

# Tidal Energy Suitability Offshore of Massachusetts

## Introduction

The goal for this project was to determine the best area in Massachusetts to implement tidal energy projects. The analysis was done based on a list of relevant criteria, mostly inspired by a holistic method presented by Energy Conservation and Management (Vasquez).

Tidal power based electricity is generated in a variety of ways, which makes suitability a multifaceted issue, but since there are no large unpopulated coastal inlets, tidal barrages (large dams) will likely not be feasible in Massachusetts on a large scale. Even if there was a suitable location, the tidal ranges on the entire eastern seaboard are not high enough to generate significant amounts of energy. However, there is a type of tidal energy which might be applicable to Massachusetts.

The type of tidal energy which seems most feasible in Massachusetts is tidal turbine generation, which uses kinetic energy instead of potential energy to generate electricity. This is more feasible in Massachusetts because of many tidal streams and channels between islands which high currents flow through. Therefore, this project only analyzes the possibility for tidal turbine, or other kinetic energy based energy generation methods. The analysis was done based on a list of relevant criteria, mostly inspired by a holistic method presented by Energy Conservation and Management (Vasquez).

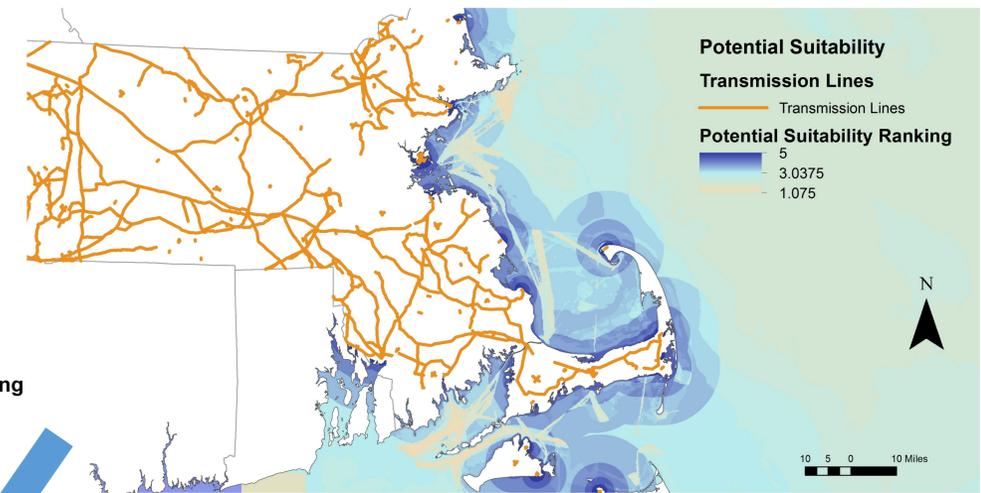
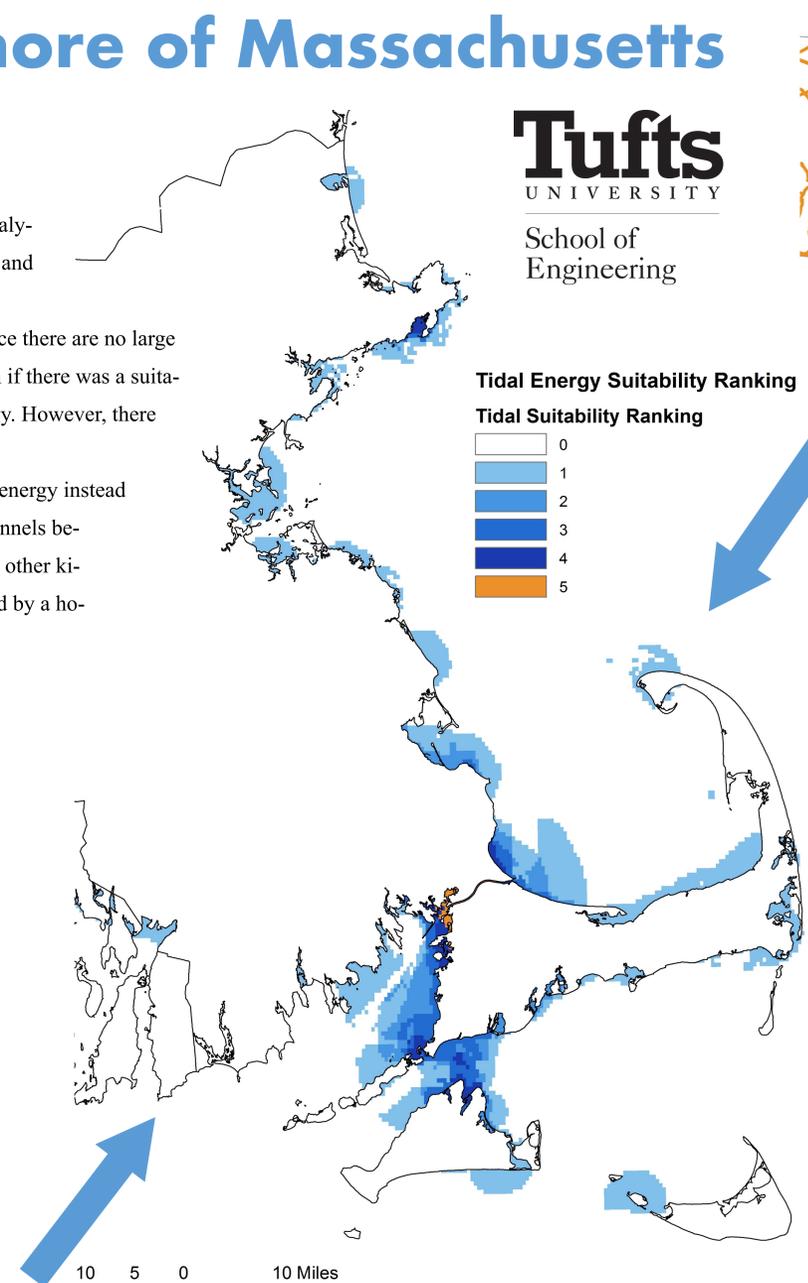
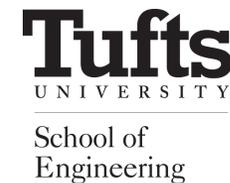
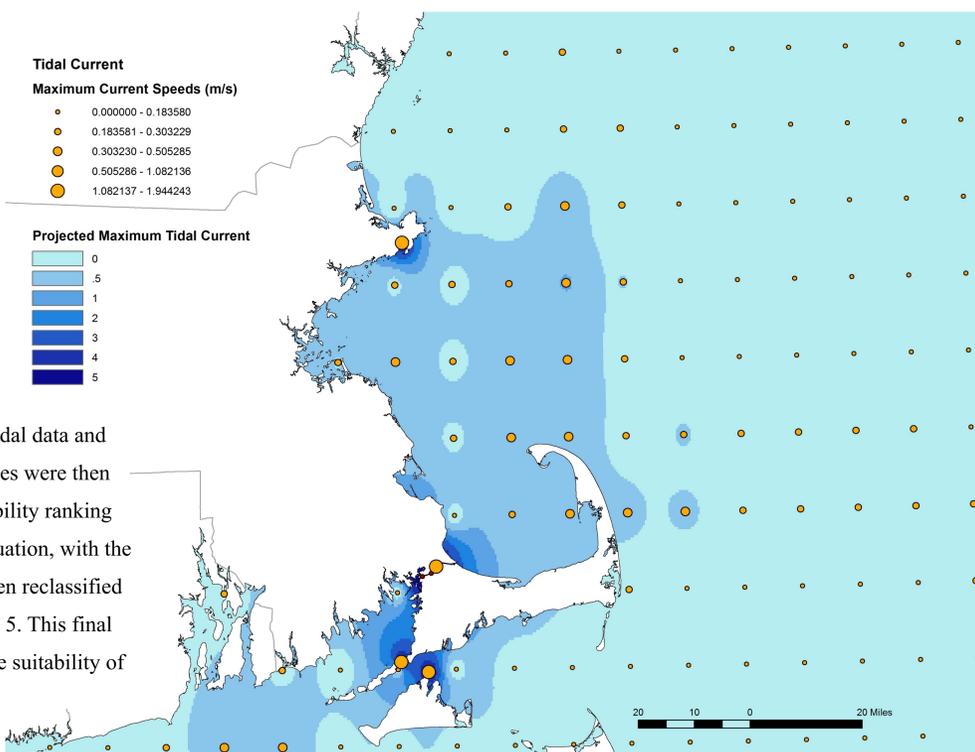
## Methods

The first piece of determining suitability for tidal energy was analyzing and quantifying limiting factors on the potential to locate energy generating infrastructure near shore in Massachusetts. The factors selected were a matter of data availability, since tidal energy is a new technology (Tang). This was done by making all of the suitability factors besides current, including areas of marine traffic and eelgrass habitat, depth and transmission line distance into reclassified rasters of the same range of values, and then combining them with a raster calculator into a total suitability ranking (Top Right).

All of the reclassification functions converted the raster values into a scale from 0 to 5 (in most cases, 0 or 5, besides bathymetry and transmission line distance). Then the raster calculator was applied to all the layers, an additive scale with different weights given to different categories. The weights, for commercial traffic, commercial fishing, recreational boating, recreational fishing, eelgrass, bathymetry, and transmission lines, respectively, are .2, .1, .025, .025, .05, .2, and 0.4. These weights were determined based on the weights in similar studies, with the main reference being Energy Conservation and Management (Vasquez). The weights add up to one, so the final suitability score is on a scale from 0 to 5.

The most important piece of this project was finding a reasonable continuous model for tidal current off the shore of Massachusetts. This was done by interpolating two point type data sources from NOAA NOS and MORIS (Data Sources). The result was a

raster containing tidal current at any point within the datasets within a .05 degree of accuracy (Below). The resulting raster from these datasets was then reclassified into a 0 to 5 scale using natural breaks (like the transmission lines and bathymetry layers). The results of the tidal data and potential suitability processes were then combined into a final suitability ranking using a raster calculator equation, with the two rankings added, and then reclassified on the same scale from 0 to 5. This final ranking raster represents the suitability of every point near shore in Massachusetts (Above).



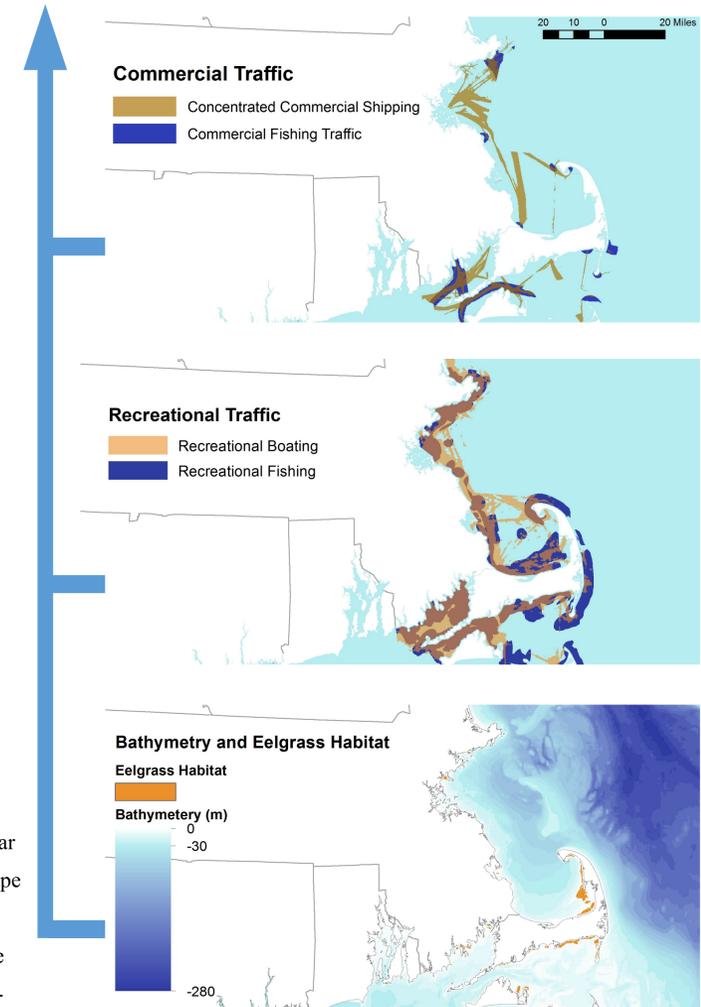
## Results and Discussion

The result of this project is the map above right, containing a final suitability score map for near shore areas of Massachusetts. The orange area, which scored the highest, is near and inside Cape Cod Canal, which is a dredged channel, and connects the north and south sides of the cape for mainly commercial reasons. It is the area with the highest currents near Massachusetts, and the algorithm implemented in this project picked areas near the mouth, just out of the way of commercial traffic lanes. This result makes intuitive sense, and the area indicated should be the first area to evaluate further for a tidal energy generation system. However, several other areas were also very promising, and could be possible sites if the Cape Cod site has a limiting factor not included in this project. These areas are Woods Hole, a nearby area of Vineyard Sound, and the mouth of the channel in Gloucester. This project was successful in its goal of creating a suitability map for tidal energy generation near Massachusetts. However, the tidal data used by this project was not very detailed, and so the results are limited by that precision. There are also many relevant variables which were not accounted for, including volume of flow, pressure differentials, and duration of high currents. Future studies could explore the areas suggested by this suitability analysis, and use mathematical models for pressure differential based on tidal ranges upstream and basin area to quantify suitability in economic or energy production units.

### Map Projection and Coordinate System:

NAD 1983, Massachusetts Stateplane FIPS 2001

CEE 187 Final Project, December 2016, Cartographer: Jackson McCoy



### Data Sources:

Massachusetts Ocean Resource Information System  
MassGIS  
NOAA NOS Tidal Current Predictions

### References:

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