

# Wind Farm in Humboldt County

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## Introduction

In today's day of age, it is becoming more important than ever to be mindful of how our environment is treated. With that in mind, alternative sources of energy to fossil fuels are rising in popularity because of their long term availability making them the most economical energy option. We have been tasked in this project to conduct an analysis of Humboldt County to determine where the most viable location for a wind farm would be. Wind farms have few requirements, but those requirements can be considerable depending on the farm size. For example, there must be a plentiful source of wind and open, uninhabited land (*Encouraging Renewable Energy*). Wind harnessed energy is a fairly simple concept which utilizes the constant power of the wind to propel giant fan like towers called turbines. When these turbines are forced to move by the wind, they drive a generator that in turn produces electricity (*Wind Energy Basics*). Considering the geographic location of Humboldt County, it is qualified for such a project to take place.

## Methods

### 1. Data Acquisition

The data collected for this project include a 3-arc second (90-m resolution) Digital Elevation Model (DEM) for the entire state of California, and the coastal zones of the Pacific Ocean and a wind speed index for both on and offshore the data for which represents the average wind speeds at 50m above ground and 90m above ground respectively. The wind speed data was acquired in a shapefile (.shp) with polygons with a wind-power index attributed to them by the producer. A vegetation raster for the entire state of California is also included, as well as a vector file representing the high-voltage transmission lines in the State. The entirety of the data utilized for this analysis was downloaded off the internet, from various databases.

### 2. Data Management and Sub-setting

Because the data for this analysis arrived in a variety of formats with different special references, steps were taken to collect the information in uniform projections and file formats, for ease of use and more accurate analysis. The target projection chosen was North American Datum 1983 Universal Transverse

Mercator Zone 10 North. All vector files were converted to the .shp format and rasters, to the .img format. The area of interest (AOI) was defined as Humboldt County and the surrounding area, and was manually defined as a rectangle encompassing the region. The DEM raster arrived in the format Arc ASCII with a geographic spatial reference World Geodetic System 1984 and represented a much larger area than that of interest. ArcMap tools projected, converted and clipped the raster to the appropriate specifications. Similar measures were used on all of the other data required, including the conversion of an .E00 file to a .shp showing transmission lines in Humboldt County. All data was constrained to the AOI.

### 3. Analysis

The DEM for the region was separated into onshore (elevation > 0 meters) and offshore (elevation<=0 meters) files for ease of visualization and processing using the Map Algebra tool's Set Null Function. Color ramps could then be utilized separately on and off land.

For the offshore option, the DEM was used to calculate areas of a depth no greater than 80m, and the resulting raster was converted to a shapefile. The highest wind-power index polygons were then clipped to the 80m depth features, resulting in the optimal offshore locations for the farm.

**Table 1. Wind Data Elevation 50 m (164 ft)**

Wind Power Class	Wind Power Density (W/m <sup>2</sup> )	Mean Wind Speed ( m/s, (mph) )
	0	
1	200	5.6 (12.5)
2	300	6.4 (14.3)
3	400	7.0 (15.7)
4	500	7.5 (16.8)
5	600	8.0 (17.9)
6	800	8.8 (19.7)
7	2000	11.9 (26.6)

With the onshore option, the vegetation data was sub-setted to include only areas classified as “Annual Grassland” or “Barren”, to maximize wind speeds and minimize the need for logging to construct the installation. A data set with protected lands was also included to ensure the best location would not fall in a wilderness area, parks and refuges, or a wetland (but this data set is not depicted in any of the maps). The highest indexed wind speed (see table 1) polygons were then clipped to the grasslands and barren terrain areas, resulting in 55 locations. The two locations with the highest area (using the calculate geometry function in the attribute table)

was the chosen site for an on-land wind farm.

### Results

After a full analysis of the data, it has been concluded that two locations on-shore and two locations off-shore are the most viable areas to create a medium scale wind farm. These are the largest areas which receive the highest wind speeds in the county, they are relatively distant from civilization as well as

being located on open, ridge-like land yet close enough to Scotia, Fortuna and Ferndale that connecting to the electric grid would be feasible. Figure 2 shows a map with the highest wind index locations highlighted red. The highlighted blue areas are the optimal locations for large area and acceptable depth.

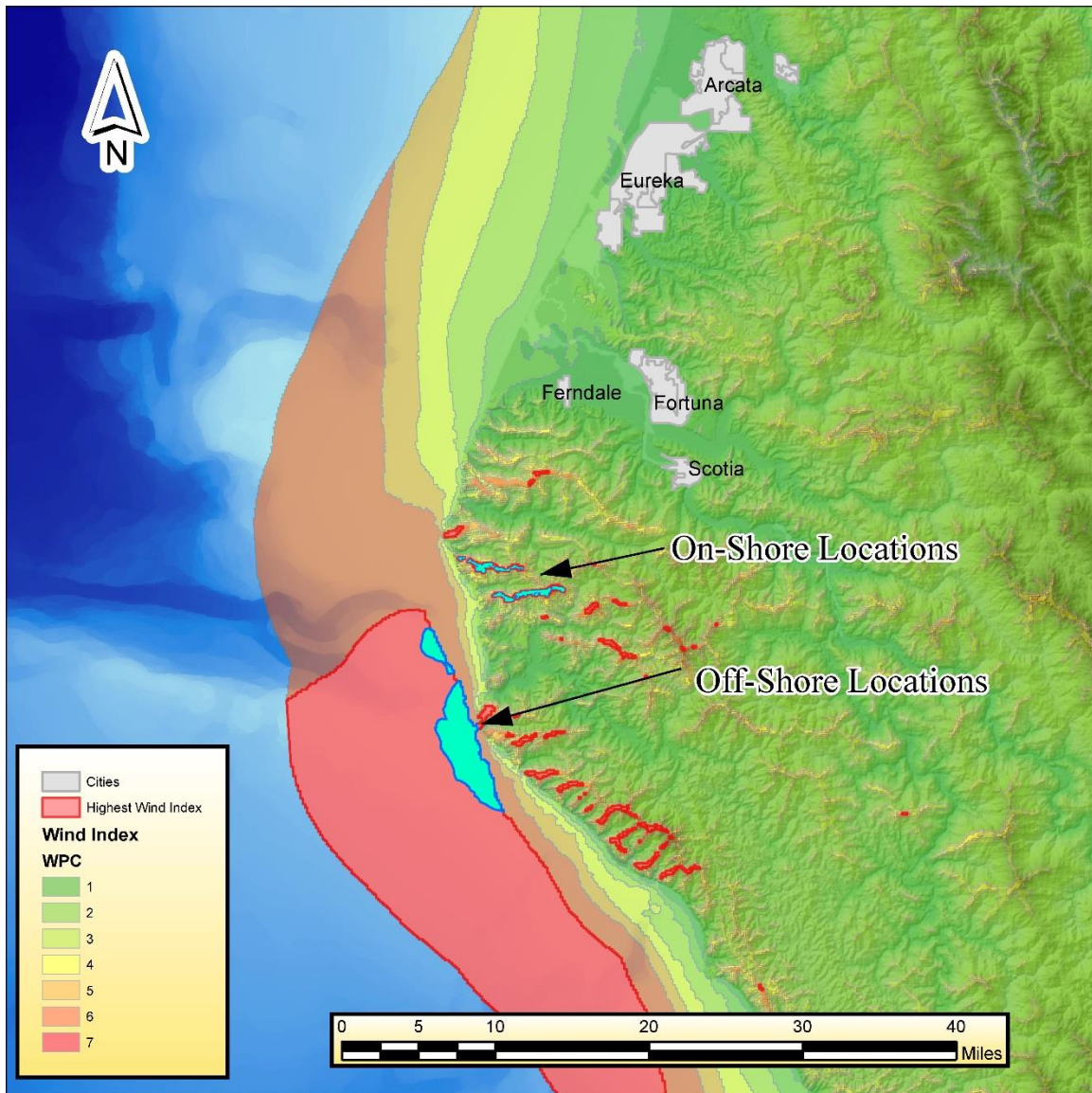


Figure 2. On-Shore and Off-Shore wind farm locations with included wind index

## Conclusion

This analysis showed the most appropriate location for a medium scale wind farm would be in one of two areas located on-shore, about 5 miles south of the City of Ferndale, and two areas off-shore. These areas have the highest recorded wind speeds in Humboldt County and are located on a ridge giving it ideal conditions to generate the most amount of electricity. Also, this location is far enough away from

civilization that residents will not be disturbed by noise pollution produced from the turbines, yet it is close enough so running a power line will still be feasible. The results from this analysis are simply to provide a general location for the wind farm(see figure 3). The total number and actual placing of the turbines for optimal performance will require further analysis. All in all, it can be stated in confidence that the construction of a wind farm within Humboldt County is certainly a possibility with very high potential.

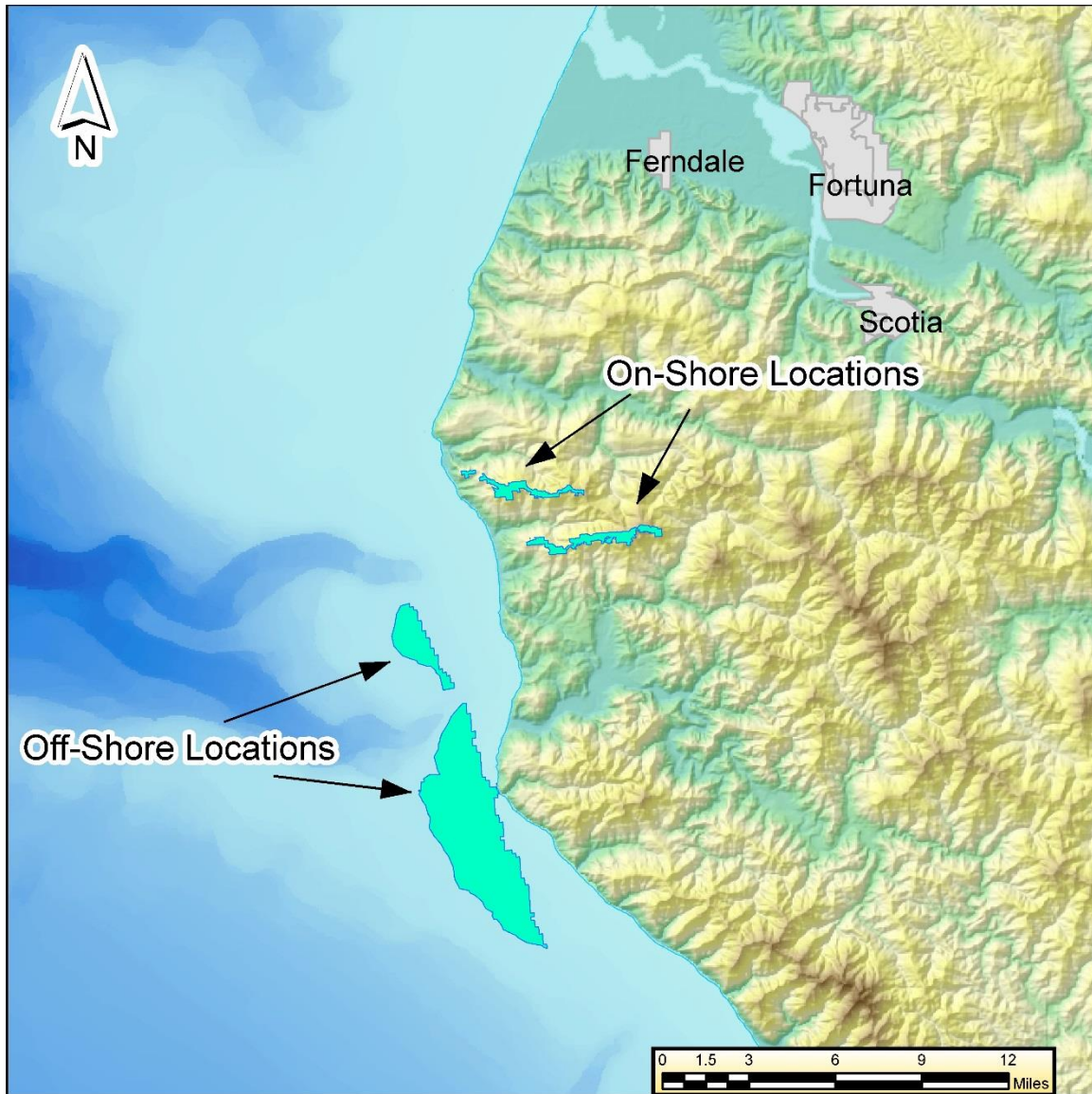


Figure 3. Final designated locations most suitable for a wind farm

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