GEC
GLOBAL ENERGY CONCEPTS
THE Wind Resource

Preliminary Survey of Potential Wind Project Sites in Aquinnah, Massachusetts

FSRP0023-B

March 3, 2008

Prepared for:

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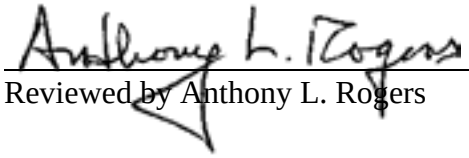
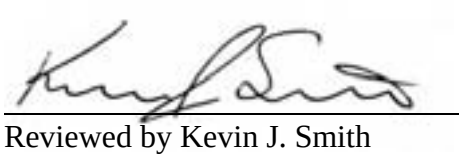


Reviewed by Anthony L. Rogers — March 3, 2008 Date



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Version Block

Version	Release Date	Summary of Changes
A	February 20, 2008	Original
B	March 3, 2008	Revised per client comments

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Introduction

In October 2007 the Town of Aquinnah, Massachusetts, submitted a Municipal Wind Turbine Site Survey Application to the Massachusetts Technology Collaborative (MTC) to request assistance in evaluating municipally-owned property for community-scale wind development potential. Global Energy Concepts (GEC) was contracted by MTC to conduct a preliminary assessment on behalf of the town, including the identification of potential barriers to development, the estimation of wind resource potential, and the identification of potential wind turbine locations. During this review, GEC utilized maps, aerial photos, available wind data, observations from the site visit, and GEC's in-house experience and expertise. This high-level report is not intended as a detailed feasibility study suitable for project development. Further analysis, including wind resource measurement, is recommended prior to project development.

Site Description

The Town of Aquinnah is located on the southwest portion of Martha's Vineyard Island off the southern coast of Massachusetts as shown in Figure 1. The ground elevation ranges from approximately 5 m near the water to 60 m at locations further inland (see Figure 2).

During the site visit, two sites were evaluated for the possible placement of a wind turbine: the Town Hall and Gay Head Cliffs. Aerial photos of each property are provided in Figure 3 and Figure 4. The Town Hall property consists of three parcels totaling 5.8 acres. The parcel adjacent to South Road contains the town office buildings and the fire station. The other two parcels are currently undeveloped; however, there are plans to construct affordable housing units in the northwest parcel. The Gay Head Cliffs property, at the intersection of Lighthouse Road, South Road, and Moshup Trail, consists of seven parcels totaling approximately 16 acres. Gay Head Cliffs is a national monument and the properties host a number of shops, a restaurant, public restroom, and a museum.

Three additional sites were discussed with local representatives and eliminated from further consideration. The town-owned Loran Tower site, located off of Moshup Trail, was eliminated from consideration due to the zoning regulations of this parcel, which prohibit the construction of any structures on the property. The town-owned Lot 33 near Menemsha Pond is a 14-acre parcel that is currently undeveloped and is adjacent to cranberry bogs and land bank properties. This property was eliminated from consideration due to the lack of road access, lack of an on-site electric load, and the significant number of wetlands on the property. The Town Landfill property is a single 6.4-acre parcel located on South Road. The northern portion of the property hosts the capped landfill and a parking lot, while the southern portion is undeveloped wetland. Due to the small size of this parcel and close proximity to homes, the site was eliminated from further consideration.

Figure 1. Location of Aquinnah, Massachusetts

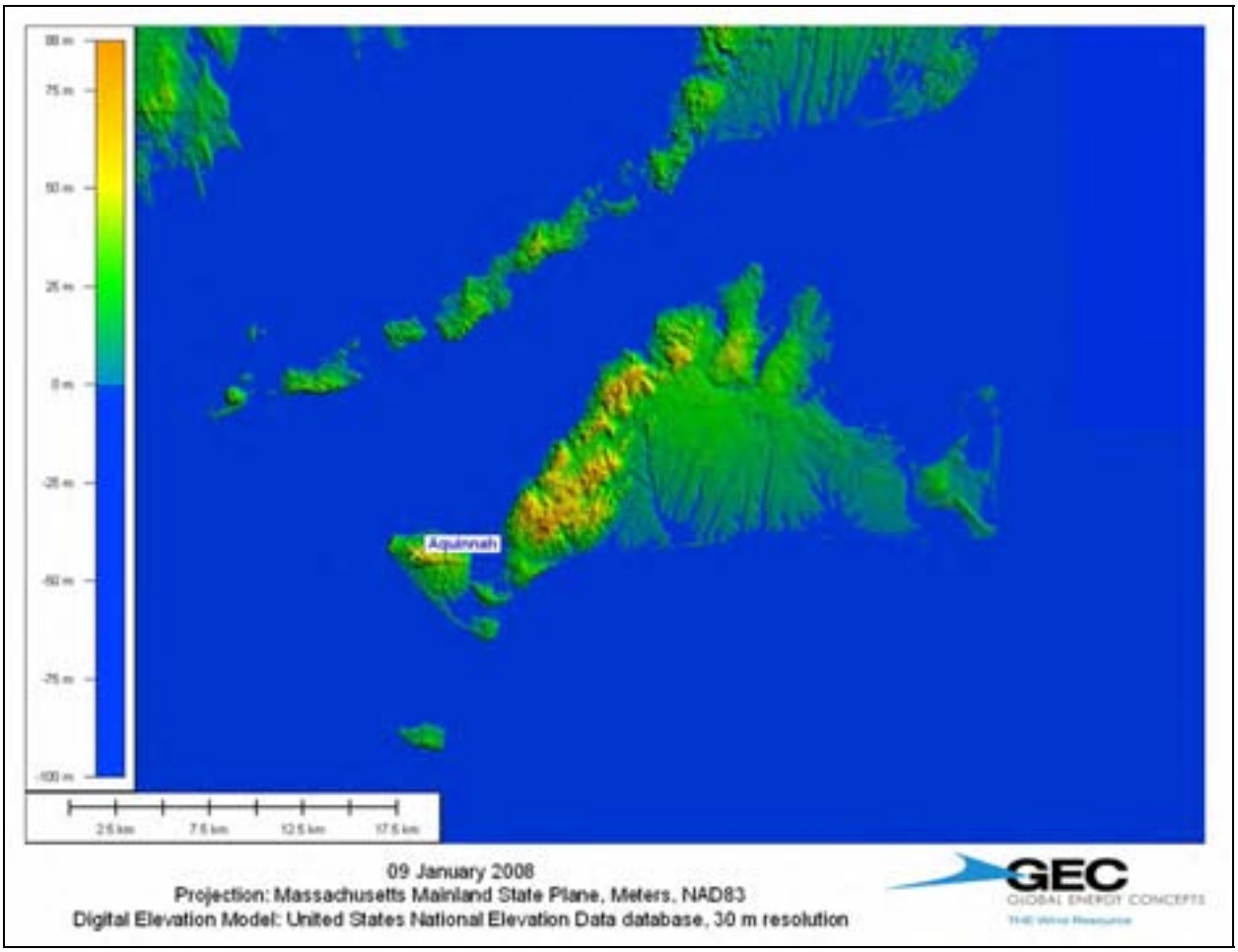

Figure 2. Elevation Map of Aquinnah Area

Figure 3. Aerial Image of the Town Hall Site

Figure 4. Aerial Image of the Gay Head Cliffs Site

Wind Resource Potential

Wind resource information for Massachusetts is available from the New England Wind Map and several weather stations and meteorological (met) towers in the area. This information is used to estimate the range of possible wind speeds in the area; however, the actual wind resource at a particular location is highly site-specific. In order to reduce uncertainty in energy estimates, on-site measurements are recommended prior to the installation of wind turbines at a particular location.

The portion of the New England Wind Map that encompasses Aquinnah is shown in Figure 5. According to the wind map, the estimated wind resource at the Town Hall site is 8.0 to 8.5 m/s at a height of 70 m above ground level. The estimated wind resource at the Gay Head Cliff site is 8.5 to 9.0 m/s at a height of 70 m above ground level. This wind resource range is considered "excellent" according to wind industry standards for developing economically viable projects.

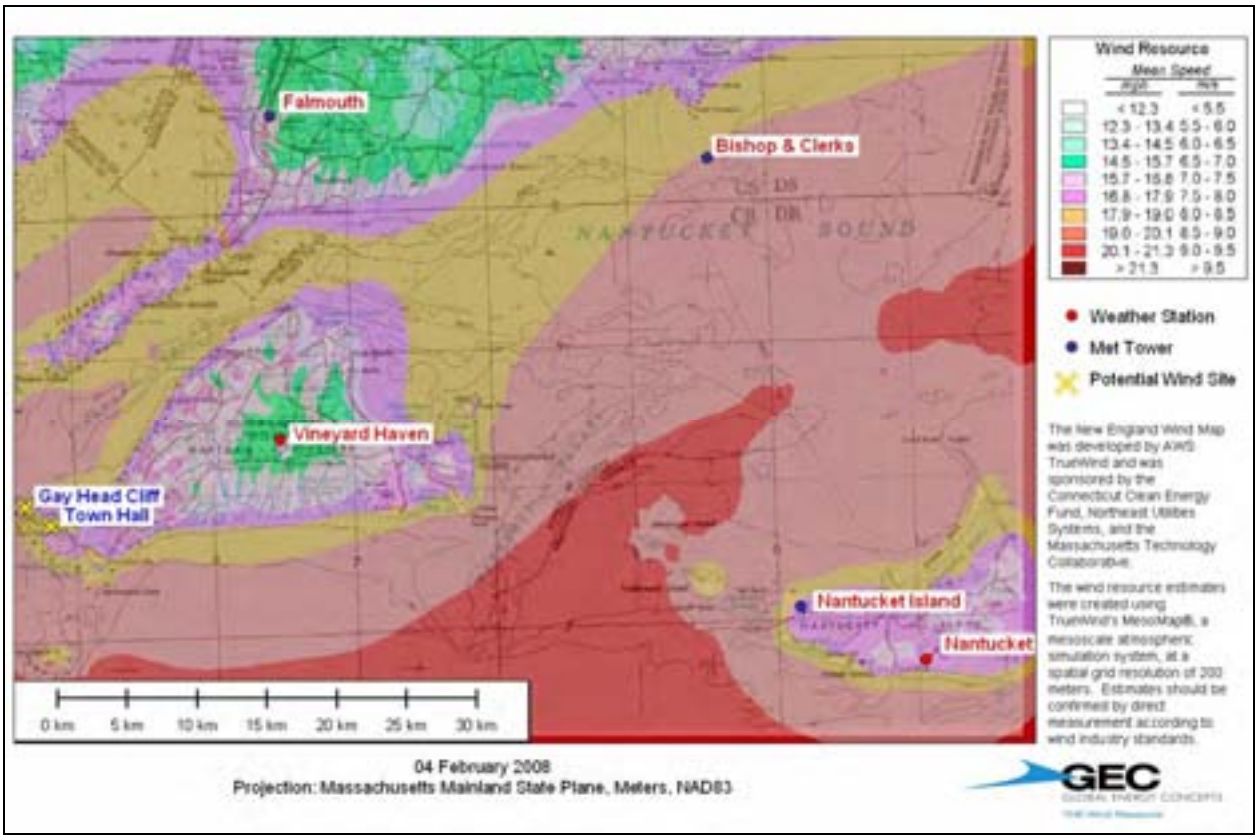

Figure 5. Wind Resource Map of Martha's Vineyard Area

The locations of weather stations and met towers in close proximity to Aquinnah are shown in Figure 5. A summary of the wind data measured at each location is provided in Table 1. Data from the Vineyard Haven and Nantucket weather stations are maintained by the National Climatic Data Center. Data loggers at these stations record hourly wind speed and direction data at a height of 10 m (33 ft) above ground level. Data from Bishop and Clerks, Falmouth, and Nantucket Island were obtained from met towers installed and maintained by the University of Massachusetts at Amherst (UMass). Data loggers at these towers record 10-minute wind speed and direction data at various heights above ground level for a period of one year. In GEC's experience the annual average wind speed in the area typically varies by up to 6% from year to year. To account for this variability, GEC has included a range of wind speeds around the one-year average recorded from the UMass met towers.

Table 1. Summary of Available Wind Data

Location	Coordinates (MA State Plane Meters, NAD83)		Elevation (m)	Measurement Height (m)	Annual Average Wind Speed (m/s)	Wind Class[4]
	Easting	Northing				
Vineyard Haven[1]	274019	794035	18	10	4.6	2
Nantucket[1]	320613	779119	12	10	5.5	3
Bishop & Clerk's[2]	304261	814555	0	15	7.1 - 8.1	7
Falmouth[2]	273273	817686	40	39	5.2 – 5.8	1 - 2
Nantucket Island[2]	311513	782081	3	68	8.3 – 9.3	5 - 7
Gay Head Cliffs[3]	255667	788707	28	70	8.5 – 9.0	6
Town Hall[3]	257534	788406	49	70	8.0 – 8.5	5

[1] Source: National Climatic Data Center, based on a 10-year period of measurement

[2] Source: University of Massachusetts Amherst Renewable Energy Research Lab. Based on a 1-year period of measurement and includes a +/- 6% range to account for inter-annual fluctuations in the average wind speed.

[3] Source: AWS Truewind New England Wind Map estimate

[4] Based on the Department of Energy's Wind Power Classification System

While the wind map suggests a Class 5 to Class 6 wind resource at the Aquinnah sites, on-site measurements from locations surrounding Aquinnah indicate that the resource varies from Class 2 to Class 7. This underscores the site-specific nature of the wind resource and the uncertainty in the wind map estimate. Collecting on-site measurements at the potential wind turbine location is the best way to determine the wind resource at a particular site and to reduce uncertainty in the energy production estimate.

The wind rose for Aquinnah according to the New England Wind Map is shown in Figure 6. The wind rose indicates a prevailing southwest wind direction. Aquinnah is located on the southwest coast of Martha's Vineyard Island and is thus well exposed to the strong winds off of the ocean. The Gay Head Cliffs site has few trees or other surrounding obstructions, as shown in Figure 7. At the Town Hall site the primary obstructions to the winds from the southwest are trees, which were observed to be up to 10 m in height, as shown in Figure 8.

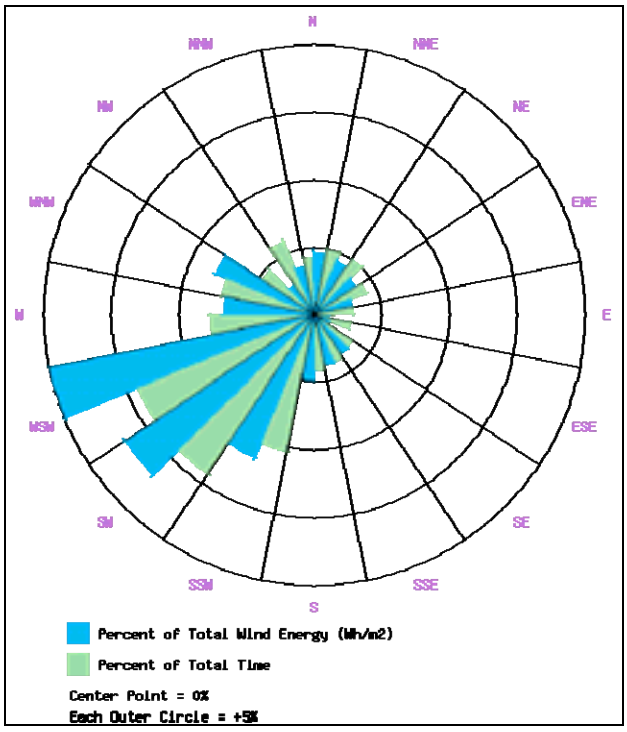

Figure 6. Area Wind Rose

(Source: New England Wind Map, AWS Truewind)

Figure 7. Gay Head Cliffs Property, Facing Southwest

Figure 8. Example of Tree Coverage at the Town Hall Site

Potential Offset of Electrical Loads and Electrical Grid Access

Under current net-metering regulations in Massachusetts, any net excess electricity generated by a wind turbine rated at 60 kW or less can be credited to the customer's next monthly utility bill at the average market rate. For a wind turbine greater than 60 kW in size, the utility is not obligated to purchase excess electricity. New net-metering legislation is currently being discussed in the Massachusetts legislature, which would increase the eligible wind turbine size to up to 2 MW and allow for virtual net-metering. Virtual net-metering would allow the Town of Aquinnah to aggregate municipal electric loads from different meters under one virtual meter that would be supplied by the wind project. Any unused wind-generated electricity would be credited towards the next month's energy consumption.

As an alternative to net metering, wind-generated electricity could be sold directly to the wholesale market through a power purchase agreement. However, the wholesale market rate is likely to be significantly less than the retail rate and will lead to a longer payback period than if the wind-generated electricity were to be used on site to displace retail electric rates. The sale of renewable energy credits (RECs) may help to improve project economics; however, the long-term market for RECs is highly uncertain.

Typically, the most cost-effective development scenario for community-scale wind projects is a behind-the-meter installation where the entire output of a wind project serves to offset the retail electric rates of on-site electric load, such as a school or wastewater treatment plant. However, in Aquinnah, the electric demand at each of the proposed wind project sites is minimal. Without an on-site electric load or virtual net-metering legislation in place, identifying a viable economic scenario for a community-scale wind project in Aquinnah is a significant barrier to development.

Table 2 provides estimated energy production from different sizes of wind turbines that may be appropriate for Aquinnah (project scale is discussed further in a later section), based on the wind resource at the Gay Head Cliffs site.

Table 2. P50 Energy Estimates from Example Wind Turbines at Gay Head Cliffs Site

Turbine Type	Rated Capacity (kW)	Hub Height (m)	Estimated Net Annual Energy Production (MWh/yr)	Estimated Net Capacity Factor[1]
Fuhrlander FL600	600	50	2,100 – 2,280	40 – 43%
Vestas RRB V47-600	600	65	1,930 – 2,100	37 – 40%
Enertech E-48	600	65	2,090 – 2,260	40 – 43%
Distributed Energy Systems NW100/21	100	32	260 – 290	30 – 33%

[1] Defined as the ratio of estimated energy production to the maximum possible energy production if the wind turbine were to operate at rated power for the entire year.

In calculating annual energy production from various wind turbines, GEC used the estimated annual average wind speed range of 8.5 to 9.0 m/s at a height of 70 m above ground level from the New England Wind Map. The wind speed is adjusted to the various turbine hub heights using the power law[1] and a wind shear exponent of 0.22 based on estimates from the New England Wind Map. An annual wind frequency distribution was created using a Weibull shape factor of 2.27 from the New England Wind Map. GEC estimated the annual average air density in Aquinnah to be 1.24 kg/m^3 based on an annual average temperature of 10ºC and a site elevation of 30 m. The standard wind turbine power curves provided by the manufacturers were adjusted to the site air density. GEC estimates aggregate energy losses of 18%, which includes downtime for maintenance and component repair, weather-related downtime, electrical line losses, blade soiling and degradation, turbulence, faults, and other factors.

The energy production and capacity factor estimates listed in Table 2 represent best estimates of the range of P50 values. The estimates rely solely on wind map data, which can have a high degree of uncertainty. Other sources of uncertainty, such as annual and spatial variability in the wind resource, system energy losses, the shape of the wind frequency distribution, and other factors are not included in this preliminary analysis and would further increase the range of possible capacity factor values.

[1] The power law is defined by the equation $(V_1/V_2) = (H_1/H_2)^{\alpha}$, where V_1 and V_2 are wind speeds at heights H_1 and H_2, respectively (above ground level), and α is the dimensionless wind shear exponent. This is a typical method of describing the extent to which wind speeds vary with increasing height above the ground.

Electrical Grid Access

Martha's Vineyard Island currently receives power from NSTAR via undersea cables from the mainland with a total capacity of approximately 64 MW. A network of 3-phase, 460-volt power lines serves the island and passes within 200 m of the potential wind project sites in Aquinnah. Connection of a wind turbine to the electrical grid at either of the potential wind project sites does not appear to be a significant barrier to development, although a system interconnect study through NSTAR will need to be completed to confirm this initial opinion.

Transportation and Site Access

Reasonable access to a potential development area is necessary in order to receive turbine and tower components, to allow for the mobilization of cranes, and to allow for reasonable response time from service personnel. Martha's Vineyard Island is only accessible by sea or air as no bridge or tunnel exists to the mainland. The island hosts four harbors that are utilized by ferries, fishing vessels and recreational water craft. Vineyard Haven Harbor at Tisbury (located on the northeast side of the island) is the primary working port, and year-round passenger and vehicle ferry service is available. Fuel and other freight are typically delivered by barge. There are also three airstrips on the island, with Martha's Vineyard Airport being the largest and most heavily used. Local roads are paved but limited to two lanes in width, which can lead to congested traffic during the summer months. In addition to restricted turbine delivery options, the ability of service personnel to access the site will be restricted by the ferry and flight schedules and will likely lead to increased downtime (reducing energy production) and costs for maintenance.

A letter report from Black & Veatch to MTC and the Town of Tisbury summarizes a preliminary assessment of the feasibility of transporting a 600 kW wind turbine and related components onto Martha's Vineyard Island. The length of the blades and tower sections of the wind turbine would be approximately 25 m and the weight of the nacelle would be approximately 28 tons. In the report, Black & Veatch recommended that all components, including a crane large enough to erect the wind turbine, be delivered by barge to Vineyard Haven Terminal. In addition, a smaller crane located on Martha's Vineyard Island may be needed to offload the components from the barge. Once the components are on the island, transportation by truck on surface roads is feasible with some modifications. The primary obstacle is a 90° turn near the terminal at the intersection of Water Street and Beach Street, which would require the temporary removal of fencing and landscaping from the Tisbury Post Office parking lot. Some telephone lines, power lines, and parked cars would also need to be temporarily removed and traffic would need to be diverted. Black & Veatch concludes that delivery of a 600 kW wind turbine to Tisbury appears to be feasible but with additional financial burden to the project that would not be incurred by mainland projects.

When transporting wind turbine components from Tisbury to the potential wind project site in Aquinnah, additional telephone and power lines would likely need to be lifted or temporarily removed along portions of the road. There are also a number of culverts and one bridge that would need to be crossed. The weight limit of these items is currently unknown. A more detailed transportation study including a detailed cost estimate would need to be completed once a wind turbine model and dimensions have been specified.

The municipal parking lot at the Gay Head Cliffs site could be used as a staging area for the assembly of components. At the Town Hall site, an area would need to be cleared of trees.

Aviation Conflicts

Wind turbines must be installed in a manner that meets federal and local air space regulations. The actual effect of a project on air navigation is evaluated on a case by case basis and in consultation with local regulators. The Federal Aviation Administration (FAA) requires that a Notice of Proposed Construction be filed for the construction of any object that would extend more than 200 ft above ground level. For each filed project, the FAA undertakes an initial aeronautical study and issues either a Determination of No Hazard to Air Navigation (DNH) or a Notice of Presumed Hazard (NPH). If an NPH is issued, the FAA will conduct a more extensive analysis to evaluate impacts on air operations. Other local air space regulations may also apply.

Construction of a wind project within 4 miles of airports would be more likely to impact navigable airspace or aviation communications than projects located farther away. Three airport runways are located on Martha's Vineyard Island, each approximately 11 to 15 miles northeast of Aquinnah. Wind turbines in Aquinnah are not likely to pose a hazard to air navigation at these airports based on the small size of the runways and distance from the project site. However, there may be local air space restrictions that could affect turbine location or height. According to local representatives, the FAA imposed a 73.5-m (241-ft) height restriction on a proposed wind project in the Town of Tisbury, which is located closer to Martha's Vineyard Airport than the proposed wind project sites in Aquinnah. However, it is unclear whether the restriction applies to the maximum tip height or the hub height of the turbine. Possible turbine options that would satisfy this potential aviation restriction are presented in a later section.

The FAA online Long-range Radar Tool provides a preliminary estimate of the effect of a wind project on Air Defense and Homeland Security radar. As shown in Figure 9, the area surrounding Aquinnah is flagged as "yellow," which is defined as "likely to impact Air Defense and Homeland Security radars." While the presence of this equipment does not necessarily prohibit wind turbine development in the area, some restrictions in regard to wind turbine placement or height may be imposed. A more detailed aeronautical study is required to determine the extent of the impact and possible mitigation strategies. In addition, potential impacts on other types of radar must be evaluated.

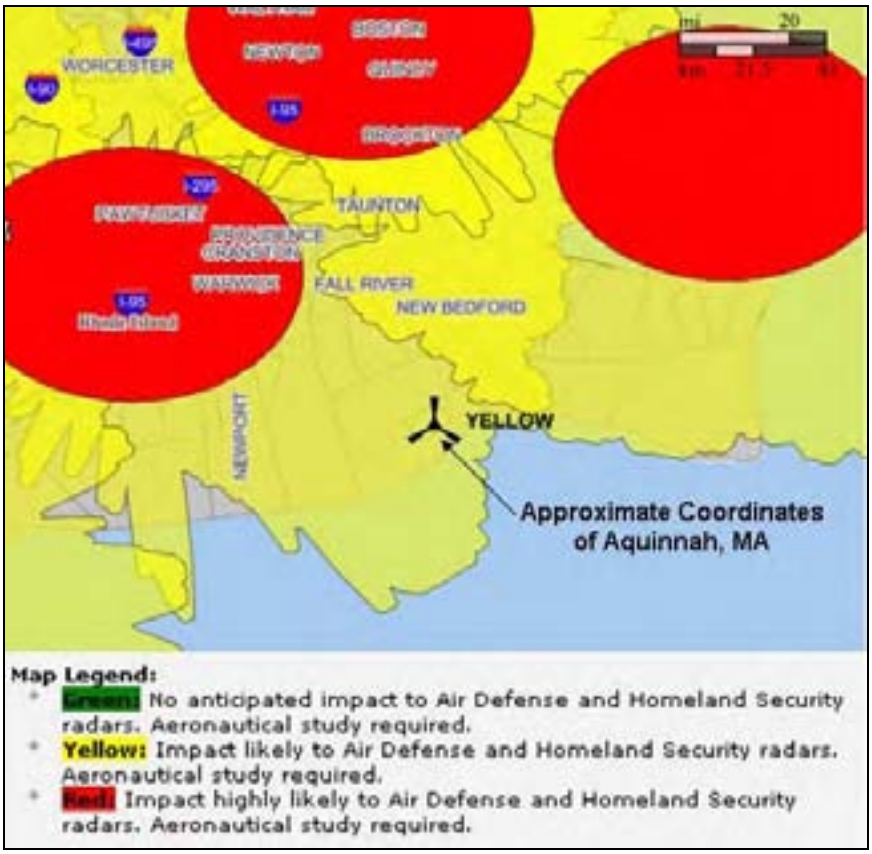

Figure 9. Preliminary Results of FAA Long-range Radar Impact Evaluation

Environmental Issues and Permitting

GEC completed a geographic information system (GIS) analysis to determine the location of sensitive environmental and cultural areas relative to the proposed wind project site. Results of the GIS analysis are shown in Figure 10.

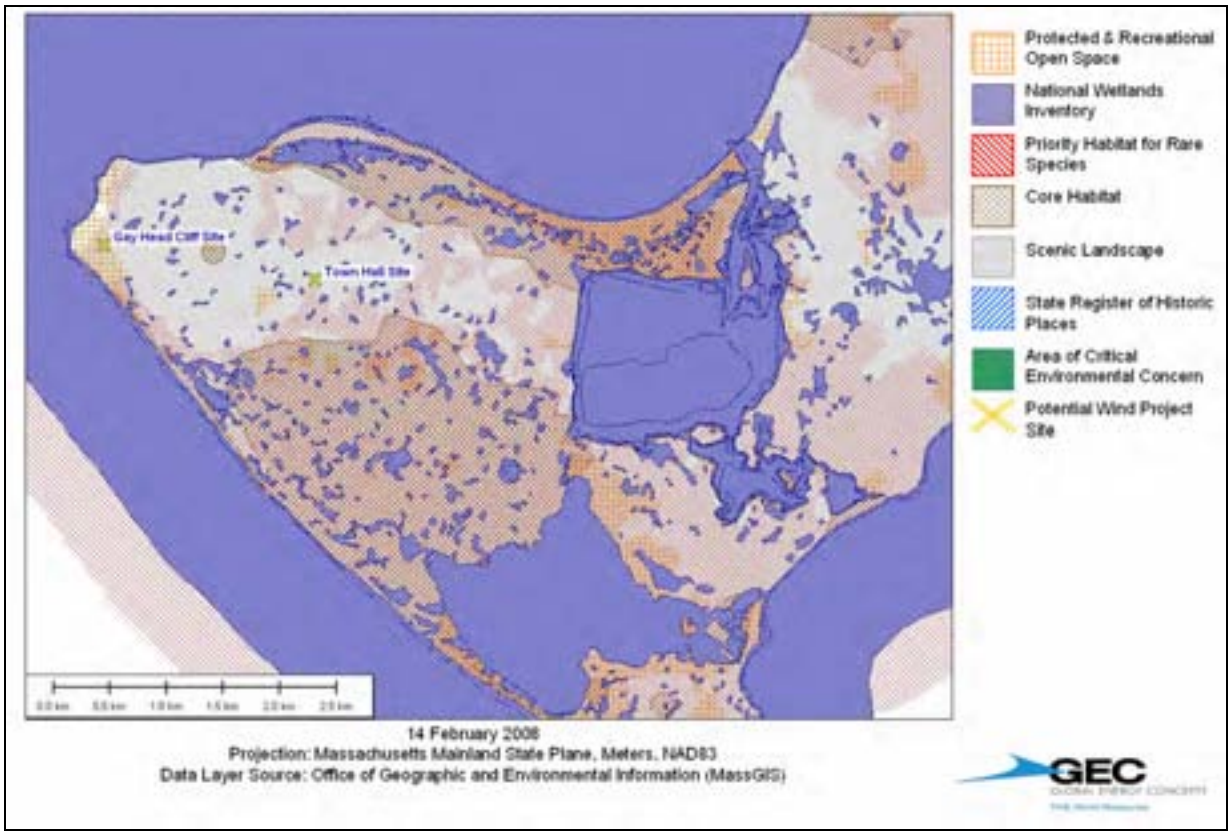

Figure 10. Areas of Potential Environmental and Cultural Concern

Each of the data layers included in the analysis was obtained from the Massachusetts Office of Geographic and Environmental Information (MassGIS) and are described below. These data layers are made available to the public for planning purposes only. More detailed site-specific analyses should be completed to verify the accuracy of these data layers.

- **Areas of Critical Environmental Concern (ACEC)**, last updated March 2007 – ACEC areas are designated by the Secretary of Environmental Affairs as "places that receive special recognition because of the quality, uniqueness and significance of their natural and cultural resources." There are no areas designated as an ACEC within 30 km of Aquinnah; therefore, conflicts with an ACEC are expected to be minimal.
- **NHESP BioMap Core Habitat**, last updated June 2002 – Core Habitat areas are identified by the Natural Heritage and Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries and Wildlife as areas that provide "the most viable habitat for rare species and natural communities in Massachusetts." Core Habitat areas are located within 500 m of the Town Hall and Gay Head Cliff sites. Although areas with this designation may not necessarily be prohibited from wind development, a proposed project in these areas would require an increased level of environmental review. Consultation with NHESP is recommended to determine potential impacts and mitigation strategies.
- **NHESP Priority Habitats for Rare Species**, last updated September 2006 – Priority habitats are identified based on observations documented within the last 25 years in the

database of the NHESP, as published in the 12th Edition of the Massachusetts Natural Heritage Atlas. A number of priority habitats are located adjacent to the proposed project locations and along the coast. Consultation with NHESP is recommended to determine potential impacts and mitigation strategies.

- **National Wetlands Inventory (NWI)**, last updated October 2007 – The NWI data set was created by the U.S. Fish and Wildlife Service to identify the approximate location and characteristics of wetlands and deepwater habitats. The map does not indicate any wetlands within the Town Hall or Gay Head Cliffs properties; however, a possible wetland area was observed on the northern portion of the Town Hall property. Wetlands were not observed on the Gay Head Cliffs property and conflicts are expected to be minimal at this site. A wetlands delineation should be completed to verify this conclusion.
- **Protected and Recreational Open Space**, last updated January 2007 – This data layer includes conservation land and outdoor recreation facilities, including parkways, town parks, playing fields, and walking trails owned by federal, state, county, municipal, and nonprofit enterprises. Gay Head Cliffs site is designated as a protected and recreational open space. In addition the Gay Head Cliffs are designated as a National Monument. The impact of this designation is unknown and should be discussed with local representatives.
- **Scenic Landscapes**, last updated July 1999 – Scenic landscapes are identified by the Massachusetts Landscape Inventory Project in the Department of Conservation and Recreation. The majority of Martha's Vineyard Island, including the area around Aquinnah, is designated as a scenic landscape. The implications of this designation on a wind project are not clear and depend on local public opinion.
- **State Register of Historic Places**, last updated January 2000 – This data layer, maintained by the Massachusetts Historical Commission, denotes locations or boundaries of significant historic properties and sites with legal designations under several specific local, state, and federal statutes. There are no registered sites near the potential project sites in Aquinnah. Archaeological sites are not included in this data layer; however, topographic maps indicate that an Indian burial ground is located approximately 800 m south of the Town Hall site.

A map of important bird areas around Martha's Vineyard was obtained from the Massachusetts Audubon Society as shown in Figure 11. An Important Bird Area is a site that provides essential habitat to one or more species of breeding, wintering, or migrating birds. These sites typically support high-priority species, large concentrations of birds, exceptional bird habitat or have substantial research or educational value. Chappaquidick Island, located approximately 25 km east of Aquinnah is designated as an Important Bird Area for shorebirds, waterfowl, and seabirds. Consultation with the Massachusetts Audubon Society is recommended to determine potential impacts and mitigation strategies.

Figure 11. Important Bird Areas

Source: Massachusetts Audubon Society

The permitting process and implications of each of these environmental designations is not clearly defined and can vary from site to site. Since several areas of environmental concern are located in or around the proposed wind project locations, an increased level of environmental review will likely be required. A site-specific environmental survey is recommended.

Telecommunications Conflicts

Wind turbines, like all tall structures, can create interference or degradation of certain communication signals if they are located in the line-of-sight of any communications equipment such as microwave, radio, or satellite dishes. A number of microwave communication stations are located around Martha's Vineyard, the closest of which is 8 km northeast of Aquinnah, as shown in Figure 12. Analysis of microwave line-of-sight is beyond the scope of this review. Due to the remote location of Aquinnah and the distance to known communication towers, signal interference is not expected to be a major barrier to development; however, the actual effect of a project on communications systems will need to be evaluated on a case-by-case basis and in consultation with local regulators and technicians. Such a study would take into account the proposed turbine dimensions, turbine location, and transmittal paths of various types of communication signals in the area.

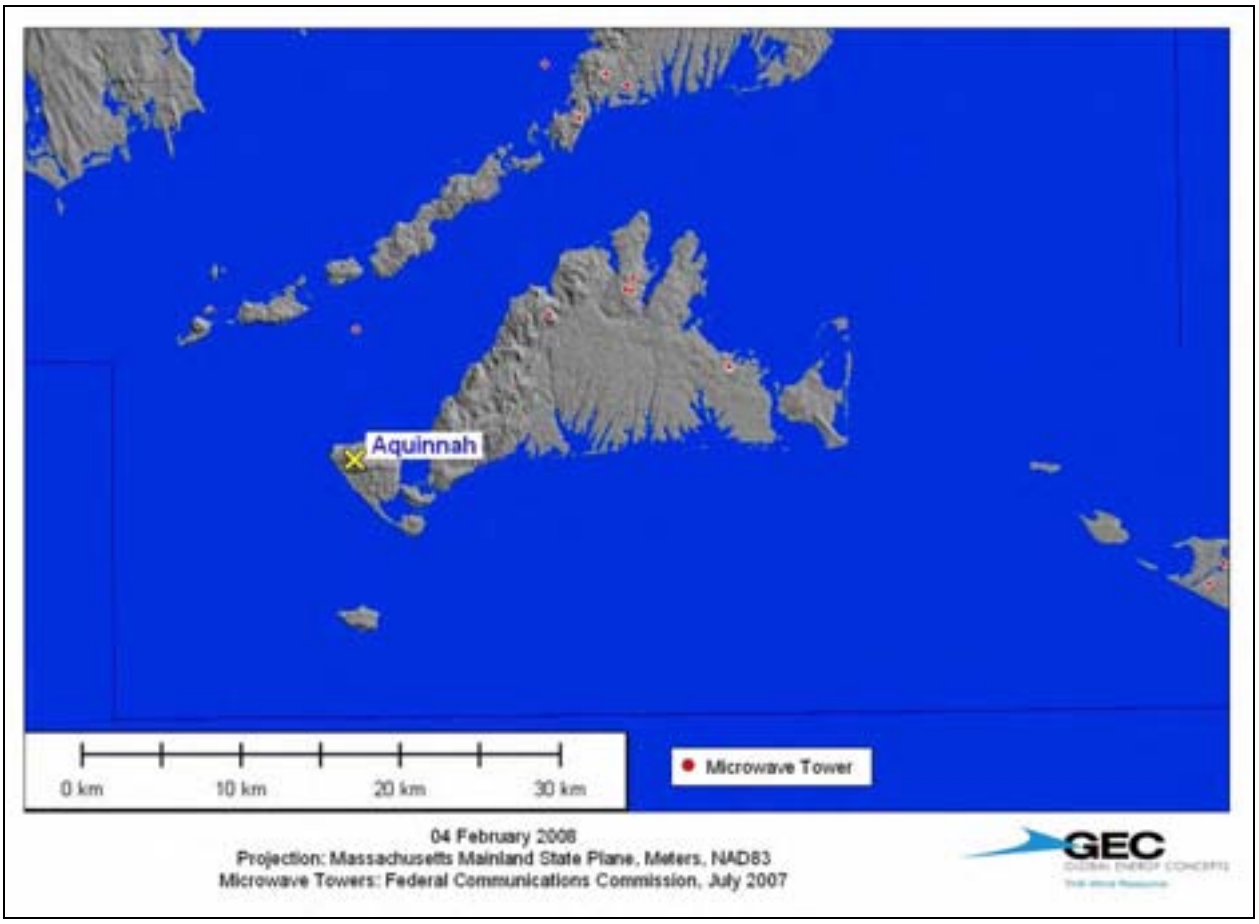

Figure 12. Location of Weather and Microwave Communication Stations near Aquinnah

Social Acceptability

Negative social perceptions of a wind project have the potential to inhibit or terminate wind project development. If neighbors of the sites under consideration are opposed to a wind energy project, the costs and time required for addressing and mitigating their concerns may increase development costs significantly. Primary social concerns include noise from the wind turbine, the visual impact of the wind turbine on the landscape, shadow flicker effects, and public safety.

When operating, wind turbines produce a “swishing” or “whooshing” sound as their rotating blades encounter turbulence in the passing air, as well as some sounds from the mechanical parts such as the gearbox, generator, and cooling fans. Wind turbines are typically quiet enough for people to hold a normal conversation while standing at the base of the tower. If mechanical sounds are significant, it usually means something in the nacelle needs maintenance or repair. At a distance, the sounds generated by a wind turbine are typically masked by the “background noise” of winds blowing through trees or moving around obstacles.

Massachusetts state regulations allow for an increase in noise levels of up to 10 dB over normal background levels at the property boundary. Typically, a distance from the property boundary equivalent to three times the maximum wind turbine tip height is required to satisfy this

regulation. Depending on the background noise levels at the site and the turbine size, a noise setback of approximately 150 to 300 m (492 ft to 984 ft) from the property boundary may be required. Due to the limited dimensions of the Town Hall property and the close proximity of residential areas, the noise setback requirement would likely eliminate this site from further consideration. The Gay Head Cliffs site has more available land area located a greater distance from residences than the Town Hall site. A single wind turbine placed in the center or on the western side of the property is likely to satisfy noise regulations. A sound impact analysis should be completed to verify this conclusion.

The proposed Cape Wind project in Nantucket Sound, located approximately 30 km northeast of Martha's Vineyard has received significant public opposition due to concerns about the aesthetic impact on the landscape. Although a wind project in Aquinnah would be much smaller in scale, a wind turbine would be highly visible and visual concerns might cause opposition to the project. As described previously, Martha's Vineyard Island is designated as a "scenic landscape." In addition, the island is a popular summer vacation destination and the Gay Head Cliffs is a popular tourist attraction and cultural landmark. Photo simulations of a potential wind project, as well as informational community meetings, can help to address any public concern about the visual impact on these areas.

Another potential concern is shadow flicker that can be generated by the rotating blades of a wind turbine during certain ambient lighting conditions. For example, the residences located to the east of the Gay Head Cliffs site may experience shadow flicker as the sun sets in the west and causes the shadow of the wind turbine to fall on the homes to the east. The shadow of the rotating blades can cause an annoyance until the sun changes position in the sky. A shadow flicker analysis can be completed once the turbine dimensions and location are specified.

Public safety concerns are usually focused on the potential for wind turbine failure and ice shedding from the blades. Although incidences of turbine failure that result in tower collapse or components falling to the ground are rare, measures can be taken to minimize the potential impact of such occurrences. Typically, wind turbines are placed a maximum-tip-height distance from the property boundary or occupied buildings. In addition, wind turbines shut down in cases of extreme wind or icing in order to minimize damage. If desired, the wind turbine can be programmed so that a visual inspection is required before restarting the turbine after icing conditions. This will minimize the likelihood that ice shedding from blades will cause damage.

Project Scale

Based on a preliminary review of transportation logistics, it appears feasible that a wind turbine of up to 600 kW in size and with a rotor diameter of up to 50 m can be delivered to sites in Aquinnah. Wind turbines larger than 600 kW in size would likely not be feasible due to the prohibitively high transportation, crane mobilization, and logistical coordination costs and due to the physical limitations of the dock, narrow streets, and tight corners. Table 3 summarizes the dimensions of example wind turbines with rated capacities of up to 600 kW.

Table 3. Example Wind Turbine Models

Turbine Model	Rated Capacity (kW)	Rotor Diameter (m)	Hub Height (m)	Maximum Tip Height (m)	Other
Fuhrlander FL600	600	50	50, 75	75, 100	CS, VP
Vestas RRB V47-600	600	47	50, 65	73.5, 88.5	CS, VP
Enertech E-48	600	48	50. 65	74, 89	CS, FP
Distributed Energy Systems NW100/21	100	21	32	42.5	FP, SG, DD

CS = constant speed FP = fixed pitch blades SG = synchronous generator
VS = variable speed VP = variable pitch blades DD = direct drive

The Town of Aquinnah is considering a zoning by-law regarding wind turbines; however, it is not yet available. For the purposes of identifying potential wind turbine locations, GEC calculated a fall-zone setback from the property boundary equivalent to the maximum tip height of the potential turbines. The minimum fall-zone setback for the shortest wind turbine option is 42.5 m and the largest setback based on the tallest wind turbine option is 100 m. Based on these setbacks, potential wind turbine locations are identified for the Gay Head Cliffs site and the Town Hall site in Figure 13 and Figure 14, respectively.

The proposed wind turbine locations were selected based on currently available information on the project boundary and setback requirements. Additional factors may influence the final wind turbine location, such as a surveyor's verification of the property boundary, subsurface conditions, constructability of the site, environmental permitting, FAA restrictions, conflicts with communications equipment, noise and shadow flicker impact analysis, or other factors.

Figure 13. Setback Zones and Potential Wind Turbine Locations at Gay Head Cliffs

Figure 14. Setback Zones and Potential Wind Turbine Location at Town Hall Site

Conclusions

Based on a preliminary review, GEC concludes that the Gay Head Cliffs site in Aquinnah has wind development potential; however, key concerns need to be addressed. The primary barrier to development at this site is social acceptability. Gay Head Cliffs is a national monument with strong historic and cultural significance. Although some may consider a wind turbine a positive development for increased tourism in the community, others may place higher value on the preservation and minimal development of the area. Whether or not the community will support a wind turbine at the Gay Head Cliffs site is a primary concern and should be resolved prior to moving forward.

Another significant barrier to development is the lack of on-site electric load at the Gay Head Cliffs site. It is unclear if selling electricity into the local power market is likely to yield a sufficient return on the investment for a community-scale wind project. A subsequent feasibility study should evaluate this and other economic factors in more detail. Enactment of the proposed net-metering law in Massachusetts might improve the economics of the project significantly.

Other potential project barriers are expected to be minimal but should be addressed in a more detailed feasibility study. A communications interference study that includes microwave, radar, and radio signals would determine whether or not a wind turbine at the Gay Head Cliffs site would cause interference with nearby communications towers. To address potential public nuisance concerns, a detailed feasibility study should include photo simulations from viewpoints of concern, a sound impact analysis on nearby residences, and a shadow flicker analysis on surrounding areas. An environmental impact analysis is recommended to determine potential impact of a wind turbine on avian and wildlife species in the area. Finally, a geotechnical investigation is required to confirm the viability of the proposed turbine location and to determine the design and cost of the turbine foundation.

The recommended wind turbine size for the Gay Head Cliffs site is 600 kW or smaller. A turbine of this size could feasibly be delivered to the site. In addition, preliminary analysis of airspace and flight navigation indicates that a turbine of this size in Aquinnah should be approvable following further analysis by the FAA.

The wind resource potential at the Gay Head Cliffs site is estimated to be 8.5 to 9.0 m/s at a height of 70 m above ground level. If the key concerns listed above are addressed, GEC recommends the installation of a met tower on site to verify the wind resource and to collect data necessary for a detailed economic analysis.

Other municipally-owned property was evaluated during the site visit; however, GEC concludes that the wind development potential at these sites is not sufficient to warrant further consideration. The Town Hall site also has a good wind resource potential; however, space constraints at this site would limit the size of a wind turbine to 100 kW or less.

Met Tower Recommendations

In order to collect on-site wind resource data necessary for a detailed feasibility study, GEC recommends the installation of a 50-m met tower at the Gay Head Cliffs site. Ideally, a met tower would be placed at the exact location of the future wind turbine to collect wind resource information for a period of one year. However, the met tower footprint is larger than the wind turbine footprint and the potential wind turbine location at the Gay Head Cliffs site has limited area for the placement of the met tower anchors and guy wires. Therefore, the met tower could be placed in the municipal parking lot, in the backyard of the museum building, or in the circle park. At each of these locations, fencing should be placed around the base of the tower as well as each anchor. Wind resource information collected at these sites would be representative of the expected wind resource at the potential wind turbine location.