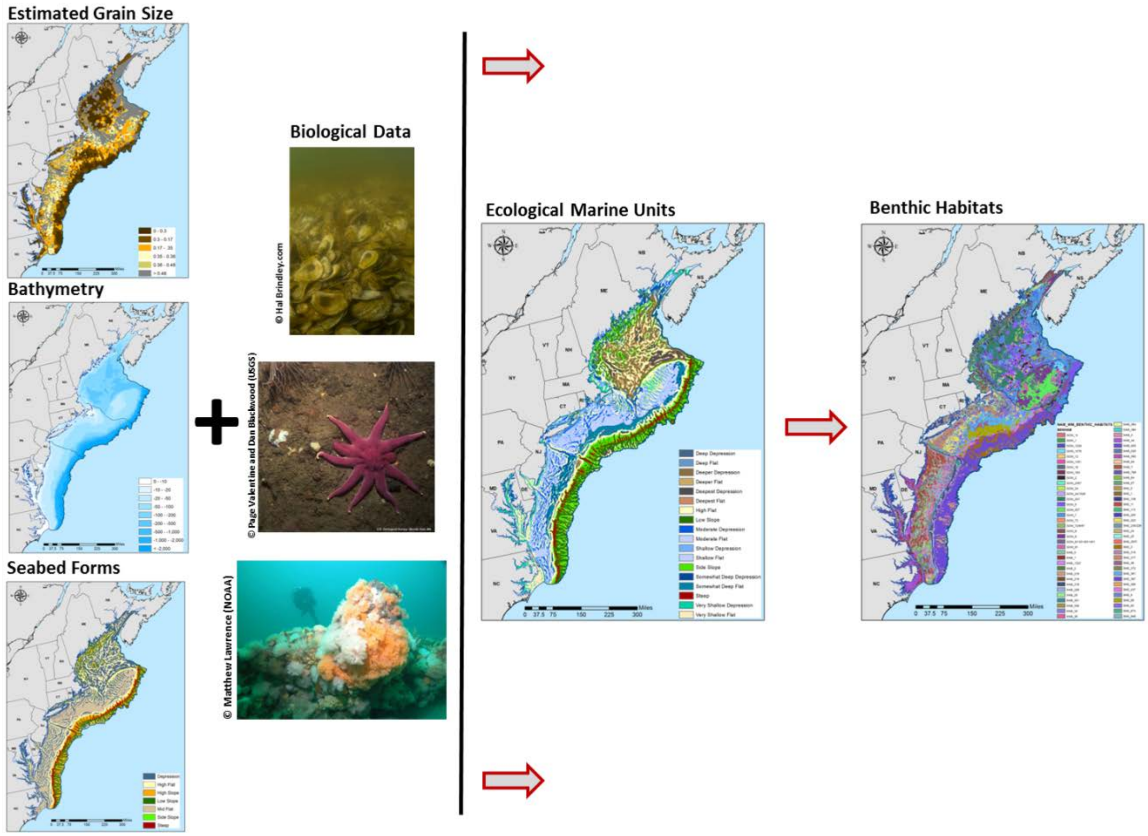


Figure 2: NAMERA Benthic Habitat Model diagram outlining the physical and biotic components that compose the model.

The National Estuarine Research Reserve System Classification (NERRSC, Kutcher et al., 2008) as outlined in section 315 of the Coastal Zone Management Act was developed through a partnership between NOAA and coastal states of the United States, for a system of protected areas that are managed for research and educational purposes. The classification scheme attempts to standardize the method of classifying system-wide land cover data by producing a hierarchical framework for any marine, estuarine, riverine, lacustrine, palustrine, upland, perennial snow and ice habitats and cultural land cover. In this project we focused on the marine (subtidal and intertidal zones), estuarine (subtidal haline, intertidal haline, supratidal haline, subtidal fresh, and intertidal fresh zones), lacustrine (limnetic, littoral zones), perennial snow and ice habitats and cultural land cover of the Northwest Atlantic (Kutcher et al., 2008). We worked in conjunction with Mark Finkbeiner (NOAA) to review his existing NERRS-CMECS crosswalk; however, we did not create a spatial map of the classification.

3. Methods

3.1 Crosswalking

At each scale, all source scheme units were crosswalked according to the methods outlined in Appendix H of the CMECS manual (FGDC 2012). We also relied on CMECS Implementation Group Members Mark Finkbeiner (NOAA) and Kathy Goodin (NatureServe) to assist with crosswalk decisions and to help explain CMECS units when clarification was necessary.

To conduct the crosswalk, the first step was to determine which CMECS component the source unit was most related to. Substrate source units were crosswalked to the Substrate Component; biological source features were crosswalked to the Biotic Component, etc. If the source unit could crosswalk to multiple CMECS components, we preserved and identified them as co-occurring elements in the crosswalking tables. For example, sand dune was crosswalked to the Geoform level 2 dune and to the Substrate Component sand. Second, it was determined which level in the CMECS hierarchy was most compatible with the source unit. All crosswalking attempted to match the same level of detail that the source unit was trying to achieve. For example, for a source unit of "submerged aquatic vegetation" achieving a CMECS biotic subclass level was sufficient; for a source unit of "eelgrass" the CMECS biotic community level was used. As a general rule, no inferences were made; if a lower (finer) level in the hierarchy could not be determined, higher (more general) levels in the hierarchy were used, or co-occurring elements were added to identify the presence of multiple source units. Modifiers were used as needed to most accurately crosswalk the source unit.

If a source unit crosswalked to more than one CMECS unit, then the source unit and the additional possible CMECS units were listed in separate, individual rows or columns. In addition to translating source units into CMECS units, a relationship class denoting the source unit relationship to the CMECS unit was included (**Table 2**). The relationship class helps identify the similarities and differences between the source unit and the crosswalked CMECS unit. Also, a confidence class was assigned to each crosswalked unit documenting the crosswalker's confidence in the relationship between the source and CMECS units (**Table 2**). Lastly, notes were maintained for each unit describing decisions made during the crosswalk process.

In the regional scale crosswalk, source units were used to construct provisional Biotopes after crosswalking the initial datasets. A CMECS Biotope is defined by repeating biological communities across an extent that relies on similar habitat settings (i.e. abiotic features; FGDC 2012). Refer to section 4.3 in this document for more information on the method used to construct the Biotopes.

Table 2: Descriptions of CMECS relationship and confidence classes

Relationship	
Equal	One-to-one relationship
Nearly equal	Thresholds or concepts vary in small, insignificant ways
Greater than	The source unit is more general than the CMECS unit (and may contain more than one CMECS unit)
Less than	The source unit is more specific than the CMECS unit
Overlapping	Neither conceptual unit is fully contained in the other
No equivalent	The source unit does not have an equivalent CMECS unit
Confidence	
Certain	Relationship between units is clear, synonymous
Somewhat certain	Relationship between units is inferred but not explicitly stated
Not certain	Relationship between units is a best educated guess

Since the teams conducted their crosswalks independently, consistency was established via regular conference calls and presentations with the authors. The end results of phase one consisted of a list of existing classification units for all scales and individual crosswalk tables for the local, subregional and regional scales (**Appendices 9.1-9.3.3**). An example of a crosswalk table is provided in **Table 3** demonstrating the various crosswalk relationships and confidence classes.

Table 3: Examples of source units crosswalked to CMECS Substrate units with varying relationships and confidence classes

Sources	Source Units	CMECS Substrate Units	Relationship to CMECS	Confidence
NOAA ESI	Scrub-shrub wetlands	Organic	Nearly Equal	Certain
NOAA ESI	Coarse-grained sand beaches	Unconsolidated Mineral Substrate, Fine Unconsolidated Mineral Substrate, Slightly gravelly	Greater Than	Certain
NOAA ESI	Coarse-grained sand beaches	Unconsolidated Mineral Substrate, Fine Unconsolidated Mineral Substrate, Sand	Greater Than	Certain
NOAA ESI	Exposed scarps and steep slopes in clay	Unconsolidated Mineral Substrate, Fine Unconsolidated Mineral Substrate, Mud, Clay	Less Than	Somewhat Certain
USGS-Knebel	Erosion or nondeposition		No Equivalent	Certain

3.2 Relationship Assessment

After the crosswalking effort, all teams conducted relationship assessments using the relationship classes defined in **Table 2** to examine how closely matched the source units and CMECS units were overall. These assessments were completed by calculating how many of the total crosswalked units were in each relationship class and representing this as a percentage.

3.3 Space-Time Diagrams

After source schemes were crosswalked, space-time diagrams (**Figure 3**) were created to highlight which CMECS units are relevant to each source scheme. The figures are organized by general spatial scale along the y-axis and by general temporal scale along the x-axis. Habitat units in the top right corner of the figures tend to be large and persistent whereas habitat units in the bottom left tend to be small and ephemeral. The space-time diagrams appear within the CMECS documentation (Chapter 11, figure 11.1) in order to place CMECS terminology in a common ecological framework and to show each unit within the global marine ecosystem (FGDC 2012). It is important to note that the boxes representing habitat units are clipped (on the lower left of each box) in order to avoid overlap and confusion between units. The diagrams are not meant to be interpreted strictly quantitatively, but to generally place habitat units in a common framework where they might be compared between and among habitat classification schemes. For example, by comparing space-time diagrams between classification schemes, it can help the user determine if one scheme contains units equivalent to Geoforms (unit boxes plotted in upper right) and the other does not (no unit boxes plotted in upper right). CMECS Modifiers are listed within the figure (if relevant to the source scheme) but their placement is not with respect to the spatial-temporal framework. "GC" refers to the CMECS Geoform Component; "SC" refers to the CMECS Substrate Component; "BC" refers to the CMECS Biotic Component.

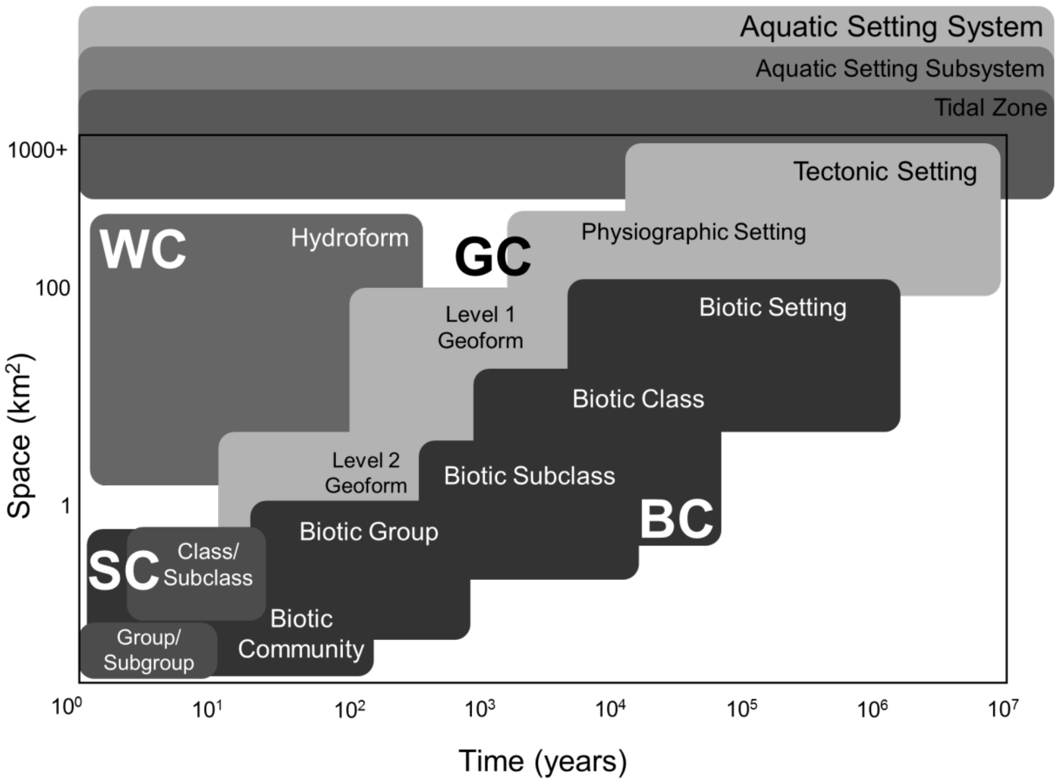


Figure 3: CMECS Space-time diagram. "GC" refers to the CMECS Geoform Component; "SC" refers to the CMECS Substrate Component; "BC" refers to the CMECS Biotic Component. (*Figure 11.1 from FGDC 2012* CMECS manual)

3.4 Mapping

Maps were created in ArcGIS by joining the crosswalk tables to the attribute tables of the original source data. If the source unit crosswalked to more than one CMECS unit ("greater than" relationships), one unit was selected as the dominant unit and the additional CMECS unit(s) was(were) either identified as co-occurring elements or we moved up one level in the CMECS hierarchy to a level where the CMECS units were coincident. All teams independently created separate maps for each CMECS component (Biotic, Substrate, and Geoform).

At the local scale, the maps were generated by combining multiple input data sources and source classification layers, and dissolving the crosswalked source data to create maps of CMECS units. The subregional and regional teams found it necessary to produce three crosswalked maps in order to convey the method of crosswalking to

CMECS. The first map in the series contains the original source scheme components; the second map is a combination of the source scheme and CMECS units (so no information is lost) and the third map is composed of CMECS units alone. Additional detail about scale and component-specific decisions and methods are provided in Section 4.

4. Crosswalk Schemes to CMECS

4.1 Local

At the local scale a total of 346 source units crosswalked to 447 potential CMECS units. These units represented CMECS units that can be found across wide spatial and temporal scales (**Figure 4**). Only 52 units (15%) were "equal" or "nearly equal" between the two schemes. The majority (51%) of crosswalks were "greater than," for example; the "blue mussel" source unit crosswalked to three CMECS units: Attached Mussels or Mussel Bed or Mussel Reef. In this case, the existing source data were not sufficiently fine grained enough to determine the specific corresponding CMECS unit. The reverse situation, "less than" (units that were more finely subdivided than a single CMECS unit), accounted for 23% of the crosswalks. In all, there were 190 (42%) "equal," "nearly equal," "less than," and "overlapping" relationships that we treated as one-to-one relationships (one source unit to one CMECS unit) because we could not subdivide the CMECS units further. There were 19 (4%) no equivalent units: units appropriate to the classification but either too fine scale or based on characteristics not found in CMECS (**Figure 5**). To address these and also several of the "less than" units we moved far up in the CMECS hierarchy to crosswalk based on broad similarities (e.g. caisson crosswalked to Anthropogenic). These are recommended for additions to the CMECS scheme and can be found in **Appendix 9.4**. Finally, there were 24 source units not appropriate because they were out of the domain of CMECS (e.g. upwelling, freshwater stream) and were not crosswalked.

For the crosswalk, all potential CMECS units were identified. For the mapping they were handled in one of two ways, either we attempted to select a "best" or dominant CMECS unit based on local knowledge or we moved up in the CMECS hierarchy to a level where the CMECS units were coincident. In many cases, local knowledge or more specific information about the source data behind the habitat was not available. In the absence of local knowledge or additional information, our other option of moving up in the hierarchy may result in a significant loss of information. In the example above, the "blue mussel" source unit would become "Benthic/Attached Biota" as this was the level we were confident in crosswalking to. Therefore as a result, the "greater than" units pose the greatest risk of detail loss or inaccuracy in the maps.

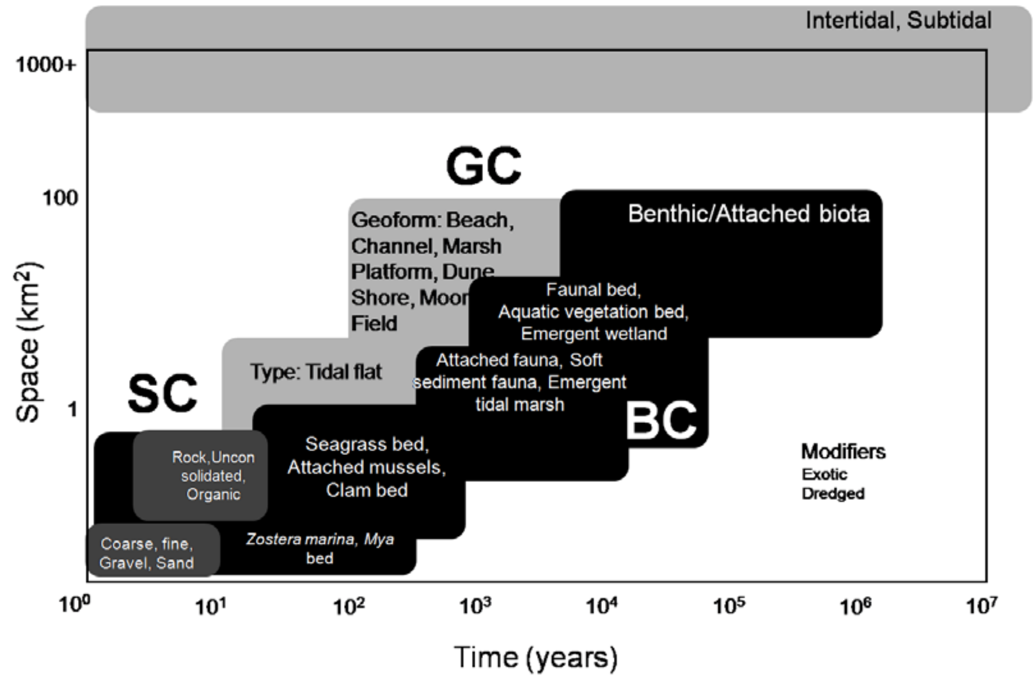


Figure 4: Space-time diagram for the local-scale crosswalk.

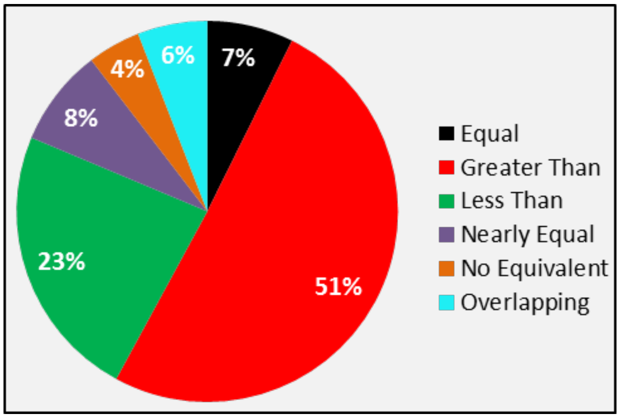


Figure 5: Distribution of relationships between source units and CMECS units for the local-scale crosswalk.

After crosswalking, one map for each CMECS Component (Biotic, Geoform, and Substrate) was generated for Boston Harbor. Originally, the maps were intended to illustrate the crosswalks for each source classification. However, since a CMECS map of Boston Harbor was the desired product, we integrated the source data to create a single "best" CMECS map of Boston Harbor for each of the three CMECS Components. Our target scale of 1:5,000 for mapping was not achieved; the highest resolution source data had a scale of 1:12,000 (DEP Wetlands 2009), though in some cases there was no explicit scale identified in the data source or classification. The maps were produced at a scale of 1:30,000 in order to illustrate the multiple crosswalked units from many different sources (**Figure 6-8**). Certain classifications and data sources did not have units or coverage in Boston Harbor (e.g. the CZM substrate classification), so they were not used for mapping. When sources had overlapping polygons and concept units, the highest quality data source was used based on time, scale, and identifiable quality of the source information. For example, we chose to use the DEP Wetlands units instead of NOAA ESI units since upon inspection at a 1:5,000 scale the DEP Wetlands maps were more consistent with features visible on aerial photographs. If a source unit did not crosswalk to CMECS, it was not used. At times one source unit was crosswalked to two CMECS components. For example, a source unit of "gravel beach" was used in both the geoform map and the substrate map.

4.1.1 Boston Harbor Biology

The Biotic Component map (**Figure 6**) relied on four primary sources: DEP Wetlands, DEP Eelgrass 2012, DMF Shellfish Suitability, and artificial reefs. The eelgrass and wetlands layers crosswalked to CMECS in a straightforward manner; however, the shellfish layers were more difficult to crosswalk for two reasons. First, at the CMECS Biotic class level it was necessary to determine if the shellfish area was a "Faunal Bed" or "Reef Biota" and at the biotic subclass level if the animals were "Attached Fauna" or "Soft Sediment Fauna." Lacking that information, it was difficult to crosswalk to the more specific group and subgroup levels of the CMECS Biotic Component hierarchy where species are defined. Further, the Shellfish Suitability data used for the crosswalk was created using species presence data and contains no additional habitat specific information. Therefore, based on first-hand knowledge of the study area it was determined that the primary shellfish structure was bed so only class "Faunal Bed" was used for the Shellfish Suitability crosswalk ("Reef Biota" was used for the artificial reef layer). Second, the shellfish dataset contains single species polygons and at times these polygons may overlap in the same area, as these species share the same habitat. Since we used existing datasets, it was difficult to know which shellfish species would be considered dominant in an area. Similarly, in areas that had both wetlands and shellfish mapped, it was challenging to know which unit was dominant. In all overlapping scenarios the Wetlands layer (containing more detail and attributes than the shellfish layers) was considered dominant and the shellfish units were listed as a co-occurring element. There was no overlap between wetlands and eelgrass or between shellfish and eelgrass.

There are large areas of "open water" where the biota has not been assessed. However, if an assessment of infauna and epifauna was conducted, there would likely be identifiable biota, thus we crosswalked "open water" to "benthic/attached biota." However, an alternative would be to map "open water" as "no data" or "not specified."

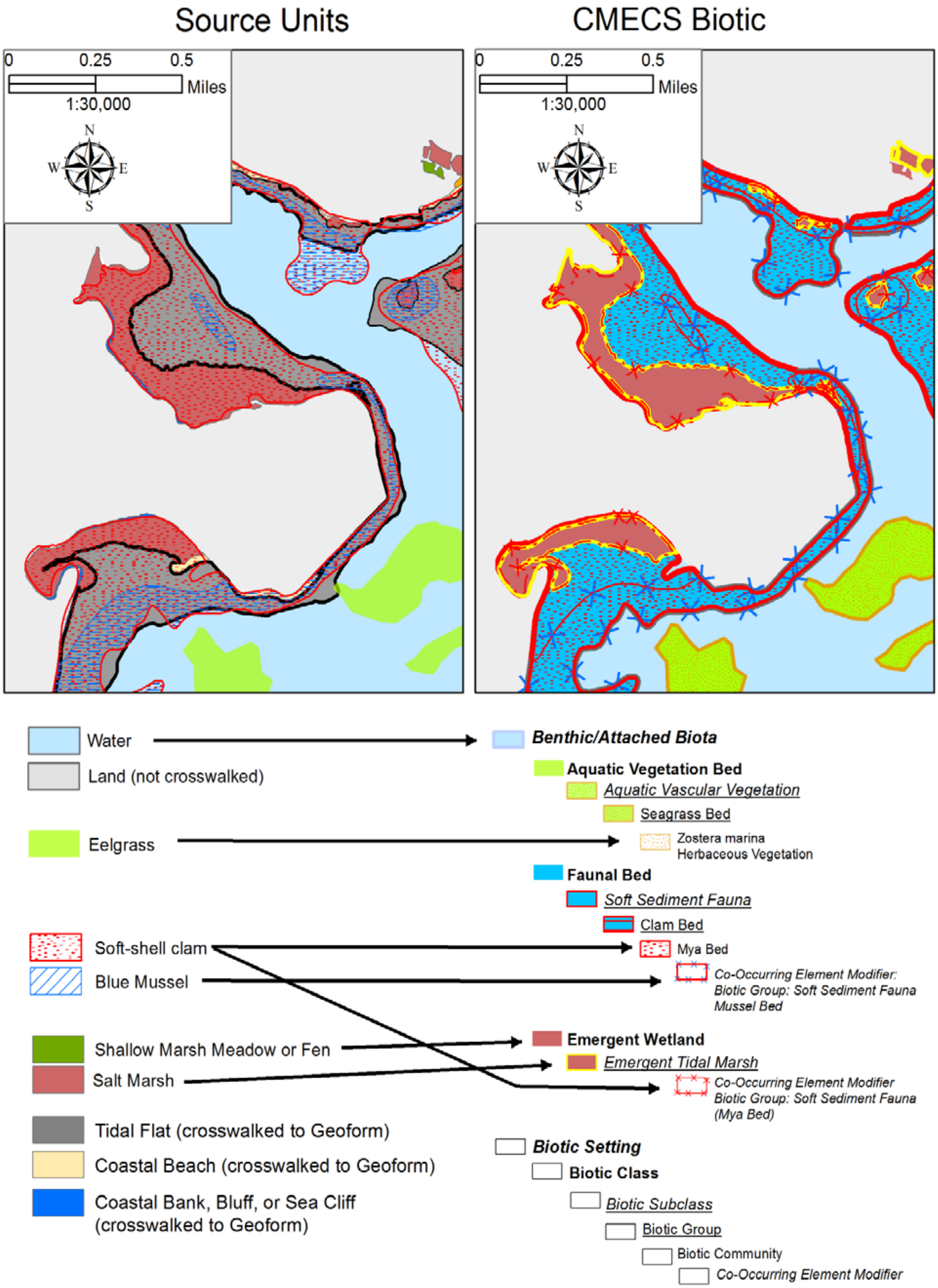


Figure 6: Boston Harbor Biotic Map: On the left is a map with the source units and the source unit legend underneath the map. On the right is a map with the CMECS units and the CMECS unit legend underneath the map. The arrows indicate how the source units crosswalk to the CMECS units. The hierarchical levels in CMECS are outlined in the lower right portion of the legend. Only units visible in the map are included in the legend.

4.1.2 Boston Harbor Substrate

The United States Fish and Wildlife Service (USFWS) mapped sediment as part of a Gulf of Maine habitat modeling project (Banner and Schaller 2001). They used usSEABED point data along with the backscatter and geoform feature type assessments conducted by Knebel and Circe (1995) to define substrate unit boundaries. A visual assessment showed exceptional agreement where DEP Wetlands polygons intersected with the USFWS map for Unconsolidated Mineral Substrate units but not organic units (salt marshes), consequently the USFWS map was augmented with an overlay of the organic polygons from the DEP layer. It was further augmented with the dams, artificial reefs, and wreck-obstructions layers from MORIS for the Substrate Component map (**Figure 7**). Other datasets were not used (**Table 4**).

The primary substrate layer, the USFWS layer, was a raster with 30 meter cells. All other layers were converted to this same resolution and snapped to the USFWS layer. The grids were individually converted to polygon layers, the tables were updated manually to include pertinent information such as source unit and CMECS unit, and then the layers were merged to create a single polygon shapefile. The polygon format enabled more flexible use of symbology in the final map than the raster format.

The source data did not differentiate Substrate Origins. Therefore, many of the hardened shorelines are likely anthropogenic rock, instead of geologic rock.

Table 4: Description of surficial geology models for Substrate Component mapping in Boston Harbor rejected from use in this analysis

Source	Notes
Ackerman et al., 2006	Much of the harbor was classified with the "Anthropogenic" category, so large parts of the harbor could not be crosswalked to substrate. Another key limitation of this USGS dataset is that it covers only deeper waters of the harbor.
Knebel and Circe 1995	Knebel and Circe drew classification unit boundaries throughout Boston Harbor using sediment and backscatter data. However, the classification units use erosion and deposition as the primary characteristic described (not sediment type or grain size), so they are not crosswalkable to CMECS. The USFWS relied on the boundaries in the Knebel-Circe maps in order to define individual substrate units using sediment type descriptors which are crosswalkable to CMECS.
Ford and Voss 2010	Used an interpolation algorithm of point data only; did not use other data to improve substrate unit boundaries.
NOAA ESI	ESI line dataset had a very specific shoreline assessment for their particular needs/scales that didn't merge well with the more clearly substrate-oriented USFWS product; ESI polygons overlapped well with USFWS so were redundant.
NHESP	Only select examples of aquatic habitats are mapped. In BH there were only a couple of examples that were relevant to substrate (e.g. rock cliff community) but they overlapped with USFWS rocky units.
TNC NAMERA surficial geology	Scale too coarse.
TNC NAMERA coastal habitats	Secondary dataset, scale too coarse.
NOAA Nautical Chart	Is an image file; has not been digitized to points, lines, polygons, or classified raster.
USGS Topo Quad	Is an image file; has not been digitized to points, lines, polygons, or classified raster.
Pipelines	Pipelines are generally under the sediment surface.
Fish rok from USGS BH Atlas	Area already portrayed as Gravelly in the USFWS model.
CZM Barrier Beach Inventory	Based on DEP wetlands layer, redundant.

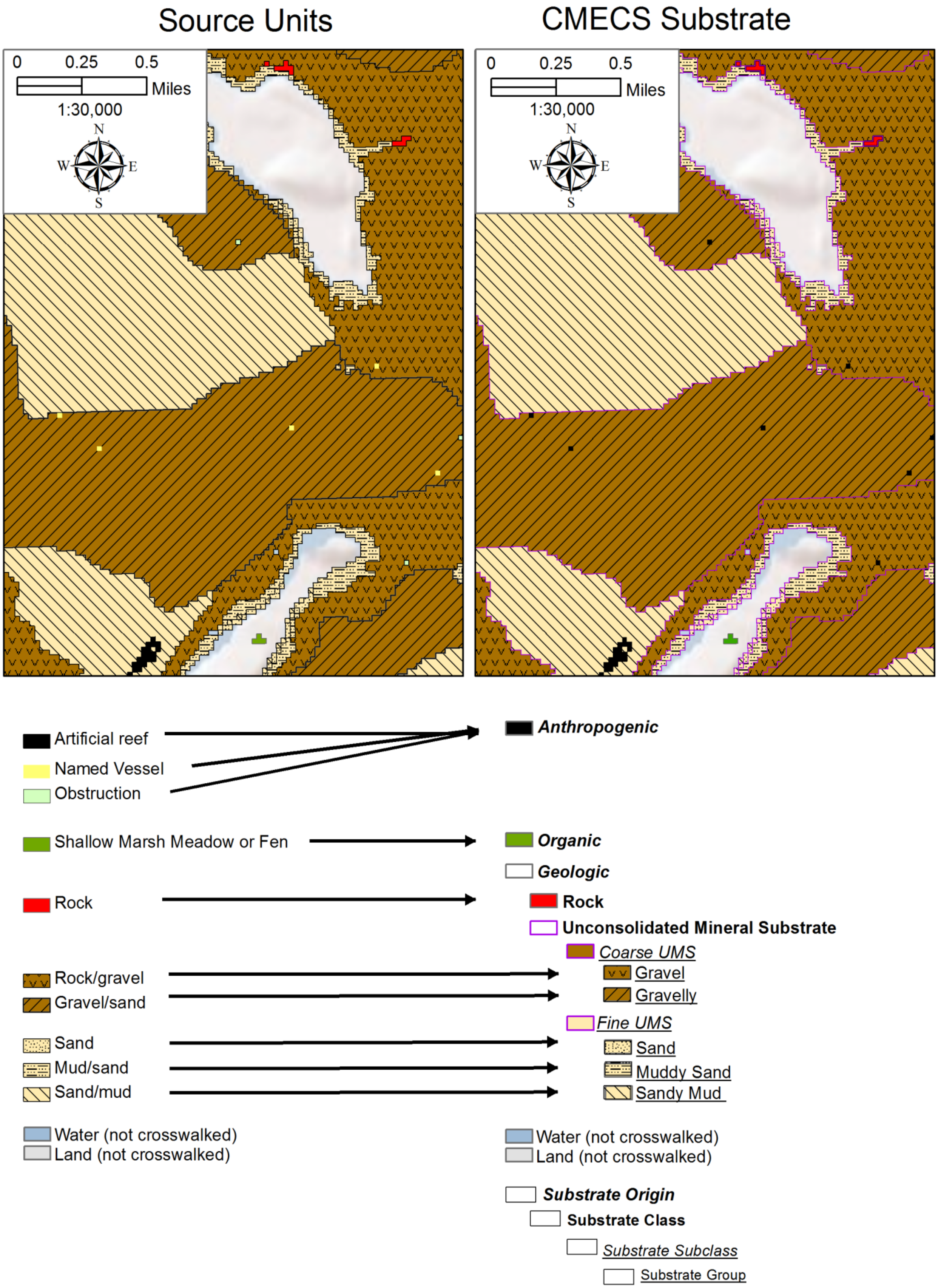


Figure 7: Boston Harbor Substrate Map: On the left is a map with the source units and the source unit legend underneath the map. On the right is a map with the CMECS units and the CMECS unit legend underneath the map. The arrows indicate how the source units crosswalk to the CMECS units. The hierarchical levels in CMECS are outlined in the lower right portion of the legend. Only units visible in the map are included in the legend.

4.1.3 Boston Harbor Geoform

The only Boston Harbor-wide Geoform related dataset was The Nature Conservancy's NAMERA Seabed Form layer (Anderson et al., 2010). Unfortunately, the scale was too coarse for the local scale of Boston Harbor. For example, tidal flats nearshore were classified as "depressions" since the nearshore has a low slope and a low land position compared to the upland, and seabed forms are strictly a description of the morphology (see discussion of crosswalking the full EMU below as "tidal flats" have a characteristic depth and sediment size in addition to their geomorphology). The USGS Quaternary geology maps were ideal for the Geoform Component, but the maps do not extend into the ocean. The DEP Wetlands layer was used 1.) for Marsh Platform, Beach, and Tidal Flat units; however, they do not extend far enough into the harbor 2.) instead of the National Wetlands Inventory (which is what NAMERA used for Coastal Habitats) since the DEP layer was created at a higher resolution 3.) instead of NOAA ESI mapped units since upon inspection at a 1:5,000 scale the DEP Wetlands maps were more consistent with features visible on aerial photographs.

We also added the following units to our final geoform map: 1.) Anthropogenic units from Ackerman et al., 2006, 2.) wrecks/obstructions (NOAA/MORIS), 3.) outfalls (EPA), 4.) marina point locations (MORIS), 5.) mooring field boundaries (MORIS), 6.) Army Corps of Engineers dredge locations (MORIS), 7.) artificial reefs (MORIS), 8.) private seawall and coastal structures inventory (MORIS), and 9.) pipelines (MORIS). These were overlaid on the final map since the Geoform Component allows overlap and nesting of units, they were kept as separate layers in their native point, line, or polygon format (**Figure 8**).

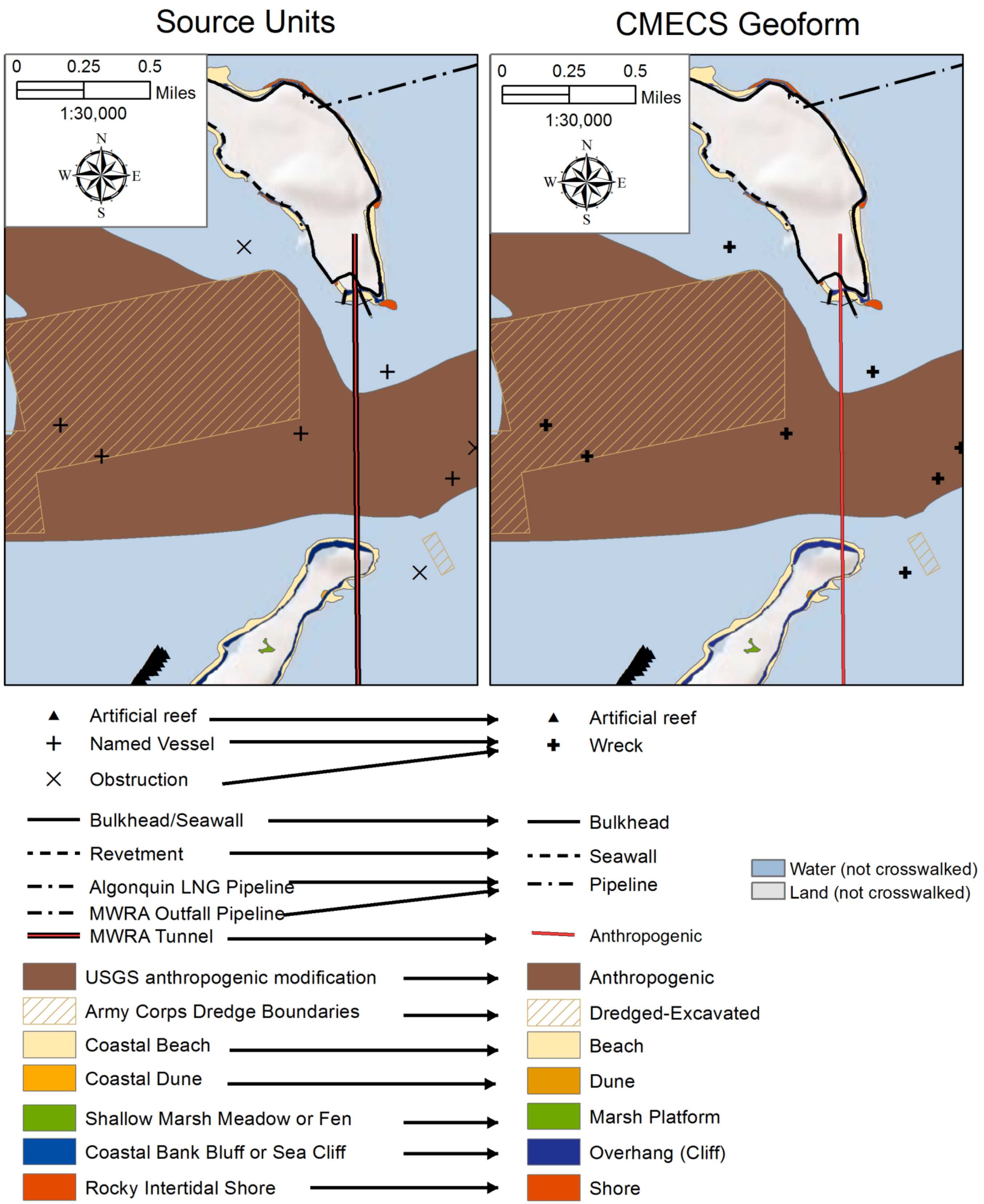


Figure 8: Boston Harbor Geoform Map: On the left is a map with the source units and the source unit legend underneath the map. On the right is a map with the CMECS units and the CMECS unit legend underneath the map. The arrows indicate how the source units crosswalk to the CMECS units. Only units visible in the map are included in the legend.

4.2 Subregional

All subregional scale source schemes could be crosswalked to CMECS to some extent; however, the extent to which source schemes overlapped with CMECS was different depending on the purpose or focus of the source scheme. For each subregional scheme that we examined, we plotted the equivalent CMECS units on space-time diagrams in order to show the breadth and extent of each scheme. For seven of the eight schemes, the space-time diagrams represent the quickest way to visualize the relationships between the source scheme and CMECS. These space-time diagrams are most useful for comparing among the eight schemes. For a better understanding of the attributes of each scheme individually, we recommend consulting the draft crosswalk tables. These draft unit-for-unit crosswalk tables for each source scheme (and the detailed crosswalk table for the Rhode Island Ocean SAMP) are included in **Appendices 9.2.1-9.2.8**. We provide a much more detailed analysis of the Rhode Island Ocean SAMP scheme in Section 4.2.5.

4.2.1 Maine Overview

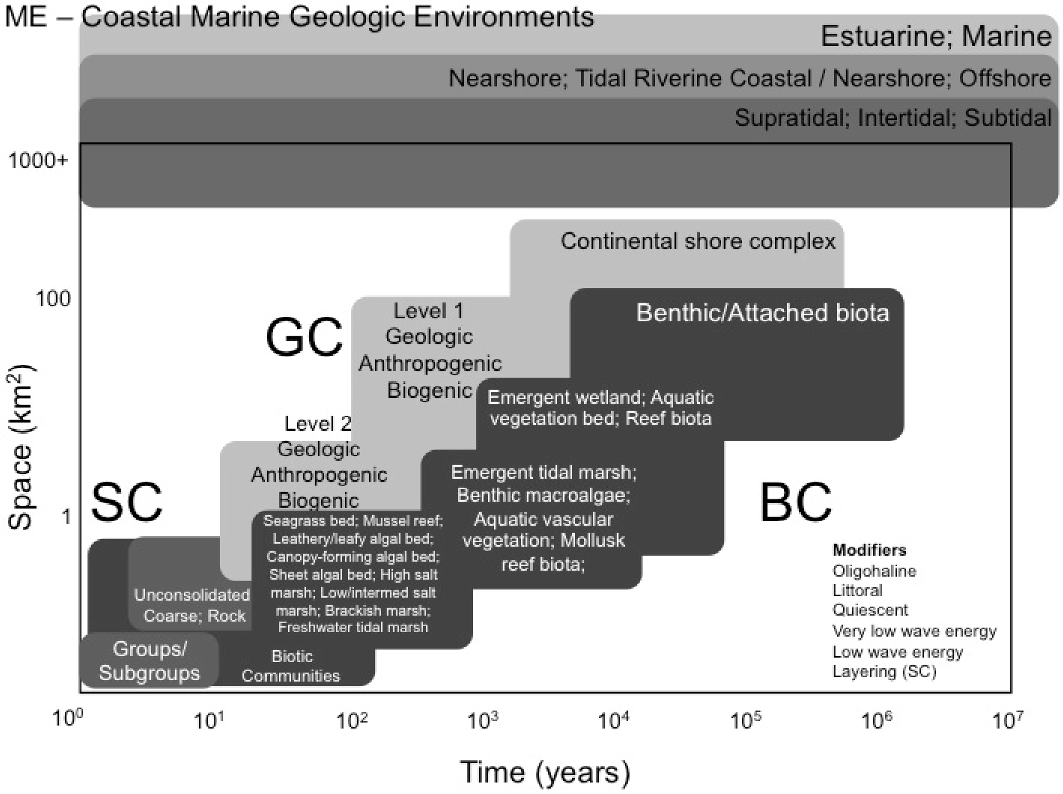


Figure 9: Maine coastal and marine geological environments are relevant to a wide range of CMECS units.

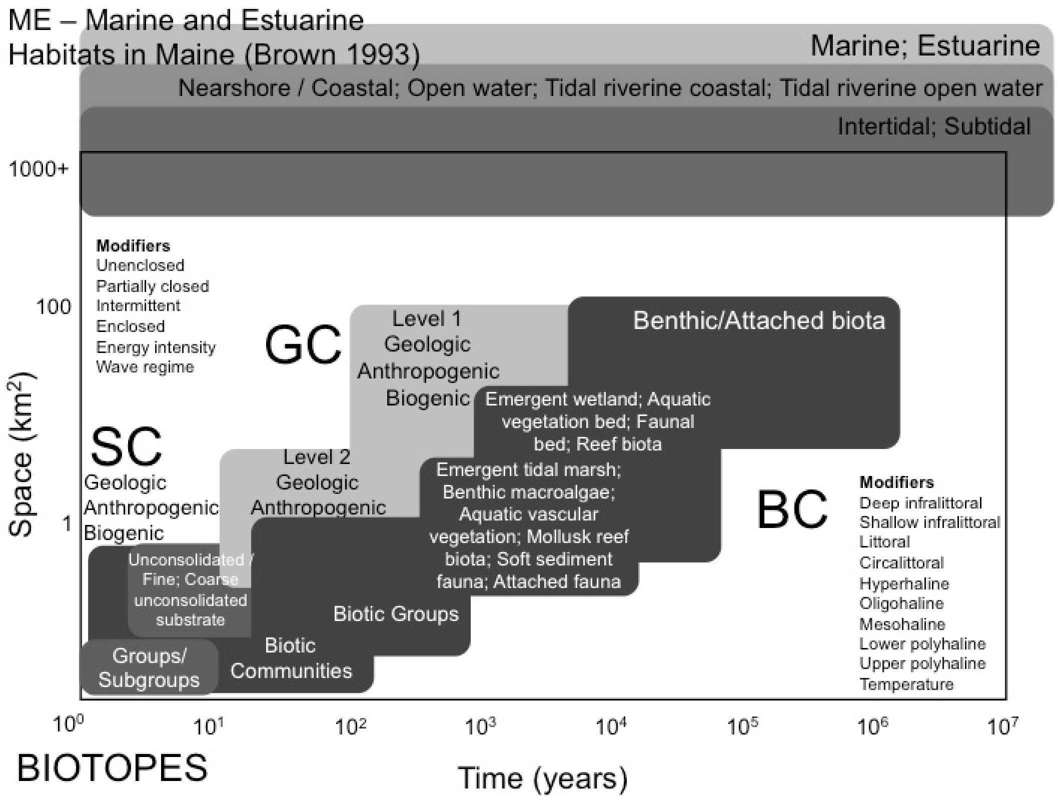


Figure 10: Marine and estuarine habitats in Maine, Benthic habitats encompass meso- and fine-scale CMECS units. This scheme described units that could be crosswalked to CMECS Biotopes, but it was beyond the scope of this project to do so.

4.2.2 New Hampshire Overview

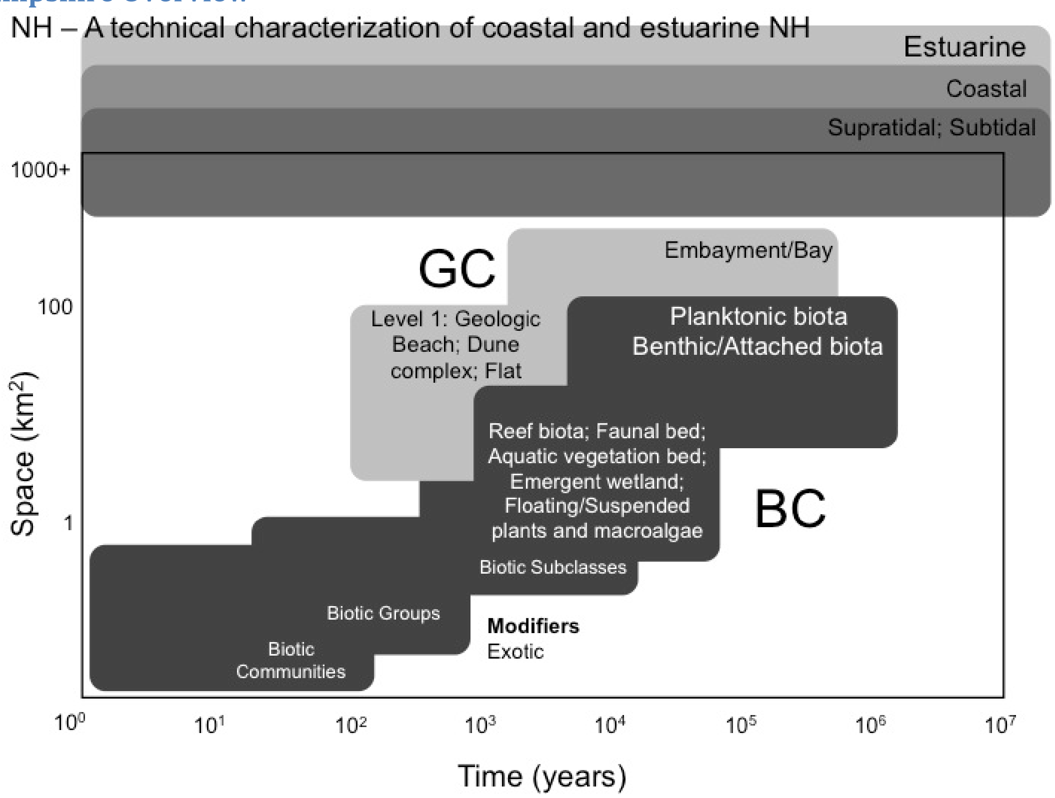


Figure 11: A technical characterization of coastal and estuarine New Hampshire contained mostly biological information and therefore was almost exclusively relevant to the CMECS Biotic Component.

4.2.3 Rhode Island Overview

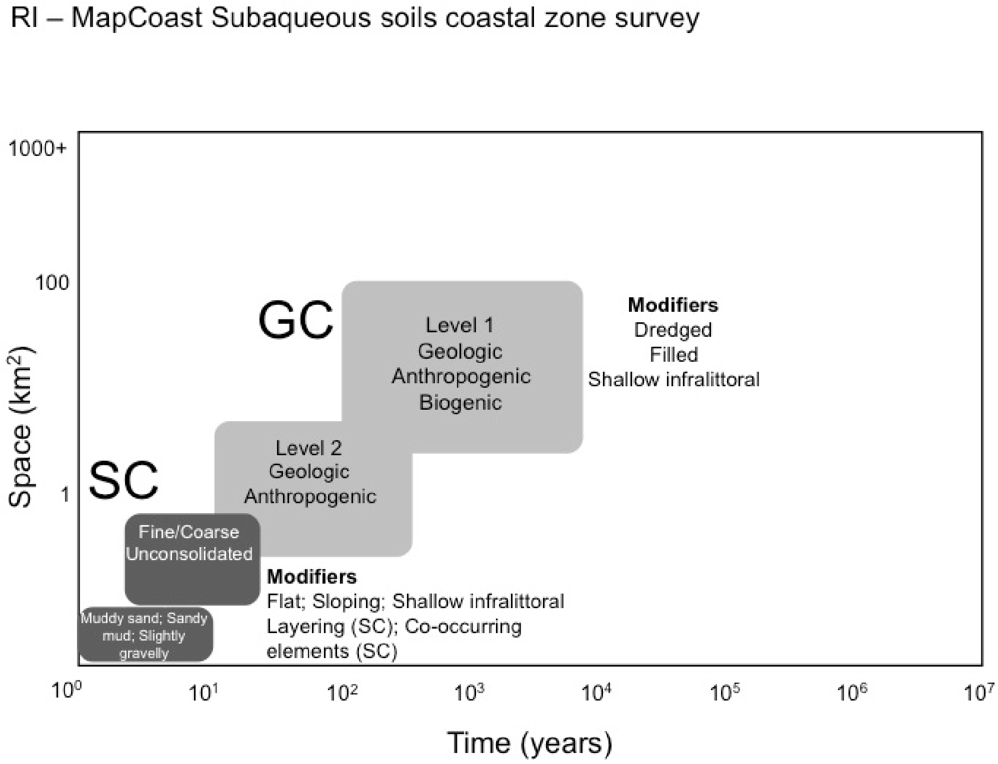


Figure 12: The MapCoast subaqueous soils classification was relevant only to CMECS Geoform and Substrate Components. No biological units or very broad-scale units of any type were embedded within this scheme.

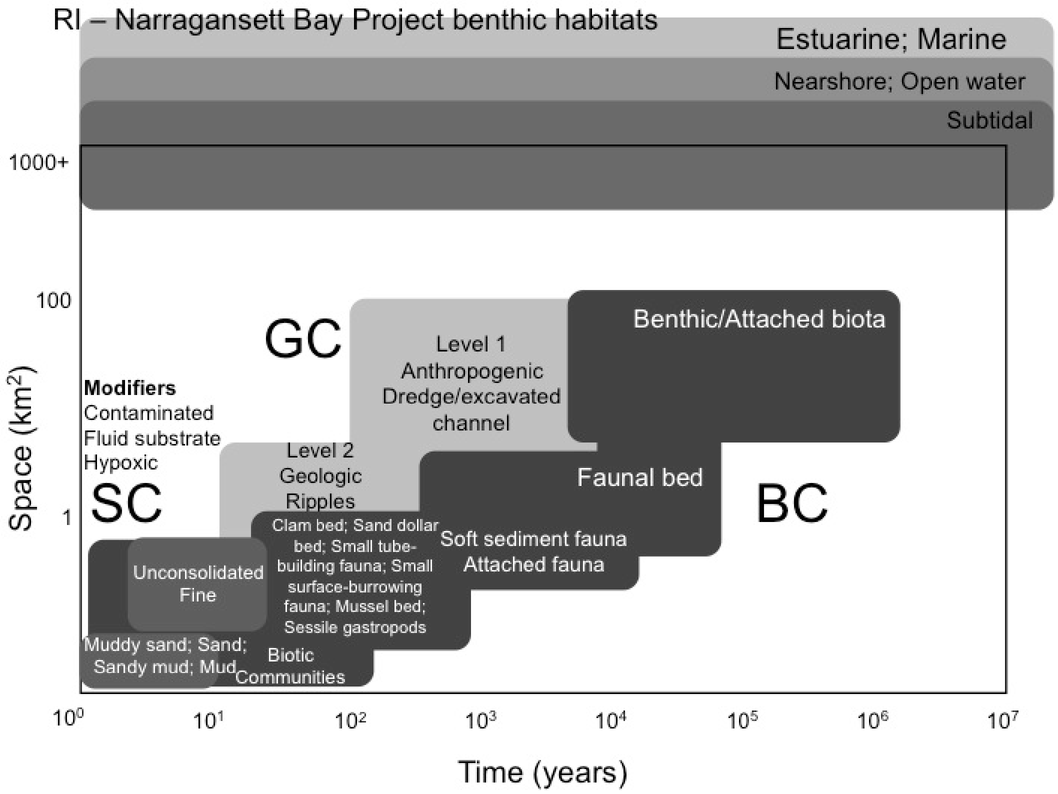


Figure 13: The spatial-temporal framework for The Narragansett Bay Project benthic habitat scheme shows mainly meso- and fine-scale units with geological and biological properties.

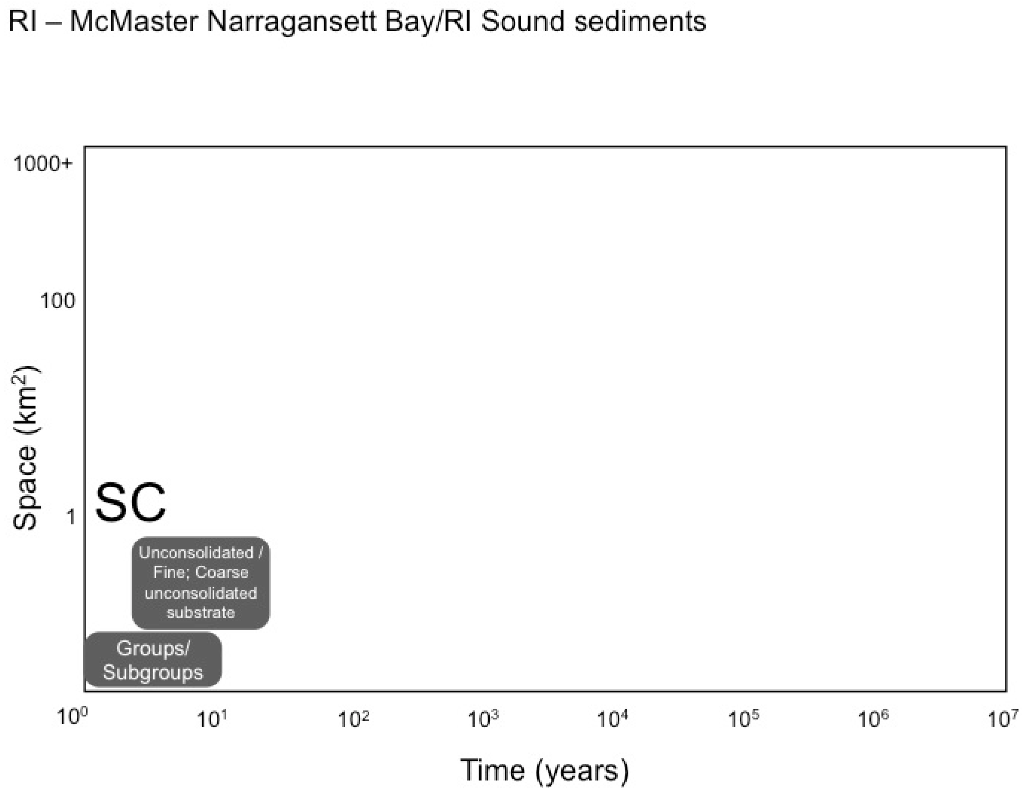


Figure 14: The Narragansett Bay and Rhode Island Sound sediments classification scheme is quite limited in scope. Units were only relevant to the CMECS Substrate Component.

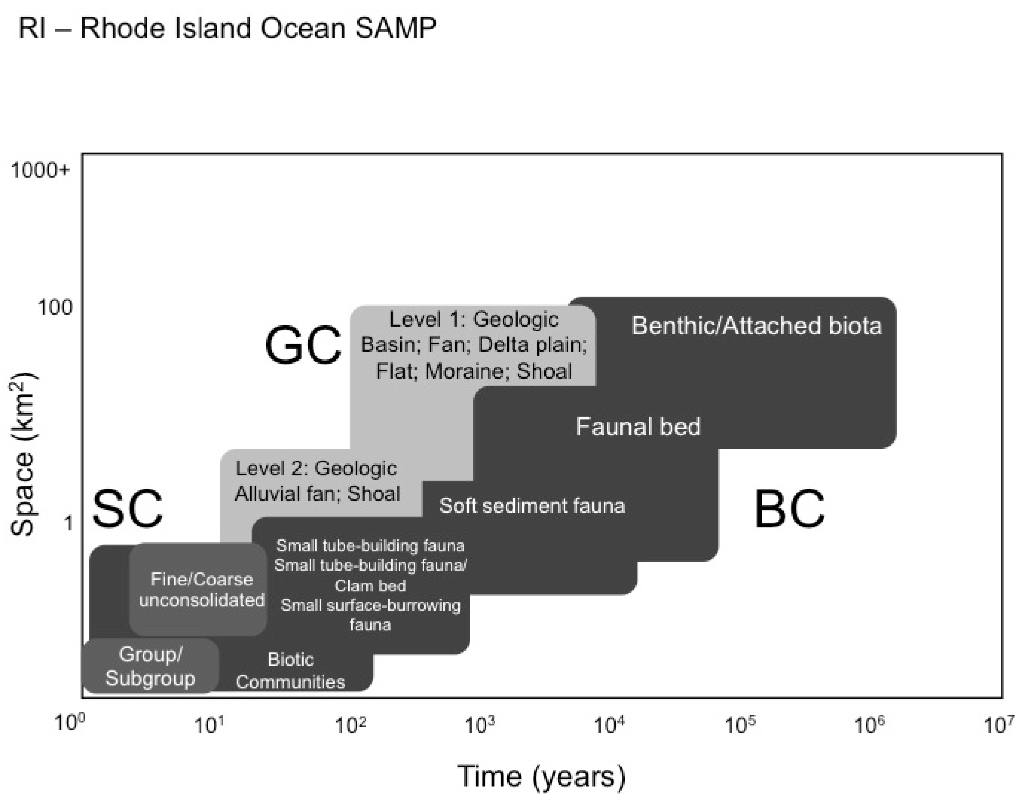


Figure 15: The Rhode Island Ocean SAMP scheme contains units at meso- and fine scales for geological and biological attributes.

4.2.4 Connecticut Overview

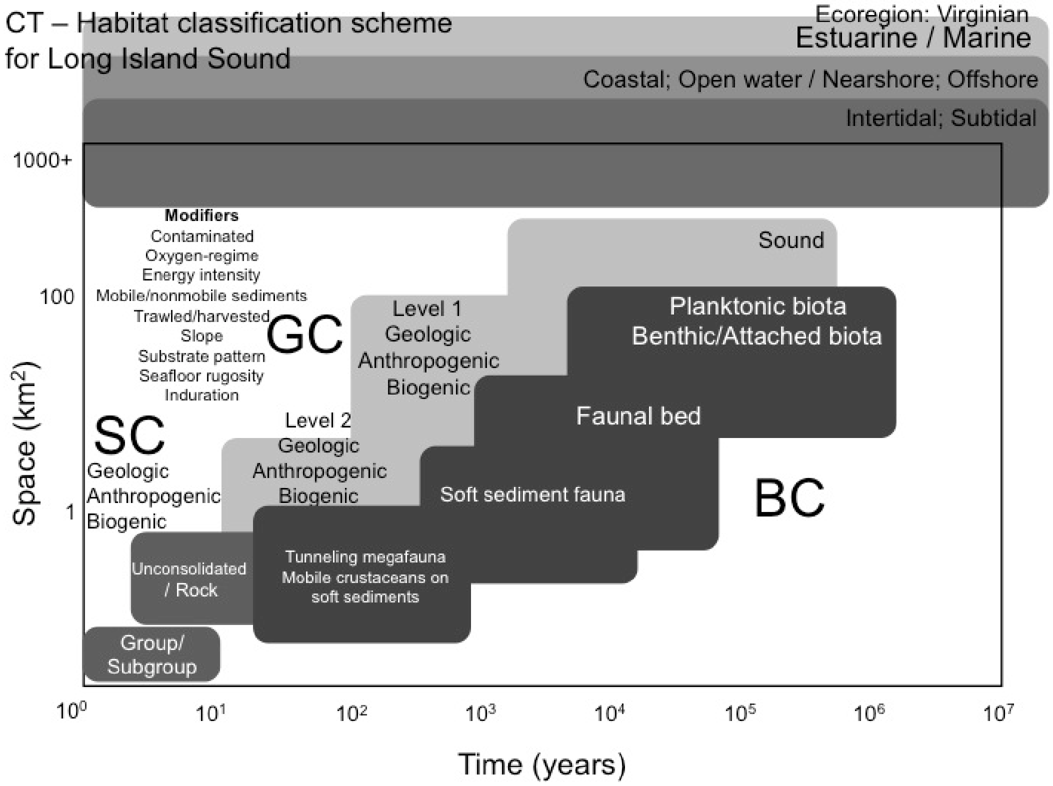


Figure 16: The Long Island Sound scheme is relevant to a broad range of CMECS units. Several CMECS Modifiers were required in order to capture the detail in the process-based elements of the source scheme.

4.2.5 Detailed Rhode Island Ocean SAMP Crosswalk

The Rhode Island Ocean SAMP scheme contained geological and biological units in three categories: Forms, Facies and Biotopes. Forms and Facies are strictly geological and based on mapping of depositional environments and grain size. Biotopes contain biological information and were mapped with the intention of being adaptable to CMECS Biotopes.

4.2.5.1 Rhode Island Ocean SAMP Geoforms and Substrate

The crosswalk from Rhode Island Ocean SAMP geological Form units to CMECS Level 1 Geoforms was primarily a one-to-one unit translation (**Table 5**), but since the Rhode Island Ocean SAMP scheme uses process-specific terminology (e.g., “Glacial alluvial fan”), most of the units crosswalked with a “less than” relationship (i.e., Glacial alluvial fan crosswalks to CMECS Geoform Alluvial fan; **Figure 17**). In addition, there was one case where a unit crosswalked to a single Level 1 Geoform and a Physiographic Setting (Inner Shelf Moraine = Physiographic Setting: Continental Shelf; Level 1 Geoform: Moraine). Overall, the map of CMECS Level 1 Geoforms does not look very different from the map of Rhode Island Ocean SAMP Forms (**Figure 18**).

Table 5: Crosswalk from RI Ocean SAMP Forms to CMECS Level 1 Geoforms.
(For full relationship and confidence classes, see Appendix 9.2.8).

RI Ocean SAMP Form	CMECS Level 1 Geoform
Depositional basin	Basin
Glacial alluvial fan	Alluvial fan
Glacial delta plain	Delta plain
Glacial lake floor	Flat
Glacial lacustrine fan	Fan
Hummocky moraine	Moraine
Inner Shelf Moraine	Moraine
Moraine shoal	Moraine shoal
Point Judith-Buzzards Bay Moraine	Moraine

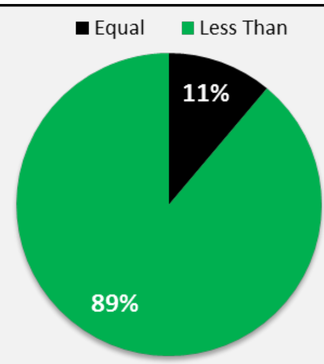


Figure 17: Relationship of RI Ocean SAMP Forms to CMECS Level 1 Geoforms.

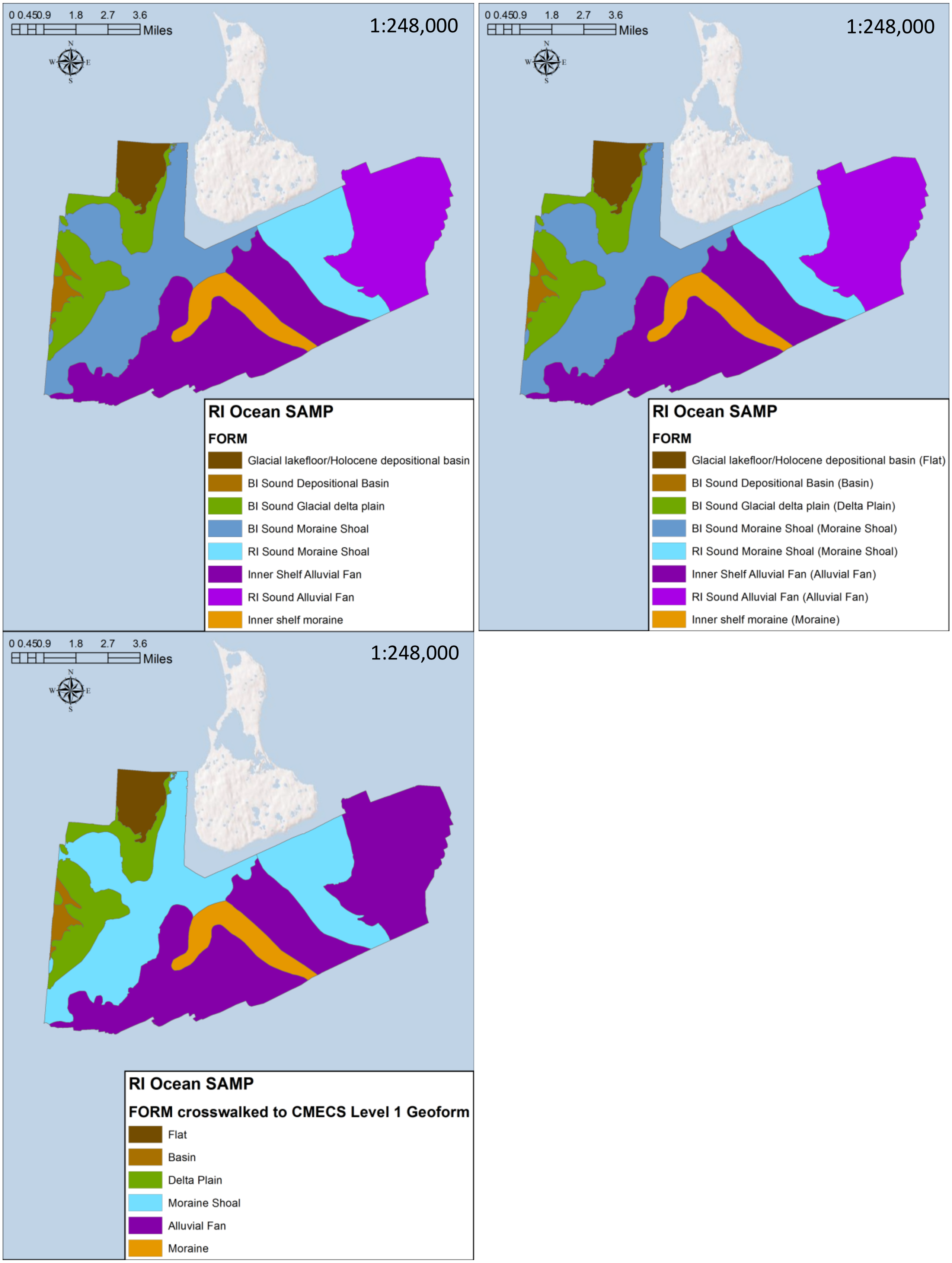


Figure 18: The Rhode Island Ocean SAMP scheme contained units for geological forms (top left panel), which were crosswalked to CMECS Geoforms. In the top right panel, the Ocean SAMP forms are shown with the same legend as the top left panel, but with the corresponding CMECS Geoform in parentheses. In the bottom left panel, the map is changed to reflect one less habitat unit due to the removal of terminology referring to the moraine shoal geographic location.

Rhode Island Ocean SAMP Facies units did not always crosswalk to a single CMECS component. Several Facies had a Geoform and Substrate element and so more than one CMECS component was relevant for a single Facies unit (**Table 6**). When completing the crosswalk tables, this did not cause a conflict and CMECS adequately represented the Rhode Island Ocean SAMP data. Facies that contained just grain size information matched equally with CMECS Substrate Groups and Subgroups (**Figure 19**). However, when creating CMECS maps of Rhode Island Ocean SAMP data, there were cases where more than one Level 1 Geoform was mapped in a geographic area. One Geoform was defined from the previous Form crosswalk and one from the Facies crosswalk. We addressed this conflict by choosing Level 1 Geoform units for the geological Form crosswalk and Level 2 Geoform units for the Facies crosswalk (**Figure 20**).

Table 6: Crosswalk from RI Ocean SAMP Facies to CMECS Level 2 Geoforms and Substrate Component. ***(For full relationship and confidence classes see Appendix 9.2.8)***

RI Ocean SAMP Facies	CMECS Level 2 Geoform	CMECS Substrate Component
Silty sand		(Subgroup) Silty Sand
Boulder gravel concentrations		(Group) Gravel mixes WITH (Subgroup) Boulder
Cobble gravel pavement		(Group) Gravel mixes WITH (Subgroup) Cobble
Coarse sand		(Subgroup) Coarse sand
Coarse sand with small dunes	Sediment wave field	(Subgroup) Coarse sand
Fine sand		(Subgroup) Fine sand
Pebble gravel coarse sand		(Group) Gravel mixes
Silt		(Subgroup) Silt
Coarse silt		(Group) Sandy mud
Sheet sand	Flat	(Group) Sand
Sand sheet with gravel	Flat	(Group) Slightly gravelly
Sand waves	Sediment wave field	(Group) Sand

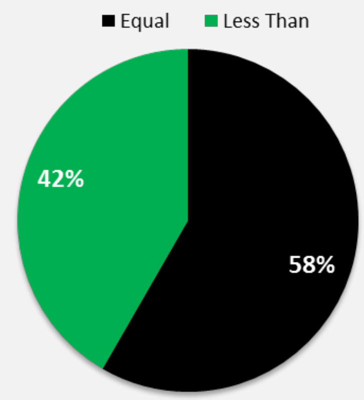


Figure 19: Relationships between RI Ocean SAMP Facies and CMECS Level 2 Geoforms and Substrate Component.

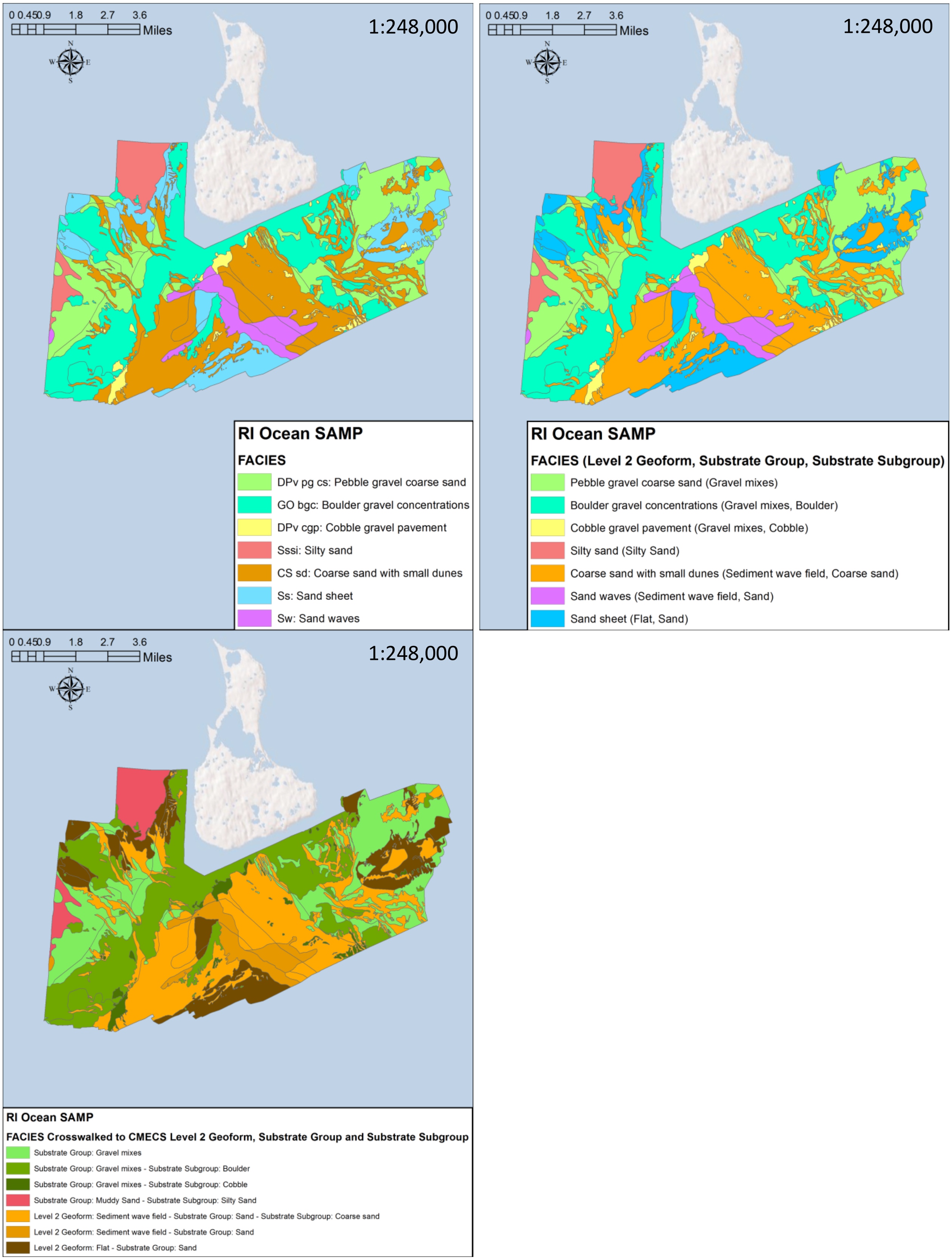


Figure 20: The Rhode Island Ocean SAMP scheme contained units for geological Facies (top left panel), which were crosswalked to CMECS level 2 Geoform Component units and Substrate Component units. In the top right panel, the Ocean SAMP Facies are shown with the same legend as the top left panel, but with the corresponding CMECS Geoform or Substrate unit in parentheses. In the bottom panel, the map is changed to better reflect relationships between the geological units due to the hierarchical structure of the Geoform and Substrate Components.

4.2.5.2 Rhode Island Ocean SAMP Biology

We crosswalked Rhode Island Ocean SAMP Biotopes using the CMECS Biotic Component. The finest level of classification in the CMECS Biotic Component is Biotope, but since CMECS requires an extensive description of repeatable abiotic and biotic associations to form a Biotope, the Rhode Island Ocean SAMP Biotopes were not equivalent to CMECS Biotopes. Two out of the five Rhode Island Ocean SAMP Biotopes were crosswalked to CMECS Biotic Groups and the remaining three were equivalent to Biotic Communities (**Table 7**). Two Rhode Island Ocean SAMP Biotopes were named for co-dominant species. This convention is not demonstrated in existing CMECS Biotic Groups or Biotic Communities, and complicated the crosswalk considerably. One of these two Biotopes contained a Biotic Group and a Biotic Community (there was no equivalent Biotic Community for one of the co-dominant species). The other Biotope corresponded to two Biotic Communities. For simplicity, the relationship of the units for these two crosswalks was classified as “greater than”, indicating a “one to many” relationship, even though CMECS did adequately address portions of each Biotope (**Figure 21**). We made separate maps of CMECS Biotic Groups and Biotic Communities (**Figure 22**). The CMECS Biotic Community map has blank space where there were no equivalent CMECS Biotic Communities for Bybis or Jassa Rhode Island Ocean SAMP Biotopes. Instead of showing “no equivalent” relationships in the crosswalk table or maps, we crosswalked these units by going “up a level” in the CMECS hierarchy (i.e., to Biotic Group). We have proposed additions to CMECS Biotic Communities to incorporate these two elements at the Biotic Community level in the list of Northeast CMECS Habitats (**Appendix 9.4**).

Table 7: Crosswalk from RI Ocean SAMP Biotopes to CMECS Biotic Component.
(For full relationship and confidence classes, see Appendix 9.2.8)

RI Ocean SAMP Biotope	CMECS Biotic Component
Ampelisca vadorum	(Biotic Community) Ampelisca bed
Byblis	(Biotic Group) Small tube-building fauna
Jassa	(Biotic Group) Small tube-building fauna
Lumbrinereis hebes-Polycirrus	(Biotic Group) Attached tube-buidling fauna WITH (Biotic Community) Lumbrinerid bed
Nucula annulata-Ampelisca agassizi	(Biotic Community) Nucula bed WITH Ampelisca bed

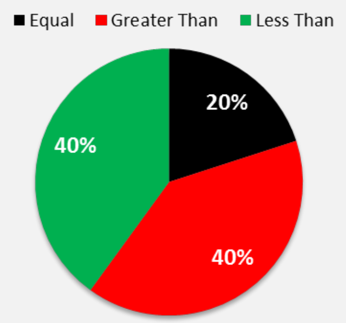


Figure 21: Relationship between RI Ocean SAMP Biotopes and CMECS Biotic Component.

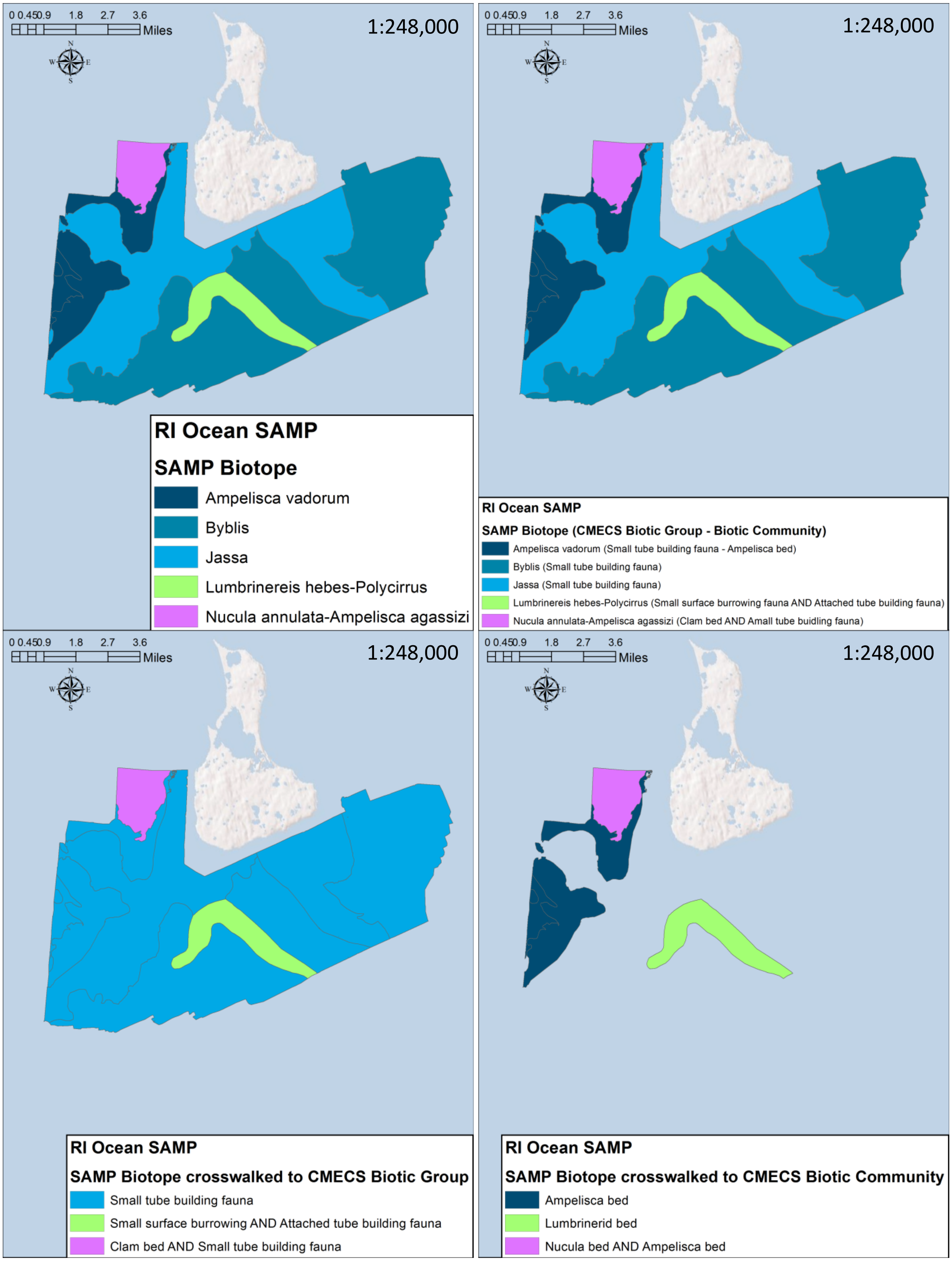


Figure 22: The Rhode Island Ocean SAMP scheme contained units for Biotopes (top left panel), which were crosswalked to CMECS Biotic Component units – Biotic Groups and Biotic Communities. In the top right panel, the Ocean SAMP Biotopes are shown with the same legend as the left panel, but with the corresponding CMECS Biotic Group or Biotic Community in parentheses. In the bottom left panel, the map is changed to show only three corresponding CMECS Biotic Groups in the study area. The bottom right panel shows that the Rhode Island Ocean SAMP area could not be entirely classified to the CMECS Biotic Community level (i.e., there are blank areas). Gaps in the map are due to lack of corresponding CMECS Biotic Communities for Byblis and Jassa amphipod communities. We have proposed new CMECS Biotic Communities as a result of this finding.

4.3 Regional

At the regional scale, the NAMERA Benthic Habitat Model and NERRS land cover classification were crosswalked to CMECS to assess the ability of capturing regional scaled datasets in the current CMECS framework. As with the other crosswalks examined in this project, the extent to which source schemes overlapped with CMECS was different depending on the purpose or focus of the source scheme. The subsections below provide a description of each crosswalk at the regional scale. The detailed unit-for-unit crosswalks for each source scheme are included in **Appendices 9.3.1-9.3.3**. Here we also show graphical representations (space-time diagrams) of the overlap between each source scheme and CMECS as well as discuss how the individual datasets fit within the CMECS framework.

4.3.1 The National Estuarine Research Reserve System Classification Scheme (NERRSCS)

The NERRS classification scheme was crosswalked to CMECS by Mark Finkbeiner (NOAA) who provided a table with the source units paired with corresponding CMECS unit(s), relationship, and confidence classes (**Appendix 9.3.1**). We reviewed the crosswalk, provided edits and created a space-time diagram (**Figure 23**) to understand the overlap between CMECS and the NERRS classification.

Almost one third (31%) of the NERRS units equally crosswalked (one-to-one) to CMECS units (**Figure 24**). Most of these were NERRS units that crosswalked at the CMECS biotic subclass level (i.e. Rooted/Drift Algal, Aquatic Moss, Coral, Faunal, Floating/Rooted Vegetation, Mollusk, and Worm), or the biotic class level (aquatic beds, emergent/forested/scrub-shrub wetlands). 5% of the NEERS units could not be crosswalked to CMECS because CMECS does not extend into the upland, riverine or palustrine habitats. Relationships that were “nearly equal” accounted for 19% of the NEERS crosswalks; these were mostly due to the different substrate grain sizes between the schemes. Another 18% had a “less than” and 16% had a “greater than” relationship demonstrating the places where one scheme subdivided the component further than the other scheme. For example, the NERRS Marine “intertidal” crosswalked to both the CMECS “intertidal” and “supratidal” zones, so the NEERS unit was “greater than” the CMECS unit.

The NERRS scheme utilizes a wide range of modifiers, based on natural and anthropogenic disturbances such as the water regime modifier (seasonally, temporally, artificially flooded, etc.), various disturbances (tornados, fire), and human modifications such as mowing, burning, or farming. These modifiers (51%) are currently outside the CMECS domain and do not have an equivalent CMECS modifier or unit. However, 27% do have a direct crosswalk and include the NERRS salinity modifier (hypersaline, eusaline, polysaline, mesosaline, oligosaline, and fresh zones) and some of the tidal geoforms.

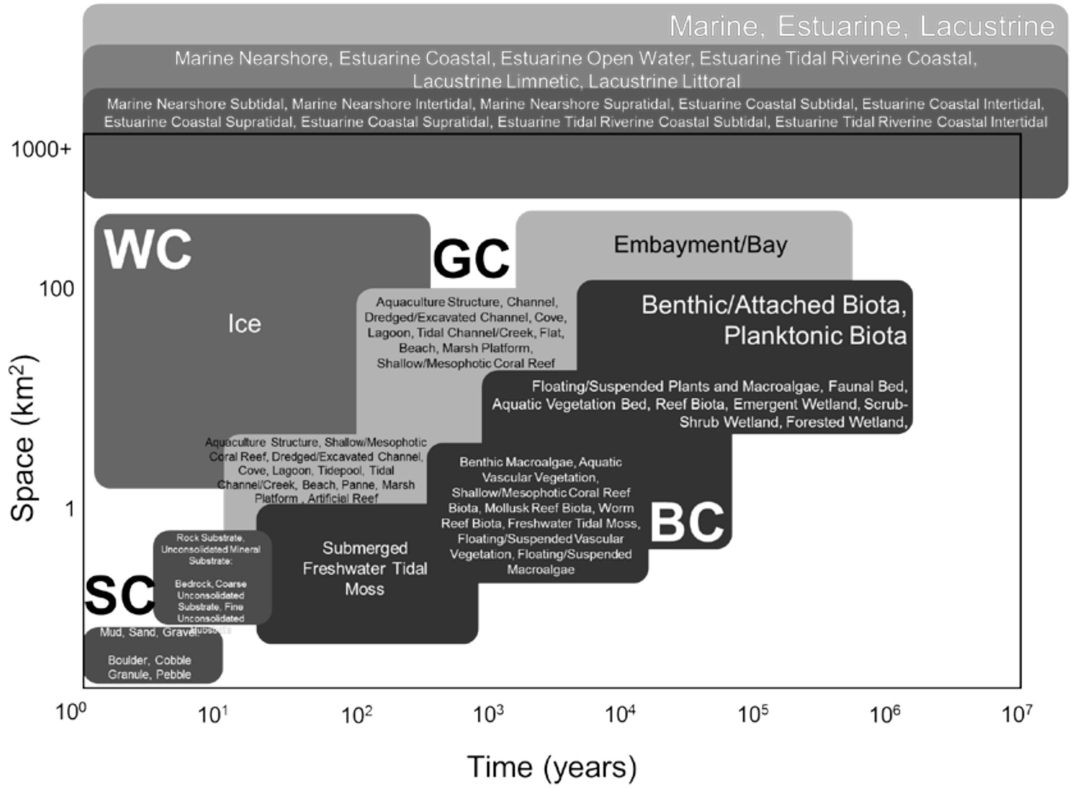


Figure 23: Space-time diagram for the National Estuarine Research Reserve System classification Scheme.

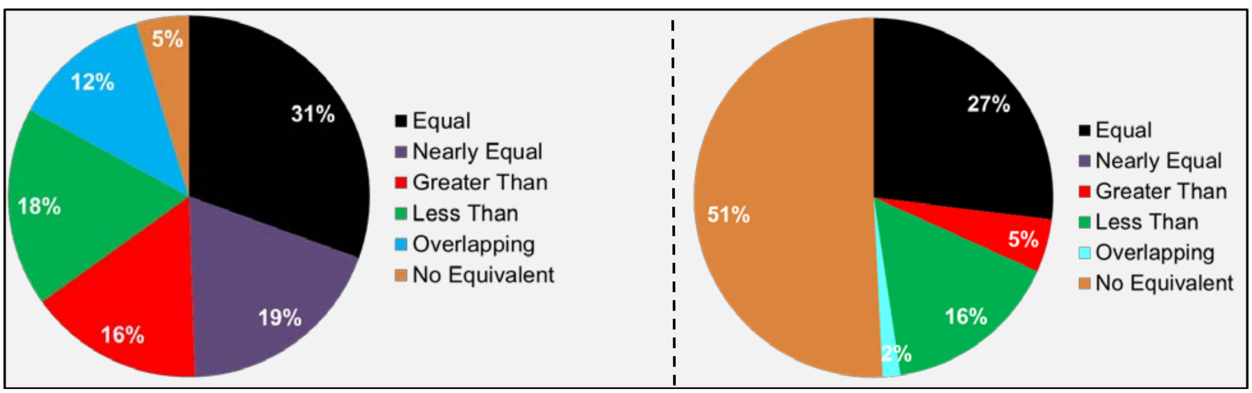


Figure 24: NERRS-CMECS Crosswalking Analysis using the Relationship Class. (Left) NERRS units. (Right) NERRS modifiers *(Pie Chart Analysis by Mark Finkbeiner (NOAA))*

4.3.2 The Northwest Atlantic Marine Ecoregional Assessment (NAMERA)

The NAMERA Benthic Habitat Model has both a purely physical set of units (the Ecological Marine Units or EMUs) that were based on bathymetry, substrate, and seafloor topography, and a set of integrated biotic/physical units (the benthic habitats) that incorporates the distribution of invertebrate communities and their relationship with the physical habitats. The EMUs could be crosswalked to the CMECS Biogeographic Setting, Benthic Depth Zone Modifier, Substrate and Geoform, while the benthic habitats were most similar to the CMECS “Biotope.” In this section we crosswalked the individual physical components of the EMUs that form the foundation of the NAMERA Benthic Habitat Model to the equivalent CMECS components, and we also explore the crosswalk of the benthic habitats to CMECS Biotopes, preserving the nature of the source model and methodology.

Each component of the Benthic Habitat Model was crosswalked to individual CMECS components (**Table 8**) and a space-time diagram was created revealing the wide extent of source and CMECS units in both space and over time (**Figure 25**).

Table 8: NAMERA Benthic Habitat units with comparable CMECS components

NAMERA Benthic Habitat Units		CMECS Components
Ecoregion	=	Biogeographic Setting
Bathymetry	=	Benthic Depth Zone Modifier
Estimated Grain Size	=	Substrate Component
Seabed Form & Depth (From EMUs)	=	Geoform Component
Benthic Habitats	=	Provisional Biotopes

This crosswalk is discussed below and the full table can be found in **Appendix 9.3.2**. After each component was crosswalked, the CMECS units were joined to the original benthic habitat attribute table in order to produce the provisional Biotopes and CMECS component maps. For mapping purposes, if a "greater than" relationship occurred between the source model and CMECS, the dominant CMECS unit was mapped and the secondary units (co-occurring elements) were added as other possible comparable units. The crosswalked maps are organized by NAMERA components (ecoregions, bathymetry, estimated grain size, seabed forms/depth and biology). At times it was necessary to produce two crosswalked maps in order to convey the method of crosswalking to CMECS.

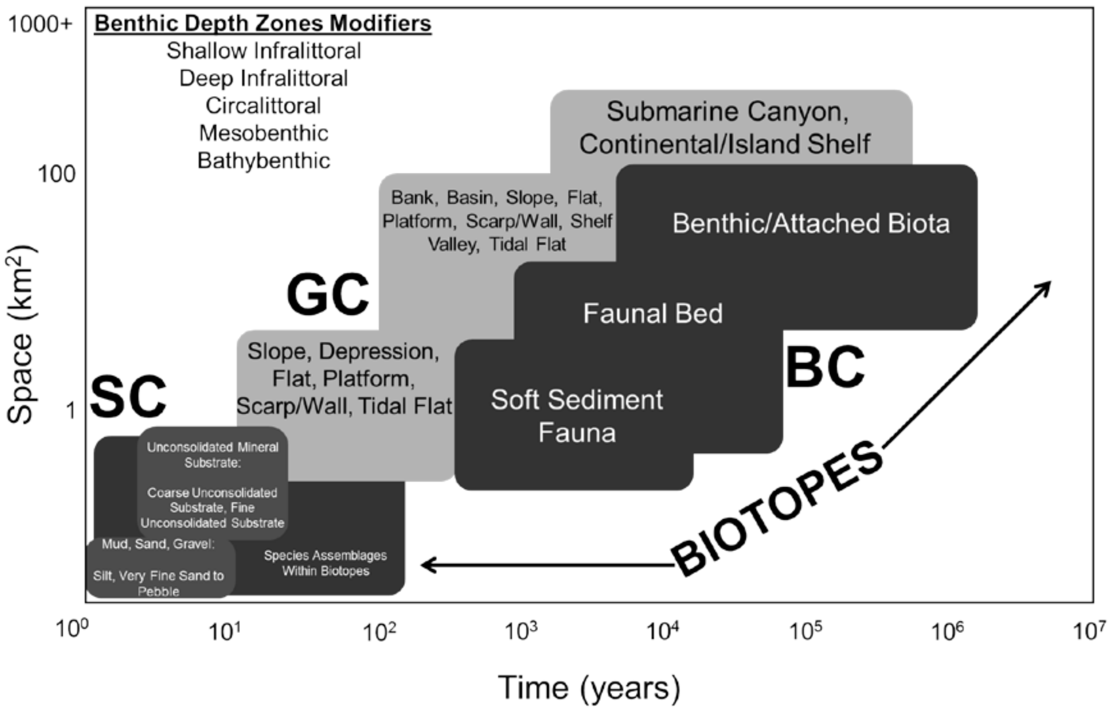


Figure 25: Space-Time Diagram for The Northwest Atlantic Marine Ecoregional Assessment's Benthic Habitat Model

4.3.2.1 NAMERA Biogeographic Setting

The extent of the NAMERA Benthic Habitat model covers the Gulf of Maine, Southern New England, and Mid-Atlantic Bight ecoregions (**Figure 26**). The Gulf of Maine ecoregion crosswalked to CMECS's Gulf of Maine/Bay of Fundy ecoregion (Biogeographic Setting Component) with an "equal" relationship while the Southern New England and the Mid-Atlantic Bight ecoregions both crosswalk to CMECS's Virginian ecoregion creating a "less than" relationship (**Table 9**). Therefore, the overall boundary of the NAMERA equally crosswalked to two CMECS ecoregions but the NAMERA further subdivided the Virginian ecoregion in to smaller subregions (**Figure 27**). The perfect nesting of the NAMERA regions within the CMECS regions made this difference easy to understand and work with, but it has implications in the later classification.

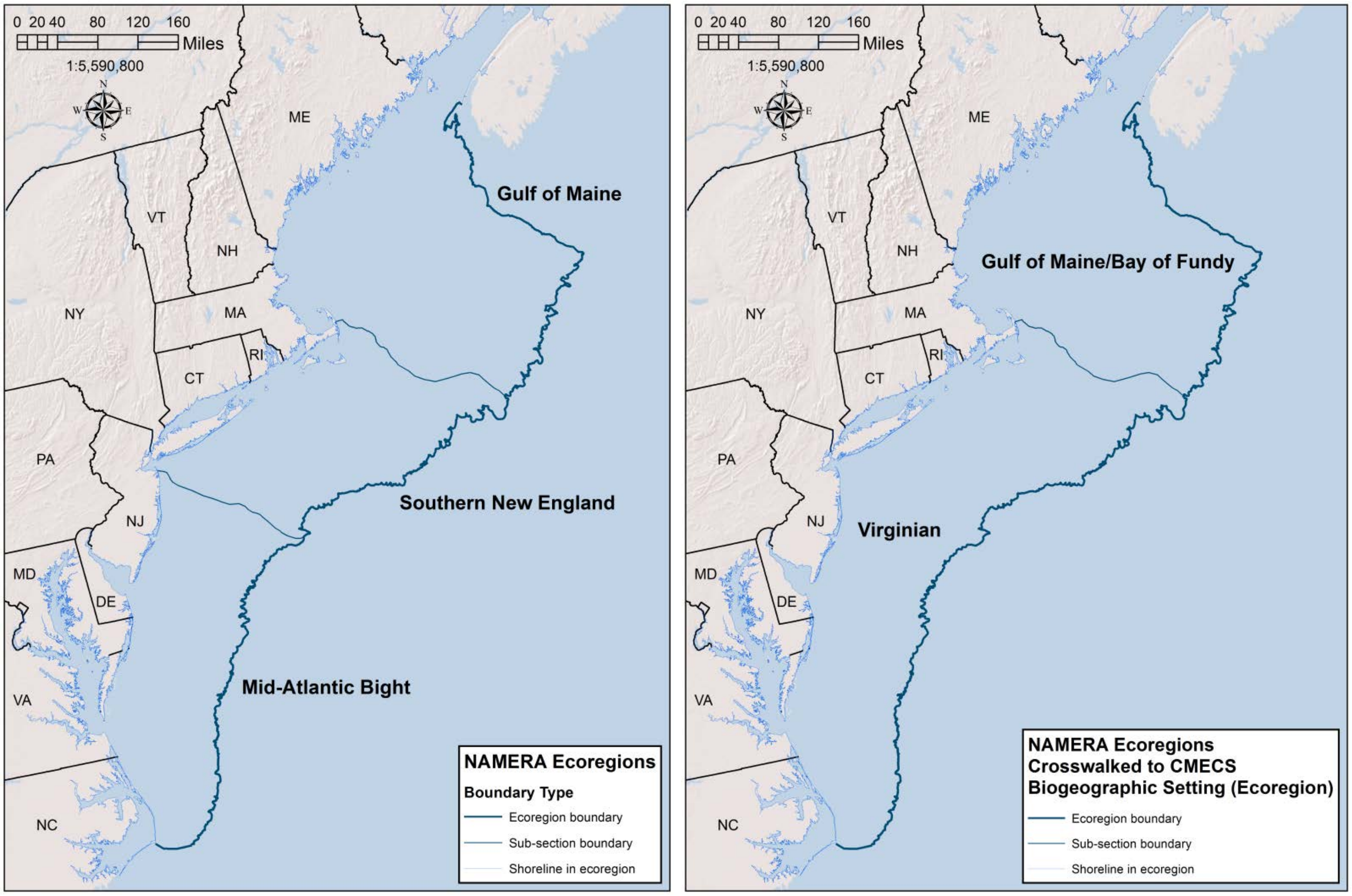


Figure 26: NAMERA–CMECS Biogeographic Setting (Ecoregion) Crosswalked Maps. (Left) NAMERA Ecoregions. (Right) Corresponding CMECS Ecoregions

Table 9: NAMERA Ecoregion Crosswalk *(see appendix 9.3.2 for Relationship and confidence classes)*

NAMERA Ecoregions	CMECS Biogeographic Setting Component
Gulf of Maine	Gulf of Maine/Bay of Fundy - Ecoregion
Southern New England	Virginian - Ecoregion
Mid Atlantic Bight	Virginian - Ecoregion

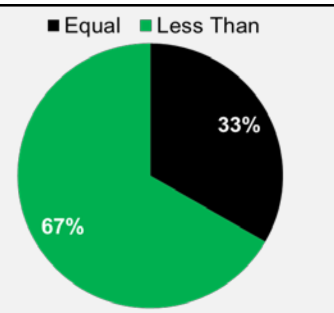


Figure 27: Relationship of NAMERA Ecoregions and CMECS Units

4.3.2.2 NAMERA Benthic Depth Zone Modifier

The NAMERA region's bathymetry ranges from the shoreline extending past the Atlantic Ocean's continental shelf/slope break to a depth of approximately 2,400 meters below sea level (**Figure 28-top left**). Bathymetry zones were developed for each ecoregion based on a recursive partitioning analysis to determine which depth thresholds most completely separated one benthic community (or set of benthic communities) from the others. As a result each NAMERA ecoregion had multiple depth zones whose thresholds corresponded to changes in the biota. These classes were difficult to crosswalk to CMECS because most NAMERA bathymetric zones were more finely classified than the CMECS benthic depth zones (**Table 10**) and many (57%) nested within one CMECS zone. On the other hand, 43% of the NAMERA depth classes crosswalked to two or more CMECS depth zones representing a "greater than" relationship (**Figure 29**).

We explored mapping the bathymetric crosswalks two different ways. First, we labeled the original NAMERA bathymetric map (**Figure 28-top left**) with the corresponding CMECS Benthic Depth Zone(s) (**Figure 28-top right**). This map did not change the original NAMERA map; it simply added the CMECS depth zone to the NAMERA depths in the legend. Second, we classified the NAMERA bathymetric data into CMECS depth zone classes. The resulting CMECS map (**Figure 28-bottom left**) has fewer classes than the source unit map since the CMECS depth zones are broader than the NAMERA depth zones. Since the NAMERA depth zones are based on biological thresholds, if a biologically-relevant depth map is being developed, the middle map allows the maintenance of the original detail and biological relevance while providing CMECS language. Since the CMECS depth units do not appear to reflect important biological thresholds in this Northwest Atlantic study area, we would recommend either altering the CMECS depth zones or adding NAMERA-based depth modifiers to CMECS. This illustrates a situation where the differences in the classifications reflect their different objectives, with CMECS recognizing broadly defined and well accepted depth classes and the NAMERA model identifying localized zones where the benthic communities change.

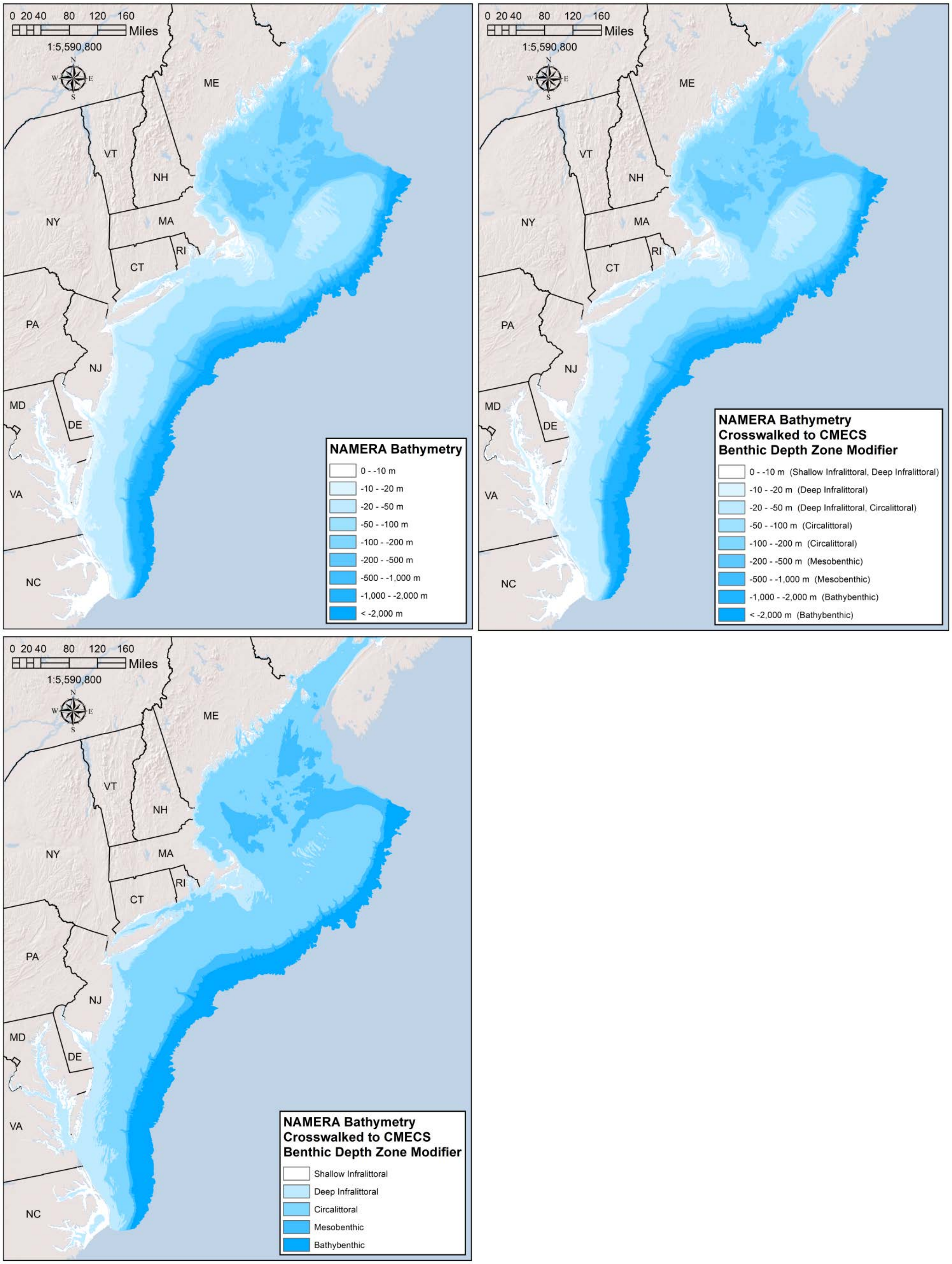


Figure 28: NAMERA–CMECS Bathymetry Crosswalked Maps: (Top Left) NAMERA bathymetry. (Top Right) NAMERA original bathymetry map with crosswalked CMECS units. (Bottom Left) NAMERA bathymetry collapsed into CMECS bathymetric depth zones.

Table 10: NAMERA Bathymetry Crosswalk *(see appendix 9.3.2 for relationship and confidence classes)*

Bathymetry (meters)	Benthic Depth Zones Values (Spatial Modifier for Geoform Component)
0 - 9	Shallow Infralittoral, Deep Infralittoral
0 - 15	Shallow Infralittoral, Deep Infralittoral
0 - 42	Shallow Infralittoral, Deep Infralittoral, Circalittoral
9 - 23	Deep Infralittoral
15 - 22	Deep Infralittoral
23 - 31	Deep Infralittoral
22 - 45	Deep Infralittoral, Circalittoral
31 - 44	Circalittoral
42 - 69	Circalittoral
44 - 75	Circalittoral
45 - 80	Circalittoral
69 - 83	Circalittoral
75 - 139	Circalittoral
80 - 95	Circalittoral
83 - 101	Circalittoral
95 - 592	Circalittoral, Mesobenthic
101 - 143	Circalittoral
139+	Circalittoral, Mesobenthic, Bathybenthic
143 - 233	Circalittoral, Mesobenthic
233+	Mesobenthic, Bathybenthic
592+	Mesobenthic, Bathybenthic

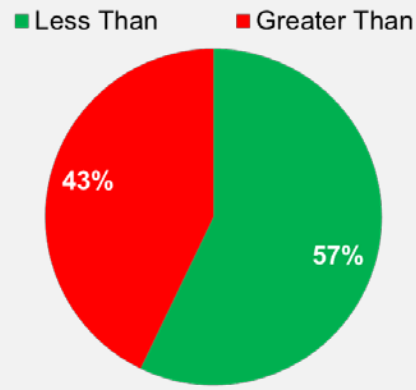


Figure 29: Relationship of NAMERA Bathymetry and CMECS Units

4.3.2.3 NAMERA Substrate

The NAMERA region has an estimated range of sediment grain sizes from 0.001 mm to 9 mm (**Figure 30-Top Left**). The estimated grain sizes were statistically assigned to each benthic habitat based on the degree to which different benthic organism communities corresponded to changes in the grain size. The NAMERA grain size class results did not crosswalk equivalently to the Wentworth scale used by CMECS for describing substrate component units (one-to-one), providing a range of units for many NAMERA substrate classes (**Table 11**). As a result, 50% of the NAMERA units crosswalked to a range of CMECS subgroup units, providing a "greater than" relationship to the CMECS scheme. Conversely, 33% of the units were more finely defined in NAMERA and nested within one CMECS substrate unit (**Figure 31**).

As with bathymetry, two methods were used when mapping the crosswalked CMECS units. First, we labeled the NAMERA source units with the corresponding CMECS substrate subgroup units (**Figure 30-Top Right**). This technique added CMECS units in the legend and preserved the spatial distribution of the substrates. Second, we collapsed the source substrate classes into the CMECS substrate subgroups (**Figure 30-Bottom Left**). This method collapsed three of the NAMERA classes (0.17mm-0.48mm) into one CMECS class (fine to medium sand). The CMECS map is simpler and has less detail with respect to the "sand" class (**Figure 30-Bottom Left**).

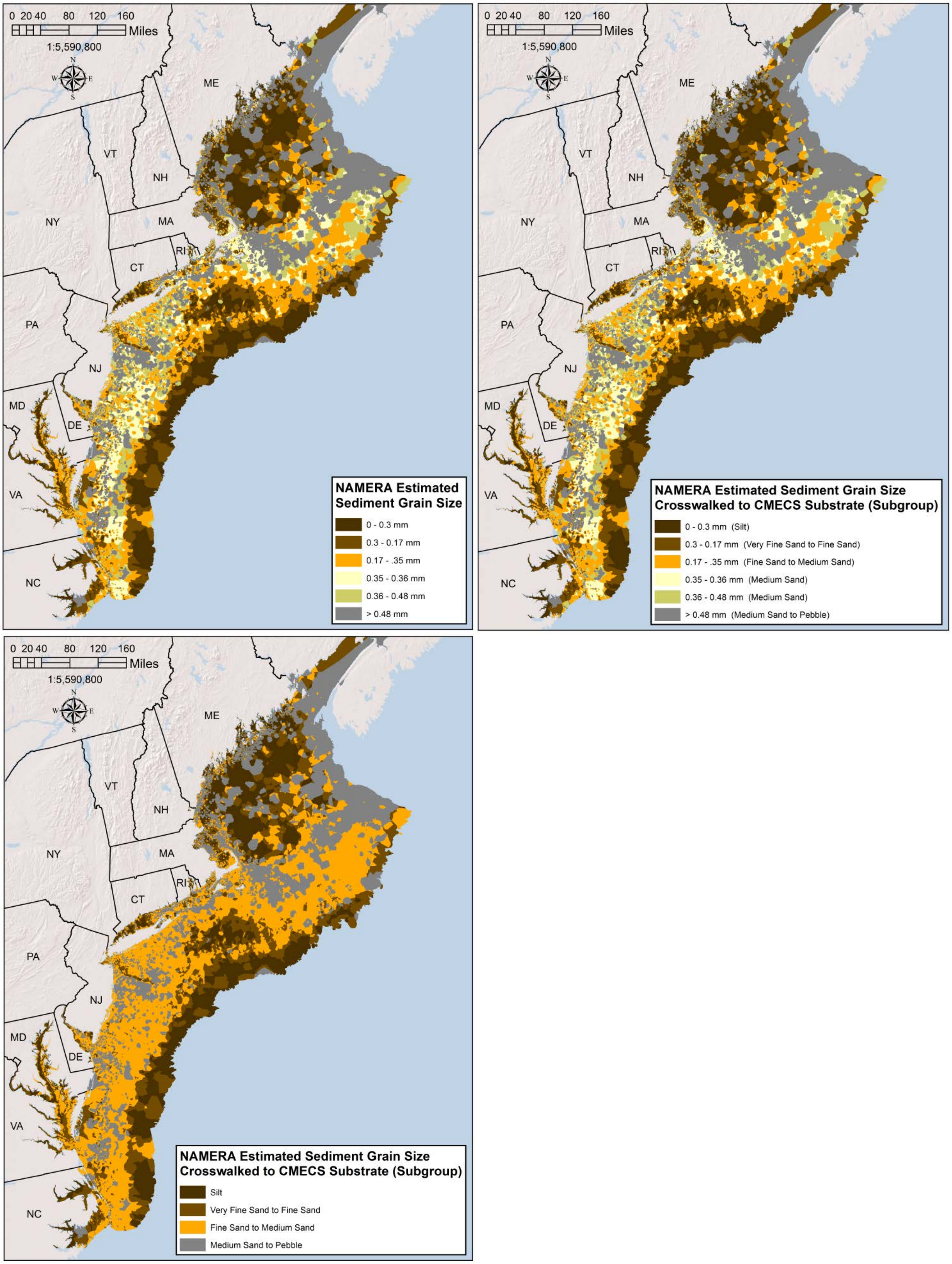


Figure 30: NAMERA–CMECS Substrate Crosswalked Maps: (Top Left) NAMERA estimated sediment grain size map. (Top Right) NAMERA sediment map crosswalked to CMECS substrate and (Bottom Left) NAMERA sediment map collapsed into CMECS substrate classes.

Table 11: NAMERA Substrate Crosswalk
(see appendix 9.3.2 for relationship and confidence classes).

NAMERA Substrate	CMECS Substrate Component
0 - 0.03 Silt/Mud	Silt – Subgroup
0.03 - 0.17 Sand	Very Fine Sand to Fine Sand - Subgroup
0.17 - 0.35 Sand	Fine Sand to Medium Sand - Subgroup
0.35 - 0.36 Sand	Medium Sand - Subgroup
0.36 - 0.48 Sand	Medium Sand - Subgroup
0.48+ Coarse Sand to Gravel	Medium Sand to Pebble - Subgroup

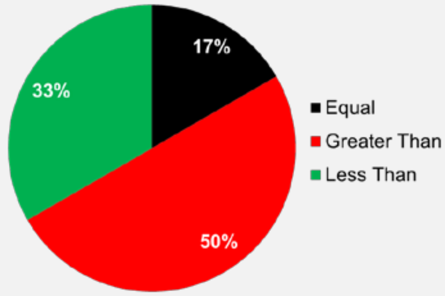


Figure 31: Relationship of NAMERA Substrate and CMECS Units

4.3.2.4 NAMERA Geoforms

The seabed form and depth components derived from the NAMERA EMUs (**Figure 32-Left**) were crosswalked to CMECS Geoforms (Level 1&2 and Physiographic Setting) units (**Figure 32-Right**). This crosswalk was the most difficult due to the different nature of the purely descriptive EMUs and feature-based descriptions of the Geoforms. There was some ambiguity and subjectivity in this crosswalk (more than the other components) and multiple Geoforms were often captured within many of the seabed forms. It was also difficult to determine if the crosswalked Geoforms were a level 1 or a level 2 unit, due to the spatial extent and resolution of the dataset. In some cases, level 1 and 2 Geoforms were both selected for the crosswalk and many benthic habitats contained multiple Geoforms based on their EMUs, so dominant and secondary Geoforms (co-occurring elements) were selected when one Geoform was not obvious (**Appendix 9.3.2**).

For the analysis section, if the seabed form contained dominant and secondary Geoforms (co-occurring elements) we considered it “greater than” for the relationship class, accounting for about 56% of the crosswalks. However, 44% of the NAMERA seabed forms crosswalked equally to one CMECS Geoform (**Figure 33**).

For mapping purposes, the dominant Geoforms were used (**Table 12**) that largely represented the seabed forms at a regional scale. In general, the crosswalked CMECS map did not change much from the original NAMERA seabed form map even though eighteen seabed forms were collapsed into eleven dominant Geoforms. By using only the Geoforms Component, the specific information on the depth zone classes that is contained within the EMU was lost. However, depth is implied in several of the CMECS geoforms, for example “tidal flat” implies shallow water, and “submarine canyon” implies deep water. We could map these units more specifically using the combination of seabed form with depth. Additionally, since the NAMERA Benthic Habitat crosswalks into CMECS Biotopes, these depth classes are preserved within the bathymetric component of the provisional Biotopes.

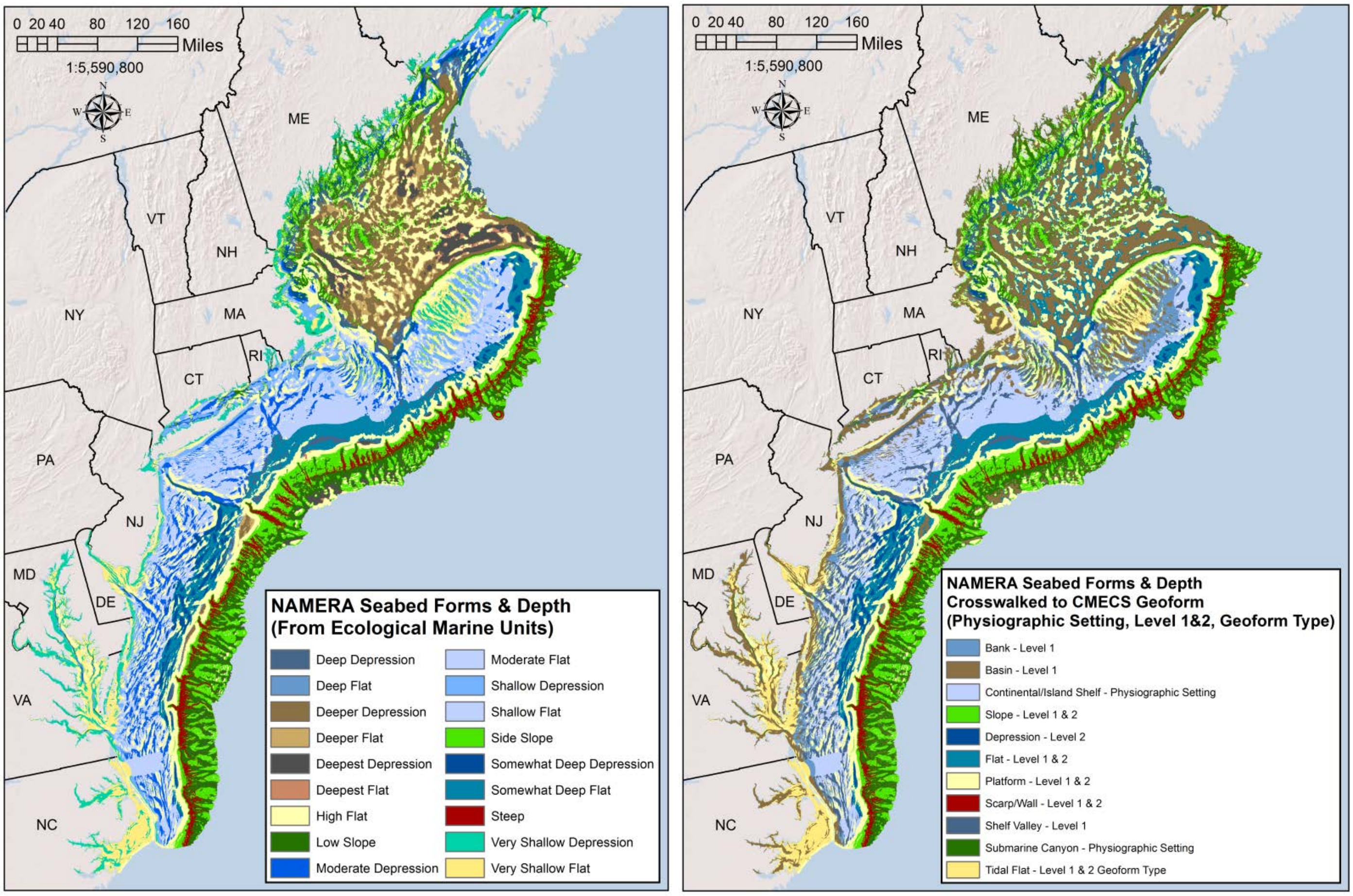


Figure 32: NAMERA–CMECS Geoform Crosswalked Maps: (Left) NAMERA seabed form and depth only (derived from EMUs). (Right) crosswalked to CMECS geoforms

Table 12: NAMERA Ecological Marine Units (Seabed Forms & Depth) Crosswalk
(see appendix 9.3.2 for relationship and confidence classes)

NAMERA Ecological Marine Units (Seabed Forms and Depth)	CMECS Geoform Component (Dominant)
Deep Depression	Shelf Valley - Level 1 Geoform
Deep Flat	Flat - Level 1 and 2 Geoform
Deeper Depression	Basin - Level 1 Geoform
Deeper Flat	Flat - Level 1 and 2 Geoform
Deepest Depression	Basin - Level 1 Geoform
Deepest Flat	Flat - Level 1 and 2 Geoform
High Flat	Platform - Level 1 and 2 Geoform
Low Slope	Submarine Canyon - Physiographic Setting
Moderate Depression	Shelf Valley - Level 1 Geoform
Moderate Flat	Continental/Island Shelf - Physiographic Setting
Shallow Depression	Basin - Level 1 Geoform
Shallow Flat	Bank - Level 1 Geoform
Side Slope	Slope - Level 1 and 2 Geoform
Somewhat Deep Depression	Depression - Level 2 Geoform
Somewhat Deep Flat	Flat - Level 1 and 2 Geoform
Steep	Scarp/Wall - Level 1 and 2 Geoform
Very Shallow Depression	Basin - Level 1 Geoform
Very Shallow Flat	Tidal Flat - Level 1 and 2 Geoform type

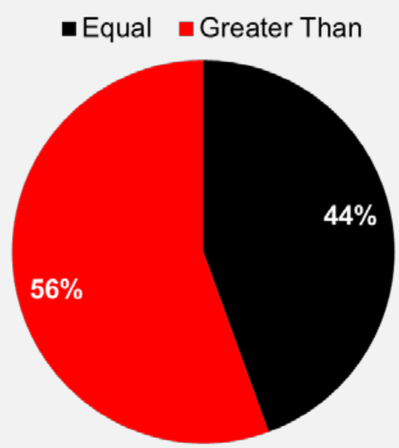


Figure 33: Relationship of Ecological Marine Units (Seabed Forms and Depth) and CMECS Units

4.3.2.5 NAMERA Biology and Biotopes

The NAMERA Benthic Habitat Model contains over 2,000 soft sediment invertebrate species (of the phyla including annelids, arthropods, cnidarians, echinoderms, bryozoans, phoronids, sipunculids, chaetognathans, brachiopods, protozoans, chordates, nemerteans, hemichordates, cephalopods, and mollusks), many of these co-occurring in the habitats. Most of these species (75%) crosswalked to the CMECS soft sediment fauna biotic subclass (**Table 13**), while a few did not have an equal CMECS counterpart (25%; **Figure 34**). All of those that did not crosswalk were a result of the original NAMERA grab sampling method, as the Chaetognathans, Bryozoans, Protozoans and the Cephalopods may have been collected unintentionally in the water column from the grab samples.

In order to preserve the Benthic Habitat Model and the species assemblages, the species within each phylum were not crosswalked directly to CMECS Biotic Communities, which are based on dominance (an attribute that we did not have in the Benthic Model). Also more information relating to size, life stage, and grab sample location is necessary in order to crosswalk them to the Biotic Community level requiring further research. Also, many species contained in the Benthic Habitat Model were not listed within the CMECS Biotic Community level of the Soft Sediment Fauna Subclass. In order to prevent loss of information at the community level, these were not directly crosswalked. We preserved the original species (common and scientific names) contained in the model which essentially serve as Biotic Community units.

Table 13: NAMERA Benthic Organisms Crosswalk
(see appendix 9.3.2 for relationship and confidence classes)

NAMERA Benthic Organisms	Benthic Organisms - Biotic
Annelids	Soft Sediment Fauna - Subclass
Arthropods	Soft Sediment Fauna - Subclass
Cnidarians	Soft Sediment Fauna - Subclass
Echinoderms	Soft Sediment Fauna - Subclass
Bryozoans	Soft Sediment Fauna - Subclass
Phoronids	Soft Sediment Fauna - Subclass
Sipunculids	Soft Sediment Fauna - Subclass
Chaetognatha	*No direct CMECS crosswalk*
Brachipods and Bryozoans	Soft Sediment Fauna - Subclass
Bryozoans and Protozoans	*No direct CMECS crosswalk*
Chordates	Soft Sediment Fauna - Subclass
Nemerteans	Soft Sediment Fauna - Subclass
Hemichordates	Soft Sediment Fauna - Subclass
Protozoans	*No direct CMECS crosswalk*
Cephalopods	*No direct CMECS crosswalk*
Mollusks	Soft Sediment Fauna - Subclass

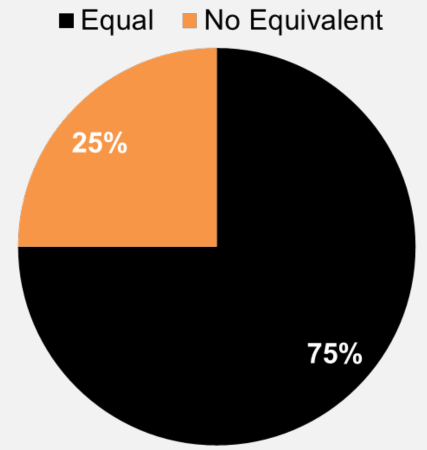


Figure 34: Relationship of NAMERA Benthic Organisms and CMECS Units

In CMECS, Biotopes are defined as repeating combinations of abiotic and biotic features (FGDC 2012). Thus, the connection between the CMECS Biotope framework and the NAMERA Benthic Habitat framework (**Figure 35**) was strong and allowed us to include organism information that did not fit comfortably into the CMECS Biotic Communities. However, since most of the NAMERA Benthic Habitats consisted of multiple environmental components specific to each habitat, it was imperative to keep these components together when crosswalking these to CMECS in order to retain the maximum amount of ecological meaning in the data and maps. For this project, we explored the connection between the existing Benthic Habitat Model and the CMECS Biotopes. This project not only demonstrates the capability of CMECS in capturing classification systems like the NAMERA, but it also provides context and need for further development, which will make CMECS more flexible with existing and future classification schemes.

Biotopes were constructed after each component of the Benthic Habitat Model (ecoregion, bathymetry, grain size, seabed forms/depth and biology) had been individually crosswalked. The original attribute table of the NAMERA Benthic Habitat Model consisted of fields containing the Benthic Habitat name, ecoregion, substrate, seabed form, bathymetric depth, and benthic species. For example, **Table 14** displays the Mid-Atlantic Bight 1 (MAB 1) habitat consisting of species pertaining to annelids, arthropods, chordates and mollusks found in the Mid-Atlantic Bight ecoregion at a depth between 0-45 meters on depressions composed of sand and gravels. The environmental signature for this community is broader than a single EMU because, for example, it occurs in both sand and gravel (six EMUs overall; **Figure 36**). Using the methodology outlined in section 9 of the CMECS manual, the crosswalked CMECS units were joined to the NAMERA attribute table and provisional Biotopes were constructed by concatenating the components in each habitat. For example, **Table 15** shows the CMECS crosswalked units for MAB 1 and after concatenating these units the CMECS provisional Biotope is: “Virginian Shallow Infralittoral to Circalittoral Basins, Tidal Flats and Shelf Valleys with Fine Sand to Pebble substrates and Annelids, Arthropods, Chordates and Mollusks.”

This provisional Biotope combines all of the features that were used to statistically characterize the habitat and were extracted from the attribute table after the crosswalks were joined to the original Benthic Habitat Model. Biotopes were created for all NAMERA Benthic Habitats (see **Appendix 9.3.3**). However, CMECS Biotopes were lengthy due to the fact that individual Benthic Habitats were composed of multiple EMUs with similar biology and physical environments. The complexity in providing names to physically-biologically linked data highlights the true ecological complexity in the Northwest Atlantic study area. The provisional Biotope names are long because multiple physical environment types are relevant to similar groups of species, just as the types of species found in each physical environment varies widely. There is incredible detail in the NAMERA dataset, and while CMECS Biotopes are capable of handling that data, the tradeoff is a complex and perhaps confusing legend.

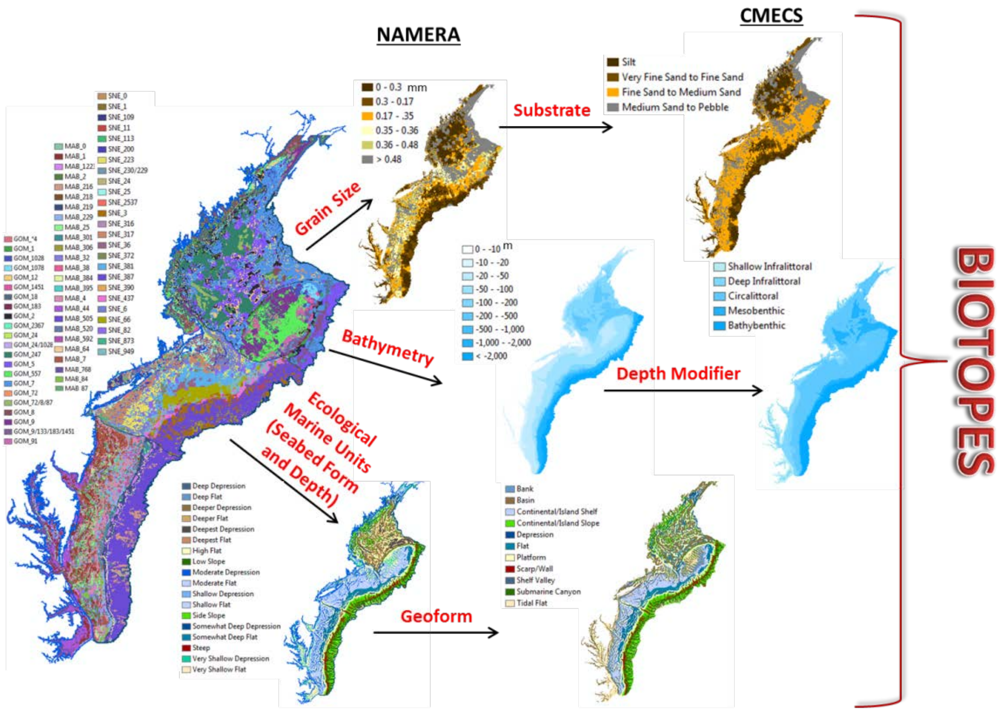


Figure 35: NAMERA components crosswalked to CMECS units is comparable to CMECS Biotopes

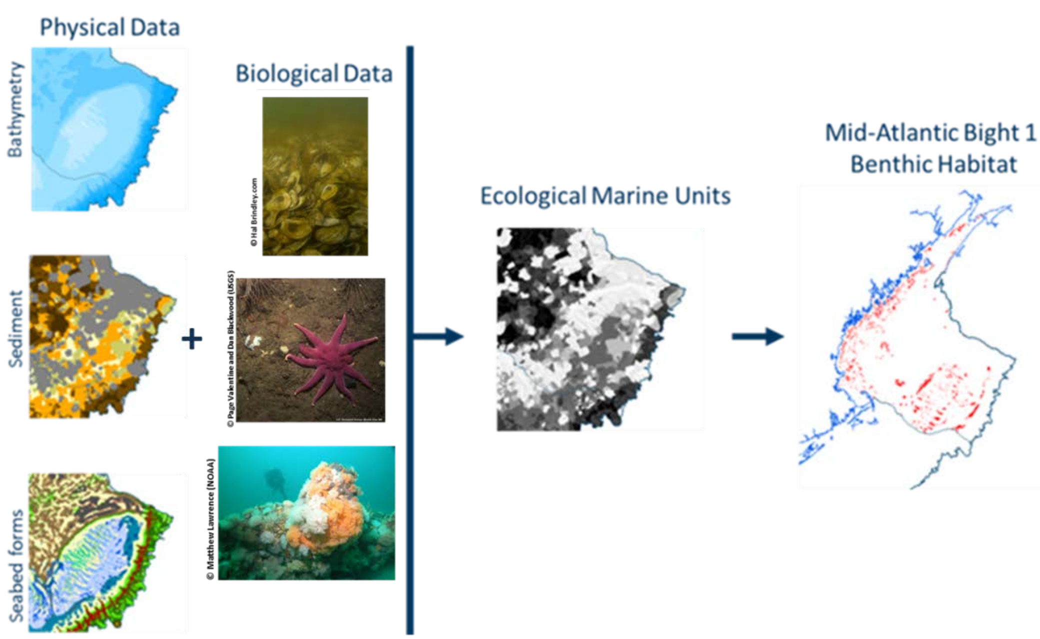


Figure 36: NAMERA Mid-Atlantic Bight Habitat 1 with physical and biological component diagram

Table 14: NAMERA Mid-Atlantic Bight 1 Benthic Habitat Table

ID	Benthic Habitat	Ecoregion	Depth (meters)	Seabed Form & Depth	Sediment	Annelids	Arthropods	Chordates	Mollusks
1	MAB_1	Mid Atlantic Bight	0 - 15	Very Shallow Depression	0.17 - 0.35 Sand	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (*Branchiostoma virginiae*)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*
2	MAB_1	Mid Atlantic Bight	0 - 15	Very Shallow Flat	0.17 - 0.35 Sand	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (Branchiostoma virginiae)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*
3	MAB_1	Mid Atlantic Bight	15 - 22	Shallow Depression	0.36 - 0.48 Sand	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (Branchiostoma virginiae)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*
4	MAB_1	Mid Atlantic Bight	15 - 22	Shallow Depression	0.48+ Coarse Sand to Gravel	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (Branchiostoma virginiae)	*Astarte (Astarte borealis), Lunate crassinella (Crassinella lunulata)*
5	MAB_1	Mid Atlantic Bight	22 - 45	Moderate Depression	0.36 - 0.48 Sand	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (Branchiostoma virginiae)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*
6	MAB_1	Mid Atlantic Bight	22 - 45	Moderate Depression	0.48+ Coarse Sand to Gravel	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (*Branchiostoma virginiae*)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*

Table 15: CMECS Crosswalk Unit Table for Mid-Atlantic Bight Habitat 1.

ID	Benthic Habitat	Ecoregion	Benthic Zone Depth Modifier	Geoform (Dominant)	Substrate	Annelids	Arthropods	Chordates	Mollusks
1	MAB_1	Virginian - Ecoregion (BS)	Shallow Infralittoral, Deep Infralittoral	Basin - Level 1 Geoform (GC)	Fine Sand to Medium Sand - Substrate Subgroup (SC)	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (*Branchiostoma virginiae*)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*
2	MAB_1	Virginian - Ecoregion (BS)	Shallow Infralittoral, Deep Infralittoral	Tidal Flat - Level 1 and 2 Geoform type (GC)	Fine Sand to Medium Sand - Substrate Subgroup (SC)	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (*Branchiostoma virginiae*)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*
3	MAB_1	Virginian - Ecoregion (BS)	Deep Infralittoral	Basin - Level 1 Geoform (GC)	Medium Sand - Substrate Subgroup (SC)	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (*Branchiostoma virginiae*)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*
4	MAB_1	Virginian - Ecoregion (BS)	Deep Infralittoral	Basin - Level 1 Geoform (GC)	Medium Sand to Pebble - Substrate Subgroup (SC)	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (*Branchiostoma virginiae*)	*Astarte (Astarte borealis), Lunate crassinella (Crassinella lunulata)*
5	MAB_1	Virginian - Ecoregion (BS)	Deep Infralittoral, Circalittoral	Shelf Valley - Level 1 Geoform (GC)	Medium Sand - Substrate Subgroup (SC)	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (*Branchiostoma virginiae*)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*
6	MAB_1	Virginian - Ecoregion (BS)	Deep Infralittoral, Circalittoral	Shelf Valley - Level 1 Geoform (GC)	Medium Sand to Pebble - Substrate Subgroup (SC)	Shimmy worm (*Nephtys bucera*)	Other amphipods (*Protohaustorius deichmannae, Acanthohaustorius spinosus, A. shoemakeri*)	Lancelet (*Branchiostoma virginiae*)	Astarte *(Astarte borealis), Lunate crassinella (Crassinella lunulata)*

5. Challenges

5.1 Crosswalking

The crosswalking process was conceptually straight forward and the CMECS manual had clear guidance with respect to the crosswalking process. The fundamental challenge that each team faced was making subjective decisions about how to translate source units into CMECS equivalences while minimizing information loss. The following is a list of recommendations for users working with CMECS and additional challenges that we found throughout the crosswalking process:

1. The potential suitability and usefulness of a dataset/source scheme should be assessed before crosswalking it. Some datasets, although environmentally or biologically descriptive, cannot adequately contribute to habitat maps in the detailed way that we are attempting (because of a lack of thematic specificity or mismatch in scale). Success in crosswalking will be maximized if inappropriate datasets are immediately weeded out.
2. The System, Subsystem, Physiographic Setting, Tectonic Setting, and Origin are typically not explicitly defined in source units. Additional datasets or knowledge is necessary in order to identify these from the data.

3. A single source scheme unit can often be described by many CMECS Components (which is OK). For example, marshes are classified in the Biotic Component as Biotic Subclass: Emergent tidal marsh; AND in the Substrate Component as Biogenic Substrate Origin: Organic Substrate; AND in the Geoform Component as Level 1 Geoform: Marsh Platform. These crosswalks are all correct and all relevant. The delineation of marshes will show up in each CMECS map produced (for each of the Biotic, Substrate and Geoform Components).
4. The crosswalk is dependent on a certain amount of interpretation which can vary based on the crosswalker, the purpose of the crosswalking effort, and the location within the hierarchy where a source unit crosswalks to. Testing and quality control may be an issue.
5. There is overlap across components which makes the crosswalk challenging. For example, in the Geoform Component, units such as "Boulder field" and "Mollusk reef" specified Substrates instead of Geoforms, which would be "field" and "reef."
6. Source units often used descriptive language such as hard, exposed, sheltered, rocky, covers & uncovers, stony, submarine, underwater, and hardened. These require using CMECS modifiers to properly crosswalk the source units to CMECS units, but there are threshold differences that make the use of the modifiers challenging. In some cases the thresholds were different due to different purposes (e.g. the bathymetric classes used in the NAMERA source scheme were different than the CMECS Benthic Depth Zone modifier classes) and in other cases the CMECS modifier classes were so specific it was hard to take general descriptors from the source units and crosswalk them.
7. Using modifiers can either clarify or further confuse the relationships and confidence levels.
8. Crosswalking is an iterative process and requires users to revisit their previous decisions. All groups reported that they changed their minds on crosswalked units, relationship, and confidence levels. However, the process of mapping the crosswalks created a more concrete framework in which to assess the crosswalk. All teams agreed that the mapping step improved the accuracy of the crosswalk.

5.2 Mapping

After crosswalks were prepared, the mapping portion was relatively straightforward. However, we did run into a few challenges worth noting:

1. Cleaning up source scheme data before any crosswalks and maps can be produced is time consuming, as the user has to manually sort through the data and edit any formatting/text before the crosswalks and maps can be produced. However, in the long run initial cleanup improved the accuracy of the crosswalk and prepared the datasets for final mapping.
2. It is useful to identify goals for mapping prior to using CMECS (or any other) classification. You could possibly achieve a very high degree of precision (e.g. slightly-gravelly-muddy-sand; Biotic Communities with co-occurring elements and associated taxa), but if you do not need that level of precision to meet your goals you could save a lot of time. Many of the source classifications did not have very clear substrate thresholds, or they were slightly different. Knowing how relevant those distinctions are for the use of the crosswalk and/or maps is helpful. Even though CMECS is providing a more uniform language, applying that language to existing datasets introduces the need for interpretation; these interpretations can be dependent on the goals of the mapping/classification exercise.
3. It was functionally easier for each team to produced maps pertaining to individual CMECS Components as opposed to a single CMECS map that blended Component units (which is suggested as one possibility in the CMECS manual).
4. Mapping crosswalked units where one source unit crosswalked to more than one CMECS unit (the "greater than" relationship) was a challenge. As a group we decided to either select the dominant or "best" CMECS unit and map this as the crosswalked unit, or move up one level in the CMECS hierarchy mapping the feature at a coarser level of detail.

5. As a result of the “greater than” relationship and in some cases very descriptive source units that could not be adequately crosswalked and mapped, all teams recognized that the crosswalk led to information loss and wanted to illustrate where that information loss occurred. They did this by creating fairly complicated legends. At the local scale, arrows were used to connect source units to CMECS units. The subregional and regional teams created a map with source units mapped and CMECS units described. If a “CMECS map” is the goal for a project, how to illustrate potential loss of detail is worth further consideration.
6. At the local scale, multiple source datasets were combined to create a single CMECS component map. This required another set of decision-making to determine how to incorporate co-occurring elements derived from different source data/schemes. The addition of co-occurring elements complicated the mapping (and legend-making) by creating a multitude of units.

6. Recommendations

After completion of this project this project team drafted a list of general recommendations for the CMECS Implementation Group (IG) and recommendations to the Mapping/Environmental Management Community. General CMECS unit recommendations can be found in **Appendix 9.4** listed under each component under the recommendation sections.

General Recommendations to CMECS Implementation Group (IG):

1. *This report shows that that the CMECS ecological standard is generally amenable to habitat and other types of mapping efforts. However, a "Mapping Handbook" document should be developed that shows potential CMECS users how to plan and implement mapping efforts that will produce "CMECS maps."
2. A "How to do a Crosswalk to CMECS Handbook" should be produced that incorporates some of the examples from this report and other previous crosswalking efforts for the edification of potential CMECS users and some examples should be included on the CMECS website.
3. The CMECS IG should carefully examine crosswalks to CMECS that result in the loss of ecologically important information, (e.g. **Figure 28** that shows the crosswalk of NAMERA bathymetry to CMECS Benthic Depth Zone modifier and essentially "loses" Georges Bank).
4. This study indicates the need for the addition of new CMECS Biotic Communities to the Biotic Component. It would be useful for the CMECS IG to try to organize efforts by regional experts to standardize and augment the lower levels of the Biotic Component.
5. *More guidance from the CMECS IG on the descriptions and use of Biotopes is needed.
6. How is a hierarchically structured classification scheme affected when crosswalked to CMECS, does the crosswalk lose the hierarchical structure of the source scheme (i.e. do lower level components lose the connection to the upper level units)?
7. The CMECS IG should develop an approach for effective and clear mapping of co-dominant species and co-occurring elements.

General Recommendations to the Mapping/Environmental Management Community:

1. We encourage more communication between environmental managers and crosswalkers/mappers about goals – what habitat information is essential to convey?
2. We encourage discussion within the community about what map products and formats are most useful for particular goals. For example, are maps of single CMECS components more useful or are blended maps (more than one component shown) more useful and in what context?
3. We encourage careful consideration of the quality, resolution, and general limitations of existing datasets prior to attempting to crosswalk to CMECS. Our local example indicates that limitations in existing datasets can confound/complicate the crosswalking exercise and limit the resolution of the map products.

**We are aware of intentions and/or efforts already underway by the CMECS Implementation Group to address these recommendations.*

7. Discussion

The recent mandate of CMECS as the standard classification scheme for federally funded coastal and marine habitat mapping projects (e.g. BOEM and Hurricane Sandy Impacts) motivated this test of the classification system at three different scales (local, subregional and regional) in the Northwest Atlantic United States. The project successfully crosswalked a total of 40 classification schemes and single unit data sources demonstrating that the classification system could be applied at all scales tested. However, we found significant complexity in fitting a single standard to datasets of varying scales and purposes. Our multiscale approach provided insight to guidance and recommendations on crosswalking and mapping methods. We hope the results aid in the further development and refinement of CMECS, and that the practical demonstration of the methods will assist with providing context to regional marine resource inventories and monitoring.

Some general observations and products that emerged from this study are:

- CMECS is a useful classification scheme for translating state or program based datasets into a common language independent of jurisdictional boundaries.
- CMECS provides a connection between many different datasets at the regional scale using different modeling and classification techniques.
- Biotopes are useful units that are potentially powerful for some management applications since they combine abiotic and biotic component units.
- A practical product here is a list of Northwest Atlantic CMECS Habitats, and crosswalks at the local, subregional and regional scales.

Crosswalking and Mapping Caveats:

- Crosswalks were easier for source schemes that had a similar framework to CMECS or single-unit data sources.
- It is difficult to automate the crosswalk process because relationships are not always one-to-one and the crosswalker needs to manually decide on appropriate crosswalks. Also some of the crosswalk decisions changed after mapping.
- Crosswalking may be subjective and can introduce uncertainties as one person might interpret source unit differently than another person.
- The best CMECS classification may come from reclassifying raw data instead of reinterpreting source classifications.
- It is important to clean up original source scheme data as inconsistent units may be found as a result of formatting, spelling, etc.
- The crosswalker must understand CMECS units and source units before crosswalking and understand crosswalking is an iterative process.
- The crosswalker must understand that all units will not crosswalk one-to-one with CMECS units and all units might not fit into the CMECS framework and that is acceptable.
- It is helpful to have a mapping purpose prior to crosswalking in order to determine how important it may be in preserving source scheme information when the CMECS crosswalk causes loss of information.
- In some cases two to three maps were needed to represent the same data when crosswalked to CMECS all illustrating different source scheme information.

Local Scale:

The major difference between the local scale crosswalk and the subregional and regional crosswalks was the use and integration of many source datasets. There were multiple substrate, wetlands, shoreline feature models, and even separate point datasets for wrecks. The inclusion of data layers representing only a single source unit allowed us to enhance the accuracy of the final maps, as opposed to exclusively targeting entire classification schemes available in the area. Although there were many source schemes and data, none of them were available at a 1:5,000 scale and even similar layers were inconsistent with each other. Also, geologic marine features (channels, glacial features) have not yet been mapped subtidally in Boston Harbor. To achieve a scale of 1:5,000, it is likely that new mapping projects would be required. Three of the source schemes relied on expert interpretation of aerials or expert knowledge of the local area and as such "raw data" does not exist. It was clear upon inspection of aerial imagery that shoreline types were often misclassified. Furthermore, available schemes did not differentiate between features that are very high in the CMECS hierarchy. For example, the Substrate classification identifies Substrate Origin above the Class level. However, a source unit such as "hardened shoreline" doesn't differentiate between geologic or anthropogenic origin. Similarly, the biotic component requires a separation of reef and bed at the Class level, so a source unit of "blue mussel," without any inference or additional information, crosswalks to the biotic setting of Benthic/Attached Biota, the highest (most general) level in the Biotic Component.

Because of the preponderance of "greater than" relationships in the crosswalk, it is most accurate to generate or reinterpret raw data to create a map with CMECS units. However, in situations where a crosswalk is necessary due to limited resources or a lack of availability of raw data, or where approximate units are sufficient to meet assessment or mapping needs, the crosswalk procedure is recommended. In such cases, familiarity with the source units/data is essential. Better utilization of the USGS Topographic maps and the NOAA Nautical charts would improve the value of the local scale maps. In general, CMECS was an integrating standard that required to us to think about and include a broad range of source information, creating a holistic habitat map of Boston Harbor.

Subregional Scale:
For each New England state, there are clear "dominant" habitat classification schemes—either because they are the only scheme developed for that state, because they are currently in use, or both. Although we only mapped the Rhode Island Ocean SAMP scheme and data, we suspect that all subregional crosswalks and the data they support are mappable at the subregional scale of 1:250,000. This scale seems to be ideal for state ocean planning. Generally at this scale, we found abundant data to describe fine- to meso-scale habitat patterns over fairly large swaths of seafloor.

Although we found nuances of each crosswalk that could make crosswalking logistically difficult, we can conclude that crosswalking is possible for each scheme we examined in New England and recommend that crosswalking is undertaken for the major schemes in use today. Researchers will always create seafloor maps using multiple data sources and CMECS has shown that it can accommodate methodological integration at multiple scales.

This project is important because marine ecological classification is inherently linked to mapping. Ocean management and spatial planning also inherently require mapping. However, because CMECS is still officially new, there is no mapping guidance. This project provides a generalized theme of what to expect when we connect ecological classification to ocean management and planning goals at the subregional scale. Although we successfully created all-inclusive maps of the Rhode Island Ocean SAMP-to-CMECS crosswalk, maps of this type are not particularly useful for any purpose other than demonstrating that a crosswalk is possible. In general, the subregional CMECS maps do not show much more or much less habitat detail. We suspect that our maps could look different depending on the particular research or management question that we sought to answer. This result underscores the idea that communication between mappers and users (e.g., managers, planners) is essential to guiding the crosswalk and the creation of any maps.

Regional Scale:
Crosswalking the NAMERA EMUs and Benthic Habitat Model to CMECS was a relatively straightforward task because there was agreement beforehand of the general categories of the components (e.g. bathymetry/Benthic Depth Zone Modifier, estimated grain size/Substrate Component and seabed form/Geoform Component). The main issues were with the exact thresholds that subdivide the components such as bathymetric depth zone or grain size classes. For example, CMECS follows the relatively universal Wentworth scale for describing sediment grain size classes, but the

NAMERA EMUs defined grain size classes by where the benthic communities changed, and this did not correspond exactly with the Wentworth scale. While it was not difficult to collapse and split the NAMERA categories into the Wentworth scale there was a loss of information in that the new classification, while accurately grouping and displaying the grain sizes for the region, no longer provides the information on where the benthic communities change. This result reflects the fact that classification schemes are human constructions – Wentworth grain size classes are necessary for scientists to have a common framework for describing sediments, but that does not necessarily mean that benthic organisms are choosing habitats based on corresponding differences. The NAMERA is somewhat unique in that it calculated and used ecologically-relevant thresholds; however, these thresholds are unlikely to be relevant in other geographic study areas or applicable for long timescales.

When comparing all of the NAMERA Benthic Habitat Model components and related (crosswalked) CMECS components, about half of the original source scheme units crosswalked equally to a CMECS unit, while a third were of “greater than” relationship to a unit (**Figure 37**). This relationship highlights the threshold problem discussed above suggesting that there is a tradeoff between purposes. The CMECS results with predefined thresholds makes the map directly comparable to CMECS maps produced in other regions and could provide important and readily grasped information on how each region is structured. These generalized maps, however, might result in loss of important biotic distinctions and fine details that are relevant to identifying ecologically important areas such as Georges Bank (**Figure 28**).

Crosswalking the Geoforms highlighted issues in linking a purely descriptive characterization of the seafloor (the NAMERA seabed forms) with a more interpretive list of marine features (CMECS). For example, the seabed form: “high, shallow flat” could crosswalk to bank, ledge or shoal, depending on its size and context. Similarly, “deep linear depression” corresponded to “shelf valley” in some areas but not others. In order to crosswalk these we had to either choose the dominant expression, or crosswalk it one-to-many. The CMECS conventions of characterizing the crosswalk relationship was useful for the crosswalker, but it is not clear what the users of the crosswalk output can make of it if they are not familiar with the original source. We generally selected the dominant Geoform that best represented the entire region for each seabed form and depth, and this decision became much clearer after mapping the crosswalks. Although the dominant Geoform seemed to be the best overall choice, it sometimes led to erroneous results. This was the case when we crosswalked “low slope” to the Physiographic Setting-submarine canyon as this is the dominant Geoform across the region and mostly found along the continental shelf and slope. However, “low slope” also contains submarine slide deposit Geoforms at the base of canyons, which the “low slope” mapped as one unit with the canyons. Thus, the regional study reinforced the previously stated point that marine ecological classification is inherently linked to mapping, and it was difficult to choose a dominant Geoform from the EMUs without mapping them for the study area. We provided a list of secondary Geoform (Co-occurring elements) for many seabed forms when we thought it was necessary to include other Geoforms that may be found in one NAMERA seabed form.

All in all, the process resulted in “reasonable” CMECS crosswalks and maps that may be valuable for regional marine inventories and monitoring, as well as highlighting important regional ecological patterns. The Biotope crosswalks, in particular, were successful in carrying over source scheme information by preserving the connection between abiotic and biotic features inherent in the NAMERA Benthic Habitat Model. Biotopes also preserved the internal structure of the information portrayed within each habitat, so this new component of CMECS proved to be valuable in this exercise.

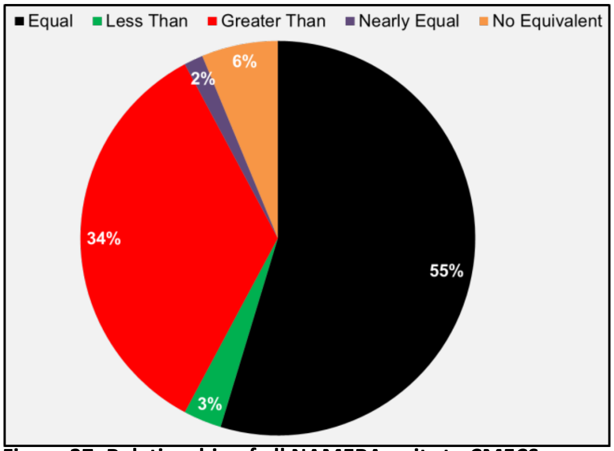


Figure 37: Relationship of all NAMERA units to CMECS

8. Citations

Text:

Ackerman, S.D., B. Butman, W.A. Barnhardt, W.W. Danforth and J.M. Crocker. 2006. High-Resolution Geologic Mapping of the Inner Continental Shelf: Boston Harbor and Approaches, Massachusetts. USGS Open-File Report 2006-1008. http://woodshole.er.usgs.gov/pubs/of2006-1008/

Anderson, M., J. Greene, D. Morse, C. Shumway, and M. Clark. 2010. Chapter 3: Benthic Habitats from Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg, eds. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA. http://nature.ly/namera

Auster, P. J. 2006. Linking Seafloor Habitat Mapping Protocols to Management and Policy Needs. Funding application to US Environmental Protection Agency.

Auster, P. J., Heinonen, K. B., Witharana, C., and Mckee, M. 2009. A Habitat Classification Scheme for The Long Island Sound Region. National Undersea Research Center and Department of Marine Sciences, University of Connecticut. EPA Long Island Sound Office, LI-97150101. 83 pp.

Banner, A. and S. Schaller. 2001. USFWS Gulf of Maine Watershed Habitat Analysis. http://www.fws.gov/r5gomp/gom/habitatstudy/Gulf_of_Maine_Watershed_Habitat_Analysis.htm

Brown, B. 1993. A classification system of marine and estuarine habitats in Maine: An ecosystem approach to habitats Part 1: Benthic habitats. Maine Natural Areas Program, Department of Economic and Community Development. 64pp +Appendix.

"CMECS Frequently Asked Questions." 8 January. 2014. PDF file. http://www.csc.noaa.gov/digitalcoast/_/pdf/CMECS-FAQ.pdf

FGDC (Federal Geographic Data Committee). 2012. FGDC-STD-018-2012. *Coastal and Marine Ecological Classification Standard*. Reston, VA. Federal Geographic Data Committee. http://csc.noaa.gov/digitalcoast/sites/default/files/files/publications/14052013/CMECS_Version%20_4_Final_for_FGDC.pdf

French, D.P., H. Rhines, J. Boothroyd, C. Galagan, M. Harlin, A. Keller, G. Klein-MacPhee, S. Pratt, M. Gould, M. Villalard- Bohnsack, L. Gould, and S. Porter. 1992. Habitat inventory/resource mapping for Narragansett Bay and associated coastline. Applied Science Associates Report 89-33, October 1992. Final Report, Narragansett Bay Project, Providence, R.I.

Greene, H. G., J. J. Bizzarro, J. E. Tilden, H. L. Lopez, and M. D. Erdey. 2005. The benefits and pitfalls of geographic information systems in marine benthic habitat mapping. Pages 34-46, in Wright, D. J. and Scholz, A. J., eds. Place Matters. Oregon State University Press, Portland, OR.

Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg, eds. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA. http://nature.ly/namera

Jones, S.H. 2000. A technical characterization of estuarine and coastal New Hampshire. The New Hampshire Estuaries Project, Durham, NH. 279 pp.

Kelley, J.T., Barnhardt, W.A., Belknap, D.F., Dickson, S.M., Kelley, A.R. 2005. The seafloor revealed: The geology of the northwestern Gulf of Maine inner continental shelf. Maine Geological Survey open file 96-6, online edition. http://www.maine.gov/doc/nrimc/mgs/explore/marine/seafloor/contents.htm.

Knebel, H.J., and R.C. Circe. 1995. Seafloor environments within the Boston Harbor-Massachusetts Bay sedimentary system: A regional synthesis. Journal of Coastal Research. 11: 230-251.

Kostylev, V. E, B. J. Todd, G. B. Fader, R. C. Courtney, G. D. M. Cameron, and R.A. Pickrill. 2001. Benthic habitat mapping on the Scotian Shelf based on multibeam bathymetry, surficial geology and sea floor photographs. Marine Ecology Progress Series. 219: 121-137.

Kutcher, T. E. 2006. A comparison of functionality between two coastal classification schemes developed within the National Oceanic and Atmospheric Administration. Report to NOAA/NOS/OCRM. Silver Spring, MD. 5 pp.

Kutcher, T.E., N.H. Garfield, S.P. Walker, K.B. Raposa, C. Nieder, E. Van Dyke, T. Reed, April 2008. Habitat and Land Cover Classification Scheme for the National Estuarine Research Reserve System, online edition. http://www.nerrs.noaa.gov/Doc/PDF/Stewardship/NERRClassificationSchemeDoc.pdf http://www.nerrs.noaa.gov/Doc/PDF/Stewardship/NERRSClassificationScheme.pdf

Lafrance, M., Shumchenia, E. J., King, J. W., Pockalny, R. A., Oakley, B. A., Pratt, S. D., and Boothroyd, J. C. 2010. Benthic Habitat Distribution and Subsurface Geology in Selected Sites from the Rhode Island Ocean Special Area Management Study Area. Rhode Island Ocean Special Area Management Plan, Rhode Island Coastal Resources Management Council, Wakefield, RI. pp. 294–391.

Lund, K. and A. R. Wilbur. 2007. Habitat Feasibility study of coastal and marine environments in Massachusetts. Massachusetts Office of Coastal Zone Management. Boston, MA. 31 pp.

Massachusetts Department of Environmental Protection. 2009. Wetlands Conservancy Program, Wetlands Datalayer. http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/depwetlands112000.html

McMaster, R. L. 1960. Sediments of Narragansett Bay system and Rhode Island Sound, Rhode Island. Journal of Sedimentary Petrology, 30(2), 249–274.

Natural Heritage and Endangered Species Program. 2011. BioMap2 Technical Report – Building a Better BioMap: A supplement to BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife, Westborough, MA. http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/land-protection-and-management/biomap2/biomap2-technical-report.html

NERRS (National Estuarine Research Reserve System). 2000. Evaluations of marine and estuarine ecosystem and habitat classification. NOAA Technical Memorandum. NMFS-F/SPO-43.

Todd, B. J. and H. G. Greene. 2008. Mapping the Seafloor for Habitat Characterization. Geological Association of Canada. 327 pp.

Valentine, P.C., B.J. Todd and V.E. Kostylev. 2005. Classification of marine sublittoral habitats, with application to the northeastern North America region. American Fisheries Society Symposium 41:183-200. Available at: http://woodshole.er.usgs.gov/project-pages/stellwagen/index.html. 31

Valente, R. M., D. A. Carey, M. E. Esten, C. R. Woods, G. A. Berman. 2007. Application of Four Candidate Habitat Classification Schemes for Coastal and Marine Environments in Massachusetts. Submitted by CoastalVision to the Massachusetts Office of Coastal Zone Management, Boston, MA, 173 pp.+appendices.

World Wildlife Fund and Conservation Law Foundation. 2006. Marine Ecosystem Conservation for New England and Maritime Canada: a Science-Based Approach to Identifying Priority Areas for Conservation. Conservation Law Foundation, Boston, MA and WWF-Canada, Halifax, Nova Scotia.

Data:

Local Scale: Classifications and data sources available in Massachusetts; those crosswalked are indicated by a star (*) and those used in mapping are indicated by a cross (†). *Links valid as of December 2013*

Local Scale Classifications	Extent	Source
USGS Topographic Maps*	National	USGS http://mapserver.mytopo.com/mapserver/topographic_symbols/USGS_top.html
NOAA Charts*	National	NOAA http://www.nauticalcharts.noaa.gov/mcd/chartno1.htm
The Nature Conservancy Northwest Atlantic Marine Ecoregional Assessment (Coastal Habitats)*	Virginia-Maine	Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg, eds. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/marine/namera/Pages/default.aspx
Natural Heritage and Endangered Species Program, Division of Fish and Wildlife	Massachusetts	Swain, P.C. and J.B. Kearsley. 2011. Classification of the Natural Communities of Massachusetts. Version 1.4. Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA. URL: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/natural-communities/classification-of-natural-communities.html#
BioMap2	Massachusetts	Natural Heritage and Endangered Species Program. 2011. BioMap2 Technical Report – Building a Better BioMap: A supplement to BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife, Westborough, MA. http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/land-protection-and-management/biomap2/biomap2-technical-report.html
Massachusetts DEP, Wetlands Conservancy Program*†	Massachusetts	Department of Environmental Protection Wetlands Conservancy Program, wetlands datalayer, 2009. http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/depwetlands112000.html
National Wetlands Inventory	National	Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/wetlands/classwet/index.htm (Version 04DEC1998).
National Estuarine Research Reserves Classification	National	Kutcher, T. E. 2008. Habitat and Land Cover Classification Scheme for the National Estuarine Research Reserve System. http://www.nerrs.noaa.gov/Doc/PDF/Stewardship/NERRClassificationSchemeDoc.pdf
NOAA Environmental Sensitivity Index*	Massachusetts	NOAA http://response.restoration.noaa.gov/maps-and-spatial-data/environmental-sensitivity-index-esi-maps.html AND http://response.restoration.noaa.gov/maps-and-spatial-data/download-esi-maps-and-gis-data.html#Massachusetts
NRCS SSURGO-Certified Soils	National	MassGIShttp://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/soi.html
Surficial Geology (Knebel, Ackerman, Massachusetts, USFWS†, TNC)*	Massachusetts, Gulf of Maine	1. Knebel, H.J., and R.C. Circe. 1995. Seafloor environments within the Boston Harbor-Massachusetts Bay sedimentary system: A regional synthesis. Journal of Coastal Research. 11: 230-251. 2. Ackerman, S.D., B. Butman, W.A. Barnhardt, W.W. Danforth and J.M. Crocker. 2006. High-Resolution Geologic Mapping of the Inner Continental Shelf: Boston Harbor and Approaches, Massachusetts. USGS Open-File Report 2006-1008. http://woodshole.er.usgs.gov/pubs/of2006-1008/ 3. Ford, K.H. and S. Voss. 2010. Seafloor sediment composition in Massachusetts determined using point data. http://www.mass.gov/eea/docs/dfg/dmf/publications/tr-45.pdf 4. Banner, A. and S. Schaller. 2001. USFWS Gulf of Maine Watershed Habitat Analysis. http://www.fws.gov/r5gomp/gom/habitatstudy/Gulf_of_Maine_Watershed_Habitat_Analysis.htm 5. Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg, eds. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/marine/namera/Pages/default.as

		px
CZM Application of Marine Classifications in Massachusetts*	Massachusetts	Valente, R. M., D. A. Carey, M. E. Esten, C. R. Woods, G. A. Berman. 2007. Application of Four Candidate Habitat Classification Schemes for Coastal and Marine Environments in Massachusetts. Submitted by CoastalVision to the Massachusetts Office of Coastal Zone Management, Boston, MA, 173 pp.+appendices.
DMF Habitat*	Massachusetts	Ford, K.H. pers comm.
Data sources		
DMF Artificial reef locations*†	Massachusetts	Mass. Ocean Resources Information System (MORIS)http://maps.massgis.state.ma.us/map_ol/moris.php
DEP Eelgrass locations*†	Massachusetts	MassGIShttp://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/massdep-eelgrass-project.html
ACE Dredge boundaries*†	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
CZM Marina boundaries*†	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
CZM Mooring field boundaries*†	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
NOAA Wreck database*†	National	NOAA, MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
Outfalls*†	Massachusetts	Environmental Protection Agency http://oaspub.epa.gov/enviro/pcsicisquery.list?pSearch=Map%20Recentered&minx=-71.272430&miny=42.187829&maxx=-70.791779&maxy=42.431566&ve=10,42.310069,-71.032104
CZM Pipelines*†	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php
DMF Shellfish suitability layers (9 species)* †	Massachusetts	MassGIShttp://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/shlfshsuit.html
DOT Dams*†	Massachusetts	MassGIShttp://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/dams.html
CZM private seawall and coastal structures inventory*	Massachusetts	MORIShttp://maps.massgis.state.ma.us/map_ol/moris.php

Subregional Scale:

Auster, P. J., Heinonen, K. B., Witharana, C., and Mckee, M. 2009. A Habitat Classification Scheme for The Long Island Sound Region. National Undersea Research Center and Department of Marine Sciences, University of Connecticut. EPA Long Island Sound Office, LI-97150101. 83 pp.

Brown, B. 1993. A classification system of marine and estuarine habitats in Maine: An ecosystem approach to habitats Part 1: Benthic habitats. Maine Natural Areas Program, Department of Economic and Community Development. 64pp +Appendix.

French, D.P., H. Rhines, J. Boothroyd, C. Galagan, M. Harlin, A. Keller, G. Klein-MacPhee, S. Pratt, M. Gould, M. Villalard- Bohnsack, L. Gould, and S. Porter. 1992. Habitat inventory/resource mapping for Narragansett Bay and associated coastline. Applied Science Associates Report 89-33, October 1992. Final Report, Narragansett Bay Project, Providence, R.I.

Jones, S.H. 2000. A technical characterization of estuarine and coastal New Hampshire. The New Hampshire Estuaries Project, Durham, NH. 279 pp.

Kelley, J.T., Barnhardt, W.A., Belknap, D.F., Dickson, S.M., Kelley, A.R. 2005. The seafloor revealed: The geology of the northwestern Gulf of Maine inner continental shelf. Maine Geological Survey open file 96-6, online edition. http://www.maine.gov/doc/nrimc/mgs/explore/marine/seafloor/contents.htm.

LaFrance, M., Shumchenia, E. J., King, J. W., Pockalny, R. A., Oakley, B. A., Pratt, S. D., and Boothroyd, J. C. 2010. Benthic Habitat Distribution and Subsurface Geology in Selected Sites from the Rhode Island Ocean Special Area Management Study Area. Rhode Island Ocean Special Area Management Plan, Rhode Island Coastal Resources Management Council, Wakefield, RI. pp. 294–391.

MapCoast. Subaqueous Soils. www.mapcoast.org

McMaster, R. L. 1960. Sediments of Narragansett Bay system and Rhode Island Sound, Rhode Island. *Journal of Sedimentary Petrology*, *30*(2), 249–274.

Regional Scale:

Anderson, M., J. Greene, D. Morse, C. Shumway, and M. Clark. 2010. Chapter 3: Benthic Habitats from Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg, eds. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA. http://nature.ly/namera

Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg, eds. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA. http://nature.ly/namera

Kutcher, T.E., N.H. Garfield, S.P. Walker, K.B. Raposa, C. Nieder, E. Van Dyke, T. Reed, April 2008. Habitat and Land Cover Classification Scheme for the National Estuarine Research Reserve System, online edition.
http://www.nerrs.noaa.gov/Doc/PDF/Stewardship/NERRClassificationSchemeDoc.pdf
http://www.nerrs.noaa.gov/Doc/PDF/Stewardship/NERRSClassificationScheme.pdf

9. Appendices

9.1: Local Scale Crosswalks

****The excel table below can be downloaded at http://nature.ly/EDcmecs**

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS Topo	Bathymetric features	Area exposed at mean low tide; sounding datum line				X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	
USGS Topo	Bathymetric features	Channel				Geologic	Channel		X					X						Nearly Equal	Certain	
USGS Topo	Bathymetric features	Sunken rock				X			Geologic	Rock				X						Greater Than	Certain	There's no way to captures the "sunken" modifier in CMECS. So in one respect, the source unit is more specific than CMECS. But since the unit crosswalks to multiple CMECS substrate units, I gave it a greater than relationship.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS Topo	Bathymetric features	Sunken rock				X			Geologic	UMS	Coarse UMS	Gravel	Boulder	X						Greater Than	Certain	There's no way to captures the "sunken" modifier in CMECS. So in one respect, the source unit is more specific than CMECS. But since the unit crosswalks to multiple CMECS substrate units, I gave it a greater than relationship.
USGS Topo	Coastal features	Breakwater, pier, jetty, or wharf				Anthropogenic	Breakwater/Jetty		Anthropogenic					X					Developed	Greater Than	Certain	
USGS Topo	Coastal features	Breakwater, pier, jetty, or wharf				Anthropogenic	Dock/Pier							X					Developed	Greater Than	Certain	
USGS Topo	Coastal features	Breakwater, pier, jetty, or wharf				Anthropogenic	Wharf							X					Developed	Greater Than	Certain	
USGS Topo	Coastal features	Coral or rock reef				Biogenic	Deep/Cold-Water Coral Reef		Anthropogenic	Anthropogenic Rock				Benthic/Attached Biota	Reef Biota					Greater Than	Certain	The source unit is really targeting the geoform here, so the Biotic Component wasn't used for the relationship assessment.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS Topo	Coastal features	Coral or rock reef				Biogenic	Shallow/Mesophotic Coral Reef		Biogenic	Coral				X						Greater Than	Certain	
USGS Topo	Coastal features	Coral or rock reef				Geologic	Ridge		Geologic	Rock				X						Greater Than	Certain	
USGS Topo	Coastal features	Coral or rock reef				Geologic	Shoal		Geologic	UMS	Coarse UMS			X						Greater Than	Somewhat Certain	There's no good geoform for "Rock reef." A Shoal is intertidal, a Bank is "generally" subtidal but the definition suggests it should be used for larger features.
USGS Topo	Coastal features	Depth curve; sounding				X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	
USGS Topo	Coastal features	Exposed wreck				Anthropogenic	Wreck		Anthropogenic					X						Less Than	Certain	The source unit describes that the wreck is partially out of the water. No similar modifier or unit in CMECS

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS Topo	Coastal features	Foreshore flat				Geologic	Flat		Geologic	UMS				X						Nearly Equal	Certain	In this case, you would use multiple Geoforms to gain specificity (which the Geoform component says you can do. It would be Geoform Shore, Type Foreshore AND Geoform Flat.
USGS Topo	Coastal features	Foreshore flat				Geologic	Shore	Foreshore	Geologic	UMS				X						Nearly Equal	Certain	In this case, you would use multiple Geoforms to gain specificity (which the Geoform component says you can do. It would be Geoform Shore, Type Foreshore AND Geoform Flat.
USGS Topo	Coastal features	Group of rocks, bare or awash				X			Geologic	Rock				X						Greater Than	Certain	
USGS Topo	Coastal features	Group of rocks, bare or awash				X			Geologic	UMS	Coarse UMS	Gravel	Boulder	X						Greater Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS Topo	Coastal features	Oil or gas well; platform				Anthropogenic	Drilling (Oil or Gas) Rig		Anthropogenic					X					Developed	Nearly Equal	Certain	Wells and platforms are distinctions, but I'm confident that the source and CMECS units have very similar meanings
USGS Topo	Coastal features	Rock, bare or awash; dangerous to navigation				X			Geologic	Rock				X						Greater Than	Somewhat Certain	The "dangerous to navigation" modifier adds information to the source unit that CMECS can't match.
USGS Topo	Coastal features	Rock, bare or awash; dangerous to navigation				X			Geologic	UMS	Coarse UMS	Gravel	Boulder	X						Greater Than	Somewhat Certain	The "dangerous to navigation" modifier adds information to the source unit that CMECS can't match.
USGS Topo	Coastal features	Seawall				Anthropogenic	Seawall		Anthropogenic					X					Developed	Equal	Certain	
USGS Topo	Marine shorelines	Apparent (edge of vegetation)				X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	
USGS Topo	Marine shorelines	Indefinite or unsurveyed				X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS Topo	Marine shorelines	Shoreline			Intertidal	Geologic	Shore		X					X						Less Than	Certain	The source unit refers to the specific shoreline (similar to coastline and land-sea interface). There is no equivalent unit in CMECS, but the Shore unit would contain the coastline.
USGS Topo	Submerged Areas and Bogs	Land subject to inundation				Geologic			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	
USGS Topo	Submerged Areas and Bogs	Marsh or swamp				Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland					Nearly Equal	Somewhat Certain	
USGS Topo	Submerged Areas and Bogs	Submerged marsh or swamp				Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland					Less Than	Somewhat Certain	There's no way to capture the "submerged" modifier in the source unit. Because this isn't in the "Coastal Features" section, one can't assume it's in tidal waters.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS Topo	Submerged Areas and Bogs	Submerged wooded marsh or swamp				Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Forested Wetland					Less Than	Somewhat Certain	There's no way to capture the "submerged" modifier in the source unit. Because this isn't in the "Coastal Features" section, one can't assume it's in tidal waters.
USGS Topo	Submerged Areas and Bogs	Wooded marsh or swamp				Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Forested Wetland					Nearly Equal	Somewhat Certain	
USGS Topo	Surface Features	Disturbed surface				Anthropogenic			X					X					Disturbed	Nearly Equal	Not Certain	The source unit definition is unclear; to most closely match the concept CMECS only has a modifier.
USGS Topo	Surface Features	Gravel beach or glacial moraine				Geologic	Beach		Geologic	UMS	Coarse UMS			X						Greater Than	Somewhat Certain	
USGS Topo	Surface Features	Gravel beach or glacial moraine				Geologic	Moraine		Geologic	UMS	Coarse UMS			X						Greater Than	Somewhat Certain	
USGS Topo	Surface Features	Levee				Anthropogenic	Artificial Dike	Artificial Levee	Anthropogenic					X						Greater Than	Certain	
USGS Topo	Surface Features	Levee							Geologic					X						Greater Than	Certain	CMECS doesn't have a unit for a natural levee.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS Topo	Surface Features	Sand or mud				X			Geologic	UMS	Fine UMS			X						Greater Than	Certain	
USGS Topo	Surface Features	Tailings pond				Anthropogenic			X					X						No Equivalent	Somewhat Certain	I'm assuming a pond is a feature within a larger physiographic feature.
NOAA Nautical	Natural Features	Coastline	Cliffs			Geologic	Overhang (Cliff)		X					X						Equal	Certain	
NOAA Nautical	Natural Features	Coastline	Coastline, surveyed and unsurveyed			Geologic	Shore		X					X						Less Than	Somewhat Certain	The source unit refers to the specific coastline. There is no equivalent unit in CMECS, but the Shore unit would contain the coastline. Source unit doesn't have to be in tidal waters, so no tidal zone could be identified.
NOAA Nautical	Natural Features	Coastline	Flat coast			Geologic	Shore		X					X					Flat	Nearly Equal	Certain	Coast and shore considered synonomous. Source unit doesn't have to be in tidal waters, so no tidal zone could be identified.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Natural Features	Coastline	Sandy shore			Geologic	Shore		Geologic	UMS	Coarse UMS	Gravelly		X						Greater Than	Certain	Requires both geoform and substrate; "sandy" in source unit is not clearly defined, and would contain several CMECS Substrate groups
NOAA Nautical	Natural Features	Coastline	Sandy shore			Geologic	Shore		Geologic	UMS	Fine UMS	Sand		X						Greater Than	Certain	Requires both geoform and substrate; "sandy" in source unit is not clearly defined, and would contain several CMECS Substrate groups
NOAA Nautical	Natural Features	Coastline	Stony shore			Geologic	Shore		Geologic	UMS	Coarse UMS	Gravel		X						Greater Than	Certain	Requires both geoform and substrate; "stony" in source unit is not clearly defined, and would contain several CMECS Substrate groups

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Natural Features	Coastline	Stony shore			Geologic	Shore		Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	Requires both geoform and substrate; "stony" in source unit is not clearly defined, and would contain several CMECS Substrate groups
NOAA Nautical	Natural Features	Supplementary National Symbols	Eelgrass			X			X					Benthic/Attached Biota	Aquatic Vegetation Bed	Aquatic Vascular Vegetation	Seagrass Bed	*Zostera marina* Herbaceous Vegetation		Equal	Certain	
NOAA Nautical	Natural Features	Supplementary National Symbols	Foreshore			Geologic	Shore	Foreshore	X					X						Equal	Somewhat Certain	
NOAA Nautical	Natural Features	Supplementary National Symbols	Lagoon		(Phys Setting) Lagoonal Estuary				X					X						Equal	Somewhat Certain	Since the CMECS unit is at the Physiographic Setting level, I am only Somewhat Certain in the equality of the relationship. Does this cover small lagoons?
NOAA Nautical	Natural Features	Vegetation	Marsh, Swamp, Reed beds			Geologic	Marsh Platform		Biogenic	Organic				X						Overlapping	Not Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Natural Features	Water Features	River, Stream						X					X						No Equivalent	Certain	The NOAA unit "River, Stream" does not identify if it is Esturaine waters.
NOAA Nautical	Natural Features	Water Features	Salt pans			Anthropogenic	Salt pond		X					X						Greater Than	Somewhat Certain	
NOAA Nautical	Natural Features	Water Features	Salt pans			Geologic	Panne		X					X						Greater Than	Somewhat Certain	
NOAA Nautical	Nature of the Seabed	Rocks	Boulders			X			Geologic	UMS	Coarse UMS	Boulder		X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Clay			X			Geologic	UMS	Fine UMS	Mud	Clay	X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Cobbles			X			Geologic	UMS	Coarse UMS	Cobbles		X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Coral, Coralline algae			X			Biogenic	Algal				X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Nature of the Seabed	Rocks	Coral, Coralline algae			X			Biogenic	Coral				X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Gravel			X			Geologic	UMS	Coarse UMS	Gravel		X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Mud			X			Geologic	UMS	Fine UMS	Mud		X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Pebbles			X			Geologic	UMS	Coarse UMS	Pebbles		X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Rock; Rocky			X			Geologic	Rock				X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Rock; Rocky			X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Nature of the Seabed	Rocks	Sand			X			Geologic	UMS	Fine UMS	Sand		X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Shells (skeletal remains)			X			Biogenic	Shell				X						Nearly Equal	Somewhat Certain	
NOAA Nautical	Nature of the Seabed	Rocks	Silt			X			Geologic	UMS	Fine UMS	Mud	Silt	X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Stones			X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
NOAA Nautical	Nature of the Seabed	Rocks	Weed (including kelp)			X			X					Benthic /Attached Biota	Aquatic Vegetation Bed					Equal	Somewhat Certain	The source unit essentially means "aquatic vegetation" so at the class level of CMECS, the two units are interchangeable)
NOAA Nautical	Nature of the Seabed	Types of Seabed, Intertidal Areas	Areas with stones and gravel		intertidal	X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Nature of the Seabed	Types of Seabed, Intertidal Areas	Coral reef, which covers and uncovers		intertidal	Biogenic	Shallow/Mesophotic Coral Reef		Biogenic	Coral	Coral Reef			Benthic/Attached Biota	Reef Biota	Shallow/Mesophotic Coral Reef Biota				Equal	Somewhat Certain	
NOAA Nautical	Nature of the Seabed	Types of Seabed, Intertidal Areas	Rocky area, which covers and uncovers		intertidal	X			Geologic	Rock				X						Greater Than	Certain	
NOAA Nautical	Nature of the Seabed	Types of Seabed, Intertidal Areas	Rocky area, which covers and uncovers		intertidal	X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	
NOAA Nautical	Offshore Installations	Submarine Cables	Submarince cable area			Anthropogenic	Cable Area		Anthropogenic					X						Nearly Equal	Somewhat Certain	Can't assume subtidal--submarine cable area could be in the intertidal
NOAA Nautical	Offshore Installations	Submarine Cables	Submarine cable			Anthropogenic	Cable		Anthropogenic					X						Nearly Equal	Somewhat Certain	Can't assume subtidal--submarine cable area could be in the intertidal
NOAA Nautical	Offshore Installations	Submarine Pipelines	Buried pipeline pipe			Anthropogenic	Pipelines		Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Offshore Installations	Submarine Pipelines	Disused pipeline/pipe			Anthropogenic	Pipelines		Anthropogenic					X						Less Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Offshore Installations	Submarine Pipelines	Outfall and intake			Anthropogenic	Outfall/Intake		Anthropogenic					X						Less Than	Certain	Source unit is outfall and intake for a submarine pipeline, so is more specific. It also is outfall AND intake, which is more specific than Outfall/Intake.
NOAA Nautical	Offshore Installations	Submarine Pipelines	Pipeline tunnel			Anthropogenic	Pipelines		Anthropogenic					X						Less Than	Somewhat Certain	CMECS describes pipelines (so the two units contain at least one common entity), but there is no pipeline tunnel.
NOAA Nautical	Offshore Installations	Submarine Pipelines	Supply pipeline			Anthropogenic	Pipelines		Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Breakwater			Anthropogenic	Breakwater/Jetty		Anthropogenic					X					Developed	Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Caisson, gate			Anthropogenic			Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Canal			Anthropogenic	Canal		Anthropogenic					X						Equal	Certain	
NOAA Nautical	Ports	Protection Structures	Causeway			Anthropogenic			Anthropogenic					X						Less Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Ports	Protection Structures	Dam, weir			Anthropogenic	Dam		Anthropogenic					X					Developed	Greater Than	Somewhat Certain	
NOAA Nautical	Ports	Protection Structures	Dolphin			Anthropogenic			Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Dry dock, graving dock			Anthropogenic	Dock/Pier		Anthropogenic					X					Developed	Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Dyke, levee, berm			Anthropogenic	Artificial Dike	Artificial Levee	Anthropogenic					X						Greater Than	Certain	CMECS doesn't have a unit for a natural levee or for a berm.
NOAA Nautical	Ports	Protection Structures	Floating barrier, e.g. oil barrier, security barrier			Anthropogenic			Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Floating dock			Anthropogenic	Dock/Pier		Anthropogenic					X					Developed	Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Flood barrage			Anthropogenic			Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Gridiron, scrubbing grid			Anthropogenic			Anthropogenic					X						Less Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Ports	Protection Structures	Groin (always dry)			Anthropogenic	Breakwater/ Jetty	Groin	Anthropogenic					X					Developed	Less Than	Certain	Since we can't determine if the unit requires tidal waters, we can't assume that it's supratidal. Therefore, it can't be classified more specifically in CMECS.
NOAA Nautical	Ports	Protection Structures	Groin (always underwater)			Anthropogenic	Breakwater/ Jetty	Groin	Anthropogenic					X					Developed	Less Than	Certain	Since we can't determine if the unit requires tidal waters, we can't assume that it's subtidal. Therefore, it can't be classified more specifically in CMECS.
NOAA Nautical	Ports	Protection Structures	Groin (intertidal)		intertidal	Anthropogenic	Breakwater/ Jetty	Groin	Anthropogenic					X					Developed	Equal	Certain	
NOAA Nautical	Ports	Protection Structures	Hulk			Anthropogenic			Anthropogenic					X						Less Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Ports	Protection Structures	Landing for boats			Anthropogenic	Dock/Pier		Anthropogenic					X					Developed	Greater Than	Not Certain	The CMECS unit "Dock/Pier" is described as "A landing place for vessels." A wharf is where vessels load and unload. I'm uncertain how this compares to the source unit here, since the source classification has other units for docks and piers.
NOAA Nautical	Ports	Protection Structures	Landing for boats			Anthropogenic	Wharf		Anthropogenic					X					Developed	Greater Than	Not Certain	The CMECS unit "Dock/Pier" is described as "A landing place for vessels." A wharf is where vessels load and unload. I'm uncertain how this compares to the source unit here, since the source classification has other units for docks and piers.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Ports	Protection Structures	Lock			Anthropogenic	Lock		Anthropogenic					X					Developed	Equal	Certain	
NOAA Nautical	Ports	Protection Structures	Minor post or pile			Anthropogenic	Pilings		Anthropogenic					X						Less Than	Certain	"minor" modifier makes the source unit more specific than available CMECS units
NOAA Nautical	Ports	Protection Structures	Mole (with berthing facility)			Anthropogenic			Anthropogenic					X					Developed	Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Non-tidal basin, wet-dock			Anthropogenic			Anthropogenic					X					Developed	Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Oil retention barrier (high pressure pipe)			Anthropogenic	Pipelines		Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Pier, jetty			Anthropogenic	Breakwater/Jetty		Anthropogenic					X					Developed	Greater Than	Somewhat Certain	
NOAA Nautical	Ports	Protection Structures	Pier, jetty			Anthropogenic	Dock/Pier		Anthropogenic					X					Developed	Greater Than	Somewhat Certain	
NOAA Nautical	Ports	Protection Structures	Pontoon			Anthropogenic			Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Promenade pier			Anthropogenic	Dock/Pier		Anthropogenic					X					Developed	Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Quay, wharf			Anthropogenic	Wharf		Anthropogenic					X					Developed	Greater Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Ports	Protection Structures	Ruin			Anthropogenic			Anthropogenic					X						Less Than	Somewhat Certain	CMECS has a wreck unit which could apply here, but the source classification has a separate wreck unit, so I said no equivalent. Could also be pilings or a house falling in the water, so not a wreck.
NOAA Nautical	Ports	Protection Structures	Ruined pier, partly submerged at high water			Anthropogenic	Dock/Pier		Anthropogenic					X					Developed	Less Than	Somewhat Certain	CMECS dock/pier description specifies it is a landing place for vessels. A "ruined pier" suggests otherwise. So I went with no equivalent.
NOAA Nautical	Ports	Protection Structures	Seawall			Anthropogenic	Seawall		Anthropogenic					X					Developed	Equal	Certain	
NOAA Nautical	Ports	Protection Structures	Slipway, patent slip, ramp			Anthropogenic			Anthropogenic					X					Developed	Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Steps, landing stairs			Anthropogenic			Anthropogenic					X					Developed	Less Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Ports	Protection Structures	Tidal basin, tidal harbor			Anthropogenic	Harbor		X					X						Greater Than	Not Certain	The source unit contains two "feature types" so is less specific than. Assuming "harbor" in CMECS assumes a tidal harbor, but this migh be wrong.
NOAA Nautical	Ports	Protection Structures	Training wall (partly submerged at high water)			Anthropogenic			Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Ports	Protection Structures	Works at sea, area under reclamation			Anthropogenic			X					X						No Equivalent	Certain	
NOAA Nautical	Ports	Supplementary National Symbols	Jetty (partly below MHW)			Anthropogenic	Breakwater/ Jetty		Anthropogenic					X					Developed	Less Than	Certain	
NOAA Nautical	Ports	Supplementary National Symbols	Mooring canal			Anthropogenic	Canal		X					X						Less Than	Somewhat Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Ports	Supplementary National Symbols	Submerged jetty			Anthropogenic	Breakwater/ Jetty		Anthropogenic					X					Developed	Less Than	Certain	This would be subtidal if in tidal waters. But the source classification doesn't specify that the units are in tidal waters (in other words, the jetty could be submerged in a lake or river).
NOAA Nautical	Rocks, Wrecks, and Obstructions	Rocks	Breakers						Geologic	Rock				X						No Equivalent	Somewhat Certain	Since the term "breakers" really refers to a geoform, I elected to use "No Equivalent" for the Relationship.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Rocks	Rock (islet) which does not cover		supratidal	Geologic	Island		Geologic	Rock				X						Greater Than	Somewhat Certain	Because the source modifier is "never covers" I used supratidal for the tidal zone.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Rocks	Rock (islet) which does not cover		supratidal	Geologic	Island		Geologic	UMS	Coarse UMS	Boulder		X						Greater Than	Somewhat Certain	Because the source modifier is "never covers" I used supratidal for the tidal zone.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Rocks	Rock awash			X			Geologic	Rock				X						Greater Than	Somewhat Certain	Couldn’t assign to tidal zone “interidal” since it could be "supratidal" too. The "awash" modifier adds information to the source unit that CMECS can't match. But I used "greater than" since there are multiple CMECS units that equate to "rock."

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Rocks	Rock awash			X			Geologic	UMS	Coarse UMS	Boulder		X						Greater Than	Somewhat Certain	Couldn’t assign to tidal zone “interidal” since it could be "supratidal" too. The "awash" modifier adds information to the source unit that CMECS can't match. But I used "greater than" since there are multiple CMECS units that equate to "rock."

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Rocks	Rock which covers and uncovers			X			Geologic	Rock				X						Greater Than	Somewhat Certain	Couldn’t assign to tidal zone “interidal” since it could be "supratidal" too. The "cover" modifier adds information to the source unit that CMECS can't match. But I used "greater than" since there are multiple CMECS units that equate to "rock." Note that for source unit "wreck covers and uncovers" a different decision was made!

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Rocks	Rock which covers and uncovers			X			Geologic	UMS	Coarse UMS	Boulder		X						Greater Than	Somewhat Certain	Couldn’t assign to tidal zone “interidal” since it could be "supratidal" too. The "cover" modifier adds information to the source unit that CMECS can't match. But I used "greater than" since there are multiple CMECS units that equate to "rock." Note that for source unit "wreck covers and uncovers" a different decision was made!

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Rocks	Underwater rock			X			Geologic	Rock				X						Greater Than	Somewhat Certain	The "underwater" modifier adds information to the source unit that CMECS can't match. This would be subtidal if in tidal waters. But the source classification doesn't specify that the units are in tidal waters (in other words, the rock could be underwater in a lake or river). I used "greater than" since there are multiple CMECS units that equate to "rock." Note that for source unit "submerged wreck" a different decision was made!

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Rocks	Underwater rock			X			Geologic	UMS	Coarse UMS	Boulder		X						Greater Than	Somewhat Certain	The "underwater" modifier adds information to the source unit that CMECS can't match. This would be subtidal if in tidal waters. But the source classification doesn't specify that the units are in tidal waters (in other words, the rock could be underwater in a lake or river). I used "greater than" since there are multiple CMECS units that equate to "rock." Note that for source unit "submerged wreck" a different decision was made!
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Crib, duck blind			Anthropogenic			X					X						Less Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Discolored water			X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Water column focused, not defining a geoform
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Float			Anthropogenic			X					X						Less Than	Certain	
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Foul area dangerous to navigation						X					X						No Equivalent	Somewhat Certain	CMECS units don't have reference to impact on navigation
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Reef			Anthropogenic	Artificial Reef		X					X						Greater Than	Somewhat Certain	Not sure if source classification means "Reef" for artificial reefs and natural reefs.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Reef			Biogenic	Mollusk reef		Biogenic	Shell				Benthic/Attached Biota	Reef Biota	Mollusk Reef Biota	Mollusk Reef			Greater Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Reef			Biogenic	Shallow/Mesophotic Coral Reef		Biogenic	Coral				Benthic/Attached Biota	Reef Biota	Shallow/Mesophotic Coral Reef Biota				Greater Than	Somewhat Certain	Did not include "deep/cold-water reef" since the source unit is in the group "rocks, wrecks, and obstructions." I'm assuming the only reefs meant by the source unit would be in the way of vessels and so in shallow waters.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Reef			Geologic	Shoal		X					X						Greater Than	Somewhat Certain	There's no good geoform for "Rock reef." A Shoal is intertidal, a Bank is "generally" subtidal but the definition suggests it should be used for larger features.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Reef			Geologic	Ridge		X					X						Greater Than	Not Certain	There's no good geoform for "Rock reef." A Shoal is intertidal, a Bank is "generally" subtidal but the definition suggests it should be used for larger features.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Rock awash			X			Geologic	Rock				X						Greater Than	Somewhat Certain	Couldn't assign to tidal zone "interidal" since it could be "supratidal" too. The "awash" modifier adds information to the source unit that CMECS can't match.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Rock awash			X			Geologic	UMS	Coarse UMS	Boulder		X						Greater Than	Somewhat Certain	Couldn't assign to tidal zone "interidal" since it could be "supratidal" too. The "awash" modifier adds information to the source unit that CMECS can't match.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Sinkers			Anthropogenic			Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Stumps of posts or piles, which cover and uncover			Anthropogenic	Pilings		Anthropogenic					X						Less Than	Certain	Couldn't assign to tidal zone "interidal" since it could be "supratidal" too.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Submerged crib			Anthropogenic			Anthropogenic					X						Less Than	Certain	This would be subtidal if in tidal waters. But the definition doesn't mean it has to be in tidal waters.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Submerged duck blind			Anthropogenic			Anthropogenic					X						Less Than	Certain	This would be subtidal if in tidal waters. But the definition doesn't mean it has to be in tidal waters.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Submerged platform			Anthropogenic			Anthropogenic					X						Less Than	Certain	This would be subtidal if in tidal waters. But the definition doesn't mean it has to be in tidal waters.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Sunken danger						X					X						No Equivalent	Somewhat Certain	CMECS units don't have reference to degree of danger. These would be subtidal if in tidal waters. But the definition doesn't mean it has to be in tidal waters.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Supplementary National Symbols	Unexploded ordnance			Anthropogenic			Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Fish haven			Geologic	Fish pond		X					X					Trawled/harvested	Greater Than	Somewhat Certain	"Fish pond" is in CMECS, but it refers to a very specifically defined feature. I will assume that a fish pond is a fish haven, but a fish haven can be more than a fish pond.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Fish trap area, tunny nets area			Anthropogenic			X					X					Trawled/harvested	Less Than	Somewhat Certain	The source unit refers to areas where there is concentrated fishing. This can only be addressed with a modifier in CMECS.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Fish trap, fish weir, tunny nets			Anthropogenic			X					X						Less Than	Somewhat Certain	The source unit refers to areas where there is concentrated fishing. This can only be addressed with a modifier in CMECS.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Fishing stakes			Anthropogenic	Pilings		Anthropogenic					X						Less Than	Certain	
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Foul ground						X					X						No Equivalent	Certain	
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Marine farm			Anthropogenic			X					X						Less Than	Not Certain	Aquaculture facilities might include more than what you might call a marine farm.
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Obstruction											X						No Equivalent	Somewhat Certain	CMECS units don't have reference to impact on navigation
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Shellfish beds			X			X					Benthic/Attached Biota	Faunal Bed					Less Than	Certain	Biology focused, not defining a geoform
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Stumps of posts or piles			Anthropogenic	Pilings		Anthropogenic					X						Less Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Submerged wreck			Anthropogenic	Wreck		Anthropogenic					X						Less Than	Somewhat Certain	This would be subtidal if in tidal waters. But the definition doesn't mean it has to be in tidal waters. Note that in this case, since there was only one CMECS unit to describe "wreck" the relationship was identified as "less than," appreciating the increased specificity in the source unit which uses the modifier "underwater." Different approach was used for source unit "underwater rock!"

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Wreck covers and uncovers			Anthropogenic	Wreck		Anthropogenic					X						Less Than	Somewhat Certain	Couldn't assign to tidal zone "interidal" since it could be "supratidal" too. Note that in this case, since there was only one CMECS unit to describe "wreck" the relationship was identified as "less than," appreciating the increased specificity in the source unit which uses the modifier "covers and uncovers." Different approach was used for source unit "rock which covers and uncovers!"
NOAA Nautical	Rocks, Wrecks, and Obstructions	Wrecks and Fouls	Wreck never covers		supratidal	Anthropogenic	Wreck		Anthropogenic					X						Nearly Equal	Somewhat Certain	Because the source modifier is "never covers" I used supratidal for the tidal zone.
TNC Coastal	Bay scallop					X			X					Benthic/Attached Biota	Faunal Bed	Soft Sediment Fauna	Scallop Bed	*Argopecten* Bed		Nearly Equal	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
TNC Coastal	Blue mussel					X			X					Benthic /Attached Biota	Faunal Bed	Attached Fauna	Attached Mussels	Attached *Mytilus*		Greater Than	Certain	
TNC Coastal	Blue mussel					X			X					Benthic /Attached Biota	Faunal Bed	Soft Sediment Fauna	Mussel Bed	*Mytilus* bed		Greater Than	Certain	
TNC Coastal	Blue mussel					X			X					Benthic /Attached Biota	Reef Biota	Mollusk Reef Biota	Mollusk Reef	*Mytilus* reef		Greater Than	Certain	
TNC Coastal	Coastal salt ponds			Estuarine	(Phys Setting) Lagoonal Estuary				X					X						Less Than	Somewhat Certain	Source unit defines specific types of Lagoonal Estuaries. There are no Geoforms that clearly match. Since the CMECS unit is at the Physiographic Setting level, I am only Somewhat Certain in the equality of the relationship. Does this cover small lagoons?
TNC Coastal	Cobble shores					Geologic	Shore		Geologic	UMS	Coarse UMS	Gravel	Cobble	X						Greater Than	Certain	Source unit is not as specific as CMECS with respect to the definition of "cobble"
TNC Coastal	Eastern oyster					X			X					Benthic /Attached Biota	Faunal Bed	Attached Fauna	Attached Oysters	Attached *Crassostrea*		Greater Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
TNC Coastal	Eastern oyster					X			X					Benthic /Attached Biota	Faunal Bed	Soft Sediment Fauna	Oyster Bed	*Crassostrea* bed		Greater Than	Certain	
TNC Coastal	Eastern oyster					X			X					Benthic /Attached Biota	Reef Biota	Mollusk Reef Biota	Oyster Reef	*Crassostrea* reef		Greater Than	Certain	
TNC Coastal	Hard clam					X			X					Benthic /Attached Biota	Faunal Bed	Soft Sediment Fauna	Clam Bed	*Mercenaria* Bed		Greater Than	Certain	
TNC Coastal	Land-sea interface					Geologic	Shore		X					X						Less Than	Certain	The source unit refers to the specific land-sea interface. There is no equivalent unit in CMECS, but the Shore unit would contain the coastline.
TNC Coastal	Nearshore shellfish assemblages					X			X					Benthic /Attached Biota	Faunal Bed					Less Than	Certain	The source unit defines the type of faunal bed as "shellfish." Trying to go down to subclass creates units that are really too detailed compared to the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
TNC Coastal	Non-vegetated sheltered coasts, including sand and mud flats					Geologic	Shore Complex		Geologic	UMS	Fine UMS			X					Wave regime	No Equivalent	Somewhat Certain	Since the source unit identifies "non-vegetated" I decided there was No Equivalent CMECS unit
TNC Coastal	Ribbed mussel					X			X					Benthic/Attached Biota	Faunal Bed	Attached Fauna	Attached Mussels			Less Than	Certain	No CMECS community for Ribbed Mussels so had to compare at Group level.
TNC Coastal	Rocky headlands					Geologic	Overhang (Cliff)		Geologic	Rock				X						Overlapping	Somewhat Certain	Headlands are specific type of cliff, so the relationship is less than for geoform; but in substrate multiple units describe "rocky" so the relationship is greater than.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
TNC Coastal	Rocky headlands					Geologic	Overhang (Cliff)		Geologic	UMS	Coarse UMS			X						Overlapping	Somewhat Certain	Headlands are specific type of cliff, so the relationship is less than for geoform; but in substrate multiple units describe "rocky" so the relationship is greater than.
TNC Coastal	Sandy beaches					Geologic	Beach		Geologic	UMS	Fine UMS	Sand		X						Greater Than	Certain	in substrate multiple units describe "sandy" so the relationship is greater than
TNC Coastal	Sandy beaches					Geologic	Beach		Geologic	UMS	Fine UMS	Slightly Gravelly		X						Greater Than	Certain	in substrate multiple units describe "sandy" so the relationship is greater than
TNC Coastal	Seagrass beds					X			X					Benthic/Attached Biota	Aquatic Vegetation Bed	Aquatic Vascular Vegetation	Seagrass Bed	*Zostera marina* Herbaceous Vegetation		Nearly Equal	Certain	
TNC Coastal	Softshell clam					X			X					Benthic/Attached Biota	Faunal Bed	Soft Sediment Fauna	Clam Bed	*Mya* Bed		Nearly Equal	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
TNC Coastal	Vegetated tidal wetlands (salt and brackish emergent marshes)					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland	Emergent Tidal Marsh				Nearly Equal	Certain	Biotic Component only
DEP Wetlands	Coastal Beach					Geologic	Beach		Geologic	UMS				X						Equal	Certain	
DEP Wetlands	Salt Marsh					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland	Emergent Tidal Marsh				Equal	Somewhat Certain	Assumed source unit means "tidal" since it's a salt marsh
DEP Wetlands	Tidal Flat					Geologic	Flat	Tidal	Geologic	UMS				X						Equal	Certain	
DEP Wetlands	Beach/Dunes					Geologic	Beach		Geologic	UMS				X						Greater Than	Certain	The source unit contains two CMECS units.
DEP Wetlands	Beach/Dunes					Geologic	Dune		Geologic	UMS				X						Greater Than	Certain	The source unit contains two CMECS units.
DEP Wetlands	Tidal Flat/Rocky Shore					Geologic	Flat	Tidal	Geologic	UMS				X						Greater Than	Certain	The source unit contains two CMECS units.
DEP Wetlands	Tidal Flat/Rocky Shore					Geologic	Shore		Geologic					X						Greater Than	Certain	The source unit contains two CMECS units.
DEP Wetlands	Barrier Beach System					Geologic	Shore Complex		X					X						Less Than	Certain	CMECS shore complex includes the concept of a barrier beach system.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DEP Wetlands	Barrier Beach-Coastal Dune					Geologic	Dune		Geologic	UMS				X						Less Than	Certain	CMECS dune unit does not contain a type "barrier dune"
DEP Wetlands	Barrier Beach-Deep Marsh					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland					Less Than	Certain	Source unit includes two modifiers "barrier" and "deep" that the CMECS unit does not capture; could not get to Biotic Group of "Tidal Emergent Wetland" since the source unit doesn't explicitly define tidal.
DEP Wetlands	Barrier Beach-Marsh					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland					Less Than	Certain	Source unit includes one modifier "barrier beach" that the CMECS unit does not capture; could not get to Biotic Group of "Tidal Emergent Wetland" since the source unit doesn't explicitly define tidal.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DEP Wetlands	Barrier Beach-Salt Marsh					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland	Emergent Tidal Marsh				Less Than	Certain	Source unit includes "barrier beach" modifier that the CMECS units do not capture; assumed source unit means "tidal" since it's a salt marsh
DEP Wetlands	Barrier Beach-Shrub Swamp					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Scrub-Shrub Wetland					Less Than	Certain	The CMECS unit doesn't identify "Barrier Beach"; could not get to Biotic Group of "Tidal Scrub-Shrub Wetland" since the source unit doesn't explicitly define tidal.
DEP Wetlands	Barrier Beach-Wooded Swamp Coniferous					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Forested Wetland					Less Than	Certain	The CMECS unit doesn't identify "Barrier Beach"; could not get to Biotic Group of "Tidal Forested Wetland" since the source unit doesn't explicitly define tidal.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DEP Wetlands	Barrier Beach-Wooded Swamp Deciduous					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Forested Wetland					Less Than	Certain	The CMECS unit doesn't identify "Barrier Beach"; could not get to Biotic Group of "Tidal Forested Wetland" since the source unit doesn't explicitly define tidal.
DEP Wetlands	Barrier Beach-Wooded Swamp Mixed Trees					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Forested Wetland					Less Than	Certain	The CMECS unit doesn't identify "Barrier Beach"; could not get to Biotic Group of "Tidal Forested Wetland" since the source unit doesn't explicitly define tidal.
DEP Wetlands	Coastal Bank Bluff or Sea Cliff					Geologic	Overhang (Cliff)		X					X						Less Than	Certain	The source unit specifies the type of Overhang/Cliff and there is no Geoform Type or modifier for "coastal" or "sea" cliff

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DEP Wetlands	Coastal Dune					Geologic	Dune		Geologic	UMS				X						Less Than	Certain	CMECS definition for dune states "dunes occur on a beach or further inland." The source unit states "coastal."
DEP Wetlands	Deep Marsh					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland					Less Than	Certain	Source unit includes one modifier "deep" that the CMECS unit does not capture; could not get to Biotic Group of "Tidal Emergent Wetland" since the source unit can refer to freshwater environments too.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DEP Wetlands	Shallow Marsh Meadow or Fen					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland					Less Than	Certain	Source units identifies modifiers "shallow," "meadow," and "fen;" could not get to Biotic Group of "Tidal Emergent Wetland" since the source unit refers to freshwater environments too.
DEP Wetlands	Shrub Swamp					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Scrub-Shrub Wetland					Less Than	Somewhat Certain	Source unit identifies "shrub" only; could not get to Biotic Group of "Tidal Scrub-Shrub Wetland" since the source unit refers to freshwater environments too.
DEP Wetlands	Wooded Swamp					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Forested Wetland					Less Than	Somewhat Certain	Could not get to Biotic Group of "Tidal Forested Wetland" since the source unit refers to freshwater environments too.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DEP Wetlands	Wooded Swamp Coniferous					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Forested Wetland					Less Than	Certain	Could not get to Biotic Group of "Tidal Forested Wetland" since the source unit refers to freshwater environments too.
DEP Wetlands	Wooded Swamp Deciduous					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Forested Wetland					Less Than	Certain	Could not get to Biotic Group of "Tidal Forested Wetland" since the source unit refers to freshwater environments too.
DEP Wetlands	Wooded Swamp Mixed Trees					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Forested Wetland					Less Than	Certain	Could not get to Biotic Group of "Tidal Forested Wetland" since the source unit refers to freshwater environments too.
DEP Wetlands	Barrier Beach-Coastal Beach					Geologic	Beach	Barrier Beach	Geologic	UMS				X						Nearly Equal	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DEP Wetlands	Marsh					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland					Nearly Equal	Somewhat Certain	Could not get to Biotic Group of "Tidal Emergent Wetland" since the source unit can refer to freshwater environments too.
DEP Wetlands	Barrier Beach-Bog					X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	
DEP Wetlands	Barrier Beach-Open Water					X			X					Benthic/Attached Biota						Greater Than	Certain	Areas that are classified as "open water" we chose to consider populated by some sort of benthic/attached biota
DEP Wetlands	Bog					X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	
DEP Wetlands	Cranberry Bog					X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	
DEP Wetlands	Not Interpreted					X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DEP Wetlands	Open Water					X			X					Benthic/Attached Biota						Greater Than	Certain	Areas that are classified as "open water" we chose to consider populated by some sort of benthic/attached biota
DEP Wetlands	Reservoir (PWSID Coded)								X					X						No Equivalent	Certain	This should probably be considered under Geoform, but there is no existing equivalent
DEP Wetlands	Upland					X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	
DEP Wetlands	Rocky Intertidal Shore				Intertidal	Geologic	Shore		Geologic	Rock				X						Greater Than	Somewhat Certain	Using a combination of Geoform and Substrate, you can get a similar unit. However, the Geoform is more vague and the Substrate doesn't have a good equivalent for "rocky." Exact relationship is unclear.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DEP Wetlands	Rocky Intertidal Shore				Intertidal	Geologic	Shore		Geologic	UMS	Coarse UMS			X						Greater Than	Somewhat Certain	Using a combination of Geoform and Substrate, you can get a similar unit. However, the Geoform is more vague and the Substrate doesn't have a good equivalent for "rocky." Exact relationship is unclear.
NOAA ESI	Coarse-grained sand beaches					Geologic	Beach		Geologic	UMS	Fine UMS	Slightly gravelly		X						Greater Than	Certain	Requires both geoform and substrate; "coarse-grained" in source unit is not clearly defined, and would contain several CMECS Substrate groups

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Coarse-grained sand beaches					Geologic	Beach		Geologic	UMS	Fine UMS	Sand		X						Greater Than	Certain	Requires both geoform and substrate; "coarse-grained" in source unit is not clearly defined, and would contain several CMECS Substrate groups

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed rocky shores					Geologic	Shore		Geologic	Rock	Bedrock			X					Wave regime	Greater Than	Somewhat Certain	Requires both geoform and substrate; "rocky" in source unit is not clearly defined, and would contain several CMECS Substrate groups; because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is again less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed rocky shores					Geologic	Shore		Geologic	UMS	Coarse UMS	Gravel		X					Wave regime	Greater Than	Somewhat Certain	Requires both geoform and substrate; "rocky" in source unit is not clearly defined, and would contain several CMECS Substrate groups; because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is again less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed rocky shores					Geologic	Shore		Geologic	UMS	Coarse UMS	Gravel Mixes		X					Wave regime	Greater Than	Somewhat Certain	Requires both geoform and substrate; "rocky" in source unit is not clearly defined, and would contain several CMECS Substrate groups; because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is again less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed wave-cut platforms in bedrock, mud, or clay					Geologic	Scarp/Wall		Geologic	Rock	Bedrock			X					Wave regime	Greater Than	Somewhat Certain	Requires both geoform and substrate; because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed wave-cut platforms in bedrock, mud, or clay					Geologic	Scarp/Wall		Geologic	UMS	Fine UMS	Mud		X					Wave regime	Greater Than	Somewhat Certain	Requires both geoform and substrate; because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed wave-cut platforms in bedrock, mud, or clay					Geologic	Scarp/Wall		Geologic	UMS	Fine UMS	Mud	Clay	X					Wave regime	Greater Than	Somewhat Certain	Requires both geoform and substrate; because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed, solid man-made structures					Anthropogenic	Breakwater/ Jetty		Geologic	Rock	Bedrock			X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed, solid man-made structures					Anthropogenic	Bulkhead		Anthropogenic	Construction Materials				X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed, solid man-made structures					Anthropogenic	Dock/Pier		Anthropogenic	Construction Materials				X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed, solid man-made structures					Anthropogenic	Seawall		Anthropogenic	Construction Materials				X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed, solid man-made structures					Anthropogenic	Wharf		Anthropogenic	Construction Materials				X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.
NOAA ESI	Fine to medium-grain sand beaches					Geologic	Beach		Geologic	UMS	Fine UMS	Sand		X						Greater Than	Certain	Requires both geoform and substrate; "fine to medium-grain" in source unit is not clearly defined, and would contain several CMECS Substrate groups

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Fine to medium-grain sand beaches					Geologic	Beach		Geologic	UMS	Fine UMS	Muddy Sand		X						Greater Than	Certain	Requires both geoform and substrate; "fine to medium-grain" in source unit is not clearly defined, and would contain several CMECS Substrate groups
NOAA ESI	Gravel beaches					Geologic	Beach		Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	Requires both geoform and substrate; "gravel" in source unit is not clearly defined, and would contain several CMECS Substrate groups
NOAA ESI	Gravel beaches					Geologic	Beach		Geologic	UMS	Coarse UMS	Gravel		X						Greater Than	Certain	Requires both geoform and substrate; "gravel" in source unit is not clearly defined, and would contain several CMECS Substrate groups

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Mixed sand and gravel beaches					Geologi c	Beach		Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	Requires both geoform and substrate; "mixed sand and gravel" in source unit is not clearly defined, and would contain several CMECS Substrate groups
NOAA ESI	Mixed sand and gravel beaches					Geologi c	Beach		Geologic	UMS	Coarse UMS	Gravelly		X						Greater Than	Certain	Requires both geoform and substrate; "mixed sand and gravel" in source unit is not clearly defined, and would contain several CMECS Substrate groups

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Scarps and steep slopes in sand					Geologic	Scarp/Wall		Geologic	UMS	Coarse UMS	Gravelly		X					Slope	Greater Than	Certain	Requires both geoform and substrate; "sand" in source unit is not clearly defined, and would contain several CMECS Substrate groups
NOAA ESI	Scarps and steep slopes in sand					Geologic	Scarp/Wall		Geologic	UMS	Fine UMS	Sand		X					Slope	Greater Than	Certain	Requires both geoform and substrate; "sand" in source unit is not clearly defined, and would contain several CMECS Substrate groups

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered rocky shores and sheltered scarps in bedrock, mud, or clay					Geologic	Scarp/Wall		Geologic	Rock	Bedrock			X					Wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered rocky shores and sheltered scarps in bedrock, mud, or clay					Geologic	Shore		Geologic	UMS	Coarse UMS			X					Wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered rocky shores and sheltered scarps in bedrock, mud, or clay					Geologic	Scarp/Wall		Geologic	UMS	Fine UMS	Mud		X					Wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered rocky shores and sheltered scarps in bedrock, mud, or clay					Geologic	Shore		Geologic	UMS	Fine UMS	Mud		X					Wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered rocky shores and sheltered scarps in bedrock, mud, or clay					Geologic	Scarp/Wall		Geologic	UMS	Fine UMS	Mud	Clay	X					Wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered rocky shores and sheltered scarps in bedrock, mud, or clay					Geologic	Shore		Geologic	UMS	Fine UMS	Mud	Clay	X					Wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered tidal flats					Geologic	Flat	Tidal	Geologic	UMS	Fine UMS			X					Wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered, solid man-made structures					Anthropogenic	Breakwater/ Jetty		Anthropogenic	Construction Materials				X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered, solid man-made structures					Anthropogenic	Bulkhead		Anthropogenic	Construction Materials				X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered, solid man-made structures					Anthropogenic	Dock/Pier		Anthropogenic	Construction Materials				X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered, solid man-made structures					Anthropogenic	Seawall		Anthropogenic	Construction Materials				X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered, solid man-made structures					Anthropogenic	Wharf		Anthropogenic	Construction Materials				X					Developed, wave regime	Greater Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed scarps and steep slopes in clay					Geologic	Scarp/Wall		Geologic	UMS	Fine UMS	Mud	Clay	X					Slope, wave regime	Less Than	Somewhat Certain	Requires both geoform and substrate; because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Exposed tidal flats					Geologic	Flat	Tidal	Geologic	UMS	Fine UMS			X					Wave regime	Less Than	Somewhat Certain	Requires both geoform and substrate; because source unit uses term "exposed," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered riprap					Anthropogenic	Riprap Deposit		Anthropogenic	Anthropogenic Rock	Anthropogenic Rock Reef			X					Wave regime	Less Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Sheltered riprap					Anthropogenic	Riprap Deposit		Anthropogenic	Anthropogenic Rock	Anthropogenic Rock Rubble			X					Wave regime	Less Than	Somewhat Certain	because source unit uses term "sheltered," in that respect it is more finely defined than the CMECS unit without a modifier. With a modifier, it is less specific (greater than) CMECS because the wave regime thresholds are more specific than what is used in the source unit.
NOAA ESI	Vegetated, steeply-sloping riverine bluffs					Geologic	Scarp/Wall		Biogenic	Organic				X					Slope	Less Than	Somewhat Certain	
NOAA ESI	Riprap					Anthropogenic	Riprap Deposit		Anthropogenic	Anthropogenic Rock	Anthropogenic Rock Reef			X						Nearly Equal	Certain	Nearly equal with Geoform; greater than with substrate
NOAA ESI	Riprap					Anthropogenic	Riprap Deposit		Anthropogenic	Anthropogenic Rock	Anthropogenic Rock Rubble			X						Nearly Equal	Certain	Nearly equal with Geoform; greater than with substrate
NOAA ESI	Scrub-shrub wetlands					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Scrub-Shrub Wetland					Nearly Equal	Certain	Nearly equal with Biotic only

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
NOAA ESI	Swamps					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland					Nearly Equal	Not Certain	could not get to Biotic Group of "Tidal Emergent Wetland" since the source unit doesn't explicitly define tidal.
NOAA ESI	Freshwater marshes					X			X					X					Don't crosswalk to CMECS Bio-Geo-Sub	No Equivalent	Certain	CMECS isn't intended to cover freshwater features
NOAA ESI	Vegetated low riverine banks								Biogenic	Organic				X						No Equivalent	Certain	CMECS doesn't cover the feature of tidal rivers.
NOAA ESI	Salt- and brackish-water marshes					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland	Emergent Tidal Marsh				Overlapping	Not Certain	assumed source unit means "tidal" since it's a salt or brackish marsh
USGS-Knebel	Deposition	Patterns of weak backscatter							X					X						No Equivalent	Certain	Although the source unit is process-oriented, it doesn't coincide with CMECS units
USGS-Knebel	Erosion or nondeposition	Patterns of strong backscatter							X					X						No Equivalent	Certain	Although the source unit is process-oriented, it doesn't coincide with CMECS units

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Knebel	Erosion or nondeposition	Patterns with isolated reflections							X					X						No Equivalent	Certain	Although the source unit is process-oriented, it doesn't coincide with CMECS units
USGS-Knebel	Sediment reworking	Patterns with patches of strong to weak backscatter							X					X						No Equivalent	Certain	Although the source unit is process-oriented, it doesn't coincide with CMECS units
USGS BH Atlas	Fish-rok					X			Geologic	Rock				X						Overlapping	Certain	This unit refers to rocky areas that have a lot of fish; but that doesn't really translate well. "Fish pond" or "Boulder field" or "Rubble field" could be used, but would require too many assumptions I think. Biotic Component doesn't cover fish.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Anthropogenic modification	Dredged Channels				Anthropogenic	Dredged/Excavated Channel		Anthropogenic					X					Dredged	Greater Than	Certain	The source unit is anthropogenic modification. Each subclass is defined under the definiton of anthropogenic modification, but the source data does not distinguish between them.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Anthropogenic modification	Anchorage areas				Anthropogenic			Anthropogenic					X						No Equivalent	Certain	The source unit is anthropogenic modification. Each subclass is defined under the definiton of anthropogenic modification, but the source data does not distinguish between them. Note that the source unit includes "anchorage area" and there is no equivalent CMECS unit. This may call into question the relationship.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Anthropogenic modification	Dredge spoil disposal area				Anthropogenic			Anthropogenic					X						Greater Than	Certain	The source unit is anthropogenic modification. Each subclass is defined under the definiton of anthropogenic modification, but the source data does not distinguish between them.
USGS-Ackerman	Anthropogenic modification	Artificial reef				Anthropogenic	Artificial Reef		Anthropogenic					X						Greater Than	Certain	The source unit is anthropogenic modification. Each subclass is defined under the definiton of anthropogenic modification, but the source data does not distinguish between them.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Anthropogenic modification	Piers				Anthropogenic	Dock/Pier		Anthropogenic					X					Developed	Greater Than	Certain	The source unit is anthropogenic modification. Each subclass is defined under the definiton of anthropogenic modification, but the source data does not distinguish between them.
USGS-Ackerman	Anthropogenic modification	Pipelines				Anthropogenic	Pipelines		Anthropogenic					X						Greater Than	Certain	The source unit is anthropogenic modification. Each subclass is defined under the definiton of anthropogenic modification, but the source data does not distinguish between them.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Anthropogenic modification	Submerged Wrecks				Anthropogenic	Wreck		Anthropogenic					X						Greater Than	Certain	The source unit is anthropogenic modification. Each subclass is defined under the definiton of anthropogenic modification, but the source data does not distinguish between them.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	High-relief bedrock and boulder					X			Geologic	Rock				X					Sloping	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	High-relief bedrock and boulder					X			Geologic	UMS	Coarse UMS	Gravel		X					Sloping	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	High-relief bedrock and boulder					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X					Sloping	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Low-relief gravel and sand					X			Geologic	UMS	Coarse UMS	Gravelly		X					Flat	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Low-relief gravel and sand					X			Geologic	UMS	Fine UMS	Slightly Gravelly		X					Flat	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Low-relief mud					X			Geologic	UMS	Fine UMS	Sandy Mud		X					Flat	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Low-relief mud					X			Geologic	UMS	Fine UMS	Mud		X					Flat	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Low-relief sand					X			Geologic	UMS	Fine UMS	Sand		X					Flat	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Low-relief sand					X			Geologic	UMS	Fine UMS	Muddy Sand		X					Flat	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Medium-relief boulder and cobble					X			Geologic	UMS	Coarse UMS	Gravel		X					Flat	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USGS-Ackerman	Medium-relief boulder and cobble					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X					Flat	Greater Than	Certain	The source unit does not define the grain sizes as specifically as CMECS does, so multiple CMECS units would apply. The slope modifier is more general in CMECs, having only two units that correspond to the three in the source classification. The thresholds are minorly different (4 and 5 degrees between source and CMECS, respectively).
DMF-USGS-CZM Sediment	Coarse Unconsolidated Substrate, Gravel					X			Geologic	UMS	Coarse UMS	Gravel		X						Equal	Certain	This unit was generated using CMECS thresholds.
DMF-USGS-CZM Sediment	Coarse Unconsolidated Substrate, Gravel Mixes					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X						Equal	Certain	This unit was generated using CMECS thresholds.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF-USGS-CZM Sediment	Coarse Unconsolidated Substrate, Gravelly					X			Geologic	UMS	Coarse UMS	Gravelly		X						Equal	Certain	This unit was generated using CMECS thresholds.
DMF-USGS-CZM Sediment	Coarse Unconsolidated Substrate, Slightly Gravelly					X			Geologic	UMS	Fine UMS	Slightly Gravelly		X						Equal	Certain	This unit was generated using CMECS thresholds.
DMF-USGS-CZM Sediment	Fine Unconsolidated Substrate, Mud					X			Geologic	UMS	Fine UMS	Mud		X						Equal	Certain	This unit was generated using CMECS thresholds.
DMF-USGS-CZM Sediment	Fine Unconsolidated Substrate, Muddy Sand					X			Geologic	UMS	Fine UMS	Sandy Mud		X						Equal	Certain	This unit was generated using CMECS thresholds.
DMF-USGS-CZM Sediment	Fine Unconsolidated Substrate, Sand					X			Geologic	UMS	Fine UMS	Sand		X						Equal	Certain	This unit was generated using CMECS thresholds.
DMF-USGS-CZM Sediment	Fine Unconsolidated Substrate, Sandy Mud					X			Geologic	UMS	Fine UMS	Muddy Sand		X						Equal	Certain	This unit was generated using CMECS thresholds.
DMF-USGS-CZM Sediment	Hard					X			Geologic	Rock				X						Greater Than	Certain	There is no single good CMECS unit for the general term "Hard"
DMF-USGS-CZM Sediment	Hard					X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	There is no single good CMECS unit for the general term "Hard"
DMF Tech Rpt	Gravelly					X			Geologic	UMS	Coarse UMS	Gravel		X						Greater Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Tech Rpt	Gravelly					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	
DMF Tech Rpt	Gravelly					X			Geologic	UMS	Coarse UMS	Gravelly		X						Greater Than	Certain	
DMF Tech Rpt	Sandy					X			Geologic	UMS	Fine UMS	Slightly Gravelly		X						Greater Than	Certain	
DMF Tech Rpt	Muddy					X			Geologic	UMS	Fine UMS	Mud		X						Greater Than	Certain	
DMF Tech Rpt	Sandy					X			Geologic	UMS	Fine UMS	Sandy Mud		X						Greater Than	Certain	
DMF Tech Rpt	Sandy					X			Geologic	UMS	Fine UMS	Sand		X						Greater Than	Certain	
DMF Tech Rpt	Muddy					X			Geologic	UMS	Fine UMS	Muddy Sand		X						Greater Than	Certain	
DMF Tech Rpt	Hard					X			Geologic	Rock				X						Greater Than	Certain	There is no single good CMECS unit for the general term "Hard"
DMF Tech Rpt	Hard					X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	There is no single good CMECS unit for the general term "Hard"

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	gravel					X			Geologic	UMS	Coarse UMS	Gravel		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	gravel/mud					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	gravel/rock					X			Geologic	UMS	Coarse UMS	Gravel		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	gravel/sand					X			Geologic	UMS	Coarse UMS	Gravelly		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	mud					X			Geologic	UMS	Fine UMS	Mud		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	mud/gravel					X			Geologic	UMS	Coarse UMS	Gravelly		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	mud/rock					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	mud/sand					X			Geologic	UMS	Fine UMS	Muddy Sand		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	rock					X			Geologic	Rock	Bedrock			X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	rock					X			Geologic	UMS	Coarse UMS	Gravel	Boulder	X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	rock/gravel					X			Geologic	UMS	Coarse UMS	Gravel	Cobble	X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	rock/gravel					X			Geologic	UMS	Coarse UMS	Gravel	Pebble	X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	rock/gravel					X			Geologic	UMS	Coarse UMS	Gravel	Granule	X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	rock/mud					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	rock/mud					X			Geologic	UMS	Coarse UMS	Gravelly		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	rock/sand					X			Geologic	UMS	Coarse UMS	Gravelly		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	rock/sand					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	sand					X			Geologic	UMS	Fine UMS	Sand		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	sand/gravel					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	sand/mud					X			Geologic	UMS	Fine UMS	Sandy Mud		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
USFWS	sand/rock					X			Geologic	UMS	Coarse UMS	Gravel Mixes		X						Greater Than	Certain	The source unit percent grain size to separate into primary and secondary grain sizes but it's not well-described in the metadata. I decided that "the concept of the source unit fully contains the concept of the CMECS unit" and multiple CMECS units would be assigned to a single source unit. I'm Certain of the relationship, but I'm not Certain exactly how the CMECS units would get assigned to each source unit.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
TNC Surf. Geo	Coarse clay					X			Geologic	UMS	Fine UMS	Mud	Clay	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Coarse pebbles					X			Geologic	UMS	Coarse UMS	Gravel	Granule	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Coarse sand					X			Geologic	UMS	Fine UMS	Sand	Coarse Sand	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Coarse silt					X			Geologic	UMS	Fine UMS	Mud	Silt	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
TNC Surf. Geo	Fine pebbles					X			Geologic	UMS	Coarse UMS	Gravel	Granule	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Fine sand					X			Geologic	UMS	Fine UMS	Sand	Fine Sand	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Fine silt					X			Geologic	UMS	Fine UMS	Mud	Silt	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Medium clay					X			Geologic	UMS	Fine UMS	Mud	Clay	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
TNC Surf. Geo	Medium pebbles					X			Geologic	UMS	Coarse UMS	Gravel	Granule	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Medium sand					X			Geologic	UMS	Fine UMS	Sand	Medium Sand	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Medium silt					X			Geologic	UMS	Fine UMS	Mud	Silt	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Very coarse pebbles to cobbles					X			Geologic	UMS	Coarse UMS	Gravel	Cobbles	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
TNC Surf. Geo	Very coarse sand					X			Geologic	UMS	Fine UMS	Sand	Very Coarse Sand	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Very fine pebbles (granules)					X			Geologic	UMS	Coarse UMS	Gravel	Granule	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Very fine sand					X			Geologic	UMS	Fine UMS	Sand	Very Fine Sand	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.
TNC Surf. Geo	Very fine silt					X			Geologic	UMS	Fine UMS	Mud	Silt	X						Overlapping	Somewhat Certain	The source unit used average grain size. The result is a similar concept, but cannot be directly linked to CMECS.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
CZM	HardLow	Sand or gravel flat or valley floor				Geologic			Geologic	UMS	Coarse UMS			X					Flat, Hard	Greater Than	Somewhat Certain	There are similar concepts in the two classifications, and the source classification essentially contains many different CMECS units. The modifier thresholds are similar but different. How source unit defines "flat" really just pertains to the slope, not comparable to a CMECS flat. I think.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
CZM	HardModerate	Bank, cobble or boulder field, flank of moraine				Geologic			Geologic	UMS	Coarse UMS			X					Flat, Hard	Greater Than	Somewhat Certain	There are similar concepts in the two classifications, and the source classification essentially contains many different CMECS units both for geoform and substrate. What the source unit considers a "bank" appears different than the CMECS definition for bank. There is no "flank of moraine" in CMECS. The modifier thresholds are similar but different.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
CZM	HardSteep	Rocky, bedrock, pinnacle, moraine, drumlin				Geologic			Geologic	Rock				X					Sloping, Hard	Greater Than	Somewhat Certain	There are similar concepts in the two classifications, and the source classification essentially contains many different CMECS units. The modifier thresholds are similar but different.
CZM	MediumLow	Silty sand flat, shoal top, or valley floor				Geologic			Geologic	UMS	Fine UMS			X					Flat, Mixed	Greater Than	Somewhat Certain	There are similar concepts in the two classifications, and the source classification essentially contains many different CMECS units. The modifier thresholds are similar but different.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
CZM	MediumModerate	Not present				Geologic			Geologic	UMS	Fine UMS			X					Flat, Mixed	Overlapping	Somewhat Certain	The modifiers are similar but different. A CMECS unit of Flat, Mixed Fine UMS would be somewhat similar, so I went with overlapping for a relationship.
CZM	MediumSteep	Not present				Geologic			Geologic	UMS	Fine UMS			X					Sloping, Mixed	Overlapping	Somewhat Certain	The modifiers are similar but different. A CMECS unit of Sloping, Mixed Fine UMS would be somewhat similar, so I went with overlapping for a relationship.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
CZM	SoftLow	Depositional, silty, muddy basin				Geologic	Basin		Geologic	UMS	Fine UMS			X					Flat, Soft	Greater Than	Somewhat Certain	In this unit a specific Geoform is identified in the source unit. However, multiple CMECS substrate types are represented so I went with a greather than relationship.
CZM	SoftModerate	Moderately steep sides and bottoms of channels				Geologic	Channel		Geologic	UMS	Fine UMS			X					Flat, Soft	Greater Than	Somewhat Certain	In this unit a specific Geoform is identified in the source unit. However, multiple CMECS substrate types are represented so I went with a greather than relationship.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
CZM	SoftSteep	Not used, some channel sides steep but small area				Geologic			Geologic	UMS	Fine UMS			X					Sloping, Soft	Overlapping	Somewhat Certain	The modifiers are similar but different. A CMECS unit of Sloping, Soft Fine UMS would be somewhat similar, so I went with overlapping for a relationship.
DMF Anthropogenic	Aquaculture Facility					Anthropogenic	Aquaculture		X					X					Aquaculture, Trawled/Harvested	Equal	Certain	
DMF Anthropogenic	Cables					Anthropogenic	Cable		X					X						Equal	Certain	
DMF Anthropogenic	Concentrated Fishing	Dredges				Anthropogenic			X					X					Trawled/harvested	Less Than	Somewhat Certain	The source unit refers to areas where there is concentrated fishing. This can only be addressed with a modifier in CMECS. Without the modifier, there's No Equivalent.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Anthropogenic	Concentrated Fishing	Hook & Line				Anthropogenic			X					X					Trawled/harvested	Less Than	Somewhat Certain	The source unit refers to areas where there is concentrated fishing. This can only be addressed with a modifier in CMECS. Without the modifier, there's No Equivalent.
DMF Anthropogenic	Concentrated Fishing	Nets				Anthropogenic			X					X					Trawled/harvested	Less Than	Somewhat Certain	The source unit refers to areas where there is concentrated fishing. This can only be addressed with a modifier in CMECS. Without the modifier, there's No Equivalent.
DMF Anthropogenic	Concentrated Fishing	Pots				Anthropogenic			X					X					Trawled/harvested	Less Than	Somewhat Certain	The source unit refers to areas where there is concentrated fishing. This can only be addressed with a modifier in CMECS. Without the modifier, there's No Equivalent.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Anthropogenic	Concentrated Fishing	Trawls				Anthropogenic			X					X					Trawled/harvested	Less Than	Somewhat Certain	The source unit refers to areas where there is concentrated fishing. This can only be addressed with a modifier in CMECS. Without the modifier, there's No Equivalent.
DMF Anthropogenic	Disposal areas	Frequent				Anthropogenic	Dredge deposit		X					X					Temporal persistence	Greater Than	Somewhat Certain	CMECS unit "Dredge deposit" is contained within the source unit, but the source unit doesn't indicate that it's dredge spoils; no other applicable CMECS units

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Anthropogenic	Disposal areas	Infrequent				Anthropogenic	Dredge deposit		X					X					Temporal persistence	Greater Than	Somewhat Certain	CMECS unit "Dredge deposit" is contained within the source unit, but the source unit doesn't indicate that it's dredge spoils; no other applicable CMECS units
DMF Anthropogenic	Dredged areas	Frequent				Anthropogenic	Dredged/Excavated Channel							X					Dredged, temporal persistence	Greater Than	Somewhat Certain	CMECS unit "Dredged/Excavated Channel" is contained within the source unit, but the source unit doesn't indicate that it's a channel (marinas get dredged, for example); no other applicable CMECS units

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Anthropogenic	Dredged areas	Infrequent				Anthropogenic	Dredged/Excavated Channel							X					Dredged, temporal persistence	Greater Than	Somewhat Certain	CMECS unit "Dredged/Excavated Channel" is contained within the source unit, but the source unit doesn't indicate that it's a channel (marinas get dredged, for example); no other applicable CMECS units
DMF Anthropogenic	Ghost gear collection area					Anthropogenic	Lost/Discarded Fishing Gear		Anthropogenic	Trash				X						Nearly Equal	Certain	
DMF Anthropogenic	Hardened shoreline					Anthropogenic	Breakwater/Jetty		Anthropogenic	Anthropogenic Rock	Anthropogenic Rock Reef			X					Developed, induration	Greater Than	Somewhat Certain	
DMF Anthropogenic	Hardened shoreline					Anthropogenic	Dock/Pier		Anthropogenic	Anthropogenic Rock	Anthropogenic Rock Rubble			X					Developed, induration	Greater Than	Somewhat Certain	
DMF Anthropogenic	Hardened shoreline					Anthropogenic	Seawall		Anthropogenic	Construction Materials				X					Developed, induration	Greater Than	Somewhat Certain	
DMF Anthropogenic	Hardened shoreline					Anthropogenic	Wharf							X					Developed, induration	Greater Than	Somewhat Certain	
DMF Anthropogenic	Intakes					Anthropogenic	Outfall/Intake		Anthropogenic					X						Less Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Anthropogenic	Moorings					Anthropogenic			Anthropogenic					X						No Equivalent	Certain	CMECS has a mooring field unit, but a mooring doesn't have to be within a mooring field. So there's no equivalent.
DMF Anthropogenic	Outfalls					Anthropogenic	Outfall/Intake		Anthropogenic					X						Less Than	Certain	
DMF Anthropogenic	Pipelines					Anthropogenic	Pipelines		Anthropogenic					X						Equal	Certain	
DMF Anthropogenic	Wrecks					Anthropogenic	Wreck		Anthropogenic					X						Equal	Certain	
DMF Biotic	2D Biotic					X			X					Benthic/Attached Biota	Faunal Bed	Soft Sediment Fauna				Greater Than	Certain	
DMF Biotic	2D Biotic					X			X					Benthic/Attached Biota	Aquatic Vegetation Bed	Benthic Macroalgae	Coralline/Crustose Algal Bed			Greater Than	Certain	The source unit can refer to hard bottoms without 3D growth.
DMF Biotic	3D Biotic					X			X					Benthic/Attached Biota	Aquatic Vegetation Bed					Greater Than	Certain	
DMF Biotic	3D Biotic					X			X					Benthic/Attached Biota	Faunal Bed	Attached Fauna				Greater Than	Certain	
DMF Biotic	3D Biotic					X			X					Benthic/Attached Biota	Reef Biota					Greater Than	Certain	
DMF Biotic	Bivalve reef					Biogenic	Mollusk Reef		X					Benthic/Attached Biota	Reef Biota	Mollusk Reef Biota				Equal	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Biotic	Kelp					X			X					Benthic /Attached Biota	Benthic Macroalgae	Canopy-Forming Algal Bed				Less Than	Certain	There's more than one species of kelp, so the community level is too specific and the group level isn't specific enough. I did the relationship assessment on the Group Level.
DMF Biotic	SAV					X			X					Benthic /Attached Biota	Aquatic Vegetation Bed	Aquatic Vascular Vegetation	Seagrass Bed			Nearly Equal	Certain	
DMF Biotic	Shell					X			Biogenic	Shell				X						Greater Than	Certain	CMECS is more specific with its thresholds
DMF Geoform	Channels	Approach channels				Geologic	Channel		X					X						Less Than	Certain	
DMF Geoform	Channels	Inlet channels				Geologic	Channel		X					X						Less Than	Certain	
DMF Geoform	Depressions					Geologic	Depressions		X					X						Nearly Equal	Certain	
DMF Geoform	Glacial deposit/mixed hard bottom areas					Geologic	Boulder Field		Geologic	UMS	Coarse UMS			X						Greater Than	Certain	
DMF Geoform	Glacial deposit/mixed hard bottom areas					Geologic	Ridge	Esker						X						Greater Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Geoform	Glacial deposit/mixed hard bottom areas					Geologic	Rubble Field							X						Greater Than	Certain	
DMF Geoform	Glacial deposit/mixed hard bottom areas					Geologic	Shoal	Moraine Shoal						X						Greater Than	Certain	
DMF Geoform	Glacial deposit/mixed hard bottom areas					Geologic	Drumlin							X						Greater Than	Certain	
DMF Geoform	Glacial deposit/mixed hard bottom areas					Geologic	Drumlin Field							X						Greater Than	Certain	
DMF Geoform	Glacial deposit/mixed hard bottom areas					Geologic	Moraine							X						Greater Than	Certain	
DMF Geoform	Glacial deposit/mixed hard bottom areas					Geologic	Till Surface							X						Greater Than	Certain	
DMF Geoform	Mudflats					Geologic	Flat	Tidal	Geologic	UMS	Fine UMS			X						Equal	Certain	
DMF Geoform	Salt Marshes					Geologic	Marsh Platform		Biogenic	Organic				Benthic/Attached Biota	Emergent Wetland	Emergent Tidal Marsh				Equal	Certain	
DMF Geoform	Tidal Rivers			Estuarine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	CMECS doesn't cover the feature of tidal rivers.
DMF Substrate	Hard	Coarse				X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Substrate	Hard	Hard bottom				X			Geologic	Rock				X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
DMF Substrate	Hard	Hard bottom				X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
DMF Substrate	Hard	Mixed coarse				X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
DMF Substrate	Hard	Rocky				X			Geologic	Rock				X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
DMF Substrate	Hard	Rocky				X			Geologic	UMS	Coarse UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
DMF Substrate	Soft	Fine				X			Geologic	UMS	Fine UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Substrate	Soft	Mixed fine				X			Geologic	UMS	Fine UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
DMF Substrate	Soft	Mud				X			Geologic	UMS	Fine UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
DMF Substrate	Soft	Sand				X			Geologic	UMS	Fine UMS			X						Greater Than	Certain	The source units don't have as specific thresholds as the CMECS units.
DMF Water Column	Estuarine	Littoral cells		Estuarine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Estuarine	Tide rips		Estuarine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Estuarine	Upwelling		Estuarine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Marine	Littoral cells		Marine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Water Column	Marine	Tide rips		Marine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Marine	Upwelling		Marine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Tidal Riverine	Littoral cells		Estuarine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Tidal Riverine	Tide rips		Estuarine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Tidal Riverine	Upwelling		Estuarine		X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Zones of rapid salinity change: tidal river-estuary boundaries; estuary-marine boundaries;	Littoral cells				X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Zones of rapid salinity change: tidal river-estuary boundaries; estuary-marine	Tide rips				X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component
DMF Water Column	Zones of rapid salinity change: tidal river-estuary boundaries; estuary-marine boundaries;	Upwelling				X			X					X						Don't crosswalk to CMECS Bio-Geo-Sub	Certain	Note: did not look at CMECS water column component

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF/Mass GIS	Artificial Reef locations					Anthropogenic	Artificial Reef		Anthropogenic					Benthic/Attached Biota						Nearly Equal	Certain	Artificial reefs can be made out of natural materials, so it's unclear if the substrate should be geologic or anthropogenic.
DEP Eelgrass layer	Eelgrass					X			X					Benthic/Attached Biota	Aquatic Vegetation Bed	Aquatic Vascular Vegetation	Seagrass Bed	*Zostera marina* Herbaceous Vegetation		Nearly Equal	Certain	There are likely threshold differences making the relationship nearly equal.
ACE	Army Corps Dredge Boundaries					Anthropogenic	Dredged/Excavated Channel		X					X					Dredged	Nearly Equal	Somewhat Certain	
MORIS Marinas	Boatyard					Anthropogenic	Marina/Boat Ramp		X					X						Less Than	Certain	
MORIS Marinas	Marina					Anthropogenic	Marina/Boat Ramp		X					X						Less Than	Certain	
MORIS Marinas	Yacht Club					Anthropogenic	Marina/Boat Ramp		X					X						Less Than	Certain	
MORIS	Mooring Field Boundaries					Anthropogenic	Mooring Field		X					X						Equal	Certain	
AWOIS/MORIS	Active wreck					Anthropogenic	Wreck		X					X						Less Than	Certain	
AWOIS/MORIS	Named vessel					Anthropogenic	Wreck		X					X						Less Than	Certain	
AWOIS/MORIS	Obstruction					Anthropogenic	Wreck		X					X						Less Than	Certain	
AWOIS/MORIS	Unknown wreck/obstruction					Anthropogenic	Wreck		X					X						Less Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
MORIS/EPA	Outfalls-intakes					Anthropogenic	Outfall/Intake		X					X						Less Than	Certain	
MORIS	MWRA Outfall Pipeline					Anthropogenic	Pipeline Area		X					X						Less Than	Certain	The source unit has more detail than the CMECS unit regarding what kind of pipeline (sewer outfall).
MORIS	MWRA Tunnel					Anthropogenic			X					X						No equivalent	Certain	
MORIS	Algonquin Hubline LNG Pipeline					Anthropogenic	Pipeline Area		X					X						Less Than	Somewhat certain	The source unit has more detail than the CMECS unit regarding what kind of pipeline (LNG).
DMF Shellfish Suitability	American oyster					X			X					Benthic/Attached Biota	Faunal Bed	Attached Fauna	Attached Oysters	Attached *Crassostrea*		Greater Than	Certain	
DMF Shellfish Suitability	American oyster					X			X					Benthic/Attached Biota	Faunal Bed	Soft Sediment Fauna	Oyster Bed	*Crassostrea* bed		Greater Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Shellfish Suitability	American oyster					Biogenic	Mollusk Reef		X					Benthic/Attached Biota	Reef Biota	Mollusk Reef Biota	Oyster Reef	*Crassostrea* reef		Greater Than	Certain	Relationship done with Biotic; hard to determine if this should xwalk to Geoform or Substrate. Chose not to do substrate since it depends on how much shell is there to really consider it a substrate.
DMF Shellfish Suitability	Bay scallop					X			X					Benthic/Attached Biota	Faunal Bed	Soft Sediment Fauna	Scallop Bed	*Argopecten* bed		Nearly Equal	Certain	
DMF Shellfish Suitability	Blue mussel					X			X					Benthic/Attached Biota	Faunal Bed	Attached Fauna	Attached Mussels	Attached *Mytilus*		Greater Than	Certain	
DMF Shellfish Suitability	Blue mussel					X			X					Benthic/Attached Biota	Faunal Bed	Soft Sediment Fauna	Mussel Bed	*Mytilus* bed		Greater Than	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Shellfish Suitability	Blue mussel					Biogenic	Mollusk Reef		X					Benthic /Attached Biota	Reef Biota	Mollusk Reef Biota	Mussel Reef	*Mytilus* reef		Greater Than	Certain	Relationship done with Biotic; hard to determine if this should xwalk to Geoform or Substrate. Chose not to do substrate since it depends on how much shell is there to really consider it a substrate.
DMF Shellfish Suitability	European oyster					X			X					Benthic /Attached Biota	Faunal Bed	Attached Fauna	Attached Oysters	Attached *Ostrea*	Exotic	Greater Than	Certain	
DMF Shellfish Suitability	European oyster					X			X					Benthic /Attached Biota	Faunal Bed	Soft Sediment Fauna	Oyster Bed	*Ostrea* bed	Exotic	Greater Than	Certain	
DMF Shellfish Suitability	European oyster					Biogenic	Mollusk Reef		X					Benthic /Attached Biota	Reef Biota	Mollusk Reef Biota	Oyster Reef	*Ostrea* reef	Exotic	Greater Than	Certain	Relationship done with Biotic; hard to determine if this should xwalk to Geoform or Substrate. Chose not to do substrate since it depends on how much shell is there to really consider it a substrate.

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
DMF Shellfish Suitability	Hard clam					X			X					Benthic /Attached Biota	Faunal Bed	Soft Sediment Fauna	Clam Bed	*Mercenaria* Bed		Nearly Equal	Certain	
DMF Shellfish Suitability	Razor clam					X			X					Benthic /Attached Biota	Faunal Bed	Soft Sediment Fauna	Clam Bed	*Ensis* Bed		Nearly Equal	Certain	
DMF Shellfish Suitability	Sea scallop					X			X					Benthic /Attached Biota	Faunal Bed	Soft Sediment Fauna	Scallop Bed	*Placopecten* Bed		Nearly Equal	Certain	
DMF Shellfish Suitability	Softshell clam					X			X					Benthic /Attached Biota	Faunal Bed	Soft Sediment Fauna	Clam Bed	*Mya* Bed		Nearly Equal	Certain	
DMF Shellfish Suitability	Surf clam					X			X					Benthic /Attached Biota	Faunal Bed	Soft Sediment Fauna	Clam Bed	*Spisula* Bed		Nearly Equal	Certain	
DOT	Dam					Anthropogenic	Dam		X					X						Equal	Certain	
MORIS Coastal Structure Inventory_ Private	Bulkhead/seawall					Anthropogenic	Bulkhead		X					X						Greater Than	Certain	
MORIS Coastal Structure Inventory_ Private	Bulkhead/seawall					Anthropogenic	Seawall													Greater Than	Certain	
MORIS Coastal Structure Inventory_ Private	Groin/jetty					Anthropogenic	Breakwater/ jetty		X					X						Overlapping	Certain	

Data Source	Source Unit	Source Unit 2	Source Unit 3	Aquatic Setting		Geoform Component			Substrate Component					Biotic Component					Mod.	Relat.	Conf.	Notes
Source	Source Unit	Source Unit 2	Source Unit 3	System	Tidal Zone	Geoform Origin	Geoform	Geoform Type	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifiers	Relationship to CMECS	Confidence	Notes
MORIS Coastal Structure Inventory_ Private	Revetment					Anthropogenic	Seawall		X					X						Nearly Equal	Somewhat Certain	The number of distinctions in coastal infrastructure should be considered in CMECS.

9.2: Subregional Scale Crosswalks

9.2.1 McMaster Sediments of Narragansett Bay and Rhode Island Sound (McMaster, 1960)

****The excel table below can be downloaded at http://nature.ly/EDcmecs**

McMaster 1960		RELEVANT CMECS UNITS							
		Aquatic Setting			Substrate Component				
		System	Subsystem	Zone	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup
		Estuarine	Coastal AND Open Water	Subtidal AND Intertidal					
Clayey silt					Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; SiltClay; SandySilt; SandySiltClay
Gravel					Geologic substrate	Unconsolidated mineral substrate	Coarse unconsolidated	Gravel; Gravel mixes	MuddySandyGravel; SandyGravel; Gravel
Gravelly sediment					Geologic substrate	Unconsolidated mineral substrate	Coarse unconsolidated	Gravel mixes; Gravelly	MuddySandyGravel; SandyGravel; MuddyGravel; GravellyMud
Sand					Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Muddy sand; Sand	Sand; SiltySand; SiltyClayeySand; ClayeySand
Sand Silt Clay					Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Muddy sand; Sandy mud	ClayeySand; SiltyClayeySand; SiltySand; SandyClay; SandySiltClay; SandySilt
Silt					Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; SiltClay; SandySiltClay; SandySilt
Silty Sand					Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Muddy sand; Sandy mud	Silt; SiltClay; SandySiltClay; SandySilt

9.2.2 Rhode Island Subaqueous Soils (www.mapcoast.org)

****The excel table below can be downloaded at http://nature.ly/EDcmecs**

Subaqueous Soils				RELEVANT CMECS UNITS										
Landscapes, Landforms, Parent Materials	Soil Series	Map Unit		Geoform Component				Substrate Component						
				Geoform Origin	Level 1	Level 2	Modifier	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Modifier	Co-occurring element modifier
Beach				Geologic	Beach	Beach								
Back-Barrier Beach				Geologic	Beach	Barrier Beach								
Back-Barrier Flat				Geologic	Flat	Back Barrier Flat								
Barrier Beach				Geologic	Beach	Barrier Beach								
Barrier Cove				Geologic	Cove	Barrier Cove								
Barrier Flat				Geologic	Flat; Barrier Flat	Flat; Barrier Flat								
Barrier Island				Geologic	Island; Barrier Island	Island; Barrier Island								
Bay Bottom				Geologic	Flat; Basin	Flat; Basin								
Cove				Geologic	Cove	Cove								
Deflation Flat				Geologic	Flat	Flat								
Dredged Area, Inlet, Marina	Dredged Area			Anthropogenic	Harbor	Marina/Boat Ramp								
		WDr		Anthropogenic	Harbor	Marina/Boat Ramp	Dredged	Anthropogenic						
Dredged Channel				Anthropogenic	Dredged/ Excavated Channel		Dredged							
Dredge-Deposit Shoal				Anthropogenic	Dredge deposit	Dredge deposit shoal	Dredged							
Dredge Spoils				Anthropogenic	Dredge deposit		Dredged							
Dredge Spoil Bank				Anthropogenic	Dredge deposit	Dredge deposit bank	Dredged							
Dune Field				Geologic	Dune Field									
Dune Slack				Geologic	Dune Field									
Filled Marshland				Anthropogenic		Fill Area	Filled							
Flood-Tidal Delta	Massapog sand			Geologic	Delta	Flood-Tidal Delta								

Subaqueous Soils				RELEVANT CMECS UNITS										
Landscapes, Landforms, Parent Materials	Soil Series	Map Unit		Geoform Component				Substrate Component						
				Geoform Origin	Level 1	Level 2	Modifier	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Modifier	Co-occurring element modifier
		Wmg 0		Geologic	Delta	Flood-Tidal Delta		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand		Shallow infralittoral; Flat; Layering: buried lenses of algal material	
		Wmg I		Geologic	Delta	Flood-Tidal Delta		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand		Shallow infralittoral; Flat; Layering: buried lenses of algal material	
		Wmg C		Geologic	Delta	Flood-Tidal Delta		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand		Layering: relict channel phase	
Flood-Tidal Delta Flat				Geologic	Delta	Flood-Tidal Delta								
Flood-Tidal Delta Slope	Marshneck fine sand			Geologic	Delta	Flood-Tidal Delta Slope								
		Wma 0		Geologic	Delta	Flood-Tidal Delta Slope		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand	Fine sand	Shallow infralittoral; Flat - Sloping; Layering: >1 m marine sands over marine silts	
		Wma 1		Geologic	Delta	Flood-Tidal Delta Slope		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand	Fine sand	Shallow infralittoral; Flat - Sloping; Layering: >1 m marine sands over marine silts	
Fluviomarine Bottom				Geologic	Fluviomarine Deposit	Fluviomarine Deposit								
Fluviomarine Deposit				Geologic	Fluviomarine Deposit	Fluviomarine Deposit								
Fluviomarine Terrace				Geologic	Fluviomarine Deposit	Fluviomarine Deposit								
Fringe-Tidal Marsh				Geologic	Marsh Platform	Marsh Platform								
Inlet				Geologic	Inlet	Inlet								
Island				Geologic	Island	Island								
Lagoon				Geologic	Lagoon	Lagoon								

Subaqueous Soils				RELEVANT CMECS UNITS										
Landscapes, Landforms, Parent Materials	Soil Series	Map Unit		Geoform Component				Substrate Component						
				Geoform Origin	Level 1	Level 2	Modifier	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Modifier	Co-occurring element modifier
Lagoon Bottom	Pishagqua silt loam			Geologic	Flat; Basin	Flat; Basin								
		Wpa 0		Geologic	Flat; Basin	Flat; Basin		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Shallow infralittoral; Flat	
		Wpa 1		Geologic	Flat; Basin	Flat; Basin		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Shallow infralittoral; Flat	
		Wpa 2		Geologic	Flat; Basin	Flat; Basin		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Shallow infralittoral; Flat	
	Fort neck silt loam			Geologic	Flat; Basin	Flat; Basin								
		WFn 0		Geologic	Flat; Basin	Flat; Basin		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Shallow infralittoral; Flat; Layering: < 1 m marine silts over marine sands or stratified sand and gravel	
		WFn 1		Geologic	Flat; Basin	Flat; Basin		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Shallow infralittoral; Flat; Layering: < 1 m marine silts over marine sands or stratified sand and gravel	
		WFn 2		Geologic	Flat; Basin	Flat; Basin		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Shallow infralittoral; Flat; Layering: < 1 m marine silts over marine sands or stratified sand and gravel	
Lagoon Channel				Geologic	Channel	Pass/Lagoon Channel								
Lagoonal Deposit				Geologic	Lagoon	Flat; Basin								

Subaqueous Soils				RELEVANT CMECS UNITS										
Landscapes, Landforms, Parent Materials	**Soil Series**	**Map Unit**		**Geoform Component**				**Substrate Component**						
				Geoform Origin	**Level 1**	**Level 2**	**Modifier**	**Substrate Origin**	**Substrate Class**	**Substrate Subclass**	**Substrate Group**	**Substrate Subgroup**	**Modifier**	**Co-occurring element modifier**
Longshore Bar				Geologic	Longshore Bar									
Mainland Cove	Billington silt loam			Geologic	Cove	Mainland Cove								
		WBn 0		Geologic	Cove	Mainland Cove		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Shallow infralittoral; Flat; Layering: Marine silts over organic deposits within 1 m of surface	
		WBn 1		Geologic	Cove	Mainland Cove		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Shallow infralittoral; Flat; Layering: Marine silts over organic deposits within 1 m of surface	
		Wbn 2		Geologic	Cove	Mainland Cove		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Shallow infralittoral; Flat; Layering: Marine silts over organic deposits within 1 m of surface	
		WBn D		Geologic	Cove	Mainland Cove		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy mud	Silt; Sandy silt; Sandy SiltClay; SiltClay	Layering: Organic layer between 1-2 m from surface	
Marine Terrace				Geologic	Marine Terrace									
Point Bar				Geologic	Bar	Point Bar								
Reef				Biogenic	Mollusk Reef Complex; Shallow/Mesophotic Coral Reef									
Relict-Tidal Inlet				Geologic	Relict Tidal Inlet									
Shoal				Geologic	Bank/Shoal									
Shore				Geologic	Shore	Shore								

Subaqueous Soils			RELEVANT CMECS UNITS											
Landscapes, Landforms, Parent Materials	Soil Series	Map Unit	Geoform Component				Substrate Component							
			Geoform Origin	Level 1	Level 2	Modifier	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Modifier	Co-occurring element modifier
Shore Complex			Geologic	Shore Complex									
Shoreline			Geologic	Shore									
Spit			Geologic	Spit									
Submerged-Upland Tidal Marsh			Geologic	Marsh Platform									
Submerged Back-Barrier Beach			Geologic	Beach	Barrier Beach	Shallow infralittoral							
Submerged Mainland Beach	Anguilla loamy sand		Geologic	Beach	Mainland Beach	Shallow infralittoral							
		Waa 0	Geologic	Beach	Mainland Beach	Shallow infralittoral	Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand; Muddy Sand	Very coarse sand, Coarse sand; Medium sand, Fine sand; Very fine sand; Clayey sand; Siltyclayey sand; Silty sand	Shallow infralittoral; Flat - Sloping; Layering: Overlying outwash deposits	
Submerged Mainland Beach-bouldery phase	Napatree loamy sand		Geologic	Beach	Mainland Beach	Shallow infralittoral							
		Wne 0	Geologic	Beach	Mainland Beach	Shallow infralittoral	Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand; Muddy Sand	Very coarse sand, Coarse sand; Medium sand, Fine sand; Very fine sand; Clayey sand; Siltyclayey sand; Silty sand	Shallow infralittoral; Flat - Sloping; Layering: Overlying submerged terrestrial till deposits	Geologic substrate; Unconsolidated mineral substrate; Coarse unconsolidated substrate; Gravel; Boulder

Subaqueous Soils				RELEVANT CMECS UNITS										
Landscapes, Landforms, Parent Materials	**Soil Series**	**Map Unit**		**Geoform Component**				**Substrate Component**						
				Geoform Origin	**Level 1**	**Level 2**	**Modifier**	**Substrate Origin**	**Substrate Class**	**Substrate Subclass**	**Substrate Group**	**Substrate Subgroup**	**Modifier**	**Co-occurring element modifier**
		WNx 0		Geologic	Beach	Mainland Beach	Shallow infralittoral	Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand; Muddy Sand	Very coarse sand, Coarse sand; Medium sand, Fine sand; Very fine sand; Clayey sand; Siltyclayey sand; Silty sand	Shallow infralittoral; Flat - Sloping; Layering: Overlying submerged terrestrial till deposits	Geologic substrate; Unconsolidated mineral substrate; Coarse unconsolidated substrate; Gravel; Boulder
Submerged stream valley	Wamphassuc sandy loam			Geologic	Channel; Slough		Shallow infralittoral							
		WWc 0		Geologic	Channel; Slough		Shallow infralittoral	Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand; Muddy Sand	Very coarse sand, Coarse sand; Medium sand, Fine sand; Very fine sand; Clayey sand; Siltyclayey sand; Silty sand	Shallow infralittoral; Flat	
		WWc 1		Geologic	Channel; Slough		Shallow infralittoral	Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand; Muddy Sand	Very coarse sand, Coarse sand; Medium sand, Fine sand; Very fine sand; Clayey sand; Siltyclayey sand; Silty sand	Shallow infralittoral; Flat	
Submerged Wave-Built Terrace				Geologic	Wave-built terrace		Shallow infralittoral							
Submerged Wave-Cut Platform				Geologic	Wave-cut platform		Shallow infralittoral							
Swash Zone				Geologic	Shore	Foreshore								
Tidal Flat				Geologic	Flat	Tidal Flat								
Tidal Inlet				Geologic	Inlet	Tidal Inlet								

Subaqueous Soils				RELEVANT CMECS UNITS										
Landscapes, Landforms, Parent Materials	Soil Series	Map Unit		Geoform Component				Substrate Component						
				Geoform Origin	Level 1	Level 2	Modifier	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Modifier	Co-occurring element modifier
Tidal Marsh				Geologic	Marsh Platform									
Washover Fan	Nagunt sand			Geologic	Fan	Washover Fan								
		Wna 0		Geologic	Fan	Washover Fan		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand		Shallow infralittoral; Flat	
		Wna 1		Geologic	Fan	Washover Fan		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand		Shallow infralittoral; Flat	
		Wna 2		Geologic	Fan	Washover Fan		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand		Shallow infralittoral; Flat	
		Wna I		Geologic	Fan	Washover Fan		Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand		Shallow infralittoral; Flat	
Washover Fan Flat				Geologic	Washover Fan Flat									
Washover-Fan Slope	Nagunt sand			Geologic	Washover Fan Slope									
		Wns 1		Geologic	Washover Fan Slope			Geologic substrate	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand		Shallow infralittoral; Sloping	
Wave-built Terrace				Geologic	Wave-built terrace									
Wave-cut Platform				Geologic	Wave-cut platform									
Wind-tidal Flat				Geologic	Wind tidal flat									

9.2.3 Maine Coastal Marine Geological Enviromnents (Kelley et al., 2005)

****The excel table below can be downloaded at http://nature.ly/EDcmecs**

MAINE GEOLOGICAL SURVEY	RELEVANT CMECS UNITS															
	Aquatic Setting	Geoform Component				Substrate Component					Biotic Component					
	System Subsystem Tidal Zone	Physiographic Setting	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifier
PHYSIOGRAPHIC ZONE																
Nearshore Ramp	Marine Nearshore Subtidal	Continental Shore Complex	Geologic		Slope											
Nearshore Basin	Marine Nearshore Subtidal	Continental Shore Complex	Geologic	Basin	Rock Outcrops											
Rocky Zones	Marine Nearshore; Offshore Subtidal	Continental Shore Complex	Geologic	Aprons; Boulder fields; Ledges; Moraines; Rock Outcrops; Rubble Fields	Knobs; Overhangs (Cliffs)											
Shelf Valleys	Marine Nearshore Subtidal	Continental Shore Complex	Geologic	Shelf Valley												
Outer Basins	Marine Offshore Subtidal	Continental Shore Complex	Geologic	Basin												
Hard-bottom Plains	Marine Nearshore; Offshore Subtidal	Continental Shore Complex	Geologic	Pavement Area; Rubble Field; Till Surface												
SUPRATIDAL ENVIRONMENTS	Marine Nearshore Supratidal															
Dunes and vegetated beach ridges			Geologic	Dune field	Dune	Geologic	Unconsolidated mineral substrate	Coarse/Fine Unconsolidated Substrate			N/A					
Fresh-brackish water			Geologic	Marsh platform							Benthic/attached biota	Emergent Wetland	Emergent tidal marsh	Brackish marsh; Freshwater tidal marsh		Oligohaline
Fresh-brackish marsh			Geologic	Marsh platform							Benthic/attached biota	Emergent Wetland	Emergent tidal marsh	Brackish marsh; Freshwater tidal marsh		Oligohaline
Man-made land			Anthropogenic		Fill Area											

MAINE GEOLOGICAL SURVEY	RELEVANT CMECS UNITS															
	Aquatic Setting	**Geoform Component**				**Substrate Component**					**Biotic Component**					
	System Subsystem Tidal Zone	**Physiographic Setting**	**Geoform Origin**	**Level 1**	**Level 2**	**Substrate Origin**	**Substrate Class**	**Substrate Subclass**	**Substrate Group**	**Substrate Subgroup**	**Biotic Setting**	**Biotic Class**	**Biotic Subclass**	**Biotic Group**	**Biotic Community**	**Modifier**
Landslide excavation and deposits			Geologic	Submarine slide deposit?												Littoral?
Eoilian flat			Geologic	Flat	Flat	Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand							
Washover flat			Geologic	Flat	Washover fan flat											
Fluvial marsh			Geologic	Marsh platform							Benthic/attached biota	Emergent Wetland	Emergent tidal marsh	Freshwater tidal marsh		
INTERTIDAL ENVIRONMENTS	Marine Nearshore Intertidal															Littoral
Marsh environments			Geologic	Marsh platform							Benthic/attached biota	Emergent Wetland	Emergent tidal marsh			Littoral
High salt mash			Geologic	Marsh platform							Benthic/attached biota	Emergent Wetland	Emergent tidal marsh	High salt marsh	Spartina patens	Littoral
Low salt marsh			Geologic	Marsh platform							Benthic/attached biota	Emergent Wetland	Emergent tidal marsh	Low and intermediate salt marsh	Spartina alterniflora	Littoral
Marsh levee			Geologic	Natural levee							Benthic/attached biota	Emergent Wetland	Emergent tidal marsh	High salt marsh	Spartina patens	Littoral
Salt pannes and salt ponds			Geologic; Anthropogenic	Panne; Salt pond												Littoral
Beach environments			Geologic	Beach												Littoral
Sand beach			Geologic	Beach		Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand							Littoral
Mixed sand and gravel beach			Geologic	Beach		Geologic	Unconsolidated mineral substrate	Coarse/Fine unconsolidated substrate								Littoral
Gravel beach			Geologic	Beach		Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel; Gravel mixes; Gravelly							Littoral
Boulder beach			Geologic	Beach		Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel	Boulder						Littoral

MAINE GEOLOGICAL SURVEY	RELEVANT CMECS UNITS															
	Aquatic Setting	Geoform Component				Substrate Component					Biotic Component					
	System Subsystem Tidal Zone	Physiographic Setting	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifier
Low-energy beach			Geologic	Beach		Geologic	Unconsolidated mineral substrate									Littoral; Quiescent; Very low wave energy; low wave energy
Boulder ramp			Geologic	Pavement area		Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel	Boulder						Littoral
Washover fan			Geologic	Fan	Washover fan	Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel							Littoral
Spits			Geologic	Spit/Tombolo												Littoral
Flat environments			Geologic	Flat												Littoral
Mud flats			Geologic	Flat	Flat	Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud							Littoral
Coarse-grained flat			Geologic	Flat	Flat	Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate								Littoral
Seaweed-covered coarse flat			Geologic	Flat	Flat	Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate			Benthic/attached biota	Aquatic vegetation bed	Benthic macroalgae	Leathery/Leafy Algal bed; Sheet Algal bed; Canopy-forming Algal bed	*Ulva* , *Enteromorpha* , *Ascophyllum* , and *Laminaria*	Littoral
Mussel bar			Biogenic	Mollusk reef	Patch mollusk reef	Biogenic	Shell substrate	Shell reef substrate	Mussel reef substrate		Benthic/attached biota	Reef biota	Mollusk reef biota	Mussel reef	Mytilus reef	Littoral
Channel levee			Geologic	Natural levee												Littoral
Algal flats			Geologic	Flat		Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate			Benthic/attached biota	Aquatic vegetation bed	Benthic macroalgae	Sheet algal bed	Ulva community	Littoral
Veneered ramp			Geologic	Pavement area		Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel	Boulder						Littoral; Layering: fine-grained sediment veneer
Miscellaneous environments																

MAINE GEOLOGICAL SURVEY	RELEVANT CMECS UNITS															
	Aquatic Setting	Geoform Component				Substrate Component					Biotic Component					
	System Subsystem Tidal Zone	Physiographic Setting	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifier
Ledge			Geologic	Ledge		Geologic	Rock substrate	Bedrock								Littoral
Fluvial-estuarine channel			Geologic	Channel	Tidal channel/creek?											Littoral
Point or lateral bars			Geologic	Bar	Point bar											Littoral
Swash bars			Geologic	Bar												Littoral
Flood-tidal delta			Geologic	Delta	Flood tidal delta											Littoral
Ebb-tidal delta			Geologic	Delta	Ebb tidal delta											Littoral
Fan delta			Geologic	Flat	Flood tidal delta flat											Littoral
Spillover lobes			Geologic	Delta	Flood tidal delta slope											Littoral
SUBTIDAL ENVIRONMENTS	Marine Nearshore Subtidal															
Flat environments																
Mud flat			Geologic	Flat	Flat	Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud							
Coarse-grained flat			Geologic	Flat	Flat	Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate								
Eelgrass flat			Geologic	Flat	Flat	Geologic	Unconsolidated mineral substrate	Coarse/fine unconsolidated substrate			Benthic/attached biota	Aquatic vegetation bed	Aquatic vascular vegetation	Seagrass bed	Zostera community	
Seaweed community			Geologic	Flat	Flat	Geologic	Rock substrate; Unconsolidated mineral substrate	Bedrock; Coarse unconsolidated substrate			Benthic/attached biota	Aquatic vegetation bed	Benthic macroalgae			
Upper shoreface			Geologic	Shore complex	Shore; Foreshore	Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand							
Lower shoreface			Geologic	Shore complex	Shore	Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand; Mud							
Channel environments																
High-velocity tidal channel			Geologic	Channel	Tidal channel/creek											High current energy

MAINE GEOLOGICAL SURVEY	RELEVANT CMECS UNITS															
	Aquatic Setting	Geoform Component				Substrate Component					Biotic Component					
	System Subsystem Tidal Zone	Physiographic Setting	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifier
Medium-velocity tidal channel			Geologic	Channel	Tidal channel/creek											Moderate current energy
Low-velocity tidal channel			Geologic	Channel	Tidal channel/creek											Low current energy
Estuarine channel	Estuarine Tidal Riverine Coastal Subtidal		Geologic	Channel												Mesohaline; Upper polyhaline; Lower polyhaline
Estuarine flood channel	Estuarine Tidal Riverine Coastal Subtidal		Geologic	Channel	Tidal channel/creek											
Estuarine ebb channel	Estuarine Tidal Riverine Coastal Subtidal		Geologic	Channel	Tidal channel/creek											
Inlet channel			Geologic	Inlet; Channel	Pass/Lagoon channel											
Dredged channel			Anthropogenic	Dredged/excavated channel												
Channel slope			Geologic	Channel												
Abandoned tidal channel			Geologic	Inlet	Relict tidal inlet											
Tidal fluvial channel			Geologic	Channel	Tidal channel/creek											
Tidal creeks			Geologic	Channel	Tidal channel/creek											
Marsh drainage ditch			Anthropogenic	Mosquito ditch												
Surficial geology																
Rocky						Geologic	Rock Substrate	Bedrock								
Gravelly						Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel; Gravel Mixes; Gravelly							
Sandy						Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Slightly gravelly; Sand; Muddy Sand; Sandy Mud							

MAINE GEOLOGICAL SURVEY	RELEVANT CMECS UNITS																
		Aquatic Setting	Geoform Component				Substrate Component					Biotic Component					
		System Subsystem Tidal Zone	Physiographic Setting	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifier
Muddy							Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Muddy Sand; Sandy Mud; Mud							

9.2.4 Marine and Estuarine Habitats in Maine (Brown 1993)

****The excel table below can be downloaded at http://nature.ly/EDcmecs**

MARINE AND ESTUARINE HABITATS IN MAINE	RELEVANT CMECS UNITS														
	Aquatic Setting	Geoform Component			Substrate Component					Biotic Component					
	System Subsystem Tidal Zone	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotope	Modifier
SYSTEMS: BIOMES															
Marine	Marine / Nearshore /														
Estuarine	Estuarine / Coastal; Open water; Tidal riverine coastal; Tidal riverine open water /														
SUBSYSTEMS: TIDAL REGIMES															
Intertidal	/ / Intertidal														
Subtidal	/ / Subtidal														
CLASSES: SUBSTRATA															
Rock					Geologic	Rock substrate	Bedrock; Megaclast								
Boulders					Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel	Boulder						
Hardpan* NOT FOUND TO DATE IN MAINE					Geologic										
Cobble					Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel	Cobble						
Mixed coarse					Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel mixes	Sandy gravel						
Gravel					Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel	Pebble; Granule						
Sand					Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand							
Mixed coarse and fine					Geologic	Unconsolidated mineral substrate	Coarse unconsolidated substrate	Gravel mixes							
Mixed-fine					Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Slightly gravelly							
Mud					Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud							

MARINE AND ESTUARINE HABITATS IN MAINE		RELEVANT CMECS UNITS														
		Aquatic Setting	**Geoform Component**			**Substrate Component**					**Biotic Component**					
		System Subsystem Tidal Zone	**Geoform Origin**	**Level 1**	**Level 2**	**Substrate Origin**	**Substrate Class**	**Substrate Subclass**	**Substrate Group**	**Substrate Subgroup**	**Biotic Setting**	**Biotic Class**	**Biotic Subclass**	**Biotic Group**	**Biotope**	**Modifier**
Organic						Biogenic	Organic substrate	Organic debris; Organic detritus								
Artifical			Anthropogenic	Aquaculture structure	Aquaculture structure; Bulkhead; Dock/pier; Pilings; Riprap deposit	Anthropogenic	Anthropogenic rock; Anthropogenic wood; Construction materials; Metal; Trash									
Bioherms			Biogenic	Mollusk reef		Biogenic	Shell substrate	Shell reef substrate	Mussel reef substrate; Oyster reef substrate							
SUBCLASSES: ENERGY LEVELS																
Intertidal exposed																Unenclosed
Intertidal partially exposed																Partially enclosed; Intermittent
Intertidal semi-protected																Partially enclosed
Intertidal protected																Enclosed
Marine subtidal high energy																Energy intensity; Wave regime
Marine subtidal moderate energy																Energy intensity; Wave regime
Marine subtidal low energy																Energy intensity; Wave regime
Estuarine intertidal and subtidal open																Unenclosed
Estuarine intertidal and subtidal partly enclosed																Partially enclosed
Estuarine intertidal and subtidal lagoon* NOT FOUND TO DATE IN MAINE																Intermittent

MARINE AND ESTUARINE HABITATS IN MAINE		RELEVANT CMECS UNITS														
		Aquatic Setting	Geoform Component			Substrate Component					Biotic Component					
		System Subsystem Tidal Zone	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotope	Modifier
Estuarine intertidal and subtidal channel			Geologic	Channel; Inlet	Tidal channel/creek; Tidal inlet											Intermittent
MODIFIERS																
Depth, shallow																Deep infralittoral; Shallow infralittoral; Littoral
Depth, deep																Circalittoral
Hypersaline																Hyperhaline
Mixohaline																Oligohaline; Mesohaline; Lowerpolyhaline; Upperpolyhaline
Polyhaline																Lower polyhaline; Upper polyhaline
Mesohaline																Mesohaline
Oligohaline																Oligohaline
Estuarine mud, pockmark			Geologic	Pockmark field	Pockmark											
Estuarine organic intertidal: salt marsh; subtidal sawdust			Geologic	Marsh platform		Anthropogenic	Anthropogenic wood	Anthropogenic wood hash			Benthic/Attached biota	Emergent wetland	Emergent tidal marsh			
Bioherm mussel or oyster bars			Biogenic	Mollusk reef							Benthic/Attached biota	Reef biota	Mollusk reef biota	Mussel reef; Oyster reef		
Temperature eurythermal																Temperature modifier
Temperature stenothermal																Temperature modifier
DIAGNOSTIC SPECIES																
COMMON SPECIES																
MARINE INTERTIDAL																

MARINE AND ESTUARINE HABITATS IN MAINE		RELEVANT CMECS UNITS														
		Aquatic Setting	Geoform Component			Substrate Component					Biotic Component					
		System Subsystem Tidal Zone	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotope	Modifier
Rock: Exposed											Benthic/Attached biota	Moss and lichen communitites; Faunal bed; Aquatic vegetation bed	Marine lichens; Attached fauna; Benthic macroalgae		X	
Rock: Partially exposed											Benthic/Attached biota	Moss and lichen communitites; Faunal bed; Aquatic vegetation bed	Marine lichens; Attached fauna; Benthic macroalgae		X	
Rock: Semi-protected and protected											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Benthic macroalgae		X	
Boulder: Partially exposed											Benthic/Attached biota	Faunal bed	Attached fauna		X	
Cobble: Partially exposed											Benthic/Attached biota	Faunal bed	Attached fauna		X	
Gravel: Exposed and partially exposed											Benthic/Attached biota	Faunal bed	Attached fauna		X	
Mixed coarse: Exposed and partially exposed											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Benthic macroalgae		X	
Mixed coarse: Semi-protected and protected											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Benthic macroalgae		X	
Mixed coarse and fine: semi-protected											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Soft sediment fauna; Aquatic vascular vegetation		X	
Sand: Exposed and partially exposed											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Sand: Semi-protected and protected											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Soft sediment fauna; Aquatic vascular vegetation; Attached fauna		X	
Mixed fine: Semi-protected and protected											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Mud: Protected											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Soft sediment fauna; Benthic macroalgae		X	
MARINE SUBTIDAL															X	

MARINE AND ESTUARINE HABITATS IN MAINE	RELEVANT CMECS UNITS															
		Aquatic Setting	Geoform Component			Substrate Component					Biotic Component					
		System Subsystem Tidal Zone	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotope	Modifier
Rock: High energy, shallow											Benthic/Attached biota	Aquatic vegetation bed	Benthic macroalgae		X	
Rock: High wave energy, shallow											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Benthic macroalgae		X	
Rock: High current energy, shallow											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Benthic macroalgae		X	
Rock: High energy, deep											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Benthic macroalgae		X	
Rock: High current energy, deep, stenothermal											Benthic/Attached biota	Faunal bed	Attached fauna		X	
Boulder: High energy, deep											Benthic/Attached biota	Faunal bed	Attached fauna		X	
Cobble: High energy, shallow											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Benthic macroalgae		X	
Gravel: High to moderate energy, shallow and deep											UNKNOWN				X	
Mixed coarse: High to moderate energy, shallow											UNKNOWN				X	
Mixed coarse: High to moderate energy, deep															X	
Mixed coarse and fine: Moderate energy, shallow											Benthic/Attached biota	Faunal bed	Attached fauna		X	
Mixed coarse and fine: Moderate energy, deep											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Aquatic vascular vegetation		X	
Sand: High to moderate energy, shallow											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Aquatic vascular vegetation		X	
Sand: High to moderate energy, deep											Benthic/Attached biota	Aquatic vegetation bed	Aquatic vascular vegetation		X	
Mixed fines: Low energy, shallow and deep											Benthic/Attached biota	Aquatic vegetation bed	Aquatic vascular vegetation		X	

MARINE AND ESTUARINE HABITATS IN MAINE		RELEVANT CMECS UNITS														
		Aquatic Setting	Geoform Component			Substrate Component					Biotic Component					
		System Subsystem Tidal Zone	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotope	Modifier
Mud: Low energy, shallow											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Mud: Low energy, deep											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Mud: Low energy, deep, stenothermal											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Organic (sawdust and woodchips): Moderate to low energy, shallow											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	Contaminated
Bioherm: Moderate energy, shallow, mussel bar											Benthic/Attached biota	Reef biota; Faunal bed	Mollusk reef biota; Attached fauna		X	
Artificial (dump site): Low energy, shallow											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	Contaminated
ESTUARINE INTERTIDAL															X	
Rocky: Open and partly enclosed, polyhaline											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Benthic macroalgae		X	
Mixed coarse: Open and polyhaline											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Attached fauna; Benthic macroalgae		X	
Mixed coarse and fine: Open ana partly enclosed, polyhaline											Benthic/Attached biota	Faunal bed; Aquatic vegetation bed	Soft sediment fauna; Benthic macroalgae		X	
Mixed coarse and fine: Open and partly enclosed, mesohaline											Benthic/Attached biota	Aquatic vegetation bed; Emergent wetland	Benthic macroalgae; Emergent tidal marsh		X	
Sand: open and partly enclosed, polyhaline											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Mixed fines: partly enclosed, polyhaline											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Mud: partly enclosed or lagoon, polyhaline											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Mud: channel, mesohaline											Benthic/Attached biota	Faunal bed	Soft sediment fauna; Attached fauna		X	

MARINE AND ESTUARINE HABITATS IN MAINE	RELEVANT CMECS UNITS															
		Aquatic Setting	Geoform Component			Substrate Component					Biotic Component					
		System Subsystem Tidal Zone	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotope	Modifier
Organic: open and partly enclosed, polyhaline salt marsh											Benthic/Attached biota	Emergent wetland	Emergent tidal marsh		X	
Organic: partly enclosed, mesohaline, salt marsh											Benthic/Attached biota	Emergent wetland	Emergent tidal marsh		X	
Organic: partly enclosed, oligohaline, salt marsh											Benthic/Attached biota	Emergent wetland	Emergent tidal marsh		X	
Bioherm: partly enclosed, polyhaline, mussel bar											Benthic/Attached biota	Reef biota	Mollusk reef biota		X	
ESTUARINE SUBTIDAL															X	
Rock: open, shallow, mixohaline											Benthic/Attached biota	Aquatic vegetation bed; Faunal bed	Benthic macroalgae; Attached fauna		X	
Rock: open, shallow, polyhaline											Benthic/Attached biota	Faunal bed	Attached fauna		X	
Rock: channel, shallow, polyhaline											Benthic/Attached biota	Faunal bed	Attached fauna		X	
Mixed coarse and fine: open and partly enclosed, shallow, polyhaline, stenothermal											Benthic/Attached biota	Faunal bed	Attached fauna; Soft sediment fauna		X	
Mixed coarse and fine: open and partly enclosed, shallow, polyhaline, eurythermal											Benthic/Attached biota	Faunal bed	Attached fauna; Soft sediment fauna		X	
Mixed coarse and fine: channel, shallow, polyhaline											Benthic/Attached biota	Aquatic vegetation bed; Faunal bed	Aquatic vascular vegetation; Attached fauna		X	
Sand: open and partly enclosed, shallow, polyhaline											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	

MARINE AND ESTUARINE HABITATS IN MAINE	RELEVANT CMECS UNITS															
		Aquatic Setting	Geoform Component			Substrate Component					Biotic Component					
		System Subsystem Tidal Zone	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotope	Modifier
Mud: partly enclosed, shallow, oligohaline											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Mud: open, deep, polyhaline											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Mud: gas-escape pockmark, open, shallow to deep, polyhaline											UNKNOWN				X	
Organic (sawdust and woodchips): open and partly enclosed, shallow, polyhaline											Benthic/Attached biota	Faunal bed	Soft sediment fauna		X	
Bioherm: partly enclosed, shallow, polyhaline, mussel bar											Benthic/Attached biota	Reef biota	Mollusk reef biota		X	
Bioherm: open and partly enclosed, shallow, mixohaline, oyster bar											Benthic/Attached biota	Reef biota	Mollusk reef biota		X	

9.2.5 A Technical Characterization of Estuarine and Coastal New Hampshire (Jones 2000)

****The excel table below can be downloaded at http://nature.ly/EDcmecs**

A TECHNICAL CHARACTERIZATION OF ESTUARINE AND COASTAL NH	RELEVANT CMECS UNITS									
	Aquatic Setting	Geoform Component			Biotic Component					
	System Subsystem Tidal Zone	Physiographic Setting	Geoform Origin	Level 1	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifier
Great Bay Estuary	Estuarine Coastal Subtidal	Embayment/Bay								
Oyster beds					Benthic/attached biota	Reef biota; Faunal bed	Mollusk reef biota; Attached fauna	Oyster reef; Attached oysters		
Scattered oysters					Benthic/attached biota	Faunal bed	Attached fauna	Attached oysters		
Soft-shell clams					Benthic/attached biota	Faunal bed	Soft sediment fauna	Clam bed	Mya bed	
Hampton/Seabrook Estuary	Estuarine Coastal Subtidal	Embayment/Bay								
Harbor clam flats			Geologic	Flat	Benthic/attached biota	Faunal bed	Soft sediment fauna	Clam bed		
Beach and Dune Systems	Estuarine Coastal Supratidal		Geologic	Beach; Dune Complex						
Selected Invertebrate Species										
Eastern oyster (Crassostrea virginica)					Benthic/attached biota	Reef biota; Faunal bed	Mollusk reef biota; Attached fauna	Oyster reef; Attached oysters	Crassostrea reef; Attached Crassostrea	
Softshell clam (Mya arenaria)					Benthic/attached biota	Faunal bed	Soft sediment fauna	Clam bed	Mya bed	
Blue mussel (Mytilus edulis)					Benthic/attached biota	Reef biota; Faunal bed	Mollusk reef biota; Attached fauna	Mussel reef; Attached mussels	Mytilus reef; Attached Mytilus	
Sea scallop (Placopecten magellanicus)					Benthic/attached biota	Faunal bed	Soft sediment fauna	Scallop bed	Placopecten bed	
American lobster					Benthic/attached biota	Faunal bed	Soft sediment fauna; Attached fauna	Tunneling megafauna; Mobile crustaceans on soft sediments; Mobile crustaceans on hard or mixed substrates	Homarus	
Horseshoe Crab (Limulus polyphemus)					Benthic/attached biota	Faunal bed				
Cordgrass/Salt Hay Habitat	Estuarine Coastal Intertidal				Benthic/attached biota	Emergent Wetland	Emergent tidal marsh	High salt marsh/Low salt marsh	Spartina patens/Spartina alterniflora	
Tufted Redweed					Benthic/attached biota	Aquatic vegetation bed	Benthic macroalgae	Leathery/Leafy Algal bed	Mastocarpus community	
Rockweed					Benthic/attached biota	Aquatic vegetation bed	Benthic macroalgae	Leathery/Leafy Algal bed	Ascophyllum community	
Irish Moss					Benthic/attached biota	Aquatic vegetation bed	Benthic macroalgae	Leathery/Leafy Algal bed	Chondrus community	

A TECHNICAL CHARACTERIZATION OF ESTUARINE AND COASTAL NH	RELEVANT CMECS UNITS									
	Aquatic Setting	Geoform Component			Biotic Component					
	System Subsystem Tidal Zone	Physiographic Setting	Geoform Origin	Level 1	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifier
Eelgrass bed					Benthic/attached biota	Aquatic vegetation bed	Aquatic vascular vegetation	Seagrass bed	Zostera community	
Introduced and nuisance species										
Green crab (Carcinus maenus)-I&N					Benthic/attached biota	Faunal bed	Soft sediment fauna; Attached fauna	Mobile crustaceans on soft sediments; Mobile crustaceans on hard or mixed substrates	Carcinus	Exotic
European flat oyster (Ostrea edulis)-I					Benthic/attached biota	Reef biota; Faunal bed	Mollusk reef biota; Attached fauna	Oyster reef; Attached oysters	Ostrea reef; Attached Ostrea	Exotic
Common periwinkle (Littorina littorea)-I					Benthic/attached biota	Faunal bed	Attached fauna	Mobile mollusks on hard or mixed substrates	Littorina community	Exotic
Oyster drill (Urosalpinx cinerea)-N					Benthic/attached biota	Faunal bed	Attached fauna	Mobile mollusks on hard or mixed substrates	Urosalpinx community	
Sea lettuce (Ulva lactuca)-N					Benthic/attached biota; Planktonic biota	Aquatic vegetation bed; Floating/suspended plants and macroalgae	Benthic macroalgae; Floating/Suspended macroalgae	Sheet algal bed; Algal rafts	Ulva community; Ulva rafts	
Drift algal beds-N					Planktonic biota	Floating/Suspended plants and macroalgae	Floating/Suspended macroalgae	Algal rafts		

9.2.6 Narragansett Bay Project Benthic Habitats (French et al., 1992)

****The excel table below can be downloaded at http://nature.ly/EDcmecs**

NARRAGANSETT BAY PROJECT BENTHIC HABITATS	RELEVANT CMECS UNITS														
	Aquatic Setting	Geoform Component			Substrate Component					Biotic Component					
	System Subsystem Tidal Zone	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifier
BSA Marine Sand	Marine Nearshore Subtidal; Estuarine Open Water Subtidal				Geologic	Unconsolidated mineral substrate	Fine unconsolidated Substrate	Muddy Sand	Silty Sand	Benthic/attached biota	Faunal bed	Soft sediment fauna	Clam bed		
BSS Marine Silty Sand	Marine Nearshore Subtidal; Estuarine Open Water Subtidal				Geologic	Unconsolidated mineral substrate	Fine unconsolidated Substrate	Sand	Fine Sand	Benthic/attached biota	Faunal bed	Soft sediment fauna	Clam bed; Sand dollar bed; Small tube-building fauna		
BLB Lower Bay Complex	Marine Nearshore Subtidal; Estuarine Open Water Subtidal				Geologic; Biogenic	Unconsolidated mineral substrate; Shell substrate	Fine unconsolidated Substrate; Shell rubble	Mussel rubble; Crepidula rubble		Benthic/attached biota	Faunal bed	Soft sediment fauna	Small tube-building fauna; Small surface-burrowing fauna	Ampelisca community	
BMB Mid Bay Complex	Estuarine Open Water Subtidal				Geologic	Unconsolidated mineral substrate	Fine unconsolidated Substrate	Mud; Sandy Mud		Benthic/attached biota	Faunal bed	Soft sediment fauna	Clam bed; Small surface-burrowing fauna		
BUB Upper Bay Complex	Estuarine Open Water Subtidal	Geologic		Ripples	Geologic	Unconsolidated mineral substrate	Fine unconsolidated Substrate	Sand		Benthic/attached biota	Faunal bed	Soft sediment fauna; Attached fauna	Mussel bed; Sessile gastropods	Mytilus bed; Crepidula	
BME Mussel Beds	Estuarine Open Water Subtidal									Benthic/attached biota	Faunal bed	Soft sediment fauna	Mussel bed	Mytilus bed	
BCF Crepidula Beds	Estuarine Open Water Subtidal									Benthic/attached biota	Faunal bed	Attached fauna	Sessile gastropods	Attached Crepidula	
BAA Amphipod Bed	Estuarine Open Water Subtidal									Benthic/attached biota	Faunal bed	Soft sediment fauna	Small tube-building fauna	Ampelisca community	
BMH Mt Hope Bay Soft Bottom	Estuarine Open Water Subtidal				Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Mud; Sandy Mud		Benthic/attached biota	Faunal bed	Soft sediment fauna	Small tube-building fauna	Spiochaetopterus community	
BUS Upper Bay Soft Bottom	Estuarine Open Water Subtidal				Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate			Benthic/attached biota	Faunal bed	Soft sediment fauna	Small tube-building fauna	Mediomastus, Streblospio bed	
BLP Estuarine Dredged Channel	Estuarine Open Water Subtidal	Anthropogenic	Dredged/excavated channel		Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate			Benthic/attached biota	Faunal bed	Soft sediment fauna	Clam bed; Small surface-burrowing fauna		
BUP Polluted Dredged Channel	Estuarine Open Water Subtidal	Anthropogenic	Dredged/excavated channel		Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate								Contaminated; Fluid substrate; Hypoxic

NARRAGANSETT BAY PROJECT BENTHIC HABITATS		RELEVANT CMECS UNITS														
		Aquatic Setting	Geoform Component			Substrate Component					Biotic Component					
		System Subsystem Tidal Zone	Geoform Origin	Level 1	Level 2	Substrate Origin	Substrate Class	Substrate Subclass	Substrate Group	Substrate Subgroup	Biotic Setting	Biotic Class	Biotic Subclass	Biotic Group	Biotic Community	Modifier
BSU Shallow Undredged Brackish		Estuarine Open Water Subtidal				Geologic	Unconsolidated mineral substrate	Fine unconsolidated substrate	Sand; Mud	Fine Sand; Silt	Benthic/attached biota	Faunal bed	Soft sediment fauna	Clam bed; Small surface burrowing fauna		

9.2.7 Habitat Classification Scheme for the Long Island Sound Region (Auster et al., 2009)

****The excel table below can be downloaded at http://nature.ly/EDcmecs**

Auster et al., 2009		Relationship to CMECS	Confidence	Notes-M.Finkbeiner	Notes-E.Shumchenia
Auster - System	**CMECS**				
Narrows	Virginian - *Ecoregion* (BS) AND Sound/Channel *Physiographic Setting/Level 1 Geoform* (GC)	Less Than	Certain	The Auster system is tailored to Long Island Sound and thus is specific and explicit in its upper geographical units. This is more detailed than the lowest BS unit in CMECS.	
Western Long Island Sound	Virginian - *Ecoregion* (BS) AND Sound *Physiographic Setting* (GC)	Less Than	Certain	The Auster system is tailored to Long Island Sound and thus is specific and explicit in its upper geographical units. This is more detailed than the lowest BS unit in CMECS.	
Central Long Island Sound	Virginian - *Ecoregion* (BS) AND Sound *Physiographic Setting* (GC)	Less Than	Certain	The Auster system is tailored to Long Island Sound and thus is specific and explicit in its upper geographical units. This is more detailed than the lowest BS unit in CMECS.	
Eastern Long Island Sound	Virginian - *Ecoregion* (BS) AND Sound *Physiographic Setting* (GC)	Less Than	Certain	The Auster system is tailored to Long Island Sound and thus is specific and explicit in its upper geographical units. This is more detailed than the lowest BS unit in CMECS.	
Fishers Island Sound	Virginian - *Ecoregion* (BS) AND Sound *Physiographic Setting* (GC)	Less Than	Certain	The Auster system is tailored to Long Island Sound and thus is specific and explicit in its upper geographical units. This is more detailed than the lowest BS unit in CMECS.	
Auster - Subsystem	**CMECS**	**Relationship to CMECS**	**Confidence**	**Notes**	**Notes**
Intertidal	Estuarine Coastal Intertidal - *Tidal Zone* (AS) OR Marine Nearshore Intertidal - *Tidal Zone* (AS)	Greater Than	Certain	The Auster system intertidal boundaries are based on extreme high and low tides which include a wider area then CMECS where the boundaries are MLLW and MHHW.	
Subtidal Shallow	Estuarine Coastal Subtidal - *Tidal Zone* (AS) OR Marine Nearshore Subtidal - *Tidal Zone* (AS)	Less Than	Certain	The Auster system upper subtidal boundary is lower in the gradient than CMECS and thus this area is smaller spatially than in CMECS.	
Subtidal Deep	Estuarine Open Water Subtidal - *Tidal Zone* (AS) OR Marine Nearshore Subtidal - *Tidal Zone* (AS) OR Marine Offshore Subtidal - *Tidal Zone* (AS)	Overlapping	Certain	The -4m depth contour here is the same as the CMECS boundary between Estuarine Coastal and Estuarine Open Water. However it is much shallower than the CMECS Marine Nearshore and Offshore boundary.	
Auster - Class	**CMECS**	**Relationship to CMECS**	**Confidence**	**Notes**	**Notes**
Artificial Structure	Anthropogenic Geoform - *Geoform Origin* (GC)	Greater Than	Certain	In Auster this could include several CMECS anthropogenic structures and so is more general.	Use *WITH* Anthropogenic Impact Modifier
Bank	Bank - *Level 1 or 2 Geoform* (GC)	Nearly Equal	Certain	In Auster a bank is surrounded by shallow water. There is no such restriction in CMECS. Otherwise the units are equivalent	
Basin	Basin - *Level 1 or 2 Geoform* (GC)	Equal	Certain		
Boulder Field	Boulder Field - *Level 1 Geoform* (GC)	Equal	Certain	Auster's Boulder Field unit can only be applied where the boulders do not occur on topopgraphic highs.	
Non-Biogenic Reef	Rock Outcrop - *Level 1 and 2 Geoform* (GC) OR Boulder Field - *Level 1 and 2* Geoform (GC)	Nearly Equal	Certain	Auster's Non-biogenic reef includes both rock outcrops or boulder fields where they occur on topographic highs.	

Channel	Channel - *Level 1 or 2 Geoform* (GC)	Greater Than	Certain		
Gravel Pavement	Boulder Field - *Level 1 Geoform* (GC) AND Coarse Unconsolidated Substrate - *Substrate Group* (SC)	Overlapping	Certain	The Auster unit includes both a sediment grain size element as well as a topopgraphic configuration element. In CMECS these are handled separately.	I added the Boulder Field Geoform to cover the topographic element.
Ledge	Ridge - *Level 1 and 2 Geoform* (GC) OR Ledge - *Level 1 and 2 Geoform* (GC)	Greater Than	Certain	While both CMECS and Auster share a Ledge unit, in Auster this includes ridges and lines of rocks. Auster also restricts this term to features in the sea, whereas CMECS would allow a ledge in the inter or supra-tidal zone.	
Moraine	Moraine - *Level 1 Geoform* (GC)	Equal	Certain		
Mud Fields	Flat - *Level 1 and 2 Geoform* (GC) AND Mud - *Substrate Group* (SC)	Equal	Certain		
Ridge	Ridge - *Level 1 and 2 Geoform* (GC)	Equal	Certain		
Sand Bar	Bar - *Level 1 and 2 Geoform* (GC) AND Sand - *Substrate Group* (SC)	Equal	Certain		
Sand Dune	Dune - *Level 1 and 2 Geoform* (GC) AND Sand - *Substrate Group* (SC)	Equal	Certain	Note- Auster's definition is that these features are formed by current flow.	
Sand Ripple	Ripples - *Level 2 Geoform* (GC) AND Sand - *Substrate Group* (SC)	Equal	Certain		
Sand Wave	Sediment Wave Field - *Level 1 and 2 Geoform* (GC) AND Sand - *Substrate Group* (SC)	Nearly Equal	Certain	While Auster's unit refers to an individual sand wave, CMECS aggregates this spatially into the Wave Field geoform, thus a slight difference in scalel; however in practice this should not pose a problem.	
Scarp	Scarp/Wall - *Level 1 and 2 Geoform* (GC)	Equal	Certain		
Shoal	Shoal - *Level 1 and 2 Geoform* (GC) AND Sand - *Substrate Group* (SC)	Equal	Certain		
Sill	No Equivalent	No Equivalent	Certain		
Terrace	Terrace - *Level 1 Geoform* (GC)	Nearly Equal	Certain	Auster refers only to the fact that a terrace will be bounded by a drop-off on one side and these will occur on the margins of water bodies. CMECS includes a topographic rise and descent as bounding features and allows them to occur in places other than water body margins.	
Vertical Wall	Scarp/Wall - *Level 1 and 2 Geoform* (GC)	Equal	Certain		
Auster - Primary Subclass	**CMECS**	**Relationship to CMECS**	**Confidence**	**Notes**	**Notes**
Organic Debris	Organic Debris - *Substrate Subclass* (SC)	Equal	Certain		
Mud	Mud -*Substrate Group* (SC)	Equal	Certain		
Sand	Sand - *Substrate Group* (SC)	Equal	Certain		
Pebble	Pebble - *Substrate Subgroup* (SC)	Equal	Certain		
Cobble	Cobble - *Substrate Subgroup* (SC)	Equal	Certain		
Boulder	Boulder - *Substrate Subgroup* (SC)	Equal	Certain		
Gravel	Gravel - *Substrate Group* (SC)	Equal	Certain		

Mixed Sediments	Co-Occurring Elements (SC)	Greater Than	Certain		I'm not sure what "mixed sediments" refers to in the context of Wentworth, Folk and Shepard. I would also use co-occurring elements.
Bedrock	Bedrock - *Substrate Subclass* (SC)	Equal	Certain		
Auster - Secondary Subclass	**CMECS**	**Relationship to CMECS**	**Confidence**	**Notes**	**Notes**
Biogenic Reef	Mollusk Reef - *Level 1 or 2 Geoform* (GC) OR Shallow/Mesophotic Coral Reef - *Level 1 and 2 Geoform* (GC)	Greater Than	Certain	In CMECS a user is required to determine whether a biogenic reef is formed by mollusks, worms, or corals.	
Depression	Depression - *Level 2 Geoform* (GC)	Equal	Certain		
Mound	Mound/Hummock - *Level 1 and 2 Geoform* (GC)	Nearly Equal	Certain	CMECS and Auster units are basically equivalent except that in Auster mounds are formed of seafloor sediments whereas in CMECS the type of material forming the mound is not specified.	
Mud Burrows	Burrows/Bioturbation - *Level 2 Geoform* (GC) AND Mud - *Substrate Group* (SC)	Equal	Certain		
Sand Dune Crest	Dune - *Level 2 Geoform* (GC)	Less Than	Certain	Auster's system includes sections of the Dune which CMECS would address through a descriptive attribute.	
Sand Dune Trough	Swale/Slack - *Level 2 Geoform* (GC)	Less Than	Certain	Auster's system includes sections of the Dune which CMECS would address through a descriptive attribute.	
Piled Boulder	Mound/Hummock - *Level 1 and 2 Geoform* (GC) AND Boulder - *Substrate Subgroup* (SC)	Less Than	Certain	While CMECS has an equivalent Boulder unit, Auster goes further by describing the way they are arranged.	
Auster - Biological Processes Modifiers	**CMECS**	**Relationship to CMECS**	**Confidence**	**Notes**	**Notes**
Habitat-Forming Species	Various - *Biotic Community* (BC) AND Co-Occurring Element	Overlapping	Somewhat Certain	This would be handled through various units in the BC in CMECS	
Biogenic Features	Biotic Component AND/OR Biogenic Geoforms - *Geoform Origin* (GC)	Greater Than	Certain	Auster's unit could include both living biota as well as the physical features created by biota. In CMECS these would be captured through units in either the BC or GC.	
Lobster Burrows	Burrows/Bioturbation - *Level 2 Geoform* (GC) WITH Description	Less Than	Certain	The equivalent Burrow/Bioturbation unit in CMECS does not define the source of the burrow. This would be captured through a descriptive attribute.	
Biogenic Depressions from Fishes and Crustaceans	Depression - *Level 2 Geoform* (GC) WITH Description	Less Than	Certain	The equivalent Depression unit in CMECS does not define the source of the feature. This would be captured through a descriptive attrbute.	
Dominant Species Groups	Various - *Biotic Community* (BC)	Overlapping	Somewhat Certain	This would be handled through various units in the BC in CMECS	Associated Taxa Modifier
Dominant Species	Various - *Biotic Community* (BC) AND Co-Occurring Element	Overlapping	Somewhat Certain	This would be handled through various units in the BC in CMECS	Associated Taxa Modifier
Community Type	Various - *Biotic Community* (BC)	Overlapping	Somewhat Certain	This would be handled through various units in the BC in CMECS	
Key Managed Species	Various - *Biotic Community* (BC) WITH Description OR Description - *Associated Taxa* (Modifers)	Overlapping	Somewhat Certain	This would be handled through various units in the BC in CMECS	

Key Species	Various - *Biotic Community* (BC) WITH Description OR Description - *Associated Taxa* (Modifers)	Overlapping	Somewhat Certain	This would be handled through various units in the BC in CMECS	
Auster - Anthropogenic Processes Modifiers	**CMECS**	**Relationship to CMECS**	**Confidence**	**Notes**	**Notes**
Aquaculture	Aquaculture Structure - *Geoform Origin* (GC)	Overlapping	Somewhat Certain	The Auster unit describes an activity whereas CMECS describes a feature.	
Invasive Species	Various - *Biotic Community* (BC) WITH Description	Overlapping	Somewhat Certain	This would be handled through various units in the BC in CMECS with a descriptive attribute.	Anthropogenic Impact Modifier - Exotic?
Trawl and Dredge Marks	Dredge Disturbance - *Level 2 Geoform* (GC) OR Trawling Scar - *Level 2 Geoform* (GC)	Equal	Certain		
Abandoned Fishing Gear	Lost or Discarded Fishing Gear - *Level 2 Geoform* (GC)	Equal	Certain		
Fixed Fishing Gear	No Equivalent	No Equivalent	Certain	CMECS does not have a unit that captures fishing gear that is in operation (such as long lines or traps).	Anthropogenic Impact Modifier
Dredged Material	Dredge Deposit - *Levels 1 and 2 Geoform* (GC)	Nearly Equal	Certain	A slight difference between Auster and CMECS in this unit is Auster refers to the material itself, CMECS refers to the feature formed by an accumulation of that material.	
Dock	Dock/Pier - *Level 2 Geoform* (GC)	Less Than	Certain	Auster discriminates between these two while CMECS joins them together in a single unit.	
Pier	Dock/Pier - *Level 2 Geoform* (GC)	Less Than	Certain	Auster discriminates between these two while CMECS joins them together in a single unit.	
Breakwater	Breakwater/Jetty - *Level 2 Geoform* (GC)	Equal	Certain		
Groin	Breakwater/Jetty - *Level 2 Geoform* (GC)	Equal	Certain		
Seawall	Seawall - *Level 1 Geoform* (GC)	Equal	Certain		
Rip-Rap	Rip-Rap Deposit - *Level 2 Geoform* (GC)	Nearly Equal	Certain	A slight difference between Auster and CMECS in this unit is Auster refers to the material itself, CMECS refers to the feature formed by an accumulation of that material.	
Mooring	Mooring Field - *Level 1 Geoform* (GC)	Nearly Equal	Certain	While Auster's unit refers to an individual sand wave, CMECS aggregates this spatially into the Wave Field geoform, thus a slight difference in scale; however in practice this should not pose a problem.	
Subsea Cables and Pipelines	Cable Area - *Level 1 Geoform* (GC) OR Pipeline - *Level 1 Geoform* (GC)	Nearly Equal	Certain	While Auster's unit refers to an individual sand wave, CMECS aggregates this spatially into the Wave Field geoform, thus a slight difference in scale; however in practice this should not pose a problem.	
Auster - Disturbance Regime Modifiers	**CMECS**	**Relationship to CMECS**	**Confidence**	**Notes**	**Notes**
Mean Annual Tidal Current Velocity at Seafloor	No Equivalent	No Equivalent	Somewhat Certain	A temporal aspect of the environment is inherent in the Auster unit. CMECS takes a "snapshot in time" approach to unit definitions and thus there is no direct equivalent CMECS unit; however, over time CMECS units could be used to arrive at this.	

Maximum Annual Tidal Current Velocity	No Equivalent	No Equivalent	Somewhat Certain	A temporal aspect of the environment is inherent in the Auster unit. CMECS takes a "snapshot in time" approach to unit definitions and thus there is no direct equivalent CMECS unit; however, over time CMECS units could be used to arrive at this.	
Percent of Time That Current Esceeds Critical Value	No Equivalent	No Equivalent	Somewhat Certain	A temporal aspect of the environment is inherent in the Auster unit. CMECS takes a "snapshot in time" approach to unit definitions and thus there is no direct equivalent CMECS unit; however, over time CMECS units could be used to arrive at this.	
Extend of Specific Episodic Events (Storm Generated Waves)	No Equivalent	No Equivalent	Somewhat Certain	A temporal aspect of the environment is inherent in the Auster unit. CMECS takes a "snapshot in time" approach to unit definitions and thus there is no direct equivalent CMECS unit; however, over time CMECS units could be used to arrive at this.	
Delineation of Mobile and Immobile Sediments	Mobile OR Non-Mobile - *Substrate Descriptor* (Modifiers)	Overlapping	Somewhat Certain	The Auster unit describes an activity whereas CMECS describes a feature.	
Fishing Efforts	Trawled/Harvested - *Anthropogenic Impact* (Modifers)	Overlapping	Somewhat Certain	The Auster unit describes an activity whereas CMECS describes a feature.	
Auster - Depth Gradient/Relief Modifiers	**CMECS**	**Relationship to CMECS**	**Confidence**	**Notes**	**Notes**
Slope	Slope (Modifers)	Equal	Certain		
Physiographic Complexity	Substrate Pattern (Modifiers)	Equal	Uncertain	The methods used to determine Physiographic Complexity are not explicit in the Auster unit and may affect the relationship between this unit and the equivalent CMECS unit.	
Terrain Roughness	Seafloor Rugosity (Modifers)	Equal	Uncertain	The methods used to determine Terrain Roughness are not explicit in the Auster unit and may affect the relationship between this unit and the equivalent CMECS unit.	
Auster -Chemical Processes Modfiers	**CMECS**	**Relationship to CMECS**	**Confidence**	**Notes**	**Notes**
Organic Carbon	No Equivalent	No Equivalent	Certain		
Other Organic Chemical Constituents	No Equivalent	No Equivalent	Certain		
Contaminants	Contaminated - *Anthropogenic Impact* (Modifiers) OR Description	Overlapping	Certain	Auster approaches this as a discrete attribute for the presence of contaminants. CMECS captures this as a conditional modifier for a feature.	
Dissolved Oxygen	Oxygen Regime (Modifiers) OR Description	Less Than	Certain	CMECS aggregates multiple DO measures into the Oxygen Regime modifier. For discrete measurements the actual DO reading itself could be captured as a descriptive attribute.	
Fix this name too					

9.2.8 Rhode Island Ocean SAMP (LaFrance et al., 2010)

****The excel table below can be downloaded at http://nature.ly/EDcmecs**

Rhode Island Ocean SAMP				
RISAMP Unit	**CMECS**	**Relationship to CMECS**	**Confidence**	**Comments**
RISAMP - Form				
Depositional basin	Basin - *Level 1 Geoform (GC)*	Less Than	Certain	Notation of "deposition" provides more specificity than CMECS
Glacial alluvial fan	Alluvial Fan - *Level 1 Geoform (GC)*	Less Than	Certain	Notation of "glacial" origin provides more specificity than CMECS
Glacial delta plain	Delta plain - *Level 1 Geoform (GC)*	Less Than	Certain	Notation of "glacial" origin provides more specificity than CMECS
Glacial lake floor	Flat - *Level 1 or 2 Geoform (GC)*	Less Than	Certain	Notation of "glacial" and "lake floor" origins provides more specificity than CMECS
Glacial lacustrine fan	Fan - *Level 1 or 2 Geoform (GC)*	Less Than	Certain	Notation of "glacial" and "lacustrine" origins provides more specificity than CMECS
Hummocky moraine	Moraine - *Level 1 Geoform (GC)*	Less Than	Certain	Notation of "hummocky" provides more specificity than CMECS
Inner shelf moraine	Continental Shelf - *Physiographic Setting (GC)* AND Moraine - *Level 1 Geoform (GC)*	Less Than	Certain	Notation of "Inner shelf" provides more location information than CMECS
Moraine shoal	Moraine Shoal - *Level 1 or 2 Geoform (GC)*	Equal	Certain	
Point Judith-Buzzards Bay moraine	Moraine - *Level 1 Geoform (GC)*	Less Than	Certain	Notation of "Point Judith-Buzzards Bay" provides more location information than CMECS
RISAMP - Facies	**CMECS**	**Relationship to CMECS**	**Confidence**	**Comments**
Silty sand	Silty sand - *Sustrate Subgroup (SC)*	Equal	Certain	
Boulder gravel concentrations	Boulder - *Sustrate Subgroup* (SC) WITH Gravel mixes - *Substrate Group (SC)*	Less Than	Somewhat Certain	Exact composition of "Gravel concentrations" in unclear
Cobble gravel pavement	Cobble - *Substrate Subgroup (SC)* WITH Gravel mixes - *Substrate Group (SC)*	Less Than	Somewhat Certain	Exact composition of gravel component is unclear
Coarse sand	Coarse sand - *Substrate Subgroup (SC)*	Equal	Certain	
Coarse sand with small dunes	Sediment wave field - *Level 2 Geoform (GC)* WITH Coarse sand - *Substrate Subgroup (SC)*	Equal	Certain	
Fine sand	Fine Sand - *Substrate Subgroup (SC)*	Equal	Certain	
Pebble gravel coarse sand	Gravel mixes - *Substrate Group (SC)*	Less Than	Somewhat Certain	Exact proportions/composition of the mix is unclear
Silt	Silt - *Substrate Subgroup (SC)*	Equal	Certain	
Coarse silt	Sandy mud - *Substrate Group (SC)*	Less Than	Certain	
Sheet sand	Flat - *Level 2 Geoform (GC)* WITH Sand - *Substrate Group (SC)*	Equal	Certain	
Sand sheet with gravel	Flat - *Level 2 Geoform (GC)* WITH Slightly gravelly - *Substrate Group (SC)*	Less Than	Somewhat Certain	Proportions/composition of gravel component is unclear

Sand waves	Sediment wave field - *Level 2 Geoform (GC)* WITH Sand - *Substrate Group (SC)*	Equal	Certain	
RISAMP - Biotope	**CMECS**	**Relationship to CMECS**	**Confidence**	**Comments**
Ampelisca vadorum	Ampelisca bed - *Biotic Community (BC)*	Equal	Certain	
Byblis	Small tube building fauna - *Biotic Group (BC) /* No equivalent - *Biotic Community (BC)*	Less Than	Certain	Byblis are Small tube building fauna - no Biotic Community defined
Jassa	Small tube building fauna - *Biotic Group (BC)*	Less Than	Certain	Jassa are Small tube building fauna - no Biotic Community defined
Lumbrineries hebes - Polycirrus	Lumbrinerid bed - *Biotic Community (BC) AND* Attached tube building fauna - *Biotic Group (BC)*	Greater Than	Certain	Polycirrus are epifaunal tube building terebellid worms - no Biotic Community defined
Nucula annulata - Ampelisca agassizi	Nucula bed - *Biotic Community (BC) AND* Ampelisca bed - *Biotic Community (BC)*	Greater Than	Certain	
Not defined	N/A	N/A	N/A	
RISAMP - Bathymetry	**CMECS**	**Relationship to CMECS**	**Confidence**	**Comments**
9.8 - 54.6 meters (gradient scale)	Deep infralittoral *AND* Circalittoral *(Benthic Depth Zone Modifiers)*	N/A	N/A	Source data was not truly "classified"
RISAMP - Slope	**CMECS**	**Relationship to CMECS**	**Confidence**	**Comments**
0.002 - 5.702 (gradient scale)	Flat *AND* Sloping *(Small-scale Slope Modifier)*	N/A	N/A	Source data was not truly "classified"

9.3 Regional Crosswalks

9.3.1 Regional Crosswalks: National Estuarine Research Reserve System Classification Scheme (Kutcher et al., 2008)

****Crosswalk by Mark Finkbeiner (NOAA)**

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Marine - *System*	Marine - *System* (AS)	Less Than	Certain	The marine system in NERR only extends to the edge of the continental shelf vs. CMECS which extends to the deepest ocean
Subtidal - *Subsystem*	Marine/Nearshore/Subtidal - *Tidal Zone* (AS)	Nearly Equal	Certain	The NERR system subtidal zone is not explicitly defined at its shoreward edge. It may vary with the CMECS subtidal which is below MLLW.
Rock Bottom - *Class*	Rock Substrate OR Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Rock Bottom in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Bottom - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Nearshore/Subtidal -*Subsystem/Tidal Zone* (AS)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Granule OR Pebble - *Substrate Subgroup* (SC) AND Nearshore/Subtidal -*Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	NERR organic is smaller than stones, whereas CMECS has no size restriction on Organic Substrate.
Aquatic Bed - *Class*	Aquatic Vegetation Bed OR Faunal Bed- *Biotic Class* (BC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR includes both flora and fauna in this class.
Rooted Algal - *Subclass*	Benthic Macroalgae - *Biotic Subclass* (BC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Drift Algal - *Subclass*	Floating/Suspended Macroalgae - *Biotic Subclass* (BC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Rooted Vascular - *Subclass*	Aquatic Vascular Vegetation - *Biotic Subclass* (BC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Faunal - *Subclass*	Faunal Bed - *Biotic Class* (BC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Reef - *Class*	Mollusk Reef OR Worm Reef OR Shallow/Mesophotic Coral Reef- *Level 1 and 2 Geoform* (GC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Reef includes three CMECS Geoform units

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Coral - *Subclass*	Shallow/Mesophotic Coral Reef Biota - *Biotic Subclass* (BC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	Equivalent units here are in the CMECS Biotic Component
Mollusk - *Subclass*	Mollusk Reef Biota - *Biotic Subclass* (BC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	Equivalent units here are in the CMECS Biotic Component
Worm - *Subclass*	Worm Reef Biota - *Biotic Subclass* (BC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	Equivalent units here are in the CMECS Biotic Component
Artificial - *Subclass*	Artificial Reef - *Level 2 Geoform* (GC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	The CMECS Artificial Reef Geoform relfects the NERR Artificial unit under the Reef class.
Intertidal - Subsystem	Nearshore/Intertidal OR Nearshore/Supratidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Intertidal zone includes the spray zone which would be supratidal in CMECS. Seaward boundary is not explict so may vary with CMECS line (MLLW)
Aquatic Bed - *Class*	Aquatic Vegetation Bed - *Biotic Class* (BC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Rooted Algal - *Subclass*	Benthic Macroalgae - *Biotic Subclass* (BC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Drift Algal - *Subclass*	Floating/Suspended Macroalgae - *Biotic Subclass* (BC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Rooted Vascular - *Subclass*	Aquatic Vascular Vegetation - *Biotic Subclass* (BC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Reef - *Class*	Shallow/Mesophotic Coral Reef - *Level 1 and 2 Geoform* (GC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Reef includes three CMECS Geoform units
Coral - *Subclass*	Shallow/Mesophotic Coral Reef Biota - *Biotic subclass* (BC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Worm - *Subclass*	Worm Reef Biota - *Biotic Subclass* (BC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Rocky Shore - *Class*	Rock Substrate - *Substrate Class* (SC) AND Nearshore/Intertidal - *Susbsystem/Tidal Zone* (AS)	Less Than	Certain	Rocky Shore in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Shore - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Granule - *Substrate Subgroup* (SC) OR Pebble - *Substrate Subgroup* AND Nearshore/Intertidal -*Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Nearshore/Intertidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	NERR organic is smaller than stones (254mm), whereas CMECS has no size restriction on Organic Substrate.
Estuarine Habitats - *System*	Estuarine - *System* (AS)	Equal	Certain	Spatial limits of both NERR and CMECS are equivalent and not based on salinity as Cowardin.
Subtidal Haline- *Subsystem*	Coastal OR Open Water/Subtidal - *Substem/Tidal Zone* (AS)	Greater Than	Certain	CMECS differentiates the estuarine subtidal based on water depth. NERR shoreward boundary may be slightly deeper than CMECS as NERR requires continuous submergence and CMECS MLLW areas may occasionally be exposed. NERR also has a salinity minimum of 0.5 parts per hundred.
Rock Bottom - *Class*	Rock Substrate - *Substrate Class* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Rock Bottm in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Bottom - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) AND Coastal OR Open Water/Subtidal -*Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Granule OR Pebble - *Substrate Subgroup* (SC) AND Coastal OR Open Water/Subtidal -*Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/ Tidal Zone* (AS)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	NERR organic is smaller than stones, whereas CMECS has no size restriction on Organic Substrate.
Aquatic Bed - *Class*	Aquatic Vegetation Bed - *Biotic Class* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Rooted Algal - *Subclass*	Benthic Macroalgae - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Drift Algal - *Subclass*	Floating/Suspended Macroalgae - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Rooted Vascular - *Subclass*	Aquatic Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Floating Vascular- *Subclass*	Floating/Suspended Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Faunal- *Subclass*	Faunal Bed - *Biotic Class* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	NERR specifies that Faunal Aquatic Beds consist of soft, sessile invertebrates, whereas CMECS does include some hard-shelled mollusks and also some slow moving species (sea stars, etc.)
Reef - *Class*	Shallow/Mesophotic Coral Reef - *Level 1 and 2 Geoform* (GC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Reef includes three CMECS Geoform units
Mollusk - *Subclass*	Mollusk Reef Biota - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal -*Subsystem/Tidal Zone* (AS)	Equal	Certain	Equivalent units here are in the CMECS Biotic Component
Worm - *Subclass*	Worm Reef Biota - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	Equivalent units here are in the CMECS Biotic Component
Artificial - *Subclass*	Artificial Reef - *Level 2 Geoform* (GC) AND Nearshore/Subtidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Intertidal Haline - Subsystem	Coastal/Intertidal -*Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Intertidal zone includes the spray zone which would be supratidal in CMECS. Seaward boundary is not explict so may vary with CMECS line (MLLW)
Aquatic Bed - *Class*	Aquatic Vegetation Bed - *Biotic Class* (BC) AND Coastal/Intertidal - *Subsytem /Tidal Zone* (AS)	Equal	Certain	
Rooted Algal - *Subclass*	Benthic Macroalgae - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Drift Algal - *Subclass*	Floating/Suspended Macroalgae - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Rooted Vascular - *Subclass*	Aquatic Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Floating Vascular - *Subclass*	Floating/Suspended Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Reef - *Class*	Shallow/Mesophotic Coral Reef OR Mollusk Reef - *Level 1 and 2 Geoform* (GC) or Mollusk Reef AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Reef includes three CMECS Geoform units
Mollusk - *Subclass*	Mollusk Reef Biota - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	Equivalent units here are in the CMECS Biotic Component
Worm - *Subclass*	Worm Reef Biota - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	Equivalent units here are in the CMECS Biotic Component
Streambed - *Class*	Channel - *Level 1 and 2 Geoform* (GC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Somewhat Certain	
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Granule OR Pebble - *Substrate Subgroup* (SC) AND Coastal/Intertidal -*Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	NERR organic is smaller than stones (254mm), whereas CMECS has no size restriction on Organic Substrate.
Vegetated- *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	
Rocky Shore - *Class*	Rock Substrate - *Substrate Class* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Rocky Shore in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Shore - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) AND Coastal OR Open Water/Intertidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Granule OR Pebble -*Substrate Subgroup* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Coastal/Intertidal - *SubsystemTidal Zone* (AS)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Coastal/Intertidal - Subsystem/*Tidal Zone* (AS)	Less Than	Certain	NERR organic is smaller than stones (254mm), whereas CMECS has no size restriction on Organic Substrate.
Emergent Wetland - *Class*	Emergent Wetland - *Class* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Persistent - *Subclass*	Temporal Persistence - *Temporal* (Modifier) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	Persistent and Non-Persistent Emergent Wetlands can be captured as Years in the CMECS temporal persistence modifier.
Non-Persistent - *Subclass*	Temporal Persistence - *Temporal* (Modifier) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	Persistent and Non-Persistent Emergent Wetlands can be captured as Years in the CMECS temporal persistence modifier.
Scrub-Shrub Wetland - *Class*	Scrub-Shrub Wetland - *Class* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Broad-Leaved Deciduoous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle_Leaved Deciduous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Broad-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Dead - *Subclass*	Not In CMECS Scope	No CMECS Equivalent	Certain	CMECS does not address the condition of units
Forested Wetland - *Class*	Forested Wetland - *Class* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Broad-Leaved Deciduoous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle_Leaved Deciduous - *Subclass*	with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Broad-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Mixed - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Dead - *Subclass*	Not In CMECS Scope	No CMECS Equivalent	Certain	CMECS does not address the condition of units
Supratidal Haline - Subsystem	Coastal/Supratidal - *Substem/Tidal Zone* (AS)	Equal	Certain	
Rock Bottom - *Class*	Rock Substrate - *Substrate Class* (SC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Rock Bottm in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Coastal/Subtidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Bottom - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Gravel - *Subclass*	Granule OR Pebble - *Substrate Subgroup* (SC) AND Coastal/Supratidal -*Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Coastal/Supratidal -*Subsystem/ Tidal Zone* (AS)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Less Than	Certain	NERR organic is smaller than stones, whereas CMECS has no size restriction on Organic Substrate.
Aquatic Bed - *Class*	Aquatic Vegetation Bed - *Biotic Class* (BC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Rooted Algal - *Subclass*	Benthic Macroalgae - *Biotic Subclass* (BC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Drift Algal - *Subclass*	Floating/Suspended Macroalgae - *Biotic Subclass* (BC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Rooted Vascular - *Subclass*	Aquatic Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Floating Vascular- *Subclass*	Floating/Suspended Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Emergent Wetland - *Class*	Emergent Wetland - *Class* (BC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Persistent - *Subclass*	Temporal Persistence - *Temporal* (Modifier) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Non-Persistent - *Subclass*	Temporal Persistence - Temporal (Modifier) AND Coastal OR Open Water/Supratidal - Subsystem/Tidal Zone (AS)	Equal	Certain	
Scrub-Shrub Wetland - *Class*	Scrub-Shrub Wetland - Class (BC) AND Coastal OR Open Water/Supratidal - Subsystem/Tidal Zone (AS)	Equal	Certain	
Broad-Leaved Deciduoous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle_Leaved Deciduous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Broad-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Dead - *Subclass*	Not In CMECS Scope	No CMECS Equivalent	Certain	CMECS does not address the condition of units
Forested Wetland - *Class*	Forested Wetland - *Class* (BC) AND Coastal/Supratidal - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Broad-Leaved Deciduoous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Needle_Leaved Deciduous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Broad-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Mixed - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Dead - *Subclass*	Not In CMECS Scope	No CMECS Equivalent	Certain	CMECS does not address the condition of units
Subtidal Fresh - Subsystem	Coastal/Subtidal - *Substem/Tidal Zone* (AS) AND Oligohaline-*Salinity (Modifiers)*	Equal	Somewhat Certain	It is not clear where the determination of salinity would be taken to apply this unit. Areas where this unit might apply often have a salinity wedge that can result in very different measurements at depth vs. at the surface.
Rock Bottom - *Class*	Rock Substrate - *Substrate Class* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Less Than	Certain	Rock Bottom in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Bottom - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) AND Coastal OR Open Water/Subtidal -*Subsystem/Tidal Zone* (AS) AND Oligohaline - Salinity (Modifiers)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Granule OR Pebble - *Substrate Subgroup* (SC) AND Coastal OR Open Water/Subtidal -*Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/ Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Less Than	Certain	NERR organic is smaller than stones, whereas CMECS has no size restriction on Organic Substrate.

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Aquatic Bed - *Class*	Aquatic Vegetation Bed - *Biotic Class* (BC) AND Coastal OR Open Water/Subtidal - *Subsytem /Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Rooted Algal - *Subclass*	Benthic Macroalgae - *Biotic Subclass* (BC) AND Coastal OR Open Water/ Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Drift Algal - *Subclass*	Floating/Suspended Macroalgae - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Rooted Vascular - *Subclass*	Aquatic Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Floating Vascular- *Subclass*	Floating/Suspended Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Aquatic Moss - *Subclass*	Freshwater Tidal Moss - *Biotic Subclass* (BC) AND Coastal OR Open Water/ Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Reef - *Class*	Shallow/Mesophotic Coral Reef OR Mollusk Reef - *Level 1 and 2 Geoform* (GC) or Mollusk Reef AND Coastal OR Open Water/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Greater Than	Certain	NERR Reef includes three CMECS Geoform units
Mollusk - *Subclass*	Mollusk Reef Biota - *Biotic Subclass* (BC) AND Coastal OR Open Water/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - Salinity (Modifiers)	Equal	Certain	Equivalent units here are in the CMECS Biotic Component
Intertidal Fresh - Subsystem	Coastal/Intertidal - *Substem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	Since there is unlikely to be a spray zone in an intertidal fresh enviroment this unit is equal to CMECS Estuarine/Coastal subsystem with a provisional Fresh modifier.
Aquatic Bed - *Class*	Aquatic Vegetation Bed - *Biotic Class* (BC) AND Coastal/Intertidal - *Subsytem /Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Rooted Algal - *Subclass*	Benthic Macroalgae - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Drift Algal - *Subclass*	Floating/Suspended Macroalgae - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Rooted Vascular - *Subclass*	Aquatic Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Floating Vascular- *Subclass*	Floating/Suspended Vascular Vegetation - *Biotic Subclass* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Aquatic Moss - *Subclass*		Equal	Certain	
Streambed - *Class*	Channel - *Level 1 and 2 Geoform* (GC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Less Than	Somewhat Certain	The NERR Streambed class only includes those portions of estuarine channels that are de-watered (exposed) at low tide. The CMECS geoform would also include that lower portion of the channel that still contained water so NERR is more specific (less than) in this case.
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Coastal/Subtidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Cobble - *Subclass*	Cobble - *Substrate Subgroup (* SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Granule OR Pebble - *Substrate subgroup* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Less Than	Certain	NERR organic is smaller than stones, whereas CMECS has no size restriction on Organic Substrate.
Vegetated- *Subclass*	Overlaps with various Biotic Community Units	Overlapping		
Rocky Shore - *Class*	Rock Substrate - *Substrate Class* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Less Than	Certain	Rocky Shore in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Shore - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.
Cobble - *Subclass*	Cobble - *Substrate Group* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Gravel - *Subclass*	Granule OR Pebble - *Substrate Subgroup* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Coastal/Intertidal - *SubsystemTidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Coastal/Intertidal - Subsystem/*Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Less Than	Certain	NERR organic is smaller than stones, whereas CMECS has no size restriction on Organic Substrate.
Emergent Wetland - *Class*	Emergent Wetland - *Class* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Persistent - *Subclass*	Temporal Persistence - *Temporal* (Modifier) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Non-Persistent - *Subclass*	Temporal Persistence - *Temporal* (Modifier) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Scrub-Shrub Wetland - *Class*	Scrub-Shrub Wetland - *Class* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Oligohaline - *Salinity* (Modifiers)	Equal	Certain	
Broad-Leaved Deciduoous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle_Leaved Deciduous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Broad-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Dead - *Subclass*	Not In CMECS Scope	No CMECS Equivalent	Certain	CMECS does not address the condition of units
Forested Wetland - *Class*	Forested Wetland - *Class* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Fresh - Salinity (Modifiers-PROVISIONAL)	Equal	Certain	
Broad-Leaved Deciduoous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Needle_Leaved Deciduous - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Broad-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Needle-Leaved Evergreen - *Subclass*	Overlaps with various Biotic Community Units	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Mixed - *Subclass*	Forested Wetland - *Class* (BC) AND Coastal/Intertidal - *Subsystem/Tidal Zone* (AS) AND Fresh - Salinity (Modifiers-PROVISIONAL)	Overlapping	Certain	These units based on leaf morphology overlap the CMECS Biotic Communities
Dead - *Subclass*	Not In CMECS Scope	No CMECS Equivalent	Certain	CMECS does not address the condition of units
Lacustrine - *System*	Lacustrine - *System*	Equal	Certain	
Limnetic - *Subsystem*	Limnetic - *Subsystem*	Equal	Certain	
Rock Bottom - *Class*	Rock Substrate - *Substrate Class* (SC) AND Limnetic - *Subsystem* (AS)	Less Than	Certain	Rock Bottom in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Limnetic - *Subsystem* (AS)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Limnetic - *Subsystem* (AS)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Bottom - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Limnetic - *Subsystem* (AS)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) AND Limnetic - *Subsystem* (AS)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Granule OR Pebble - *Substrate Subgroup* (SC) AND Limnetic - *Subsystem* (AS)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Limnetic - *Subsystem* (AS)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Limnetic - *Subsystem* (AS)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Limnetic - *Subsystem* (AS)	Less Than	Certain	NERR organic is smaller than stones, whereas CMECS has no size restriction on Organic Substrate.
Aquatic Bed - *Class*	Aquatic Vegetation Bed - *Biotic Class* (BC) AND Limnetic - *Subsystem* (AS)	Equal	Certain	
Algal - *Subclass*	Benthic Macroalgae - *Biotic Subclass* (BC) AND Limnetic - *Subsystem* (AS)	Equal	Certain	
Aquatic Moss - *Subclass*	Submerged Freshwater Tidal Moss - *Biotic Group* (BC) AND Limnetic - *Subsystem* (AS)	Equal	Certain	
Rooted Vascular - *Subclass*	Aquatic Vascular Vegetation - *Biotic Subclass* (BC) AND Limnetic - *Subsystem* (AS)	Equal	Certain	

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Floating Vascular - *Subclass*	Floating/Suspended Vascular Vegetation - *Biotic Subclass* (BC) AND Limnetic - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Littoral - Subsystem	Littoral - Subsystem	Equal	Certain	
Rock Bottom - *Class*	Rock Substrate - *Substrate Class* (SC) AND Littoral - *Subsystem* (AS)	Less Than	Certain	Rock Bottom in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Littoral - *Subsystem* (AS)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Littoral - *Subsystem* (AS)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Bottom - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Littoral - *Subsystem* (AS)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) - *Substrate Group* (SC) AND Littoral -*Subsystem* (AS)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Granule OR Pebble - *Substrate Subgroup* (SC) AND Littoral - *Subsystem* (AS)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Littoral - *Subsystem* (AS)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Littoral - *Subsystem* (AS)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Littoral - *Subsystem* (AS)	Nearly Equal	Certain	NERR organic is smaller than stones, whereas CMECS has no size restriction on Organic Substrate.
Aquatic Bed - *Class*	Aquatic Vegetation Bed - *Biotic Class* (BC) AND Littoral - *Subsystem* (AS)	Equal	Certain	
Algal - *Subclass*	Benthic Macroalgae - *Biotic Subclass* (BC) AND Littoral - *Subsystem* (AS)	Equal	Certain	
Aquatic Moss - *Subclass*	Submerged Freshwater Tidal Moss - *Biotic Group* (BC) AND Littoral - *Subsystem* (AS)	Equal	Certain	
Rooted Vascular - *Subclass*	Aquatic Vascular Vegetation - *Biotic Subclass* (BC) AND Littoral - *Subsystem* (AS)	Equal	Certain	
Floating Vascular - *Subclass*	Floating/Suspended Vascular Vegetation - *Biotic Subclass* (BC) AND Littoral - *Subsystem/Tidal Zone* (AS)	Equal	Certain	
Rocky Shore - *Class*	Rock Substrate - *Substrate Class* (SC) AND Littoral - *Subsystem* (AS)	Less Than	Certain	Rocky Shore in NERR requires 75% coverage and < 30% vegetative cover. This is more restrictive than CMECS which only requires a spatial majority
Bedrock - *Subclass*	Bedrock - *Substrate Subclass* (SC) AND Littoral - *Subsystem* (AS)	Less Than	Certain	Bedrock in NERR requires 75% coverage. This is more restrictive than CMECS which only requires a spatial majority
Rubble - *Subclass*	Boulder - *Substrate Subgroup* (SC) AND Littoral - *Subsystem* (AS)	Greater Than	Certain	NERR Rubble range is > 254mm CMECS range for Boulder is 2mm-4096mm
Unconsolidated Shore - *Class*	Unconsolidated Mineral Substrate - *Substrate Class* (SC) AND Littoral - *Subsystem* (AS)	Greater Than	Certain	The minimum threshold in NERR is 25% with >30% vegetation. This can allow other units to spatially dominate a mapped unit. CMECS requres at least 50% coverage for this unit.

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Cobble - *Subclass*	Cobble - *Substrate Subgroup* (SC) AND Littoral -*Subsystem* (AS)	Nearly Equal	Certain	NERR grain size range is 76-254mm and CMECS is 64-255. However, NERR only requires 25% coverage. This can allow other units to spatially dominate a mapped unit in NERR
Gravel - *Subclass*	Gravel - *Substrate Group* (SC) AND Littoral -*Subsystem* (AS)	Nearly Equal	Certain	NERR Gravel is more equivalent to CMECS Pebble/Granule and the values are close. CMECS Gravel is much more broadly defined.
Sand - *Subclass*	Sand - *Substrate Group* (SC) AND Littoral - *Subsystem* (AS)	Nearly Equal	Certain	NERR sand is .074-2mm CMECS is .063-2mm
Mud - *Subclass*	Mud - *Substrate Group* (SC) AND Littoral - *Subsystem* (AS)	Nearly Equal	Certain	Mud in both systems begins below either .074 or .063mm
Organic - *Subclass*	Biogenic Substrate - *Substrate Origin* (SC) AND Littoral - *Subsystem* (AS)	Less Than	Certain	NERR organic is smaller than stones, whereas CMECS has no size restriction on Organic Substrate.
Emergent Wetland - *Class*	Emergent Wetland - *Class* AND Littoral - *Subsystem* (AS)	Equal	Certain	
Non-Persistent - *Subclass*	Temporal Persistence - *Temporal* (Modifier) AND Littoral - *Subsystem* (AS)	Equal	Certain	
Perennial Snow and Ice Habitats - *System*	Ice - Hydroform (WC)	Greater Than	Certain	The NERR class includes perennial snow and ice that may overlie a terrestrial landscape while CMECS only includes Ice when over water. However NERR is more specific in the sense that it includes a temporal element into this unit.
Perennial Snowfields - *Subsystem*	No Equivalent	No CMECS Equivalent	Certain	
Glaciers - *Subsystem*	No Equivalent	No CMECS Equivalent	Uncertain	Glaciers extending out over open water as in Antarctica?
Cultural Land Cover - *System*	Anthropogenic Geoform - *Geoform Origin* (GC)	Greater Than	Certain	Elements of this system will fall into some of the CMECS anthropogenic geoforms but most will not.
Developed Upland - *Subsystem*	Outside of CMECS Domain	No CMECS Equivalent	Certain	
Agricultural Upland - *Subsystem*	Outside of CMECS Domain	No CMECS Equivalent	Certain	
Developed and Managed Wetlands and Water - *Subsystem*	Developed - *Anthropogentic Impact* (Modifiers)	Greater Than	Somewhat Certain	The closest CMECS equivalent is the developed modifier; however, the NERR unit will include many terrestrial wetlands that are outside the CMECS domain
Impervious Cover - *Class*	Anthropogenic Substrate - *Substrate Origin* (SC)	Nearly Equal	Somewhat Certain	While both NERR and CMECS equivalent units are both general, NERR adds more specificity related to cohesive nature of the material, CMECS adds specificity related to the composition/grain size of the material.
Impervious Bottom - *Class*	Anthropogenic Substrate - *Substrate Origin* (SC)	Less Than	Somewhat Certain	While both NERR and CMECS equivalent units are both general, NERR adds more specificity related to cohesive nature of the material, CMECS adds specificity related to the composition/grain size of the material. NERR further refines their unit to reflect that it is on or forms the benthos.

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Impervious In-Water Structure - *Class*	Anthropogenic Geoform - *Geoform Origin* (GC)	Nearly Equal	Somewhat Certain	While both NERR and CMECS equivalent units are both general, NERR adds more specificity related to cohesive nature of the material, CMECS adds specificity related to the composition/grain size of the material.
Built-Up Cover - *Class*	Anthropogenic Geoform - *Geoform Origin* (GC) AND VARIOUS - *Level 1 and 2 Geoforms* (GC)	Greater Than	Somewhat Certain	NERR Built-Up Cover is generally equivalent to Anthropogenic Substrate but the spatial domain of the NERR unit includes areas outside the CMECS domain and thus is listed as Greater Than.
Pervious In-Water Structure - *Subclass*	Anthropogenic Geoform - *Geoform Origin* (GC) AND VARIOUS - *Level 1 and 2 Geoforms* (GC)	Overlapping	Somewhat Certain	While NERR units are more specific in terms of the use of the structure, CMECS is more specific in terms of the type of structure.
In-Water Commercial or Service Complex - *Subclass*	Anthropogenic Geoform - *Geoform Origin* (GC) AND VARIOUS - *Level 1 and 2 Geoforms* (GC)	Overlapping	Certain	While NERR units are more specific in terms of the use of the structure, CMECS is more specific in terms of the type of structure.
In-Water Industrial Complex - *Subclass*	Anthropogenic Geoform - *Geoform Origin* (GC) AND VARIOUS - *Level 1 and 2 Geoforms* (GC)	Overlapping	Certain	While NERR units are more specific in terms of the use of the structure, CMECS is more specific in terms of the type of structure.
Shellfish Aquaculture - *Subclass*	Aquaculture Structure - *Level 1 and 2 Geoforms* (GC)	Less Than	Certain	The CMECS Aquaculture Structure is more general than the NERR unit
Finfish Aquaculture - *Subclass*	Aquaculture Structure - *Level 1 and 2 Geoforms* (GC)	Less Than	Certain	The CMECS Aquaculture Structure is more general than the NERR unit
Residential Cover - *Class*	Anthropogenic Substrate - *Substrate Origin* (SC)	Overlapping	Somewhat Certain	The NERR unit is more specific as it conveys information on the use of the structure, but will include terrestrial wetland settings outside the CMECS domain.
In-Water Residential Complex - *Subclass*	Anthropogenic Geoform - *Geoform Origin* (GC)	Overlapping	Somewhat Certain	The NERR unit is more specific as it conveys information on the use of the structure, but will include terrestrial wetland settings outside the CMECS domain.
Rocky Cover - *Class*	Anthropogenic Rock - *Substrate Class* (SC)	Greater Than	Certain	The NERR unit is very equivalent to CMECS Anthropogenic Rock substrate but will include terrestrial settings outside of CMECS domain.
Rocky Shoreline Structure - *Subclass*	Anthropogenic Geoform - *Geoform Origin* (GC) AND VARIOUS - *Level 1 and 2 Geoforms* (GC)	Greater Than	Certain	The more general NERR unit will include several potential CMECS anthropogenic geoforms. It will also apply to many terrestrial wetland settings outside of CMECS
Rocky In-Water Structure - *Subclass*	Anthropogenic Geoform - *Geoform Origin* (GC) AND VARIOUS - *Level 1 and 2 Geoforms* (GC)	Greater Than	Certain	The more general NERR unit will include several potential CMECS anthropogenic geoforms. It will also apply to many terrestrial wetland settings outside of CMECS
Unconsolidated Cover - *Class*	Anthropogenic Substrate - *Substrate Origin* (SC)	Less Than	Certain	
Managed Unconsolidated Bottom - *Subclass*	Anthropogenic Substrate - *Substrate Origin* (SC)	Less Than	Uncertain	
Managed Unconsolidated Shore - *Subclass*	Anthropogenic Substrate - *Substrate Origin* (SC)	Less Than	Uncertain	

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Herbaceous Cover - *Class*	Emergent Wetland - *Class* (BC) AND Developed - *Anthropogentic Impact* (Modifiers)	Greater Than	Somewhat Certain	The NERR unit is very equivalent to the CMECS emergent wetland class but would also include terrestrial settings.
Managed Herbaceous Wetland - *Subclass*	Emergent Wetland - *Class* (BC) AND Developed - *Anthropogentic Impact* (Modifiers)	Greater Than	Uncertain	The NERR unit is very equivalent to the CMECS emergent wetland class but would also include terrestrial settings.
Agricultural Herbaceous Wetland - *Subclass*	Emergent Wetland - *Class* (BC) AND Developed - *Anthropogentic Impact* (Modifiers)	Less Than	Uncertain	NERR Herbaceous wetland is generally equivalent to CMECS emergent wetland with a developed modifier but the NERR "agricultural" terminology makes this more specific than CMECS. However, the NERR unit will include terrestrial wetlands outside the CMECS domain so the systems overlap here.
Grazed Herbaceous Wetland - *Subclass*	Emergent Wetland - *Class* (BC) AND Developed - *Anthropogentic Impact* (Modifiers)	Less Than	Uncertain	NERR Herbaceous wetland is generally equivalent to CMECS emergent wetland with a developed modifier but the NERR "grazed" terminology makes this more specific than CMECS. However, the NERR unit will include terrestrial wetlands outside the CMECS domain so the systems overlap here.
Shrub Cover - *Class*	Scrub-Shrub Wetland - *Class* (BC) AND Developed - *Anthropogenic Impact* (Modifiers)	Greater Than	Somewhat Certain	The NERR unit is very equivalent to the CMECS Scrub-Shrub wetland class but would also include terrestrial settings.
Managed Shrub Wetland - *Subclass*	Scrub-Shrub Wetland - *Class* (BC) AND Developed - *Anthropogenic Impact* (Modifiers)	Greater Than	Uncertain	The NERR and CMECS units are generally equivalent but NERR is more general in that it includes terrestrial settings.
Agricultural Shrub Wetland - *Subclass*	Scrub-Shrub Wetland - *Class* (BC) AND Developed - *Anthropogenic Impact* (Modifiers)	Less Than	Uncertain	NERR Shrub wetland is generally equivalent to CMECS emergent wetland with a developed modifier but the NERR "agricultural" terminology makes this more specific than CMECS. However, the NERR unit will include terrestrial wetlands outside the CMECS domain so the systems overlap here.
Grazed Shrub Wetland - *Subclass*	Scrub-Shrub Wetland - *Class* (BC) AND Developed - *Anthropogenic Impact* (Modifiers)	Less Than	Uncertain	NERR Shrub wetland is generally equivalent to CMECS Scrub-Shrub wetland with a developed modifier but the NERR "grazed" terminology makes this more specific than CMECS. However, the NERR unit will include terrestrial wetlands outside the CMECS domain so the systems overlap here.
Tree Cover - *Class*	Forested Wetland - *Class* (BC) AND Developed - *Anthropogenic Impact* (Modifiers)	Greater Than	Somewhat Certain	The NERR and CMECS units are generally equivalent but NERR is more general in that it includes terrestrial settings.
Managed Wetland Trees - *Subclass*	Forested Wetland - *Class* (BC) AND Developed - *Anthropogenic Impact* (Modifiers)	Less Than	Uncertain	
Agricultural Wetland Trees- *Subclass*	Forested Wetland - *Class* (BC) AND Developed - *Anthropogenic Impact* (Modifiers)	Less Than	Uncertain	
Grazed Wooded Wetland - *Class*	Forested Wetland - *Class* (BC) AND Developed - *Anthropogenic Impact* (Modifiers)	Less Than	Uncertain	
Upland Habitats - *System*	Outside of CMECS Domain	No CMECS Equivalent	Certain	The full list of NERR Upland Habitats is not included here as they are outside the CMECS domain
Riverine Habitats- *System*	Outside of CMECS Domain	No CMECS Equivalent	Certain	NERR Riverine Habitats only occur in areas above tidal influence so would be out of the CMECS domain.
Palustrine- *System*	Outside of CMECS Domain	No CMECS Equivalent	Certain	NERR Palustrine Habitats only occur in areas above tidal influence so would be out of the CMECS domain.

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Non-Hierarchical Categories				
Dominant Species	VARIOUS - *Biotic Community* (BC)	Equal	Somewhat Certain	Rules for determining dominance in NERR are loosely based on number or spatial cover. These NERR units may help translate to the lower levels of the Biotic Component in CMECS
Descriptors	Descriptive Comments	Equal	Somewhat Certain	
Modifiers	**CMECS Equivalents**	**Relationship to CMECS**	**Confidence**	**Notes**
Water Regime Modifiers				
Non-Tidal	Atidal (Modifier)	Equal	Certain	
Temporarily Flooded	No CMECS Equivalent	No CMECS Equivalent	Certain	
Saturated	No CMECS Equivalent	No CMECS Equivalent	Certain	
Seasonally Flooded	No CMECS Equivalent	No CMECS Equivalent	Certain	
Seasonal Well-Drained	No CMECS Equivalent	No CMECS Equivalent	Certain	
Seasonal Saturated	No CMECS Equivalent	No CMECS Equivalent	Certain	
Semi-Permanently Flooded	No CMECS Equivalent	No CMECS Equivalent	Certain	
Intermittently Exposed	No CMECS Equivalent	No CMECS Equivalent	Certain	
Permanently Flooded	No CMECS Equivalent	No CMECS Equivalent	Certain	
Intermittently Flooded	No CMECS Equivalent	No CMECS Equivalent	Certain	
Artificially Flooded	No CMECS Equivalent	No CMECS Equivalent	Certain	
Tidal	No CMECS Equivalent	No CMECS Equivalent	Certain	
Subtidal	Nearshore OR Coastal OR Open Water/Subtidal - Subsystem/*Tidal Zone* (AS)	Greater Than	Certain	CMECS indicates tidal regime within the Aquatic Setting.
Irregularly Exposed	No CMECS Equivalent	No CMECS Equivalent	Certain	
Regularly Flooded	No CMECS Equivalent	No CMECS Equivalent	Certain	
Irregularly Flooded	No CMECS Equivalent	No CMECS Equivalent	Certain	
Salinity Modifiers				
Salinity	Salinity Regime (Modifier)	Equal	Certain	
Hyperhaline	Hyperhaline - *Salinity Regime* (Modifier)	Equal	Certain	

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
Euhaline	Euhaline - *Salinity Regime* (Modifier)	Equal	Certain	
Polyhaline	Upper Polyhaline OR Lower Polyhaline - *Salinity Regime* (Modifier)	Greater Than	Certain	
Mesohaline	Mesohaline - *Salinity Regime* (Modifier)	Equal	Certain	
Oligohaline	Oligohaline - *Salinity Regime* (Modifier)	Equal	Certain	
Fresh	No CMECS Equivalent	Less Than	Certain	Fresh falls within the CMECS Oligohaline class (<5psu) but is specifically differentiated in the NERR system
Hypersaline	Outside of CMECS Domain	No CMECS Equivalent	Certain	
Eusaline	Outside of CMECS Domain	No CMECS Equivalent	Certain	
Polysaline	Outside of CMECS Domain	No CMECS Equivalent	Certain	
Mesosaline	Outside of CMECS Domain	No CMECS Equivalent	Certain	
Oligosaline	Outside of CMECS Domain	No CMECS Equivalent	Certain	
Fresh	Outside of CMECS Domain	No CMECS Equivalent	Certain	
Special Modifiers				
Excavated	Dredged/Excavated Channel - *Level 1 and 2 Geoform* (GC)	Equal	Certain	
Impounded	Impounded/Diverted - *Anthropogenic Impact* (Modifier)	Equal	Certain	
Diked	Impounded/Diverted - *Anthropogenic Impact* (Modifier)	Equal	Certain	
Partly Drained	Outside of CMECS Domain	No CMECS Equivalent	Certain	The process of draining would remove an area from the CMECS domain.
Artificial	Geoform Origin (GC)	Equal	Certain	
Farmed	Outside of CMECS Domain	Equal	Certain	
Dredged	Dredged/Excavated Channel - *Level 1 and 2 Geoform* (GC)	Equal	Certain	
Tidal Geoform Modifiers				
Bay	Embayment/Bay - *Physioigraphic Setting* (GC)	Equal	Certain	
Cove	Cove - *Level 1 and 2 Geoform* (GC)	Equal	Certain	
Lagoon	Lagoon - *Level 1 and 2 Geoform* (GC)	Equal	Certain	
Pool	Tidepool - *Level 2 Geoform* (GC)	Greater Than	Certain	CMECS tidepool is included in this but NERR unit has broader definition. Near-equivalent unit in CMECS would be Hole/Pit or Depression
Subtidal Creek	Tidal Channel/Creek - *Level 1 and 2 Geoform Type* (GC) AND Subtidal - *Tidal Zone* (AS)	Less Than	Certain	NERR and CMECS units are equal except that NERR includes tidal regime in the unit name while CMECS allows this to be added using Aquatic Setting.
Intertidal Creek	Tidal Channel/Creek - *Level 1 and 2 Geoform Type* (GC) AND Intertidal - *Tidal Zone* (AS)	Less Than	Somewhat Certain	NERR and CMECS units are equal except that NERR includes tidal regime in the unit name while CMECS allows this to be added using Aquatic Setting. There is some potential overlap between this and the Streambed class.

NERR Classification Units	CMECS Equivalents	Relationship to CMECS	Confidence	Notes
intertidal Flat	Flat - *Level 1 and 2 Geoform* (GC) AND Intertidal - *Tidal Zone* (AS)	Less Than	Certain	NERR and CMECS units are equal except that NERR includes tidal regime in the unit name while CMECS allows this to be added using Aquatic Setting.
Beach	Beach - *Level 1 and 2 Geoform* (GC)	Equal	Certain	
Panne	Panne - *Level 2 Geoform* (GC)	Equal	Certain	
Low Marsh	Marsh Platform - *Level 1 and 2 Geoform* (GC)	Less Than	Certain	NERR differentiates elevation into the geoform. CMECS differentiates the marsh level by the biotic communities that are present.
High Marsh Surface	Marsh Platform - *Level 1 and 2 Geoform* (GC)	Less Than	Certain	
Managed Modifiers				
Burned 0	No CMECS Equivalent	No CMECS Equivalent	Certain	
Burned 1	No CMECS Equivalent	No CMECS Equivalent	Certain	
Burned 2	No CMECS Equivalent	No CMECS Equivalent	Certain	
Mowed 0	No CMECS Equivalent	No CMECS Equivalent	Certain	
Mowed 1	No CMECS Equivalent	No CMECS Equivalent	Certain	
Mowed 2	No CMECS Equivalent	No CMECS Equivalent	Certain	
Tidally Restored 0	Restored - *Anthropogenic Impact* (Modifier)	Less Than	Certain	
Tidally Restored 1	Restored - *Anthropogenic Impact* (Modifier)	Less Than	Certain	
Tidally Restored 2	Restored - *Anthropogenic Impact* (Modifier)	Less Than	Certain	
Prehistoric Modifiers				
Ceremonial Mounds	Mound/Hummock - *Level 2 Geoform* (GC) AND	Less Than	Certain	NERR adds more specificity here by includeing the use of the mound vs. CMECS.
Middens	No CMECS Equivalent	No CMECS Equivalent	Certain	
Scatter Sites	No CMECS Equivalent	No CMECS Equivalent	Somewhat Certain	How this would translate into CMECS is not clear.
Natural Disturbance Modifiers				
Fire	No CMECS Equivalent	No CMECS Equivalent	Certain	This could be distinguished between actual flames and a burned area.
Flooding	No CMECS Equivalent	No CMECS Equivalent	Somewhat Certain	This NERR unit includes some process information. There may be overlap between this and the Temporarily Flooded modifier.
Tornado	No CMECS Equivalent	No CMECS Equivalent	Somewhat Certain	Assume this refers to a tornado track or debris caused by a tornado rather than the actual tornado.
Important Species Modifiers				
Species Information	Co-Occurring Element - (BC) OR Associated Taxa - *Biologic* (Modifiers)	Overlapping	Certain	

9.3.2 NAMERA Benthic Habitat Crosswalk

NAMERA Units	CMECS Units			
Ecoregions	**Biogeographic Setting**	**Relationship**	**Confidence**	**Notes**
Gulf of Maine	Gulf of Maine/Bay of Fundy - *Ecoregion (BS)*	Equal	Certain	
Southern New England	Virginian - *Ecoregion (BS)*	Less Than	Certain	CMECS Virginian covers more area (includes NAMERA Southern New England and Mid Atlantic Bight ecoregions)
Mid Atlantic Bight	Virginian - *Ecoregion (BS)*	Less Than	Certain	CMECS Virginian covers more area (includes NAMERA Southern New England and Mid Atlantic Bight ecoregions)

NAMERA Units	CMECS Units (Dominant)	CMECS Units (Secondary/ Co-occurring)			
Ecological Marine Units (Seabed Forms and Depth)	**Geoform**	**Geoform**	**Relationship**	**Confidence**	**Notes**
Deep Depression	Shelf Valley - *Level 1 Geoform (GC)*		Greater Than	Somewhat Certain	Dominant geoform selected, Most occur between 100-200 meter depth and at the shelf-slope break and found in Gulf of Maine area in NAMERA
Deep Flat	Flat - *Level 1 and 2 Geoform (GC)*	Shelf Valley - *Level 1 Geoform (GC)*	Greater Than	Certain	Dominant geoform selected; however, can find shelf valleys in this classification due to regional scale.
Deeper Depression	Basin - *Level 1 Geoform (GC)*		Equal	Certain	Dominant geoform selected.
Deeper Flat	Flat - *Level 1 and 2 Geoform (GC)*		Equal	Certain	Dominant geoform selected.
Deepest Depression	Basin - *Level 1 Geoform (GC)*		Equal	Certain	Dominant geoform selected.
Deepest Flat	Flat - *Level 1 and 2 Geoform (GC)*		Equal	Certain	Dominant geoform selected.
High Flat	Platform - *Level 1 and 2 Geoform (GC)*	Shoal - *Level 1 and 2 Geoform (GC) or* Ledge - *Level 1 and 2 Geoform (GC) or* Megaripples - *Level 1 Geoform (GC) or* Ridge - *Level 1 and 2 Geoform (GC)*	Greater Than	Certain	Some are ledges (in Gulf of Maine and Southern New England) some are megaripples (Mid Atlantic Bight). Platform is the Dominant geoform.
Low Slope	Submarine Canyon - *Physiographic Setting (GC)*	Submarine Slide Deposit - *Level 1 Geoform (GC) or* Slope - *Level 1 and 2 Geoform (GC)*	Greater Than	Certain	Dominant geoform selected. There also might be deposits at base of ledges
Moderate Depression	Shelf Valley - *Level 1 Geoform (GC)*		Greater Than	Certain	Dominant geoform selected, Contains valleys crossing shelf, however also contains valleys running parallel to slope break in Mid Atlantic Bight region
Moderate Flat	Continental/Island Shelf - *Physiographic Setting (GC)*	Platform - *Level 1 and 2 Geoform (GC) or* Flat - *Level 1 and 2 Geoform (GC)*	Greater Than	Certain	Dominant geoform selected; however, due to regional scale other geoforms are found.
Shallow Depression	Basin - *Level 1 Geoform (GC)*		Equal	Somewhat Certain	Dominant geoform selected.

Shallow Flat	Bank - *Level 1 Geoform (GC)*	Ledge - *Level 1 and 2 Geoform (GC)*	Greater Than	Somewhat Certain	Dominant geoform selected, Mostly found on George's Bank and close to the shore. Ledges can be found here as well due to regional scale.
Side Slope	Slope - Level 1 and 2 Geoform (GC)	Megaripples - Level 1 Geoform (GC) or Continental/Island Slope - Physiographic Setting (GC)	Greater Than	Certain	Dominant geoform selected. Mostly Continental/Island Slope; however, used slope since GOM contains these features. You can find NAMERA side slopes closer to shoreline as well.
Somewhat Deep Depression	Depression - *Level 2 Geoform (GC)*		Equal	Certain	Dominant geoform selected.
Somewhat Deep Flat	Flat - *Level 1 and 2 Geoform (GC)*		Equal	Certain	Dominant geoform selected.
Steep	Scarp/Wall - *Level 1 and 2 Geoform (GC)*	Ridge - *Level 1 and 2 Geoform (GC) or* Seamount - *Level 1 Geoform (GC) or* Slope - *Level 1 and 2 Geoform (GC) or* Submarine Canyon - *Physiographic Setting (GC)*	Greater Than	Certain	Dominant geoform selected; however, can find other geoforms in this classification due to regional scale.
Very Shallow Depression	Basin - *Level 1 Geoform (GC)*		Equal	Certain	Dominant geoform selected.
Very Shallow Flat	Tidal Flat - *Level 1 and 2 Geoform type (GC)*		Greater Than	Certain	Dominant geoform selected, NAMERA includes tidal flats; however, the NAMERA seabed form extends past the CMECS definition where they are constantly submerged (i.e. Georges Banks)

NAMERA Units	**CMECS Units (Dominant)**			
Bathymetry	**Benthic Depth Zones Values (Spatial Modifier Values for GC)**	**Relationship**	**Confidence**	**Notes**
0 - 15 meters	Shallow Infralittoral, Deep Infralittoral	Greater Than	Certain	NAMERA uses a range to define its bathymetry; in this case two depth zone modifiers will be used to characterize this bathymetry range since NAMERA ranges fall within two CMECS depth zones.
0 - 42 meters	Shallow Infralittoral, Deep Infralittoral, Circalittoral	Greater Than	Certain	NAMERA uses a range to define its bathymetry; in this case three depth zone modifiers will be used to characterize this bathymetry range since NAMERA ranges fall within three CMECS depth zones.
0 - 9 meters	Shallow Infralittoral, Deep Infralittoral	Greater Than	Certain	NAMERA uses a range to define its bathymetry; in this case two depth zone modifiers will be used to characterize this bathymetry range since NAMERA ranges fall within two CMECS depth zones.
101 - 143 meters	Circalittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
139 + meters	Circalittoral, Mesobenthic, Bathybenthic	Greater Than	Certain	NAMERA uses a range to define its bathymetry; in this case three depth zone modifiers will be used to characterize this bathymetry range since NAMERA ranges fall within three CMECS depth zones. NAMERA bathymetry stops at -2500m so this depth reaches the Bathybenthic CMECS zone.
143 - 233 meters	Circalittoral, Mesobenthic	Greater Than	Certain	NAMERA uses a range to define its bathymetry; in this case two depth zone modifiers will be used to characterize this bathymetry range since NAMERA ranges fall within two CMECS depth zones.
15 - 22 meters	Deep Infralittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
22 - 45 meters	Deep Infralittoral, Circalittoral	Greater Than	Certain	NAMERA uses a range to define its bathymetry; in this case two depth zone modifiers will be used to characterize this bathymetry range since NAMERA ranges fall within two CMECS depth zones.
23 - 31 meters	Deep Infralittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit

233 + meters	Mesobenthic, Bathybenthic	Greater Than	Certain	NAMERA uses a range to define its bathymetry; in this case two depth zone modifiers will be used to characterize this bathymetry range since NAMERA ranges fall within two CMECS depth zones. NAMERA bathymetry stops at -2500m so this depth reaches the Bathybenthic CMECS zone.
31 - 44 meters	Circalittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
42 - 69 meters	Circalittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
44 - 75 meters	Circalittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
45 - 80 meters	Circalittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
592 + meters	Mesobenthic, Bathybenthic	Greater Than	Certain	NAMERA uses a range to define its bathymetry; in this case two depth zone modifiers will be used to characterize this bathymetry range since NAMERA ranges fall within two CMECS depth zones. NAMERA bathymetry stops at -2500m so this depth reaches the Bathybenthic CMECS zone.
69 - 83 meters	Circalittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
75 - 139 meters	Circalittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
80 - 95 meters	Circalittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
83 - 101 meters	Circalittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
9 - 23 meters	Deep Infralittoral	Less Than	Certain	NAMERA unit falls within the threshold of one CMECS unit
95 - 592 meters	Circalittoral, Mesobenthic	Greater Than	Certain	NAMERA uses a range to define its bathymetry; in this case two depth zone modifiers will be used to characterize this bathymetry range since NAMERA ranges fall within two CMECS depth zones.

NAMERA Units	**CMECS Units**			
Estimate Grain Size	**Substrate**	**Relationship**	**Confidence**	**Notes**
0 - 0.03 Silt/Mud	Silt - *Substrate Subgroup (SC)*	Equal	Certain	
0.03 - 0.17 Sand	Very Fine Sand to Fine Sand - *Substrate Subgroup (SC)*	Greater Than	Certain	Very small amount of silt, majority of this is very fine to fine sand.
0.17 - 0.35 Sand	Fine Sand to Medium Sand - *Substrate Subgroup (SC)*	Greater Than	Certain	NAMERA grain size analysis groups these sediment grain sizes together.
0.35 - 0.36 Sand	Medium Sand - *Substrate Subgroup (SC)*	Less Than	Certain	NAMERA unit falls within CMECS sediment range
0.36 - 0.48 Sand	Medium Sand - *Substrate Subgroup (SC)*	Less Than	Certain	NAMERA unit falls within CMECS sediment range
0.48+ Coarse Sand to Gravel	Medium Sand to Pebble - *Substrate Subgroup (SC)*	Greater Than	Certain	NAMERA grain size analysis groups these sediment grain sizes together.

NAMERA Units	**CMECS Units**			
Benthic Organisms	**Biotic**	**Relationship**	**Confidence**	**Notes**
Annelids	Soft Sediment Fauna -*Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Arthropods	Soft Sediment Fauna -*Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Cnidarians	Soft Sediment Fauna -*Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Echinoderms	Soft Sediment Fauna -*Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Bryozoans	Soft Sediment Fauna -*Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Phoronids	Soft Sediment Fauna -*Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Sipunculids	Soft Sediment Fauna -*Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)

Chaetognatha	*No direct CMECS crosswalk*	No Equivalent	Certain	No direct CMECS classification, could be the Chaetognath Aggregation (BG)-in zooplankton section (no direct group for species in fine sand)
Brachiopods and Bryozoans	Soft Sediment Fauna -Biotic Subclass *(BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Bryozoans and Protozoans	*No direct CMECS crosswalk*	No Equivalent	Certain	No direct CMECS crosswalk due to poor confidence in samples
Chordates	Soft Sediment Fauna *-Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Nemerteans	Soft Sediment Fauna *-Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Hemichordates	Soft Sediment Fauna *-Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)
Protozoans	*No direct CMECS crosswalk*	No Equivalent	Certain	No direct CMECS crosswalk due to poor confidence in samples
Cephalopods	*No direct CMECS crosswalk*	No Equivalent	Certain	No direct CMECS crosswalk due to poor confidence in samples
Mollusks	Soft Sediment Fauna *-Biotic Subclass (BC)*	Equal	Certain	All NAMERA organisms are soft sediment fauna due collection of organism with substrate grain sizes between 0mm-0.48mm (not hard bottom)

9.3.3 NAMERA Benthic Habitat Provisional Biotopes

NAMERA Benthic Habitat	CMECS Provisional Biotopes
GOM_*4	No Biotope
GOM_1	Gulf of Maine/Bay of Fundy Shallow Infralittoral to Circalittoral Slopes, Platforms and Submarine Canyons with Silt to Medium Pebble substrates and Echinoderms and Mollusks
GOM_1028	Gulf of Maine/Bay of Fundy Circalittoral Flats and Continental/Island Shelf with Medium Sand to Pebble substrates and Arthropods and Mollusks
GOM_1078	No Biotope
GOM_12	Gulf of Maine/Bay of Fundy Shallow Infralittoral to Mesobenthic Slopes, Scarp/Walls, Flats and Depressions with Very Fine Sand to Pebble substrates and Arthropods, Echinoderms and Mollusks
GOM_1451	Gulf of Maine/Bay of Fundy Shallow Infralittoral to Circalittoral Basins, Submarine Canyons and Flats with Medium Sand substrate and Arthropods, Cnidarians, Echinoderms and Mollusks
GOM_18	Gulf of Maine/Bay of Fundy Shallow Infralittoral to Bathybenthic Basins, Slopes, Platforms, Scarp/Walls and Submarine Canyons with Fine Sand to Pebble substrates and Annelids, Arthropods, Echinoderms and Mollusks
GOM_183	No Biotope
GOM_2	Gulf of Maine/Bay of Fundy Circalittoral and Mesobenthic Slopes, Platforms, Shelf Valleys and Submarine Canyons with Silt to Pebble substrates and Arthropods
GOM_2367	Gulf of Maine/Bay of Fundy Circalittoral Continental/Island Shelf, Platforms and Shelf Valleys with Silt to Fine Sand substrates and Annelids, Arthropods, Cnidarians, Echinoderms, Bryozoans, Phoronids, Sipunculids and Mollusks
GOM_24	Gulf of Maine/Bay of Fundy Circalittoral to Bathybenthic Flats and Continental/Island Shelf with Silt and Medium Sand substrates and Arthropods
GOM_24/1028	Gulf of Maine/Bay of Fundy Circalittoral Flats with Fine to Medium Sand substrates and Arthropods and Mollusks
GOM_247	Gulf of Maine/Bay of Fundy Circalittoral to Bathybenthic Basins, Flats, Platforms, Submarine Canyons and Depressions with Silt substrates and Arthropods
GOM_5	Gulf of Maine/Bay of Fundy Circalittoral to Bathybenthic Basins, Slopes, Platforms and Submarine Canyons with Silt to Medium Sand substrates and Annelids and Arthropods
GOM_557	Gulf of Maine/Bay of Fundy Shallow Infralittoral to Bathybenthic Basins, Platforms, Submarine Canyons, Tidal Flats, Flats, Banks, Continental/Island Shelf and Shelf Valleys with Fine Sand to Pebble substrates and Annelids, Arthropods and Mollusks
GOM_7	Gulf of Maine/Bay of Fundy Circalittoral to Bathybenthic Slopes, Platforms, Shelf Valleys, Basins, Submarine Canyons and Depressions with Silt to Pebble substrates and Annelids, Arthropods, Cnidarians, Echinoderms, Brachiopods and Bryozoans, Chordates and Mollusks
GOM_72	Gulf of Maine/Bay of Fundy Mesobenthic to Bathybenthic Flats with Medium Sand to Pebble substrates and Arthropods
GOM_72/8/87	Gulf of Maine/Bay of Fundy Mesobenthic to Bathybenthic Basins with Silt substrate and Annelids, Arthropods, Echinoderms and Mollusks
GOM_8	Gulf of Maine/Bay of Fundy Shallow Infralittoral to Bathybenthic Basins, Slopes, Platforms, Scarp/Walls, Submarine Canyons, Tidal Flats and Flats with Silt to Medium Sand substrate and Annelids, Arthropods, Echinoderms and Mollusks

GOM_9	Gulf of Maine/Bay of Fundy Circalittoral Banks and Platforms with Medium Sand to Pebble substrates and Annelids, Arthropods, Echinoderms and Mollusks
GOM_9/133/183/1451	Gulf of Maine/Bay of Fundy Circalittoral Flats with Fine to Medium Sand substrates and Annelids, Arthropods, Cnidarians, Echinoderms and Mollusks
GOM_91	Gulf of Maine/Bay of Fundy Shallow Infralittoral to Circalittoral Platforms, Submarine Canyons, Banks, Continental/Island Shelf and Shelf Valleys with Very Fine Sand to Pebble substrates and Arthropods, Cnidarians, Echinoderms, Bryozoans and Mollusks
MAB_0	No Biotope
MAB_1	Virginian Shallow Infralittoral to Circalittoral Basins, Tidal Flats and Shelf Valleys with Fine Sand to Pebble substrates and Annelids, Arthropods, Chordates and Mollusks
MAB_1223	Virginian Circalittoral to Mesobenthic Platforms with Fine to Medium Sand substrates and Annelids, Arthropods, Cnidarians, Echinoderms and Mollusks
MAB_2	Virginian Deep Infralittoral to Circalittoral Basins, Slopes, Continental/Island Shelf and Shelf Valleys with Silt to Medium Sand substrates and Annelids, Arthropods, Cnidarians, Phoronids and Mollusks
MAB_216	Virginian Deep Infralittoral to Bathybenthic Submarine Canyons and Slopes with Very Fine Sand to Pebble substrates and Arthropods, Cnidarians and Echinoderms
MAB_218	Virginian Circalittoral Slopes and Shelf Valleys with Fine Sand to Pebble substrates and Annelids, Arthropods, Cnidarians and Mollusks
MAB_219	Virginian Circalittoral to Bathybenthic Slopes, Platforms and Submarine Canyons with Very Fine Sand to Pebble substrates and Annelids, Echinoderms and Mollusks
MAB_229	Virginian Shallow Infralittoral to Bathybenthic Platforms, Slopes, Depressions, Basins, Flats and Scarp/Walls with Silt to Pebble substrates and Arthropods, Cnidarians and Echinoderms
MAB_25	Virginian Deep Infralittoral to Mesobenthic Basins, Platforms, Submarine Canyons and Shelf Valleys with Very Fine to Medium Sand substrates and Annelids, Arthropods, Cnidarians and Mollusks
MAB_301	Virginian Circalittoral to Mesobenthic Depressions, Flats, Platforms and Basins with Silt to Pebble substrates and Cnidarians and Mollusks
MAB_306	Virginian Circalittoral Flats with Fine to Medium Sand substrates and Arthropods and Echinoderms
MAB_32	Virginian Deep Infralittoral to Circalittoral Continental/Island Shelf with Fine to Medium Sand substrates and Arthropods, Echinoderms and Mollusks
MAB_38	Virginian Deep Infralittoral Basins with Medium Sand substrate and Annelids, Arthropods, Hemichordates and Mollusks
MAB_384	Virginian Deep Infralittoral to Mesobenthic Slopes, Submarine Canyons and Scarp/Walls with Silt to Pebble substrates and Annelids and Arthropods
MAB_395	Virginian Circalittoral Depressions, Flats and Shelf Valleys with Very Fine to Medium Sand substrates and Annelids, Arthropods, Cnidarians, Echinoderms, Sipunculids and Mollusks
MAB_4	Virginian Deep Infralittoral to Circalittoral Banks, Continental/Island Shelf, Platforms, Slopes and Flats with Fine Sand to Pebble substrates and Annelids, Arthropods and Mollusks
MAB_44	Virginian Shallow Infralittoral to Bathybenthic Basins, Platforms, Slopes, Submarine Canyons, Tidal Flats, Banks and Flats with Silt to Pebble substrates and Arthropods, Echinoderms and Mollusks
MAB_505	Virginian Circalittoral to Bathybenthic Basins, Platforms, Scarp/Walls, Slopes and Submarine Canyons with Silt to Pebble substrates and Annelids, Cnidarians, Echinoderms, Sipunculids and Mollusks
MAB_520	Virginian Circalittoral to Mesobenthic Flats, Shelf Valleys and Basins with Very Fine Sand to Pebble substrates and Annelids, Arthropods, Echinoderms, Bryozoans, Sipunculids and Mollusks
MAB_592	Virginian Circalittoral Flats with Fine to Medium Sand substrates and Annelids, Arthropods and Mollusks
MAB_64	Virginian Deep Infralittoral Banks with Silt and Medium Sand substrates and Annelids, Arthropods and Mollusks
MAB_7	Virginian Deep Infralittoral to Circalittoral Banks, Continental/Island Shelf and Depressions with Medium Sand to Pebble substrates and Annelids, Arthropods, Cnidarians and Echinoderms
MAB_768	Virginian Shallow Infralittoral to Deep Infralittoral Basins, Platforms and Tidal Flats with Silt to Fine Sand substrates and Arthropods, Echinoderms and Mollusks
MAB_84	Virginian Shallow Infralittoral to Circalittoral Slopes, Continental/Island Shelf, Platforms and Flats with Silt to Pebble substrates and Annelids, Arthropods, Echinoderms and Mollusks
MAB_87	Virginian Deep Infralittoral Platforms with Silt to Pebble substrates and Annelids, Arthropods, Echinoderms and Mollusks
SNE_0	No Biotope
SNE_1	No Biotope
SNE_109	Virginian Shallow Infralittoral to Deep Infralittoral Basins, Submarine Canyons, Tidal Flats, Continental/Island Shelf, Shelf Valleys and Banks with Silt, Medium Sand to Pebble substrates and Annelids, Arthropods and Mollusks
SNE_11	Virginian Shallow Infralittoral to Bathybenthic Platforms, Flats, Scarp/Walls and Slopes with Very Fine Sand to Pebble substrates and Arthropods, Cnidarians and Mollusks
SNE_113	Virginian Shallow Infralittoral to Circalittoral Basins and Continental/Island Shelf with Very Fine to Medium Sand substrates and Annelids and Arthropods
SNE_200	Virginian Deep Infralittoral to Circalittoral Basins with Silt to Pebble substrates and Annelids and Mollusks
SNE_223	Virginian Deep Infralittoral to Circalittoral Continental/Island Shelf, Shelf Valleys and Banks with Fine Sand to Pebble substrates and Annelids, Arthropods, Sipunculids, Nemerteans and Mollusks
SNE_230/229	Virginian Deep Infralittoral Shelf Valleys with Very Fine to Fine Sand substrates and Annelids, Arthropods, Cnidarians, Echinoderms and Mollusks
SNE_24	No Biotope

SNE_25	Virginian Shallow Infralittoral to Deep Infralittoral Slopes, Tidal Flats, Banks, Basins, Platforms and Submarine Canyons with Silt to Pebble substrates and Annelids, Arthropods and Mollusks
SNE_2537	Virginian Deep Infralittoral to Circalittoral Shelf Valleys and Platforms with Very Fine to Medium Sand substrates and Annelids and Arthropods
SNE_3	No Biotope
SNE_316	Virginian Deep Infralittoral Banks, Basins and Platforms with Fine to Medium Sand substrates and Annelids, Arthropods and Mollusks
SNE_317	Virginian Deep Infralittoral to Circalittoral Continental/Island Shelf and Banks with Very Fine Sand to Pebble substrates and Annelids, Arthropods, Echinoderms and Mollusks
SNE_36	Virginian Shallow Infralittoral to Circalittoral Basins, Platforms, Submarine Canyons, Tidal Flats, Shelf Valleys and Continental/Island Shelf with Silt to Pebble substrates and Arthropods and Mollusks
SNE_372	Virginian Deep Infralittoral to Circalittoral Submarine Canyons and Shelf Valleys with Silt to Medium Sand substrates and Annelids, Arthropods, Echinoderms, Phoronids and Mollusks
SNE_381	Virginian Circalittoral Continental/Island Shelf and Platforms with Silt to Medium Sand substrates and Annelids, Arthropods, Echinoderms, Bryozoans, Hemichordates and Mollusks
SNE_387	Virginian Circalittoral to Bathybenthic Platforms, Scarp/Walls, Slopes and Submarine Canyons with Silt to Pebble substrates and Annelids, Echinoderms, Sipunculids, Nemerteans, Hemichordates and Mollusks
SNE_390	Virginian Deep Infralittoral to Circalittoral Slopes and Basins with Very Fine Sand to Pebble substrates and Annelids, Arthropods and Mollusks
SNE_437	Virginian Deep Infralittoral to Circalittoral Slopes and Platforms with Silt to Pebble substrates and Arthropods, Echinoderms and Mollusks
SNE_6	Virginian Shallow Infralittoral to Bathybenthic Slopes, Basins, Flats, Scarp/Walls, Continental/Island Shelf, Platforms and Shelf Valleys with Silt to Pebble substrates and Arthropods, Echinoderms and Mollusks
SNE_66	Virginian Circalittoral to Bathybenthic Basins, Flats, Platforms, Shelf Valleys and Submarine Canyons with Silt to Fine Sand substrates and Annelids, Cnidarians and Echinoderms
SNE_82	Virginian Circalittoral Continental/Island Shelf, Platforms, Shelf Valleys and Flats with Medium Sand to Pebble substrates and Echinoderms and Mollusks
SNE_873	Virginian Deep Infralittoral to Circalittoral Platforms, Shelf Valleys and Slopes with Very Fine Sand to Pebble substrates and Annelids and Mollusks
SNE_949	Virginian Circalittoral Basins and Flats with Fine to Medium Sand and Mollusks

9.4 A list of the Northwest Atlantic United States CMECS Habitats

This document presents a list of mappable units of the Coastal and Marine Ecological Classification Standard (CMECS) relevant to the Northwest Atlantic region. We crosswalked several classification schemes (stated below) to CMECS that are commonly used for habitat mapping and assessment studies at local, subregional, and regional scales throughout the Northwest Atlantic. This list is structured in a way that mimics the organization of the framework of CMECS). We noted whether CMECS units were mappable at local (1), subregional (2), and/or regional (3) scales. Local classification schemes were limited to those relevant to the Boston Harbor. Subregional classification schemes pertained to New England state coastal mapping and assessment programs. Regional classification schemes were broad, with a national or ecoregional focus. In addition to Northwest Atlantic units that have CMECS equivalents, we documented units that were present in Northwest Atlantic classification schemes but not captured in CMECS. We recommend the appropriate place within the CMECS framework for these units to be added in the future. This list demonstrates the degree of overlap between CMECS and smaller scale/scope habitat classification schemes and provides a starting point for a full Northwest Atlantic CMECS unit list of habitats.

Local Sources (1): Massachusetts Department of Environmental Protection Wetlands layer (Mass DEP 2009), NOAA Environmental Sensitivity Index (NOAA 2008), TNC NAMERA Coastal and, Surficial Geology layers (Greene et al. 2010), USFWS Gulf of Maine Watershed Habitat Analysis Surficial Geology layer (Banner and Schaller, 2001), USGS Topographic maps (USGS 2012), NOAA Nautical charts (NOAA 2011), DMF Draft Habitat Classification, USGS surficial geology for Boston Harbor (Ackerman et al, 2006; Knebel and Circe, 1995), and surficial geology classifications created by Massachusetts Division of Marine Fisheries (Ford and Voss 2010) and Massachusetts Coastal Zone Management (Valente et al, 2007).

Subregional Sources (2): McMaster sediments of Narragansett Bay and Rhode Island Sound (McMaster, 1960), MapCoast Subaqueous Soils (www.mapcoast.org), Rhode Island Narragansett Bay benthic habitat types (French et al., 1992), Rhode Island Ocean SAMP (LaFrance et al., 2010), Habitat Classification Scheme for the Long Island Sound Region (Auster et al., 2009), A Technical Characterization of Estuarine and Coastal New Hampshire (Jones, 2000), Maine Coastal Marine Geologic Environments (Kelley et al., 2005), Marine and Estuarine Habitats in Maine (Brown 1993).

Regional Sources (3): The Nature Conservancy's Northwest Atlantic Marine Ecoregional Assessment (NAMERA) Benthic Habitat Model (Anderson et al., 2010), Habitat and Land Cover Classification Scheme for the National Estuarine Research Reserve System (NERRS; Kutcher et al., 2008).

Biogeographic Setting (BS)

Ecoregion:

- Gulf of Maine/Bay of Fundy (3)
- Virginian (2,3)

Aquatic Setting (AS)

Aquatic Setting System*:

- Estuarine (1,2,3)
  - **Aquatic Setting Subsystem:**
  - Coastal (2,3)
    - **Aquatic Setting Tidal Zone:**
    - Intertidal (1,2,3)
    - Subtidal (2,3)
    - Supratidal (2,3)
  - Open Water (2,3)
    - **Aquatic Setting Tidal Zone:**
    - Subtidal (2,3)
  - Tidal Riverine Coastal (2,3)
    - **Aquatic Setting Tidal Zone:**
    - Intertidal (3)
    - Subtidal (2,3)
  - Tidal Riverine Open Water (2)
    - **Aquatic Setting Tidal Zone:**
    - Subtidal (2)
- Lacustrine (3)
  - **Aquatic Setting Subsystem:**
  - Limnetic (3)
  - Littoral (3)
- Marine (1,2,3)
  - **Aquatic Setting Subsystem:**
  - Nearshore (2,3)
    - **Aquatic Setting Tidal Zone:**
    - Intertidal (1,2,3)
    - Subtidal (2,3)
    - Supratidal (2,3)
  - Offshore (2)
    - **Aquatic Setting Tidal Zone:**
    - Subtidal (2)

**Systems, Subsystems, and Tidal Zones are typically not explicitly defined by the local scale classifications. So while these units exist and can be mapped, data or knowledge outside of the actual classification would be needed to achieve these levels of the CMECS hierarchy in most cases.*

Aquatic Setting (AS) Component Modifiers

- Atidal (3)

Aquatic Setting (AS) Component Recommendations

- Fresh (Modifier) (3)
- Temporarily Flooded (Modifier) (3)
- Saturated (Modifier) (3)
- Seasonally Flooded (Modifier) (3)
- Seasonal Well-Drained (Modifier) (3)
- Seasonal Saturated (Modifier) (3)
- Semi-Permanently Flooded (Modifier) (3)
- Intermittently Exposed (Modifier) (3)
- Permanently Flooded (Modifier) (3)
- Intermittently Flooded (Modifier) (3)
- Artificially Flooded (Modifier) (3)

- Tidal (Modifier) (3)
- Irregularly Exposed (Modifier) (3)
- Regularly Flooded (Modifier) (3)
- Irregularly Flooded (Modifier) (3)

Substrate Component (SC)

Substrate Origin: Geologic (1,2,3)

Substrate Class: Rock Substrate (1,2,3)

Substrate Subclass:

- Bedrock (1,2,3)
- Megaclast (2)

Substrate Subclass: Coarse Unconsolidated Substrate (1,2,3)

Substrate Group:

- Gravel (1,2,3)

  Substrate Subgroup:

  - Boulder (1,2,3)
  - Cobble (1,2,3)
  - Pebble (1,2,3)
  - Granule (1,3)
- Gravel Mixes (1,2,3)

  Substrate Subgroup:

  - Sandy Gravel (2,3)
  - Muddy Sandy Gravel (2,3)
  - Muddy Gravel (2,3)
- Gravelly (1,2,3)

  Substrate Subgroup:

  - Gravelly Sand (3)
  - Gravelly Muddy Sand (3)
  - Gravelly Mud (2,3)

Substrate Class: Unconsolidated Mineral Substrate (1,2)

Substrate Subclass: Fine Unconsolidated Substrate (1,2)

Substrate Group:

- Slightly Gravelly (1,2,3)

  Substrate Subgroup:

  - Slightly Gravelly Sand (3)
  - Slightly Gravelly Muddy Sand (3)
  - Slightly Gravelly Sandy Mud (3)
  - Slightly Gravelly Mud (3)
- Sand (1,2,3)

  Substrate Subgroup:

  - Very Coarse Sand (1,2,3)
  - Coarse Sand (1,2,3)
  - Medium Sand (1,2,3)
  - Fine Sand (1,2,3)
  - Very Fine Sand (1,2,3)
- Muddy Sand (1,2)

  Substrate Subgroup:

  - Silty Sand (2)
  - Silty-Clayey Sand (2)
  - Clayey Sand (2)
- Sandy Mud (1,2)

  Substrate Subgroup:

  - Sandy Silt (2)
  - Sandy Silt-Clay (2)
  - Sandy Clay (2)

- Mud (1,2,3)
  - **Substrate Subgroup:**
    - Silt (1,2,3)
    - Silty-Clay (2)
    - Clay (1)

Substrate Origin: Biogenic (1,2,3)

Substrate Class: Algal Substrate (1)

Substrate Class: Coral Substrate (1)

Substrate Subclass: Coral Reef (1)

Substrate Class: Organic Substrate (1,2)

Substrate Subclass:

- Organic Debris (2)
- Organic Detritus (2)

Substrate Class: Shell Substrate (1,2)

Substrate Subclass: Shell Rubble (2)

Substrate Group

- Mussel Rubble (2)
- Crepidula Rubble (2)

Substrate Subclass: Shell Reef Substrate (2)

Substrate Group:

- Mussel Reef Substrate (2)
- Oyster Reef Substrate (2)

Substrate Origin: Anthropogenic (1,2,3)

Substrate Class:

- Anthropogenic Rock (1,2,3)
  - **Substrate Subclass:**
    - Anthropogenic Rock Reef (1)
    - Anthropogenic Rock Rubble (1)
- Anthropogenic Wood (2)
  - **Substrate Subclass:** Anthropogenic Wood Hash (2)
- Construction Materials (1,2)
- Metal (2)
- Trash (1,2)

Substrate Component (SC) Modifiers

- Flat (1,2)
- Developed (1)
- Sloping (1,2)
- Wave Regime (1)
- Hard (1)
- Soft (1)
- Mixed (1)
- Shallow Infralittoral (2)
- Layering: Overlying submerged terrestrial till deposits (2)
- Layering: Overlying outwash deposits (2)
- Layering: Organic layer 1-2m from surface (2)
- Layering: Marine silts over organic deposits within 1m of surface (2)
- Layering: < 1m marine silts over marine sands or stratified sand and gravel (2)
- Layering: > 1m marine sands over marine silts (2)
- Layering: relict channel phase (2)
- Layering: buried lenses of algal material (2)
- Co-occurring element: Geologic substrate; Unconsolidated mineral substrate; Coarse unconsolidated substrate; Gravel; Boulder (2)
- Contaminated (2)
- Fluid substrate (2)

- Hypoxic (2)
- Oxygen-regime modifier (2)
- Trawled/Harvested (1)
- Aquaculture (1)

Substrate Component (SC) Recommendations

- Organic carbon (Modifier) (2)
- Other organic chemical constituents (Modifier) (2)

Geoform Components (GC)

Geoform Physiographic Setting:

- Continental/Island Shelf (3)
- Continental/Island Slope (3)
- Lagoonal Estuary (1)
- Submarine Canyon (3)

Geoform Physiographic Setting: Sound (2)

Geoform Origin: Geologic (2)

Geoform Level 1: Channel (2)

Geoform Physiographic Setting: Embayment/Bay (2,3)

Geoform Origin: Geologic (2)

Geoform Level 1

- Beach (2)
- Dune Field (2)
- Flat (2)

Geoform Physiographic Setting: Continental Shore Complex (2)

Geoform Origin: Geologic (2)

Geoform Level 1

- Apron (2)
- Basin (2)
- Boulder Field (2)
- Ledge (2)
- Moraine (2)
- Pavement Area (2)
- Rock Outcrop (2)
- Rubble Field (2)
- Shelf Valley (2)
- Till Surface (2)

Geoform Level 2

- Knob (2)
- Overhang (Cliff) (2)
- Rock Outcrop (2)
- Slope (2)

Geoform Origin: Geologic (1,2,3)

Geoform Level 1:

- Aquaculture Structure (1)
- Bank (2,3)
- Bar (2)

Geoform Type Level 1:

- Longshore Bar (2)

- Basin (1,2,3)
- Beach (1,2,3)

Geoform Type Level 1:

- Barrier Beach (1)

Geoform Type Level 2:

- Barrier Beach (1)

- Boulder Field (1,2)
- Channel (1,2,3)

  Geoform Type Level 1:
  - Slough (2)
  - Tidal Channel/Creek (3)

  Geoform Type Level 2:
  - Tidal Channel/Creek (3)
- Cove (2,3)
- Delta (2)
- Delta Plain (2)
- Dune Field (2)
- Drumlin Field (1)
- Fan (2)
- Flat (1,2,3)

  Geoform Type Level 1:
  - Barrier Flat (2)
  - Wind Tidal Flat (2)
  - Washover Fan Flat (2)
  - Tidal Flat (1,3)

  Geoform Type Level 2:
  - Tidal Flat (1,3)
- Fluviomarine Deposit (2)
- Inlet (2)

  Geoform Type Level 1:
  - Relict Tidal Inlet (2)
- Island (1,2)

  Geoform Type Level 1:
  - Barrier Island (2)
- Lagoon (2,3)
- Ledge (2,3)
- Marsh Platform (1,2,3)
- Megaripples (3)
- Moraine (1,2)
- Mound/Hummock (2,3)
- Overhang (Cliff) (1)
- Pavement Area (2)
- Platform (2,3)

  Geoform Type Level 1:
  - Wave-Cut Platform (2)
- Pockmark Field (2)
- Ridge (1,3)

  Geoform Type Level 1:
  - Esker

  Geoform Type Level 2:
  - Esker
- Rock Outcrop (2)
- Rubble Field (1)
- Scarp/Wall (1,2,3)
- Seamount (3)
- Sediment Wave Field (2)
- Shelf Valley (3)
- Shoal (1,2,3)

  Geoform Type Level 1:
  - Moraine Shoal (1)

Geoform Type Level 2:
- Moraine Shoal (1)

- Shore (1,2)

  Geoform Type Level 1:
  - Foreshore (1)
- Shore Complex (1,2)
- Slope (2,3)

  Geoform Type Level 1:
  - Washover Fan Slope (2)
- Spit (2)
- Submarine Slide Deposit (2,3)
- Terrace (2)

  Geoform Type Level 1:
  - Marine Terrace (2)
  - Wave-Built Terrace (2)
- Tidepool (3)
- Till Surface (1)
- Tombolo (2)

Geoform Level 2
- Aquaculture Structure (1)
- Bank (2)
- Bar (2)

  Geoform Type Level 2:
  - Point Bar (2)
- Basin (2)
- Beach (1,2,3)

  Geoform Type Level 1:
  - Barrier Beach (1,2)
  - Mainland Beach (2)

  Geoform Type Level 2:
  - Barrier Beach (1,2)
  - Mainland Beach (2)
- Channel (1,2,3)

  Geoform Type Level 2:
  - Pass/Lagoon Channel (2)
  - Tidal Channel/Creek (2,3)
- Cove (2,3)

  Geoform Type Level 1:
  - Barrier Cove (2)
  - Mainland Cove (2)

  Geoform Type Level 2:
  - Barrier Cove (2)
  - Mainland Cove (2)
- Depression (1,2,3)
- Delta (2)

  Geoform Type Level 2:
  - Ebb Tidal Delta (2)
  - Flood Tidal Delta (2)
  - Flood Tidal Delta Slope (2)
- Drumlin (1)
- Dune (1,2)
- Fan (2)

  Geoform Type Level 1:
  - Alluvial Fan (2)
  - Washover Fan (2)

  Geoform Type Level 1:

        - Washover Fan (2)
- Flat (1,2,3)
    Geoform Type Level 1:
    - Back Barrier Flat (2)
    - Barrier Flat (2)
    - Tidal Flat (1,2,3)
    - Washover Fan Flat (2)

    Geoform Type Level 2:
    - Tidal Flat (1,2,3)
- Fluviomarine Deposit (2)
- Inlet (2)
    Geoform Type Level 1:
    - Tidal Inlet (2)
    - Relict Tidal Inlet (2)
- Island (1,2)
    Geoform Type Level 1:
    - Barrier Island (2)

    Geoform Type Level 2:
    - Barrier Island (2)
- Lagoon (2,3)
- Ledge (2,3)
- Marsh Platform (1,2,3)
- Mound/Hummock (2)
- Overhang (Cliff) (1)
- Panne (1,2,3)
- Platform (3)
- Pockmark (2)
- Ridge (1,2,3)
    Geoform Type Level 1:
    - Esker

    Geoform Type Level 2:
    - Esker
- Ripples (2)
- Rock Outcrop (2)
- Scarp/Wall (1,2,3)
- Sediment Wave Field (2)
- Shoal (1,2,3)
    Geoform Type Level 1:
    - Moraine Shoal (1)

    Geoform Type Level 2:
    - Moraine Shoal (1)
- Shore (1,2)
    Geoform Type Level 1:
    - Foreshore (1,2)

    Geoform Type Level 2:
    - Foreshore (1,2)
- Slope (3)
- Swale/Slack (2)
- Till Surface (1)

Geoform Origin: Anthropogenic (1,2,3)

Geoform Level 1
- Artificial Dike (1)
    Geoform Type Level 1:
    - Artificial Levee (1)
- Aquaculture Structure (2,3)
- Cable Area (1,2)

- Canal (1)
- Dam (1)
- Dredge Deposit (1,2)
- Dredged/Excavated Channel (1,2,3)
- Harbor (2)
- Mooring Field (1,2)
- Pipeline Area (1,2)
- Seawall (1,2)

  <u>Geoform Level 2</u>
  - Aquaculture Structure (2,3)
  - Artificial Reef (1,3)
  - Artificial Scar (2)

    <u>Geoform Type Level 2:</u>
    - Prop Scar (2)
    - Trawling Scar (2)
  - Bulkhead (1,2)
  - Buoy (2)
  - Breakwater/Jetty (1,2)

    <u>Geoform Type Level 2:</u>
    - Groin (1)
  - Cable (1)
  - Canal (1)
  - Dam (1)
  - Dock/Pier (1,2)
  - Dredge Deposit (1,2)

    <u>Geoform Type Level 2:</u>
    - Dredge Deposit Shoal (2)
    - Dredge Deposit Bank (2)
  - Dredge Disturbance (2)
  - Dredged/Excavated Channel (1)
  - Drilling (Oil or Gas) Rig
  - Fill Area (2)
  - Harbor (1)
  - Lock (1)
  - Lost/Discarded Fishing Gear (1,2)
  - Marina/Boat Ramp (1,2)
  - Mosquito Ditch (2)
  - Outfall/Intake (1)
  - Pilings (1,2)
  - Rip-Rap Deposit (1,2)
  - Salt Pond (2)
  - Wreck (1)
  - Wharf (1)

<u>Geoform Origin:</u> Biogenic (1,2,3)

<u>Geoform Level 1</u>
- Deep/Cold-Water Coral Reef (1)
- Mollusk Reef (1,2,3)

  <u>Geoform Type Level 2</u>
  - Patch Mollusk Reef (2)

    <u>Geoform Level 2</u>
    - Burrows/Bioturbation (2)
    - Deep/Cold-Water Coral Reef (1)
    - Shallow/Mesophotic Coral Reef (1,3)
    - Mollusk Reef (3)
- Shallow/Mesophotic Coral Reef (1,2,3)

Geoform Component (GC) Modifiers

- Dredged (1,2,3)
- Filled (2)
- Shallow Infralittoral (2,3)
- Energy Intensity (2)
- Mobile/Nonmobile Sediments (2)
- Trawled/Harvested (1,2)
- Aquaculture (1)
- Slope (1,2)
- Substrate Pattern (2)
- Seafloor Rugosity (2)
- Induration (2)
- Exotic (2)
- Scarred (2)
- Deep Infralittoral (3)
- Circalittoral (3)
- Mesobenthic (3)
- Bathybenthic (3)
- Wave Regime (1)
- Flat (1)
- Developed (1,3)
- Restored (3)
- Temporal Persistence (1)
- Dredged (1)
- Induration (1)
- Impounded/Diverted (3)

Geoform Component (GC) Recommendations

- Barrier Beach-Bog (1)
- Barrier Beach-Open Water (1)
- Bog (1)
- Cranberry Bog (1)
- Open Water (1)
- Reservoir (1)
- Upland (1)
- Deposition (Modifier) (1)
- Erosion or Nondeposition (Modifier) (1)
- Sediment Reworking (Modifier) (1)
- Tailings Pond (1)
- River, Stream (1)
- Caisson, Gate (1)
- Causeway (1)
- Dolphin (1)
- Floating barrier, e.g. oil barrier, security barrier (1)
- Flood barrage (1)
- Gridiron, scrubbing grid (1)
- Hulk (1)
- Mole (with berthing facility) (1)
- Non-tidal basin, wet-dock (1)
- Pontoon (1)
- Ruin (1)
- Ruined pier, partly submerged at high water (1)
- Slipway, patent slip, ramp (1)
- Steps, landing stairs (1)
- Training wall (partly submerged at high water) (1)
- Works at sea, area under reclamation (1)

- Breakers (1)
- Crib, duck blind (1)
- Float (1)
- Submerged Crib (1)
- Submerged duck blind (1)
- Submerged platform (1)
- Sunken danger (1)
- Unexploded ordnance (1)
- Tunnel (1)
- Anchorage Area (1)
- CAD Cell (1)
- Blasting deposit (1)
- Ebb tidal delta slope (1)
- Separate outfall and intake (1)
- Foul area dangerous to navigation (1)
- Sinkers (1)
- Foul Ground (1)
- Obstruction (1)
- Moorings (1)
- Glaciers (3)

Biotic Components (BC)

Biotic Setting: Planktonic Biota (2,3)

- **Biotic Class:** Floating/Suspended Plants and Macroalgae (2,3)
  - **Biotic Subclass:** Floating/Suspended Macroalgae (2,3)
    - **Biotic Group:** Algal Rafts (2)
      - **Biotic Community:** *Ulva* Rafts (2)

Biotic Setting: Benthic/Attached Biota (1,2,3)

- **Biotic Class:** Reef Biota (1,3)
  - **Biotic Subclass:** Worm Reef Biota (3)
  - **Biotic Subclass:** Mollusk Reef Biota (1,2,3)
    - **Biotic Group:** Oyster Reef (1,2)
      - **Biotic Community:**
        - *Ostrea* Reef (1,2)
        - *Crassostrea* Reef (1)
    - **Biotic Group:** Mussel Reef (1,2)
      - **Biotic Community**
        - *Mytilus* Reef (1,2)
  - **Biotic Subclass:** Shallow/Mesophotic Coral Reef Biota (1,3)

- **Biotic Class:** Faunal Bed (1,2,3)
  - **Biotic Subclass:** Attached Fauna (1,2)
    - **Biotic Group:** Attached Tube-Building Fauna (2)
    - **Biotic Group:** Attached Oysters (1,2)
      - **Biotic Community**
        - Attached *Crassostrea* (1,2)
        - Attached *Ostrea* (1)
    - **Biotic Group:** Attached Mussels (1,2)
      - **Biotic Community**
        - Attached *Mytilus* (1,2)
    - **Biotic Group:** Sessile Gastropods (2)
      - **Biotic Community**
        - Attached *Crepidula* (2)
    - **Biotic Group:** Mobile Crustaceans on Hard or Mixed Sediments (2)

Biotic Group: Mobile Mollusks on Hard or Mixed Substrates (2)

Biotic Community

- *Littorina* Community (2)
- *Urosalpinx* Community (2)

Biotic Subclass: Soft Sediment Fauna (1,2,3)

Biotic Group: Clam Bed (1,2)

Biotic Community:

- *Nucula* Bed (2)
- *Mya* Bed (1,2)
- *Mercenaria* Bed (1)
- *Spisula* Bed (1)

Biotic Group: Mussel Bed (1,2)

Biotic Community

- *Mytilus* Bed (1)

Biotic Group: Oyster Bed (1)

Biotic Community

- *Crassostrea* Bed (1)
- *Ostrea* Bed (1)

Biotic Group: Sand Dollar Bed (2)

Biotic Group: Small Tube-Building Fauna (2)

Biotic Community

- *Ampelisca* Bed (2)
- *Streblospio* Bed (2)

Biotic Group: Small Surface-Burrowing Fauna (2)

Biotic Community

- Lumbrinerid Bed (2)

Biotic Group: Mobile Crustaceans on Soft Sediments (2)

Biotic Community

- Haustoriid Bed (2)

Biotic Group: Tunneling Megafauna (2)

Biotic Group: Scallop Bed (1,2)

Biotic Community

- *Placopecten* Bed (1,2)
- *Argopecten* Bed (1)

Biotic Class: Moss and Lichen Communities (2,3)

Biotic Subclass: Marine Lichens (2)

Biotic Subclass: Freshwater Tidal Moss (3)

Biotic Community: Submerged Freshwater Tidal Moss (3)

Biotic Class: Aquatic Vegetation Bed (1,2,3)

Biotic Subclass: Benthic Macroalgae (1,2,3)

Biotic Group: Leathery/Leafy Algal Bed (2)

Biotic Community

- *Ascophyllum* Community (2)
- *Chondrus* Community (2)

Biotic Group: Canopy-Forming Algal Bed (1,2)

Biotic Community:

- *Laminaria* saccharina Community (2)

Biotic Group: Sheet Algal Bed (2)

Biotic Community:

- *Ulva* (2)

Biotic Group: Coralline/Crustose Algal Bed (1)

Biotic Subclass: Aquatic Vascular Vegetation (1,2,3)

Biotic Group: Seagrass Bed (1,2)

Biotic Community:

- *Zostera* Community (2)
- *Zostera marina* Herbaceous Vegetation (1)

Biotic Class: Emergent Wetland (1,2,3)

Biotic Subclass: Emergent Tidal Marsh (1,2)

Biotic Group: High Salt Marsh (2)

Biotic Community: *Spartina patens* (2)

Biotic Group: Low and Intermediate Salt Marsh (2)

Biotic Community:

- *Spartina alterniflora* (2)

Biotic Group:

- Brackish Marsh (2)
- Freshwater Tidal Marsh (2)

Biotic Class: Scrub-Shrub Wetland (1,3)

Biotic Class: Forested Wetland (1,3)

Biotic Components (BC) Modifiers

- Exotic (1,2)
- Oligohaline (2)
- Littoral (2)
- Quiescent (2)
- Very low wave energy (2)
- Low wave energy (2)
- Layering: Fine-grained sediment veneer (2)
- High current energy (2)
- Moderate current energy (2)
- Low current energy (2)
- Hyperhaline - Salinity Regime (Modifier) (2,3)
- Mesohaline - Salinity Regime (Modifier) (2,3)
- Upper polyhaline- Salinity Regime (Modifier) (2,3)
- Lower polyhaline Salinity Regime (Modifier) (2,3)
- Oligohaline - Salinity Regime (Modifier) (2,3)
- Euhaline - Salinity Regime (Modifier) (3)
- Unenclosed (2)
- Partially enclosed (2)
- Intermittent (2)
- Enclosed (2)
- Energy intensity modifiers (2)
- Wave regime modifiers (2)
- Deep infralittoral (2)
- Shallow infralittoral
- Littoral (2)
- Circalittoral (2)
- Temperature modifier (2)
- Developed (3)
- Temporal Persistence - Temporal (3)

Biotic Components (BC) Recommendations

- *Spiochaetopterus* bed (Biotic Community) (2)
- *Mediomastus* bed (Biotic Community) (2)
- *Harmothoe* (Biotic Community) (2)

- American Lobster (*Homarus americanus*) (Biotic Community) (2)
- Horseshoe crab (*Limulus polyphemus*) (Biotic Community) (2)
- Tufted redweed (*Mastocarpus* spp. (Biotic Community) (2)
- Nuisance (Modifier or add to definition of invasive modifier) (2)
- *Carcinus maenus* (Biotic Community) (2)
- Vegetated beach ridge (Biotic Component) (2)
- Ensis Bed (1)
- Freshwater Marshes (1)
- Fresh (Modifier) (3)