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VINEYARD WIND

Draft Construction and Operations Plan

Volume III Appendices

Vineyard Wind Project

October 22, 2018

Submitted by
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700 Pleasant Street, Suite 510
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Submitted to
Bureau of Ocean Energy Management
45600 Woodland Road
Sterling, Virginia 20166

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Clarendon Hill Consulting
Ecology and Environment
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Morgan, Lewis & Bockius LLP
Public Archaeology Laboratory, Inc.
RPS
Saratoga Associates
Swanson Environmental Associates
Wood Thilsted Partners Ltd
WSP

October 22, 2018

Appendix III-H.a

Vineyard Wind Project Visual Impact Assessment

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT
VISUAL IMPACT ASSESSMENT

Prepared for:
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March 9, 2018

Landscape Architects, Architects,
Engineers and Planners, P.C.

#2017-044

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ABBREVIATIONS

APE	Proposed Area of Potential Effect
BOEM	Bureau of Ocean Energy Management
COP	Construction and Operations Plan
ESP	Electric Service Platform
FAA	Federal Aviation Administration
ft	Feet
km	Kilometer
km^2	Square kilometers
KOP	Key Observation Point
LU	Landscape Unit
m	Meter
mi	Statute mile
mi^2	Square miles
MLLW	Mean lower low water
MW	Megawatt
nm	Nautical Miles
NNL	National Natural Landmark
NRHP	National Register of Historic Places
USCG	US Coast Guard
VIA	Visual Impact Assessment
WDA	Wind Development Area
WTG	Wind Turbine Generator

1.0INTRODUCTION

Vineyard Wind, LLC ("Vineyard Wind") is proposing an ~ 800 megawatt ("MW") wind energy generating facility in the Atlantic Ocean just over 23 kilometers ("km") (14 miles ["mi"]) off the coasts of Martha's Vineyard and Nantucket, MA (the "Project"). To address issues of potential aesthetic impact Vineyard Wind has retained Saratoga Associates, Landscape Architects, Architects, Engineers, and Planners, P.C. ("Saratoga Associates") to conduct a Visual Impact Assessment ("VIA") of the Project. The purpose of this VIA is to identify potential visibility of the Project and objectively determine the difference in landscape quality with and without the Project in place. The information and recommendations included in this report are intended to assist regulatory agencies, interested stakeholders, and the general public in their review of the Project, in accordance with applicable regulatory requirements. Figure 1 illustrates the Project location.

1.1 Proposed Area of Potential Effect (APE)

The proposed area of potential affect ("APE") for this VIA includes coastal areas up to 56.8 km (35.3 mi) from the Wind Development Area ("WDA"). This highly conservative study zone extends well beyond the 8-32 km (5-20 mi) distance normally considered the outer limit for most land-based visual impact studies. 56.8 km (35.3 mi) was selected as a reasonable proposed APE considering distance and the curvature of the earth. Based on the largest Wind Turbine Generator ("WTG") under consideration this radius was conservatively established as the maximum distance at which the WTG nacelle (and Federal Aviation Administration ["FAA"] aviation obstruction lighting mounted on top of the nacelle) will be visible above the horizon. Beyond this distance, only the rotor blades would appear above the distant horizon. Considering the slender form and low contrast coloration of the rotor blades combined with atmospheric hazing, views of the WTG above the nacelle are unlikely to be detected by coastal observers at this distance.

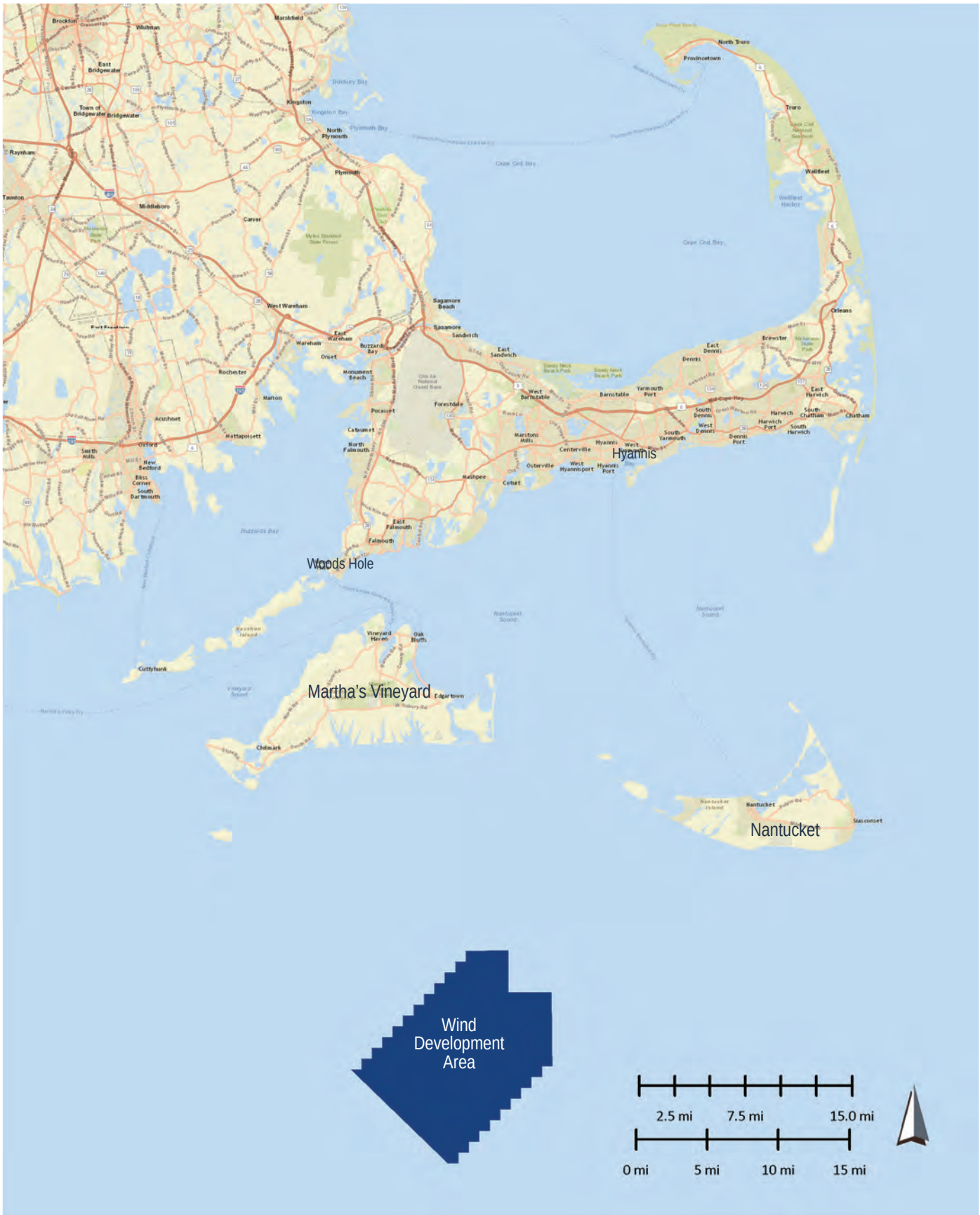
The proposed APE, for the purpose of visual impact assessment is the same as was established in the report titled "Historic Properties Visual Impact Assessment". This document is incorporated as Appendix III-H.b of the Construction and Operations Plan ("COP").

The distance that the nacelle will fall below the horizon is geometrically calculated based on the radius of the earth and the line-of-sight tangent to the horizon for a standing observer at sea level. The maximum extent of the proposed APE does not consider the variable phenomena of atmospheric refraction; the deviation of light from a straight line as it passes through the atmosphere. Although it is theoretically possible a refracted line-of-sight to nacelle elevation might exist, sheer distance, atmospheric hazing, and the presence of intervening inland vegetation render the potential for visual impact beyond the proposed APE radius negligible. Atmospheric refraction is considered in all visual simulations and calculations presented in this VIA. Refer to Section 4.0 for assessment of distance-related factors affecting Project visibility.

Within the 56.8 km (35.3 mi) radius from the WDA are numerous islands as well as Cape Cod; however, the first land masses to be affected (Cuttyhunk Island, Martha's Vineyard, Nomans Land Island, Nantucket, Muskeget Island, and Tuckernuck Island) serve to provide a visual obstruction and buffer to areas within Buzzards Bay, Vineyard Sound, and Nantucket Sound. A narrow view corridor between Martha's Vineyard and Muskeget Island into Nantucket Sound allows for the potential visibility of the WDA from the Towns of Mashpee, Barnstable, and Yarmouth on Cape Cod at the end of the 56.8 km (35.3 mi) radius. Given the extreme distance and the numerous buildings and structures along the shorelines of Mashpee, Barnstable, and Yarmouth, only those areas directly along the shoreline (highlighted on the attached maps) are considered within the proposed APE. Although simulations show that the WTGs will not be visible from these distances, they are nevertheless included to be conservative. Figure 2 illustrates the proposed APE.

1.1.1 Martha's Vineyard and Nantucket APE Viewsheds

The viewsheds that may be affected—i.e., areas where WTG and Electric Service Platforms ("ESPs") may be seen—include the southern coastlines of Martha's Vineyard and Nantucket and the open ocean surrounding the WDA. In most circumstances, Project visibility is quickly screened from inland vantage points by coastal topography and vegetation. Based on field observation conducted by as part of the "Historic Properties Visual Impact Assessment" (COP Appendix III-H.b), most views of the Project will be limited to immediate waterfront locations. Few publicly accessible vantage points with views of the Atlantic Ocean were found more than 1 km (0.6 mi) inland. For this reason, the study area is generally limited to a relatively narrow area along the coastline within the 56.8 km (35.3 mi) proposed APE. Figure 3 illustrates this likely visible area. Figure 4 and Figure 5 illustrate these individual APE areas on Martha's Vineyard and Nantucket.



VINEYARD WIND PROJECT

FIGURE 1
PROJECT LOCATION MAP

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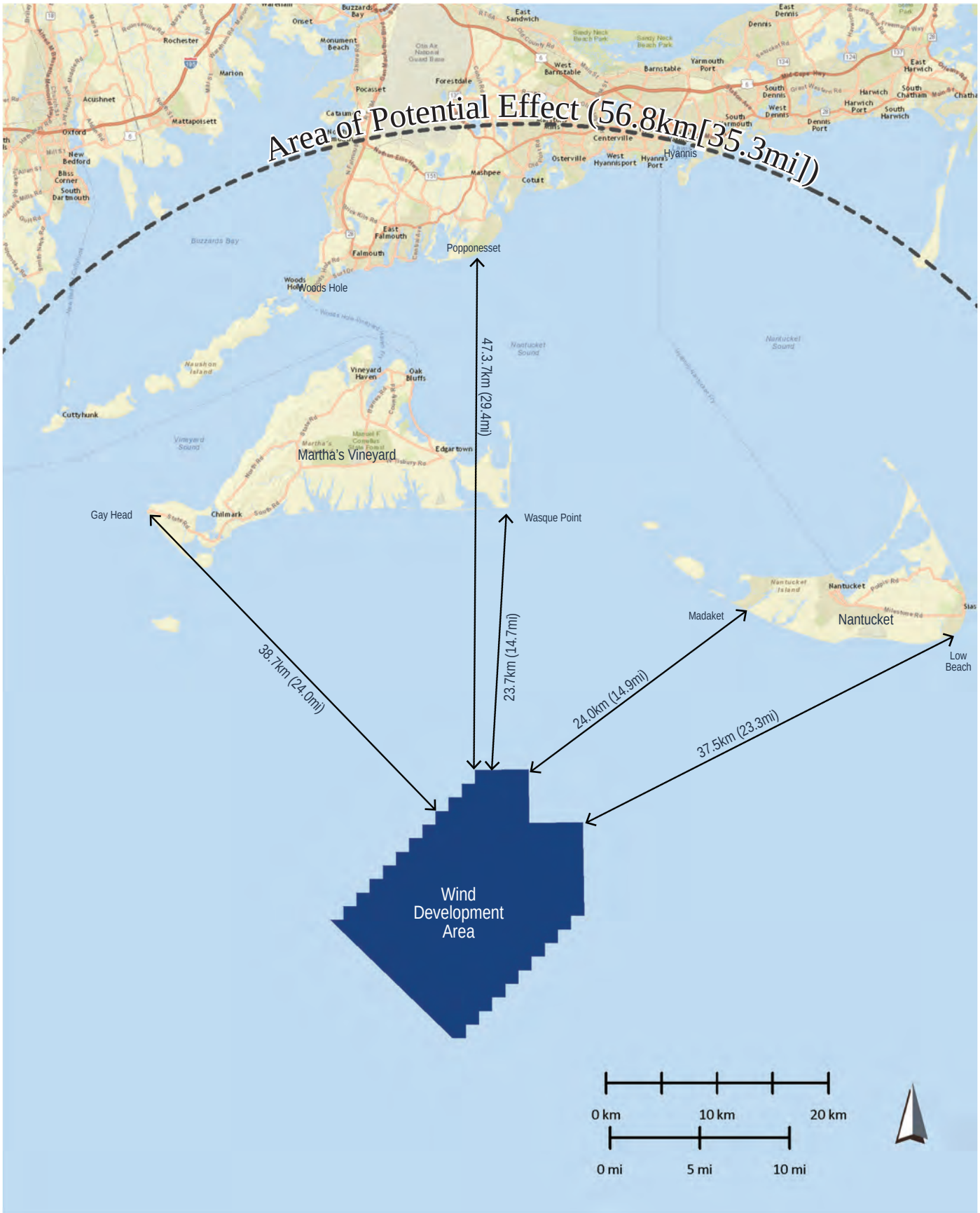
VINEYARD WIND

SARATOGA ASSOCIATES



VINEYARD WIND PROJECT

FIGURE 2
PROPOSED
AREA OF POTENTIAL EFFECT

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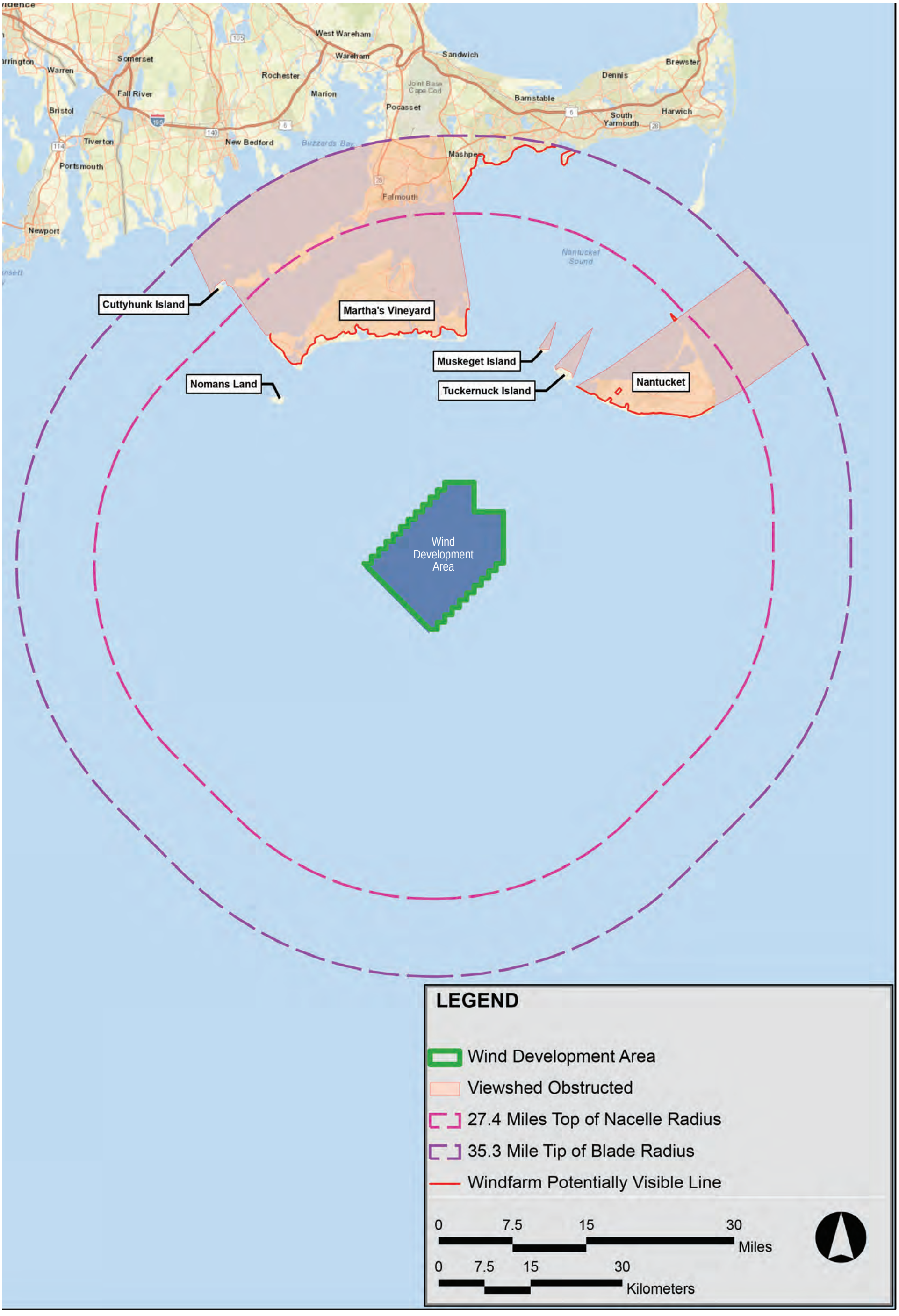
VINEYARD WIND

SARATOGA ASSOCIATES



VINEYARD WIND PROJECT

FIGURE 3
WINDFARM VIEWSHED
AREA OF POTENTIAL EFFECT

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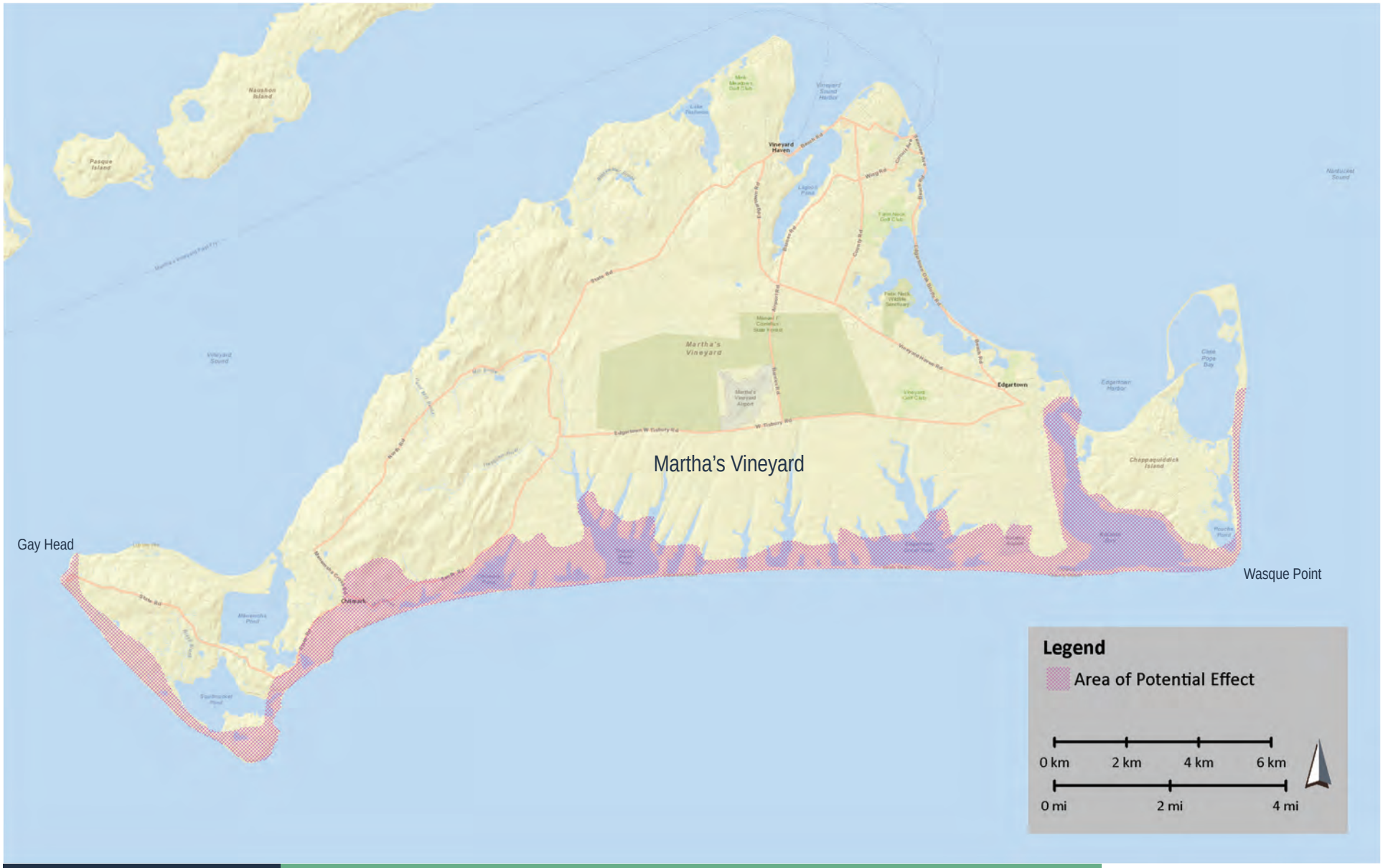
VINEYARD WIND
SARATOGA ASSOCIATES



VINEYARD WIND PROJECT

FIGURE 4
AREA OF POTENTIAL EFFECT
MARTHA'S VINEYARD

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FIGURE 5
AREA OF POTENTIAL EFFECT
NANTUCKET ISLAND

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2.0 PROJECT DESCRIPTION[1]

The WDA is just over 23 km (14 mi) south of Martha's Vineyard and Nantucket. The Project will consist of offshore WTGs, each placed on a foundation support structure, ESPs, an onshore substation, offshore and onshore cabling, and onshore operations and maintenance facilities.

The Lease Area is a 16 x 50 km (8.6 nautical miles ["nm"] x 26 nm area) area oriented northeast to southwest and located just over 23 km (14 mi) south/southwest of Nantucket and Martha's Vineyard. The Project will be located in the northern portion of the over 675 square kilometer ("km^2") (261 square miles [mi^2]) Lease Area. Power generated from the windfarm will be transmitted to Cape Cod via submarine offshore cables. Upon arriving at the shoreline of Cape Cod, the offshore cables will transition to underground onshore cables to connect with an electrical substation. An onshore substation will be constructed in order to accommodate the additional electrical load; a substation location in the Town of Barnstable is under consideration. A new substation building (if needed) will not likely be larger than the existing station.

2.1 Wind Turbine Generators

The Project includes the construction of up to 100 WTGs and up to two ESPs within the WDA. The Project is designed to provide ~800 MW of electricity and has defined a range of turbine sizes that may be used: from eight to 10 MW. Up to 106 turbine locations are being permitted to allow for spare positions (in the event of environmental or engineering challenges). Although the Project is including 106 WTG positions in the Project Envelope, only up to 100 positions will be occupied by a WTG. However, the visual simulations were conducted conservatively assuming that all 106 WTG positions will be occupied by a WTG. The WTGs will be laid out in a grid pattern along with several offshore substation platforms. The WTGs will be positioned approximately three-quarters to one nm apart from each other.

The WTGs will be supported by foundations consisting of either steel monopiles embedded into the sea floor or "jacket" structures. The jacket foundations are cross-braced structures supported by piles (three or four piles). Either foundation type (monopile or jacket) is designed to support the WTG. The WTGs will connect to the existing mainland power grid via inter-array cables that connect six to 10 WTGs to the ESPs, then offshore cables from the ESPs will connect to the shore at the landfall site. All offshore and onshore cables will be buried and will not be visible. Proposed underground cables are expected to utilize existing paved roadway and utility corridors to connect to the proposed substation location in Barnstable.

The maximum height of the WTGs considered for this project will measure approximately 212 meters ("m") (696 feet ["ft"]) above sea level at the peak of the blade tip. The supporting foundation/transition piece and wind turbine tower extends a maximum of 121 m (397 ft)

[1] See COP Volume I, Section 3.0 for full Project description.

above the ocean surface to the "nacelle height". The rotor supports the three blades and the nacelle, which houses the generator and related equipment, and is set at this height. The rotor diameter formed by the three blades will be a maximum of 180 m (591 ft). This corresponds to an approximate maximum blade length of 85 m (279 ft). The blades will taper down from a maximum width of approximately 5.1 m (17 ft) across at the base to approximately 1.6 m (5.5 ft) at the tip. The WTG assembly and the blades are typically painted off white or light gray to blend into the horizon.

The ESPs will have a maximum width of 45 m (148 ft) and a maximum length of 70 m (230 ft). Additionally, the ESPs will have a maximum height of 66.5 m (218 ft) above water. The WTGs will be joined to the ESPs via submarine inter-array cables, and, if two 400 MW ESPs are used, the ESPs will be joined to one another via submarine inter-link cables.

Although most of the WDA falls outside of the FAA jurisdictional area, BOEM intends to follow FAA guidance until they develop new guidance. The FAA guidance provides that two aviation obstruction lights (L-864) be installed on top of each nacelle. The L-864 unit is a red low intensity omni-directional light emitting 2,000 candelas (plus or minus 25%) (Federal Aviation Administration, 2016). The current FAA circular states aviation obstruction lights will flash in unison at a rate of 30 flashes per minute (FAA, 2016). Alternative lighting schemes are being assessed for usability. These include but are not limited to weather dependent light intensities, radar activated lighting, and other potential future advancements in technology.

The US Coast Guard ("USCG") requires two amber navigation warning lights (visible up to 4.6 km (2.5 nm) be mounted near the top of the foundation on each WTG approximately 19-23 m (62-75 ft) above mean lower low water ("MLLW").

2.1.1 WTG Specifications Used for Visual Impact Assessment

In conducting the visual simulations, Vineyard Wind utilized the proposed layout with 106 of the eight MW WTGs. The eight MW layout represents the maximum impact scenario for potential visual effects because the nacelle is the most visible portion of the WTG, especially at night, and the nacelle heights for the various WTGs are all within 10 m (33 ft) of one another. A 10 m (33 ft) difference in WTG hub height is not perceivable at a distance of over 23 km (14 mi), the closest approximate distance from the Project to land; in the simulation it will represent only a fraction of a millimeter based on the 11"x17" printed page. Thus, the greater potential impact will be due to the number of turbines and lights, rather than fewer, slightly taller WTGs.

The eight MW model evaluated has a hub height of 111 m (364 ft), rotor diameter of 167 m (548 ft) for a blade tip height of 194.5 m (638 ft). Turbine blades will taper down from a maximum width of approximately 5.2 m (17 ft) across at the base to approximately 1.7 m (5.5 ft) at the tip. The spacing of the 8 MW WTGs will vary from about 1.4 km (0.87 mi) to over 1.85 km (1.15 mi) under this scenario. Figure 6 illustrates the visual characteristics of the WTG evaluated in this VIA.

2.2 Electrical Service Platforms

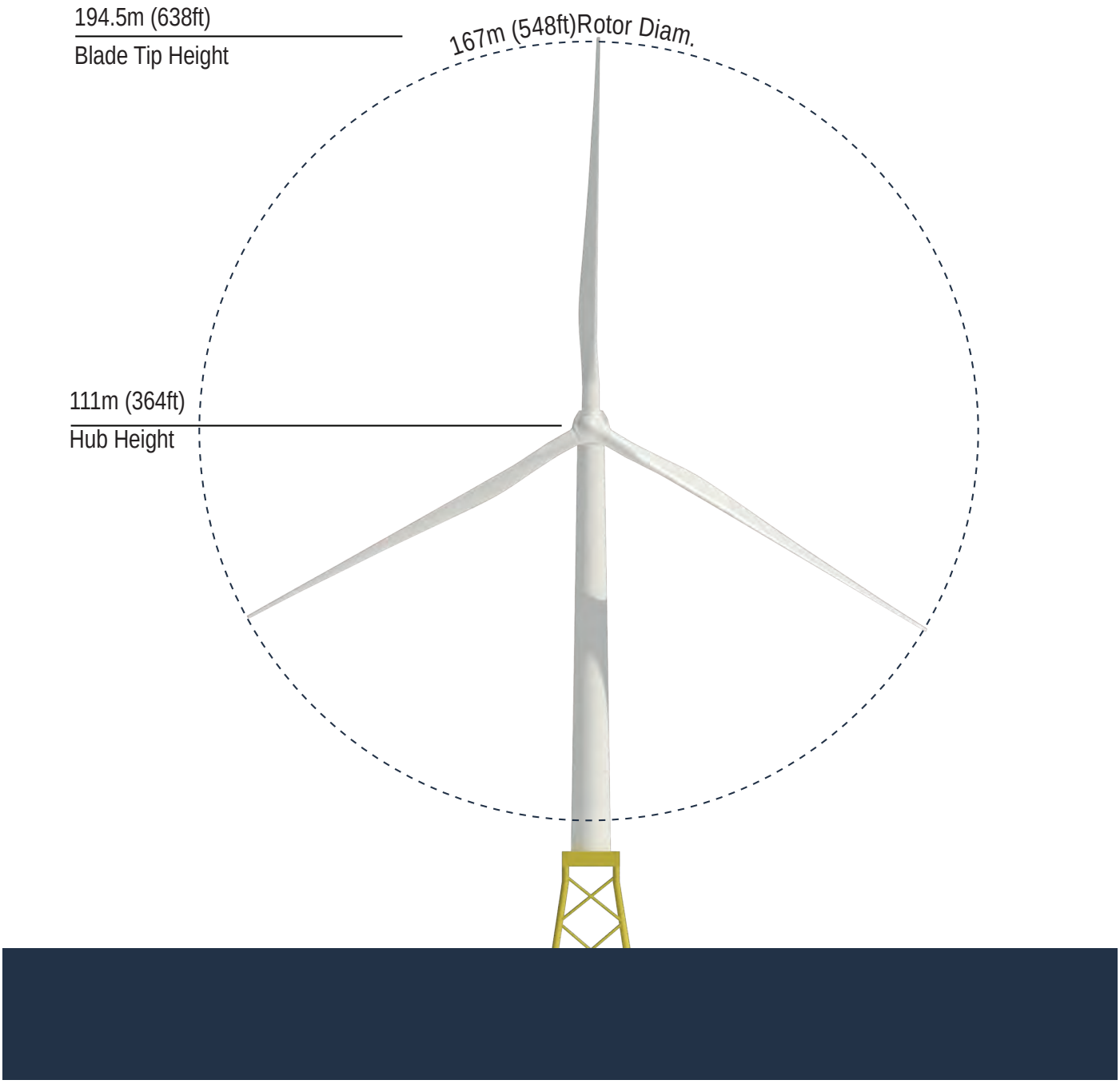
The Project will include either one 800 MW ESP or two 400 MW ESPs housing step-up transformers and other electrical gear. The ESPs will have a maximum width of 45 m (148 ft) and a maximum length of 70 m (230 ft). Additionally, the ESPs will have a maximum height of 66.5 m (218 ft) above water. The WTGs will be joined to the ESPs via submarine inter-array cables, and, if the 400 MW ESPs are used, the ESPs will be joined to one another via submarine inter-link cables. The lighting scheme for each ESP will be similar to that of the WTG, described above in Section 2.1.

Because the specific type of ESP was not determined at the time of this VIA the largest potential ESP dimension with a jacket-type foundation is evaluated herein as the maximum potential visual impact scenario. Figure 7 illustrates the general characteristics of a conventional ESP.

2.3 Export Cables and Onshore Substation

The WTGs will connect to the existing mainland power grid via inter-array cables that connect six to 10 WTGs to the ESPs, then offshore cables from the ESPs will connect to the shore at the Landfall Site. All offshore and onshore cables will be buried and will not be visible. Proposed underground cables are expected to utilize existing paved roadway and utility corridors to connect to the proposed substation location in Barnstable.

The power grid connection is proposed at an existing landside power substation. The proposed improvements will be consistent in scale and visual character with the existing electric substation. All new structures will be within the maximum height limits permitted under current zoning. Because proposed improvements are consistent with the height and visual character of the existing substation this VIA does not evaluate this Project component.



VINEYARD WIND PROJECT

FIGURE 6
WIND TURBINE GENERATOR EVALUATED

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VINEYARD WIND PROJECT

FIGURE 7
CONVENTIONAL ELECTRICAL SERVICE PLATFORM EVALUATED

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3.0 LANDSCAPE CHARACTER/VISUAL SETTING

The APE is comprised of Martha's Vineyard, Nantucket, the Elizabeth Islands, associated smaller Islands and a portion of Cape Cod. Martha's Vineyard is the largest island of the group, covering about 223 km^2 (86 square miles ["mi^2"]). Nomans Land Island, a small uninhabited island of about 2.6 km^2 (1 mi^2) located about 4.8 km (3 mi) southwest of Martha's Vineyard is protected as a National Wildlife Refuge. Nantucket is comprised of four islands: Nantucket, Esther Island, Tuckernuck Island, and Muskeget Island. Nantucket is the largest of the four islands and is approximately 126 km^2 (49 mi^2). The Elizabeth Islands are a chain of small islands extending southwest from the southern coast of Cape Cod at the outer edge of Buzzards Bay.

Martha's Vineyard and Nantucket are popular tourist destinations and summer resort communities. Access to the islands is limited to boat and air service. Most visitors and residents utilize a ferry service connecting mainland Cape Cod to the islands. According to the US Census Bureau, the year-round population on Martha's Vineyard is approximately 17,250 residents, although the summer population can swell to more than 100,000 (County of Dukes, n.d.). Nantucket has a year-round population of approximately 12,000. But with tourists and seasonal residents, the population of the island increases to more than 50,000 during the summer (Town of Nantucket, n.d.).

Martha's Vineyard and Nantucket were formed by the last period of continental glaciation and the rise in sea level that followed. The islands are generally characterized by low elevation, with undulating hills and shallow depressions. Elevations range from sea-level to approximately 110 ft above sea-level in the central portion of Martha's Vineyard and Nantucket. Most of the oceanfront is fringed by barrier beaches and sand dunes. The western and northwestern parts of Martha's Vineyard are marked by ridges and hills that extend southwesterly and end at the high cliffs of Aquinnah (Gay Head), Nashaquitsa, and Squibnocket. The elevation of these hills averages about 61 m (200 ft) above sea level but extend as high as 91 m (300 ft) in some areas (SCS, 1993).

Vegetation within the AEP is characterized by a mix of scrub forest, upland heaths, sand plain grasslands, salt marshes, and open fields (agricultural and successional). Developed features include village centers, year-round and vacation homes, roads, and harbors/ports.

The overall aesthetic character of Martha's Vineyard and Nantucket are that of a small-town landscape with minimal urban development. The horizon, looking south towards the WDA from the coast, is typically defined by a view of the open ocean. Because of the development and infrastructure at some of the viewpoints, manmade lighting results in some light pollution, but most viewpoints are typical of beaches and natural areas without much development. Lights from boats/ships can be seen from all locations of the coastline on the ocean horizon on most nights, except in extremely foggy conditions. The intensity and size of the lights varies

depending on the distance of the boat from the shore, and remains within the view different amounts of time depending on the direction and speed of the vessel (BOEM, 2014).

3.1 Landscape Units

The definition of landscape or seascape types found in the study area provides context for assessment of visual resources and viewer circumstances. Landscape Units ("LUs"), are defined based on similarity of landscape features including landform, vegetation, water, and land use patterns.

Open Ocean Unit – The open water/ocean unit includes the open water of the Atlantic Ocean, Nantucket Sound, Vineyard Sound, Buzzards Bay, and Rhode Island Sound. This unit is characterized by broad expanses of open water which forms the dominant foreground element in all directions. From all vantage points the Project will be viewed over open water. In general, the waters of the Atlantic Ocean appear dark bluish-gray typical of northeastern US oceanic water (as compared to the light greenish blue colors common to southeastern US waters). Cloud cover, wind, sun reflectance, and surface glare affect the color of the water and often create patterns of color variation over the water surface. The visible texture of the water is affected by the action of waves, which can include flat water, rolling swells and or choppy white cap conditions. These factors contribute to an amalgam of shimmering colors and patterns of light that are of aesthetic interest and may command the attention of observers.

The waters off of Cape Cod, Martha's Vineyard and Nantucket support a wide variety of human activities including water sports, recreational boating (sail and power craft), recreational and commercial fishing, ferry services, and commercial shipping, among others uses. Navigation through the area includes ocean going vessels headed to or from major ports (e.g., New York and Boston), commercial fishing vessels, ferry transport (Nantucket and Martha's Vineyard ferries), pleasure craft and sport fishing boats. The ocean, sound, channels, harbors, and bays are marked with maritime aids (e.g., buoys, channel markers, warning lights, etc.).

Ocean Beach Unit - Miles of sand beaches are a defining aesthetic feature of Martha's Vineyard, Nantucket, and Cape Cod. Beaches are a significant attraction for sunbathers, surfers, fishermen, and beachcombers. During the summer season, certain stretches of the beach setting are at capacity. At other times of the year beaches can be nearly deserted and appear in a seemingly pristine natural condition. As a daytime destination, visitors bring brightly colored umbrellas, coolers, folding chairs, towels, and recreational watercraft. Southerly views from the beach encompass views of the open water landscape across the Open Water/Ocean Unit.

The beaches are both sandy (primarily on Nantucket, along the south coast of Cape Cod, the perimeters of the Elizabeth Islands, and the eastern portion of Martha's Vineyard) and rocky (primarily on the western portion of Martha's Vineyard). Breaking surf is a continuous and unique visual condition. Viewer activity is primarily recreational in nature including passive

sunbathing, swimming, walking/beach combing, surf fishing, and surfing. Beaches are also used by recreational and commercial fishermen.

Views are almost always unobstructed and considered highly scenic. Views extend up and down the coast and across open water as one looks out to sea. Inland views include grassy dunes and coastal scrub vegetation. Man-made structures are frequently visible from beach locations, although extended stretches of beachfront on Martha's Vineyard and Nantucket are located within protected open space areas with little to no man-made development within immediate view.

Coastal Dunes Unit - The inland edge of the Ocean Beach Unit is defined by undulating sand dunes typically ranging in height from 3-6 m (10-20 ft). Dunes are typically vegetated with low grasses and low shrubs. Coastal dunes typically occur along the shoreline between the ocean beaches and more inland landforms and are present throughout the study area on Cape Cod, especially in the easterly limit of the proposed APE, as well as on Martha's Vineyard and Nantucket. The dunes are typically traversed by narrow enclosed footpaths through the beach grass that provide public access to the beaches from inland roads and parking areas. Ocean views from the back side of the Coastal Dune Unit are largely restricted by the dune terrain. Viewer activity is almost exclusively recreational; focused on walking/sight-seeing and beach access from inland roads and parking areas.

Coastal Bluffs Unit - Portions of the coastal area are defined by a distinctive topographic rise in elevation from the beach below, with coastal scrub vegetation at the top of the bluffs. Dramatic coastal bluffs occur at the eastern end of Martha's Vineyard at Gay Head, Aquinnah, and Chilmark where the land rises steeply from sand or rocky beaches to elevation of 30 m (100 ft) or more. Notable bluffs in this area include Gay Head Cliffs, Zacks Cliffs, Squibnocket Ridge, Nashaquitsa Cliffs, and Wequobaque Cliffs. Less dramatic bluffs are found at Wasque Point at the southern end of Chappaquiddick Island where topography steeply rises 15-30 m (50-100 ft) above beach elevation.

The Coastal Bluffs Unit is defined by scenic open vistas of the ocean and distant landscape from an elevated vantage point. Viewers frequently visit these areas specifically to enjoy scenic vistas over the ocean and long distance views up and down the coastline. Bluff vistas also commonly include man-made development including roads and vehicles, overhead utility lines, and residential development.

Salt Pond/Tidal Marsh Unit - Salt ponds and tidal marshes inland of the Ocean Beach Unit are common throughout the coastal area. Disconnected from the ocean except during flooding events, or connected to the ocean by narrow tidal channels, these water features are defined by shallow open water and buffered by herbaceous grasses and other salt tolerant vegetation. In those with hydraulic connections to the ocean, water levels rise and fall with the tide, exposing mud flats. Views over the water body and flat marshland extend until interrupted by

adjacent dunes and/or scrub vegetation. Residences often are present along the edges of the ponds, many with associated docks and boats. Recreational activities in this unit include walking, boating, clam digging, and bird watching.

Coastal Scrub Brush Unit - At varying distances inland from the Coastal Beach, Dunes, and Salt Pond/Tidal Marsh Units, the coastal landscape transitions into a more heavily vegetated scrub brush and low forest condition. The Coastal Scrub Brush and Forest Units (described below) are characterized by low dense woody and herbaceous vegetation -- the dominant forest is Pitch Pine-Oak forest which occurs on Cape Cod, Martha's Vineyard, and Nantucket. Scrub vegetation is commonly found on upland dunes and plains above tidal conditions. Landform is often comprised of small hills and eroded hollows. Vegetation is often thick and nearly impenetrable. Views are frequently obstructed by dense foliage. Distant vistas may be limited to view corridors along roadways or where scrub brush transitions to open meadow. Viewer activity is typically limited to local travel and recreational use such as walking and biking.

Forest Unit - Inland from various coastal units are extended wooded areas including both deciduous and coniferous species (e.g., oaks, hickories, and white pine). Understory is comprised of mixed shrubs, vines and saplings. In areas exposed to coastal winds, trees are often irregular in form and stunted. Trees in better shielded inland areas are taller and more regular in form.

Although this landscape type once dominated the interior of Martha's Vineyard, Nantucket, and Cape Cod, various forms of human development extensively encroach upon this area, leaving a patchwork of mature forest remaining. A variety of land use activities exist in the Forest Unit including residential development, roads, small open yards and fields, and other land uses. Such conditions are not specifically identified as separate units due to the visual dominance of the surrounding forest. The Manuel F. Correllus State Forest, a 21 km^2 (8 mi^2) forest is situated in the center of Martha's Vineyard, offers trails for biking and hiking.

Topography in the Forest Unit is typically level to rolling with distinct ridges and gullies. Views are frequently restricted to openings in the forest canopy and axial views along roadways. Viewer activity includes residential uses and local travel. Recreational uses include walking and bicycling through the woods along local roads and trails.

Shoreline Residential Unit - Shoreline (or near shoreline) residential development is common in coastal areas not currently protected by public and private land conservation initiatives. Residential development ranges from small bungalow style beach houses to large well maintained vacation homes. The developments are a mix of densely developed areas such as Falmouth Heights and Popponnesett (Mashpee) and Nantucket harbor, and low density developments on the south shore of Martha's Vineyard and Nantucket. Although sometimes screened by coastal scrub vegetation, shoreline residences typically have panoramic views of

the ocean, salt ponds/tidal marshes, and/or dune landscape. Architecture is a mixture of old and new construction and traditional/historic and contemporary style.

The local landscape is gently rolling with a mix of coastal scrub, heath, and dunes surrounding maintained residential landscapes. Larger trees are not generally present in beachfront locations. Shoreline residential homes are often used seasonally by owners or offered as vacation rentals. Visitors to these properties enjoy views of the ocean or beachfront landscape and frequently walk or drive from the residential property to the beach and other scenic coastal locations as part of their vacation routine.

Village/Town Center Unit - The Village/Town Center Unit includes clearly identifiable population centers including Vineyard Haven, Oak Bluffs, and Edgartown on Martha's Vineyard; Woods Hole and West Falmouth on Cape Cod; and Nantucket Village on Nantucket. This zone is comprised of moderate to high density residential and commercial development in a village setting. Vegetation most commonly includes street trees and residential landscaping yard trees. Buildings (typically two to three stories tall) and other manmade features dominate the landscape. Architecture is highly variable in size, style, and arrangement. Each town center on Martha's Vineyard and Nantucket maintains an individual and distinctive New England character. Village/Town Centers are widely recognized as quaint small town destinations and highly scenic places.

On Martha's Vineyard and Nantucket, village and town centers are small coastal seaports with clusters of historic buildings focused around clearly defined and thriving downtown commercial districts. Side streets are characterized by well maintained residential structures adjacent to the village center. Buildings are most commonly of a traditional New England architectural style and arranged in an organized pattern focusing views along the streets. Buildings, street trees, and local landscaping enclose and prevent long distance views.

Rural Residential Unit - The Rural Residential Unit is found along the frontage of rural roads through Cape Cod, Martha's Vineyard and Nantucket, outside of the Village/Town Center Unit and the Suburban Residential Unit and inland from coastal areas. Structures are typically single family homes that vary widely in age and architectural style, from the traditional Cape style house to modern modular homes and historic farm houses. Residences tend to be larger and well maintained, often with a traditional New England character. Rural residences on Cape Cod vary in size from small Cape or ranch style homes to larger farm houses, and are generally located on paved roads. On Martha's Vineyard and Nantucket the older homes vary in size, while newer seasonal homes are larger estates and located on large lots. Many rural roads on the islands are unpaved. Residential structures are often set back from the road and interspersed with hedgerows and small woodlots. Topography is characterized by relatively level to gently rolling landform typical of inland on Martha's Vineyard and Nantucket. Extended distance views are often restricted to open fields and axial views along roadways. Rural

residential uses are not typically oriented toward ocean views. Viewer activity includes common residential uses, recreation and local travel.

Suburban Residential Unit - Suburban residential development includes medium to high density single family residential neighborhoods that typically occur on the outskirts of villages and town centers, along secondary roads and cul-de-sacs. The Suburban Residential Unit is most commonly located on Cape Cod and around the perimeter of Village/Town Center Units on Martha's Vineyard, and Nantucket. Buildings are most often one- and two-story wood framed structures with peaked roofs and clapboard or shingle siding. House styles are primarily capes, ranches, bungalows, salt boxes and colonial residential structures.

Suburban Residential Units are also found in coastal areas in relatively new clusters of homes designed for year-round, seasonal, or vacation use in areas proximate to beaches and other scenic and recreational resources. Suburban residential developments generally have regularly spaced homes surrounded by landscaped yards. Residential subdivisions are commonly are located within forest areas or have pockets of remnant forest vegetation within developed areas. Streets are well-organized in layout, and are often curvilinear in form with well-defined access to collector streets. Activities include normal residential uses and local travel. Views are often limited by surrounding vegetation or adjacent structures. Suburban Residential Units are not typically oriented toward ocean views.

Agricultural/Open Field Unit - Agricultural land uses within the APE are limited to several small, generally level to gently sloping pastures and crop fields. Livestock and working farm equipment add to the visual interest of the open fields. This unit occurs primarily in inland portions of the APE as a minor component of the landscape on both Martha's Vineyard and Nantucket. Many of the agricultural landscapes are protected open space, either by public agencies, private land trusts, or non-profit organizations. Agricultural lands may offer long distance views. Adjacent forest, coastal scrub and structures commonly frame/enclose views and provide significant screening. Because this unit largely inland, views to the ocean are relatively rare, with the exception of Bartlett's Farm on Nantucket and the Allen Farm on Martha's Vineyard.

3.2 Viewer/User Groups

Viewers engaged in different activities while in the same setting are likely to perceive their surroundings differently. The description of viewer groups is provided to assist in understanding the sensitivity and probable reaction of potential observers to visual change resulting from the proposed project.

Tourists, Vacationers, Seasonal Residents and Recreational Users - One of the coastal area's greatest assets is the view of the Atlantic Ocean and Nantucket Sound and its shoreline landscape. Martha's Vineyard and Nantucket have long been a renowned tourist destination offering a broad-spectrum of passive and active recreational pursuits focused on its scenic and

upscale coastal setting. While some visit the islands for a few days or a week in the summertime others may spend the entire summer season in the area. Tourists, seasonal residents, vacationers, and recreational users are commonly involved in outdoor recreational activities at beaches, parks and conservation areas. Typical activities include sunbathing, beach combing, swimming walking, bicycling, recreational boating, fishing, and other passive recreational.

While the sensitivity of these viewers will vary, tourists, seasonal residents, vacationers, and recreational users will be the most sensitive to built elements on the landscape since quality views of the ocean is likely a primary reason for their visit and an integral part of their recreational experience. However, for other users, such as fisherman, the scenic quality of the coastal landscape may be less important.

Greater numbers of tourists, vacationers, and recreational users will be present in the coastal area during the summer and on sunny days, when the weather is clear and warm as compared to overcast, rainy or cold days. In addition, more recreational users will be present in the coastal area on weekends and holidays than on weekdays.

Year-Round Residents - Local residents live, work, and travel in the APE. They generally view the landscape from their yards, homes, local roads, and places of employment. The highest population of local residents is in and around the town center areas, but many live in more rural portions of the APE.

The coastal area also includes numerous private residential properties coastal areas that are uniquely oriented to take advantage of scenic views. These properties are almost always of very high real estate value, due in large part to water views or proximity to the waterfront, and are often cherished places for families who live or vacation there.

Local residents are likely to have the best understanding of the aesthetic character and existing conditions of the coastal area. Except when involved in local travel, these viewers are likely to be stationary and may have frequent and/or prolonged views of the Project. They know the coastline and may be sensitive to changes in particular views that are important to them.

Residents' sensitivity to visual quality varies and may be affected by the aesthetic setting of their neighborhood or work place. Those residing or working in village/community centers with views focused on the developed landscape may be less sensitive to landscape changes than those with views of a more natural landscape or seascape. However, all local residents are familiar with the coastal landscape and may be sensitive to aesthetic changes to varying degree.

Through Travelers - This group includes non-local viewers with views of the ocean. Through travelers are typically moving, have a relatively narrow field of view oriented along the axis of the roadway, and are destination oriented. Drivers will generally be focused on the road and traffic conditions, but do have the opportunity to observe roadside scenery. Passengers in moving vehicles will have greater opportunities for prolonged off-road views than will drivers, and therefore may be more aware of the quality of surrounding scenery.

Site inventory found few major roads with significant or extended views of the water.

Also included in this group are travelers that may transit the ocean on ferries from the main land. Unlike automobile users, ferry passengers have extended periods of time where views of the proposed project would be of relatively long duration (one hour or more). These viewers include those engaged in passive enjoyment of the ocean ambiance as well as those who pass the travel time occupying themselves with business or other personal activities. At its closest, the Hyannis/Nantucket ferry passes within 32 km (20 mi) of the WDA. Views from the Hyannis/Nantucket ferry would occur within a narrow view corridor between Nantucket, Tuckernuck Island, Muskeget Island, and Martha's Vineyard

Commercial Mariners - Commercial fisherman and seaman transiting the ocean would typically have low sensitivity to the presence of the Project. These viewers would be engaged in activities associated with their jobs with minimal focus on the aesthetic character of their surroundings. Moreover, commercial mariners would be more accustomed to the presence of industrial activities and ocean-going vessels within their day-to-day environment than other viewer types.

3.2.1 Public Reaction

Regardless of viewer group, public reaction to the Project is likely to be variable. Not all viewers see wind turbines as having an adverse visual impact. A number of research studies on visual impacts of offshore and onshore wind energy developments have indicated that wind power enjoys strong support among the public, and unlike most large-scale energy facilities, wind turbines are in some cases viewed as a positive visual impact by significant portions of the public (BOEM, 2007).

While there is generally strong support for wind power development, there are often local concerns relating to the aesthetics of planned wind facilities. The perceptions of visual impacts associated with wind energy development vary among potential viewers and may be positive or negative, and they can change over time, in some cases possibly trending toward more positive perceptions after the installation of wind energy facilities (BOEM, 2007).

Warren et al. (2005) assessed pre- and post development attitudes toward visual impacts associated with two onshore wind facilities in Ireland. Their survey found for one location that more than 90% of survey respondents supported the concept of wind power, but 66% of respondents were initially opposed to a local proposed wind facility. Contrary to expectations, persons living closest to the wind facilities, who had originally opposed it on aesthetic grounds, actually increased their acceptance of the visual impacts after its construction, with 62% regarding the visual impact as positive. For a second wind facility, similar results were observed. The results in both cases suggested that familiarity with the wind facilities decreased aesthetic objections. Stated reasons for changing perceptions of visual impacts varied among respondents; some felt the turbines were attractive, while others felt that the actual impacts were less than had been anticipated (BOEM, 2007).

3.3 Circumstances of View

View duration affects perceived visual impacts. Impacts that are viewed for a long period of time are generally judged to be more severe than those viewed briefly (BOEM, 2007).

Stationary Views - Stationary views are experienced from fixed viewpoints. Fixed viewpoints include beaches, recreational facilities, residential neighborhoods, historic resources, and other culturally important locations. Characteristically, stationary views offer sufficient time, either from a single observation or repeated exposure, to interpret and understand the physical surroundings. For this reason, stationary viewers have a higher potential for understanding the elements of a view than moving viewers.

Stationary views can be further divided into those of short-term and those of long-term exposure. Sites of long-term exposure include locations where a stationary observer is likely to be regularly exposed to the project such as from a place of residence or employment. Sites of short-term exposure include locations where a stationary observer is only visiting, such as beaches or other coastal recreation areas. The duration of visual impact remains at the discretion of the individual observer; however, short-term impacts diminish with repeated observations by the same observer (i.e., people become accustomed to common views).

Moving Views - Moving views are those experienced in passing, such as from moving land-based or water-based vehicles and craft, where the time available for a viewer to cognitively experience a particular view is limited. Typically, such views apply to motorists proceeding at a high rate of speed along a defined path through highly complex stimuli.

Traveling at a slower speed over open water, recreational boaters and ferry travelers may have greater opportunities to cognitively experience their surroundings. For sailboats and very slow moving motor craft, visual recognition may be similar to that described for stationary viewers. Though for reasons of safety including avoidance of other vessels and surface flotsam, a boater may nevertheless still tend to focus more on the direction of travel rather than other directions.

4.0 OTHER FACTORS AFFECTING PROJECT VISIBILITY

In the case of long distance views, theoretical visibility typically exceeds actual visibility. In seascapes, atmospheric haze reduces the practical viewing limit, sometimes significantly. The presence of waves will obscure objects very low on the horizon. The limits of human visual acuity reduce the ability of an observer to discern objects at great distances, suggesting that some WTG components (e.g., blades) would not be discernible. The color, reflectivity, and other visual characteristics of the object and its contrast with the visual background under varying lighting conditions also affect its visibility (BOEM, 2007).

4.1 Viewer Distance

4.1.1 Distance Zones

Viewer distance from an area is a key factor in determining the level of visual impact, with perceived impact generally diminishing as distance between the viewer and the affected area increases (BOEM, 2007).

Distance can be discussed in terms of pre-defined distance zones: foreground, mid-ground and background. Each zone represents a set of visual conditions that are predictive of how an object will appear to change from zone to zone. The following description of each distance zone is provided to assist in understanding the effect of distance on potential visual impacts BLM, 2013; Jones and Jones; 1977; Litton, 1968).

Foreground (0 to 1/2 mi) - At a foreground distance, viewers typically recognize a very high level of detail. Contrast and color intensity are at their greatest and human scale is an important cognitive factor in judging spatial relationships and the relative size of objects. Visual impact is likely to be considered the greatest at a foreground distance.

With the nearest coastal vantage point over 23 km (14 mi) distant, only boaters passing within very close proximity will view the Project from the foreground distance zone.

Mid-Ground (1/2 mi to 3-5 mi) - This is the distance where elements begin to visually merge or join. Colors, intensity, and textures become muted by distance, but are still identifiable. Visual detail is reduced, although distinct patterns may still be evident. Viewers at mid-ground distances typically recognize surface features such as tree stands, building clusters and small landforms. Scale is perceived in terms of identifiable features of development patterns. From this distance, the contrast of color and texture are identified in terms of their regional context rather than of the immediate surroundings.

With the nearest coastal vantage point over 23 km (14 mi) distant, only boaters passing within close proximity will view the Project from the mid-ground distance zone.

Background (3-5 mi to horizon) - At this distance, landscape elements lose detail and become less distinct. Even on the clearest of days, the sky is not entirely transparent because of the presence of atmospheric particulate matter. The light scattering effect of these particles causes a reduction in the intensity of colors and the contrast between light and dark as the distance of

objects from the observer increases. Contrast depends upon the position of the sun and the reflectance of the object, among other items. The net effect is that objects appear "washed out" over great distances; referred to as atmospheric perspective, this phenomena changes colors to blue-grays, while surface texture characteristics are lost, and only broad landforms are discernible. With atmospheric perspective, visual emphasis is on the outline or edge of one landmass or water resource against another with a strong skyline element (NYSDEC, 2000).

All land-based vantage points will view the Project from the far background distance zone.

4.1.2 Point of Visual Extinction

From the nearest coastal vantage point WTGs in the WDA will range from over 23 km (14 mi) to 47 km (29 mi). Viewing distances increase as viewers move up or down the coast on Martha's Vineyard and Nantucket. The closest location to the WDA on Cape Cod is measured as over 47km (29 mi) near Popponesset Beach in Mashpee.

As an observer moves farther and farther from an object, the smaller the object appears. Beyond a certain distance, depending upon the size and degree of contrast between the object and its surroundings, the object may not be a point of interest for most people. At this hypothetical distance it can be argued that the object has little impact on the composition of the landscape of which it is a tiny part. Eventually, at even greater distances, the naked eye is incapable of seeing the object at all (NYSDEC, 2000).

Sullivan, in "Offshore Wind Turbine Visibility and Visual Impact Threshold Distances" (2013), concludes small to moderately sized facilities were visible to the unaided eye at distances greater than 42 km (26 mi), with turbine blade movement visible up to 39 km (24 mi). At night, aerial hazard navigation lighting was visible at distances greater than 39 km (24 mi). The observed wind facilities were judged to be a major focus of visual attention at distances up to 16 km (10 mi), were noticeable to casual observers at distances of almost 29 km (18 mi), and were visible with extended or concentrated viewing at distances beyond 40 km (25 mi). The proposed Project is larger in scale than the projects evaluated by Sullivan; however, these findings provide additional perspective concerning the effect of distance on human visibility of offshore wind energy facilities and further support the conclusion that the proposed APE is highly conservative.

4.2 Curvature of the Earth

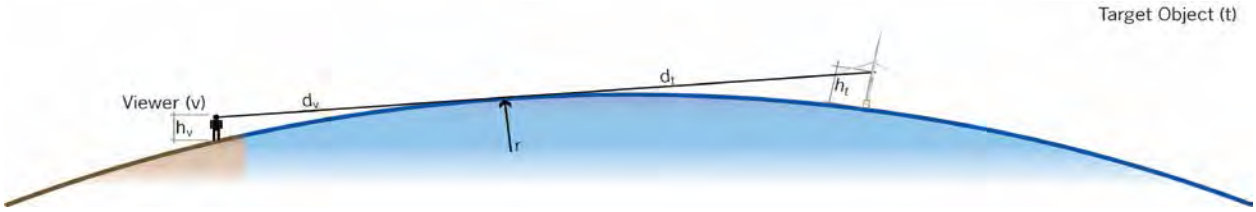
Due to the curvature of the earth's surface, objects viewed on the horizon are not seen in their entirety, because they begin to fall below the visible horizon; as the distance from the viewing location to the object continues to increase, less of the object will be visible. The impact the earth's curvature has on views of objects on the horizon are lessened by the refraction of light in the earth's atmosphere, which at long distances, curves our line of sight downwards.

From all vantage points, the Project will be viewed over open water at great distance (greater than 23 km [14 mi] from any coastal vantage point). At such extended distance, the curvature of the earth will affect the visibility of the Project. The degree of screening caused by earth

curvature depends on the elevation of the viewer above sea level ("asl") and the distance of the viewer from the proposed project.

The degree of visibility above the visible horizon for any object can be geometrically calculated using the Pythagorean Theorem ($a^2+b^2=c^2$). The distance that the target object will become visible above the horizon from a known vantage point is the sum of the distance between from the viewer location to the visible horizon and the distance from the target object to the visible horizon.

Figure 8 - Geometric Horizon Diagram



The distance to the geometric horizon from any point is calculated as follows:

From the Pythagorean theorem:

$r^2+d^2=(r+h)^2$,

Simplifying;

d = square root of (h^2+2hr)

Where:

d=distance to horizon;

h=elevation (asl) of viewer (eye level) or target object; and

r=radius of the earth (3,963 miles = 20,924,640 ft)

The sightline distance between viewer (v) and target object (t) = dv+dt

Atmospheric Refraction - The distance to the optical horizon is slightly greater than the simple geometric calculation, because the atmosphere bends light around the earth (atmospheric refraction) allowing a viewer to see farther. The exact amount of bending depends on several variables including elevation and the composition of the atmosphere (which varies with location, weather, etc.). A commonly accepted rule of thumb is that the optical horizon is calculated by multiplying the radius of the earth by a factor of 1.088 in the above formula to adjust for this optical effect (BOEM, 2015).

All calculations used in this VIA include a coefficient of refraction of 1.088 to account for atmospheric refraction.

Table 1 below provides calculations how much of a WTG would fall below the visible horizon at different distances and viewer elevations.

At 23.7 km (14.7 mi) and farther from shore there is no land-based vantage point that will view the an entire WTG or ESP. Some portion of the structures will always fall below the visible horizon. Because atmospheric haze reduces visibility, sometimes significantly, and the presence of waves obscure objects very low on the horizon, maximum theoretical viewing distances typically exceed what is experienced in reality. Furthermore, limits to human visual acuity reduce the ability to discern objects at great distances, suggesting that a WTG or ESP may

not be discernible at the maximum distances, although they theoretically would be visible (BOEM, 2007).

Table 1 - Portion of Hypothetical 8MW WTG Visible Above Horizon (square meters ["m^2"])

Eye Level Elev. (m)	Distance (km)																																		
	20	**22**	**24**	**26**	**28**	**30**	**32**	**34**	**36**	**38**	**40**	**42**	**44**	**46**	**48**	**50**	**52**	**54**	**56**	**58**	**60**	**62**	**64**	**66**	**68**	**70**	**72**	**74**	**76**	**78**	**80**	**82**	**84**
2	181	176	172	167	161	155	148	141	133	125	116	106	96	86	75	63	51	39	26	12													
4	185	181	177	172	167	162	156	149	142	134	126	117	108	98	87	76	65	53	40	27	14												
6	187	184	181	177	172	167	161	155	148	141	133	125	116	106	96	86	75	63	51	39	26	12											
8	189	186	183	180	175	171	165	159	153	146	139	131	122	113	104	94	83	72	60	48	35	22	8										
10	191	188	185	182	178	174	169	163	157	151	144	136	128	119	110	100	90	79	68	56	44	31	17	3									
12	192	190	187	184	181	176	172	167	161	155	148	141	133	124	115	106	96	86	75	63	51	38	25	12									
14	193	191	189	186	183	179	174	169	164	158	152	145	137	129	120	111	102	91	81	69	58	45	32	19	5								
16	193	192	190	187	184	181	177	172	167	161	155	148	141	133	125	116	106	97	86	75	64	52	39	26	12								
18	194	192	191	189	186	182	179	174	169	164	158	151	144	137	129	120	111	101	91	80	69	57	45	32	19	5							
20	194	193	192	190	187	184	180	176	172	166	161	154	148	140	132	124	115	106	96	85	74	63	51	38	25	11							
22	194	194	192	190	188	185	182	178	174	169	163	157	151	143	136	128	119	110	100	90	79	68	56	43	30	17	3						
24	194	194	193	191	189	187	183	180	175	171	165	160	153	146	139	131	123	114	104	94	83	72	61	48	36	22	9						
26	194	194	193	192	190	188	185	181	177	173	168	162	156	149	142	134	126	117	108	98	88	77	65	53	41	28	14						
28	194	194	194	193	191	189	186	183	179	174	169	164	158	152	145	137	129	120	111	102	91	81	70	58	45	33	19	5					
30	194	194	194	193	192	189	187	184	180	176	171	166	160	154	147	140	132	124	115	105	95	85	74	62	50	37	24	10					
32	194	194	194	193	192	190	188	185	181	178	173	168	162	156	150	143	135	127	118	109	99	88	78	66	54	42	29	15	1				
34	194	194	194	194	193	191	189	186	183	179	175	170	164	158	152	145	137	129	121	112	102	92	81	70	58	46	33	20	6				
36	194	194	194	194	193	192	190	187	184	180	176	171	166	160	154	147	140	132	124	115	105	95	85	74	62	50	38	24	11				
38	193	194	194	194	193	192	190	188	185	181	177	173	168	162	156	150	142	135	126	118	108	99	88	77	66	54	42	29	15	1			
40	193	194	194	194	194	193	191	189	186	183	179	174	170	164	158	152	145	137	129	121	111	102	92	81	70	58	46	33	19	5			
42	193	194	194	194	194	193	191	189	187	184	180	176	171	166	160	154	147	140	132	123	114	105	95	84	73	61	49	37	23	10			
44	192	194	194	194	194	193	192	190	188	185	181	177	173	167	162	156	149	142	134	126	117	108	98	87	76	65	53	40	27	14			
46	192	193	194	194	194	194	192	191	188	186	182	178	174	169	163	157	151	144	136	128	120	110	101	90	80	68	57	44	31	18	4		
48	191	193	194	194	194	194	193	191	189	186	183	179	175	170	165	159	153	146	139	131	122	113	103	93	83	72	60	48	35	22	8		
50	191	193	194	194	194	194	193	192	190	187	184	181	176	172	167	161	155	148	141	133	124	116	106	96	86	75	63	51	39	25	12		
52	190	192	193	194	194	194	193	192	190	188	185	182	178	173	168	163	156	150	143	135	127	118	109	99	89	78	66	54	42	29	16	2	
54	190	192	193	194	194	194	194	193	191	189	186	183	179	174	169	164	158	152	145	137	129	120	111	102	91	81	70	58	45	33	19	5	
56	189	191	193	194	194	194	194	193	191	189	187	183	180	176	171	166	160	153	147	139	131	123	114	104	94	84	72	61	49	36	23	9	
58	188	191	192	194	194	194	194	193	192	190	187	184	181	177	172	167	161	155	148	141	133	125	116	107	97	86	75	64	52	39	26	13	
60	188	190	192	193	194	194	194	193	192	190	188	185	182	178	173	168	163	157	150	143	135	127	118	109	99	89	78	67	55	43	30	16	2

Nacelle visible above horizon

Nacelle falls below horizon

4.3 Meteorological Visibility

Visibility can be reduced by fog, snow, particulate matter, smog, or any combination of them as part of normal atmospheric phenomena. To evaluate the effect of atmospheric conditions on Project views from Martha's Vineyard and Nantucket, a meteorological study was conducted that identifies common weather conditions and assesses visibility within the proposed APE. This meteorological analysis is included as Appendix C.

Visibility measurements from meteorological stations are typically recorded in intervals ranging from ¼ to 10 miles. Visibility was measured and recorded on a one minute basis, averaged across hours, and then binned to the following categories: less than ¼ mile, ¼ mile, ½ mile, ¾ mile, 1 mile, 1¼ miles, 1½ miles, 1¾ miles, 2 miles, 2½ miles, 3 miles, 3½ miles, 4 miles, 5 miles, 7 miles, and 10 miles or greater for the hourly reports. As shown in Table 2, analysis of the hourly data indicates majority of the hours yielded a visibility of 10 miles or greater.

Table 2 - Frequency of Reported and Truncated Visibility Ranges

	Less than 10 miles (percent)				10 miles or greater (percent)			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Martha's Vineyard	21%	24%	30%	20%	79%	76%	70%	80%
Nantucket	30%	34%	39%	26%	70%	66%	61%	74%

The results of this analysis indicate that haze, fog and other atmospheric conditions limit visibility to less than 16.1 km (10 mi) approximately 30% of the time on an annual basis. In general, views greater than 16.1 km (10 mi) are obscured more frequently during the summer - 30% of the time on Martha's Vineyard and nearly 40% of the time on Nantucket- when oceanfront vacation areas are more heavily used.

A more detailed picture of the distribution of visibility can be achieved by looking at the percent of hours in which a given threshold visibility distance is exceeded. For Martha's Vineyard, the highest visibilities during the daytime occur mainly during the summer, and the lowest visibility occurs in the fall; for the nighttime, the highest visibilities occur in the fall and the lowest in the summer. For Nantucket, the highest visibility during the daytime occurs in the spring, with the lowest visibility occurring in the fall, summer, and winter. During nighttime, for Nantucket, the highest visibility occurs in the spring, and the lowest in the fall.

It is important to note that visibilities greater than 16.1 km (10mi) are still reported as 16.1 km (10 mi). Therefore, given the nearest shoreline vantage point just over 23 km (14 m) away, it is reasonable to conclude that the project will be obscured from coastal vantage points more frequently than identified in Table 2. This will become even more frequent for points farther than this minimum distance and for WTGs and ESP farther out to sea than the closest point of the WDA.

In addition, different factors affect visibility, including air quality, sea spray and salts over the ocean's surface, the angle of the sun, and relative humidity. The presence of sea spray and salts affects visibility but is not likely accounted for in Table 2. Therefore, calculated visibility may be considered conservative since they do not account for this light-reducing factor.

5.0VISUALLY SENSITIVE RESOURCES

The scenic and aesthetic values of coastal areas play an important role in attracting visitors. Martha's Vineyard and Nantucket are both well-known tourist locations. Recreation and tourism-related industries provide almost one quarter of the employment and wages in Nantucket and Dukes Counties, which include Nantucket and Martha's Vineyard, respectively.

A mix of public, private, and residential beaches are located on Martha's Vineyard and Nantucket. Martha's Vineyard has 19 beaches: 14 are public, four are for town residents only, and one is off limits. Seven of these beaches are on the south side of Martha's Vineyard looking towards the WDA. Nantucket has 10 public beaches, four of which are on the south side of the island looking towards the WDA. Both Martha's Vineyard and Nantucket have walking and biking paths accessible to the public along the southern coasts of the islands. There are five lighthouses on Martha's Vineyard, but only one is on the southern side of the island, the Gay Head Lighthouse, which is open to the public. Of the three lighthouses on Nantucket, none are on the south side of the island. Resorts, a golf course (near Miacomet on Nantucket), and natural areas on the southern coast have open views to the ocean (BOEM, 2014).

As a practical reality, the entire oceanfront within the area of study is highly scenic and of great aesthetic importance to the social, cultural, and economic well-being of every municipality located within the proposed APE. For the purpose of this visual resource assessment, all public places with ocean views are considered to be of significance.

An inventory of visually sensitive resources is found in "Vineyard Wind Project - Historic Properties Visual Impact Assessment" (COP Appendix III-H.a). Table 3 - Visual Resource Inventory identifies the visually sensitive resources identified and evaluated in that document.

Table 3 - Visual Resource Inventory

	Name	Municipality	Resource Type	Description
Martha's Vineyard				
1	Wasque Reservation	Chappaquiddick	Public Rec., Open Space Cons.	Located along Wasque Avenue, this area includes shoreline and open fields with low tree growth and a northern treeline with larger mature tree growth approximately 15-20 ft in height. A lagoon is located north of a sandbar with dunes approximately 8-10-ft in height. The topography slopes upward inland allowing for view to the WDA above the dunes. Existing vegetation eliminates the WDA view northward along Wasque Avenue toward Pocha Road, with views present along intersecting streets at their southern ends at Katama Bay.
2	Wasque Point	Chappaquiddick	Public Rec., Open Space Cons.	Located within the Wasque Reservation, Wasque Point has a cliffside view (approximately 20-ft high) over the beach below largely to the east with a southern view through existing tree growth approximately 15-20-ft in height. View from the beach below to the south along the shoreline is unobstructed.
3	Washqua Avenue	Chappaquiddick		Running from Wasque Avenue and terminating downhill at Katama Bay, this area contains a mix of one to two-story residential buildings dating from the 20th century as well as open lawns and mature tree growth with shrubbery at Katama Bay. At the high/inland end of the street, the elevation is roughly 40-ft above sea level. View to the WDA is possible at the end of the street looking over the dunes at Katama Bay. Existing tree height along Washqua Avenue is 20-25 ft.

Table 3 - Visual Resource Inventory

	Name	Municipality	Resource Type	Description
4	Jerimiah Way	Chappaquiddick		Running from Litchfield Road southward and terminating at Katama Bay, Jerimiah Way consists of a mix mid to late 20th century single-family residences set on large lots with mature tree growth 15-30 ft in height. Tree growth lowers in height toward Katama Bay. Views from the roadway toward the WDA were largely obscured by existing tree growth and buildings. The roadway also sits behind a small rise blocking view of the horizon line. Visibility from private property across Katama Bay toward the WDA is possible.
5	Chappy Point, Gardner Beach	Chappaquiddick	Near Ntl. Register Historic Dist	Located in the vicinity of the Edgartown Historic District on Chappaquiddick Road at the ferry landing, Chappy Ferry Beach has low sporadic vegetation 5-8-ft in height with a wide open view southward to Katama Bay. View toward the WDA is partially blocked by the shoreline in Edgartown in particular Katama Point.
6	Katama Point Public Launch	Edgartown		The public launch overlooks a section of Katama Bay toward the dunes to the south. From this location significant vegetation is not present and the dunes provide the only obstruction of the horizon line. Nearby residences dating from the mid to late 20th century may have views at the second stories over the dunes that could provide visibility of the WDA from this location. Access to private property was unavailable.
7	South Beach	Edgartown	Public Recreation	South Beach / Katama Beach has significant dunes in this location 6-10 ft in height. From an inland location behind the dunes, a view of the horizon line and WDA is only possible at gaps between dunes. Inland of this location is Katama Farm and Katama Airpark, both of which are devoid of significant vegetation allowing for potential visibility of the WDA farther inland until the treeline and nearby residences (dating from the mid-late 20th century) create an obstruction.
8	Wilson's Landing	Edgartown		Located on Edgartown Great Pond, Wilson's Landing is a public boat launch. Existing mature tree growth in the area is 25-35 ft in height. The landing has a southerly view across the pond toward the dunes and the inlet. View toward the WDA and horizon line is limited to the inlet at the shoreline. Once back from the shoreline existing vegetation quickly obstructs the viewshed to the south.
9	Long Point Beach	West Tisbury	Public Rec., Open Space Cons.	Located roughly midway along Martha's Vineyard's southern coast is the Long Point Wildlife Refuge. The Refuge has mature tree growth 30-40 ft in height that lowers in height from Scrubby Neck Farm Road at the north down to shrubbery and grassed areas and dunes at the shoreline. Dunes at this location are 6-8 ft in height. View of the WDA from inland areas is partially obstructed by the dunes, though gaps exist allowing for a view toward the WDA over the grasslands
10	Tississa Point	West Tisbury		Located within the Sepiessa Point Reservation, Tississa Point has a southerly view across Tisbury Great Pond through an inlet toward the WDA. The surrounding area consists of low vegetation near the shoreline with open fields and mature tree growth farther northward approximately 30 ft in height. Dune height on either side of the inlet varies in height providing areas of substantial obstruction of the WDA on either side of the inlet.
11	322 South Road	Chilmark		Throughout most of South Road in Chilmark view of the ocean was obstructed by tree growth. In the vicinity of Able Hill Cemetery (MHC# CHL.803) and specifically through the property at 322 South Road, a view of the horizon line and toward the WDA exists via a gap in existing tree growth. Elsewhere tree growth is 25-30-ft in height. Some of the private, residences (largely dating from the mid to late 20th century) on the southern side of South Road have a clear view toward the WDA, due to the steep slope down to the shoreline and a lack of vegetation. Access to private property was not available during the field survey.

Table 3 - Visual Resource Inventory

	Name	Municipality	Resource Type	Description
12	Allen Farm, 421 South Road	Chilmark		The Allen Farm (MHC# CHL.E) consists of an 18th century house and associated farm buildings. This area along South Road has large open fields and some historic farm complexes. Via the open fields to the south, view to the WDA and horizon line is possible through openings in the vegetation and over the cliffs at Lucy Vincent Beach (#13) below.
13	Lucy Vincent Beach	Chilmark	Public Recreation	Lucy Vincent Beach has a combination of beach shoreline and cliffs roughly 35-ft in height. At the shoreline southerly views toward the WDA are unobstructed. Inland of the beach the topography rises quickly and in the immediate area has some open fields allowing for overlooking views to the WDA. Where present, such as the road to the parking lot, existing tree growth is 25-35 ft in height and, with the exception of the path to the beach, obstructs view of the horizon.
14	Chilmark General Store, 7 State Road	Chilmark		Located in the town center of Chimark the area around the Chilmark General Store (MHC# CHL.E) is obstructed from viewing the WDA and ocean generally by dense vegetation. Mature tree growth in this area is 30-40 ft in height.
15	Squibnocket Beach	Aquinnah	Public Recreation	Squibnocket Beach has unobstructed views toward the WDA. The area around the beach has varying topography including rolling hills and a high point of Squibnocket Ridge. The area surrounding the beach also has predominantly low vegetation and sporadic mature tree growth allowing for views from surrounding properties as well.
16	Zach's Cliffs / Moshup Trail	Aquinnah		This section of Moshup Trail has dense vegetation, but at the road has a partially obstructed oblique view to the southeast toward the WDA. Most of the surrounding vegetation is 6-10-ft in height. From the road Zack's Bluffs largely obstruct the view toward the WDA, but from the bluffs themselves toward the WDA can be achieved.
17	Gay Head Lighthouse	Aquinnah	Ntl. Register of Historic Places	Located on a prominent rise the State and National Register listed Gay Head Lighthouse's (MHC# GAY.900) southerly view is too far east to view the WDA due to its location at the western end of Martha's Vineyard. A southeast view is required to look toward the WDA and this view is partially obstructed by existing topography and vegetation. Only the southwestern portion of the WDA would potentially be viewable, which is at the furthest distance from the lighthouse. The area surrounding the lighthouse is a mixture of open fields and low vegetation (shrubbery) with sporadic tree growth 6-10 ft in height. Please note that a view from within or atop the lighthouse was not obtainable.
18	Gay Head Cliffs Overlook	Aquinnah	National Natural Landmark	The Gay Head Cliffs Overlook is located just north of the Aquinnah Shops. From this vantage point, a better view toward the Project area can be achieved than from the Gay Head Lighthouse, due to the increased elevation and ability to see across Aquinnah to the WDA at the southeast; however, the landmass of Aquinnah creates an obstruction. Only a partial view toward the WDA is possible and as with the lighthouse, only the southwestern portion of the WDA would the viewable, which is at the furthest distance from the overlook.
19	Aquinnah Town Hall, 65 State Road	Aquinnah		Located in an area of dense tree growth ranging from 15-40-ft in height, the area in and around State and National Register listed Aquinnah Town Hall has no view toward the ocean or WDA due to obstructing dense vegetation and topography.
20	Aquinnah Cultural Center	Aquinnah	Ntl. Register of Historic Places	The Aquinnah Cultural Center is located at the top of the Gay Head Cliffs and provides a place for the Aquinnah Wampanoag Tribe of Gay Head to preserve, interpret, and document the Aquinnah Wampanoag self-defined history, culture, and contributions.
21	Philbin Beach	Aquinnah	Public Recreation	Philbin Beach is located off Moshup Trail near the clay cliffs on the western portion of Martha's Vineyard. It is open to Aquinnah residents only.

Table 3 - Visual Resource Inventory

	Name	Municipality	Resource Type	Description
22	BarnHouse/Skiff-Mayhew-Vincent House	Chilmark	Ntl. Register of Historic Places	This historic barn complex dates to 1690 and is listed in the National Register with a view to the WDA via the open fields on the southern side of South Road from the property.
23	Captain Samuel Hancock House	Chilmark	Ntl. Register of Historic Places	This home was constructed circa 1700 and has been determined eligible for listing in the National Register by MHC.
Nantucket				
24	Great Point Lighthouse	Nantucket	Public Rec, Ntl. Register	Located at the northern end of the island is the Great Point Lighthouse constructed in 1985 as a replacement for the original 19th-century lighthouse lost during a storm. Stones from the original lighthouse were salvaged and reused in the replacement built farther inland. View toward the WDA is possible between Smith Point and Esther Island to the east and Tuckernuck Island to the west.
25	Siasconset Golf Club	Nantucket		Located at 260 Milestone Road (a main thoroughfare on the island) the Siasconset Golf Club is located on a small rise and occupies an area largely devoid of significant tree growth. The golf course can be observed as far away as the Sankaty Head Lighthouse to the northeast on Baxter Road as much of the area in between has been cleared. No view toward the WDA can be obtained from this location due to vegetation and topography.
26	Low Beach Road	Nantucket		Low Beach Road is located at the southeastern corner of the island. The road starts at the intersection of Morey Lane and Ocean Avenue and terminates at Tom Nevers Pond. Few houses are on the ocean side of the road and the road looks down to the ocean past low scrub brush, dunes and grassed areas. Buildings in the area largely consist of mid to late 20th century single-family residences one to two and half stories in height. Due to the location only an oblique view toward the WDA at the southwest is possible; however, most buildings are oriented south to southeast, to take in the full view of the water (if present). Low Beach Road is located at the southeastern corner of the island. The road starts at the intersection of Morey Lane and Ocean Avenue and terminates at Tom Nevers Pond. Few houses are on the ocean side of the road and the road looks down to the ocean past low scrub brush, dunes and grassed areas. Buildings in the area largely consist of mid to late 20th century single-family residences one to two and half stories in height. Due to the location only an oblique view toward the WDA at the southwest is possible; however, most buildings are oriented south to southeast, to take in the full view of the water (if present).
27	Low Beach	Nantucket		Low Beach located at the southeastern corner of the island. Only an oblique view toward the WDA at the southwest is possible. The beach has low dunes 4-6 ft in height and a mild grade down to the water
28	Tom Nevers Road	Nantucket		Tom Nevers Road is bordered by mid to late 20th century two and a half story homes set on large lots. The road is also bordered by large hedges and trees planted to ensure privacy among the residences. Only an oblique view toward the WDA at the southwest is possible from this location.
29	Tom Nevers Field	Nantucket	Public Recreation	Tom Nevers Field is located at the end of Tom Nevers Road. The field is set back from the shoreline by dunes and a small bluff roughly 10-12-ft in height. The immediate area is largely devoid of trees and has low scrub brush and grassed areas. View southwest toward the WDA is possible from this location.

Table 3 - Visual Resource Inventory

	Name	Municipality	Resource Type	Description
30	Surfside Road	Nantucket		Surfside Road runs north to south at the southern end of the island in the village of Surfside. At its southern end, Surfside Road intersects with Western Avenue running east to west, which has early to mid-20th century residences along its south side with a clear view of the ocean toward the WDA. Approximately 500-ft of dunes, grassed areas and scrub brush are between the residences and the beach. Residences on the northern side of Western Avenue have their water views partially obstructed by neighboring properties and their vegetation, but views toward the WDA are possible.
31	Miacomet Golf Club	Nantucket		Located at 12 West Miacomet Road, the Miacomet Golf Club has an open course with small knolls and sporadic mature tree growth approximately 25-30 ft in height. Despite the lack of significant vegetation, a view of the ocean and WDA is obstructed due to the rolling topography.
32	Barrett's Farm	Nantucket	Historic Resource	Located at 30 Bartlett Farm Road is Bartlett's Farm, a 19th century farm complex. As a farm the fields provide a wide open view of the surrounding area. View toward the WDA and WDA is possible through the fields. On nearby properties, existing treelines and residential development obstruct the view of the WDA creating a narrow inland view corridor at this location.
33	Heller's Way and Hummock Pond Road	Nantucket		Hellers Way runs roughly east to west between Hummock Pond Road and Walbang Avenue. At its southern end Hummock Pond Road terminates at Cisco Beach with views toward the WDA. Cisco beach has a small bluff approximately 10-ft in height. Vegetation in the area consists of sporadic tree growth approximately 25-ft in height along with shrubbery and grassed areas. Development in this area consists of two and half story 20th century single-family residences. The WDA view along the southern end of Hummock Pond Road diminishes quickly, with a narrow view corridor along Hummock Pond Road terminating after 243 Hummock Pond Road. At the intersection of Hummock Pond Road and Hellers Way no ocean view is possible
34	Bartlet Farm Road	Nantucket		Barrett Farm Road originates at its northern end at Madaket Road. The road is elevated originating just south of Trots Hills and has a view overlooking Trots Swamp. There are few buildings along the road and the area has dense vegetation with mature trees approximately 25-35-ft in height. Due to the elevation and a gap in vegetation, view to the WDA is possible at the northern end of the road and again at the southern end of the road where a small rise permits view over the dunes at the shoreline.
35	Washington Street and Madaket Road	Nantucket		The village of Madaket largely consists of early to mid-20th century residences one to two and a half stories in height. The village is centered along Madaket Road with short intersecting streets off of it. The area has sporadic mature tree growth 25-35 ft in height along with shrubbery and grassed areas. From H Street northward a view toward the WDA along Madaket Road is obstructed. Madaket Beach at the terminus of Madaket Road has a clear view toward the WDA.
36	Massachusetts Avenue Boat Launch	Nantucket	Public Recreation	Adjacent to Madaket is Smith Point with a dense cluster of early to mid-20th century single family residences, one to two and a half stories in height. This area also has a section of dense tree growth 35-40 ft in height. The boat launch is located on Madaket Harbor and the view toward the WDA is obstructed by buildings, topography, and vegetation.
37	Eel Point	Nantucket		At the north end of Madaket Harbor is Eel Point and the Eel Point Marsh. Eel Point has large dunes 12-15 ft in height along with grassed areas and scrub brush. From an elevated vantage point atop a dune, view toward the WDA is obstructed as Smith Point and Esther Island obstruct the view in the direction of the WDA.

Table 3 - Visual Resource Inventory

	Name	Municipality	Resource Type	Description
38	Madaket Beach	Nantucket	Public Recreation, Ntl. Register Properties Places	Madaket Beach is a natural and recreational resource. Additionally the beach is located in the historic village of Madaket and a simulation from this viewpoint will also serve to assess effects on nearby historic properties.
39	Cisco Beach	Nantucket	Public Recreation	Cisco Beach is an important natural and recreational resource. Additionally, the beach is located in the village of Cisco and a simulation from this viewpoint will also serve to assess effects on nearby properties.
40	Miacomet Beach and Pond/Surfside Beach/Nobadeer	Nantucket	Public Recreation, Historic Resources	These locations are important natural and recreational resource. Additionally, the beach is located in the historic village of Surfside and a simulation from this viewpoint will also serve to assess effects on nearby historic properties. Each of the three beaches in Surfside: Miacomet, Surfside and Nobdeer have different orientations due to the coastline and simulations will vary from each
41	Nantucket Conservation Foundation; Maequcham	Nantucket	Open Space Conservation, Public Recreation	The Nantucket Conservation Foundation is a nonprofit conservation organization that protects land on Nantucket. The area is divided into 210 property parcels dispersed over the island. A few of the areas (Sanford Farm/Ram Pasture/The Woods, Head of the Plains, Cisco, and Madequecham) are on the south side of Nantucket and include views of the ocean.
Cape Cod				
42	Popponesset Beach	Mashpee	Public Recreation	This location on Nantucket Sound is near the Popponesset Inn Beach Area (MHC# MAS.F) and represents the southernmost historic resource (closest to WDA) on Cape Cod.
43	Dowses Beach	Barnstable	Public Recreation	This location at the confluence of East Bay and Centerville Harbor is adjacent the Wianno National Register Historic District (MHC# BRN.J). Additionally, it is at a similar latitude / distance to WDA as the majority of the historic resources on Cape Cod within the proposed APE.
44	Kalmus Beach	Barnstable	Public Recreation	This location at the confluence of Lewis Bay and Nantucket Sound is adjacent the Wianno National Register Historic District (MHC# BRN.J). Additionally, it is at similar latitude / distance to WDA as BRN.E the Hyannis Port Historic District.
45	Hyannis/Nantucket Ferry	Nantucket Sound	NA	The Nantucket Ferry route is highly used as the main transportation link to the mainland.

5.1 Selection of Key Observation Points

Although the possibility of Project views exists throughout the oceanfront area, key observation points ("KOPs") were selected from which a more detailed analysis was conducted. Selection criteria included:

- Geographic distribution, including landside receptors along both the Martha's Vineyard and Nantucket coastlines, As well as representative locations on Cape Cod. On Martha's Vineyard and Nantucket, KOPs were selected at the nearest vantage point to the WDA, as well multiple locations mid-coast and near the farthest extent of each island where visibility the proposed APE is possible.
- Relative importance of public vantage points, such as recreational, cultural. and aesthetic resources designated or protected as a matter of public policy;
- Views from higher elevations along shoreline bluffs; and
- Level of viewer exposure, based on the relative number or frequency of viewers.

Selected KOPs are listed in Table 4 - Summary of Key Observation Points .

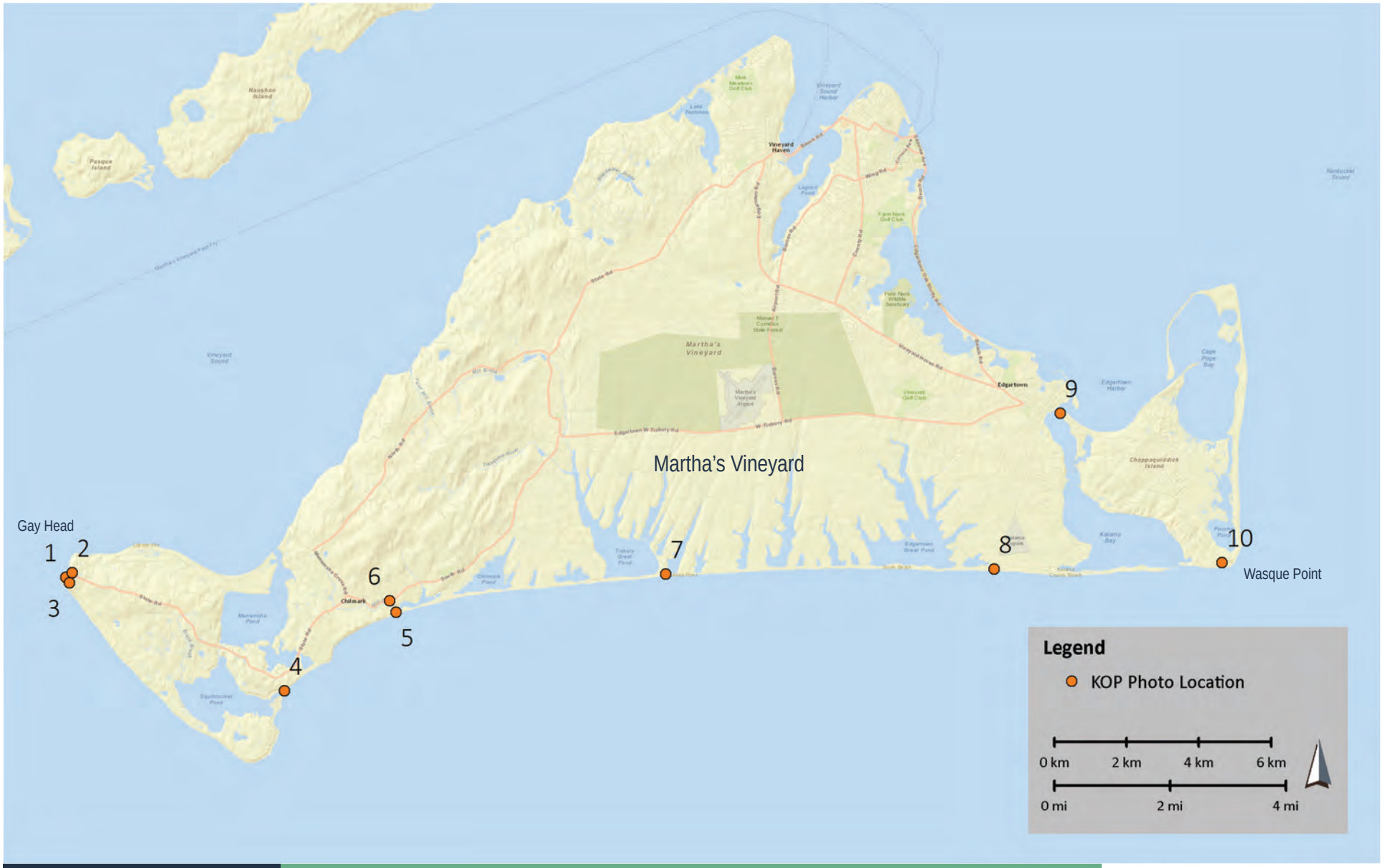
To show anticipated visual changes associated with the Project, high resolution computer enhanced image processing was used to create realistic photographic simulations of the completed Project from 20 KOPs on Martha's Vineyard, Nantucket, and Cape Cod.

Table 4 - Summary of Key Observation Points

Map ID	Name	Municipality	Resource Type	Landscape Unit	Viewer Groups	Distance Zone	Distance to nearest WTG	View Orientation
1	Gay Head Cliffs Overlook	Aquinnah	NNL NRHP	Coastal Bluffs	Tourists, Vacationers	Background	38.7km (24.0mi)	Southeast
2	Gay Head Lighthouse	Aquinnah	NNL NRHP	Coastal Bluffs	Tourists, Vacationers,	Background	38.6km (23.9mi)	Southeast
3	Aquinnah Cultural Center	Aquinnah	NNL NRHP	Coastal Bluffs	Tourists, Vacationers,	Background	38.5km (23.9mi)	Southeast
4	Squibnocket Beach	Aquinnah	Recreation, Historic Resources	Ocean Beach	Residents, Vacationers, Recreational	Background	32.2km (20.0mi)	Southeast
5	Lucy Vincent Beach	Chilmark	Recreation, Historic Resources	Ocean Beach, Coastal Dunes	Residents, Vacationers, Recreational	Background	31.5km (19.5mi)	Southeast
6	BarnHouse/Skiff-Mayhew-Vincent House	Chilmark	NRHP	Agricultural/Open Field	Residents Tourists	Background	31.8km (19.7mi)	Southeast
7	Long Point Beach	West Tisbury	Wildlife Refuge, Recreation, Historic Resources	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh	Residents, Vacationers, Recreational	Background	27.7km (17.2mi)	Southeast
8	South Beach	Edgartown	Recreation	Ocean Beach Coastal Dunes	Residents, Vacationers, Tourists, Recreational	Background	24.3km (15.1mi)	South
9	Chappy Point, Gardner Beach	Chappaquiddick	Recreation, Near NRHP District	Village/Town Center	Residents, Tourists, Vacationers, Recreational	Background	28.2km (17.5mi)	South
10	Wasque Reservation	Chappaquiddick	Recreation Open Space Conservation	Ocean Beach, Coastal Bluffs, Forest	Vacationers, Recreational	Background	23.7km (14.7mi)	South
11	Madaket Beach	Nantucket	Recreation, Historic Resources	Ocean Beach, Coastal Dunes Shoreline Residential	Residents Vacationers, Recreational	Background	24.0km (14.9mi)	Southwest
12	Cisco Beach	Nantucket	Recreation	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh	Residents, Vacationers, Recreational	Background	25.3km (15.7mi)	Southwest
13	Barrett's Farm	Nantucket	Historic Resources	Agricultural/Open Field	Residents, Tourists Vacationers	Background	26.9km (16.7mi)	West Southwest

Table 4 - Summary of Key Observation Points

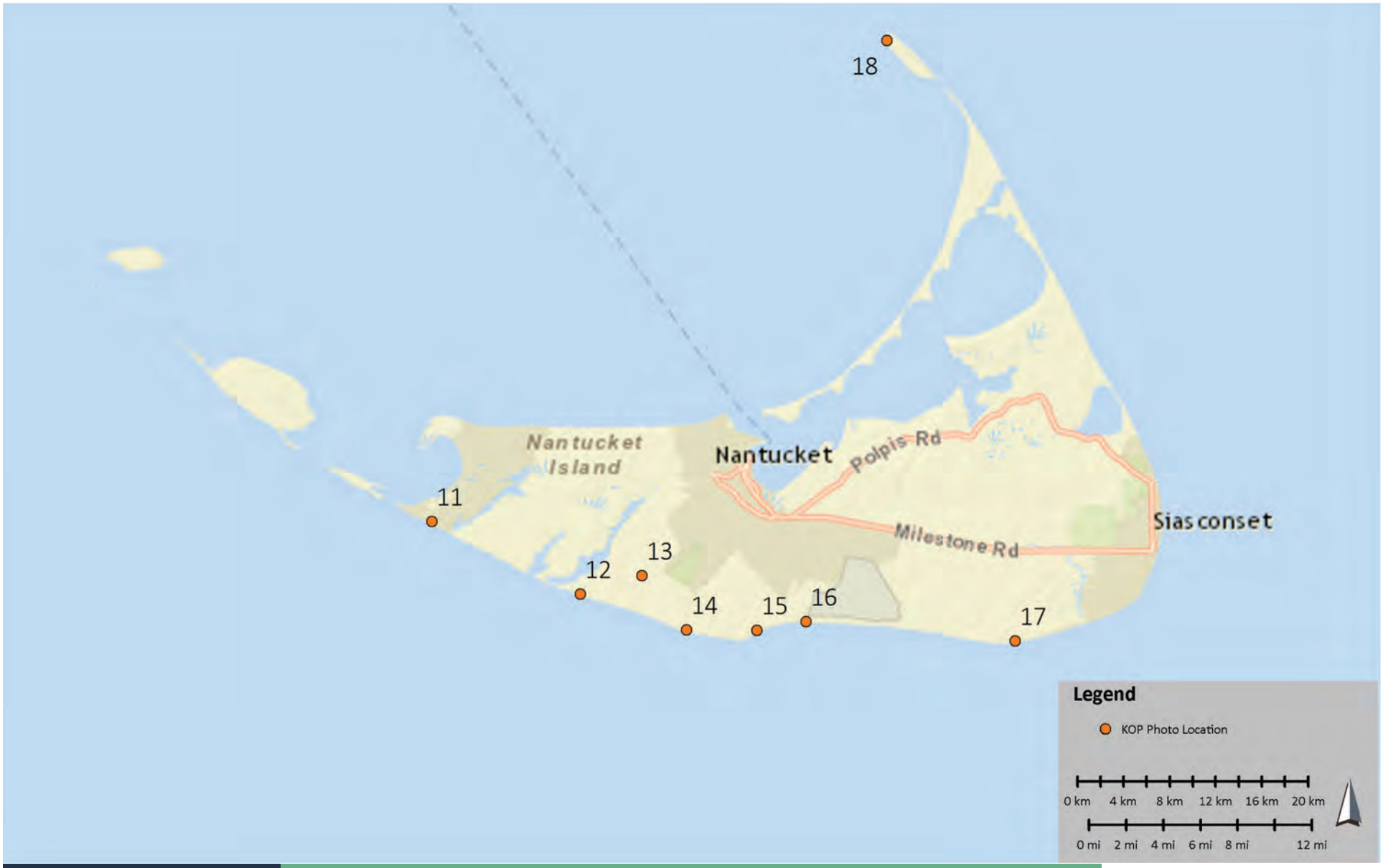
Map ID	Name	Municipality	Resource Type	Landscape Unit	Viewer Groups	Distance Zone	Distance to nearest WTG	View Orientation
14	Miacomet Beach and Pond	Nantucket	Recreation, Historic Resources	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh	Residents, Vacationers, Recreational	Background	27.0km (16.7mi)	West Southwest
15	Surfside Beach	Nantucket	Recreation, Historic Resources	Ocean Beach, Coastal Dunes	Residents, Vacationers, Recreational	Background	28.5km (17.7mi)	West Southwest
16	Nobadeer Beach Pond Road	Nantucket	Recreation, Historic Resources	Ocean Beach, Coastal Dunes	Residents, Vacationers, Recreational	Background	29.8km (18.5mi)	West Southwest
17	Tom Nevers Field	Nantucket	Recreation	Coastal Bluffs, Coastal Scrub Maintained Recreation	Residents, Vacationers, Recreational	Background	34.5km (21.4mi)	West Southwest
18	Great Point Lighthouse	Nantucket	NRHP, Recreation	Ocean Beach, Coastal Dunes	Tourists, Vacationers, Recreational	Background	42.4km (26.3mi)	Southwest
19	Rock Landing	Mashpee	Recreation, NRHP	Ocean Beach, Coastal Bluffs	Residents, Vacationers, Recreational	Background	47.3km (29.4mi)	South
20	Dowses Beach	Barnstable	Recreation, NRHP	Ocean Beach, Coastal Dunes	Residents, Vacationers, Recreational	Background	54.1km (33.6mi)	South



VINEYARD WIND PROJECT

FIGURE 9
VISUAL SIMULATION LOCATIONS
MARTHA'S VINEYARD

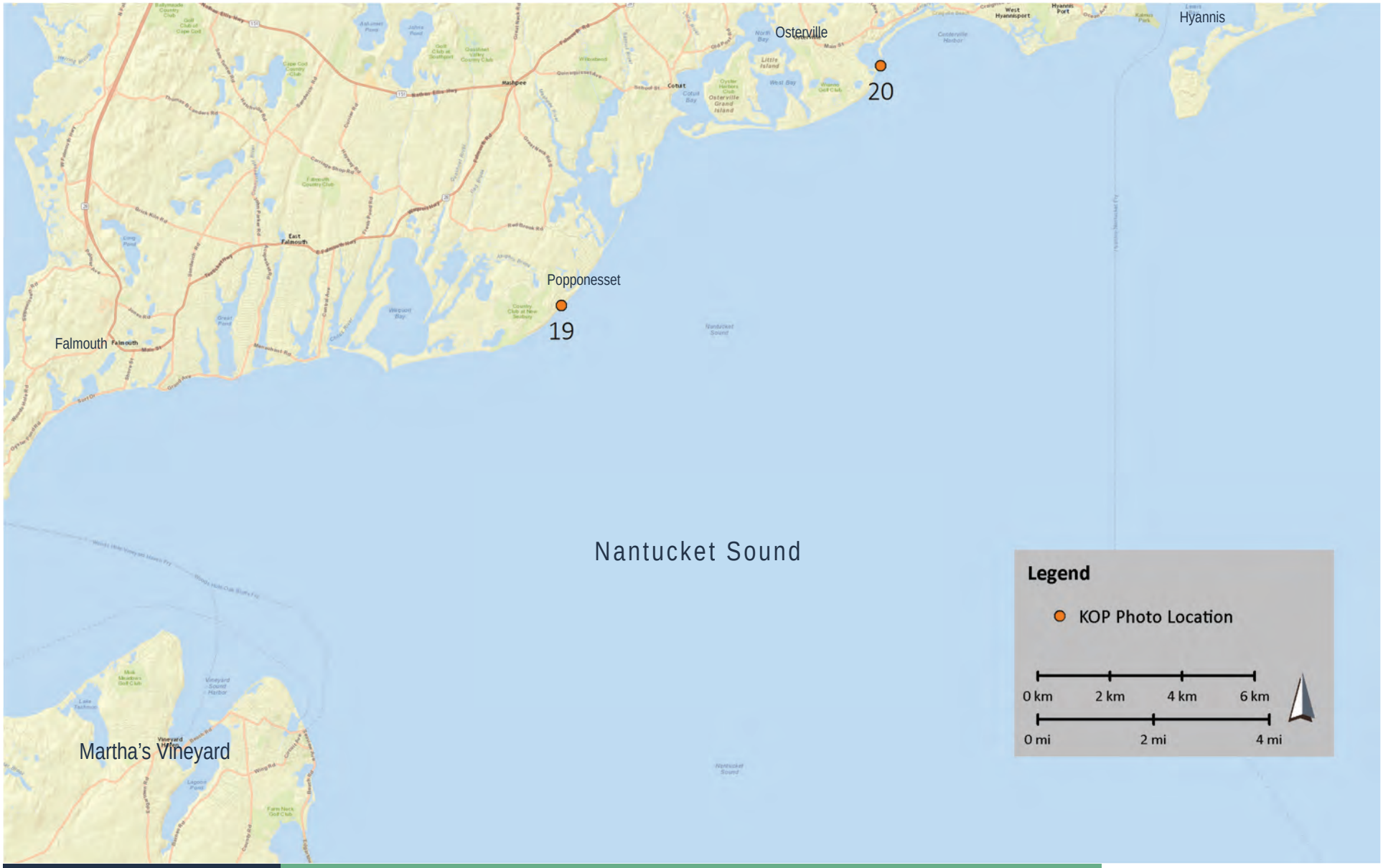
OCS-A 0501 MASS USA
VINEYARD WIND
SARATOGA ASSOCIATES



VINEYARD WIND PROJECT

FIGURE 10
VISUAL SIMULATION LOCATIONS
NANTUCKET

OCS-A 0501 MASS USA
VINEYARD WIND
SARATOGA ASSOCIATES



VINEYARD WIND PROJECT

FIGURE 11
VISUAL SIMULATION LOCATIONS
CAPE COD

OCS-A 0501 MASS USA
VINEYARD WIND

SARATOGA ASSOCIATES

5.2 Baseline Photography

Between October 17 and October 21, 2017 a visual analyst visited all of the potentially affected visual resources identified for photo simulation in the report titled "Historic Properties Visual Impact Assessment" (COP Appendix III-H.a) to document existing visibility in the direction of the proposed WDA. All photographs were taken at 30 mega pixel ("MP") resolution in uncompressed "RAW" format using a tripod mounted Canon 5d Mark IV digital SLR camera (a 35mm sensor [full frame]). A 50mm (full frame) "normal" lens was used to most closely approximate human perception of spatial relationships and scale in the landscape.

At each location, single frame photographs were taken in the direction of the Project with careful attention to capture the left and right margin of the WDA within the photo frame. A series of overlapping photographs were also taken for development of panoramic scenes Panoramic photos were taken using a robotic tripod head and capture a scene measuring a minimum of 124 degrees horizontally x 55 degrees vertically.

The location selected for each photograph is judged by the visual analyst to be the most unobstructed and representative line-of-sight to the WDA from the subject resource. Effort was made to take photographs in a front- or side-lit condition to maximize visual contrast while also capturing a variety of lighting conditions. Due to the prevailing southerly exposure some photographs were taken under front-lit conditions. These conditions accurately represent variations in lighting conditions that will be commonly experienced at coastal locations at different times of day.

The precise coordinates of each photo location was recorded in the field using a handheld Global Positioning System ("GPS") unit with sub-meter accuracy. The direction to the center of the WDA was determined using the hand held GPS. Survey flags were placed along the identified bearing marking WDA field so that the camera could be accurately aimed to capture the full spread of the WDA photo field-of-view.

5.3 Photographic Simulations

A photo simulation of the Project was prepared from each location identified in Table 4 - Summary of Key Observation Points Photo simulations were developed by superimposing a rendering of a three-dimensional computer model of the proposed Project into a base photograph taken from each corresponding location. The three-dimensional computer model for the simulations is based on the 106 turbine layout and was developed using *Autodesk Civil 3D®* and *3D Studio Max Design® software (3D Studio Max*).

Simulated perspectives (camera views) were then matched to the corresponding base photograph for each simulated view by replicating the precise coordinates of the field camera position (as recorded by GPS) and the focal length of the camera lens used (e.g., 50mm). Precisely matching these parameters assures scale accuracy between the base photograph and the subsequent simulated view. The camera's target position is set to match the bearing of the

corresponding existing condition photograph. With the existing conditions photograph displayed as a "viewport background," and the viewport properties set to match the photograph pixel dimensions, minor camera adjustments were made (horizontal and vertical positioning, and camera roll) to align the horizon in the background photograph with the corresponding features of the 3D model.

To verify the camera alignment, the GPS coordinates of the survey flags placed in the field to identify the bearing to the center and left/right margins of the WDA were imported into the 3D model. A 3D terrain model was also created (using DEM data) to replicate the existing site topography. The bearing of the 3D model camera target was then rotated so that the survey flags visible in the baseline photo aligned GPS points visible in the 3D model.

Once the camera alignment was verified, a to-scale 3D model of the proposed Project was merged into the model space. Because the exact turbine model was not yet determined at the time of this VIA, a hypothetical model was prepared (see Section 2.1.1). The 3D model of the WTG and ESP is intended to accurately convey the current design intent. To the extent practicable, and to the extent necessary, to reveal impacts, design details of the proposed turbines were built into the 3D model and incorporated into the photo simulation. Consequently, the scale, alignment, elevations and location of the visible elements of the proposed facilities are true to the conceptual design.

Because of the extreme distance at which Project WTGs will be viewed development of photo simulations must account for earth curvature and atmospheric refraction. To address this issue, a spherical surface equal to 1.088 times the radius of the earth was created in 3D Studio Max. All WTG model units were snapped to this surface for each specifically camera view.

5.3.1 Daytime Simulations

With the model in place, a daylight system is created based on the date and time of the photograph; inputs such as time zone and location are also applied to the daylight system. To accurately depict "reflected light" the spherical earth surface model element was assigned a gray-blue color and turned on allowing upward light refraction to affect the rendering model elements.

The rendered view was then imported into the baseline photo in Adobe Photoshop software for overlay. In addition, minor adjustments to the WTG color and contrast to match the lighting conditions of the baseline so that the final rendering appears as realistic as possible.

5.3.2 Panoramic Simulations

Panorama views from four KOPs were created by stitching overlapping photographs together using PTGui® photo stitch software. Project renderings prepared for corresponding single-frame photo simulations were copied into the panorama image and aligned to match visible elements in the base line photo. Panorama images create a visible frame measuring 124 degrees by 55 degrees vertically to approximate the primary human field-of-view (BOEM, 2015).

5.3.3 Nighttime Simulations

A supplemental animated video simulation will be provided to illustrate the frequency, approximate intensity and visual character of FAA aviation obstruction lighting.

5.3.4 Viewing Photo Simulations

Arms Length Rule – The single frame photo simulations included in Appendix A have been formatted to be printed on an 11"x17" page format. At this image size, the page should be held at approximately arms length[2] so that the scene appears at the correct scale. Viewing the image closer would make the scene appear too large, and viewing the image from a greater distance would make the scene appear too small compared to what an observer would actually see in the field.

For viewing photo simulations at other page sizes (i.e., computer monitor, projected image or other hard copy output) the viewing distance/page width ratio is approximately 1.5/1. For example, if the simulation were viewed on a 42 inch wide poster size enlargement, the correct viewing distance would be approximately 63 inches (5.25 ft).

Panoramic simulations included in Appendix B are provided as reference to illustrate the complete visual context of the viewpoint. At 11x 17 inch page format the images cannot be viewed at a scale that represents a correct scale relative to normal human eyesight. These images should be printed at 73 x 38 inches and viewed at a distance of 20 inches for the scene to appear at the correct scale.

Monitor Calibration – Uncalibrated computer monitors vary brightness and color clarity. Photo simulations were finalized using a color calibrated monitor. When viewing these simulations digitally monitor calibration is recommended to assure images appear with the intended brightness, contrast and color clarity.

Field Viewing – The photo simulations present an accurate depiction of the appearance of proposed WTGs suitable for a general understanding of how much of the Project is visible, as well as the character of Project visibility. However, these images are a two-dimensional representation of a three-dimensional landscape. The human eye is capable of recognizing a greater level of detail than can be illustrated in a two-dimensional image. Decision makers and interested parties may benefit from viewing the photo simulations in the field from any or all of the simulated resources. In this manner, observers can directly compare the level of detail visible in the base photograph with actual field observed conditions.

[2] Viewing distance is calculated based a 39.6-degree field-of-view for the 50mm camera lens used, and the 15.5 inch wide image presented in Appendix A. "Arm's length" is assumed to be approximately 22.5 inches from the eye. Arm lengths vary for individual viewers.

6.0POTENTIAL VISUAL IMPACTS OF THE PROJECT

6.1 Construction and Installation [3]

Visual impact during construction would be limited to vessels working out in the Atlantic Ocean and travelling back and forth between mainland ports. Construction of the proposed WTGs and ESPs will require use of jack-up barges with mobile cranes and other large construction vessels. Project components will be delivered in sections via large watercraft. Construction-related visual impacts will be relatively brief and are not expected to result in adverse prolonged visual impact.

The larger construction vessels would be a visible feature within the proposed APE. Most construction is expected to occur during daylight hours. However, construction vessels would have nighttime lights in accordance with USGC regulations. During dawn and dusk periods, particularly on cloudy days, work lights may be required for worker safety as well as to improve visibility on construction vessels. Work lights are generally downward directed and would not typically be oriented horizontally where visibility on shore would be increased.

Visual impacts associated with construction and installation would be limited to construction equipment and partially built structures depending on phase of construction. Such impacts in general would be minor as construction equipment would only be in use temporarily during the construction and decommissioning periods.

6.2 Operation and Maintenance

The Project is located more than 23.7 km (14.7 mi) from the nearest vantage point on land and thus would appear in the far background distance zone. In this area, objects appear smaller than in the foreground or mid-ground distance zone. In the background distance zone landscape elements lose detail and become less distinct. Atmospheric perspective changes colors to blue-grays, while surface texture characteristics are lost. As an observer moves farther and farther from an object, the smaller the object appears. Beyond a certain distance, depending upon the size and degree of contrast between the object and its surroundings, the object may not be a point of interest for most people. At distances beyond 15 miles, movement is not readily discernible, curvature of the earth becomes a factor in visibility, and objects become less prominent in the overall landscape due to their relative size, occupation of the horizon and deterioration of visibility due to atmospheric conditions.

Visual impacts would result from the introduction of the numerous vertical lines of the WTGs into a strongly horizontal landscape defined by the horizon line at sea. The visible structures would potentially produce visual contrasts by virtue of their design attributes (form, color, and line) and by virtue of the reflectivity of their surfaces and resulting glare. Objects on or near the horizon tend to draw visual focus, particularly if they break the horizon line. Frontlighting of the turbines would generally increase perceived impact by heightening contrast between the WTG and the background, while backlighting would increase contrast at sunrise and sunset by

[3] Refer to COP Volume I, Section 4.2 for further information concerning construction and installation.

silhouetting the WTGs against the bright sky. Visible rotor movement could attract visual attention as well. This effect could be noticeable at distances of about 10 to 15 km (6.2 to 9.3 mi). Despite their relatively low profile, ESPs will be visible from shore. Their form and geometry will contrast with the WTGs (BOEM, 2007).

For offshore viewers, potential visual impacts could be much greater than for onshore viewers, because boats could closely approach or potentially move through an offshore wind facility. In a close approach, the very large form and strong geometric lines of both the individual WTGs and the array of WTGs could dominate views, and the large sweep of the moving rotors would command visual attention. Structural details, such as surface textures, could become apparent, and the ESPs could be visible as well, as could strong specular reflections from the towers and moving rotor blades (BOEM, 2007).

The following describes the compatibility of the proposed Project with regional landscape patterns within which it is contained and viewed. This evaluation is based on views depicted in the visual simulations provided in Appendix A and B.

Form – The form of the regional landscape within the proposed APE is comprised of the Atlantic Ocean, the coastline, and upland portions of Martha's Vineyard and Nantucket. The patterns of the open water are temporal, changing with wind, sun angle, cloud cover, and other factors that affect the texture and colors of the surface. Visible shorelines (mainland and islands) may vary from a subtle linear form low on the horizon to a low undulating landform where the coastline recedes into the distance. The horizontal layering of the water and sky is visually appealing and draws viewer's attention.

The Project will be comprised of up to 106[4] thin tapered vertical structures topped with rotating blades viewed at great distance over the expanse of ocean. Although the Project is relatively small within this context, the introduction of man-made and kinetic structures can, depending on distance and meteorological conditions, create a minor visual contrast in the horizontal form of planar expanse of the ocean and sky.

Line – A WTG in a typical seascape could introduce a vertical line that would contrast with the horizon line of the horizon and would introduce a geometrical manmade element into a natural landscape. However, the main concerns related to visual impacts of WTGs would be those presented by the foundation and nacelle (the widest and most substantial portions of the WTG rather than the relatively slender tower and rotor.

From all coastal vantage points WTGs appear low on the distant horizon and are difficult to perceive. At distances greater 23 km (14 mi) WTGs appear as a distant field of fine vertical lines. When detectable, the somewhat regular vertical form of up to 106[4] tubular style monopole towers will contrast with the horizontal form of the water/sky horizon.

[4] Several refinements to the Project Envelope have been made since conducting this visual impact assessment. For example, the Project will only construct up 100 WTGs and has eliminated the option to install light-weight ESPs. As a result, this visual impact assessment, which assumes that all 106 WTG positions will be occupied, is conservative.

Color – The neutral off-white color of the turbine tower, nacelle and blades will always be viewed against the background sky. Under these conditions the WTGs will be highly compatible with the hue, saturation and brightness of the landscape. When the WTGs are backlit (side facing viewer is in shade) the degree of visual contrast is heightened and thus somewhat less compatible with the background sky than if viewed in a more illuminated front- or side-lit condition. Color contrast decreases as distance increases. Color contrast will diminish or disappear completely during periods of haze, fog or precipitation.

Texture – The ocean is generally perceived as a broad expanse of dark open water that spans the view, and a sky that features a dynamic mix of partially illuminated cloud formations. The texture of the open water viewed out to the horizon is smooth.

Tubular style monopole towers have been specifically selected, instead of skeletal (or lattice) frame towers, to minimize textural contrast and provide a more simple, visually appealing form.

Scale/Spatial Dominance – The proposed wind turbines will be the tallest visible elements on the horizon, albeit at great distance. From most foreground and mid-ground vantage points (from vessels on the ocean), the proposed turbines will be perceived as a highly dominant visual element. When viewed from far background vantage points, the turbines perceived scale and spatial dominance are considerably reduced. Even when visible under clear atmospheric conditions, the Project will be visually subordinate to the expansive Atlantic Ocean.

With regard to scale, exclusive of the effect of earth curvature and meteorological visibility, a broadside view of a WTG at a distance of 23.7 km (14.7 mi) would measure only 0.021 degrees horizontally on the horizon and 0.27 degrees vertically to nacelle height. This is roughly equivalent to viewing a pencil at a distance of about 30 m (100 ft). Similarly with a maximum width of 17 ft the blade would measure only 0.013 degrees horizontally. This is roughly equivalent to the width of a coffee straw viewed at 30 m (100 ft).

6.2.1 Nighttime Lighting

FAA aviation obstruction lights will be mounted on top of the nacelle of each constructed WTG and the ESPs. These lights will be visible from all coastal locations where daytime views of WTG nacelles occur. Inland views are typically screened by dunes, low hills, and existing vegetation. When visible from inland locations, views will include existing coastal light sources including residential light sources, streetlights and vehicle headlights.

The introduction of lights in the night sky will be noticeable from beach areas and coastal bluffs. The contrast of aviation obstruction lights in the night sky may be appreciable in the dark setting of the Martha's Vineyard and Nantucket shoreline where few man-made light sources currently exist. Viewer attention will be drawn by the slow flashing of the red lights.

Project visibility will be most noticeable from beachfront areas. Recreational beaches are primarily visited during daytime hours minimizing the number of affected viewers.

The impact of FAA lighting is substantially limited by the distance of the Project from vantage points. At greater than 23 km (14 mi) aviation obstruction lights will be visible very low on the

horizon and will appear to shimmer and vary in intensity due to the slow flash rate, intermittent shadowing as rotating blades pass in front of the light source, and atmospheric variations. Visibility can be frequently reduced or blocked by fog, snow, particulate matter, smog or any combination of thereof. Alternative lighting schemes are being assessed for usability. These include but are not limited to weather dependent light intensities, radar activated lighting, and other potential future advancements in technology.

USCG navigation warning lights will be mounted near the top of the foundation on each WTG and ESP. This lighting is very low level and is only designed to be visible up to 2.5 nm. The nearest coastal vantage point will be just over 23 km (14 mi). From many vantage points the USCG navigation warning lights will fall over the visible horizon. When not screened by the horizon these low intensity lights, generally visible to mariners up to a distance of up to 2.5 nm, would be relatively inconspicuous to observers from coastal vantage points (BOEM, 2007).

6.2.2 Decommissioning Impacts

Decommissioning of a wind energy Project would involve the dismantling and removal of infrastructure associated with each WTG; the removal of ESPs, their foundations, scour protection devices, and transmission cables; and the shipment of these materials to shore for reuse, recycling, or disposal (see Section 3.5.5). In terms of expected visual impacts, decommissioning activities would be similar to construction activities; however, activities would generally proceed in reverse order from construction, and would proceed more quickly than construction, thus the associated impacts would last for a shorter time. During decommissioning, WTGs and associated offshore facilities and equipment would be removed to below the waterline, the wind facility site would be returned to preconstruction condition; however, as noted above, impacts associated with any new or expanded permanent onshore facilities resulting from wind facility development would remain (BOEM, 2007).

7.0MITIGATION

The sheer distance of the WDA from the nearest coastal vantage point – greater than 23 km (14 mi) - serves to minimize Project visibility from sensitive visual resources. Moreover, for a project of this type mitigation options are limited due to the size and structural requirements of WTGs, the number of WTGs necessary to meet energy production requirements, and their location on an unscreened waterscape.

Visual Screening - Nearly all views occur from beachfront vantage points or elevated overlooks where the existing landscape is highly scenic. Localized screening, such as berms, vegetative barriers or fences would not be practical for screening miles of beach front views, or even welcomed in places where such would block scenic vistas.

Design and Appearance - The WTGs are uniform in shape, color, size of rotor blades, nacelles, and towers to minimize visual contrast. Tubular tower designs are similarly used throughout and components are in proportion to one another. The design and appearance of the Project are consistent best practices to minimize visual impact (BOEM, 2007).

Color Selection or Camouflage - Alternate color selection or camouflaging WTGs are unlikely to reduce Project visibility. The white to light gray color selected for all WTG components is designed to minimize contrast with the sky under most conditions. The yellow color of the turbine foundation (required by the USCG) largely falls below the visible horizon and is nearly undetectable from onshore viewpoints. No commercial/advertising messages will be placed on WTGs.

Fewer WTGs – The Project is designed to provide ~800 MW of electricity. To reach this output the Project may include the construction of up to 100[5] smaller eight MW WTGs, or fewer larger up to approximately 10 MW WTGs. There is no clear advantage to using one alternative over the other with regard to mitigating visual impact. Further reduction of the number or height of WTGs would result in the Project failing to meet its purpose and need (refer to Section 3 of COP Volume III).

Reduction in Night Lighting - Visual analysis demonstrates that the USCG warning lights will not be visible from any land-based vantage point and is thus not an impact to be mitigated. FAA warning lights on the turbines contribute to their visual impact. However, such lighting is implemented as a safety measure, and cannot be eliminated. Lighting-related impacts can be reduced by limiting turbine lighting to the minimum time duration allowable by the FAA. The feasibility of radar activated FAA aviation obstruction lights is being explored. A radar activated system would automatically turn on aviation obstruction lights when an aircraft is within range and turn the lights off when the aircraft has safely departed the area. This technology would substantially reduce the amount of time such lights would be visible.

[5] The visual simulations were conducted conservatively assuming all 106 positions would be occupied.

8.0SUMMARY AND CONCLUSIONS

The WDA is just over 23km (14 mi) off the coasts of Martha's Vineyard and Nantucket, MA. The Project includes the construction of up to 100 WTGs and up to two ESPs within the WDA. The Project is designed to provide ~ 800 MW of electricity and has defined a range of turbine sizes that may be used: from eight to 10 MW. Up to 106 turbine locations are being permitted to allow for spare positions (in the event of environmental or engineering challenges); the visual simulations were conducted conservatively assuming all 106 positions would be occupied. The maximum height of the WTGs considered for this Project will measure approximately 121 m (397 ft) above sea level to the hub and 212 m (696 ft) to the blade tip at the apex of rotation.

The Project also includes up to two ESPs with a maximum width of 45 m (148 ft) and a maximum length of 70 m (230 ft) and a maximum height of 66.5 m (218 ft) above water.

Consistent with current FAA and USCG guidance the Project will include two aviation obstruction lights (L-864) on top of each nacelle and two amber navigation warning lights mounted near the top of the foundation on each WTG approximately 19-23 m (62-75 ft) above MLLW. Alternative lighting schemes are being assessed for usability. These include but are not limited to weather dependent light intensities, radar activated lighting, and other potential future advancements in technology.

Visual impacts are contingent on the distance from shore, earth curvature, and atmospheric conditions that could screen some or all of the foundation, and portions of tower, nacelle, and rotor depending on distance and viewer elevation. As shown in the visual simulations, the widest portion of the WTG (foundation and deck) would be substantially below the visual horizon and would not be visible for most WTGs from most KOPs. In addition, given the narrow width of the tower and rotor combined with the distance from the viewpoints, these elements of the WTG would be minimally discernible by the naked eye in the best visibility conditions (a clear, low humidity day) and not detectable in haze or fog typical of this marine landscape. Overall, visual impacts to onshore viewers of WTGs in daylight would be expected to be minor

A supplemental animated video simulation will be provided to illustrate the frequency, approximate intensity and visual character of FAA aviation obstruction lights on top of each nacelle. When turned on these lights would likely be discernible on clear nights from the shoreline. Weather conditions such as fog, haze, clouds would greatly limit the visibility of the WTGs and lighting from the shore. Therefore, the presence of a flashing light or lights on WTGs and ESPs at night would result in minor impacts (BOEM, 2007).

Area of Potential Effect – The areas where WTG and ESPs may be seen include the southern coastlines of Martha's Vineyard and Nantucket and the open ocean surrounding the WDA. In most circumstances, Project visibility is quickly screened from inland vantage points by coastal topography and vegetation. Most views of the Project will be limited to immediate waterfront

locations. Few publicly accessible vantage points with views of the Atlantic Ocean were found more than 1 km (0.6 mi) inland.

The Project will be visible from beach front locations on Martha's Vineyard between Gay Head (38.6 km [24 mi] from the nearest WTG) and Chappaquiddick Island (23.7 km [14.7 mi]). Similarly, the Project will be visible on Nantucket from beachfront locations between Madaket (38.8 km [14.8 mi]) and Low Beach (38 km [23.6 mi]). Areas of visibility are also found on south facing beaches and unvegetated inland areas on uninhabited Esther Island (22.7 km [14.1 mi]), Tuckernuck Island (22.7 km [14.1 mi]), Muskeget Island (24.3 km [15.1 mi]), and Nomans Land Island (38.8 km [14.8 mi]). Although a line-of-sight exists from the westernmost of the Elizabeth Islands (Cuttyhunk and Nashawena), most of the landmass of these islands (50 km [31.0 mi] from the nearest WTG) fall behind Martha's Vineyard, substantially minimizing the degree of potential visibility.

The southern shore of Cape Cod also has a line of sight to the WDA within the proposed APE. The nearest land point to the WDA on Cape Cod is near Popponesset Beach in Mashpee, 46.3 km (28.8 mi) from the nearest WTG. A portion of the Cape within the proposed APE falls behind Martha's Vineyard substantially minimizing the degree of potential visibility in these areas.

Locations within the Open Water/Ocean, Shoreline Beach, Shoreline Bluffs, Developed Waterfront, Coastal Dunes, Shoreline Residential, Salt Pond/Tidal Marsh, Coastal Scrub, Maintained Recreation Area, and Agricultural/Open Field Landscape Units will be impacted by the Project, due to their proximity to the shoreline and/or lack of screening by vegetation and topography. Field review identified several visually sensitive resources within these zones, including historic sites, open space/wildlife conservation areas, public beaches, and recreation areas that will have views of the Project. Additionally, shoreline vacation homes and private residences which currently have ocean views will have distant views of the Project.

Greater numbers of tourists, vacationers and recreational users will be present in the coastal area during the summer and on sunny days, when the weather is clear and warm as compared to overcast, rainy or cold days. In addition, more recreational users will be present in the coastal area on weekends and holidays than on weekdays. Fewer visitors spend time at beachfront locations during the off-season.

Meteorological Visibility - Visibility is reduced by fog, snow, particulate matter, smog or any combination of thereof, and is a part of normal atmospheric phenomena. Meteorological analysis indicates that haze, fog, and other atmospheric conditions limit visibility to less than 10 nm (18.5 km [11.5 mi]) approximately 30% of the time on an annual basis. In general, views greater than 10 nm are obscured more frequently during the summer - 30% of the time on Martha's Vineyard and nearly 40% of the time on Nantucket - when oceanfront vacation areas are more heavily used. It is important to note that visibilities greater than 10 nm are still reported as 10 nm. Therefore, given the nearest shoreline vantage point is 23.7 km (14.7 mi) it is reasonable to conclude that the Project will be obscured from coastal vantage points more

frequently. In addition, the presence of sea spray and salts further affect visibility beyond what is reported in meteorological data.

Distance of Visibility – On Martha's Vineyard and Nantucket, coastal vantage points for WTGs within the WDA range from 23-47 km (14-29 mi). From Cape Cod, the closest location to the WDA is 47.5 km (29.5 mi) at Popponesset Beach in Mashpee. All land-based vantage points are in the far background distance zone where elements lose detail and become less distinct. Atmospheric perspective changes colors to blue-grays, and surface texture characteristics are lost.

At these extended distances, the curvature of the earth affects Project visibility. As distance increases the portion of Project components (i.e., WTG and ESP) visible above the horizon decreases exponentially. From the closest land point, (23 km [14 mi]) for a standing observer at beach elevation (assume 2.7 m [9 ft] above sea level), the lower 22.5 m (74 ft) will fall below the visible horizon. At 47 km (29.2 mi) the lower 109.5 m (359 ft) will be screened by the horizon.

As an observer moves along the coast farther from the WDA, the smaller the WTGs will appear. Beyond a certain distance, depending upon the size and degree of contrast between the object and its surroundings, the object may cease to be a point of interest for most people or become indistinguishable.

Exclusive of the effects of earth curvature and meteorological visibility, a broadside view of a WTG at a distance of 23.7 km (14.7 mi) would measure only 0.021 degrees horizontally on the horizon and 0.27 degrees vertically to nacelle height). This is roughly equivalent to viewing a pencil at a distance of about 30 m (100 ft). Similarly, with a maximum width of 17 ft the blade would measure only 0.013 degrees horizontally. This is roughly equivalent to the width of a coffee straw viewed at 30 m (100 ft).

At 23.7 km (14.7 mi) and farther from shore, there is no land-based vantage point that will view the entire WTG or ESP. Some portion of the structures will always fall below the visible horizon. Because atmospheric haze reduces visibility, sometimes significantly, and the presence of waves obscure objects very low on the horizon, maximum theoretical viewing distances typically exceed what is experienced in reality. Furthermore, limits to human visual acuity reduce the ability to discern objects at great distances, suggesting that a WTG or ESP may not be discernible at the maximum distances, although they theoretically would be visible (BOEM, 2007).

Sullivan, in "Offshore Wind Turbine Visibility and Visual Impact Threshold Distances" (2013), concludes small to moderately sized facilities were visible to the unaided eye at distances greater than 42 km (26 mi), with turbine blade movement visible up to 39 km (24 mi). At night, aerial hazard navigation lighting was visible at distances greater than 39 km (24 mi). The observed wind facilities were judged to be a major focus of visual attention at distances up to 16 km (10 mi), were noticeable to casual observers at distances of almost 29 km (18 mi), and

were visible with extended or concentrated viewing at distances beyond 40 km (25 mi). The proposed Project is larger in scale than the projects evaluated by Sullivan; however, these findings provide additional perspective concerning the effect of distance on human visibility of offshore wind energy facilities and further support the conclusion that the proposed APE is highly conservative.

For offshore viewers, potential visual impacts could be much greater than for onshore viewers, because boats could approach or potentially move through the Project. In a close approach, the very large form and strong geometric lines of both the individual WTGs and the array of WTGs could dominate views, and the large sweep of the moving rotors would command visual attention. Structural details, such as surface textures, could become apparent, and the ESPs could be visible as well, as could strong specular reflections from the towers and moving rotor blades (BOEM, 2007).

Visibility of Night Lighting – Night lighting may have an effect on residents and vacationers in beachfront settings where they currently experience dark skies. While many residences enjoy ocean views, most year-round and vacation homes within the proposed APE are located inland where intervening landform and vegetation provide substantial or complete screening of the ocean.

The impact of FAA lighting is substantially limited by the distance of the Project from coastal vantage points. At the distance the Project will be seen aviation obstruction lights will be visible very low on the horizon. Lights will appear to shimmer and vary in intensity due to the slow flash rate, intermittent shadowing as rotating blades pass in front of the light source, and atmospheric variations. Visibility will be frequently reduced or blocked by fog, snow, particulate matter, smog or any combination of them. Alternative lighting schemes are being assessed for usability. These include but are not limited to weather dependent light intensities, radar activated lighting, and other potential future advancements in technology.

USCG navigation warning lights fall below the visible horizon from sea level vantage points beyond 26 km (16.2 mi). Where a line-of-sight exists above the horizon these low intensity lights would be relatively inconspicuous to observers from coastal vantage points (BOEM, 2007).

Human Perception - Public reaction to the Project is likely to be variable. Not all viewers see wind turbines as having an adverse visual impact. While there is generally strong support for wind power development, there are often local concerns relating to the aesthetics of planned wind facilities. The perceptions of visual impacts associated with wind energy development vary among potential viewers and may be positive or negative, and they can change over time, in some cases possibly trending toward more positive perceptions after the installation of wind energy facilities (BOEM, 2007).

Mitigation – The Project includes a number of measures that serve to reduce or mitigate visual impact:

- The Project is located in the area identified by BOEM as suitable for offshore wind power development and was sited away from shore to minimize visual impacts;
- The location of the WDA more than 23 km (14 mi) offshore eliminates all foreground, mid-ground, and even near background views from visually sensitive public resources and population centers.
- When viewed from ground level vantage points the off-white color of the turbines generally blends well with the sky at the horizon.
- The Project will utilize FAA warning lights with a narrow beam path (approximately 3 degrees) and the longest off-cycle permitted by the FAA. Consideration can be given to the use of radar activated aviation obstruction lights in the future if approved by the FAA for use at commercial off-shore wind energy facilities.
- USCG warning lights at the base of the towers will have a designed visual range of 2.5 nm. These lights are not likely to be discernible from coastal vantage points.

Overall, the Project would result in minimal change to landscape conditions for viewers along the Martha's Vineyard and Nantucket coastline. Viewers on the islands will have limited visibility of the WTGs when weather conditions allow. However, at distances greater than 23 km (14 mi) and viewed within the context of the ocean that includes the vast expanse of water, extended beach views and dunes, as well as the sights and sounds of breaking surf and wind, the Project would likely be considered visually subordinate to the wider landscape. The Project will be virtually undetectable from Cape Cod.

All offshore and onshore cables will be subsurface/buried and will not be visible. The power grid connection will be constructed at an existing landside power substation. The proposed improvements will be consistent in scale and visual character with the existing electric substation resulting in no new visual impact.

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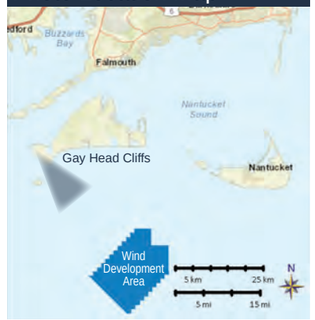
Appendix A

VISUAL SIMULATIONS – SINGLE FRAME VIEWS

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	18-Oct-2017/14:38
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'50.168"N
Longitude:	70°50'12.743"W
Elevation(±):	36.0 m (118 ft)
Nearest Turbine:	38.7 km (24.0 mi)

Visual Setting

Resource Type:	NNL NRHP
Landscape Unit:	Coastal Bluffs
Viewer Groups	Tourists, Vacationers
Circumstances of View:	Stationary

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 1a

Gay Head Cliffs

Town of Aquinnah, Martha's Vineyard Island, MA

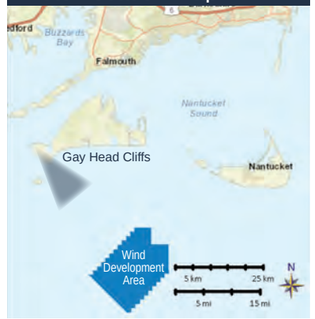
EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



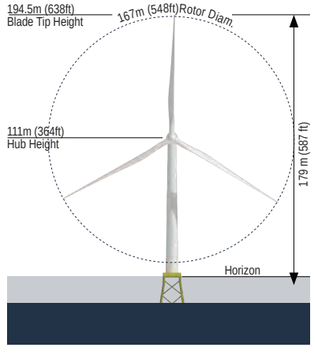
Camera Data

Date / Time	18-Oct-2017/14:38
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'50.168"N
Longitude:	70°50'12.743"W
Elevation(±):	36.0 m (118 ft)
Nearest Turbine:	38.7 km (24.0 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 1b

Gay Head Cliffs

Town of Aquinnah, Martha's Vineyard Island, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

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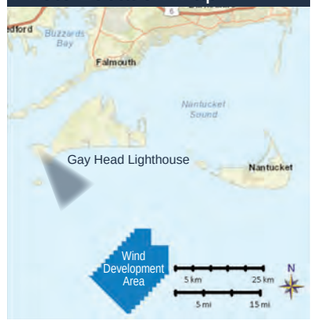
VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	18-Oct-2017/13:55
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'54.341"N
Longitude:	70°50'05.168"W
Elevation(±):	39.3 m (129 ft)
Nearest Turbine:	38.6 km (23.9 mi)

Visual Setting

Resource Type:	NNL NRHP
Landscape Unit:	Coastal Bluffs
Viewer Groups	Tourists, Vacationers
Circumstances of View:	Stationary

Figure 2a

Gay Head Lighthouse

Town of Aquinnah, Martha's Vineyard Island, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

OCS-A 0501 MASS USA

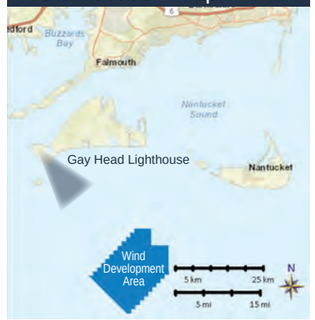
VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



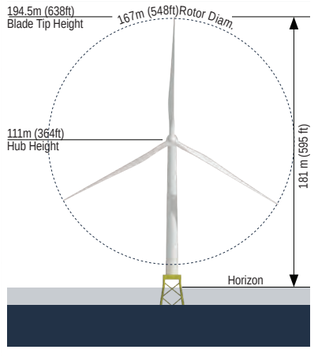
Camera Data

Date / Time	18-Oct-2017/13:55
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'54.341"N
Longitude:	70°50'05.168"W
Elevation(±):	39.3 m (129 ft)
Nearest Turbine:	38.6 km (23.9 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 2b

Gay Head Lighthouse

Town of Aquinnah, Martha's Vineyard Island, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

Figure 3a

Aquinnah Cultural Center

Town of Aquinnah, Martha's Vineyard Island, MA

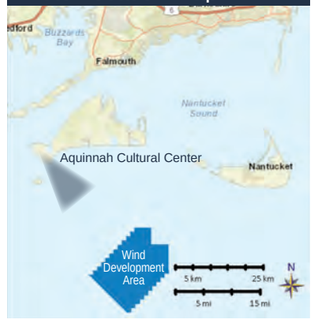
EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	18-Oct-2017/14:53
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'45.497"N
Longitude:	70°50'08.169"W
Elevation(±):	32.0 m (105 ft)
Nearest Turbine:	38.5 km (23.9 mi)

Visual Setting

Resource Type:	NNL NRHP
Landscape Unit:	Coastal Bluffs
Viewer Groups	Tourists, Vacationers
Circumstances of View:	Stationary

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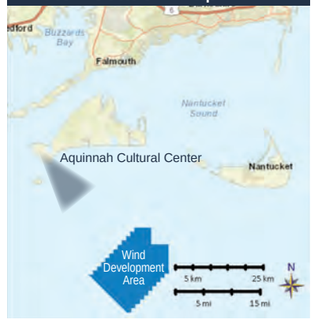
VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



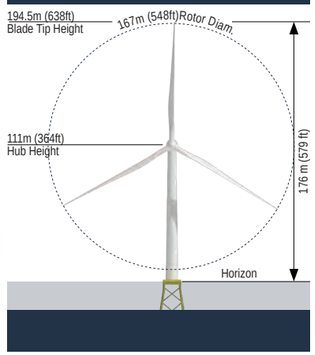
Camera Data

Date / Time	18-Oct-2017/13:55
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'45.497"N
Longitude:	70°50'08.169"W
Elevation(±):	32.0 m (105 ft)
Nearest Turbine:	38.5 km (23.9 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 3b

Aquinnah Cultural Center

Town of Aquinnah, Martha's Vineyard Island, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

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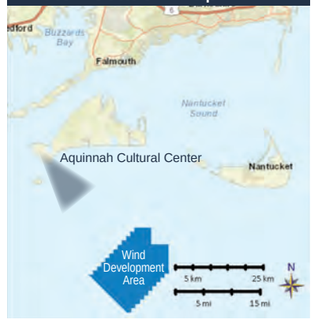
VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



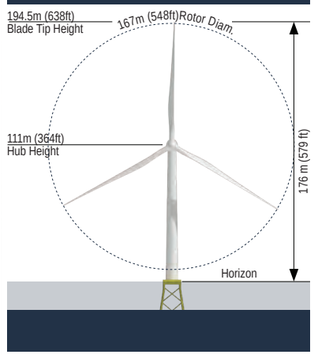
Camera Data

Date / Time	18-Oct-2017/13:55
Light Condition:	Side Light/Haze
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'45.497"N
Longitude:	70°50'08.169"W
Elevation(±):	32.0 m (105 ft)
Nearest Turbine:	38.5 km (23.9 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 3c

Aquinnah Cultural Center

Town of Aquinnah, Martha's Vineyard Island, MA

This visualization incorporates a simulated haze condition that reduces visibility of the WTGs to approximately 50%.

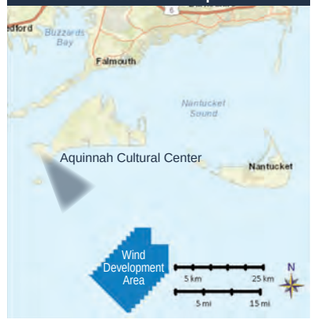
SIMULATED VIEW - MODERATE HAZE

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



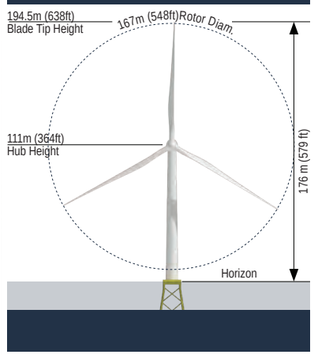
Camera Data

Date / Time	18-Oct-2017/13:55
Light Condition:	Side Light/Haze
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'45.497"N
Longitude:	70°50'08.169"W
Elevation(±):	32.0 m (105 ft)
Nearest Turbine:	38.5 km (23.9 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 3d

Aquinnah Cultural Center

Town of Aquinnah, Martha's Vineyard Island, MA

This visualization incorporates a simulated haze condition that substantialy masks visibility of the WTGs.

SIMULATED VIEW - HEAVY HAZE

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	18-Oct-2017/16:35
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°19'09.213"N
Longitude:	70°45'52.597"W
Elevation(±):	3.0 m (10 ft)
Nearest Turbine:	32.2 km (20.0 mi)

Visual Setting

Resource Type:	Recreation, Historic Resources
Landscape Unit:	Ocean Beach,
Viewer Groups	Residents, Vacationers, Recreational
Circumstances of View:	Stationary

Figure 4a

Squibnocket Beach

Town of Chilmark, Martha's Vineyard Island, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

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VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

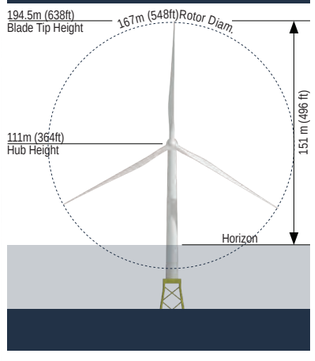
Camera Data

Date / Time	18-Oct-2017/16:35
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°19'09.213"N
Longitude:	70°45'52.597"W
Elevation(±):	3.0 m (10 ft)
Nearest Turbine:	32.2 km (20.0 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 4b

Squibnocket Beach

Town of Chilmark, Martha's Vineyard Island, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

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VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	18-Oct-2017/17:35
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'20.000"N
Longitude:	70°43'39.838"W
Elevation(±):	3.7 m (12 ft)
Nearest Turbine:	31.5 km (19.5 mi)

Visual Setting

Resource Type:	Recreation, Historic Resources
Landscape Unit:	Ocean Beach, Coastal Dunes
Viewer Groups	Residents, Vacationers, Recreational
Circumstances of View:	Stationary

Figure 5a

Lucy Vincent Beach

Town of Chilmark, Martha's Vineyard Island, MA

EXISTING VIEW

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VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

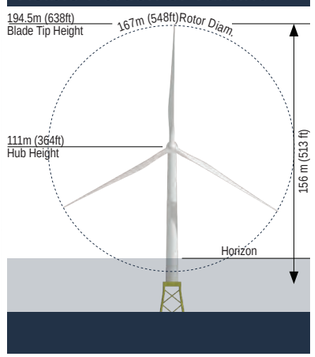
Camera Data

Date / Time	18-Oct-2017/17:35
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'20.000"N
Longitude:	70°43'39.838"W
Elevation(±):	3.7 m (12 ft)
Nearest Turbine:	31.5 km (19.5 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 5b

Lucy Vincent Beach

Town of Chilmark, Martha's Vineyard Island, MA

SIMULATED VIEW

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VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	19-Oct-2017/11:35
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'30.457"N
Longitude:	70°43'47.874"W
Elevation(±):	11.0 m (36 ft)
Nearest Turbine:	31.8 km (19.7 mi)

Visual Setting

Resource Type:	NRHP
Landscape Unit:	Coastal Bluffs
Viewer Groups	Residents Tourists
Circumstances of View:	Stationary

Figure 6a

Barn House / Skiff-Mayhew-Vincent House

Town of Chilmark, Martha's Vineyard Island, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

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VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

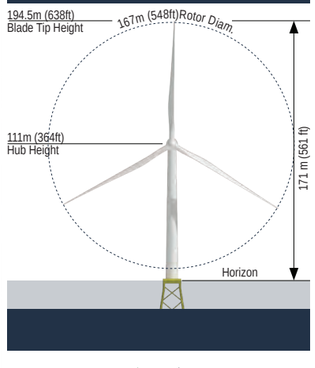
Camera Data

Date / Time	19-Oct-2017/11:35
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'30.457"N
Longitude:	70°43'47.874"W
Elevation(±):	11.0 m (36 ft)
Nearest Turbine:	31.8 km (19.7 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 6b

Barn House / Skiff-Mayhew-Vincent House

Town of Chilmark, Martha's Vineyard Island, MA

SIMULATED VIEW

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VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	18-Oct-2017/10:11
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'54.534"N
Longitude:	70°38'19.520"W
Elevation(±):	6.1 m (20 ft)
Nearest Turbine:	27.7 km (17.2 mi)

Visual Setting

Resource Type:	Wildlife Refuge, Recreation, Historic Resources
Landscape Unit:	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh
Viewer Groups	Residents, Vacationers, Recreational

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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 7a

Long Point Beach

Town of West Tisbury, Martha's Vineyard Island, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

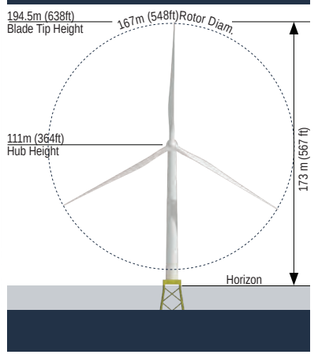
Camera Data

Date / Time	18-Oct-2017/10:11
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°20'54.534"N
Longitude:	70°38'19.520"W
Elevation(±):	6.1 m (20 ft)
Nearest Turbine:	27.7 km (17.2 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 7b

Long Point Beach

Town of West Tisbury, Martha's Vineyard Island, MA

SIMULATED VIEW

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VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	18-Oct-2017/8:48
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 20' 59.547"N
Longitude:	70° 31' 48.791"W
Elevation(±):	4.6 m (15 ft)
Nearest Turbine:	24.3 km (15.1 mi)

Visual Setting

Resource Type:	Recreation
Landscape Unit:	Ocean Beach, Coastal Dunes
Viewer Groups	Residents, Vacationers, Recreational
Circumstances of View:	Stationary

Figure 8a

South Beach

Town of Edgartown, Martha's Vineyard Island, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

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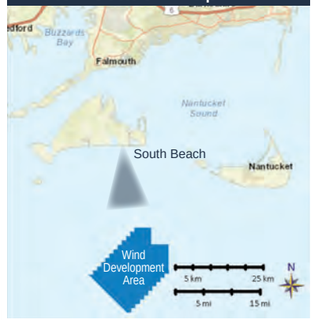
VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



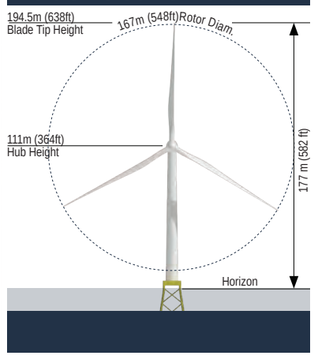
Camera Data

Date / Time	18-Oct-2017/8:48
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 20' 59.547"N
Longitude:	70° 31' 48.791"W
Elevation(±):	4.6 m (15 ft)
Nearest Turbine:	24.3 km (15.1 mi)

Visible Portion of Turbine



OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 8b

South Beach

Town of Edgartown, Martha's Vineyard Island, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

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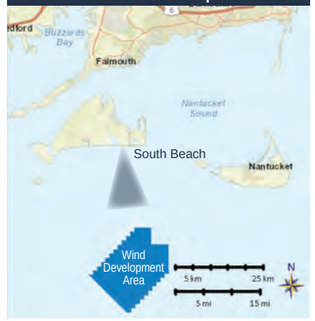
VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



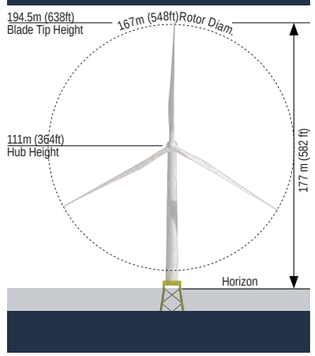
Camera Data

Date / Time	18-Oct-2017/8:48
Light Condition:	Side Light/Haze
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 20' 59.547"N
Longitude:	70° 31' 48.791"W
Elevation(±):	4.6 m (15 ft)
Nearest Turbine:	24.3 km (15.1 mi)

Visible Portion of Turbine



OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 8c

South Beach

Town of Edgartown, Martha's Vineyard Island, MA

This visualization incorporates a simulated haze condition that reduces visibility of the WTGs to approximately 50%.

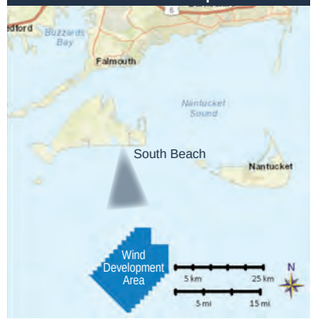
SIMULATED VIEW - MODERATE HAZE

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



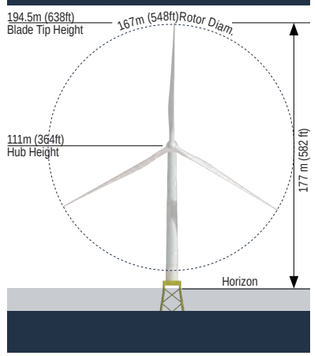
Camera Data

Date / Time	18-Oct-2017/8:48
Light Condition:	Side Light/Haze
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 20' 59.547"N
Longitude:	70° 31' 48.791"W
Elevation(±):	4.6 m (15 ft)
Nearest Turbine:	24.3 km (15.1 mi)

Visible Portion of Turbine



OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 8d

South Beach

Town of Edgartown, Martha's Vineyard Island, MA

This visualization incorporates a simulated haze condition that substantialy masks visibility of the WTGs.

SIMULATED VIEW - HEAVY HAZE

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	19-Oct-2017/9:36
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 23' 18.903"N
Longitude:	70° 30' 30.120"W
Elevation(±):	2.4 m (8 ft)
Nearest Turbine:	28.2 km (17.5 mi)

Visual Setting

Resource Type:	Recreation, Near NRHP District
Landscape Unit:	Village/Town Center
Viewer Groups	Residents, Tourists, Vacationers, Recreational
Circumstances of View:	Stationary

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 9a

Chappy Point, Gardner Beach

Town of Edgartown, Martha's Vineyard Island, MA

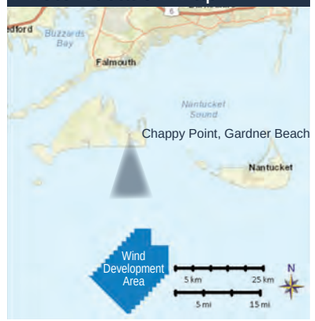
EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



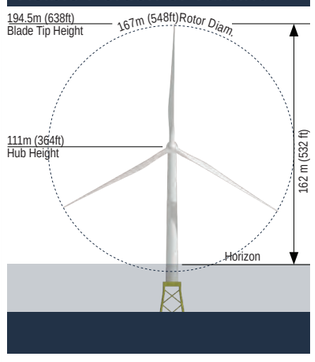
Camera Data

Date / Time	19-Oct-2017/9:36
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 23' 18.903"N
Longitude:	70° 30' 30.120"W
Elevation(±):	2.4 m (8 ft)
Nearest Turbine:	28.2 km (17.5 mi)

Visible Portion of Turbine



OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 9b

Chappy Point, Gardner Beach

Town of Edgartown, Martha's Vineyard Island, MA

SIMULATED VIEW

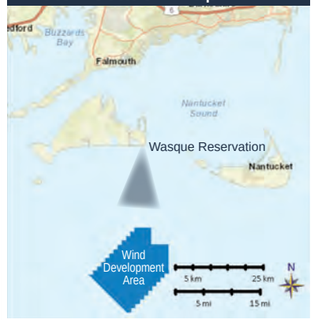
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	19-Oct-2017/8:40
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 21’ 05.109”N
Longitude:	70° 27’ 17.701”W
Elevation(±):	10.7 m (35 ft)
Nearest Turbine:	23.7 km (14.7 mi)

Visual Setting

Resource Type:	Recreation, Open Space Conservation
Landscape Unit:	Ocean Beach, Coastal Bluffs, Forest
Viewer Groups	Vacationers, Recreational
Circumstances of View:	Stationary

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 10a

Wasque Reservation

Town of Edgartown, Martha’s Vineyard Island, MA

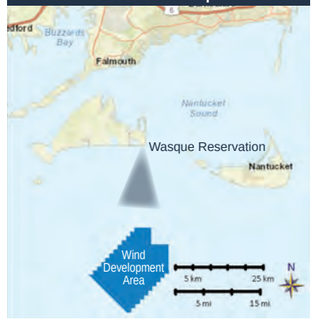
EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader’s eye when printed on 11”x17” paper and 13 inches from the reader’s eye when printed on 8 1/2” x 11” paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	19-Oct-2017/8:40
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 21' 05.109"N
Longitude:	70° 27' 17.701"W
Elevation(±):	10.7 m (35 ft)
Nearest Turbine:	23.7 km (14.7 mi)

Visible Portion of Turbine

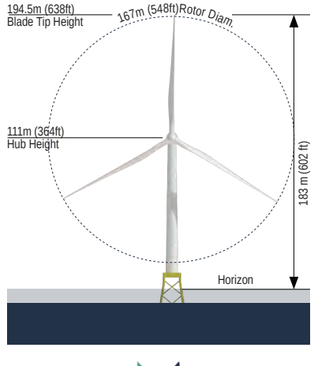


Figure 10b

Wasque Reservation

Town of Edgartown, Martha's Vineyard Island, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

OCS-A 0501 MASS USA

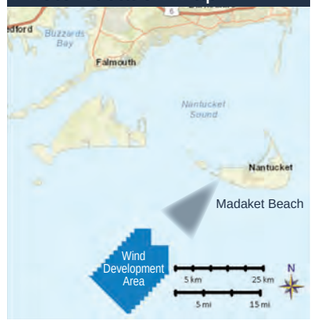
VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	20-Oct-2017/7:50
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 16' 12.833"N
Longitude:	70° 12' 05.262"W
Elevation(±):	7.3 m (24 ft)
Nearest Turbine:	24.0 km (14.9 mi)

Visual Setting

Resource Type:	Recreation, Historic Resources
Landscape Unit:	Ocean Beach, Coastal Dunes Shoreline Residential
Viewer Groups	Residents Vacationers, Recreational
Circumstances of View:	Stationary

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 11a

Madaket Beach

Town of Nantucket, Nantucket Island, MA

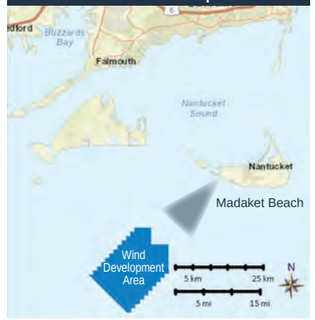
EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



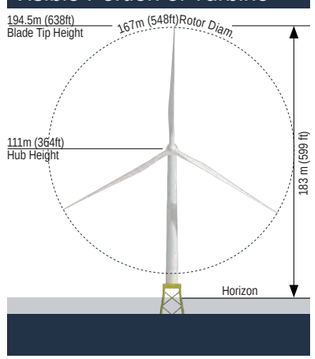
Camera Data

Date / Time	20-Oct-2017/7:50
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 16' 12.833"N
Longitude:	70° 12' 05.262"W
Elevation(±):	7.3 m (24 ft)
Nearest Turbine:	24.0 km (14.9 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 11b

Madaket Beach

Town of Nantucket, Nantucket Island, MA

SIMULATED VIEW

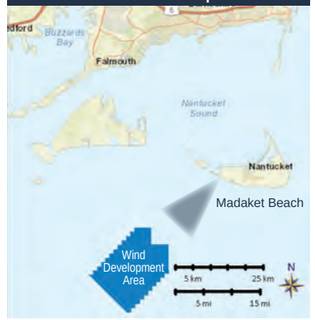
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



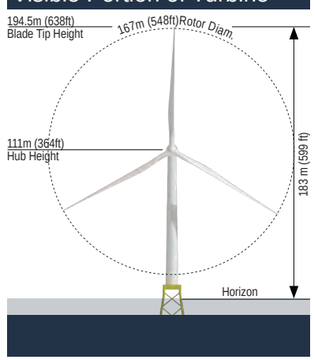
Camera Data

Date / Time	20-Oct-2017/7:50
Light Condition:	Side Light/Haze
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 16' 12.833"N
Longitude:	70° 12' 05.262"W
Elevation(±):	7.3 m (24 ft)
Nearest Turbine:	24.0 km (14.9 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 11c

Madaket Beach

Town of Nantucket, Nantucket Island, MA

This visualization incorporates a simulated haze condition that reduces visibility of the WTGs to approximately 50%.

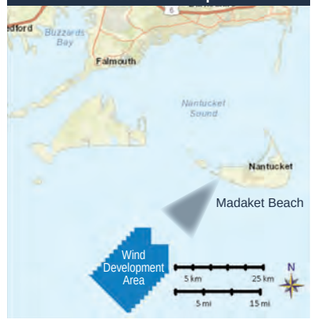
SIMULATED VIEW - MODERATE HAZE

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



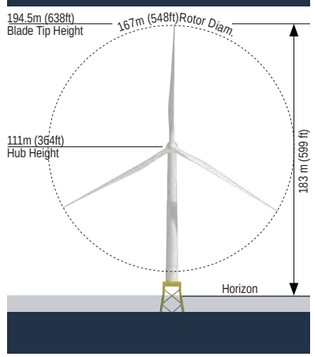
Camera Data

Date / Time	20-Oct-2017/7:50
Light Condition:	Side Light/Haze
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 16' 12.833"N
Longitude:	70° 12' 05.262"W
Elevation(±):	7.3 m (24 ft)
Nearest Turbine:	24.0 km (14.9 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 11d

Madaket Beach

Town of Nantucket, Nantucket Island, MA

This visualization incorporates a simulated haze condition that substantialy masks visibility of the WTGs.

SIMULATED VIEW - HEAVY HAZE

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	20-Oct-2017/8:59
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 15’ 07.545”N
Longitude:	70° 09’ 09.227”W
Elevation(±):	3.7 m (12 ft)
Nearest Turbine:	25.3 km (15.7 mi)

Visual Setting

Resource Type:	Recreation
Landscape Unit:	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh
Viewer Groups	Residents Vacationers, Recreational
Circumstances of View:	Stationary

Figure 12a

Cisco Beach

Town of Nantucket, Nantucket Island, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader’s eye when printed on 11”x17” paper and 13 inches from the reader’s eye when printed on 8 1/2” x 11” paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

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VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

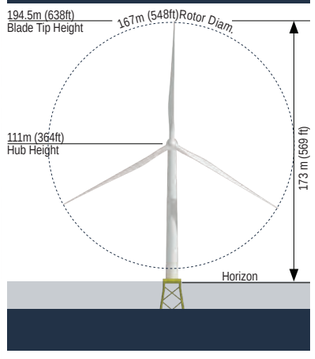
Camera Data

Date / Time	20-Oct-2017/8:59
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 15' 07.545"N
Longitude:	70° 09' 09.227"W
Elevation(±):	3.7 m (12 ft)
Nearest Turbine:	25.3 km (15.7 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 12b

Cisco Beach

Town of Nantucket, Nantucket Island, MA

SIMULATED VIEW

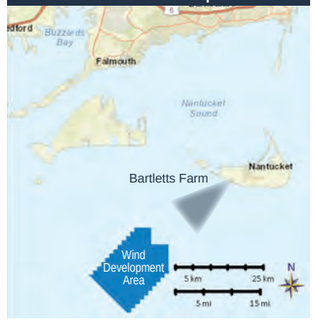
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	20-Oct-2017/11:05
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 15’ 23.806”N
Longitude:	70° 07’ 56.236”W
Elevation(±):	10.7 m (35 ft)
Nearest Turbine:	26.9 km (16.7 mi)

Visual Setting

Resource Type:	Historic Resources
Landscape Unit:	Agricultural/Open Field
Viewer Groups	Residents, Tourists Vacationers
Circumstances of View:	Stationary

Figure 13a

Bartletts Farm

Town of Nantucket, Nantucket Island, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader’s eye when printed on 11”x17” paper and 13 inches from the reader’s eye when printed on 8 1/2” x 11” paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

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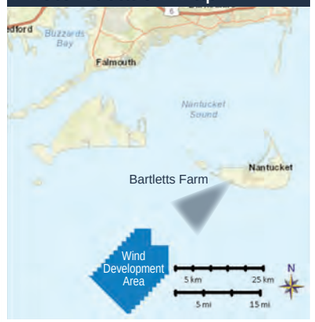
VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



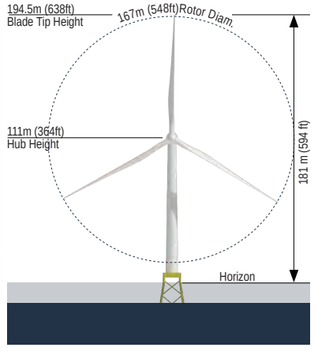
Camera Data

Date / Time	20-Oct-2017/11:05
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 15’ 23.806”N
Longitude:	70° 07’ 56.236”W
Elevation(±):	10.7 m (35 ft)
Nearest Turbine:	26.9 km (16.7 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 13b

Bartletts Farm

Town of Nantucket, Nantucket Island, MA

SIMULATED VIEW

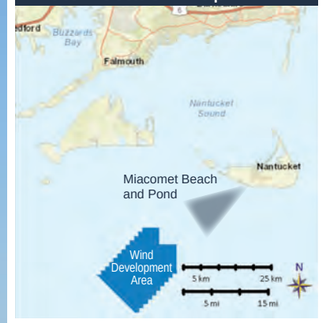
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader’s eye when printed on 11”x17” paper and 13 inches from the reader’s eye when printed on 8 1/2” x 11” paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	20-Oct-2017/10:17
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 14' 34.724"N
Longitude:	70° 07' 03.322"W
Elevation(±):	3.7 m (12 ft)
Nearest Turbine:	27.0 km (16.7 mi)

Visual Setting

Resource Type:	Recreation, Historic Resources
Landscape Unit:	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh
Viewer Groups	Residents Vacationers, Recreational
Circumstances of View:	Stationary

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 14a

Miacomet Beach and Pond

Town of Nantucket, Nantucket Island, MA

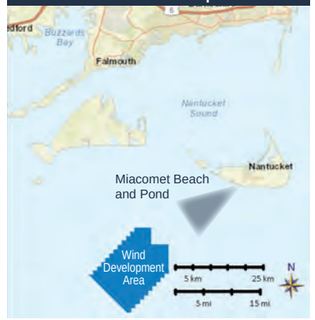
EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



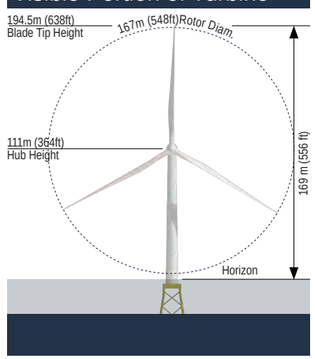
Camera Data

Date / Time	20-Oct-2017/10:17
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 14' 34.724"N
Longitude:	70° 07' 03.322"W
Elevation(±):	3.7 m (12 ft)
Nearest Turbine:	27.0 km (16.7 mi)

Visible Portion of Turbine



OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 14b

Miacomet Beach and Pond

Town of Nantucket, Nantucket Island, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	20-Oct-2017/12:00
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 14' 34.260"N
Longitude:	70° 05' 39.788"W
Elevation(±):	3.7 m (12 ft)
Nearest Turbine:	28.5 km (17.7 mi)

Visual Setting

Resource Type:	Recreation, Historic Resources
Landscape Unit:	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh
Viewer Groups	Residents Vacationers, Recreational
Circumstances of View:	Stationary

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 15a

Surfside Beach

Town of Nantucket, Nantucket Island, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

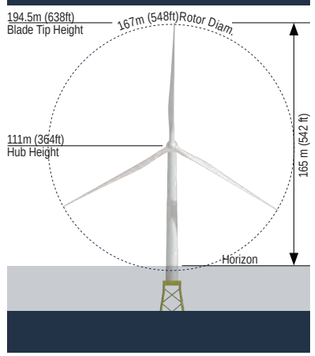
Camera Data

Date / Time	20-Oct-2017/12:00
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 14' 34.260"N
Longitude:	70° 05' 39.788"W
Elevation(±):	3.7 m (12 ft)
Nearest Turbine:	28.5 km (17.7 mi)

Visible Portion of Turbine



OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 15b

Surfside Beach

Town of Nantucket, Nantucket Island, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

Figure 16a

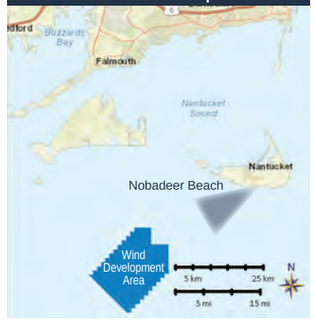
Nobadeer Beach

Town of Nantucket, Nantucket Island, MA

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	20-Oct-2017/13:12
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 14’ 41.751”N
Longitude:	70° 04’ 41.337”W
Elevation(±):	6.1 m (20 ft)
Nearest Turbine:	29.8 km (18.5 mi)

Visual Setting

Resource Type:	Recreation, Historic Resources
Landscape Unit:	Ocean Beach, Coastal Dunes, Salt Pond/Tidal Marsh
Viewer Groups	Residents Vacationers, Recreational
Circumstances of View:	Stationary

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader’s eye when printed on 11”x17” paper and 13 inches from the reader’s eye when printed on 8 1/2” x 11” paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

OCS-A 0501 MASS USA

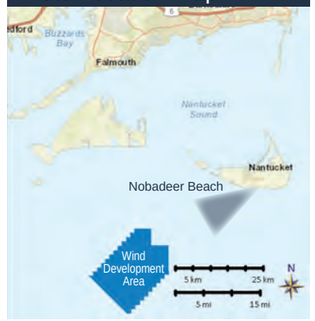
VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



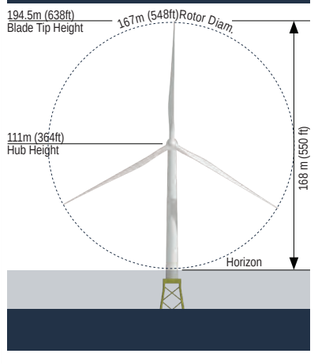
Camera Data

Date / Time	20-Oct-2017/13:12
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 14’ 41.751”N
Longitude:	70° 04’ 41.337”W
Elevation(±):	6.1 m (20 ft)
Nearest Turbine:	29.8 km (18.5 mi)

Visible Portion of Turbine



OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 16b

Nobadeer Beach

Town of Nantucket, Nantucket Island, MA

SIMULATED VIEW

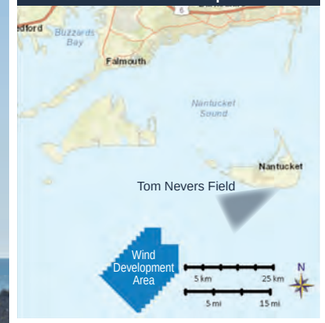
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader’s eye when printed on 11”x17” paper and 13 inches from the reader’s eye when printed on 8 1/2” x 11” paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	20-Oct-2017/14:45
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 14’ 23.522”N
Longitude:	70° 00’ 33.675”W
Elevation(±):	16.8 m (55 ft)
Nearest Turbine:	34.5 km (21.4 mi)

Visual Setting

Resource Type:	Recreation
Landscape Unit:	Maintained Recreation, Coastal Bluffs, Coastal Scrub
Viewer Groups	Residents Vacationers, Recreational
Circumstances of View:	Stationary

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 17a

Tom Nevers Field

Town of Nantucket, Nantucket Island, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader’s eye when printed on 11”x17” paper and 13 inches from the reader’s eye when printed on 8 1/2” x 11” paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

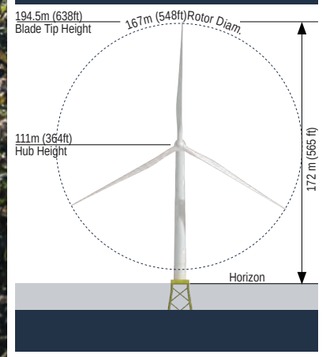
Camera Data

Date / Time	20-Oct-2017/14:45
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 14’ 23.522”N
Longitude:	70° 00’ 33.675”W
Elevation(±):	16.8 m (55 ft)
Nearest Turbine:	34.5 km (21.4 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 17b

Tom Nevers Field

Town of Nantucket, Nantucket Island, MA

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

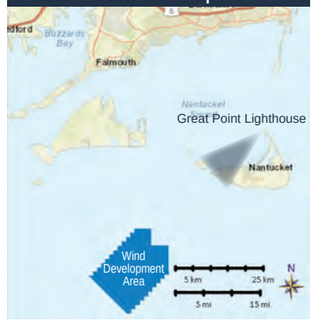
SIMULATED VIEW

The above photograph is intended to be viewed 20 inches from the reader’s eye when printed on 11”x17” paper and 13 inches from the reader’s eye when printed on 8 1/2” x 11” paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



Camera Data

Date / Time	20-Oct-2017/16:43
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 23' 22.403"N
Longitude:	70° 03' 02.137"W
Elevation(±):	2.7 m (9 ft)
Nearest Turbine:	42.4 km (26.3 mi)

Visual Setting

Resource Type:	NRHP, Recreation
Landscape Unit:	Maintained Recreation, Coastal Bluffs, Coastal Scrub
Viewer Groups	Tourists, Vacationers, Recreational
Circumstances of View:	Stationary

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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 18a

Great Point Lighthouse

Town of Nantucket, Nantucket Island, MA

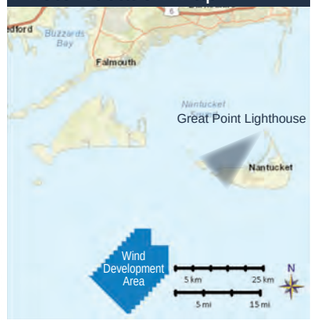
EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



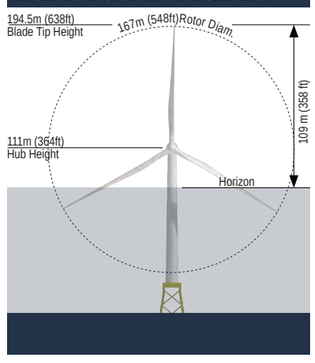
Camera Data

Date / Time	20-Oct-2017/16:43
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41° 23' 22.403"N
Longitude:	70° 03' 02.137"W
Elevation(±):	2.7 m (9 ft)
Nearest Turbine:	42.4 km (26.3 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 18b

Great Point Lighthouse

Town of Nantucket, Nantucket Island, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

Figure 19a

Popponesset Beach

Town of Mashpee, Cape Cod, MA

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	21-Oct-2017/12:42
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°33'48.364"N
Longitude:	70°28'16.211"W
Elevation(±):	2.4 m (8 ft)
Nearest Turbine:	47.3 km (29.4 mi)

Visual Setting

Resource Type:	Recreation
Landscape Unit:	Ocean Beach, Coastal Bluffs
Viewer Groups	Residents, Vacationers, Recreational
Circumstances of View:	Stationary

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

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VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

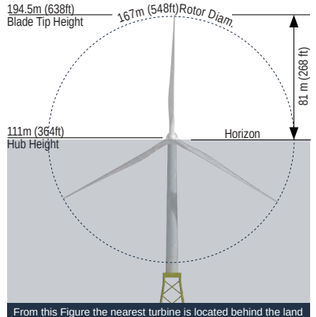
Camera Data

Date / Time	21-Oct-2017/12:42
Light Condition:	Back Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°33'48.364"N
Longitude:	70°28'16.211"W
Elevation(±):	2.4 m (8 ft)
Nearest Turbine:	47.3 km (29.4 mi)

Visible Portion of Turbine



From this Figure the nearest turbine is located behind the land mass of Martha's Vineyard further reducing the visible portion of the turbine.

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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 19b

Popponesset Beach

Town of Mashpee, Cape Cod, MA

SIMULATED VIEW

This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

Camera Data

Date / Time	17-Oct-2017/15:08
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°37'22.722"N
Longitude:	70°21'54.928"W
Elevation(±):	6.1 m (20 ft)
Nearest Turbine:	54.1 km (33.6 mi)

Visual Setting

Resource Type:	Recreation, NRHP
Landscape Unit:	Ocean Beach, Coastal Dunes
Viewer Groups	Residents, Vacationers, Recreational
Circumstances of View:	Stationary

Figure 20a

Dowses Beach

Town of Barnstable, Cape Cod, MA

EXISTING VIEW

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

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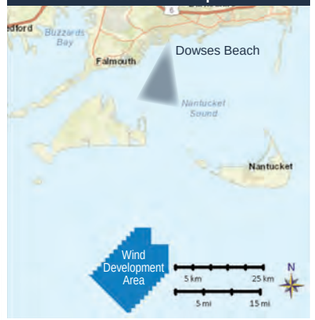
VINEYARD WIND

SARATOGA ASSOCIATES

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



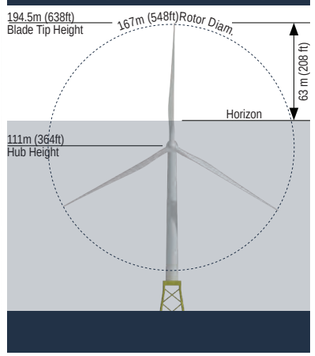
Camera Data

Date / Time	17-Oct-2017/15:08
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°37'22.722"N
Longitude:	70°21'54.928"W
Elevation(±):	6.1 m (20 ft)
Nearest Turbine:	54.1 km (33.6 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 20b

Dowses Beach

Town of Barnstable, Cape Cod, MA

SIMULATED VIEW

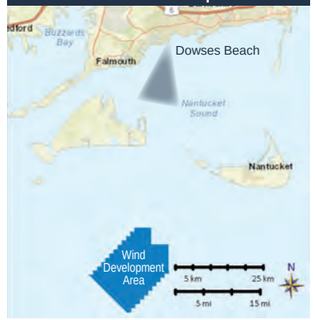
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map



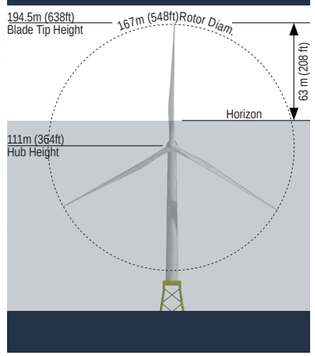
Camera Data

Date / Time	17-Oct-2017/15:08
Light Condition:	Side Light/Haze
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°37'22.722"N
Longitude:	70°21'54.928"W
Elevation(±):	6.1 m (20 ft)
Nearest Turbine:	54.1 km (33.6 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 20c

Dowses Beach

Town of Barnstable, Cape Cod, MA

This visualization incorporates a simulated haze condition that reduces visibility of the WTGs to approximately 50%.

SIMULATED VIEW - MODERATE HAZE

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

VINEYARD WIND PROJECT

Photographic Simulations

Photo Location Map

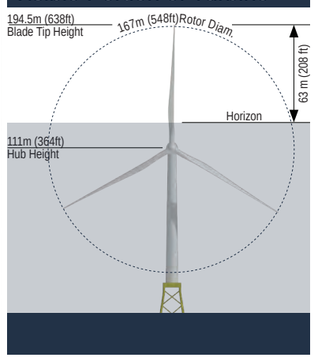
Camera Data

Date / Time	17-Oct-2017/15:08
Light Condition:	Side Light/Haze
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location

Latitude:	41°37'22.722"N
Longitude:	70°21'54.928"W
Elevation(±):	6.1 m (20 ft)
Nearest Turbine:	54.1 km (33.6 mi)

Visible Portion of Turbine



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VINEYARD WIND

SARATOGA ASSOCIATES

Figure 20d

Dowses Beach

Town of Barnstable, Cape Cod, MA

This visualization incorporates a simulated haze condition that substantialy masks visibility of the WTGs.

SIMULATED VIEW - HEAVY HAZE

The above photograph is intended to be viewed 20 inches from the reader's eye when printed on 11"x17" paper and 13 inches from the reader's eye when printed on 8 1/2" x 11" paper. Viewing on an uncalibrated video monitor can alter intended lightness, color and/or contrast of the image.

Appendix B

VISUAL SIMULATIONS – PANORAMA VIEWS

Figure 1a

Aquinnah Cultural Center

Town of Aquinnah, Martha's Vineyard Island, MA

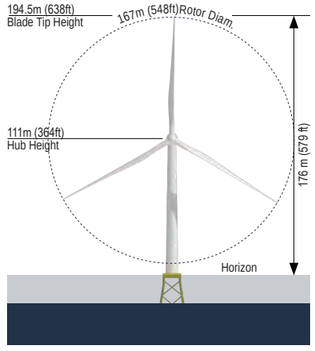
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

Panoramic Image (124º x 55º) - This panoramic image approximates the full horizontal and vertical field-of-view of normal human eyesight.

Camera Data	
Date / Time	18-Oct-2017/14:53
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location	
Latitude:	41°20'45.497"N
Longitude:	70°50'08.169"W
Elevation(±):	32.0 m (105 ft)
Nearest Turbine:	38.5 km (23.9 mi)

Visible Portion of Turbine



VINEYARD WIND PROJECT

Photographic Simulations

SIMULATED VIEW - DAYTIME VIEW

PANORAMIC IMAGE

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 2a

South Beach

Town of Edgartown, Martha's Vineyard Island, MA

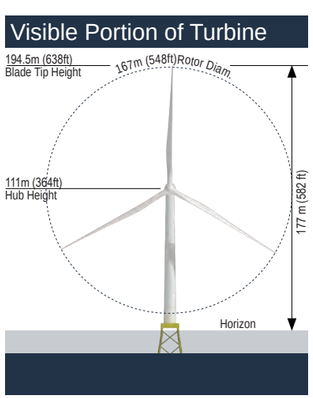
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

Panoramic Image (124º x 55º) - This panoramic image approximates the full horizontal and vertical field-of-view of normal human eyesight.

Camera Data	
Date / Time	18-Oct-2017/8:48
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location	
Latitude:	41° 20' 59.547"N
Longitude:	70° 31' 48.791"W
Elevation(±):	4.6 m (15 ft)
Nearest Turbine:	24.3 km (15.1 mi)

Visible Portion of Turbine



VINEYARD WIND PROJECT

Photographic Simulations

SIMULATED VIEW - DAYTIME VIEW

PANORAMIC IMAGE

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 3a

Madaket Beach

Town of Nantucket, Nantucket Island, MA

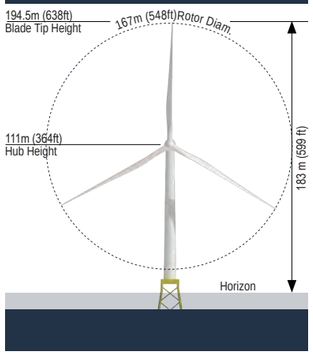
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

Panoramic Image (124º x 55º) - This panoramic image approximates the full horizontal and vertical field-of-view of normal human eyesight.

Camera Data	
Date / Time	20-Oct-2017/7:50
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location	
Latitude:	41° 16' 12.833"N
Longitude:	70° 12' 05.262"W
Elevation(±):	7.3 m (24 ft)
Nearest Turbine:	24.1 km (14.9 mi)

Visible Portion of Turbine



VINEYARD WIND PROJECT

Photographic Simulations

SIMULATED VIEW - DAYTIME VIEW

PANORAMIC IMAGE

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Figure 4a

Dowses Beach

Town of Barnstable, Cape Cod, MA

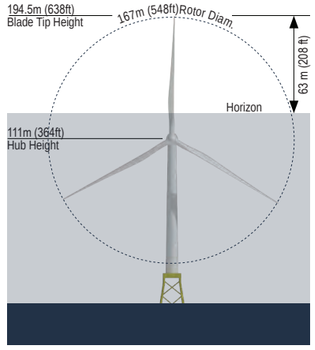
This photo simulation conservatively presents project visibility under clear weather conditions. Minimal atmospheric haze is applied to simulated elements to account for sea spray and sea salt typical of atmospheric conditions over the ocean.

Panoramic Image (124º x 55º) - This panoramic image approximates the full horizontal and vertical field-of-view of normal human eyesight.

Camera Data	
Date / Time	17-Oct-2017/15:08
Light Condition:	Side Light
Camera:	Canon 5d Mark IV
Focal Length:	50mm (full frame)

Camera Location	
Latitude:	41°37'22.722"N
Longitude:	70°21'54.928"W
Elevation(±):	6.1 m (20 ft)
Nearest Turbine:	54.1 km (33.6 mi)

Visible Portion of Turbine



VINEYARD WIND PROJECT

Photographic Simulations

SIMULATED VIEW - DAYTIME VIEW

PANORAMIC IMAGE

OCS-A 0501 MASS USA

VINEYARD WIND

SARATOGA ASSOCIATES

Appendix C

METEOROLOGICAL ANALYSIS

Vineyard Wind Project

Meteorological Analysis

Prepared for:

Vineyard Wind, LLC
700 Pleasant Street, Suite 510
New Bedford, MA 02740

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1.0 INTRODUCTION

As a supplement to the visibility assessment, a meteorological analysis was conducted to identify the common weather conditions and assess visibility within the Wind Development Area, as meteorological and atmospheric conditions play a role in providing the opportunity for the Project to be visible.

The meteorological analysis was modeled after the Bureau of Ocean Energy Management Renewable Energy Viewshed Analysis and Continental Shelf Call Area: Compendium Report, Meteorological Conditions Assessment and included the following steps:

1. A descriptive analysis of meteorological conditions, such as winds, common weather conditions, reported visibilities, and average daily high and low temperatures, and average relative humidity on an annual, seasonal, and daily basis; and

2. The development of a method to assess visibility beyond 10 miles, which is the extent of visibility predictions typically provided by airports.

2.0 METHODS

For this analysis, seasons are defined as follows:

1. Spring: March 22 – June 21;
2. Summer: June 22 – September 21;
3. Fall: September 22 – December 21; and
4. Winter: December 22 – March 21.

Daytime hours are assumed to be 7:00 am through 6:59 pm, while nighttime hours are assumed to be 7:00 pm through 6:59 am.

This methodology captures average annual day and night conditions.

2.1 Meteorological Station Selection

Two meteorological stations- Vineyard Haven on Martha's Vineyard and Nantucket Memorial Airport on Nantucket -were identified as being the closest and most representative stations to include within the Wind Development Area. There are no other locations closer to the Offshore Project Area with meteorological stations that have collected data on an hourly basis for at least the last 10 years.

Data from the Local Climatological Data ("LCD") data set, available from the National Climatic Data Center ("NCDC"), were selected as suitable data sources for this analysis. LCD data comprises hourly meteorological data for approximately 1,600 currently active stations in the US. and includes Automated Surface Observing System ("ASOS") and Automated Weather Observing System ("AWOS") observations. Both of the selected stations are ASOS stations and therefore collect data on temperature, dew point, wind direction, wind speed, precipitation, present weather, visibility and pressure on at least an hourly basis.

Both of the selected stations were evaluated for the 11-year period of 2006-2016, where hourly data were available for both locations. Figure 1 shows the location of both of these stations in relation to the Offshore Project Area.

2.2 LCD Data Validation and Processing

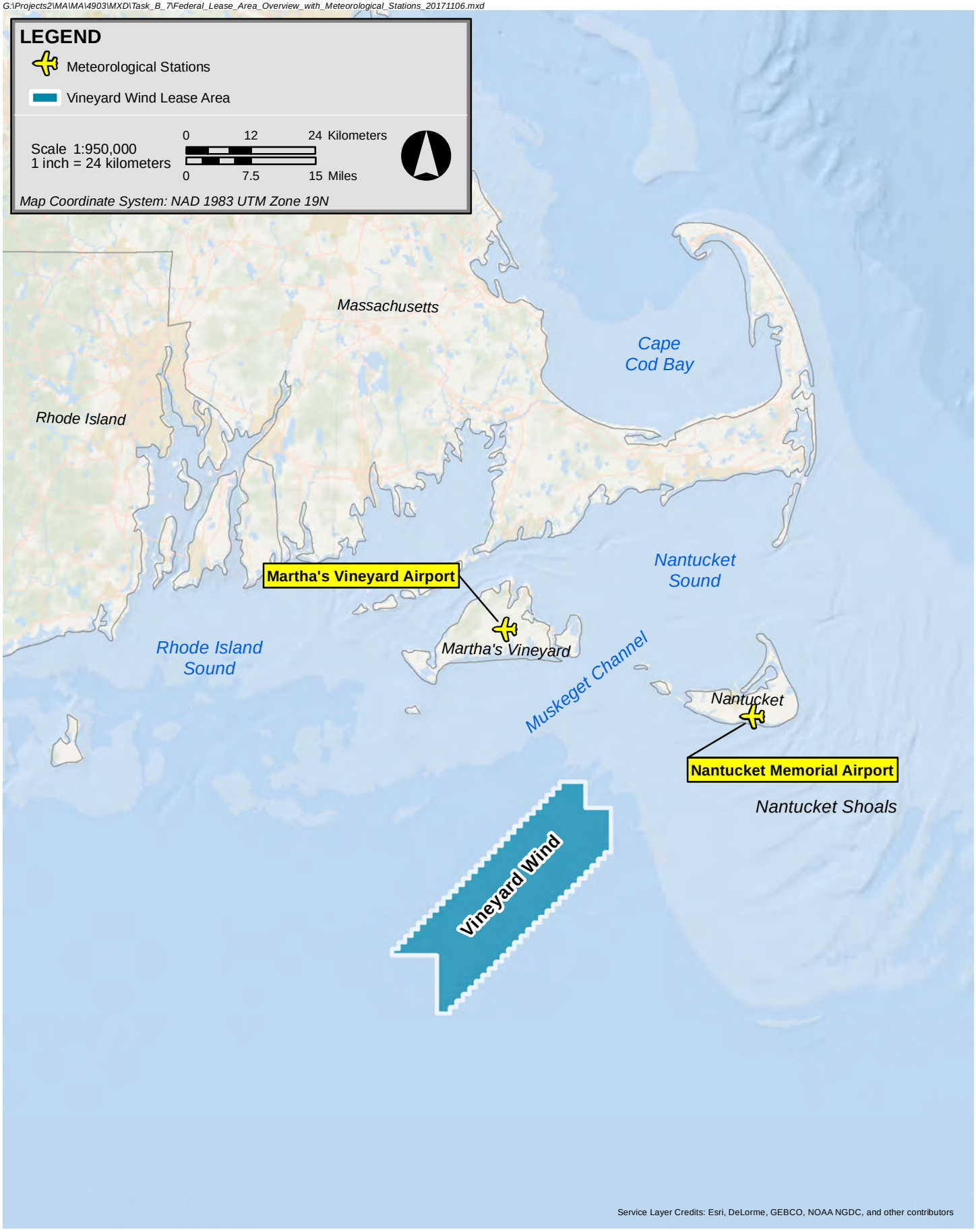
Hourly data were imported into Microsoft Excel for processing and validation. It was discovered that the data contained many more records (with each record representing one observation) than the number of hours in a given time period, indicating duplicate records. A total of 22.6% of the hours (93,393 hours) contained more than one record. Inspection of duplicates indicated that both a special observation and a standard automated observation

were often recorded in a given hour. Special observations are recorded if weather conditions are changing rapidly or crossing specific aviation thresholds. Where this occurred, the automated observation was retained and the special observation removed. This approach maximized consistency across records as the vast majority of records were automated. Some "Summary of Day" and "Summary of Month" records were also removed because these were inconsistent with the hourly data. In total, 53% of the initial raw data (219,710 records) were removed as non-hourly data.

A total of 192,690 records remained in the validated data set, representing two stations as detailed in Table 1.

Table 1 Total Records by Station

Station	Number of Records
Martha's Vineyard	96,354
Nantucket	96,336
TOTAL	**192,690**



Vineyard Wind Project

VINEYARD WIND

Figure 1

Meteorological Stations Used in the Analysis

Validation for data completeness consisted of comparing the number of remaining records to the number of possible records in a given year or season. Seasonal completeness is important to ensure that a given year's data (and thus study results) were not biased toward a particular time of year. As shown in Table 2 and Table 3, all selected sites exceeded 80%completeness for each year and season.

Table 2 Annual Completeness by Station (percent)

Station	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Martha's Vineyard	99.9%	100%	100%	100%	100%	100%	100.	99.9%	99.9%	99.8%	99.9%
Nantucket	99.4%	99.9%	100%	99.9%	100%	100%	100%	100%	100%	100%	99.9%

Table 3 Seasonal Completeness by Station (percent)

Station	Winter	Spring	Summer	Fall
Martha's Vineyard	99.8%	100.0%	99.9%	99.9%
Nantucket	99.9%	99.9%	99.9%	99.9%

In addition to the hourly LCD, ASOS 1-minute "Page 1 data" (DSI-6405) were downloaded for both the Martha's Vineyard and Nantucket stations for the period of 2005 through 2016. This data contained measurements of visibility extinction coefficient, wind speed, and wind direction and were included because they contained more detailed measurements of visibility.

3.0 DESCRIPTIVE DATA ANALYSIS

3.1 Wind Patterns

Prevailing weather at any given site can be understood by typical wind patterns. This relationship is illustrated by wind roses, which display the frequency with which the wind blows from a given direction on a polar plot representing all compass directions. Longer barbs indicate more frequent winds from that direction. Within each barb, different levels of wind speed are broken down, showing typical wind speeds originating from a particular direction. Collectively, wind direction and speed indicate approaching weather, such as warm and humid tropical air masses or cooler and drier continental air masses. Calm winds were defined as reported winds less than 0.5 meters per second and are not included in the wind roses.

Wind roses for each site, dating from 2006–2016, are shown in Figures 2 through 3. Prevailing winds at each site are generally from the southwest, with variance from west counter-clockwise through the south. The percent of hours with calm winds ranged from about 8.5% on Martha's Vineyard to 3.7% on Nantucket. Variation in wind directions and speed at each site is likely due to the location of the site relative to water, both in terms of cardinal direction and distance, and local geographic variations.

Wind roses are provided for each site by month (e.g., average January winds, for all January months in the data set) in Appendix B. In Martha's Vineyard and Nantucket, winds generally originate from the southwest in the spring and summer, shifting to northerly and westerly in the fall and winter. Spring and fall are transitional periods with more variation in wind direction. The highest wind speeds and fewest calm winds occur in winter, with the passage of winter storms, while the lowest speeds and most calm winds occur in the more often stagnant conditions of summer.

3.2 Average Temperature and Humidity

Average temperature and humidity are other metrics typically used to help understand visibility at given locations.

Both Martha's Vineyard and Nantucket display patterns of temperature change throughout the year, with warmer temperatures occurring during the springtime and summer periods and colder temperatures occurring during the fall and winter periods, as shown in Figure 4. Similar patterns between the stations were observed, as illustrated in Figures 5 and 6 with Nantucket having slightly lower daily maximum temperatures and slightly higher daily low temperatures. Histograms of the temperature distribution for each season and station are provided in Appendix C, Temperature Distribution.

Relative humidity has been shown to have a strong effect on visibility (Zhang et al., 2015; Malm, 1999). Water vapor condenses on particles in the air, thereby increasing their size and the corresponding amount of light scattered or absorbed. Figure 7 shows the seasonal changes in relative humidity amongst the two stations with Nantucket having slightly higher average relative humidity.

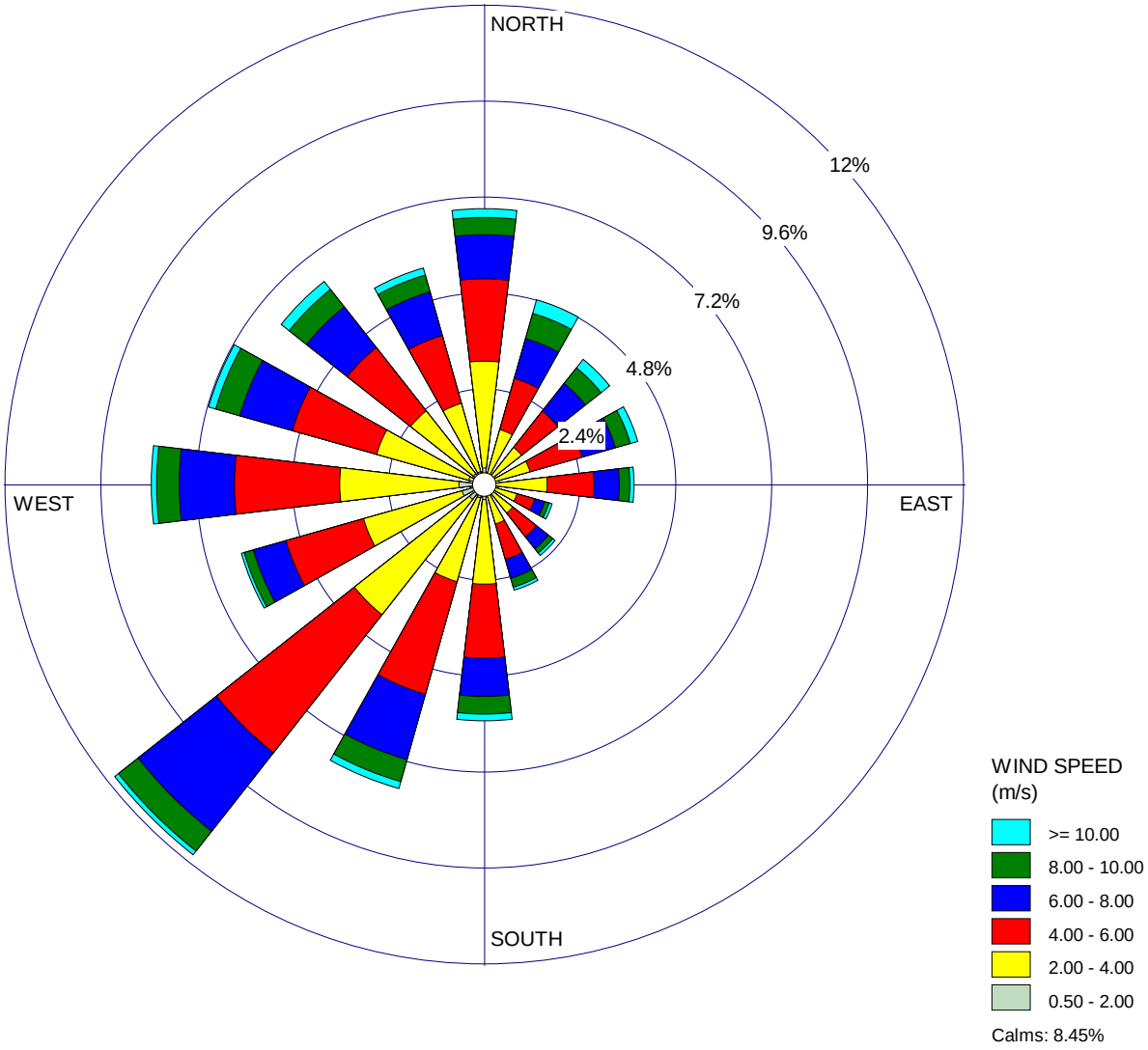
Figure 2

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
10 Year Wind Rose, 2006-2016

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:
	Start Date: 1/1/2006 - 00:00 **End Date: 12/31/2016 - 19:00**	**Epsilon Associates**
	CALM WINDS:	TOTAL COUNT:
	8.45%	**94460 hrs.**
	AVG. WIND SPEED:	DATE:
	4.44 m/s	**11/3/2017**

WRPLOT View - Lakes Environmental Software

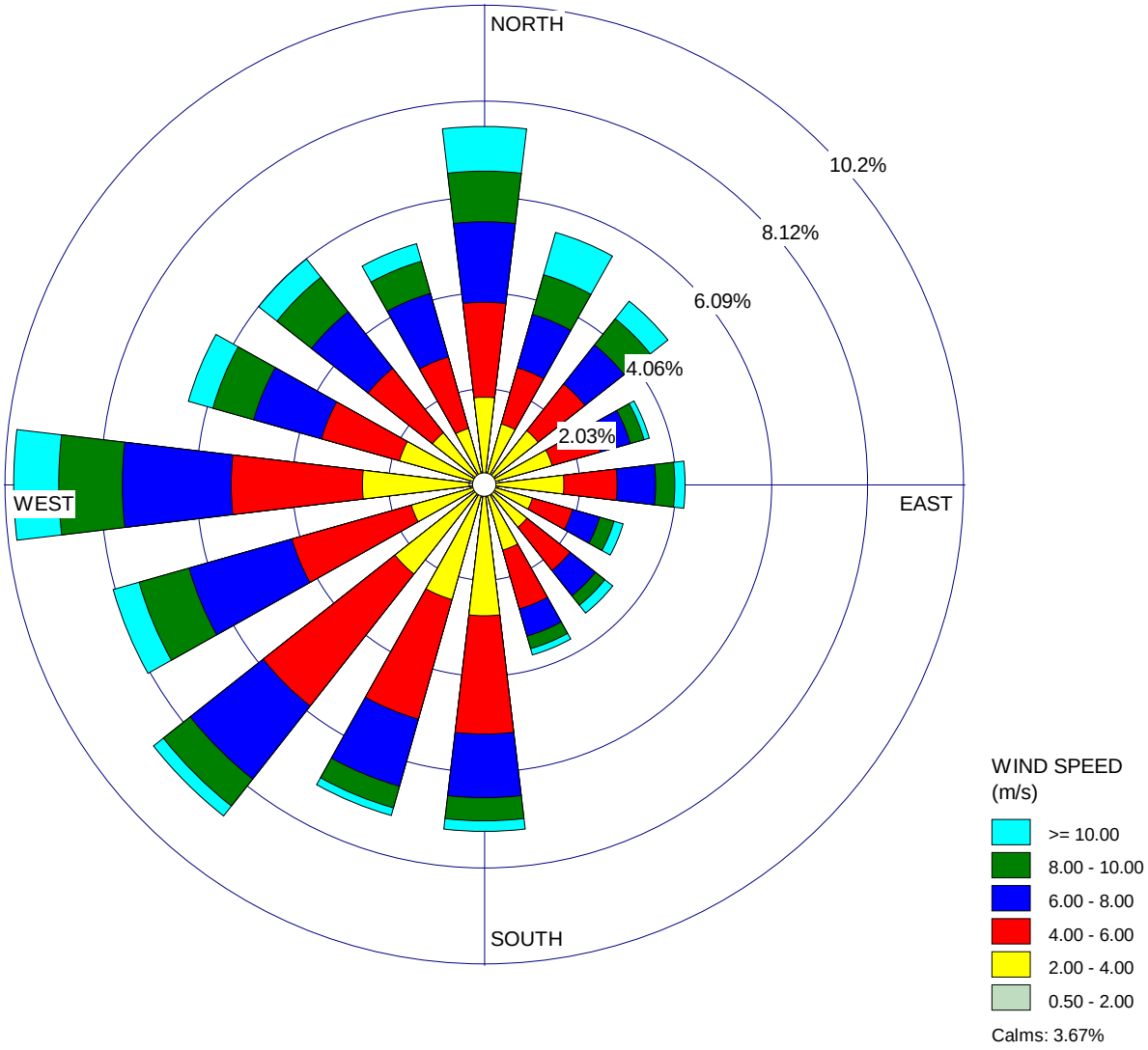
Figure 3

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
10 Year Wind Rose, 2006-2016

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 1/1/2006 - 00:00** **End Date: 12/31/2016 - 19:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **3.67%**	TOTAL COUNT: **95669 hrs.**	
	AVG. WIND SPEED: **5.43 m/s**	DATE: **11/3/2017**	

Figure 4: Monthly Average Temperature and Dewpoint

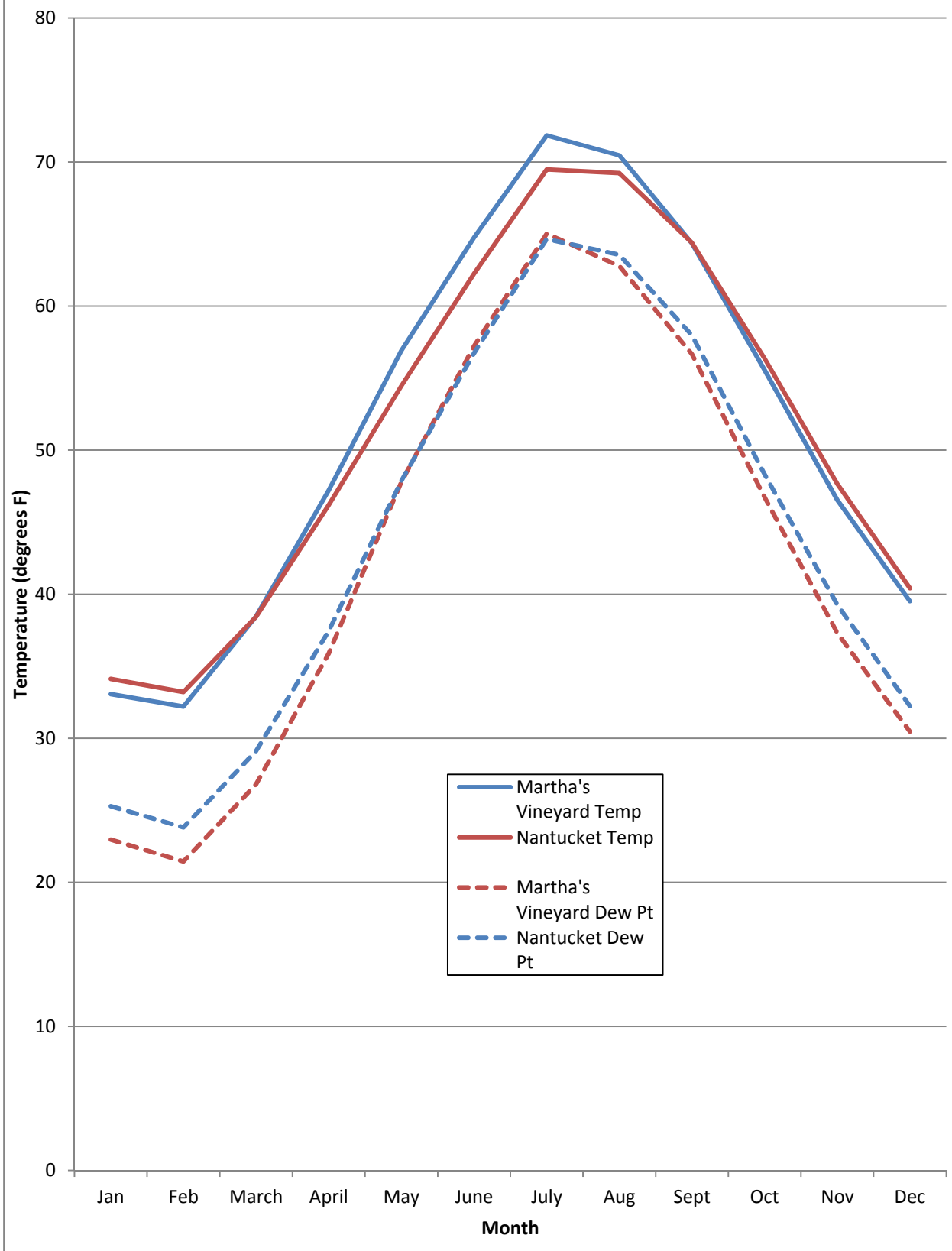


Figure 5: Average Daily High Temperature

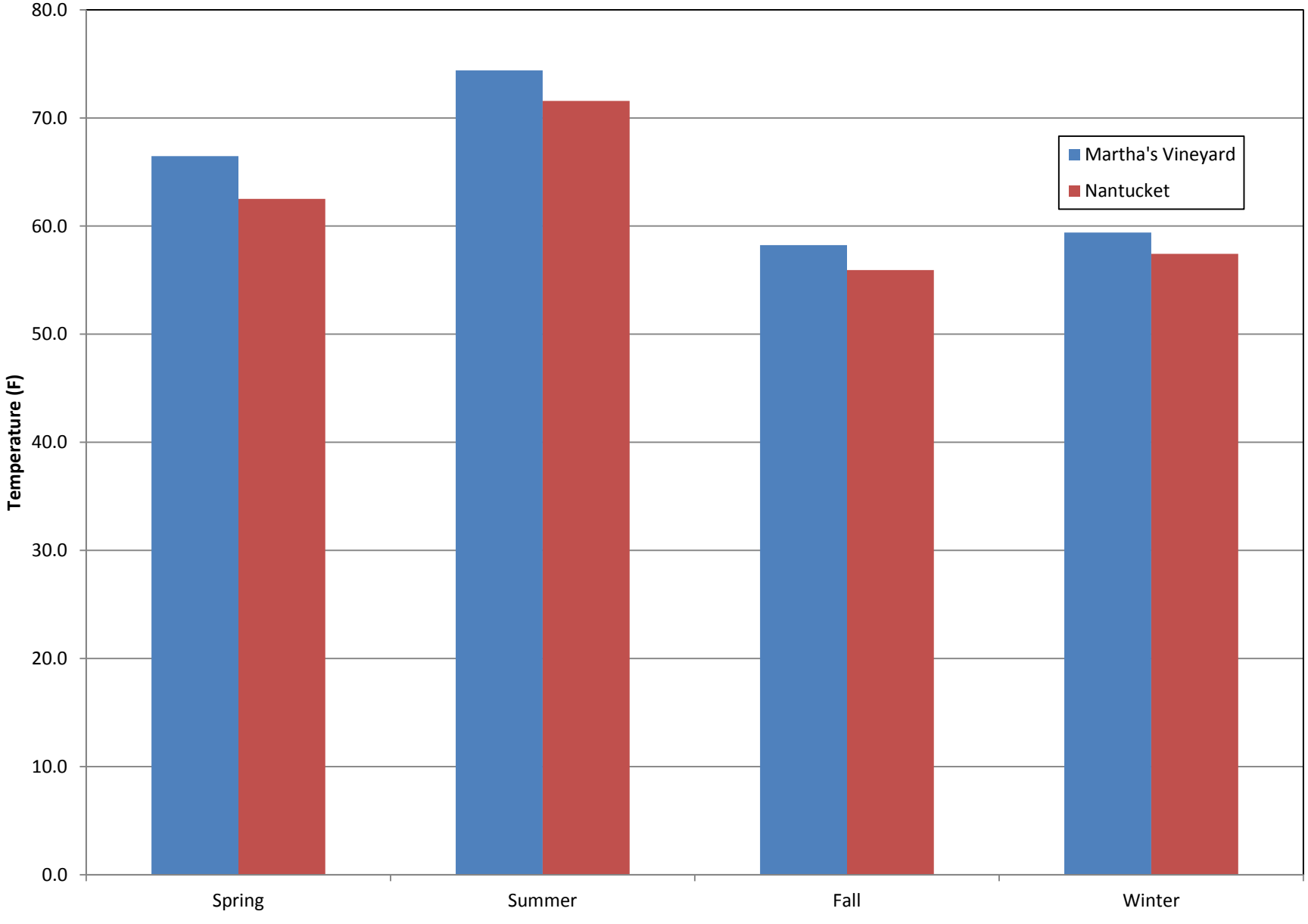


Figure 6: Average Daily Low Temperature

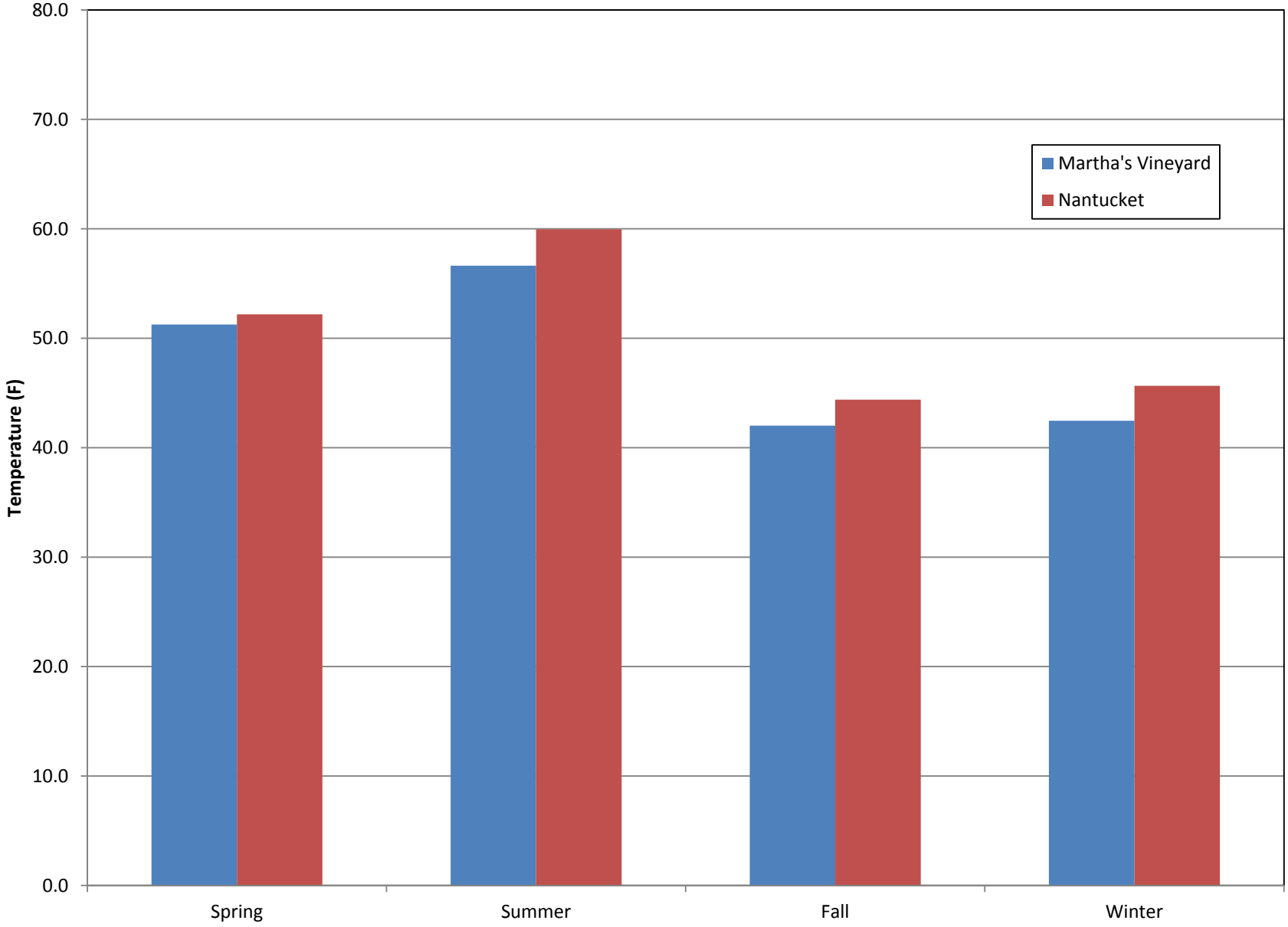
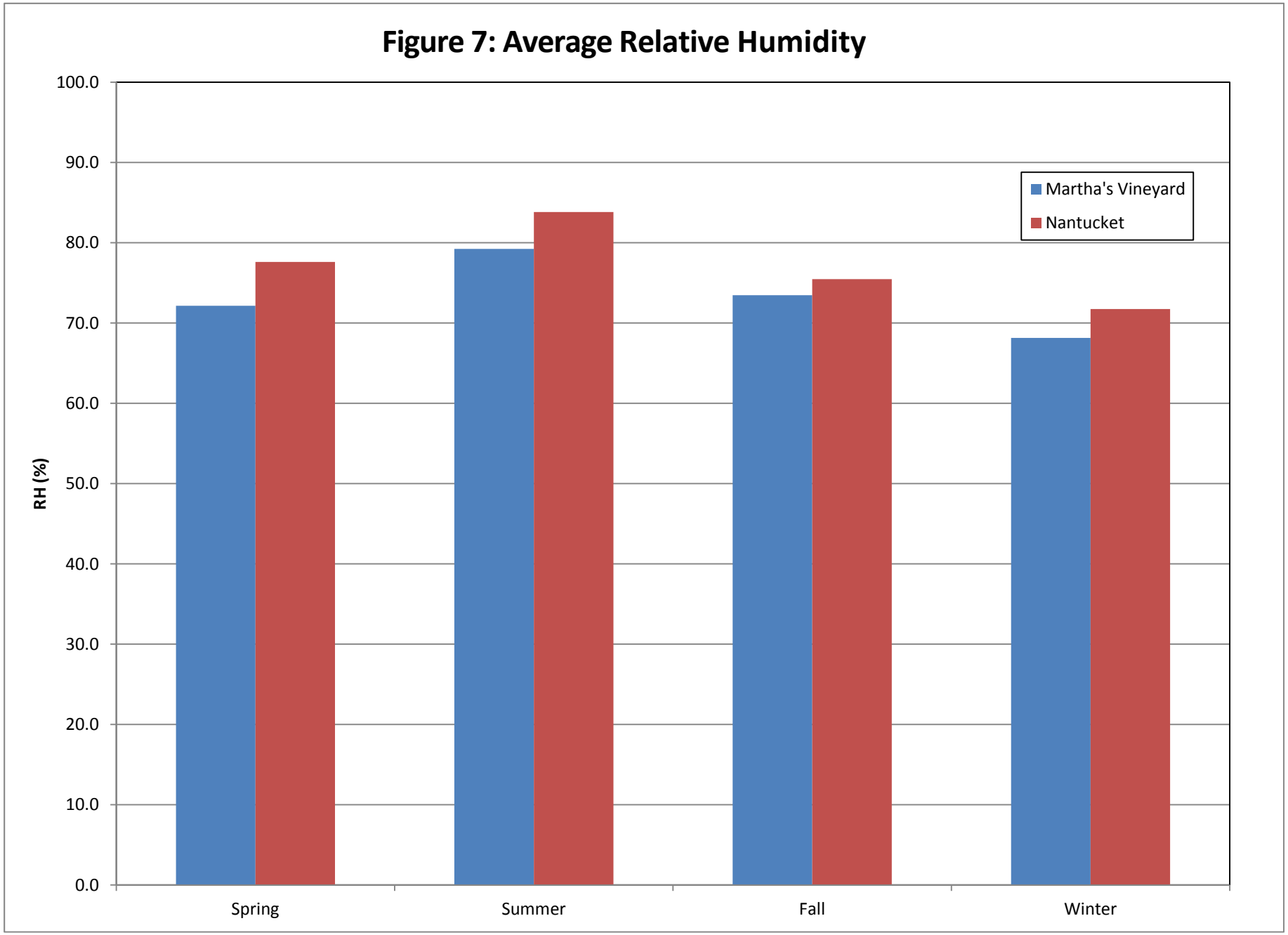


Figure 7: Average Relative Humidity



3.3 Reported Visibilities

Visibility measurements from meteorological stations are typically recorded in intervals ranging from ¼ to 10 statute miles. For the LCD data set, visibility was measured and recorded on a 1-minute basis, averaged across hours, and then binned to the following categories: less than ¼ mile, ¼ mile, ½ mile, ¾ mile, 1 mile, 1¼ miles, 1½ miles, 1¾ miles, 2 miles, 2½ miles, 3 miles, 3½ miles, 4 miles, 5 miles, 7 miles, and 10 miles or greater for the hourly reports. As shown in Table 4, analysis of the hourly data indicates majority of the hours yielded a visibility of 10 miles or greater.

Table 4 Frequency of Reported and Truncated Visibility Ranges

Station	Less than 10 miles (percent)				10 miles or greater (percent)			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Martha's Vineyard	21%	24%	30%	20%	79%	76%	70%	80%
Nantucket	30%	34%	39%	26%	70%	66%	61%	74%

3.4 Common Weather Conditions

In addition to recording information on temperature, dew point, relative humidity and visibility, meteorological stations also capture the current meteorological condition(s); these types of observations are referred to as "present weather." Present weather conditions include events such as haze, fog, various forms and intensities of precipitation, and even more obscure events such as smoke or dust storms. Several conditions may be reported at any time. Conditions that may be considered notable, such as extreme heat or high winds, are adequately captured by the measured parameters and are not included as present weather codes.

For the purposes of this analysis, the conditions most likely to affect visibility are those that would be included in the "Present Weather" field of an observation. For the vast majority of records, no present weather is reported. In other words, conditions were clear, and no "events" (such as haze, fog, and various forms and intensities of precipitation) occurred during that hourly observation. This is expected as weather conditions, such as haze or fog, typically occur infrequently compared to fair weather conditions. However, these data do not indicate periods of high visibility, such as those that may occur under low humidity and temperature. Likewise, these data do not indicate periods of lower visibility, such as that which may occur under periods of high humidity and temperature. The percentage of hours for which present weather is reported or not reported is shown in Table 5. The remaining discussion of present weather will focus on hours for which one or more present weather condition is reported.

Table 5 Frequency of Present Weather Reports (percent)

Station	Present Weather Not Reported				Present Weather Reported			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Martha's Vineyard	81%	78%	78%	83%	19%	21%	22%	17%
Nantucket	78%	73%	72%	80%	22%	27%	28%	21%

At Martha's Vineyard airport, when present weather was reported, the most common conditions were mist and rain. This was consistent across each season and under day and night conditions. At Nantucket airport, the common weather conditions were generally mist and rain as well. However, during the summer months, fog was slightly more common than rain. Mist was the most common condition in all seasons. The average distribution of these conditions on a daily basis is provided in Appendix D, Common Weather Conditions.

Figures 8 and 9 show the frequency of common weather conditions at each site, by season and day/night hours. Any condition that constituted 2% or more of the present weather reports in any season/time of day grouping was included in the charts.

4.0 VISIBILITY ASSESSMENT

4.1 Introduction

Based on the analysis reported in Table 4, approximately 70% of the hours reported visibility as 10 miles or greater. Because of this, visibility must be calculated directly to determine average visibility, the distribution of visibility, and maximum visibility using currently available data. To fill this data gap, daily typical visibility ranges and potential maximum and average visibility across seasons were calculated using the Beer-Lambert law. Martha's Vineyard and Nantucket both report data on an hourly and minute basis for general weather observations.

This analysis focuses on the meteorological variables which affect visibility the most and does not equate to actual visibility of the wind turbines or associated structures. While meteorology will impact the ability of an observer to see the wind turbines or associated structures factors such as turbine color, scale, movement, distance, and observer geometry are also other critical considerations.

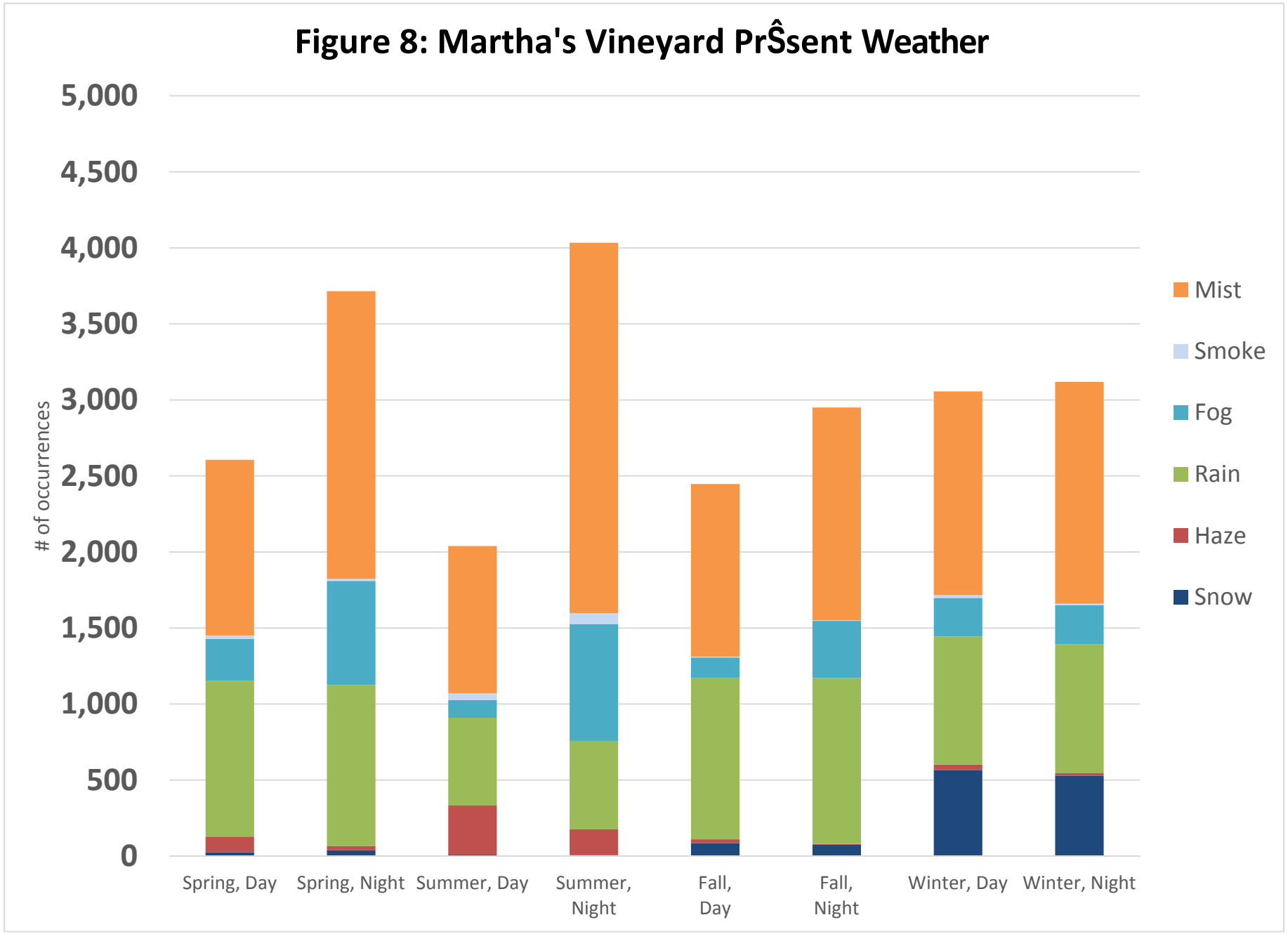
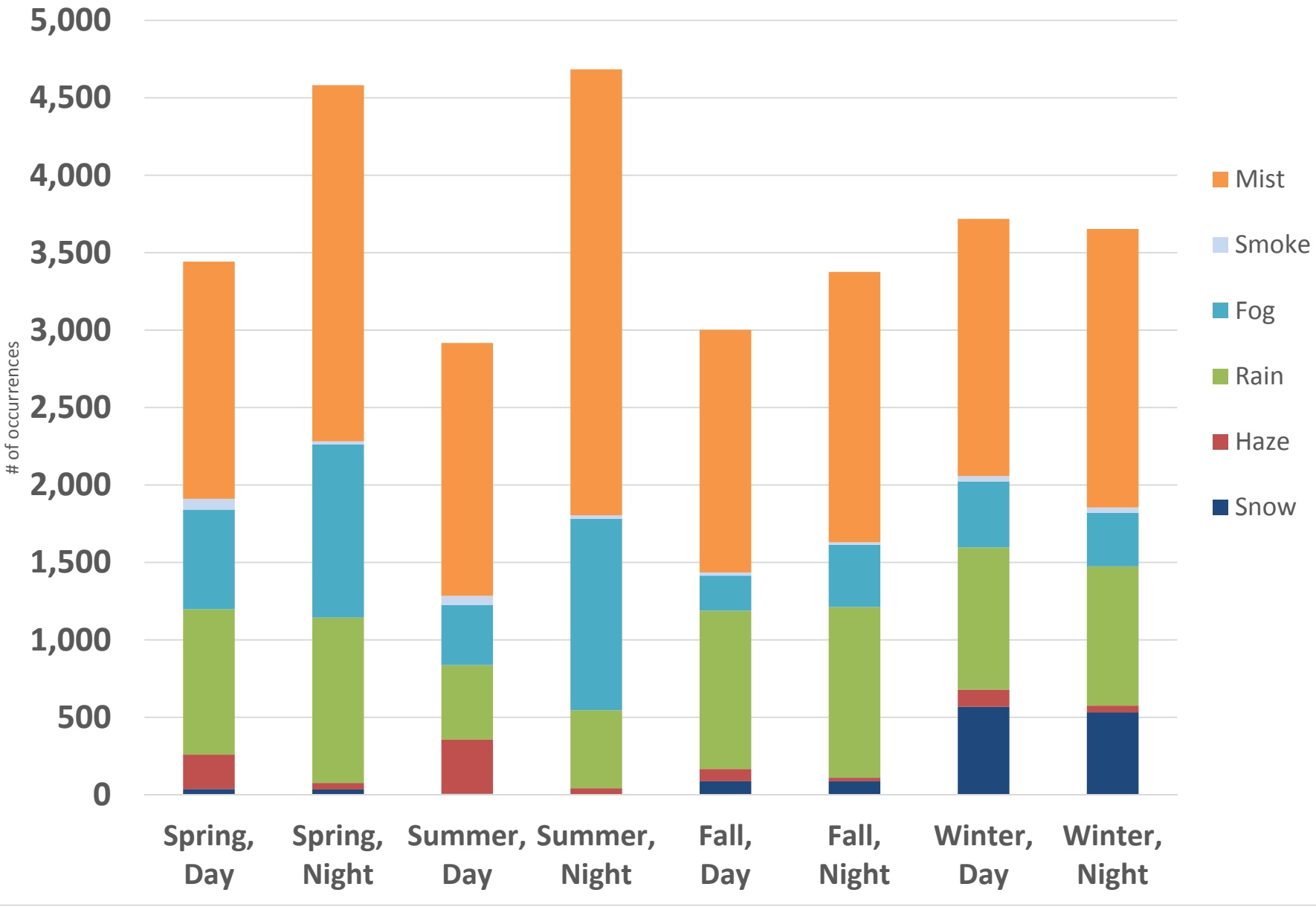


Figure 8: Martha's Vineyard PrŜsent Weather
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
# of occurrences
Spring, Day
Spring, Night
Summer, Day
Summer, Night
Fall, Day
Fall, Night
Winter, Day
Winter, Night
Mist
Smoke
Fog
Rain
Haze
Snow

Figure 9: Nantucket PWŜsent Weather



4.2 Visibility

Visibility is defined as "the greatest distance at which an observer can just see a black object viewed against the horizon sky" (Malm, 1999, page 1). The operational definition of visibility (or meteorological optical range, "MOR"), as defined by the World Meteorological Organization, is the length of a path in the atmosphere required to reduce the intensity of light to 5%of its original value (WMO, 2011). This 5% value is considered the threshold contrast, and the outer limits at which an observer can still identify an object.

The intensity of light (i.e., radiation) is affected by scattering and absorption of the light from gases or particulate matter in the atmosphere. The reduction of intensity of a beam of light due to absorption and scattering is called extinction. An extinction coefficient is used to describe the amount of scattering and absorption based on the following relationship:

$$b_{ext} = b_{s,p} + b_{s,g} + b_{a,p} + b_{a,g} \quad \text{(Eqn 1)}$$

Where:

s = scattering
a = absorption
p = particles/aerosol
g = gases

Scattering is the redirection of light from its original direction and can be caused by gases or particulates. Scattering due to gases (b_{sg}) is also known as Rayleigh scattering, where the scattering objects are much smaller than the wavelength of light. This is the baseline scattering caused by air that is always present, even in the most pristine environment. Scattering due to aerosol particles has a larger impact on the total b_{ext}, and its calculation requires knowledge of the ambient aerosol: the size distribution, optical properties, composition, and number of particles. According to Malm (1999,) scattering in the east due to ambient aerosols and air molecules can account for up to 60% of total light extinction and depends primarily on concentrations of gaseous sulfates, organics, and nitrates. Absorption is the conversion of light energy to heat or chemical energy.

The extinction coefficient, b_{ext}, relates to visibility and contrast according to the Beer-Lambert law of extinction:

$$\frac{I}{I_o} = e^{(-b_{ext} * x)} \quad \text{Equation 2}$$

Where:

I = intensity at distance x
I_o = intensity at the observer
I/I_0 = contrast
x = visibility distance

For a defined contrast of 5 percent, the equation simplifies to:

$$x = -\frac{\ln(0.05)}{b_{ext}} \qquad \text{Equation 3}$$

Therefore, determining visibility distance at any given time requires knowledge of the extinction coefficient as detailed in Equation 1. Although absorption and scattering due to ambient air (i.e., gases) play a role in determining visibility—and these processes are influenced by meteorological variables such as temperature and dew point—the greatest contributor to reduced visibility (by means of a large extinction coefficient) is scattering by aerosols (Malm, 1999). As with ambient air, scattering by aerosols is increased by high relative humidity; hygroscopic particles grow as water condenses on them, increasing their ability to scatter light. Hygroscopic particles such as ammonium nitrate, and ammonium sulfate, and sea salt have been shown to have the large impacts on visibility (EPA, 2016).

4.3 Visibility Measurement

Due to the fact that visibility is strongly impacted by scattering of aerosols, time-resolved (e.g., daily or hourly) speciated particulate matter data (e.g., mass of sulfates, nitrates, and carbon) and relative humidity data are necessary to predict visibility by calculating a site- and time-specific extinction coefficient. For this study, data of this type were unavailable. However, the basis for reported hourly (LCD) visibility data is a direct measurement of the extinction coefficient on a 1-minute time resolution. These data were used to calculate visibility, which was then used to bin to discrete intervals representing distances up to 10 miles before being reported. Although the measured extinction coefficient, and thus the calculated visibility data, account for actual ambient particulate matter, this post-processing makes it very difficult to correlate hourly visibility data with any other monitored parameter such as relative humidity and hourly fine particulate matter (defined as particulate matter with a diameter of 2.5 microns or less, or $PM_{2.5}$).

One-minute data, however, are available in their raw form (i.e., not summarized or binned), for both the Martha's Vineyard and Nantucket meteorological stations, thereby providing a more precise measurement of visibility. These data are collected by ASOS. The visibility sensor on the ASOS unit operates by measuring the amount of forward scattering across a path of known length. A transmitter projects a beam of light through a 0.75-cubic-foot volume of air and the amount of forward scattering at the receiver is measured.

The advantage of using this data for predicting visibility is that all of the variables affecting visibility are included, thereby negating the need to measure or approximate each one separately. However, one variable likely not captured by these data is the presence of sea spray and sea salts; as the monitor is on land, it would not measure any sea spray over the ocean's surface that would reduce visibility.[1] No long-term data collection sites (at airports or buoys) collect these data. Thus, visibility measurements using this measured extinction coefficient represent an upper bound of the actual visibility for an observer on land looking out over the ocean, and are therefore conservative estimates and actual visibility distances are likely shorter.

One-minute raw ASOS data from NCDC were obtained for Martha's Vineyard and Nantucket airports for the years 2006 through 2016. As reported by Husar (2002) and observed in the downloaded data, the ASOS visibility sensor has a lower detection limit of 0.05 kilometer^{-1}. This corresponds to a maximum visibility of approximately 37 miles.

4.4 Visibility Data (6405 Dataset)

The 1-minute ASOS data from Martha's Vineyard and Nantucket airports for the years 2006 through 2016 were imported into Microsoft Excel. A basic data validation measure of checking that the visibility coefficient is less than 10 was performed to ensure the correct data were being used. After this validation, the 1-minute data were summarized into hourly averages. A total of 91,408 hourly records from Martha's Vineyard and 87,654 hourly records from Nantucket were used in the analysis.

For each hour, visibility was calculated from the hourly average extinction coefficient, and assuming a contrast threshold of 5%, according to the Beer-Lambert law (equation 3). The threshold contrast was set at 5% for this work following the World Meteorological Organization definition of visibility, and also because this is the contrast used by ASOS in converting the measured extinction coefficient to visibility for the hourly data set.

The annual distribution of visibility distances at Martha's Vineyard and Nantucket appear in Figure 10 and Figure 11. Both show a relatively flat trend, with only minor maximums at around one mile. There is also a peak at the upper end of visibility because of the instrument's detection limit, which should be viewed as 32 miles or greater. This final bin is not included in the histograms. Values of 32 miles or greater constitute 22% of the data on an annual basis. The cumulative frequency distribution of annual visibilities from Martha's

[1] One data set is available from the Interagency Monitoring Of Protected Visual Environments (IMPROVE) for a monitoring station (MAVI1) on Menemsha Pond in Aquinnah, Martha's Vineyard. That data set includes light extinction attributable to sea salt. Of the 1,236 valid readings between 2003 and 2013, sea salt contributed an average of 10% to the light extinction, and a maximum of 67%.

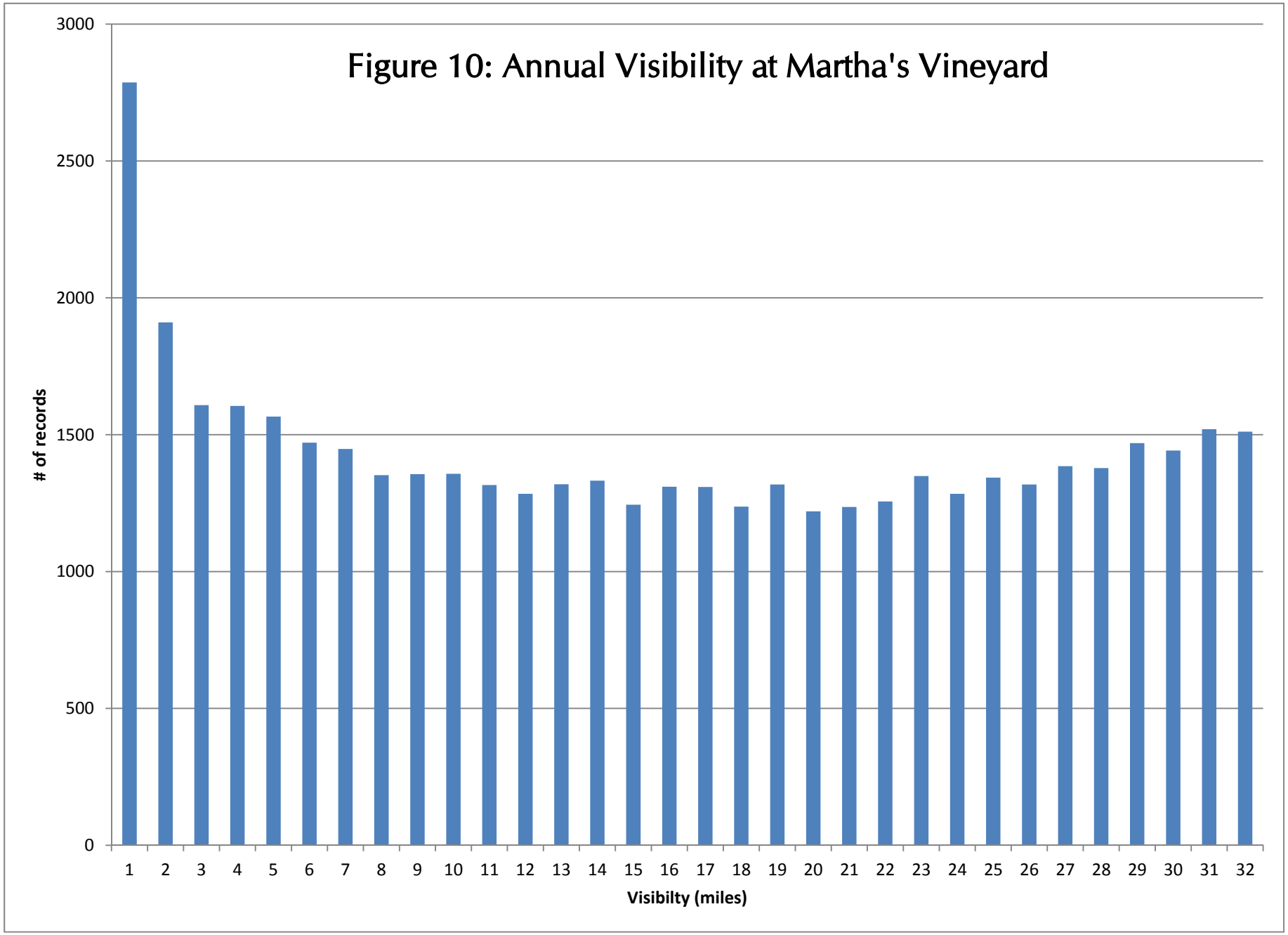


Figure 10: Annual Visibility at Martha's Vineyard
# of records
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Visibilty (miles)

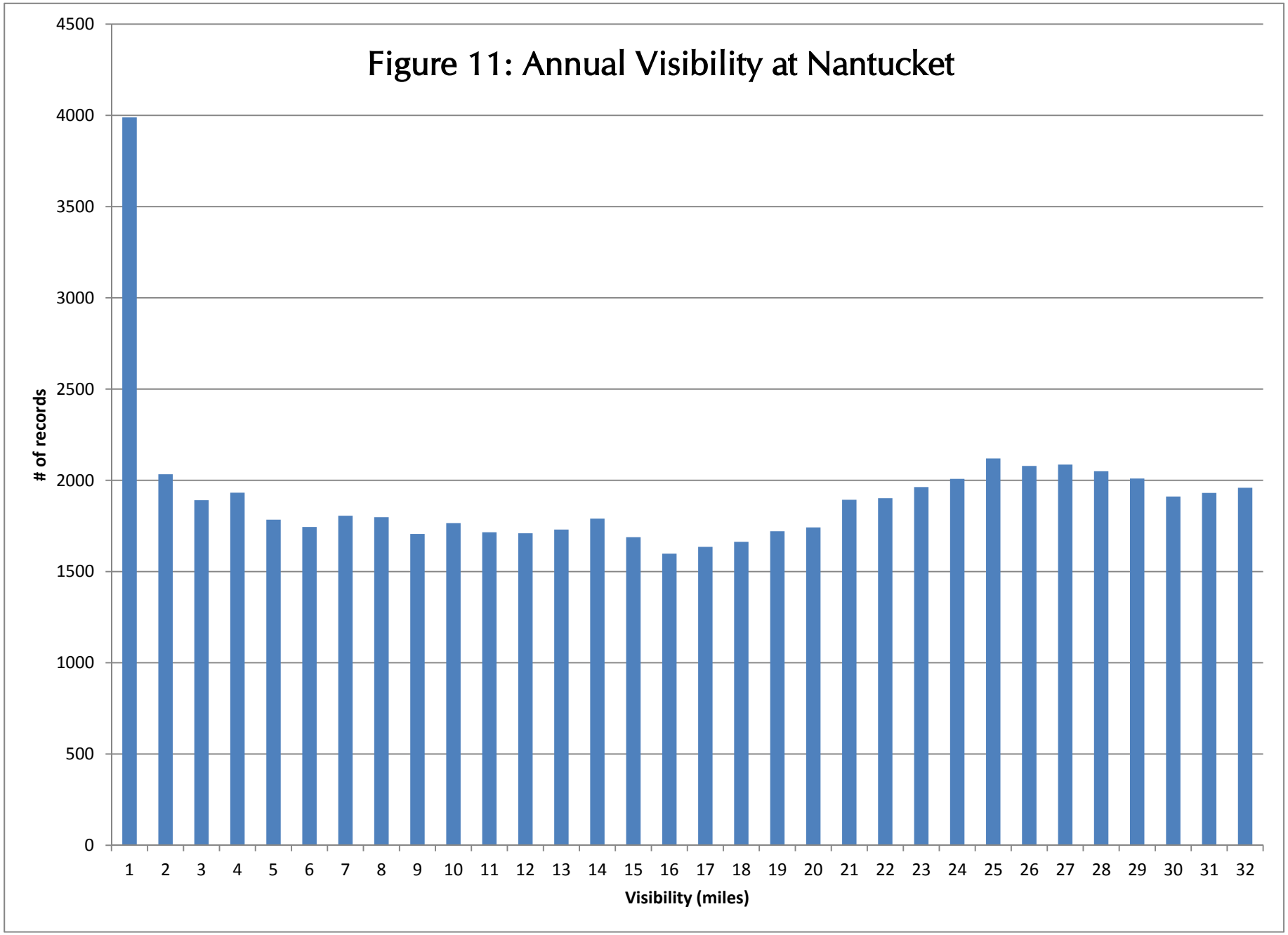


Figure 11: Annual Visibility at Nantucket
# of records
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Visibility (miles)

Vineyard and Nantucket in Figures 12 and 13, respectively, show a nearly straight line and indicate a uniform distribution. The small fluctuations in the annual distribution are influenced by seasonal trends, shown in Figure 14 for Martha's Vineyard and Figure 15 for Nantucket.

On average, visibility at both Martha's Vineyard and Nantucket is highest in the fall and lowest in the summer, as shown in Table 6. Maximum visibility in all seasons is identical as it reaches the instrument detection limit. Average visibility is a better indication of trends by season, as on any day in a given season the conditions may be right for the maximum possible visibility. The percent of days annually, and across seasons, with at least four hours exceeding a threshold visibility (10, 15, 20, 25, or 30 miles) are shown in Figure 16 for Martha's Vineyard and Figure 17 for Nantucket.

Table 6 Seasonal Average and Maximum Visibility

Station	Season	Visibility (miles)[1]		
		Minimum	Maximum	Average
Martha's Vineyard	Annual	0.3	> 32.0	30.8
	Spring	0.3	> 32.0	30.7
	Summer	0.3	> 32.0	26.5
	Fall	0.3	> 32.0	33.3
	Winter	0.3	> 32.0	32.7
Nantucket	Annual	0.3	> 32.0	23.2
	Spring	0.3	> 32.0	22.8
	Summer	0.3	> 32.0	21.2
	Fall	0.3	> 32.0	25.3
	Winter	0.3	> 32.0	23.5

[1]Distances do not account for sea spray and sea salt, therefore actual visibility is anticipated to be less.

Figure 12: Cumulative Frequency Distribution of Martha's Vineyard Visibility

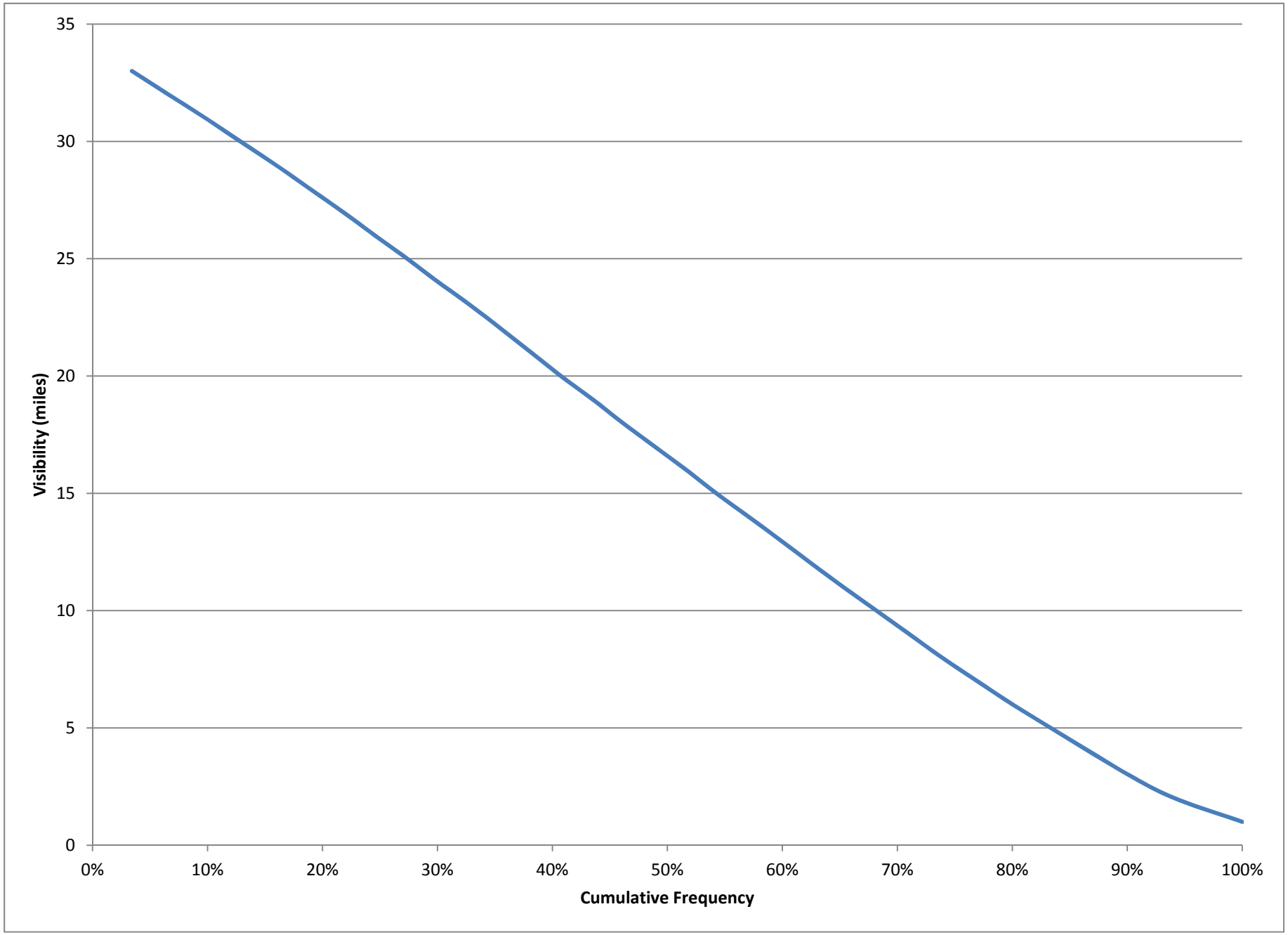
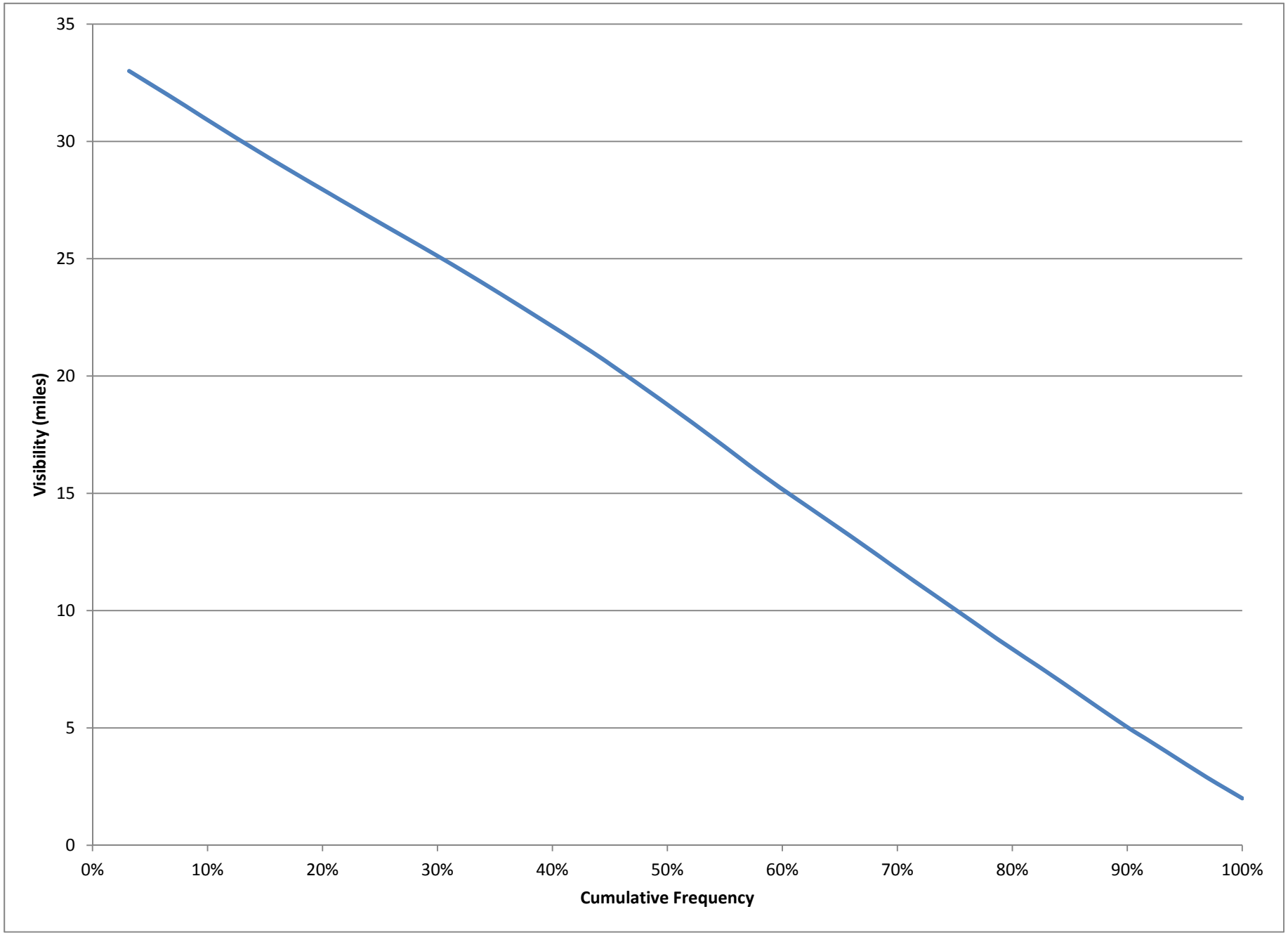


Figure 13: Cumulative Frequency Distribution of Nantucket Visibility



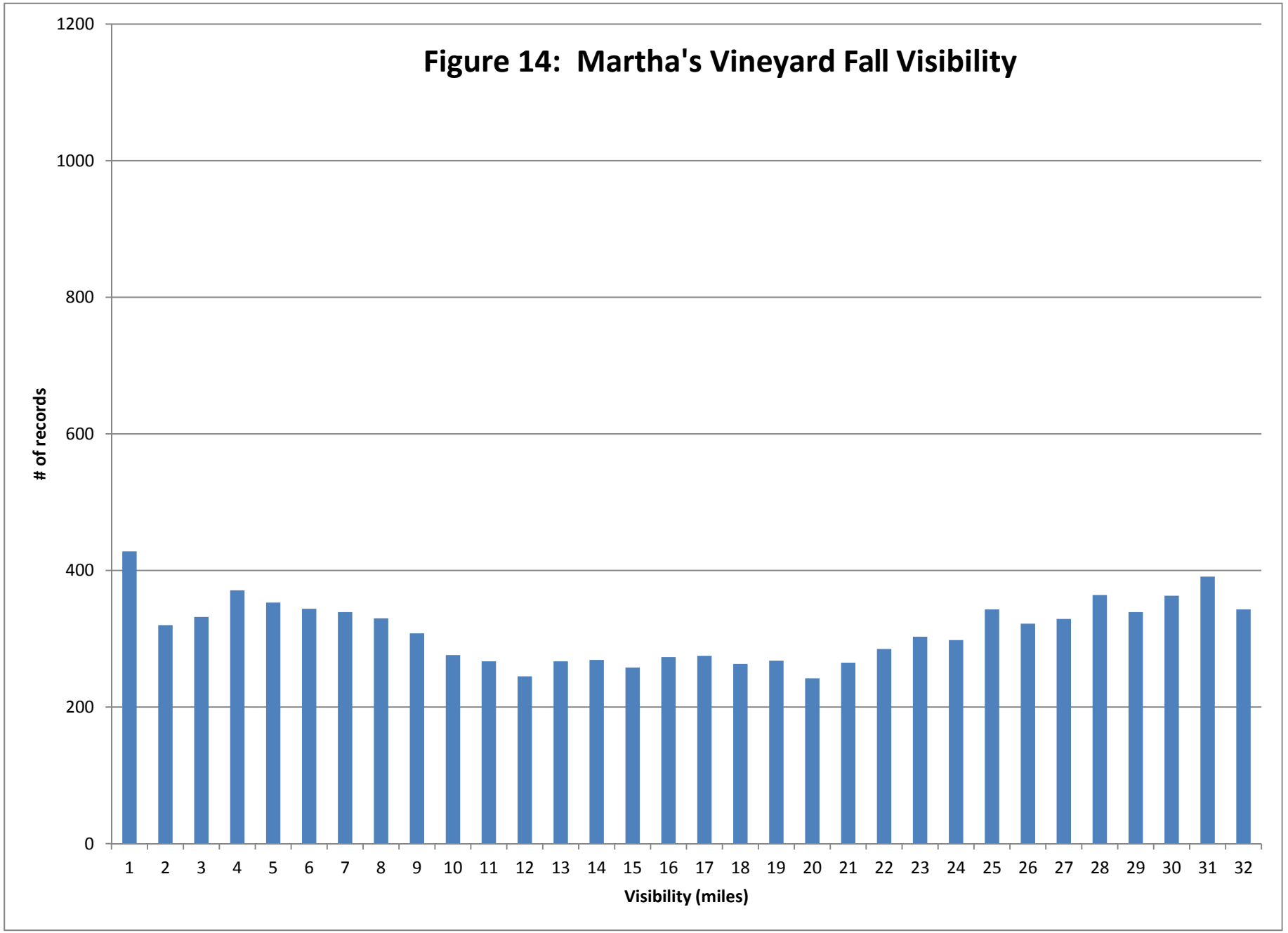


Figure 14: Martha's Vineyard Fall Visibility
1200
1000
800
600
400
200
0
# of records
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Visibility (miles)

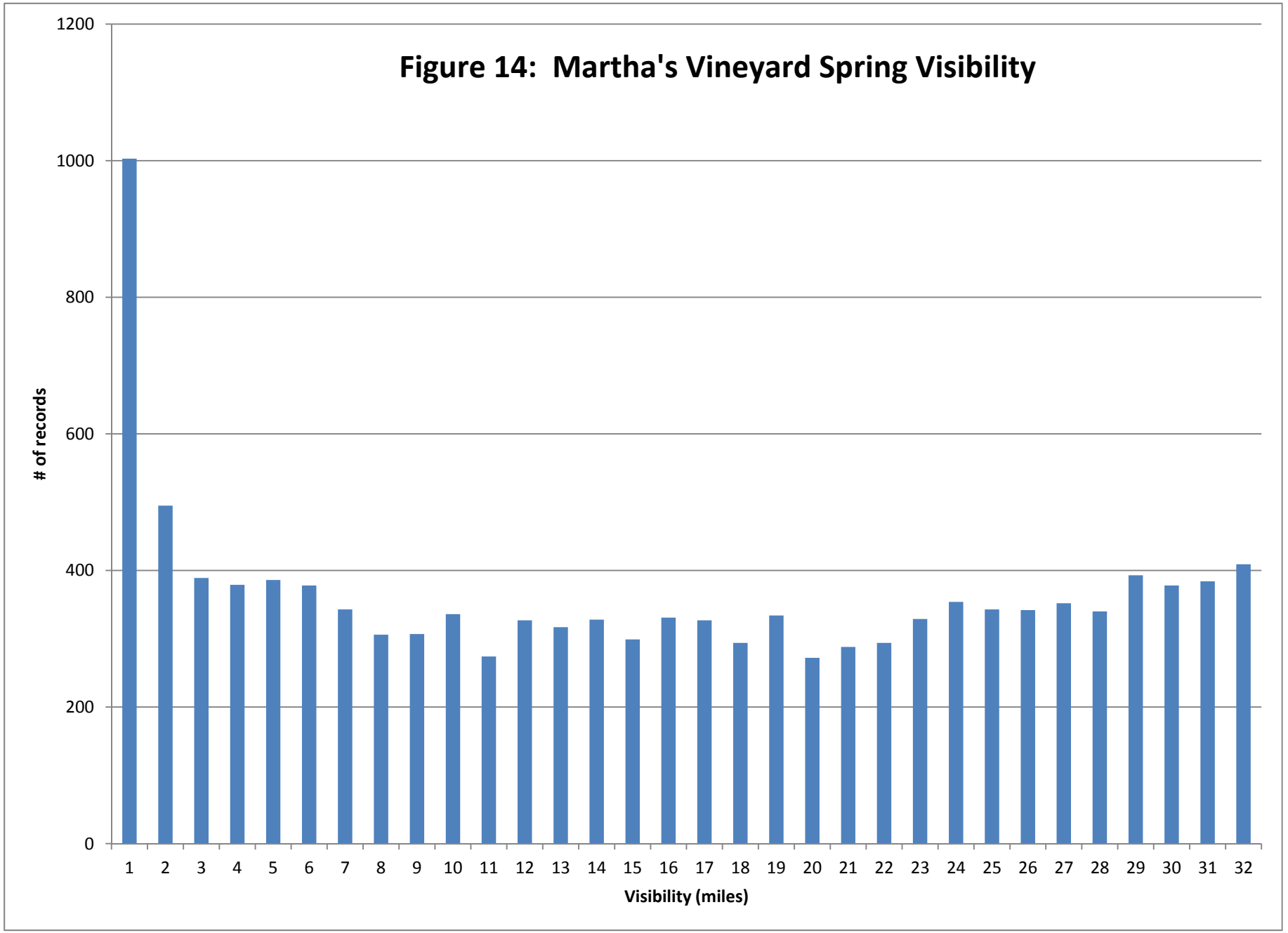


Figure 14: Martha's Vineyard Spring Visibility
1200
1000
800
600
400
200
0
# of records
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Visibility (miles)

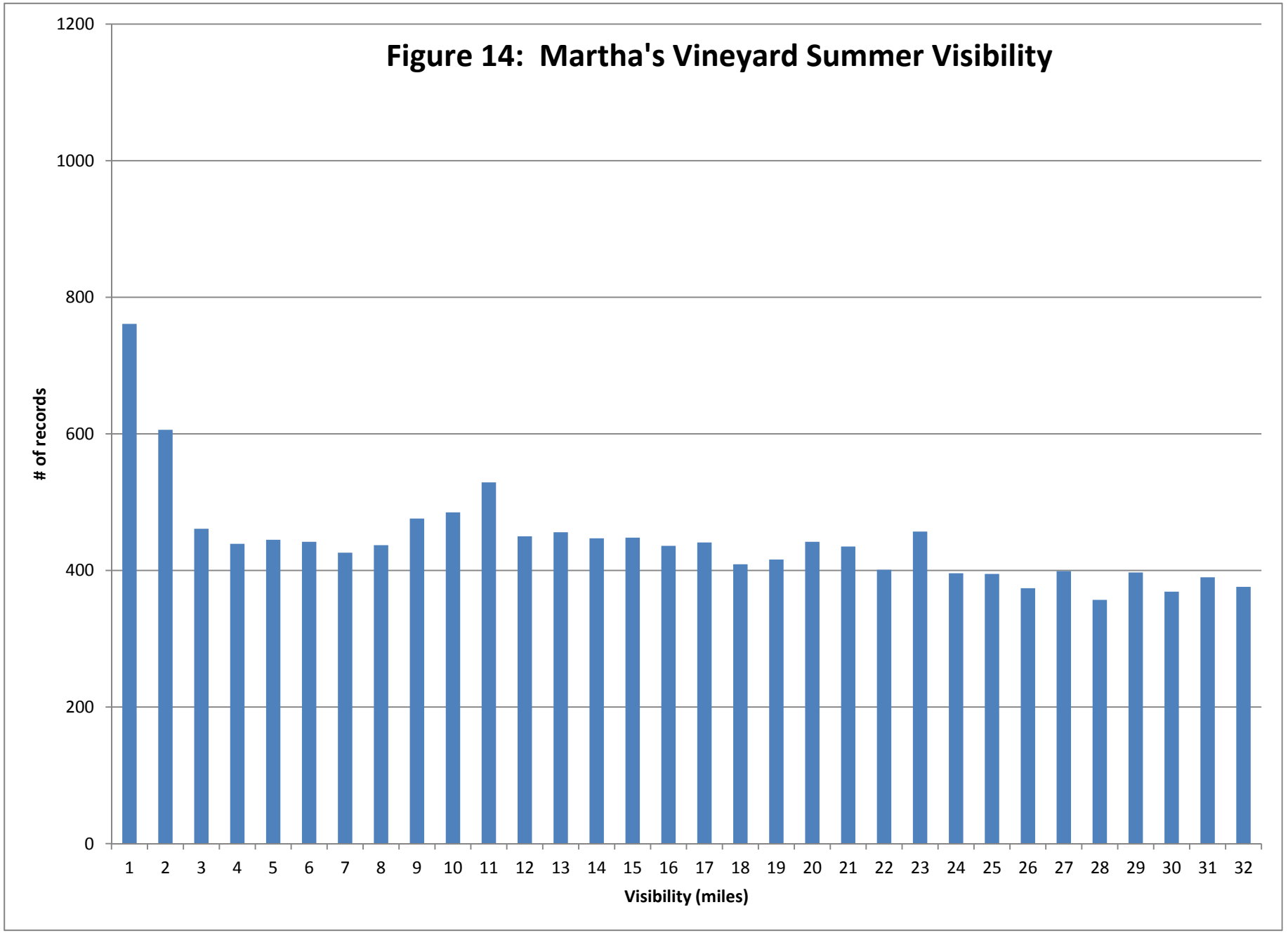


Figure 14: Martha's Vineyard Summer Visibility
1200
1000
800
600
400
200
0
# of records
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Visibility (miles)

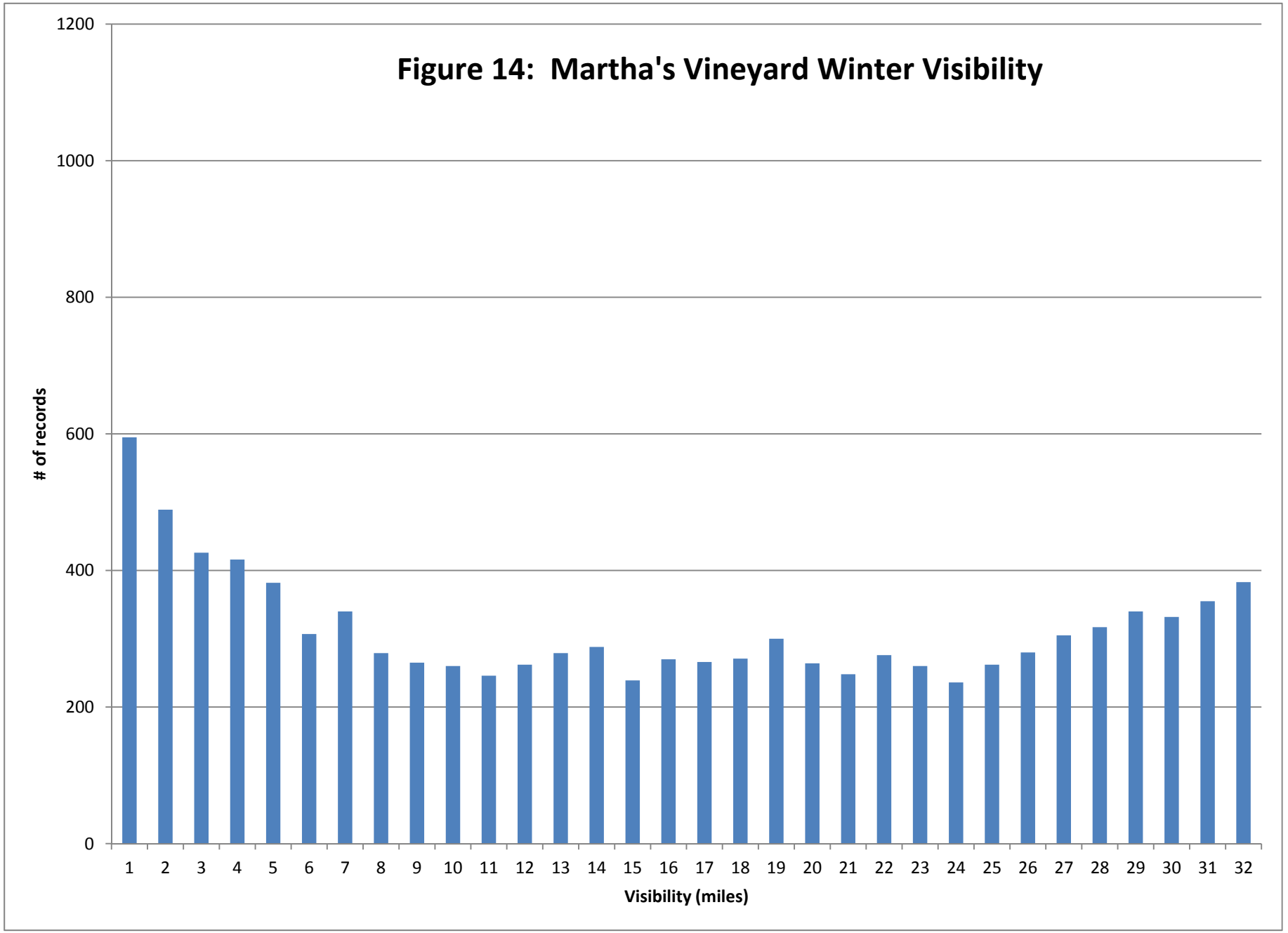


Figure 14: Martha's Vineyard Winter Visibility
1200
1000
800
600
400
200
0
# of records
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Visibility (miles)

Figure 15: Nantucket Fall Visibility

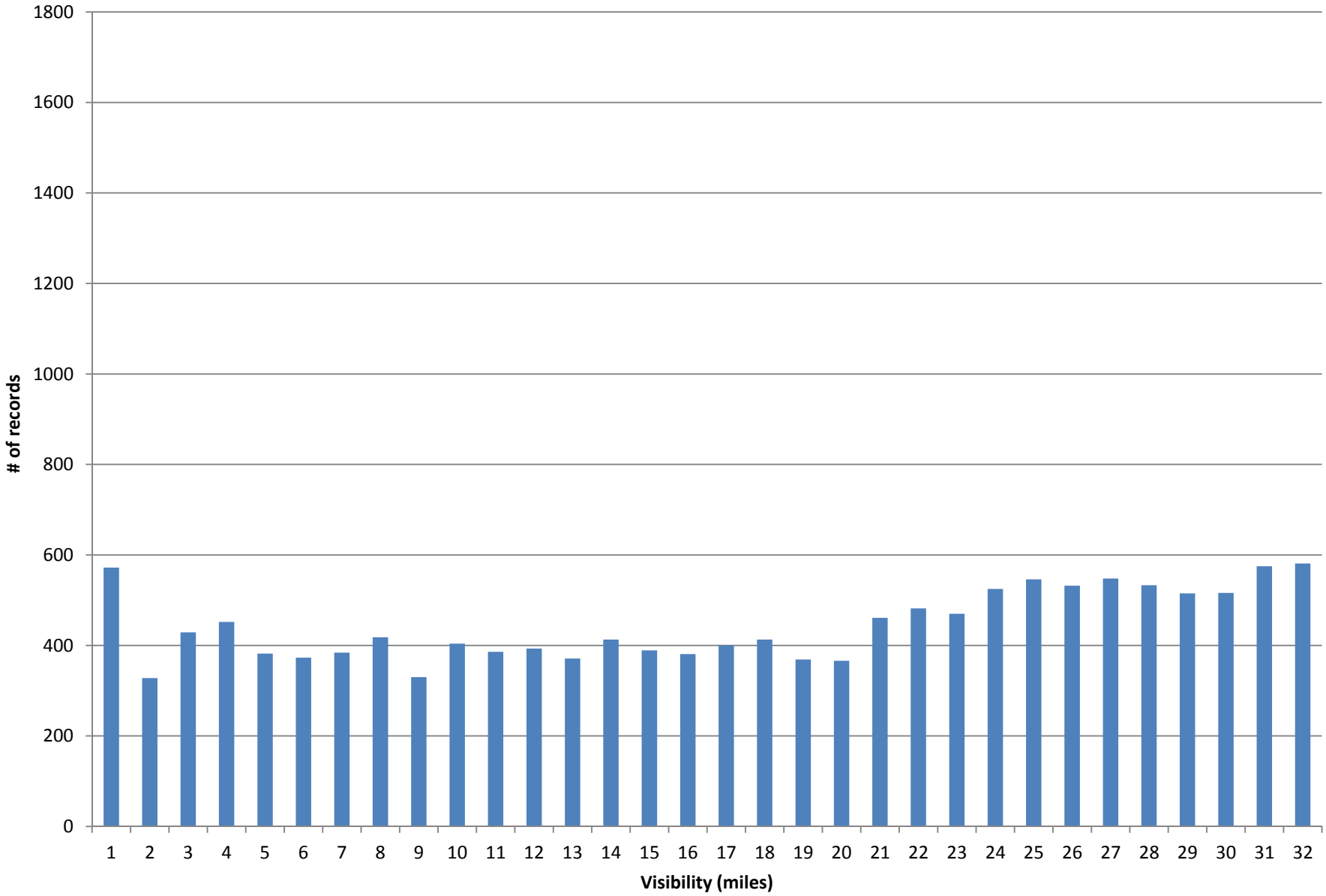
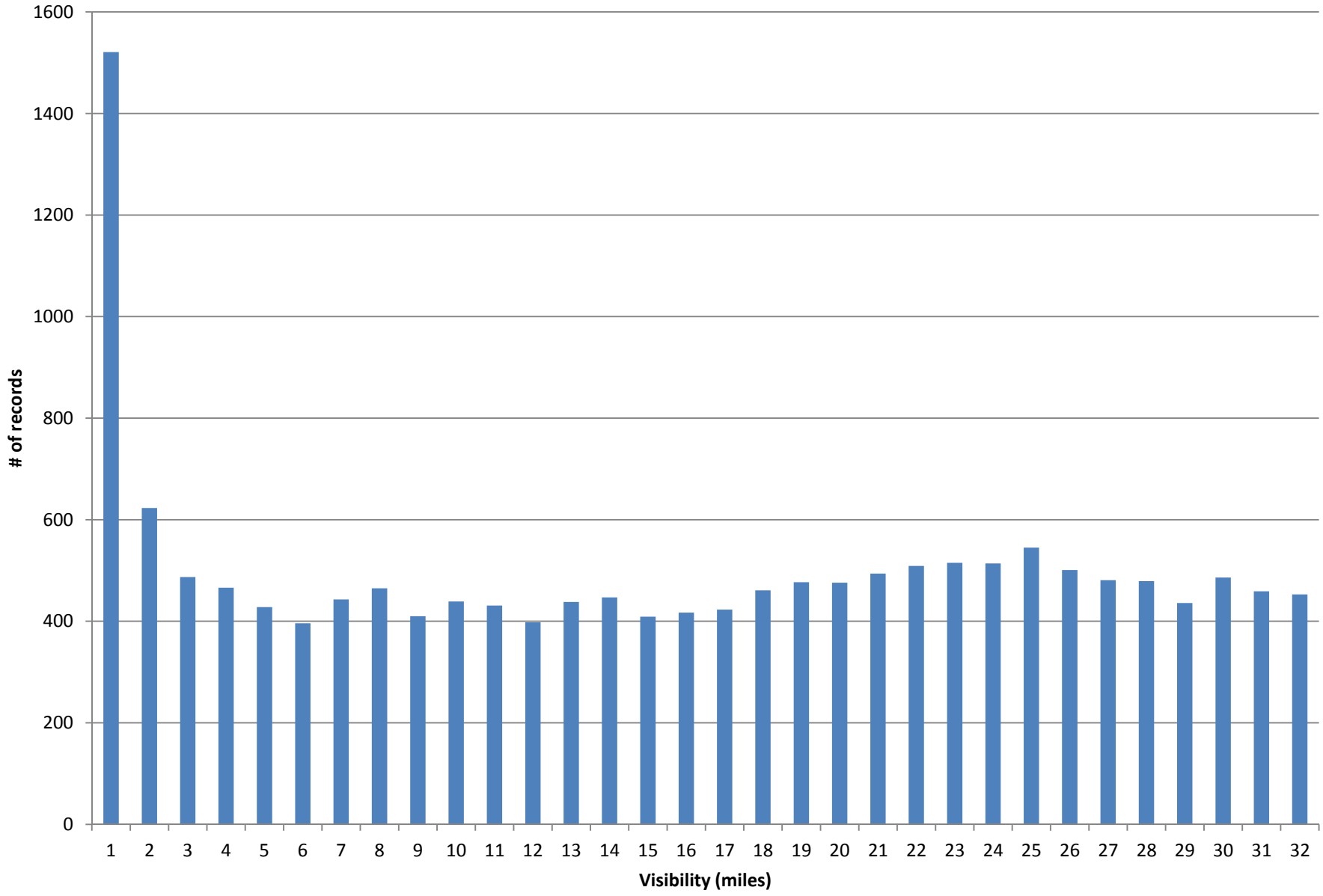


Figure 15: Nantucket Spring Visibility



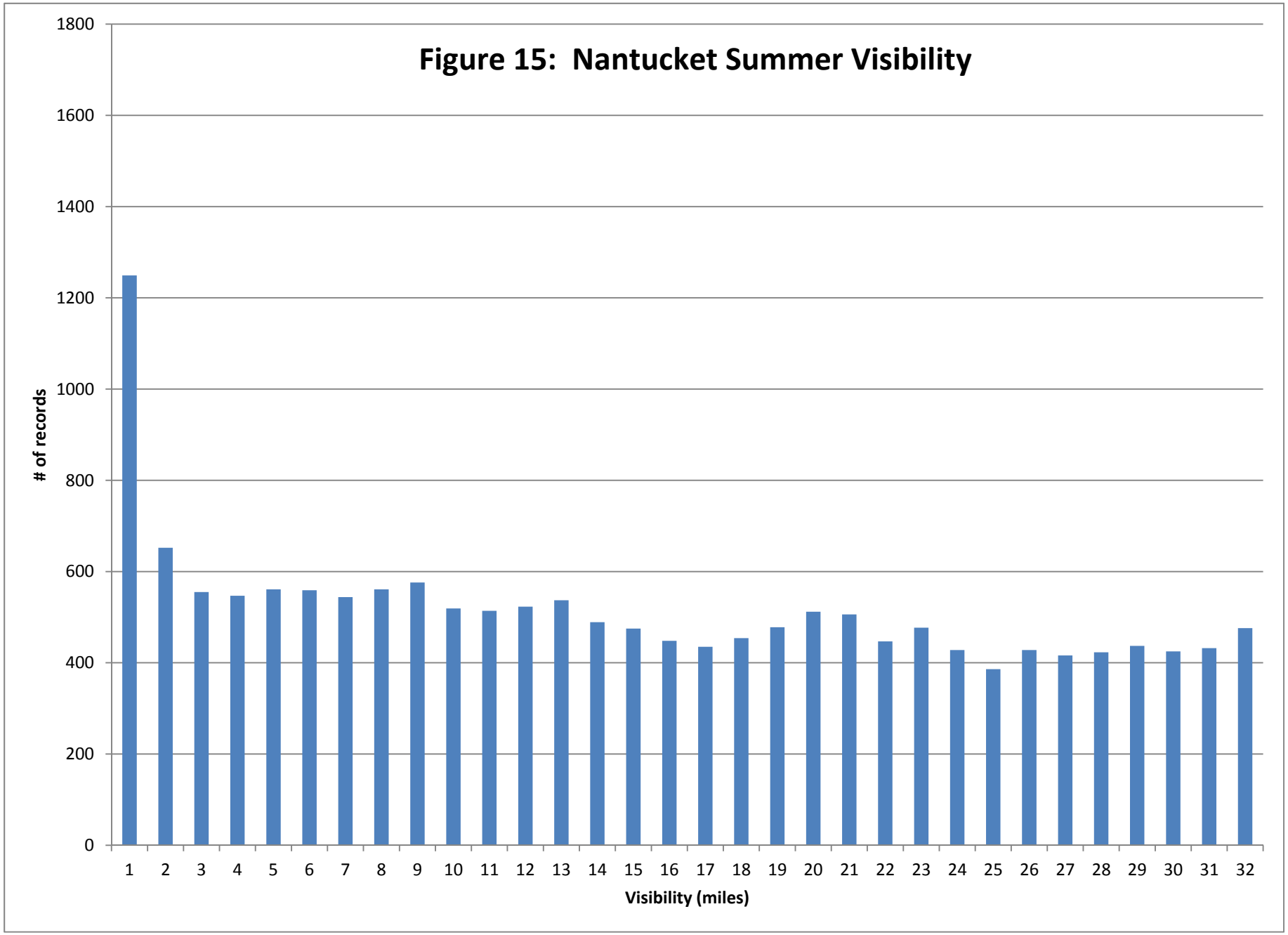


Figure 15: Nantucket Summer Visibility
# of records
1800
1600
1400
1200
1000
800
600
400
200
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Visibility (miles)

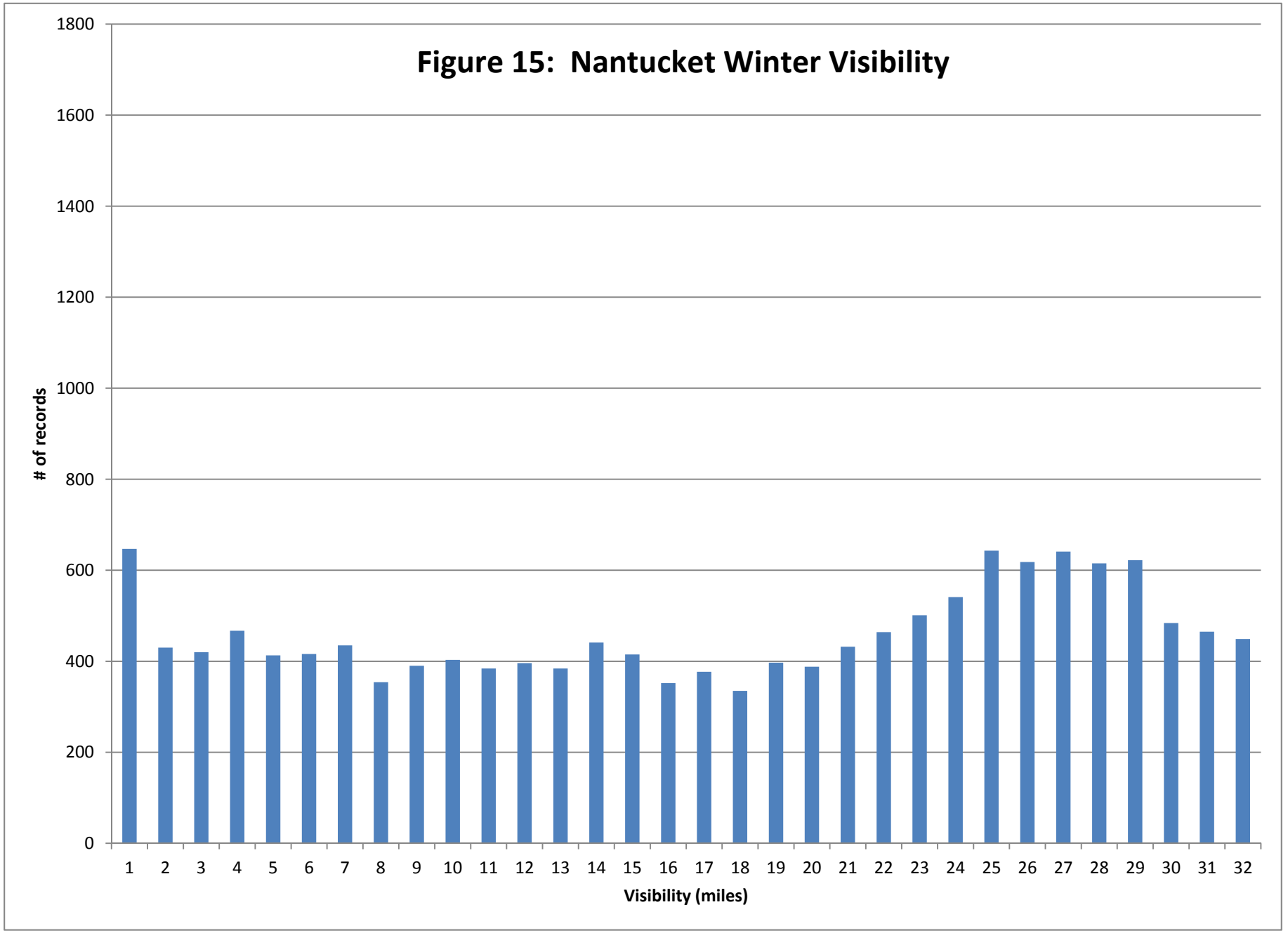


Figure 15: Nantucket Winter Visibility
1800
1600
1400
1200
1000
800
600
400
200
0
# of records
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Visibility (miles)

Figure 06: Martha's Vineyard Daily Maximum Visibility

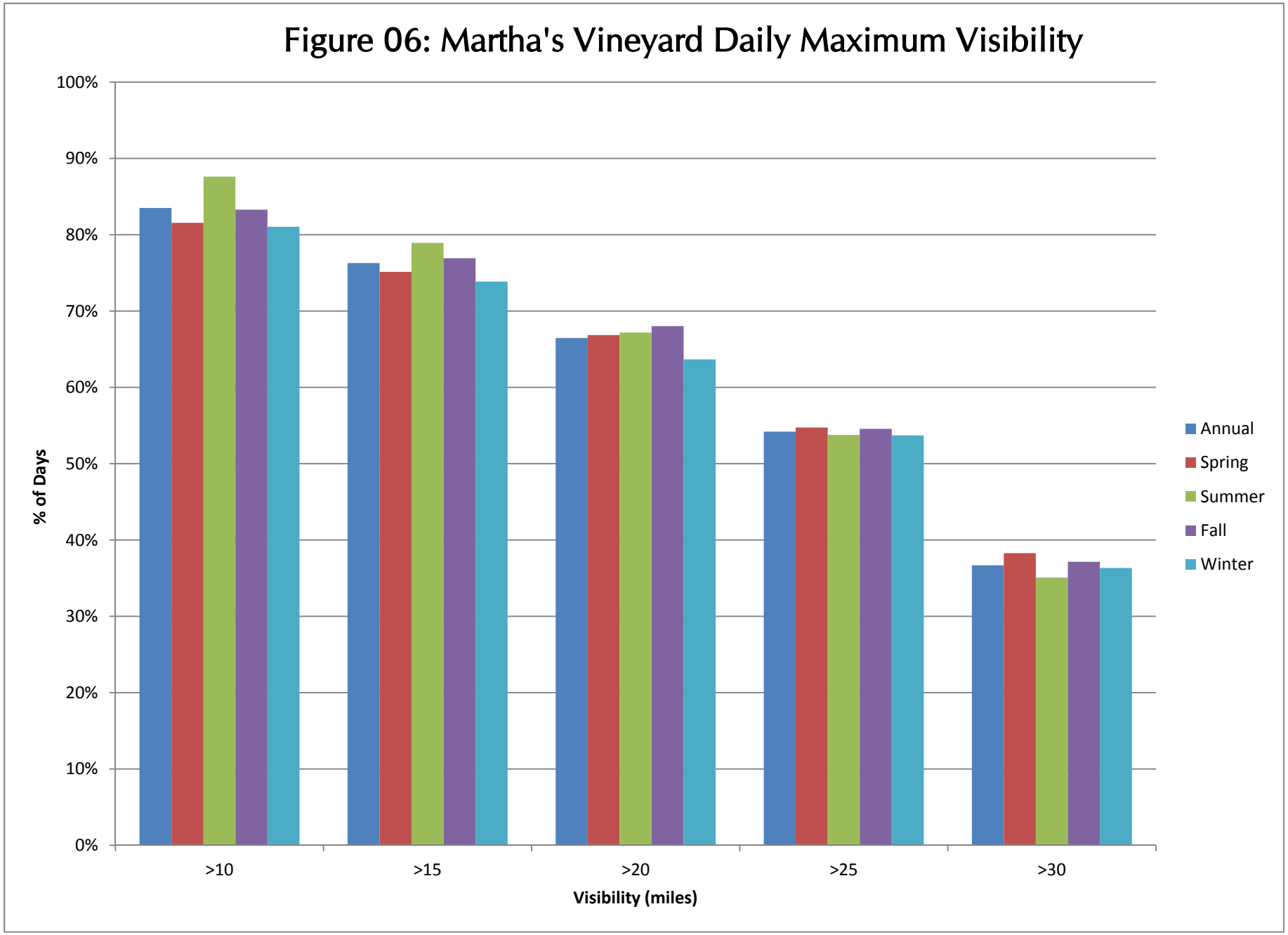
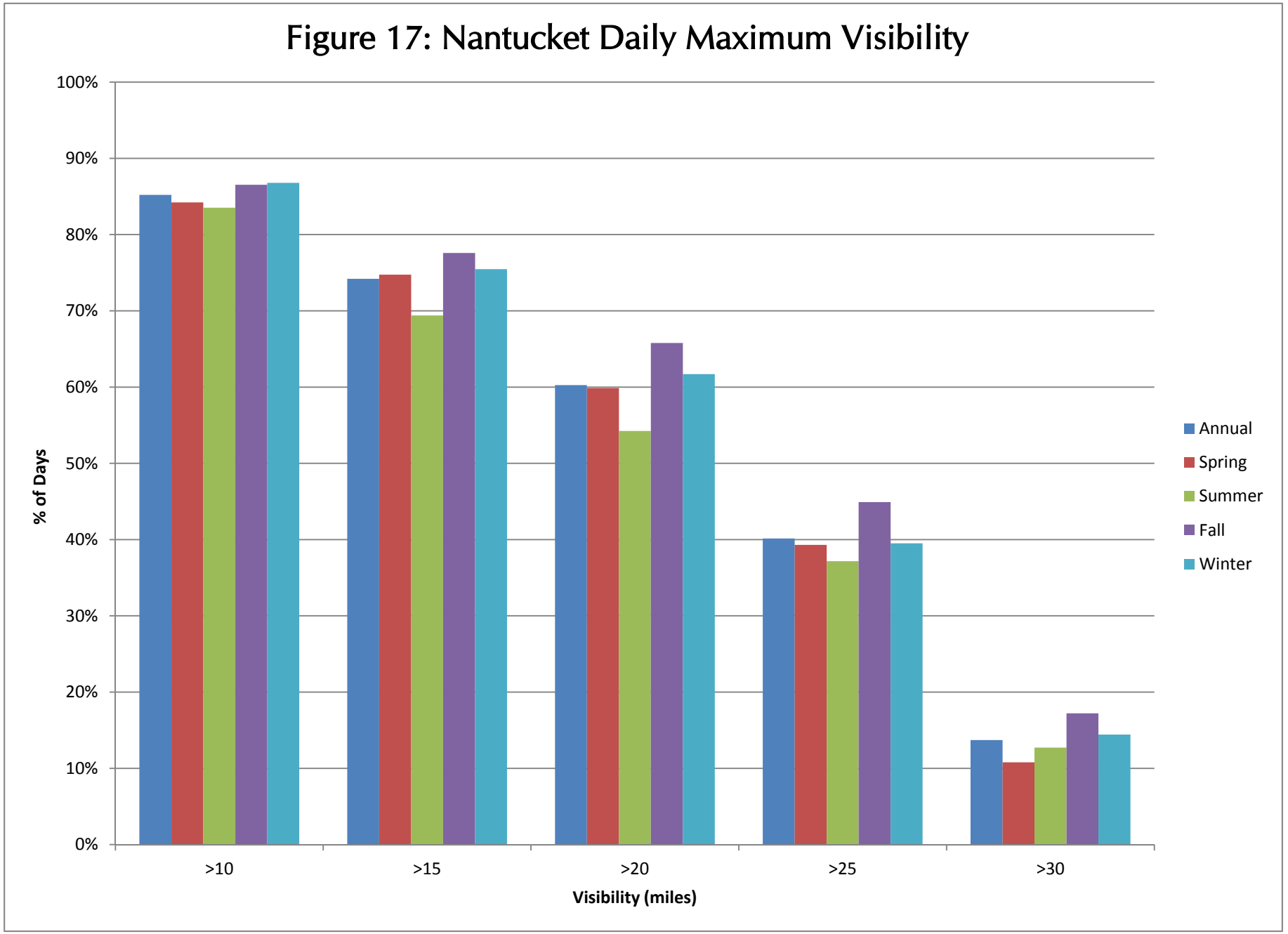


Figure 17: Nantucket Daily Maximum Visibility



A more detailed picture of the distribution of visibility can be achieved by looking at the percent of hours in which a given threshold visibility distance is exceeded. This breakdown by daytime and nighttime hours within each season is shown in Figures 18 and Figure 19 for Martha's Vineyard and Figures 20 and 21 for Nantucket. For Martha's Vineyard, the highest visibilities during the daytime occur mainly during the summertime, and the lowest visibility occurs in the fall; for the nighttime the highest visibilities occur in the fall and the lowest in the summer. For Nantucket, the highest visibility during the daytime occurs in the spring, with the lowest visibility occurring in the fall, summer and winter. During nighttime for Nantucket, the highest visibility occurs in the spring, and lowest in the fall.

5.0 CONCLUSION

The Beer-Lambert law was used in this study to measure extinction coefficients at Martha's Vineyard and Nantucket airports to determine the hourly visibility distances, and the distribution of visibility distances on an annual, seasonal, and day/night basis. Average visibility at both stations as reported in Table 6 is highest in the fall and lowest in the summer. Based on the results of the meteorological assessment, due to atmospheric conditions the Project will not be visible approximately 45% of the time from Martha's Vineyard and approximately 60% of the time from Nantucket.

Additionally, different factors affect visibility, including air quality, sea spray and salts over the ocean's surface, the angle of the sun, and relative humidity. The presence of sea spray and salts affects visibility but is not likely captured by the measurements. Therefore, calculated visibility may be considered conservative since they do not account for this light-reducing factor.

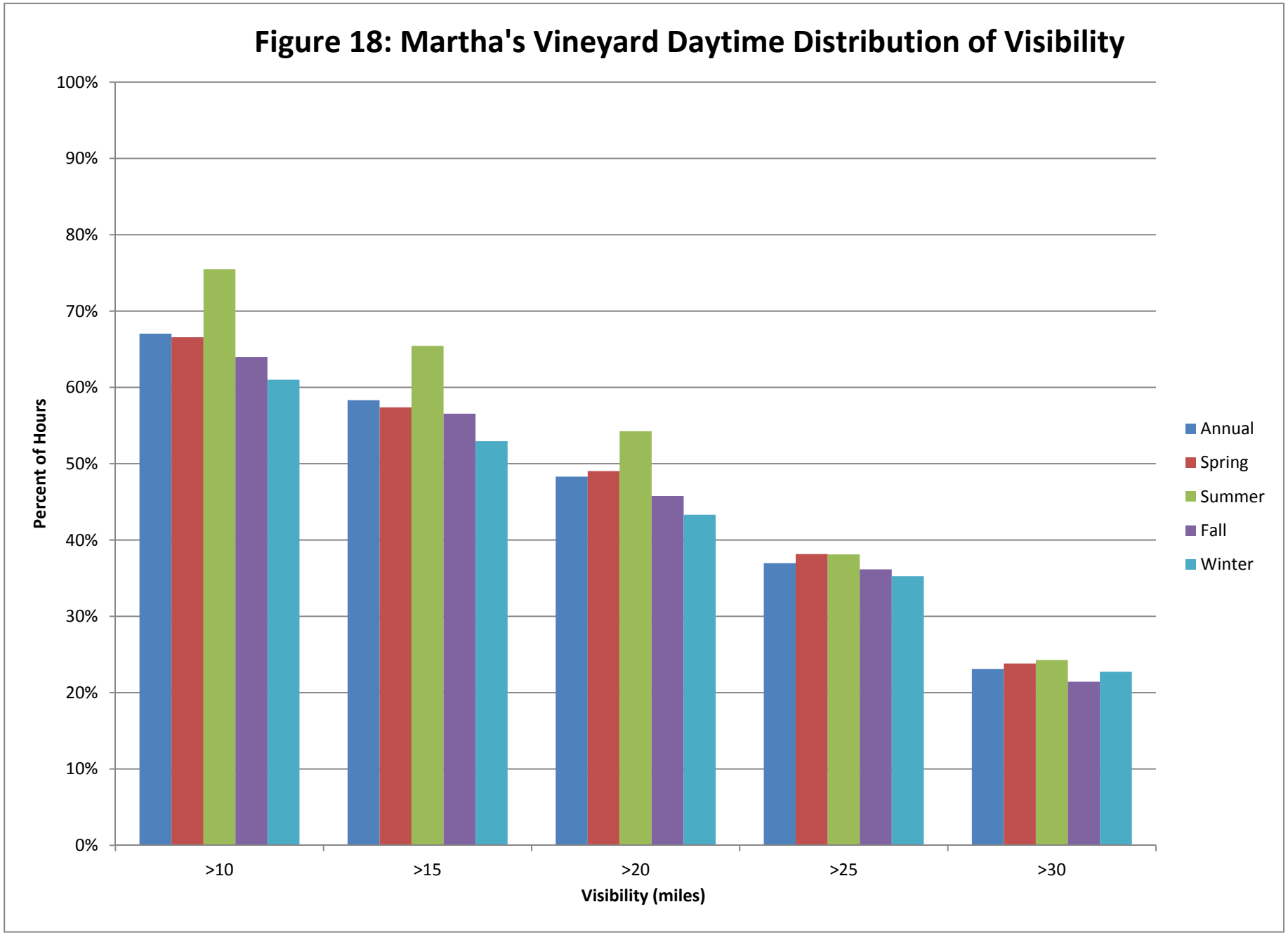


Figure 18: Martha's Vineyard Daytime Distribution of Visibility
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent of Hours
>10
>15
>20
>25
>30
Visibility (miles)
Annual
Spring
Summer
Fall
Winter

Figure 19: Martha's Vineyard Nighttime Distribution of Visibility

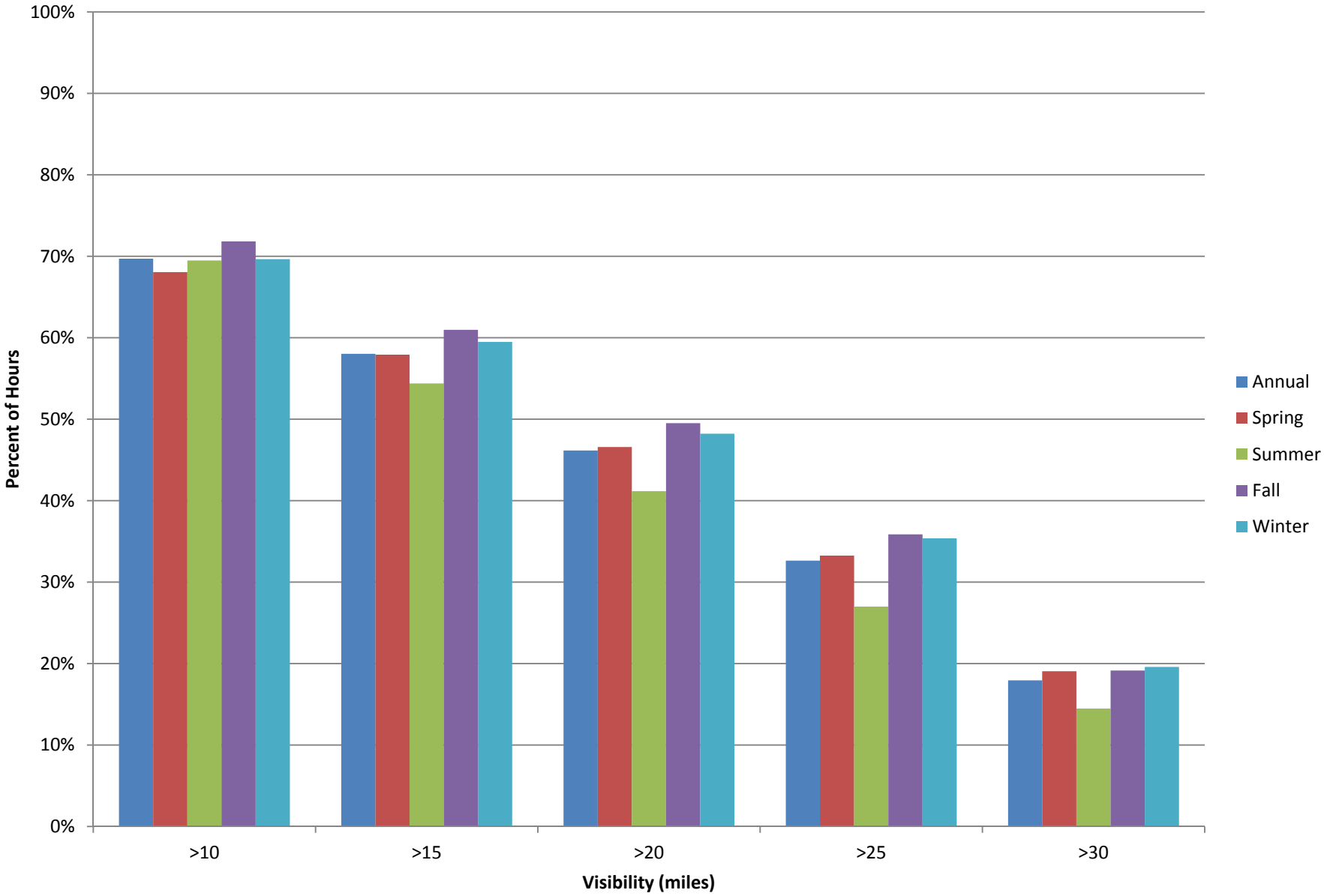


Figure 20: Nantucket Daytime Distribution of Visibility

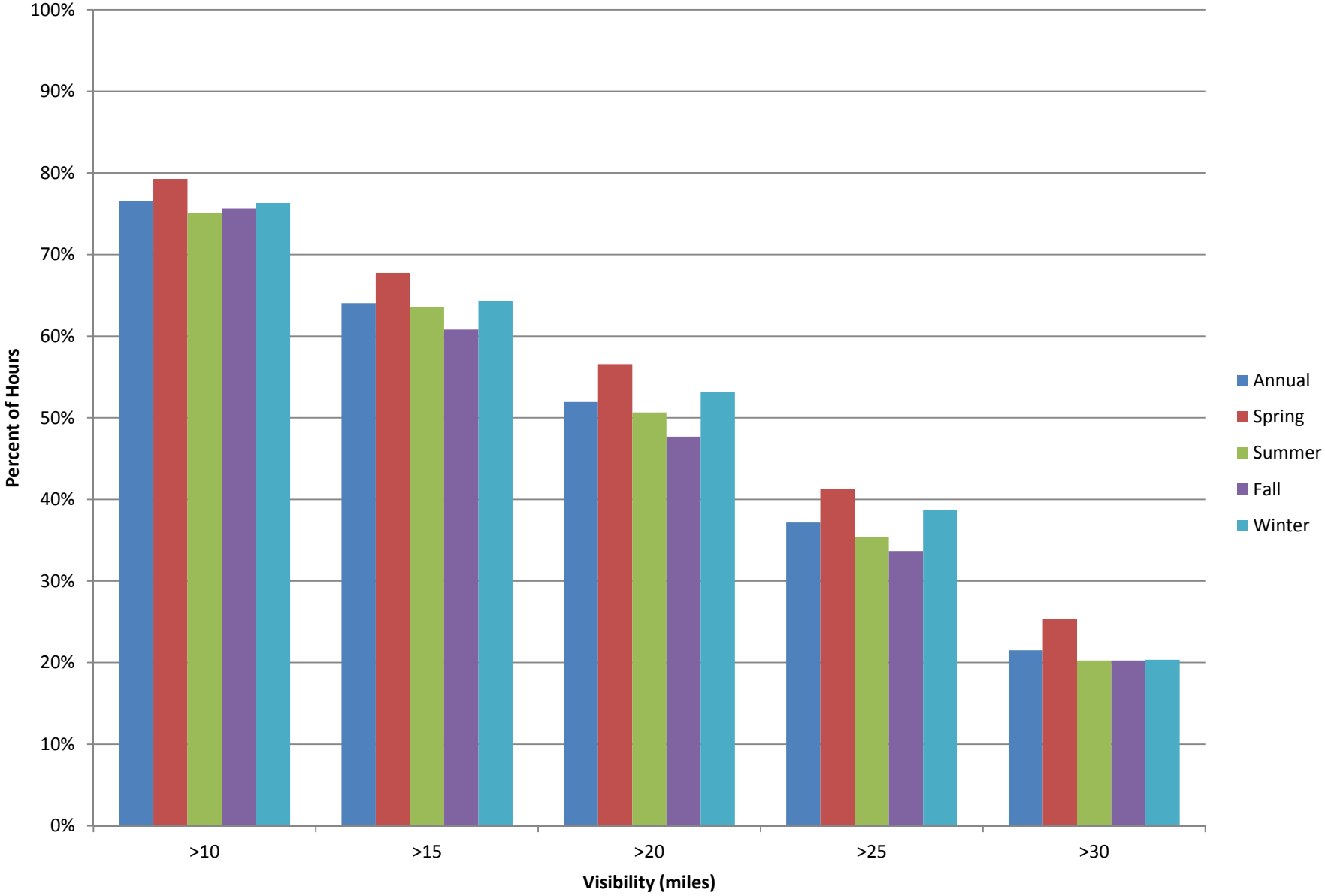
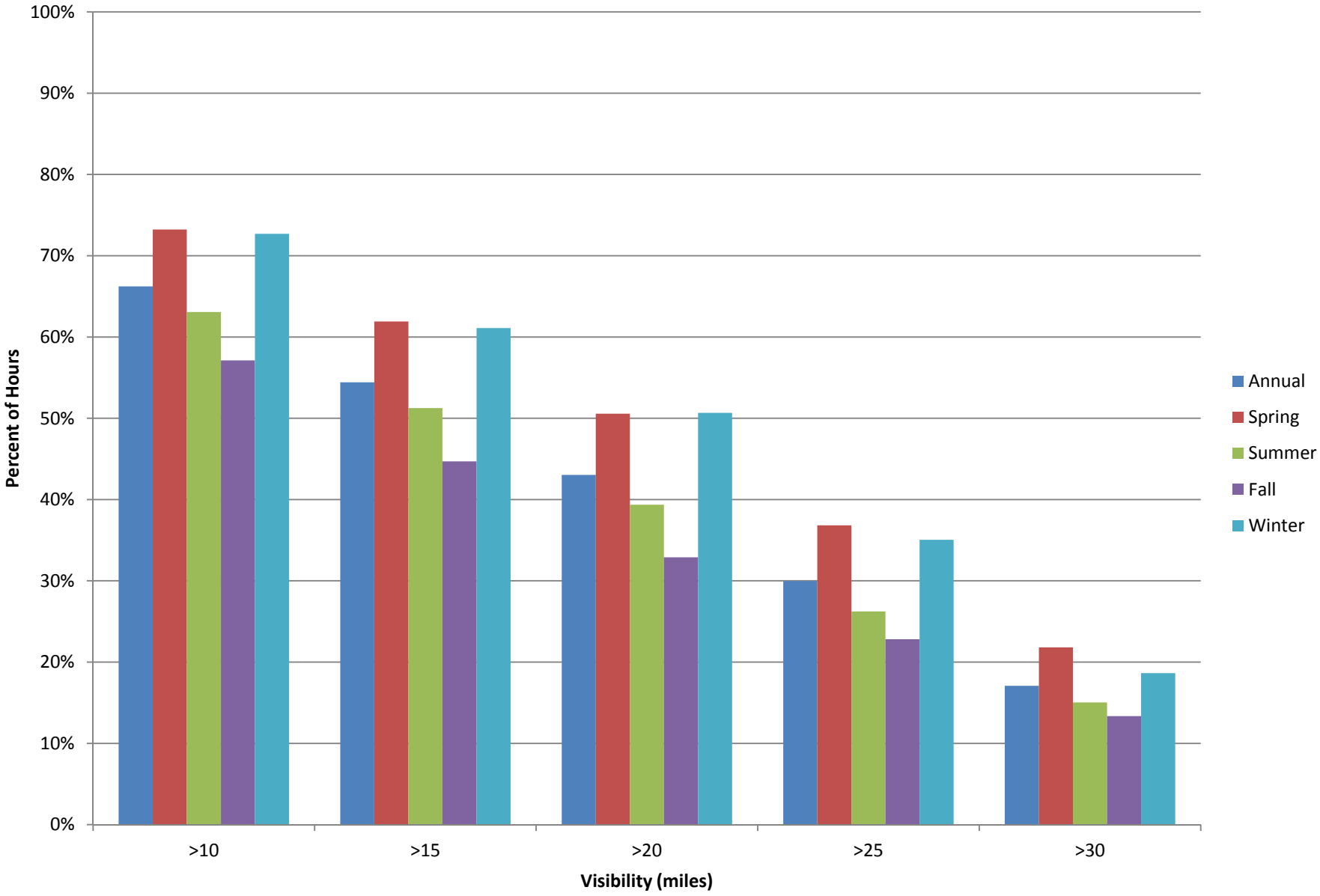


Figure 21: Nantucket Nighttime Distribution of Visibility



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APPENDICES

Appendix A

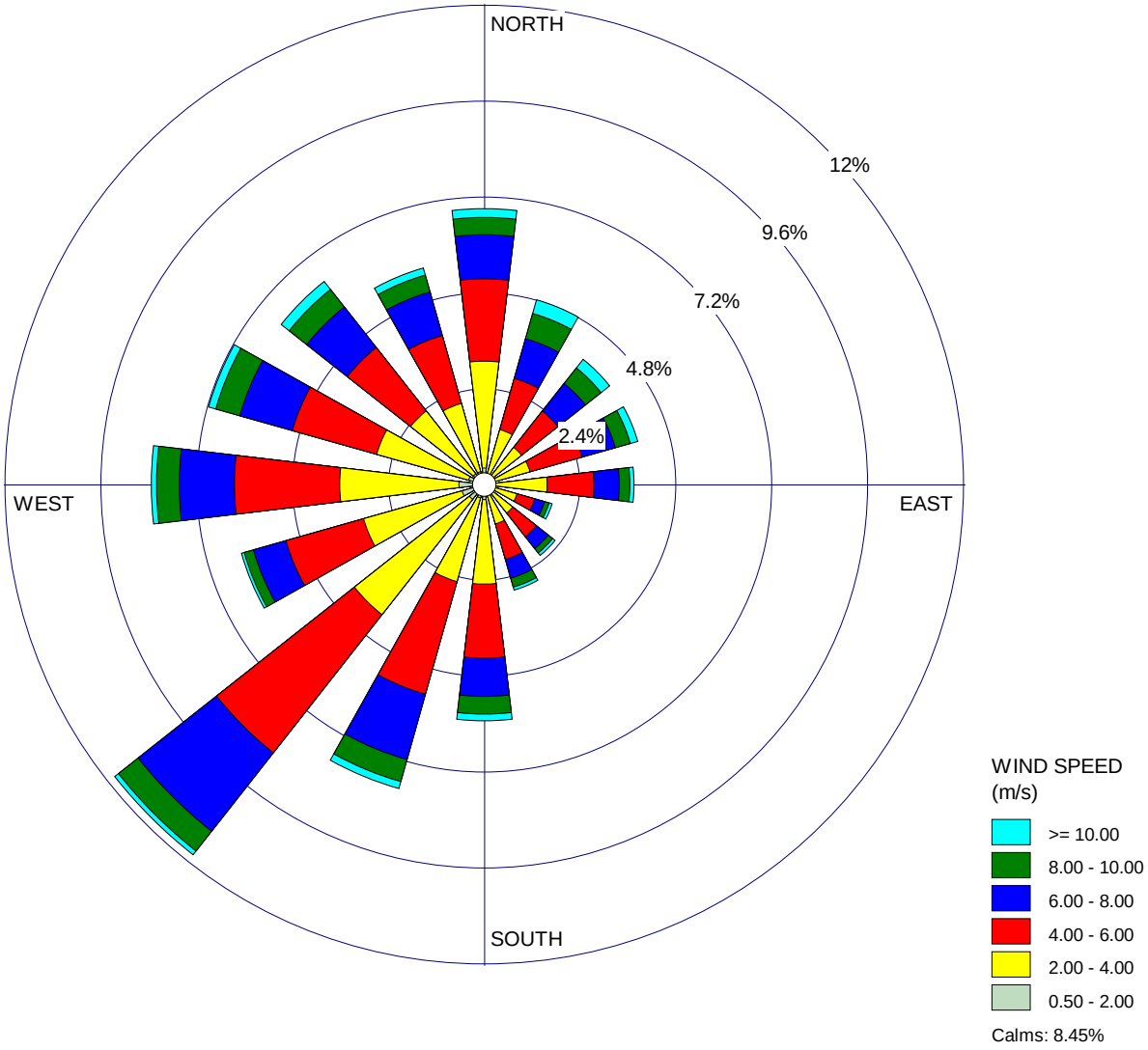
Wind Roses by Month for Martha's Vineyard and Nantucket

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
10 Year Wind Rose, 2006-2016

DISPLAY:

Wind Speed
Direction (blowing from)



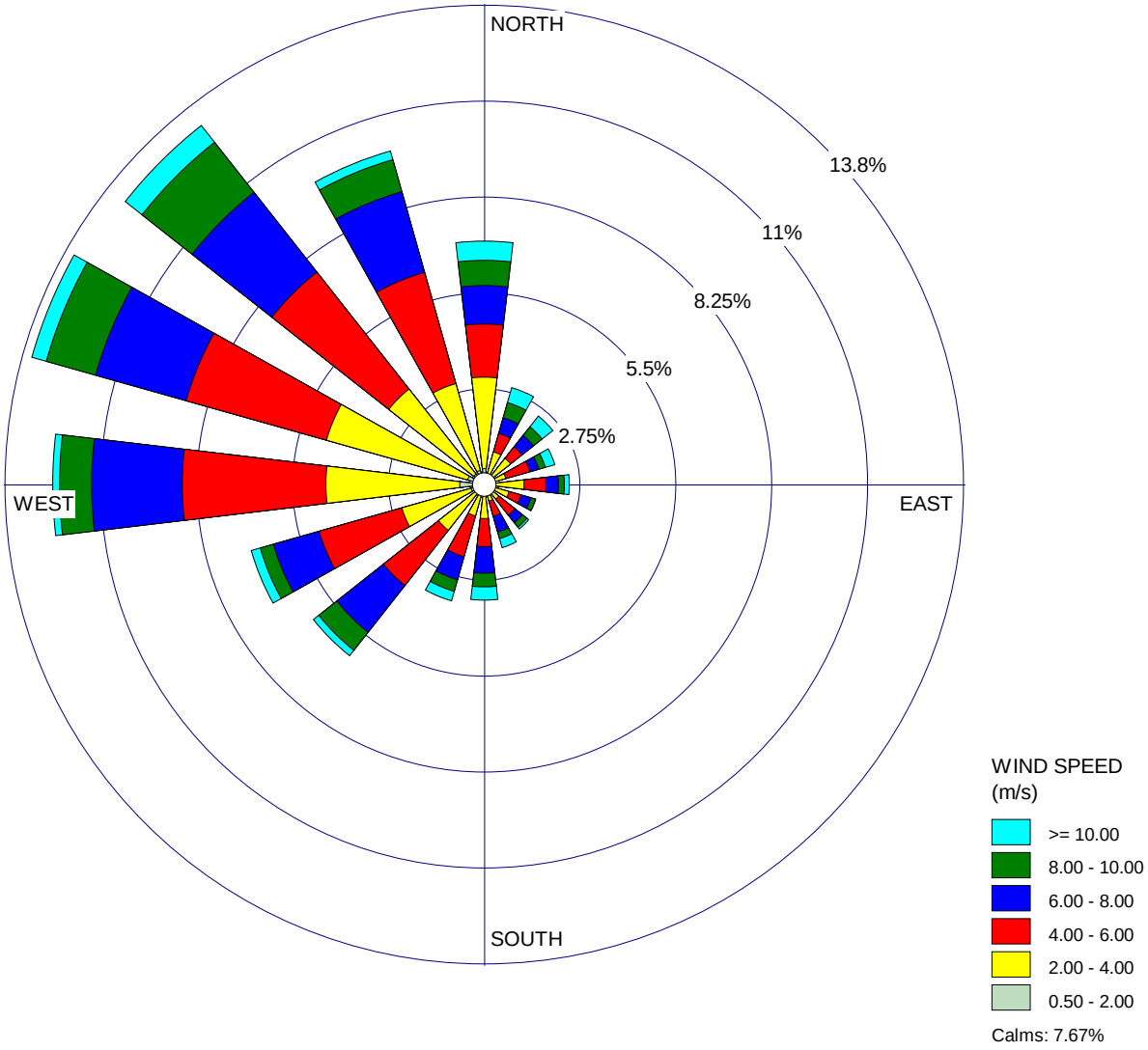
COMMENTS:	DATA PERIOD:	COMPANY NAME:
	Start Date: 1/1/2006 - 00:00 **End Date: 12/31/2016 - 19:00**	**Epsilon Associates**
	CALM WINDS:	TOTAL COUNT:
	8.45%	**94460 hrs.**
	AVG. WIND SPEED:	DATE:
	4.44 m/s	**11/3/2017**

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
January Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



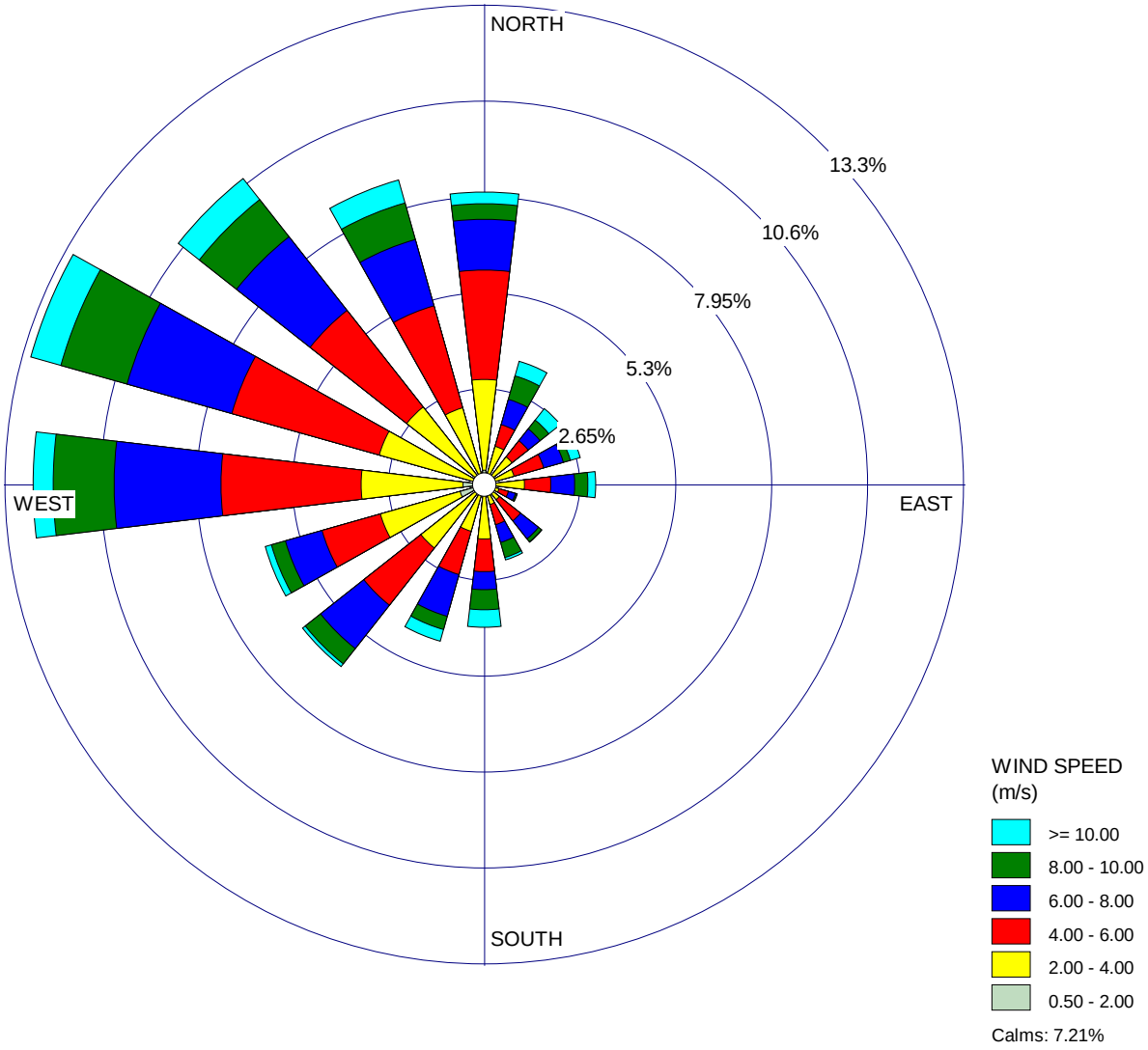
COMMENTS:	DATA PERIOD:	COMPANY NAME:
	Start Date: 1/1/2006 - 00:00 **End Date: 1/31/2016 - 23:00**	**Epsilon Associates**
	CALM WINDS:	TOTAL COUNT:
	7.67%	**8045 hrs.**
	AVG. WIND SPEED:	DATE:
	4.87 m/s	**11/3/2017**

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
February Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



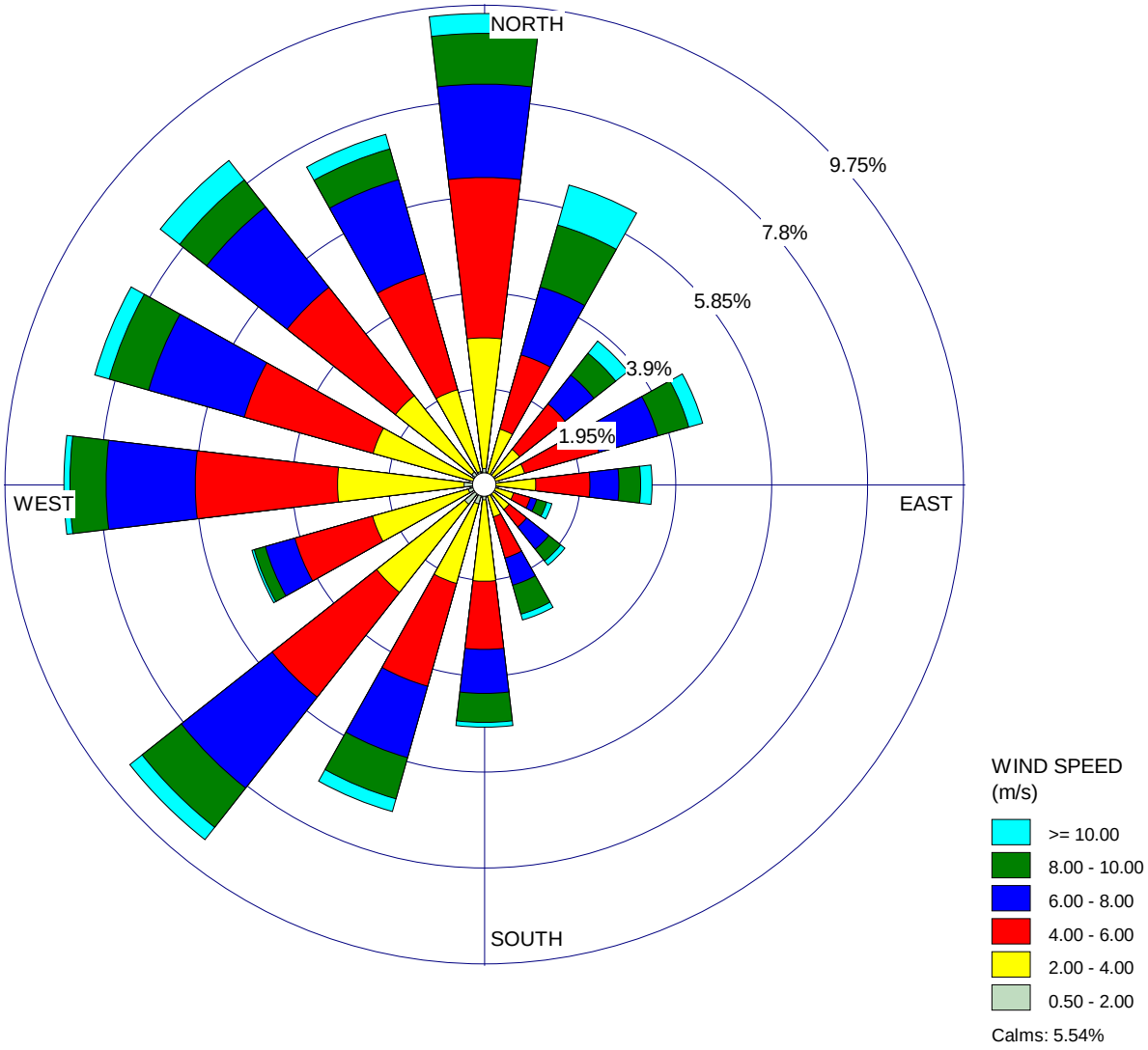
COMMENTS:	DATA PERIOD: **Start Date: 2/1/2006 - 00:00** **End Date: 2/29/2016 - 23:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **7.21%**	TOTAL COUNT: **7323 hrs.**	
	AVG. WIND SPEED: **5.08 m/s**	DATE: **11/3/2017**	

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
March Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



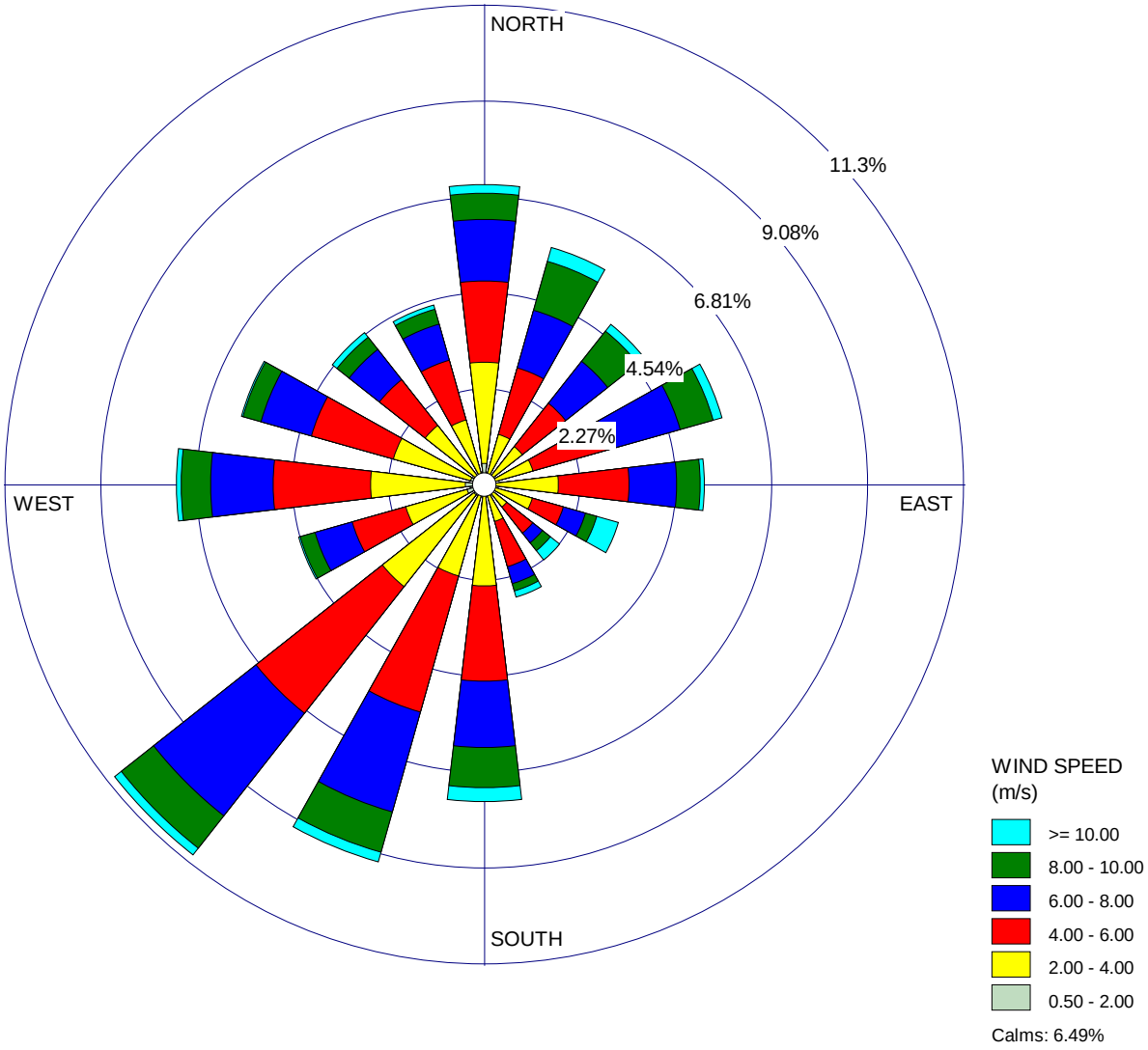
COMMENTS:	DATA PERIOD: **Start Date: 3/1/2006 - 00:00** **End Date: 3/31/2016 - 23:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **5.54%**	TOTAL COUNT: **8011 hrs.**	
	AVG. WIND SPEED: **5.09 m/s**	DATE: **11/3/2017**	

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
April Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



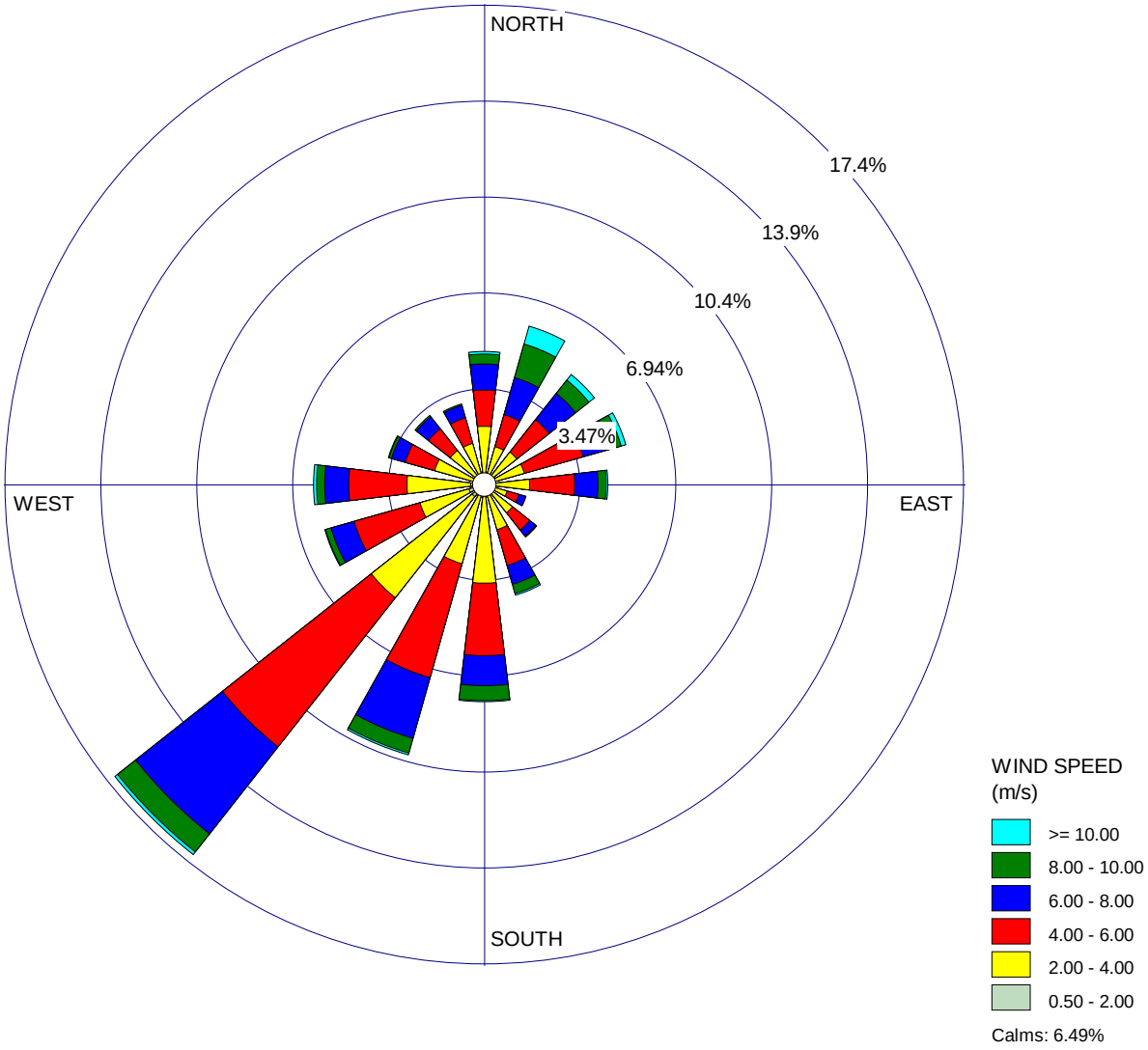
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 4/1/2006 - 00:00 **End Date: 4/30/2016 - 23:00**	**Epsilon Associates**	
	CALM WINDS:	TOTAL COUNT:	
	6.49%	**7779 hrs.**	
	AVG. WIND SPEED:	DATE:	
	4.92 m/s	**11/3/2017**	

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
May Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



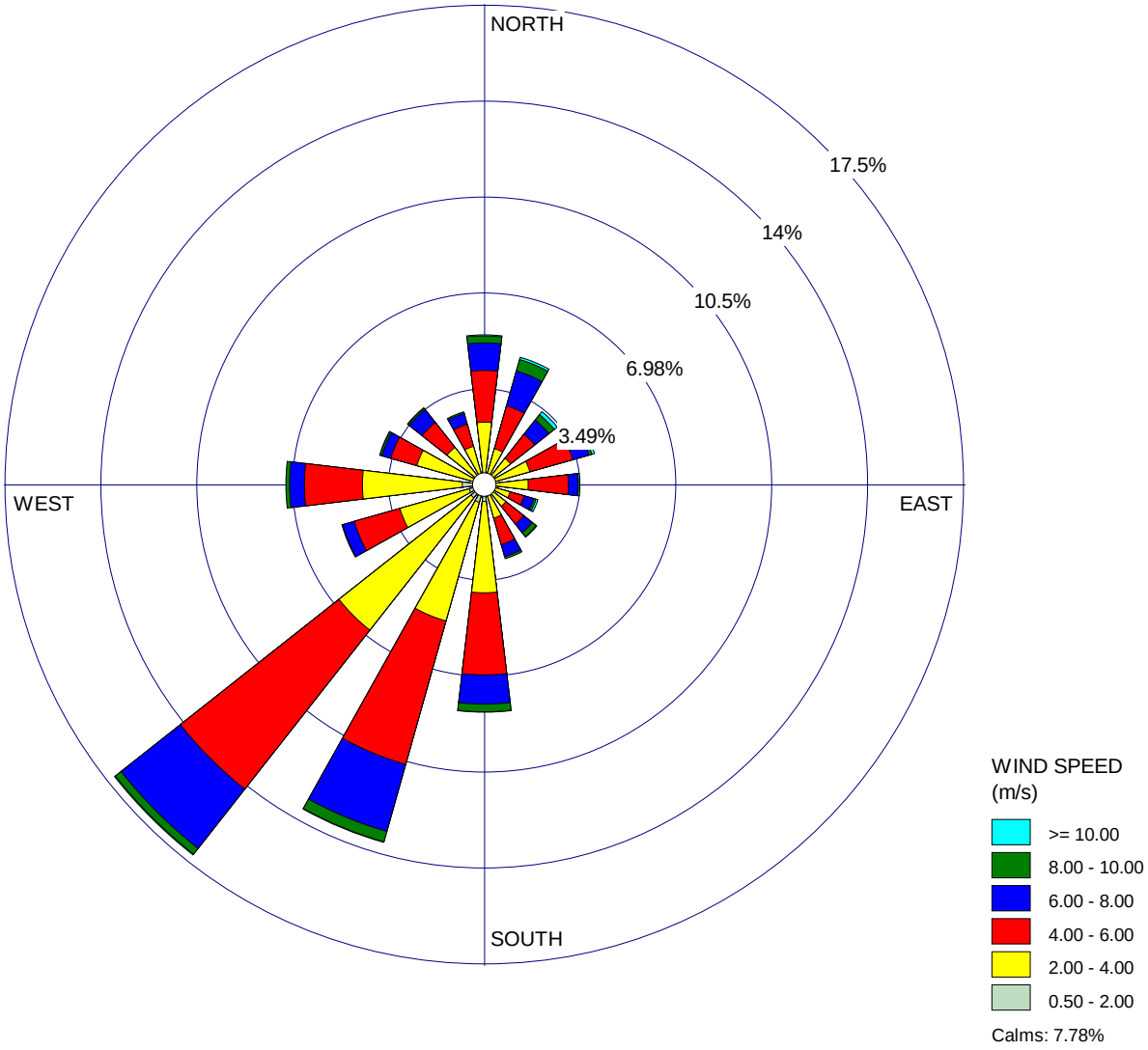
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 5/1/2006 - 00:00 **End Date: 5/31/2016 - 23:00**	**Epsilon Associates**	
	CALM WINDS:	TOTAL COUNT:	
	6.49%	**7957 hrs.**	
	AVG. WIND SPEED:	DATE:	
	4.44 m/s	**11/3/2017**	

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
June Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



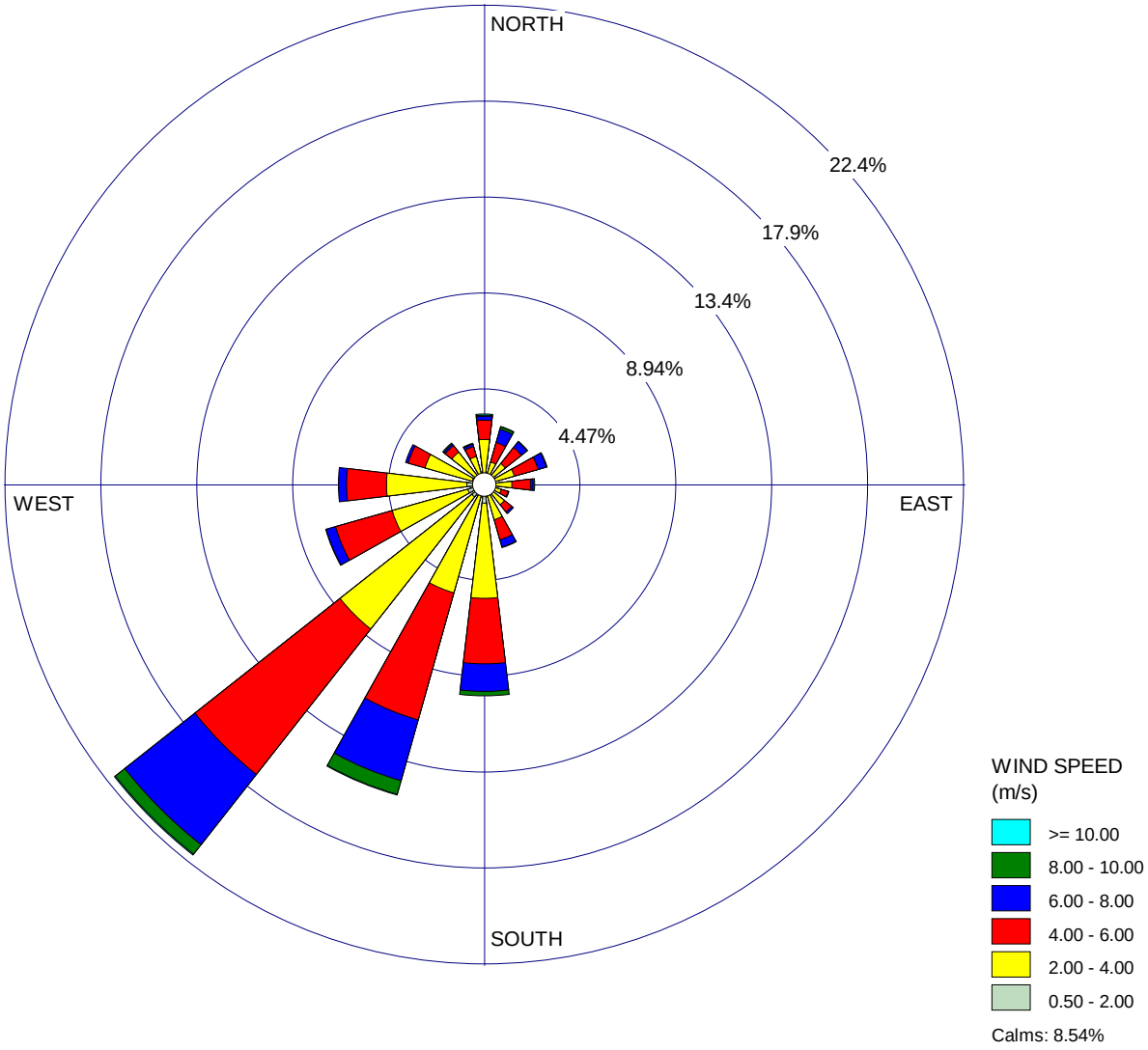
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 6/1/2006 - 00:00 **End Date: 6/30/2016 - 23:00**	**Epsilon Associates**	
	CALM WINDS:	TOTAL COUNT:	
	7.78%	**7767 hrs.**	
	AVG. WIND SPEED:	DATE:	
	3.94 m/s	**11/3/2017**	

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
July Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



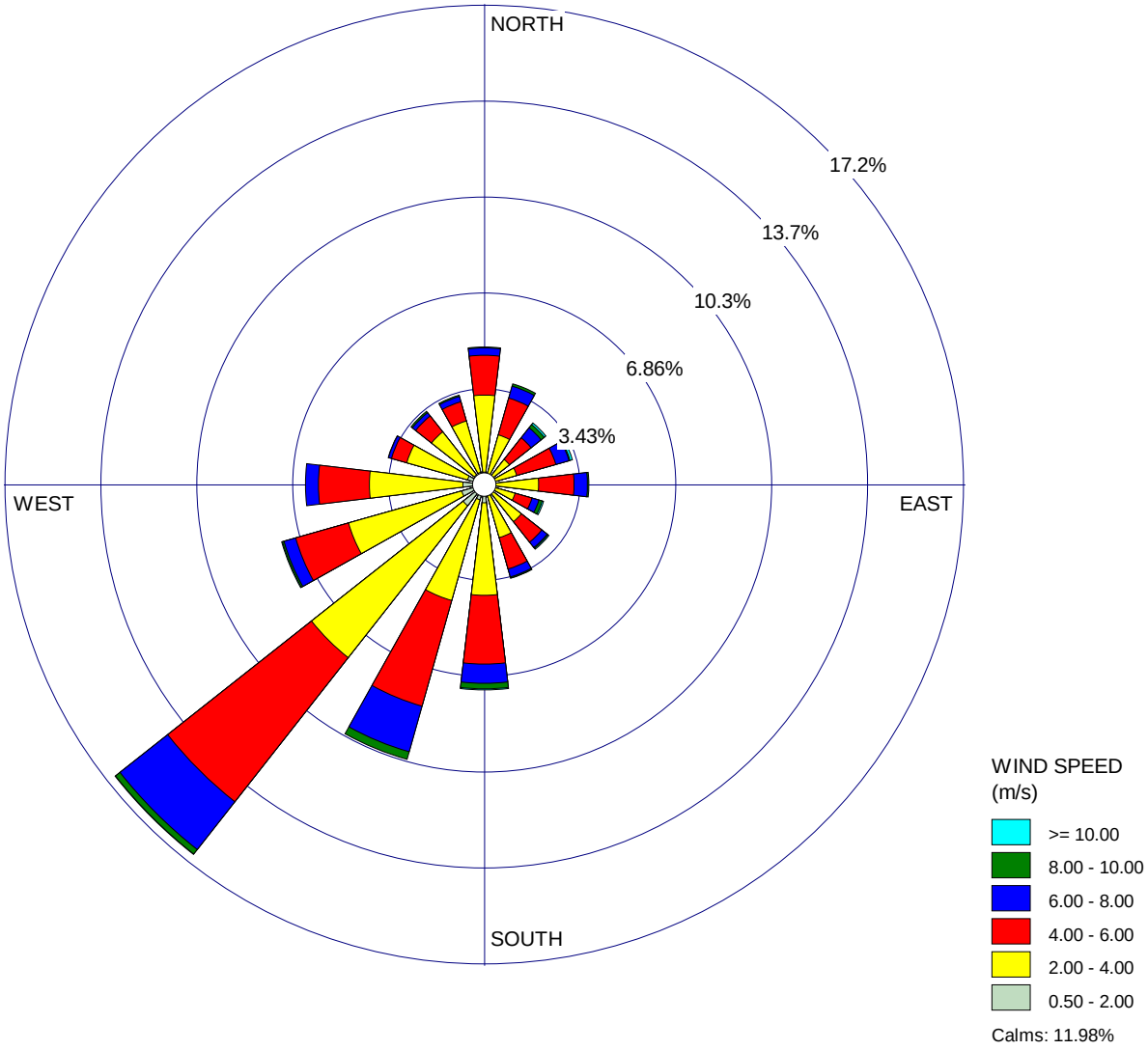
COMMENTS:	DATA PERIOD:	COMPANY NAME:
	Start Date: 7/1/2006 - 00:00 **End Date: 7/31/2016 - 23:00**	**Epsilon Associates**
	CALM WINDS:	TOTAL COUNT:
	8.54%	**8033 hrs.**
	AVG. WIND SPEED:	DATE:
	3.71 m/s	**11/3/2017**

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
August Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



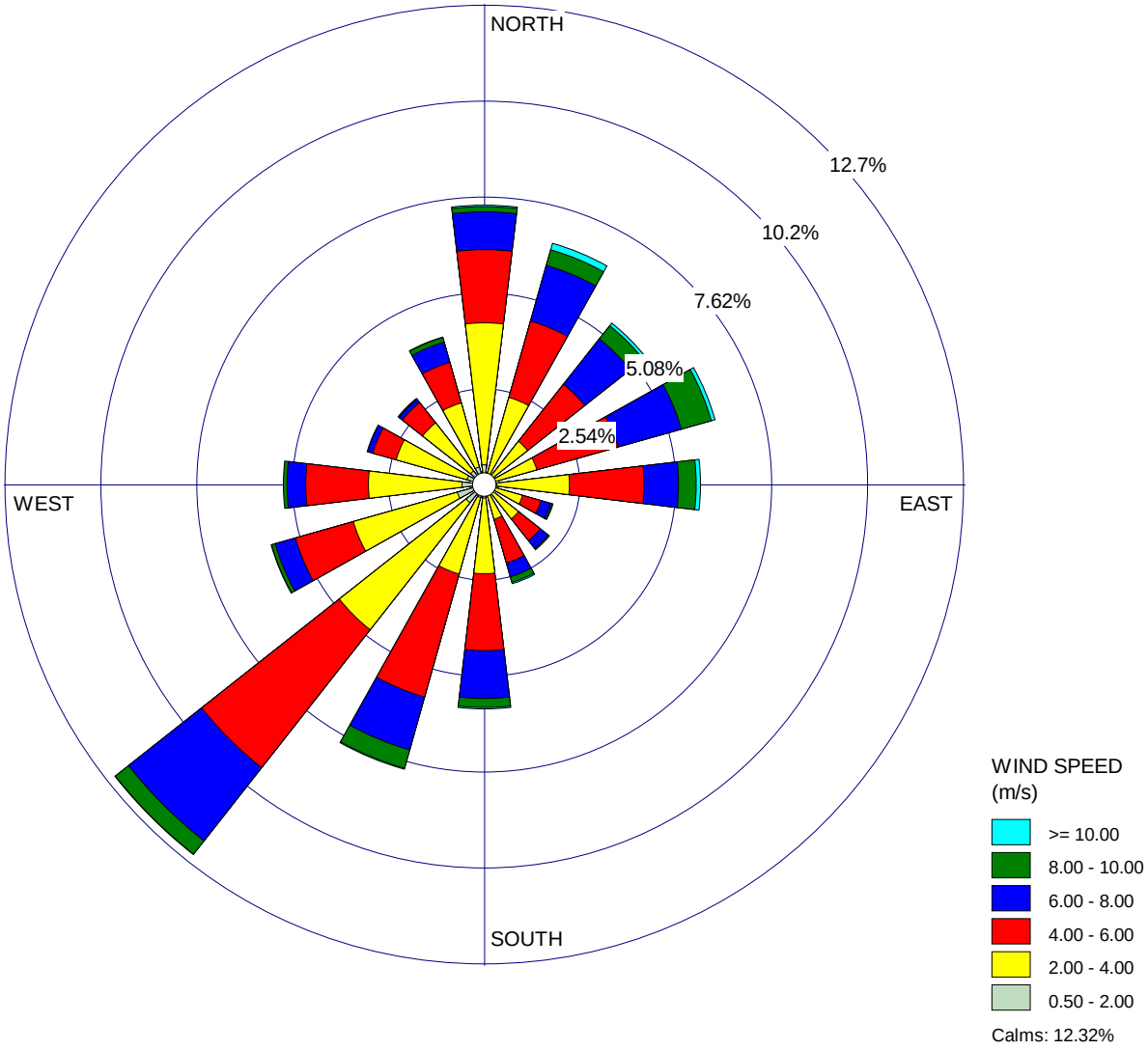
COMMENTS:	DATA PERIOD: **Start Date: 8/1/2006 - 00:00** **End Date: 8/31/2016 - 23:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **11.98%**	TOTAL COUNT: **7954 hrs.**	
	AVG. WIND SPEED: **3.39 m/s**	DATE: **11/3/2017**	

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
September Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



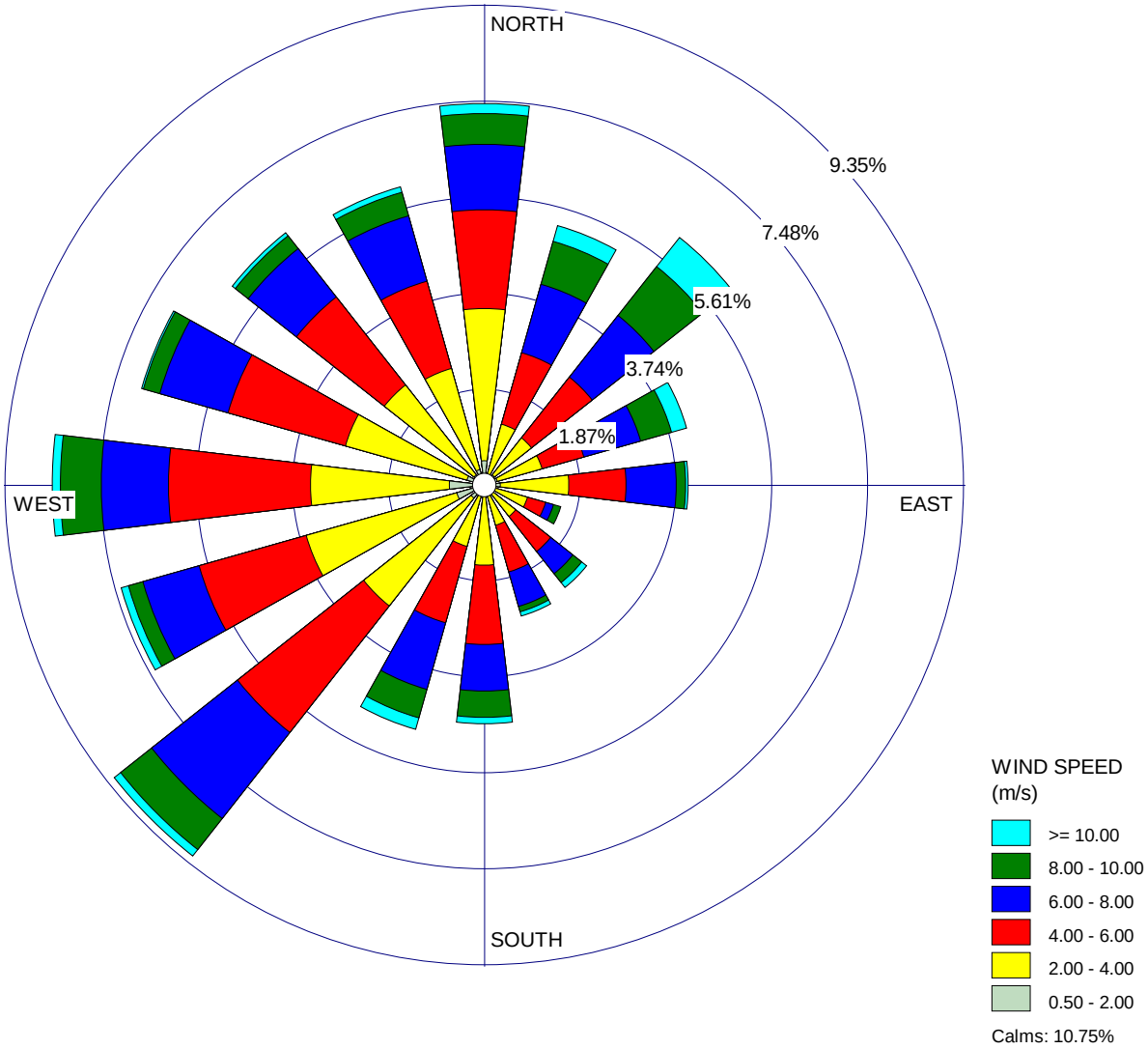
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 9/1/2006 - 00:00 **End Date: 9/30/2016 - 23:00**	**Epsilon Associates**	
	CALM WINDS:	TOTAL COUNT:	
	12.32%	**7777 hrs.**	
	AVG. WIND SPEED:	DATE:	
	3.85 m/s	**11/3/2017**	

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
October Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



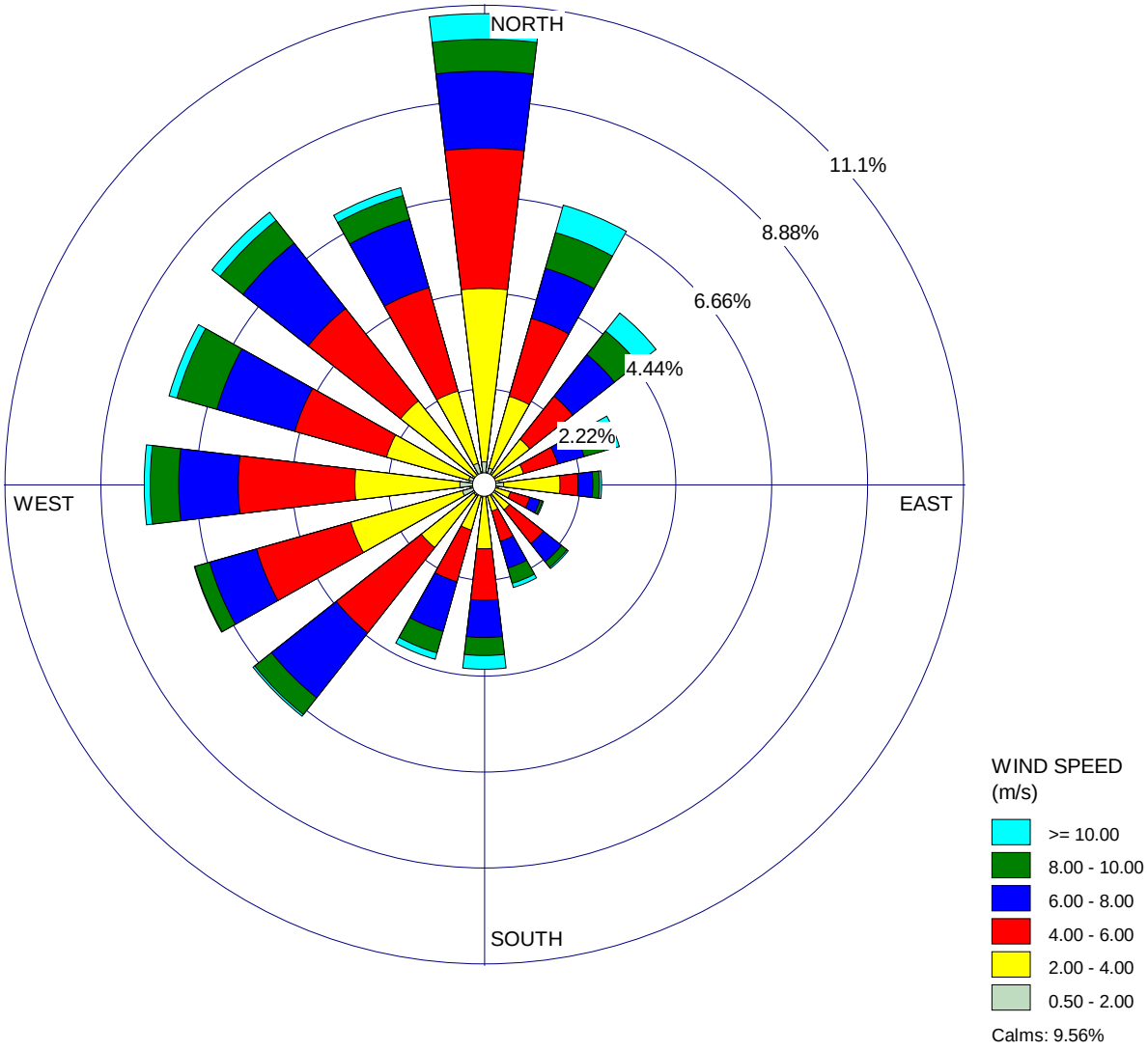
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 10/1/2006 - 00:00 **End Date: 10/31/2016 - 23:00**	**Epsilon Associates**	
	CALM WINDS:	TOTAL COUNT:	
	10.75%	**8025 hrs.**	
	AVG. WIND SPEED:	DATE:	
	4.50 m/s	**11/3/2017**	

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
November Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



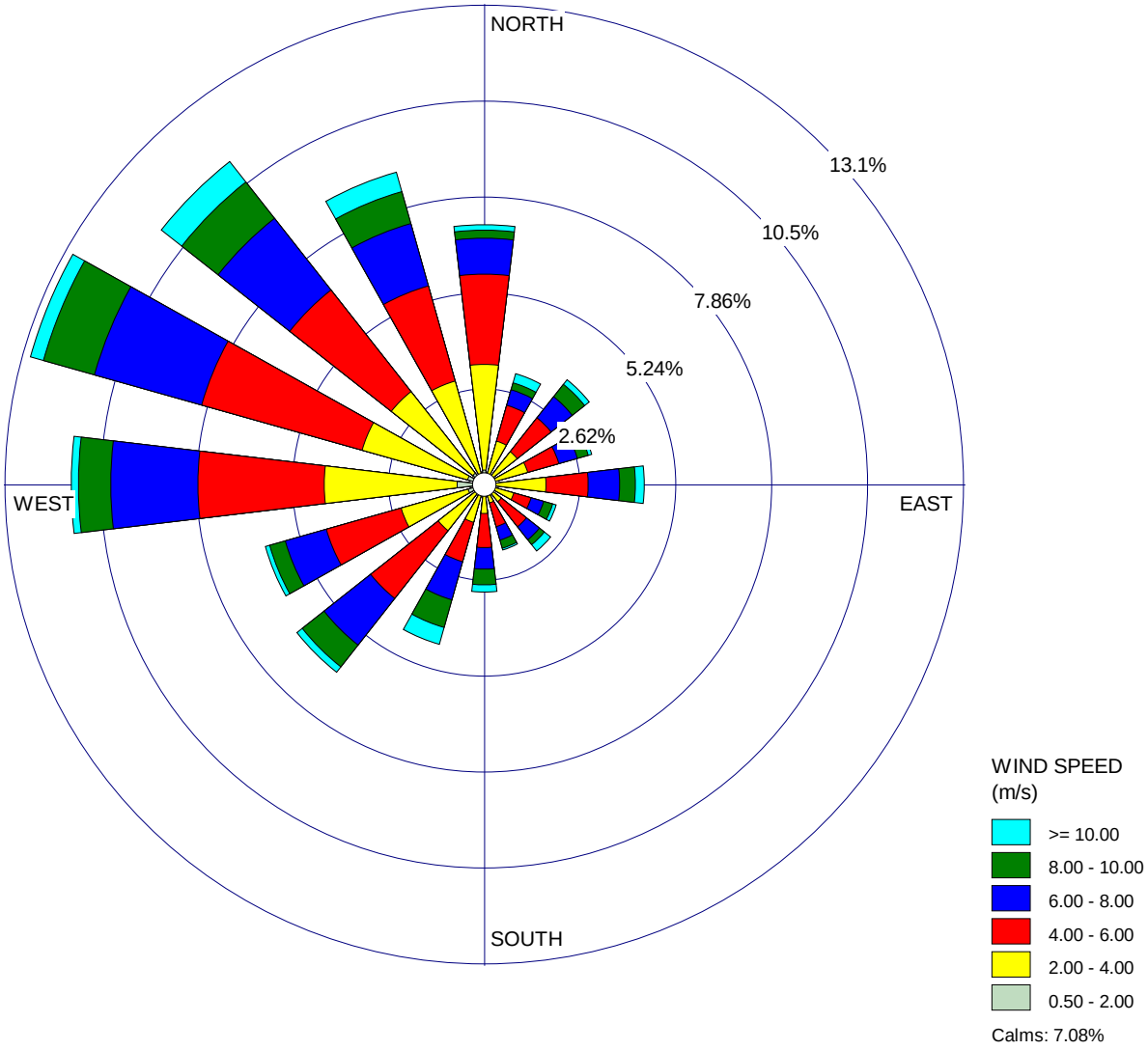
COMMENTS:	DATA PERIOD:	COMPANY NAME:
	Start Date: 11/1/2006 - 00:00 **End Date: 11/30/2016 - 23:00**	**Epsilon Associates**
	CALM WINDS:	TOTAL COUNT:
	9.56%	**7705 hrs.**
	AVG. WIND SPEED:	DATE:
	4.65 m/s	**11/3/2017**

WIND ROSE PLOT:

Martha's Vineyard Airport, Vineyard Haven, MA
December Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



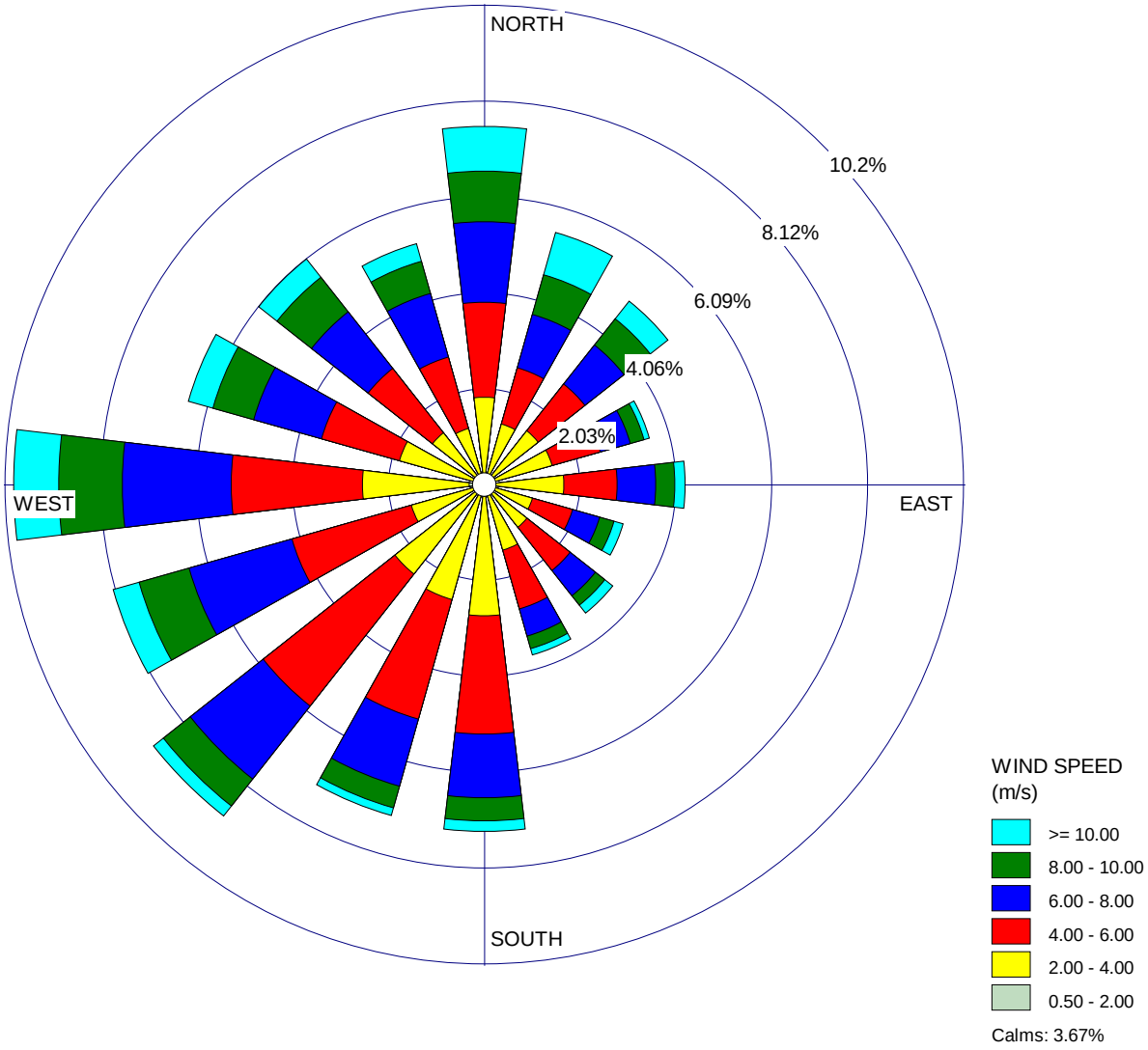
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 12/1/2006 - 00:00 **End Date: 12/31/2016 - 19:00**	**Epsilon Associates**	
	CALM WINDS:	TOTAL COUNT:	
	7.08%	**8084 hrs.**	
	AVG. WIND SPEED:	DATE:	
	4.86 m/s	**11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
10 Year Wind Rose, 2006-2016

DISPLAY:

Wind Speed
Direction (blowing from)



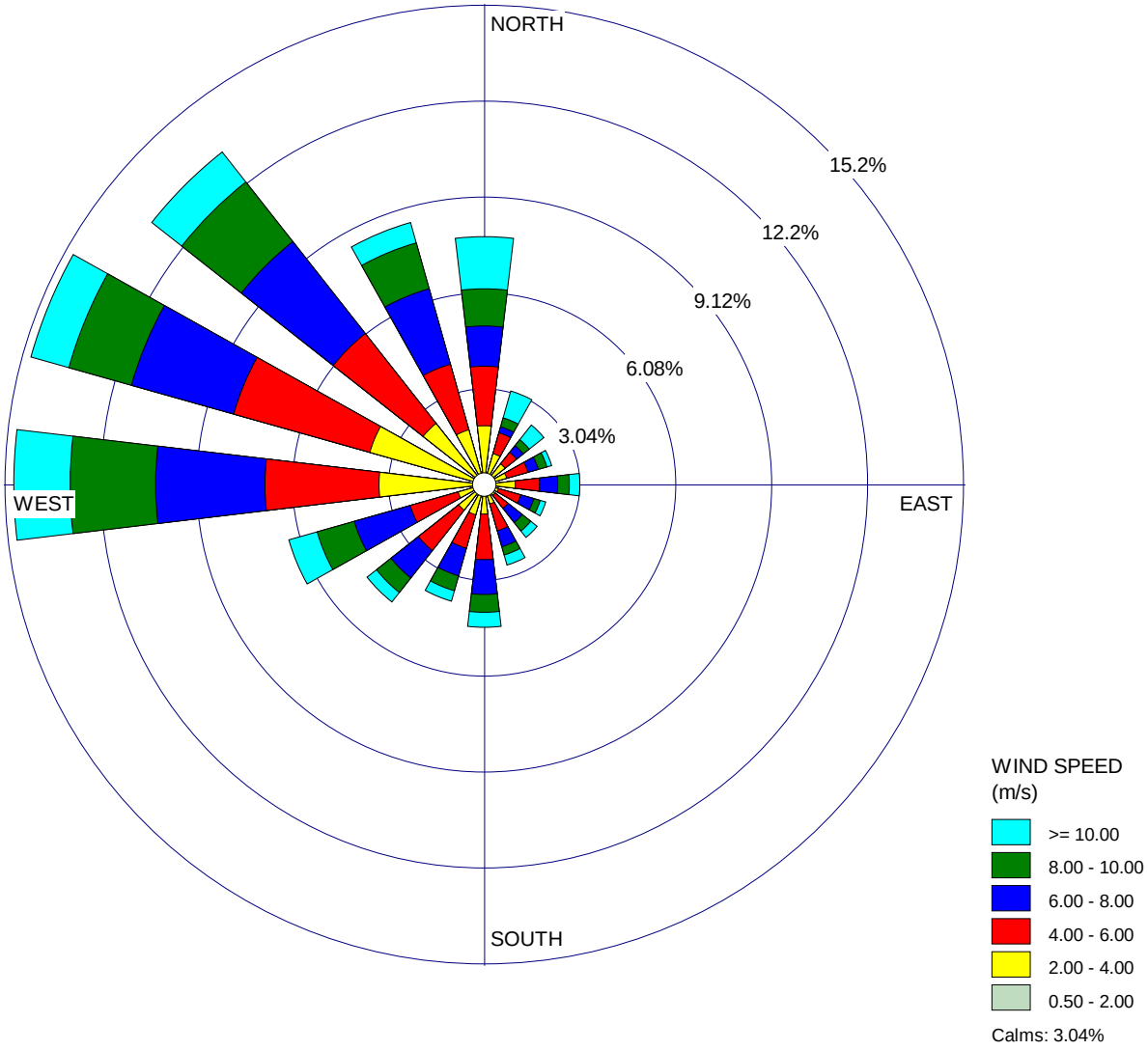
COMMENTS:	DATA PERIOD: **Start Date: 1/1/2006 - 00:00** **End Date: 12/31/2016 - 19:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **3.67%**	TOTAL COUNT: **95669 hrs.**	
	AVG. WIND SPEED: **5.43 m/s**	DATE: **11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
January Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



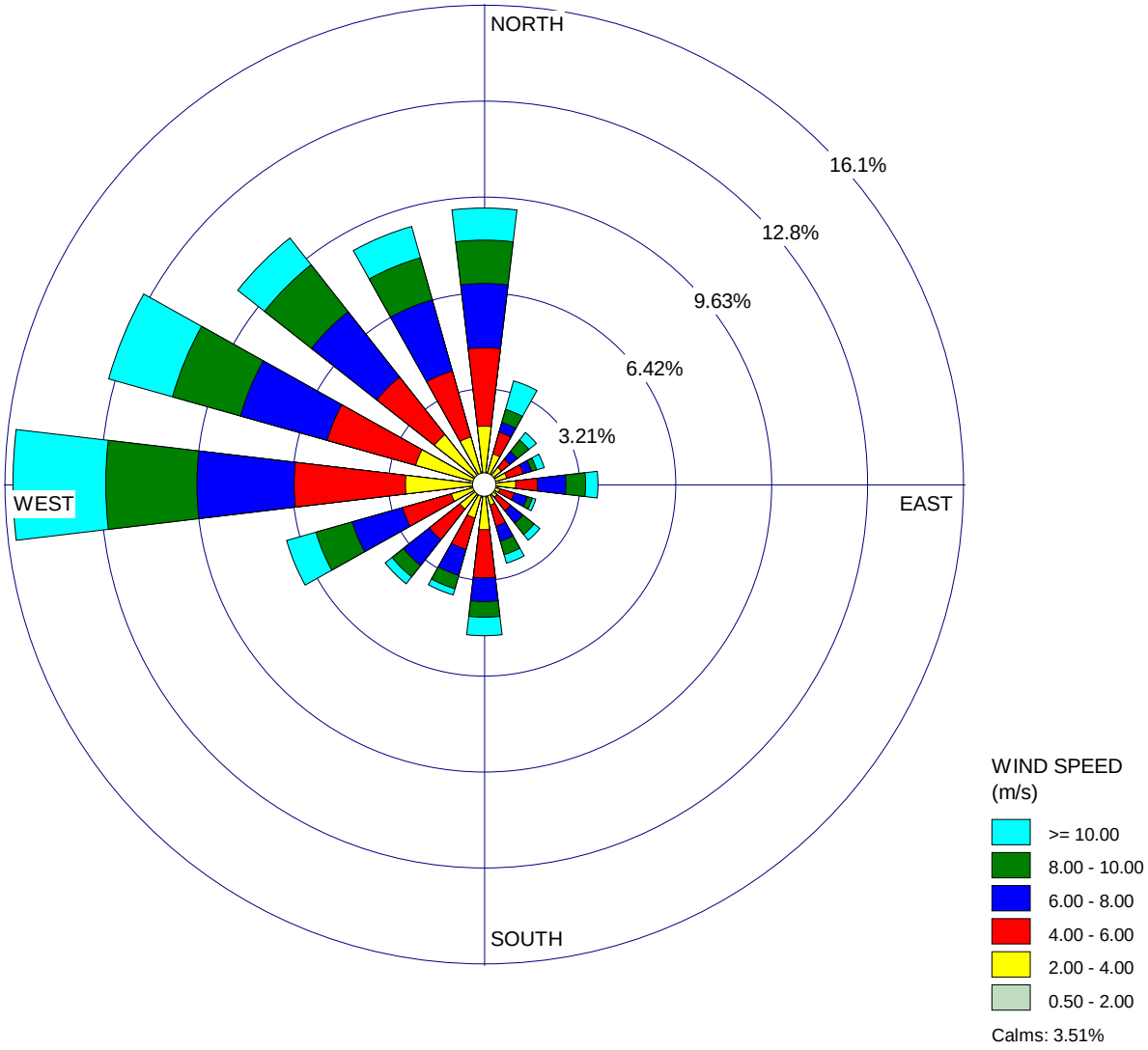
COMMENTS:	DATA PERIOD:	COMPANY NAME:
	Start Date: 1/1/2006 - 00:00 **End Date: 1/31/2016 - 23:00**	**Epsilon Associates**
	CALM WINDS:	TOTAL COUNT:
	3.04%	**8163 hrs.**
	AVG. WIND SPEED:	DATE:
	6.12 m/s	**11/3/2017**

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
February Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



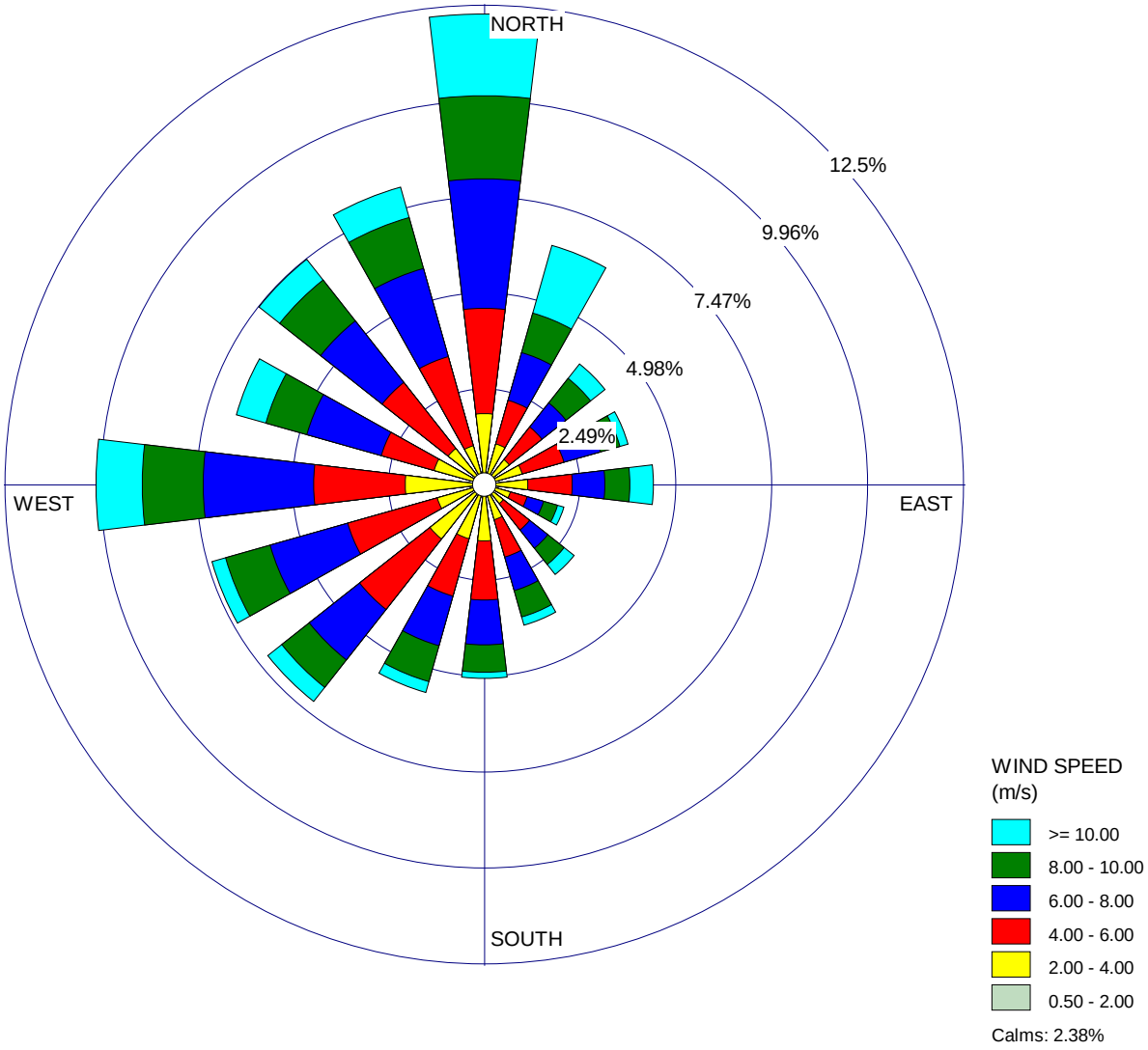
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 2/1/2006 - 00:00 **End Date: 2/29/2016 - 23:00**	**Epsilon Associates**	
	CALM WINDS:	TOTAL COUNT:	
	3.51%	**7427 hrs.**	
	AVG. WIND SPEED:	DATE:	
	6.31 m/s	**11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
March Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



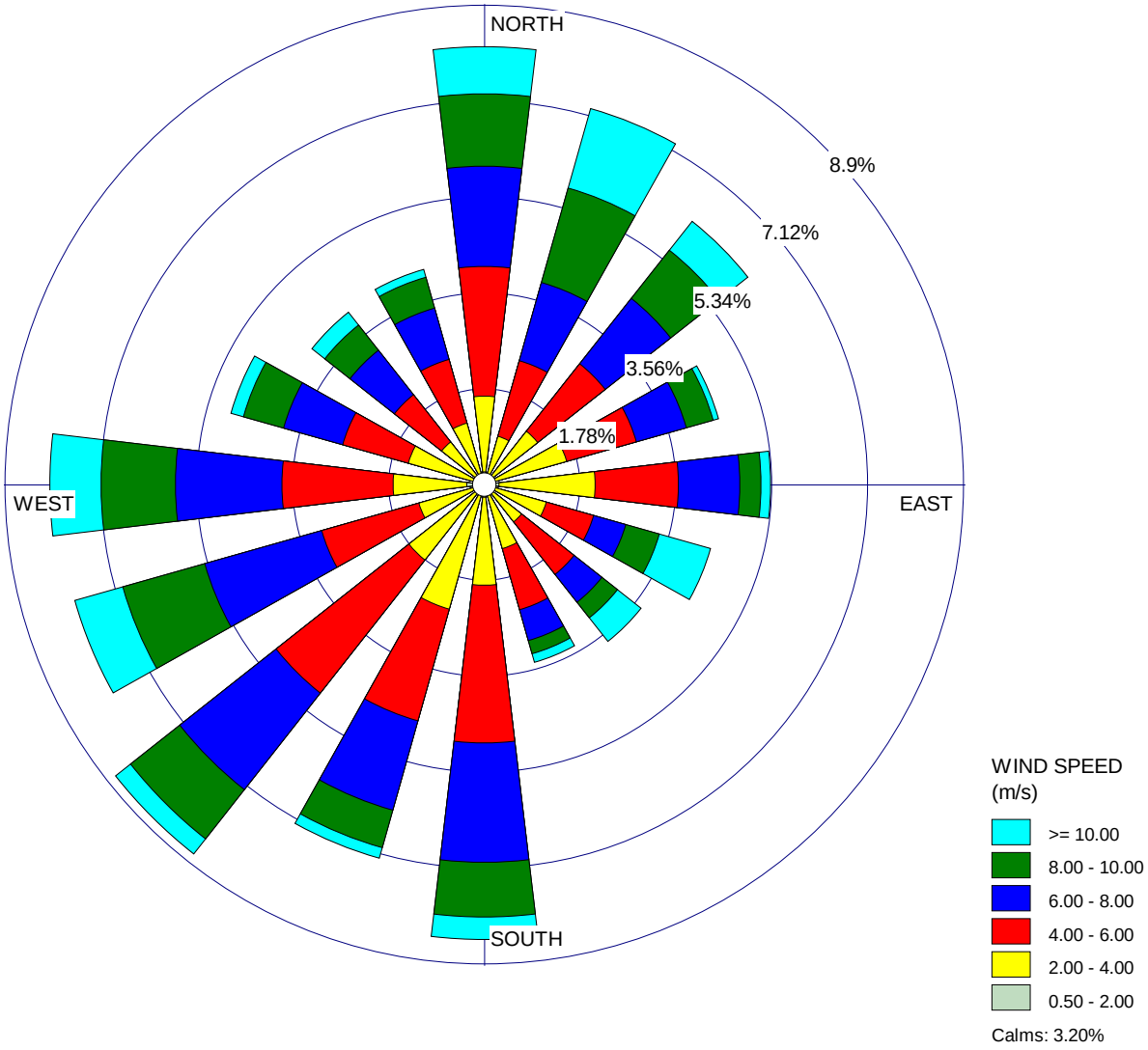
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 3/1/2006 - 00:00 **End Date: 3/31/2016 - 23:00**	**Epsilon Associates**	
	CALM WINDS:	TOTAL COUNT:	
	2.38%	**8136 hrs.**	
	AVG. WIND SPEED:	DATE:	
	6.24 m/s	**11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
April Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



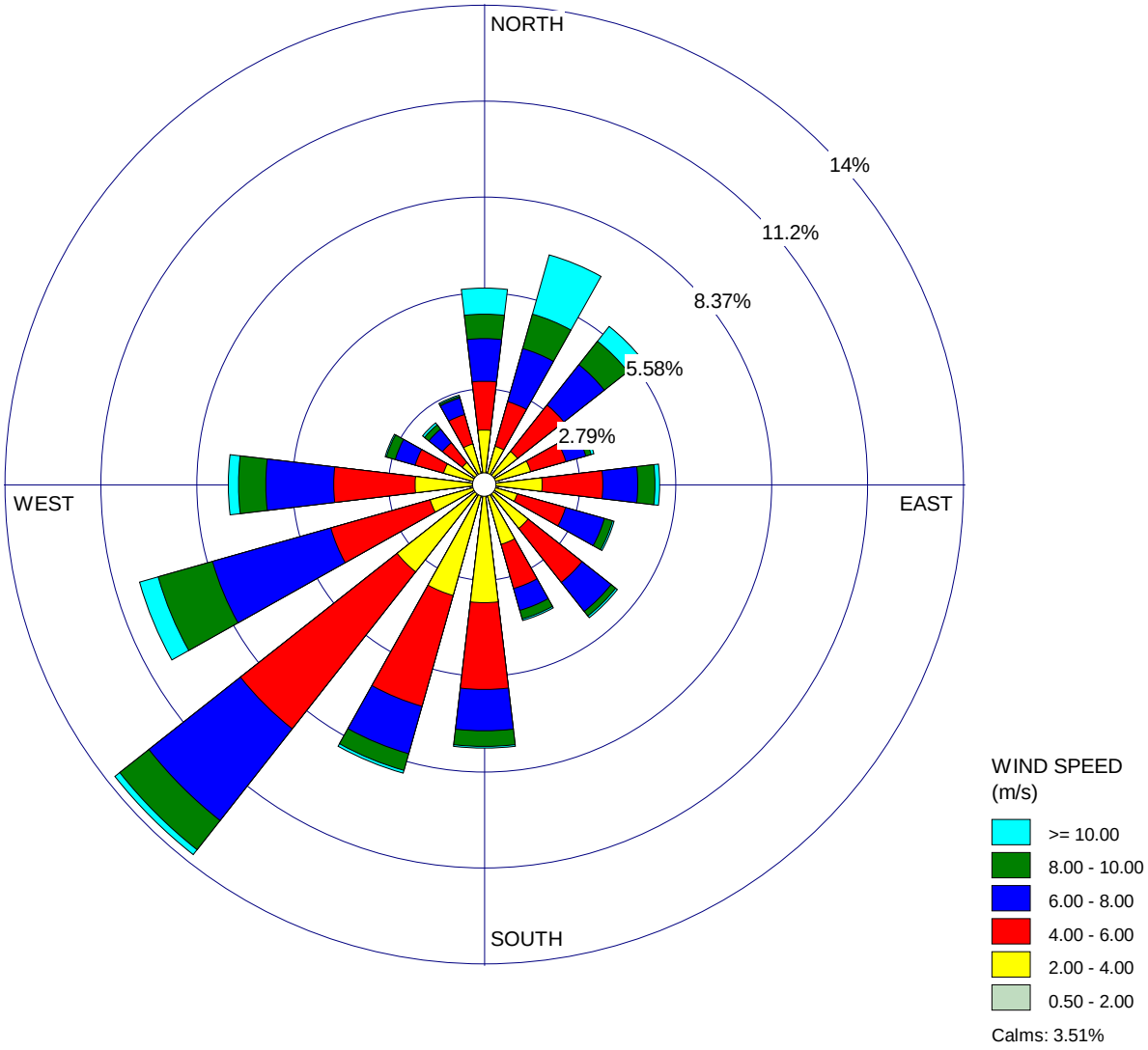
COMMENTS:	DATA PERIOD: **Start Date: 4/1/2006 - 00:00** **End Date: 4/30/2016 - 23:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **3.20%**	TOTAL COUNT: **7868 hrs.**	
	AVG. WIND SPEED: **5.82 m/s**	DATE: **11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
May Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



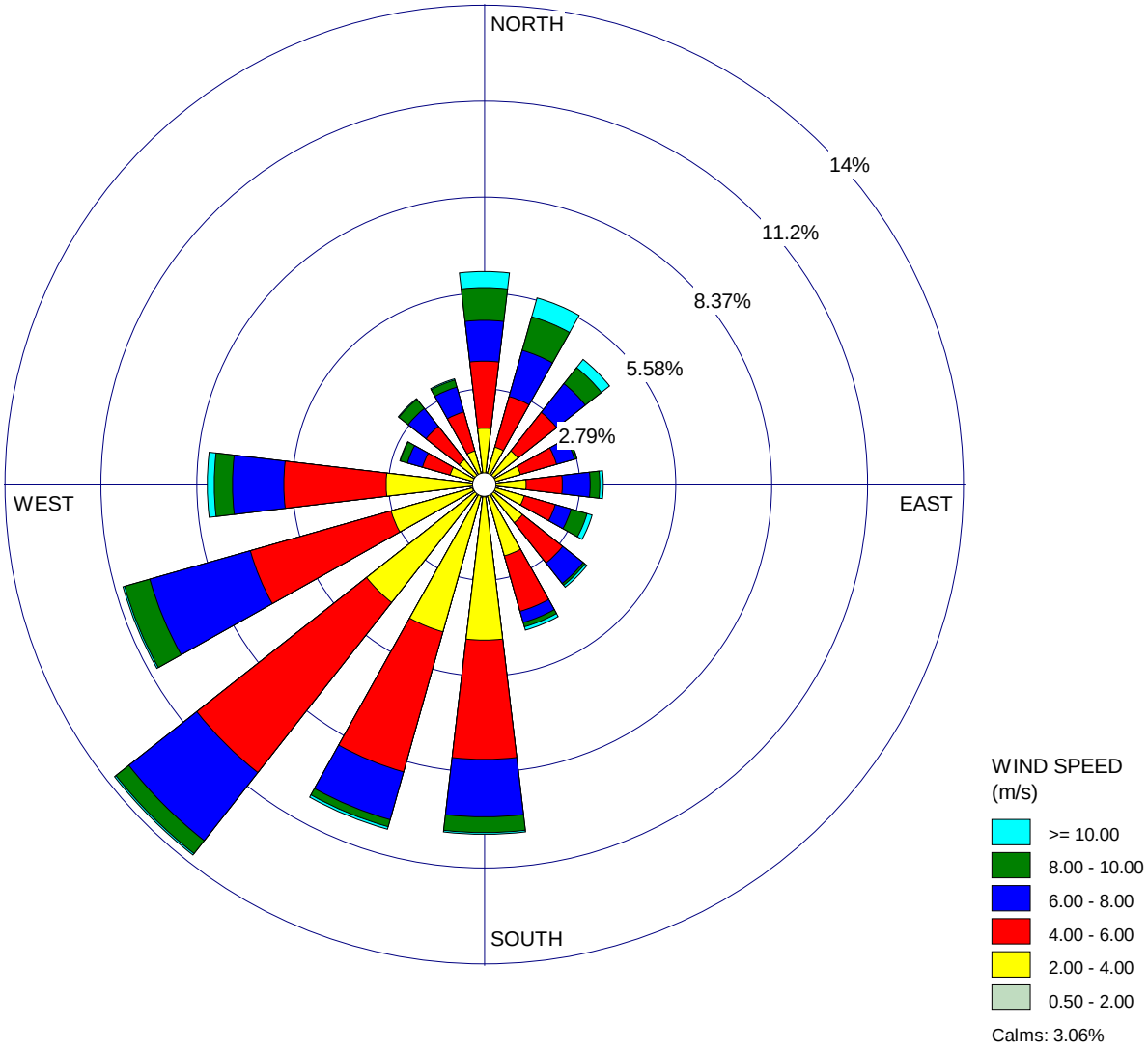
COMMENTS:	DATA PERIOD: **Start Date: 5/1/2006 - 00:00** **End Date: 5/31/2016 - 23:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **3.51%**	TOTAL COUNT: **8116 hrs.**	
	AVG. WIND SPEED: **5.21 m/s**	DATE: **11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
June Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



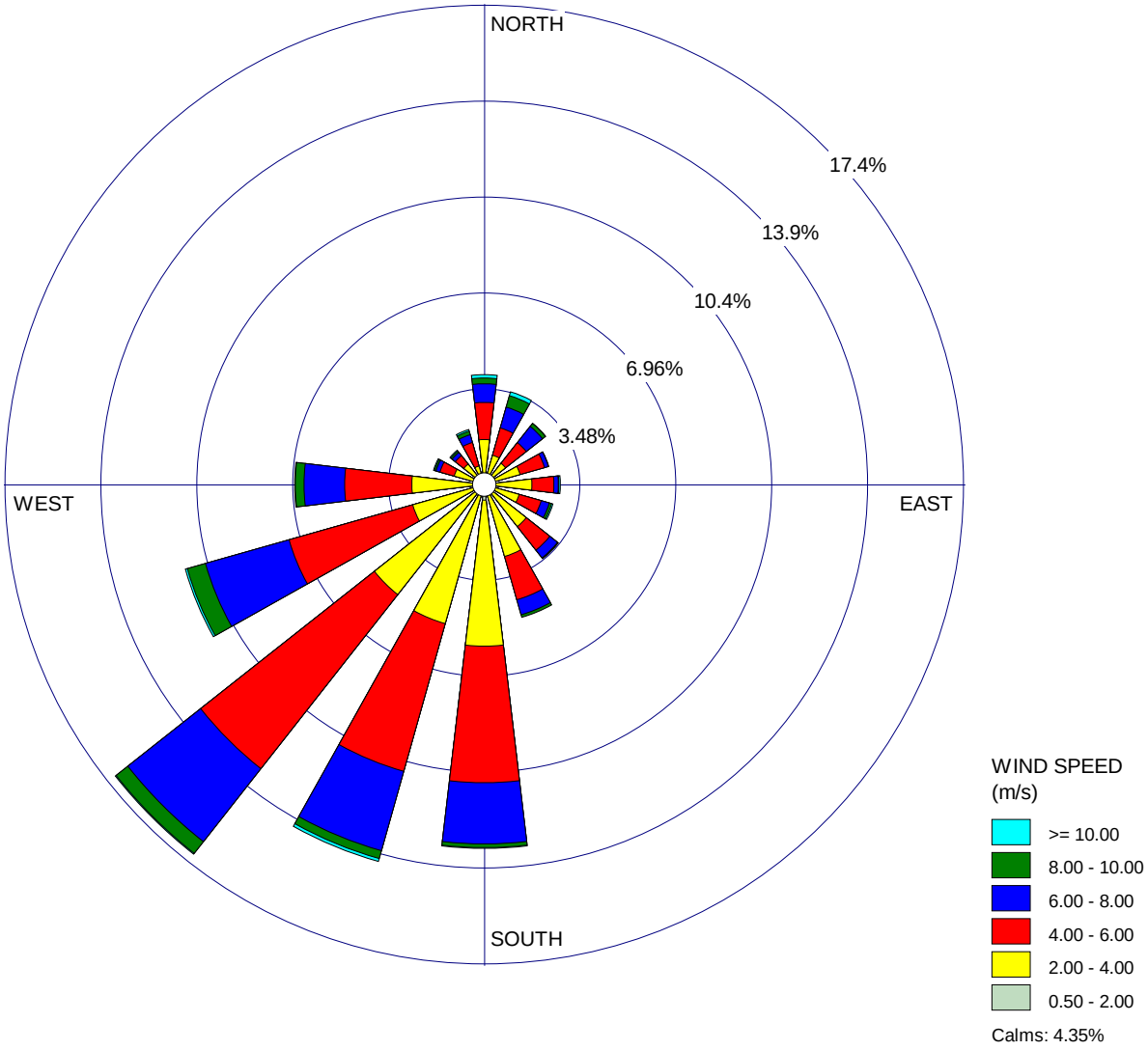
COMMENTS:	DATA PERIOD: **Start Date: 6/1/2006 - 00:00** **End Date: 6/30/2016 - 23:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **3.06%**	TOTAL COUNT: **7865 hrs.**	
	AVG. WIND SPEED: **4.78 m/s**	DATE: **11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
July Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



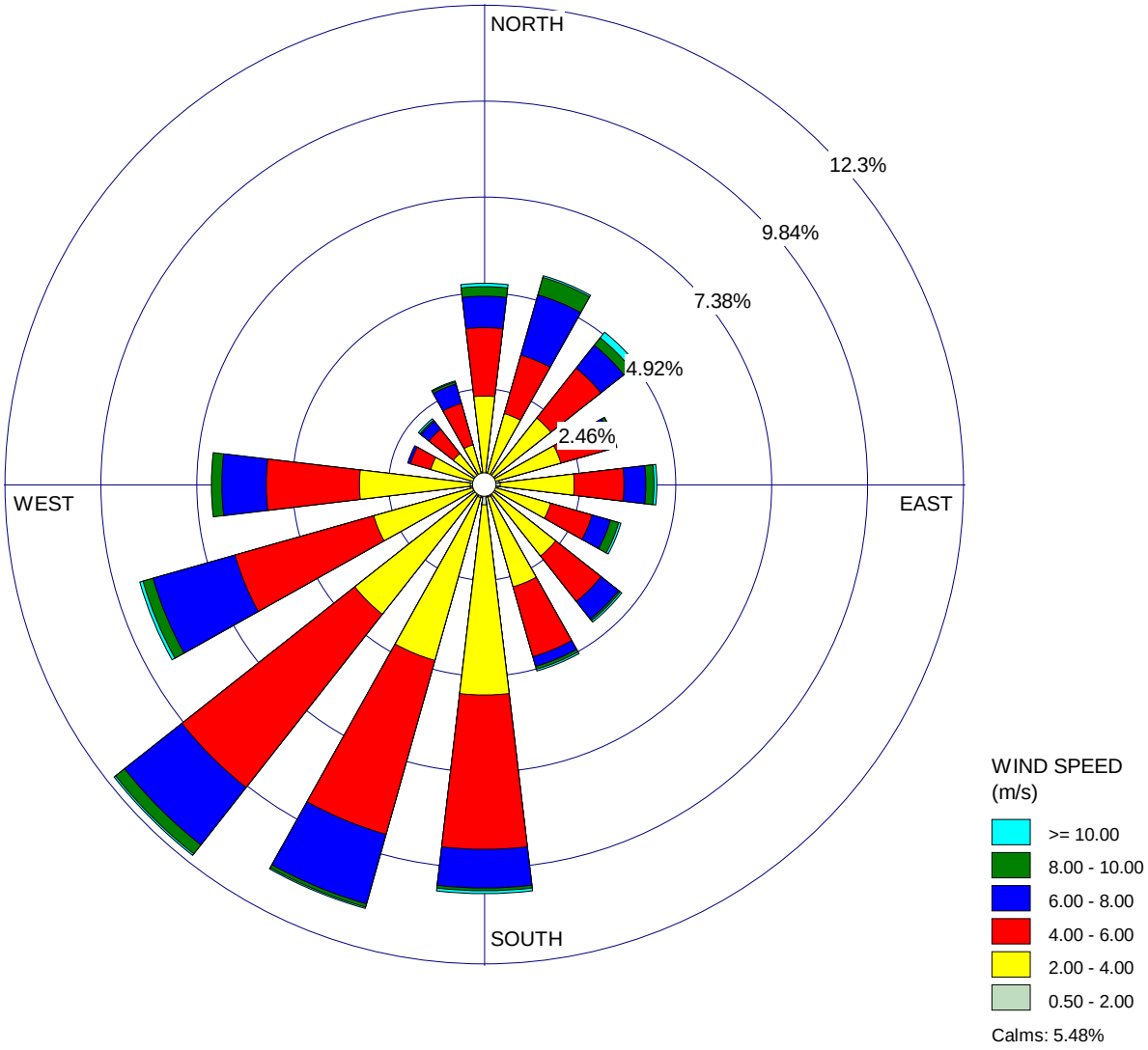
COMMENTS:	DATA PERIOD:	COMPANY NAME:
	Start Date: 7/1/2006 - 00:00 **End Date: 7/31/2016 - 23:00**	**Epsilon Associates**
	CALM WINDS:	TOTAL COUNT:
	4.35%	**8093 hrs.**
	AVG. WIND SPEED:	DATE:
	4.35 m/s	**11/3/2017**

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
August Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



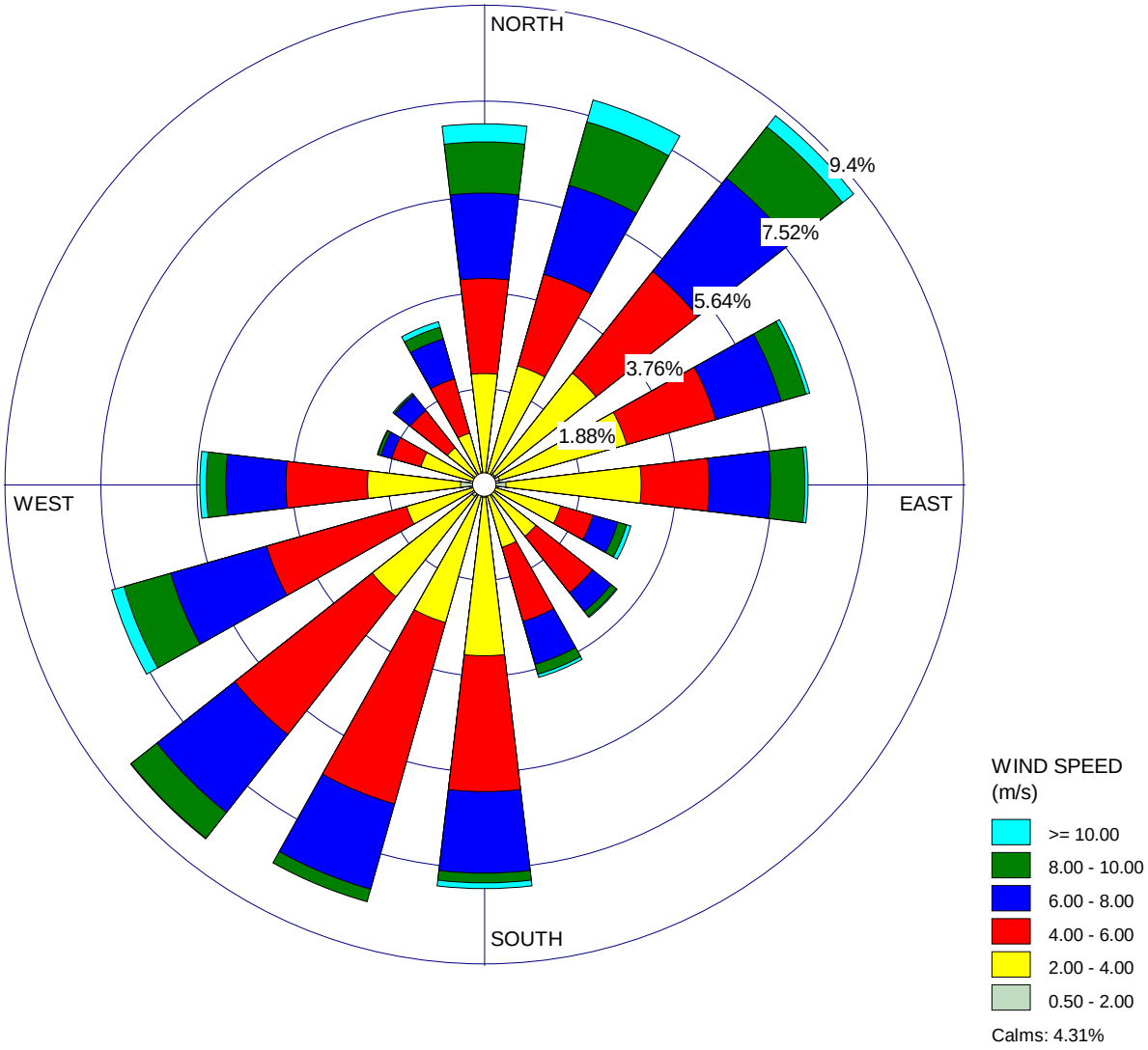
COMMENTS:	DATA PERIOD:	COMPANY NAME:
	Start Date: 8/1/2006 - 00:00 **End Date: 8/31/2016 - 23:00**	**Epsilon Associates**
	CALM WINDS:	TOTAL COUNT:
	5.48%	**8112 hrs.**
	AVG. WIND SPEED:	DATE:
	4.13 m/s	**11/3/2017**

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
September Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



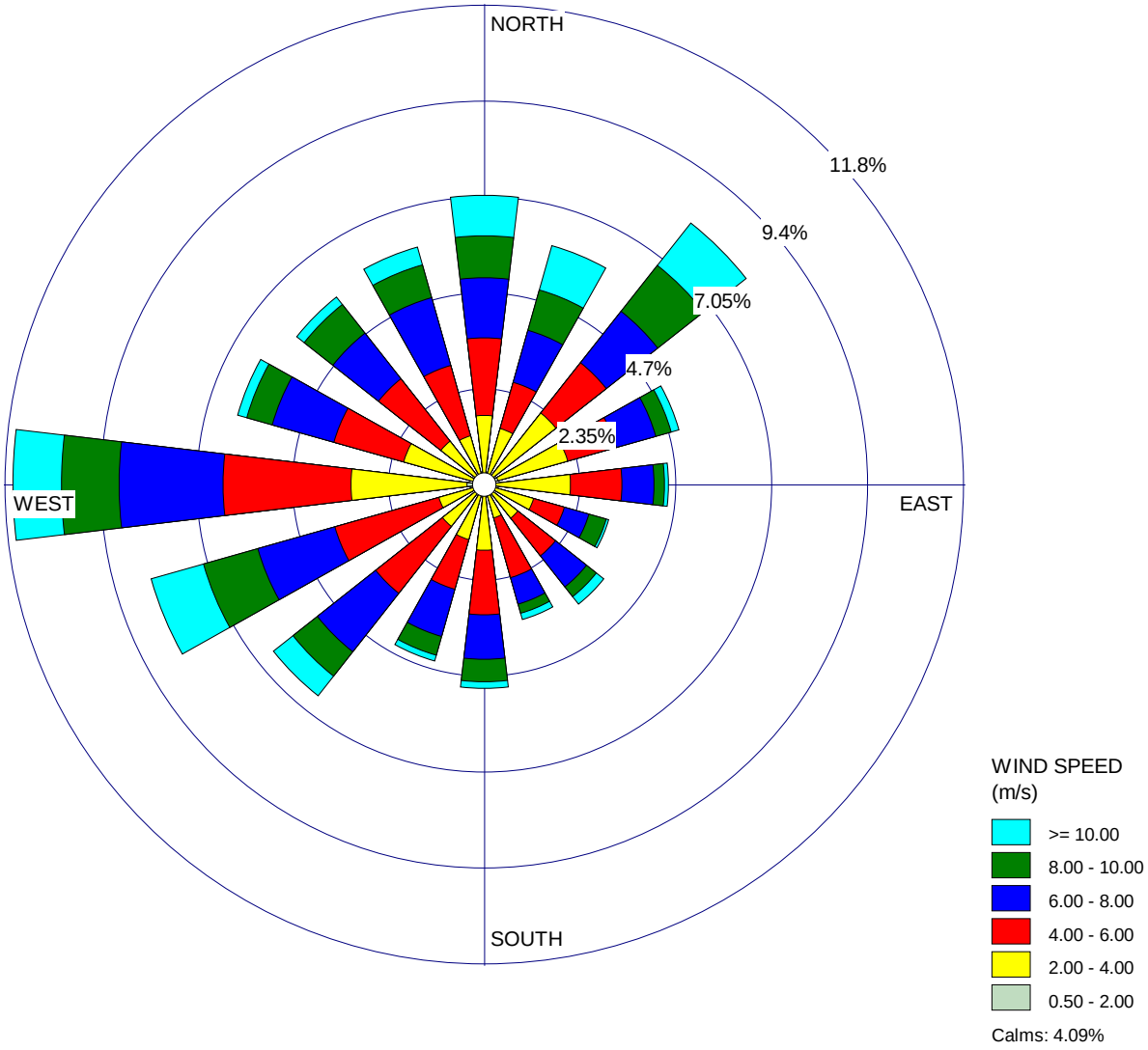
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 9/1/2006 - 00:00 **End Date: 9/30/2016 - 23:00**	**Epsilon Associates**	
	CALM WINDS:	TOTAL COUNT:	
	4.31%	**7721 hrs.**	
	AVG. WIND SPEED:	DATE:	
	4.76 m/s	**11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
October Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



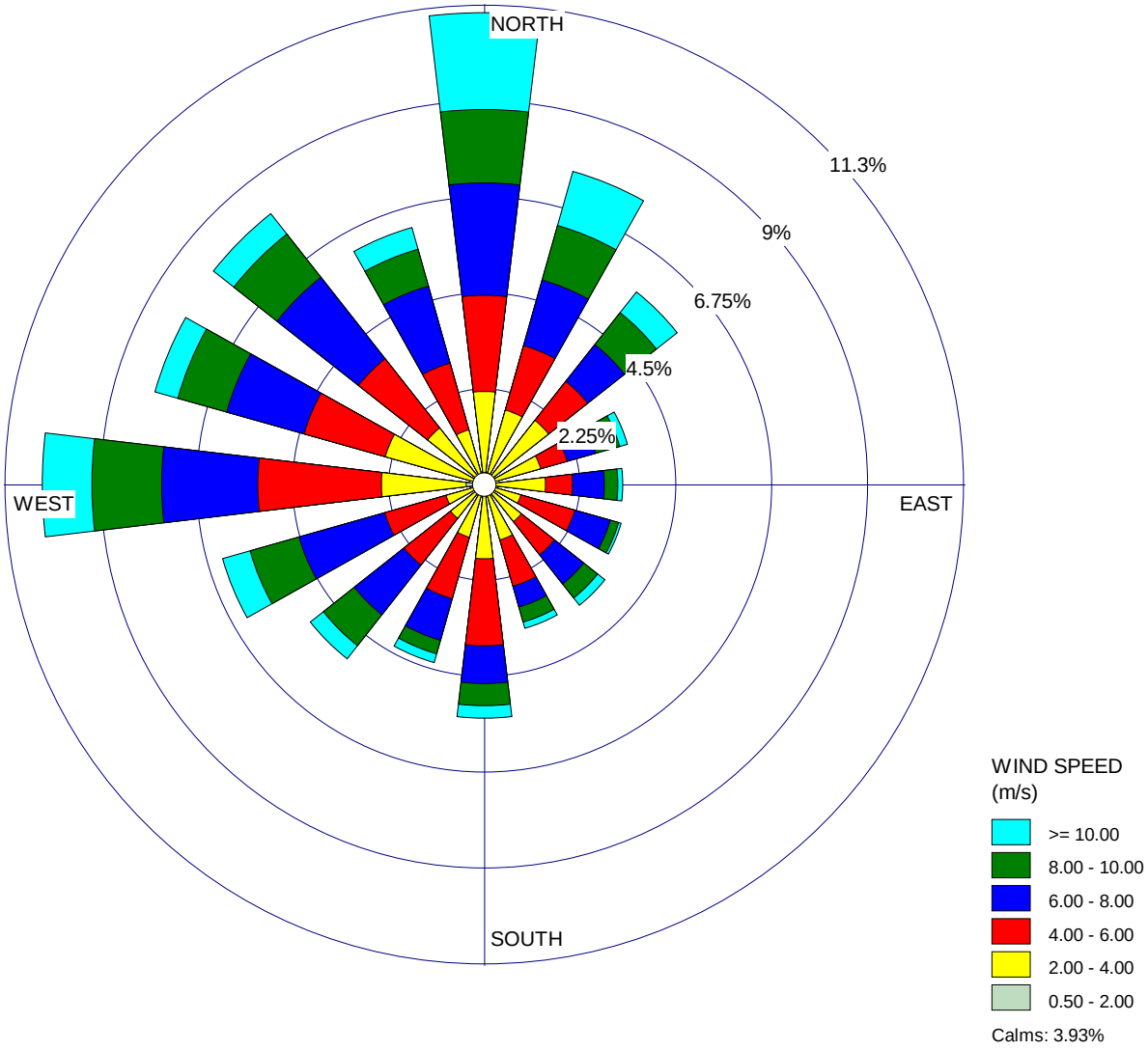
COMMENTS:	DATA PERIOD: **Start Date: 10/1/2006 - 00:00** **End Date: 10/31/2016 - 23:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **4.09%**	TOTAL COUNT: **8131 hrs.**	
	AVG. WIND SPEED: **5.64 m/s**	DATE: **11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
November Wind Rose

DISPLAY:

Wind Speed
Direction (blowing from)



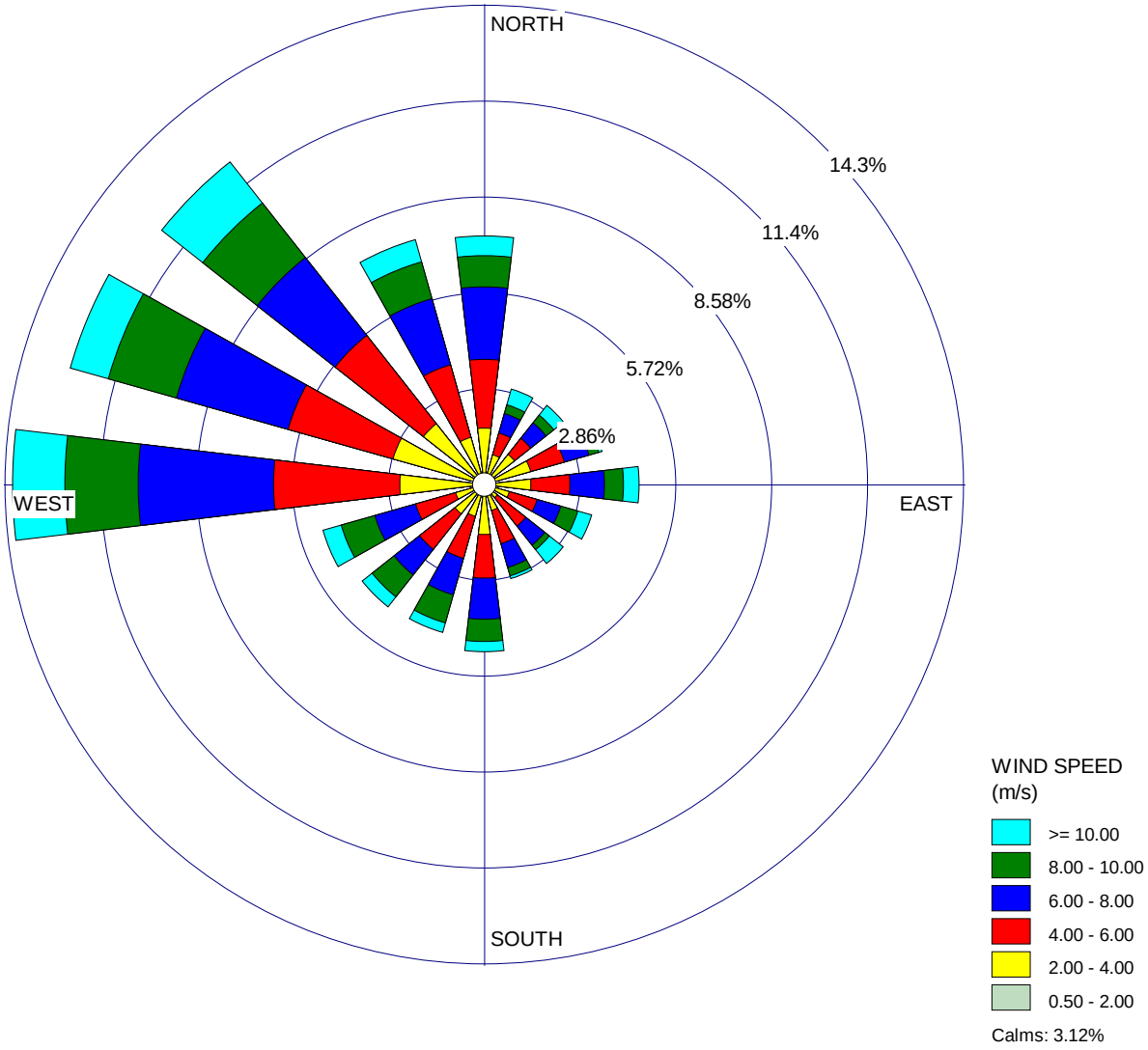
COMMENTS:	DATA PERIOD: **Start Date: 11/1/2006 - 00:00** **End Date: 11/30/2016 - 23:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **3.93%**	TOTAL COUNT: **7880 hrs.**	
	AVG. WIND SPEED: **5.83 m/s**	DATE: **11/3/2017**	

WIND ROSE PLOT:

Nantucket Memorial Airport, Nantucket, MA
December Wind Rose

DISPLAY:

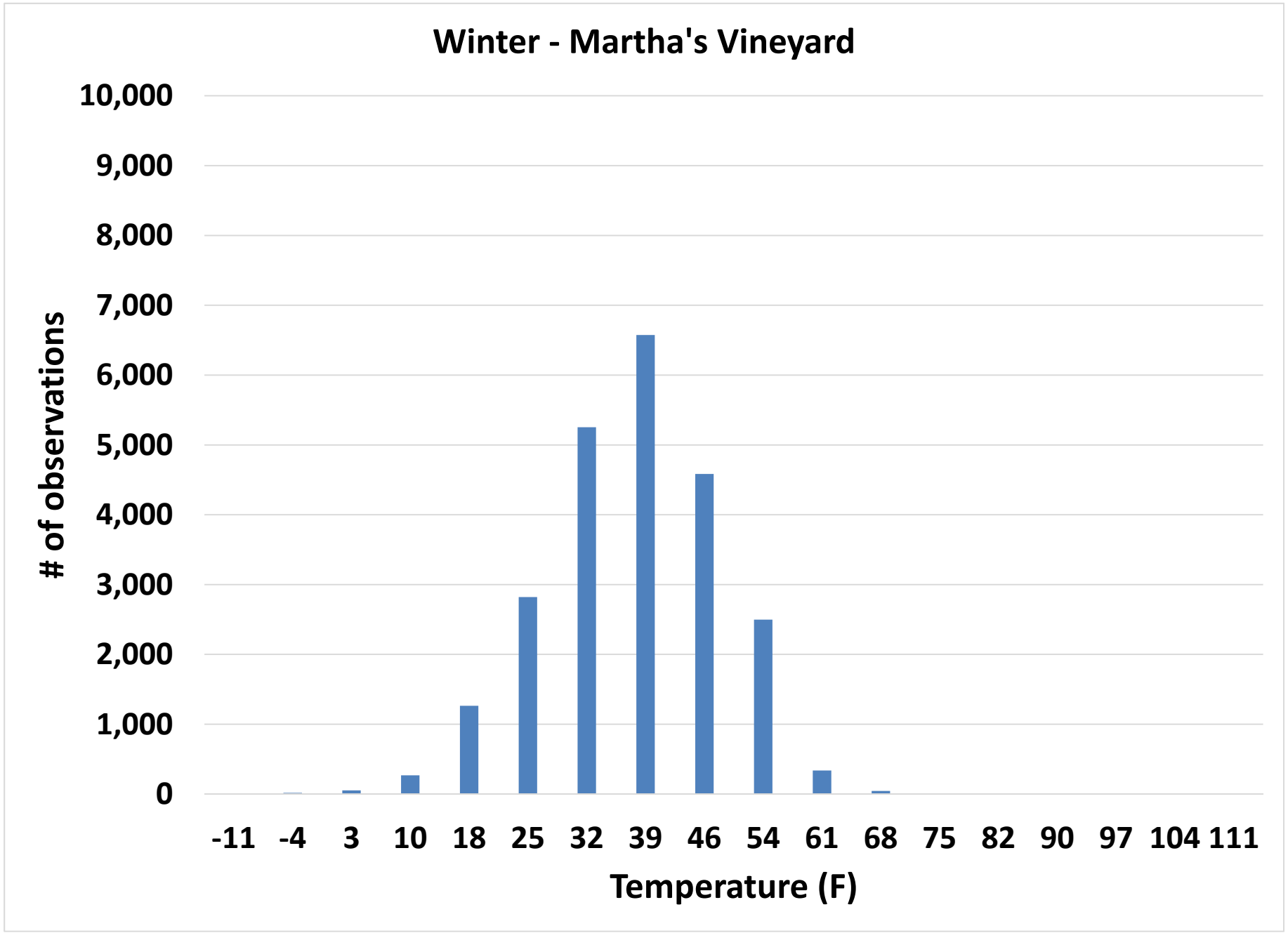
Wind Speed
Direction (blowing from)

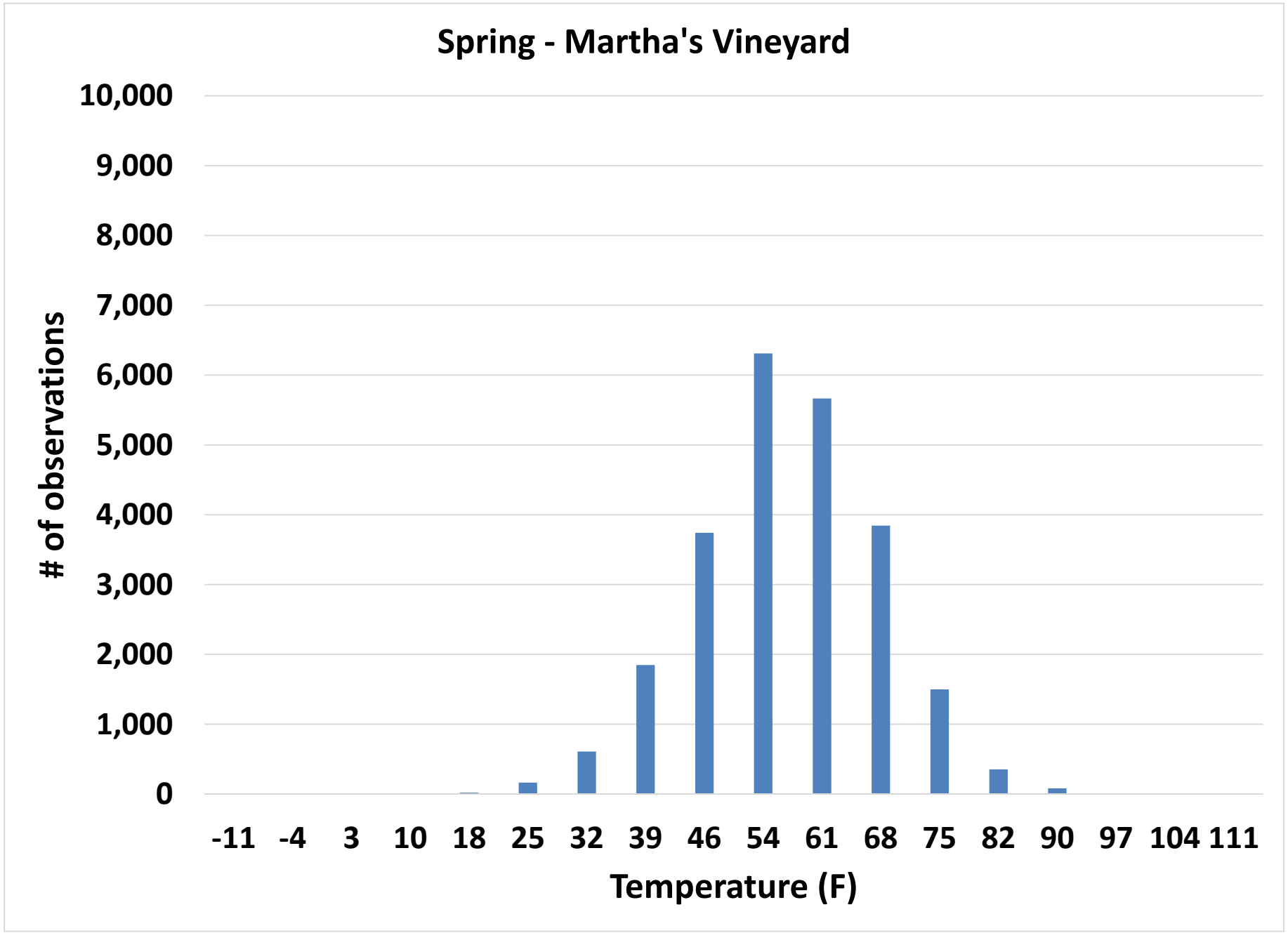


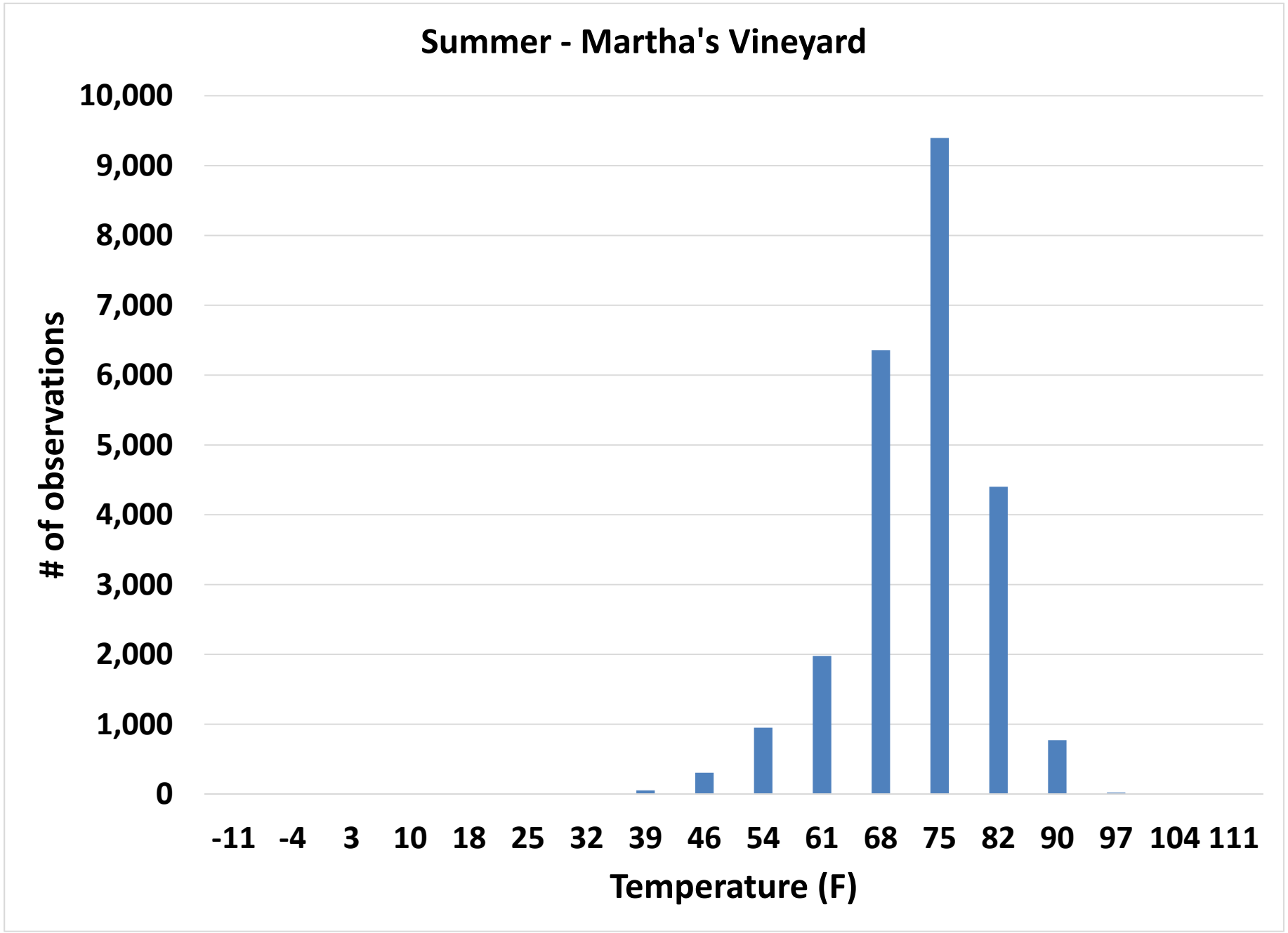
COMMENTS:	DATA PERIOD: **Start Date: 12/1/2006 - 00:00** **End Date: 12/31/2016 - 19:00**	COMPANY NAME: **Epsilon Associates**	
	CALM WINDS: **3.12%**	TOTAL COUNT: **8157 hrs.**	
	AVG. WIND SPEED: **5.98 m/s**	DATE: **11/3/2017**	

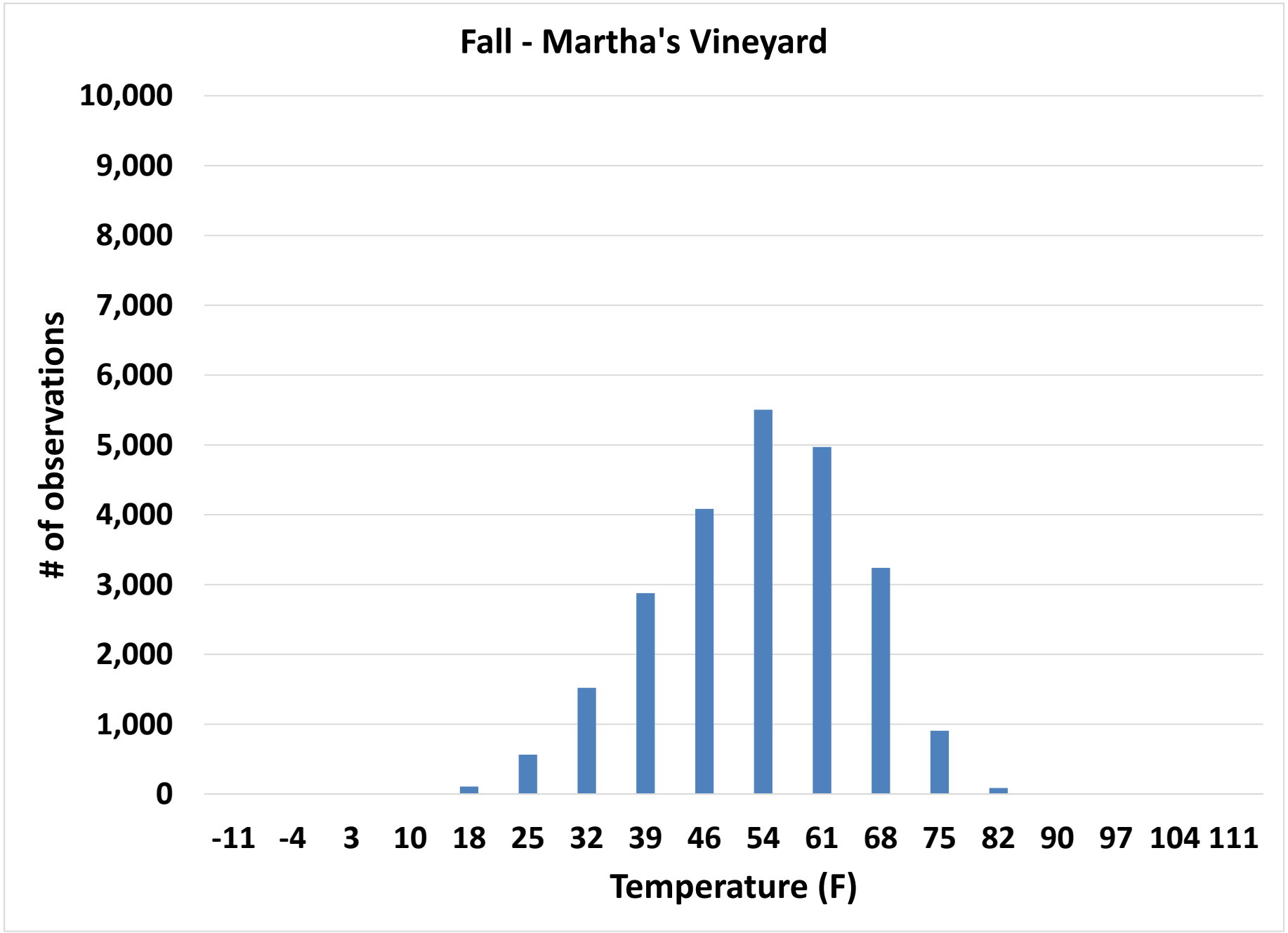
Appendix B

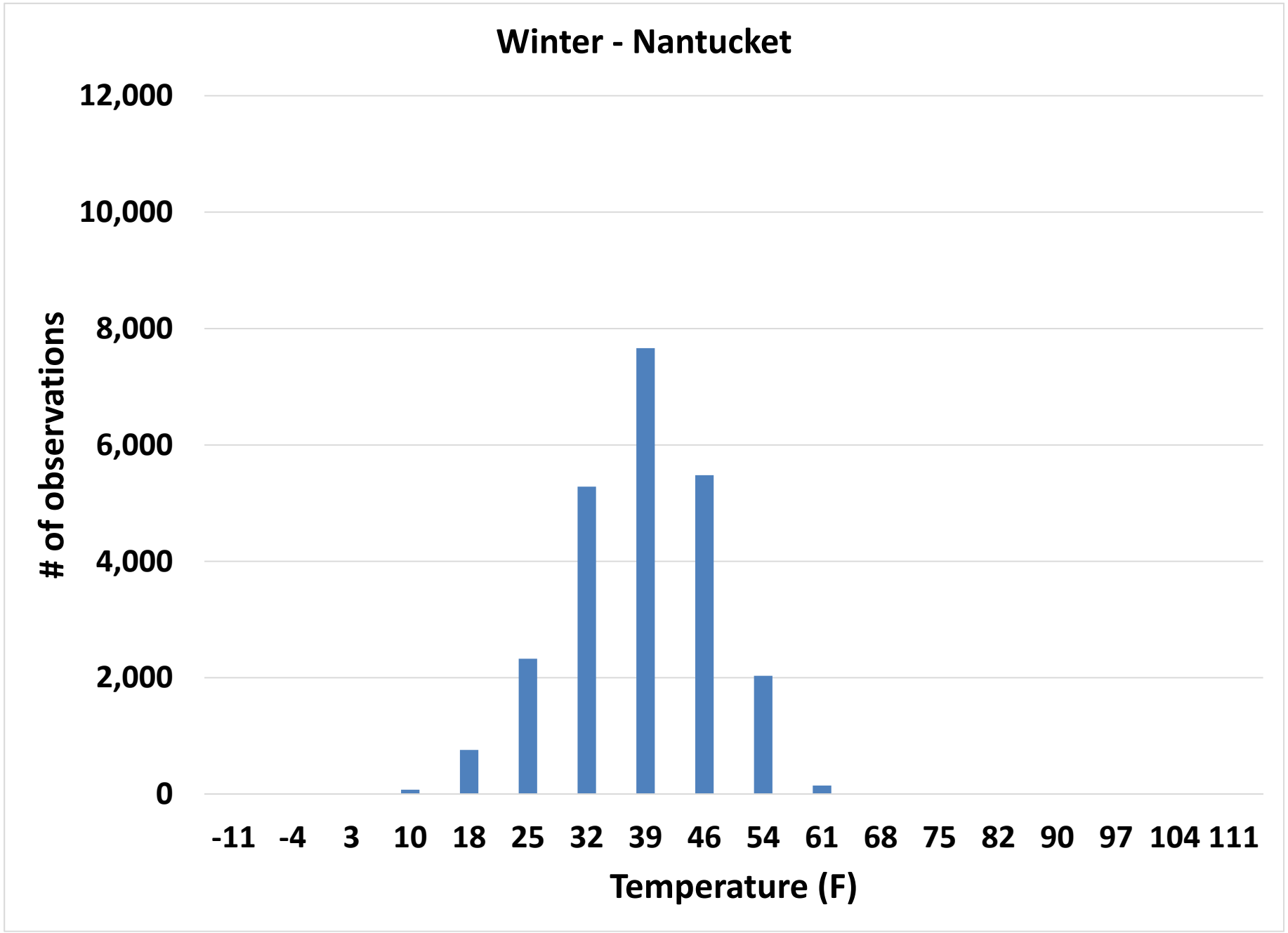
Histograms of Temperature Distributions for
Martha's Vineyard and Nantucket

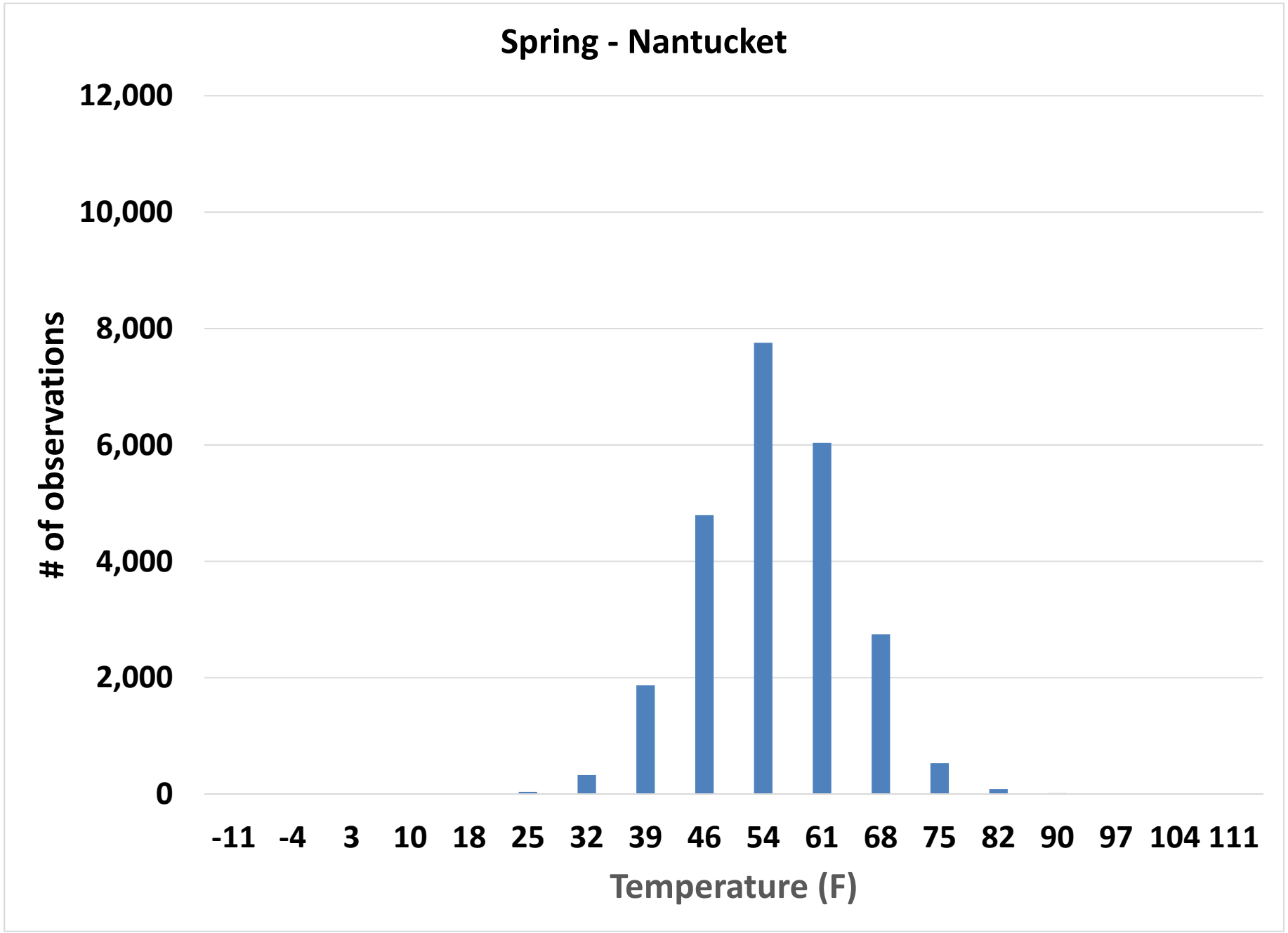

Winter - Martha's Vineyard
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
# of observations
-11
-4
3
10
18
25
32
39
46
54
61
68
75
82
90
97
104
111
Temperature (F)

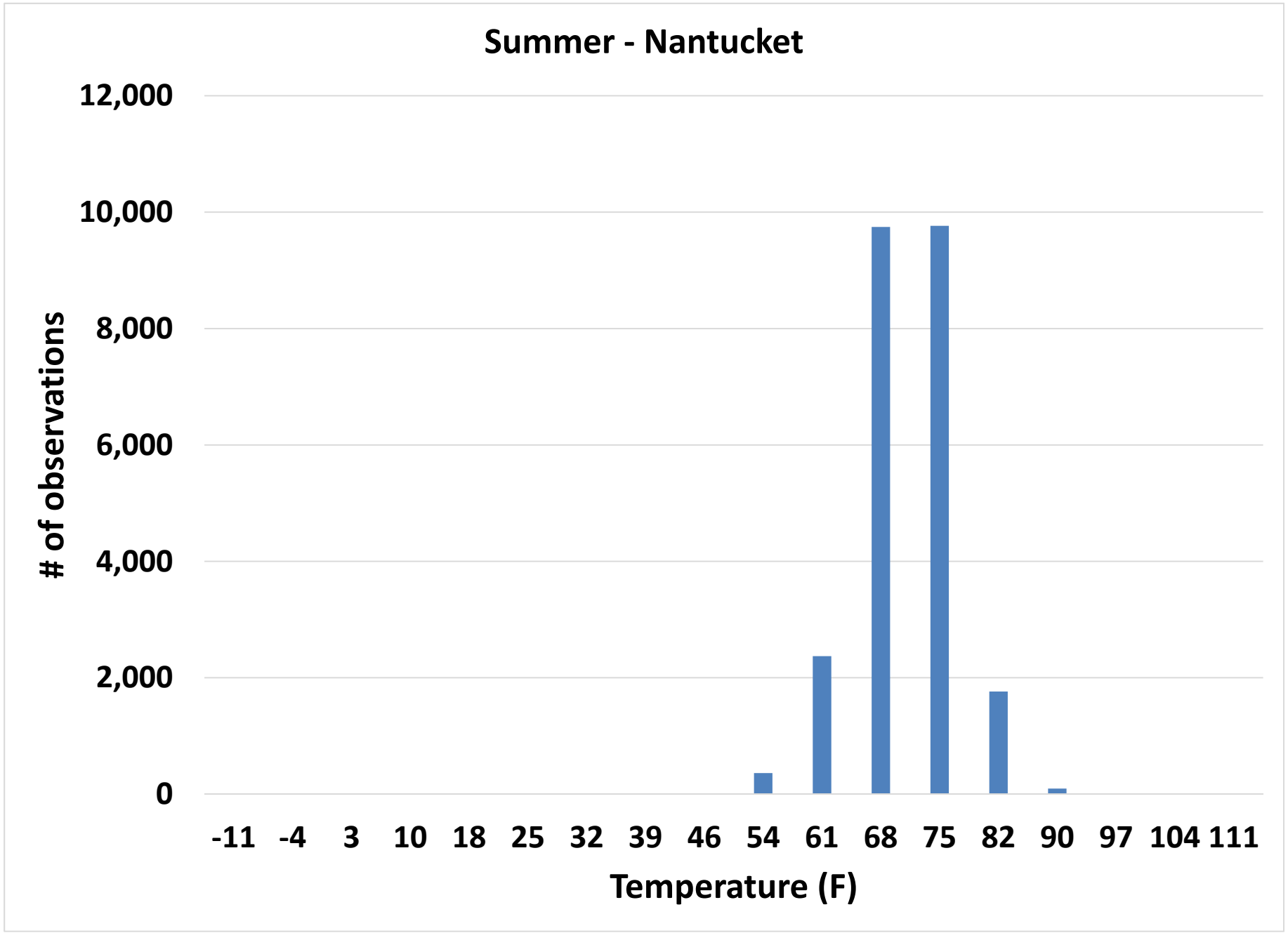

Spring - Martha's Vineyard
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
# of observations
-11
-4
3
10
18
25
32
39
46
54
61
68
75
82
90
97
104
111
Temperature (F)

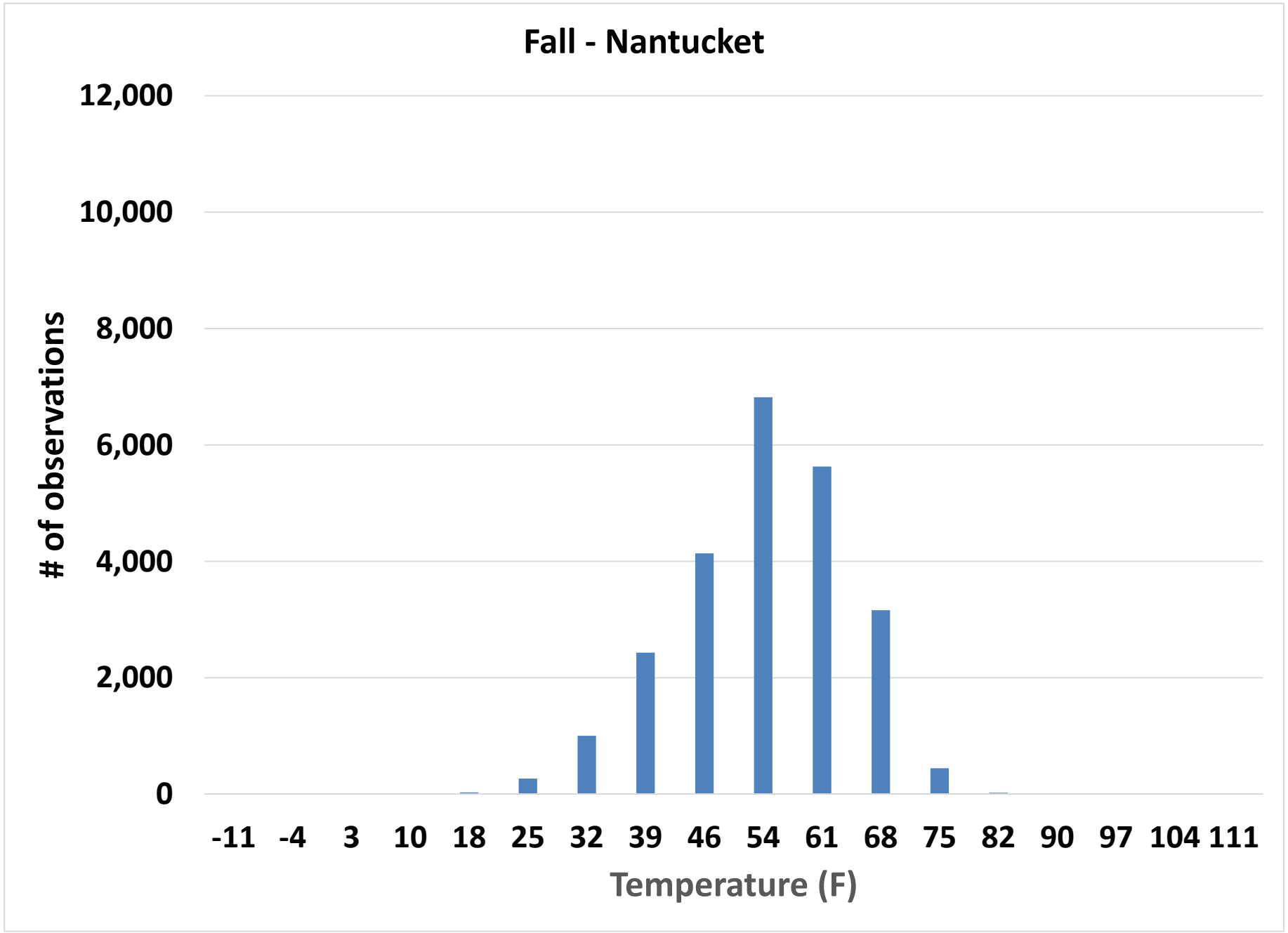

Summer - Martha's Vineyard
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
# of observations
-11
-4
3
10
18
25
32
39
46
54
61
68
75
82
90
97
104
111
Temperature (F)


Fall - Martha's Vineyard
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
# of observations
-11
-4
3
10
18
25
32
39
46
54
61
68
75
82
90
97
104
111
Temperature (F)


Winter - Nantucket
12,000
10,000
8,000
6,000
4,000
2,000
0
# of observations
-11
-4
3
10
18
25
32
39
46
54
61
68
75
82
90
97
104
111
Temperature (F)

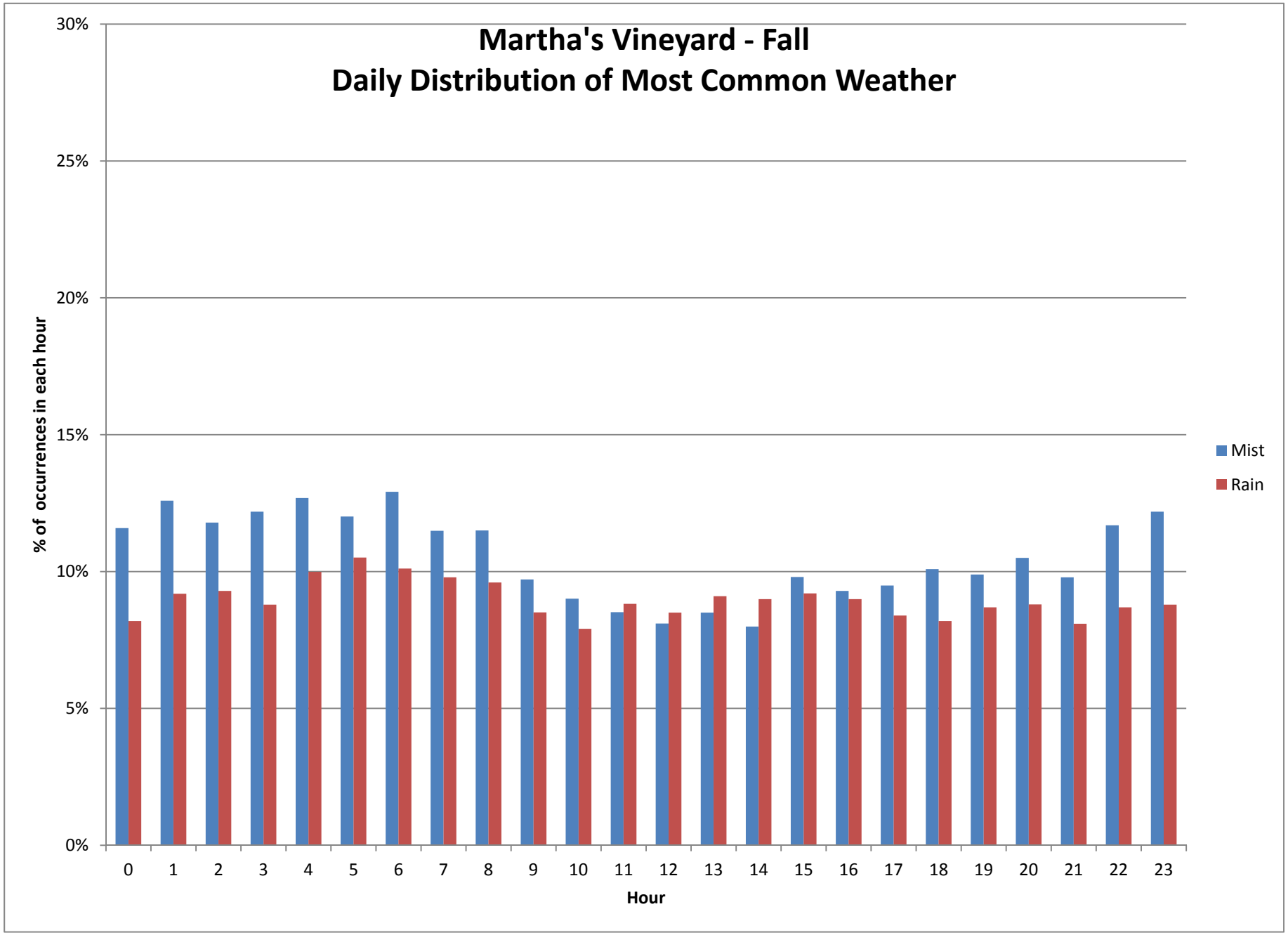

Spring - Nantucket
12,000
10,000
8,000
6,000
4,000
2,000
0
# of observations
-11
-4
3
10
18
25
32
39
46
54
61
68
75
82
90
97
104
111
Temperature (F)

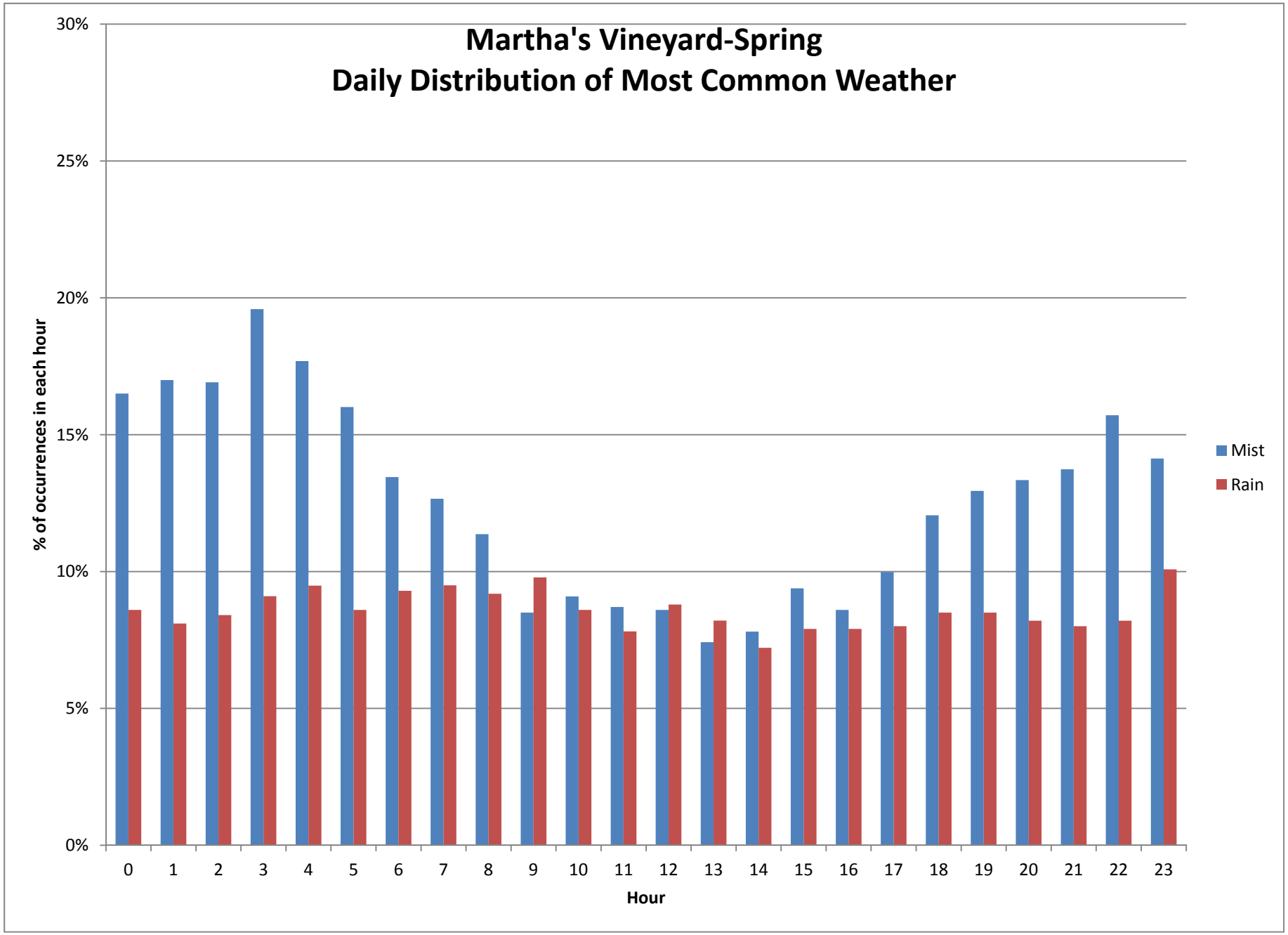

Summer - Nantucket
12,000
10,000
8,000
6,000
4,000
2,000
0
# of observations
-11
-4
3
10
18
25
32
39
46
54
61
68
75
82
90
97
104
111
Temperature (F)

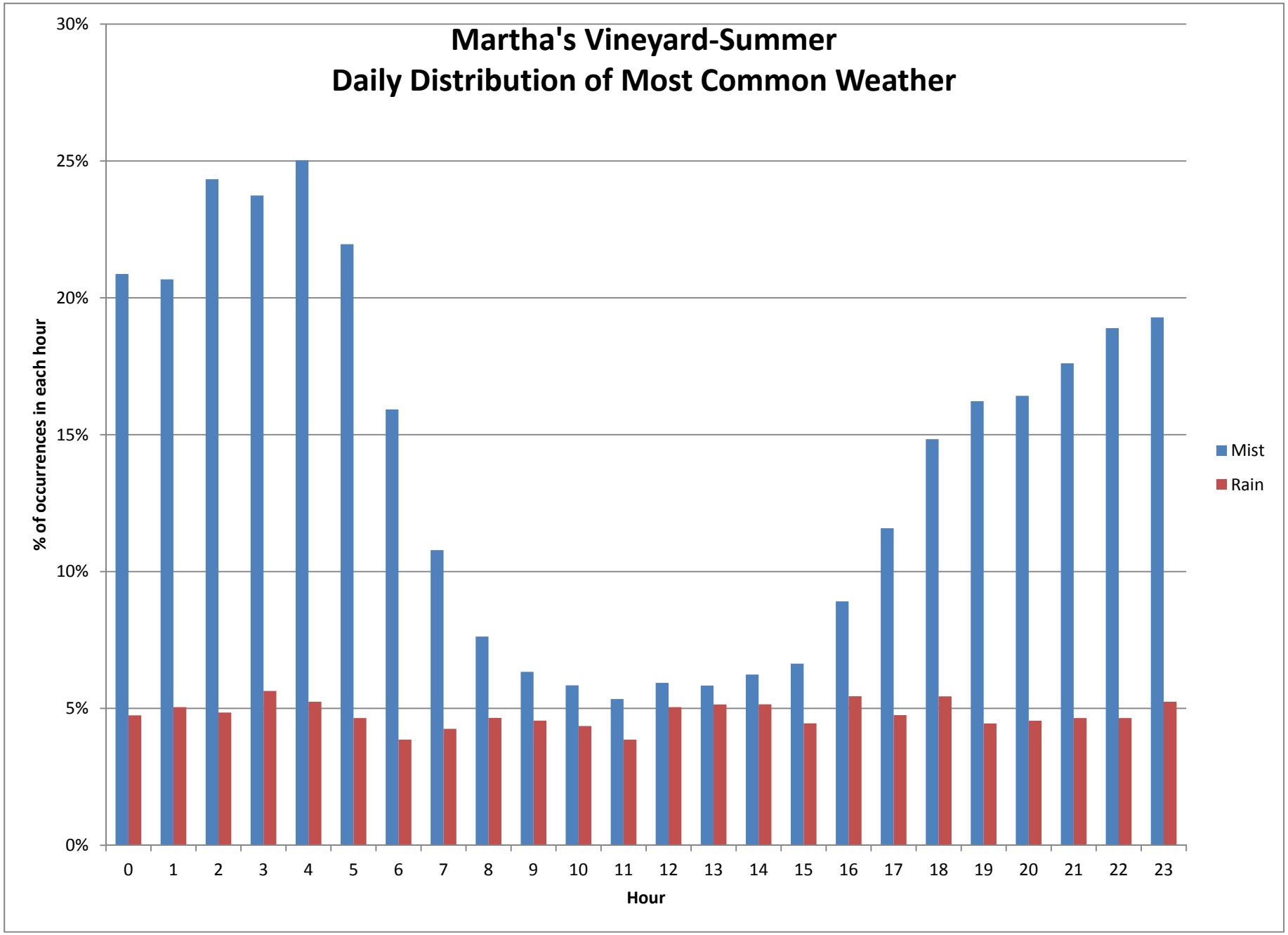

Fall - Nantucket
12,000
10,000
8,000
6,000
4,000
2,000
0
# of observations
-11
-4
3
10
18
25
32
39
46
54
61
68
75
82
90
97
104
111
Temperature (F)

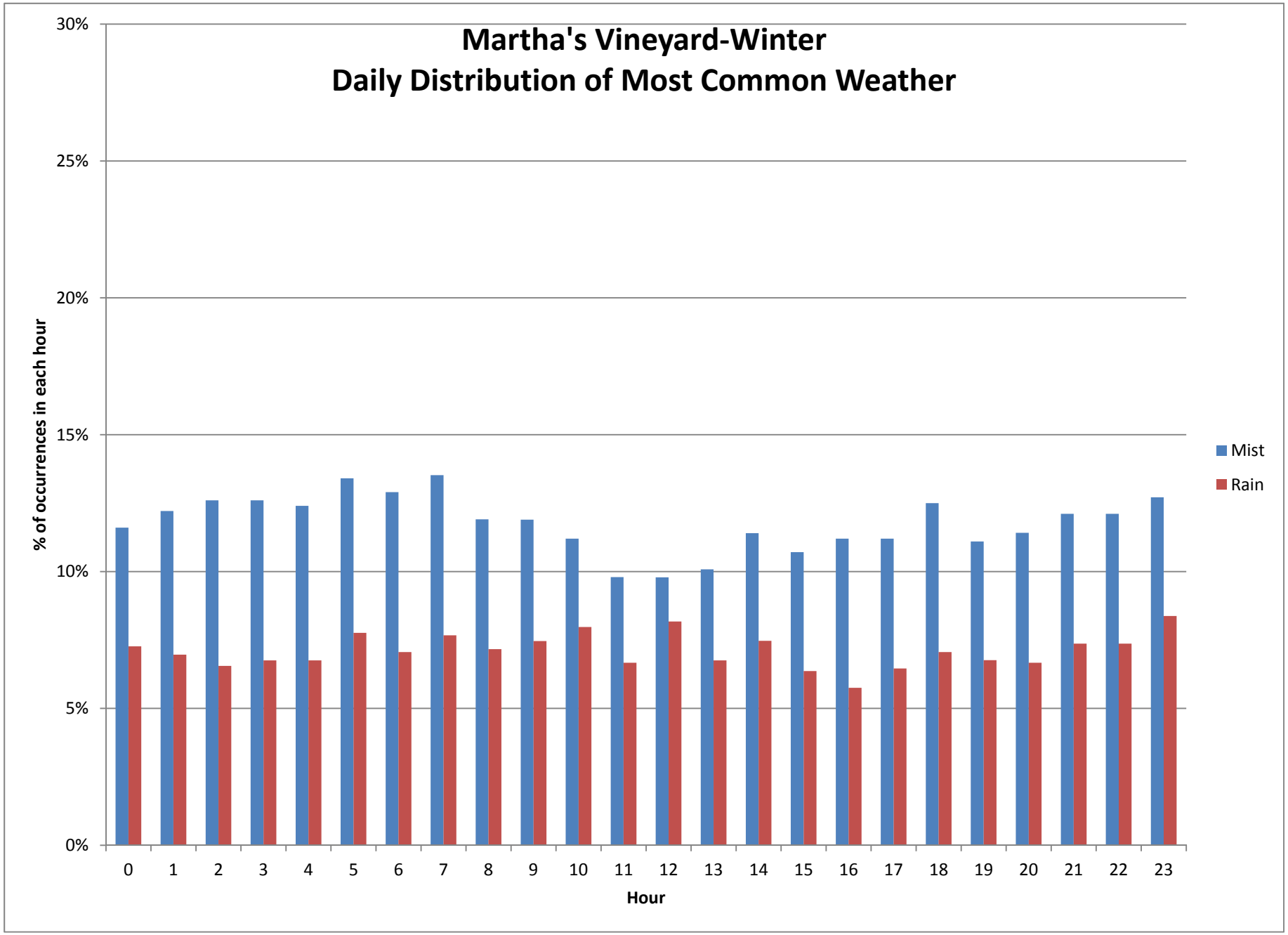
Appendix C

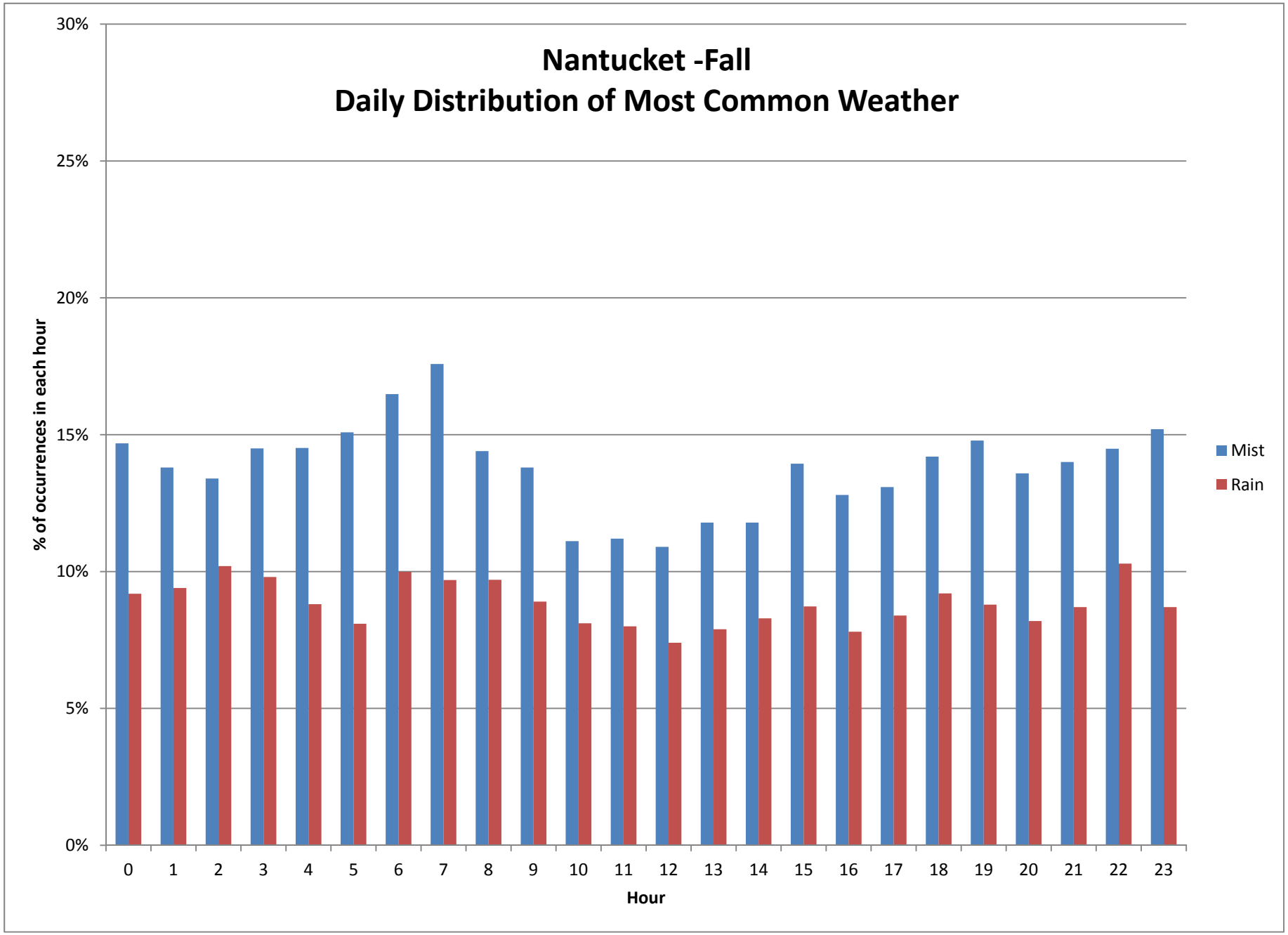
Common Weather Conditions at Martha's Vineyard and Nantucket

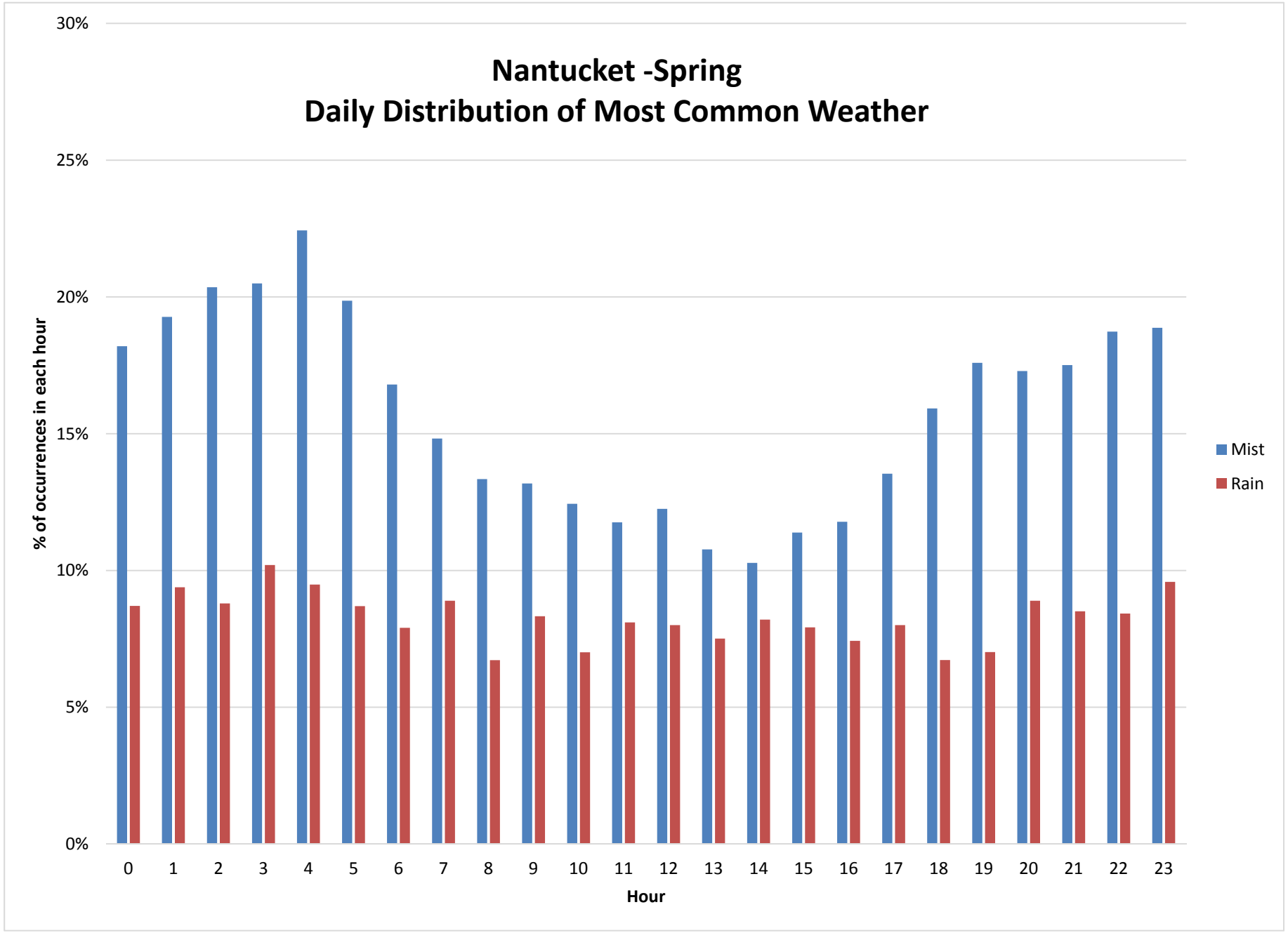

Martha's Vineyard - Fall
Daily Distribution of Most Common Weather
30%
25%
20%
15%
10%
5%
0%
% of occurrences in each hour
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Hour
Mist
Rain

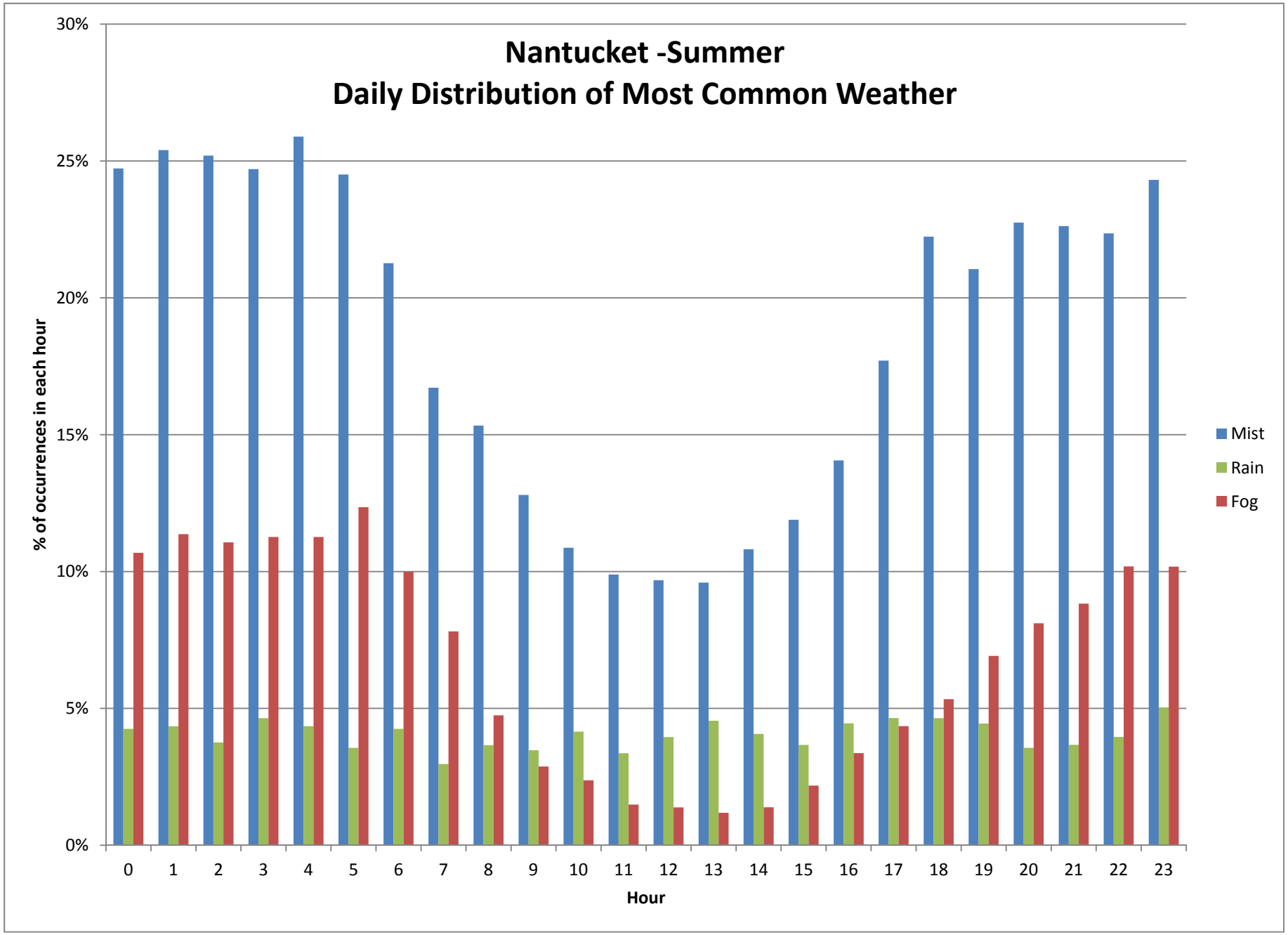

Martha's Vineyard-Spring
Daily Distribution of Most Common Weather
30%
25%
20%
15%
10%
5%
0%
% of occurrences in each hour
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Mist
Rain

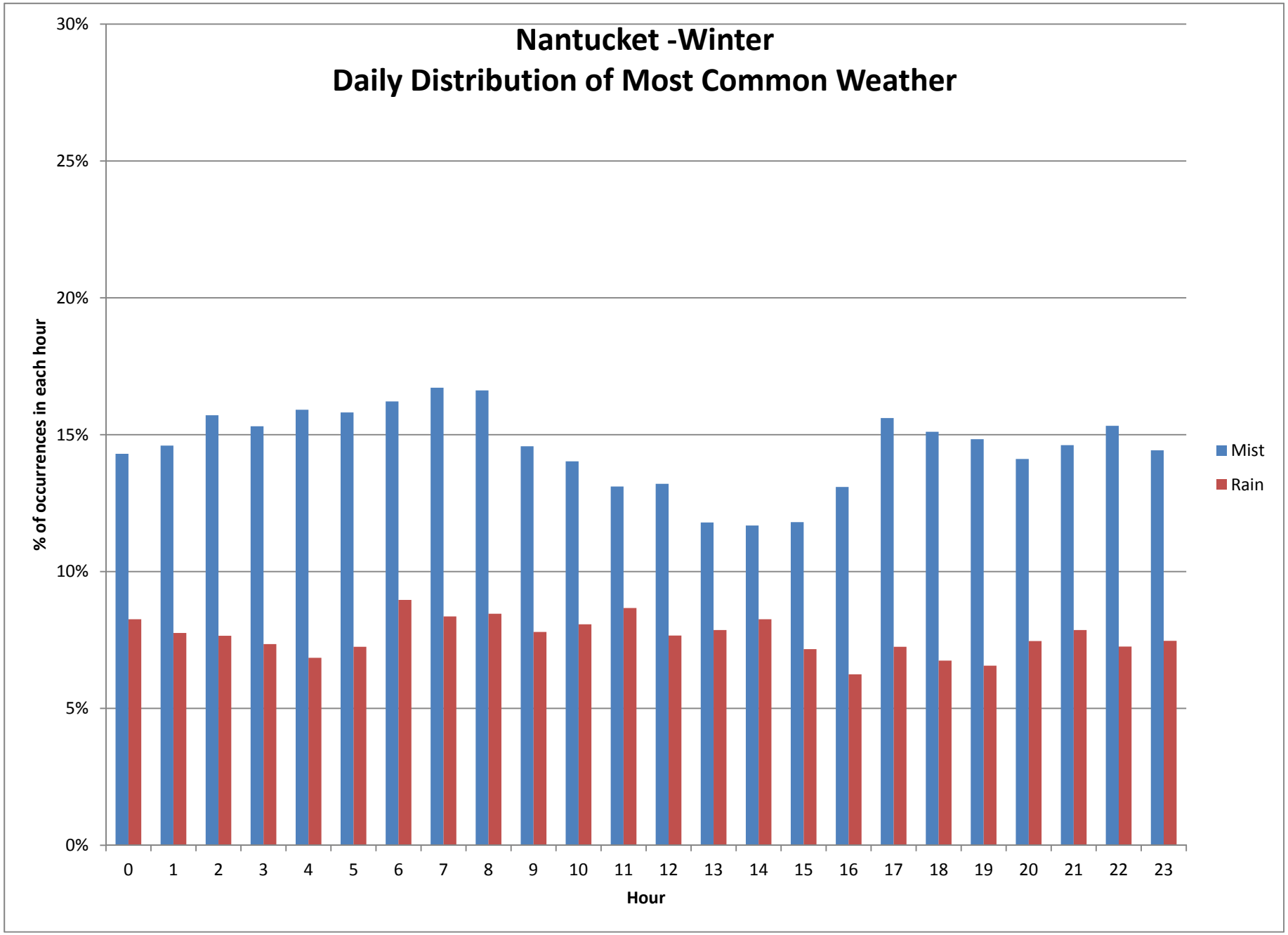

Martha's Vineyard-Summer
Daily Distribution of Most Common Weather
30%
25%
20%
15%
10%
5%
0%
% of occurrences in each hour
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Mist
Rain


Martha's Vineyard-Winter
Daily Distribution of Most Common Weather
30%
25%
20%
15%
10%
5%
0%
% of occurrences in each hour
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Mist
Rain


Nantucket -Fall
Daily Distribution of Most Common Weather
30%
25%
20%
15%
10%
5%
0%
% of occurrences in each hour
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Hour
Mist
Rain


Nantucket -Spring
Daily Distribution of Most Common Weather
30%
25%
20%
15%
10%
5%
0%
% of occurrences in each hour
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Mist
Rain


Nantucket -Summer
Daily Distribution of Most Common Weather
30%
25%
20%
15%
10%
5%
0%
% of occurrences in each hour
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Mist
Rain
Fog


Nantucket -Winter
Daily Distribution of Most Common Weather
30%
25%
20%
15%
10%
5%
0%
% of occurrences in each hour
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Hour
Mist
Rain