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VINEYARD WIND

Draft Construction and Operations Plan

Volume III Appendices

Vineyard Wind Project

October 22, 2018

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Submitted to

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Public Archaeology Laboratory, Inc.
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Saratoga Associates
Swanson Environmental Associates
Wood Thilsted Partners Ltd
WSP

October 22, 2018

Appendix III-J

Aviation Impact Assessment

Vineyard Wind Project

Vineyard Wind LLC

Outer Continental Shelf: North Atlantic Planning Area (OCS-A-501)

Aviation Impact Analysis

December 06, 2017



Capitol Airspace Group

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Summary

Capitol Airspace conducted an aviation impact analysis for the Vineyard wind project. This project consists of an approximately 261 square mile Lease Area (red outline, [Figure 1](#)) with as many as 106 wind turbine locations (black points, [Figure 1](#)) located in the northeastern majority of the Lease Area. The purpose for this analysis was to identify aviation impacts resulting from the construction of 696 foot above mean lower-low water (MLLW) wind turbines within the Lease Area.^{1, 2}

The Federal Aviation Administration (FAA) is authorized to conduct aeronautical studies for structures proposed within the United States and its territorial waters. The FAA's objective in conducting aeronautical studies is to ensure that proposed structures do not have an effect on the safety of air navigation or the efficient utilization of navigable airspace. Eight of the 106 wind turbine locations may be located within territorial waters and, as a result, would require submittal to the FAA so that an aeronautical study can be conducted. For the remainder of the turbine locations, there is no requirement for an FAA aeronautical study. However, this analysis assessed the entire Lease Area for the same physical airspace impacts that are evaluated during an FAA aeronautical study.

Obstacle clearance surface heights overlying the Vineyard wind project are a constant 549, 1,300, 1,349, or 4,849 feet above mean sea level (AMSL) and are associated with instrument approach procedures as well as minimum vectoring and instrument flight rules (IFR) altitude sectors. At 696 feet, as many as 52 wind turbines would require an increase to minimum vectoring altitudes. However, historical air traffic data obtained from the FAA indicates that it is unlikely this impact would affect a significant volume of operations.

This study did not consider electromagnetic interference on communications, navigation systems, or radar surveillance systems.

Note: Several refinements to the Project Envelope have been made since conducting this aviation impact analysis. For example, although the Project is including 106 WTG positions in the Project Envelope, only up to 100 positions will be occupied by a WTG. In addition, the Project has eliminated the option to install light-weight ESPs.

¹ Capitol Airspace applies FAA defined rules and regulations applicable to obstacle evaluation, instrument procedures assessment and visual flight rules (VFR) operations to the best of its ability and with the intent to provide the most accurate representation of limiting airspace surfaces as possible. Capitol Airspace maintains datasets obtained from the FAA which are updated on a 56 day cycle. The results of this analysis are based on the most recent data available as of the date of this report. Limiting airspace surfaces depicted in this report are subject to change due to FAA rule changes and regular procedure amendments.

² For reference, [Nantucket Island, Massachusetts datum information](#) indicates that the MLLW is 1.77 feet below the station's mean sea level.



Methodology

Capitol Airspace studied the proposed project based upon information provided by Vineyard Wind LLC.³ Using this information, Capitol Airspace generated graphical overlays to determine proximity to airports (*Figure 1*), published instrument procedures, enroute airways, FAA minimum vectoring altitude and minimum instrument flight rules (IFR) altitude charts, and military airspace and training routes.

Capitol Airspace evaluated all 14 CFR Part 77 imaginary surfaces, published instrument departure and approach procedures, visual flight rules operations, FAA minimum vectoring altitudes, minimum IFR altitudes, and enroute operations. All formulas, headings, altitudes, bearings and coordinates used during this study were derived from the following documents and data sources:

- 14 CFR Part 77 Safe, Efficient Use, and Preservation of the Navigable Airspace
- FAA Order 7400.2L Procedures for Handling Airspace Matters
- FAA Order 8260.3C United States Standard for Terminal Instrument Procedures
- FAA Order 8260.58A United States Standard for Performance Based Navigational Instrument Procedure Design
- United States Government Flight Information Publication, US Terminal Procedures
- National Airspace System Resource Aeronautical Data
- National Oceanic and Atmospheric Administration, Office of Coast Survey, U.S. Maritime Limits & Boundaries

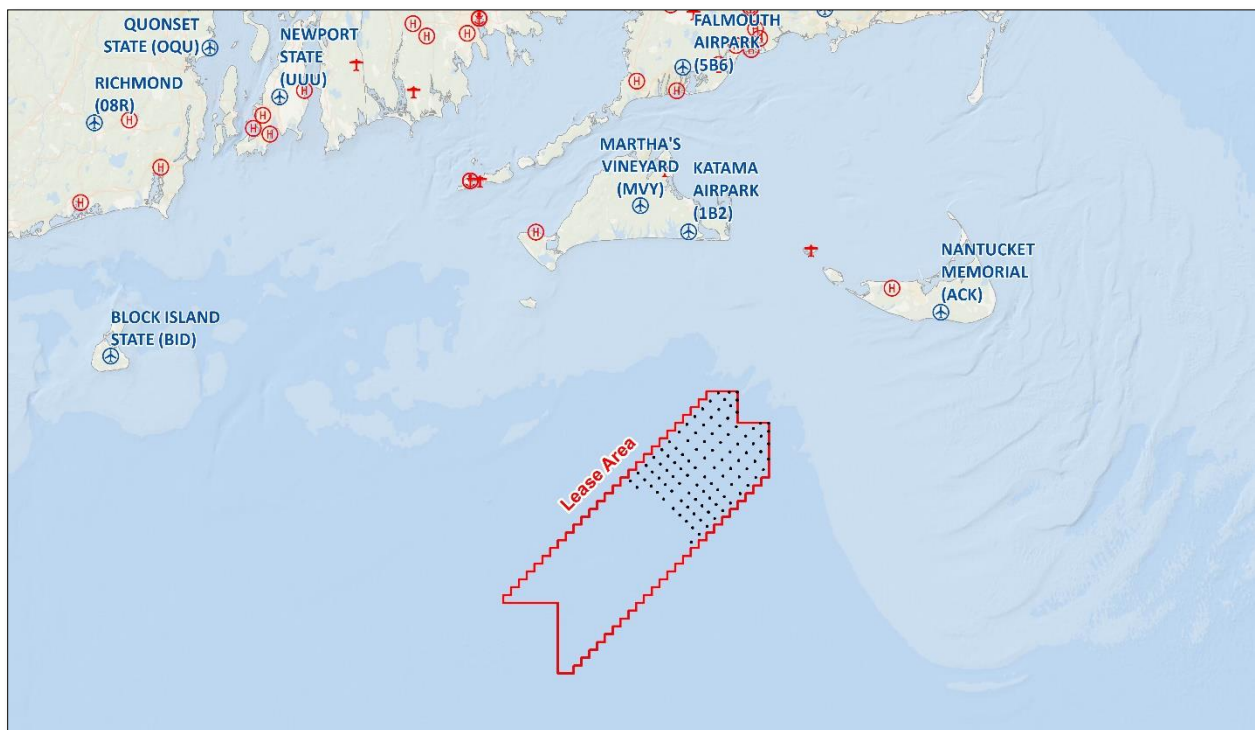


Figure 1: Public-use (blue) and private-use (red) airports in proximity to the Lease Area

³ Wind turbine locations were derived by georeferencing site overview graphics provided by Vineyard Wind LLC. Due to inaccuracies associated with georeferencing, it is possible that wind turbine locations may differ slightly from those described and depicted in this report.



Study Findings

Airspace Classification

The FAA establishes different volumes of airspace depending on the nature of aviation operations that will be encompassed. Airspace classification is often dictated by the volume and complexity of operations or the need to ensure certain levels of safety. Each segment of airspace may have defined rules and/or access restrictions to ensure separation or awareness of incompatible aviation operations. Depending on the type of airspace, obstacles located within or below these segments of airspace can cause a compression of airspace, increased minimum altitudes, or pose a hazard to the special operations occurring within special-use airspace.

Territorial Airspace

The FAA is authorized to conduct aeronautical studies for structures proposed within any state, territory, or possession of the United States, within the District of Columbia, or within territorial waters (purple, [Figure 2](#)) surrounding the United States.⁴ Eight of the proposed wind turbines (orange points, [Figure 2](#)) may be located within territorial waters and must be submitted to the FAA.⁵

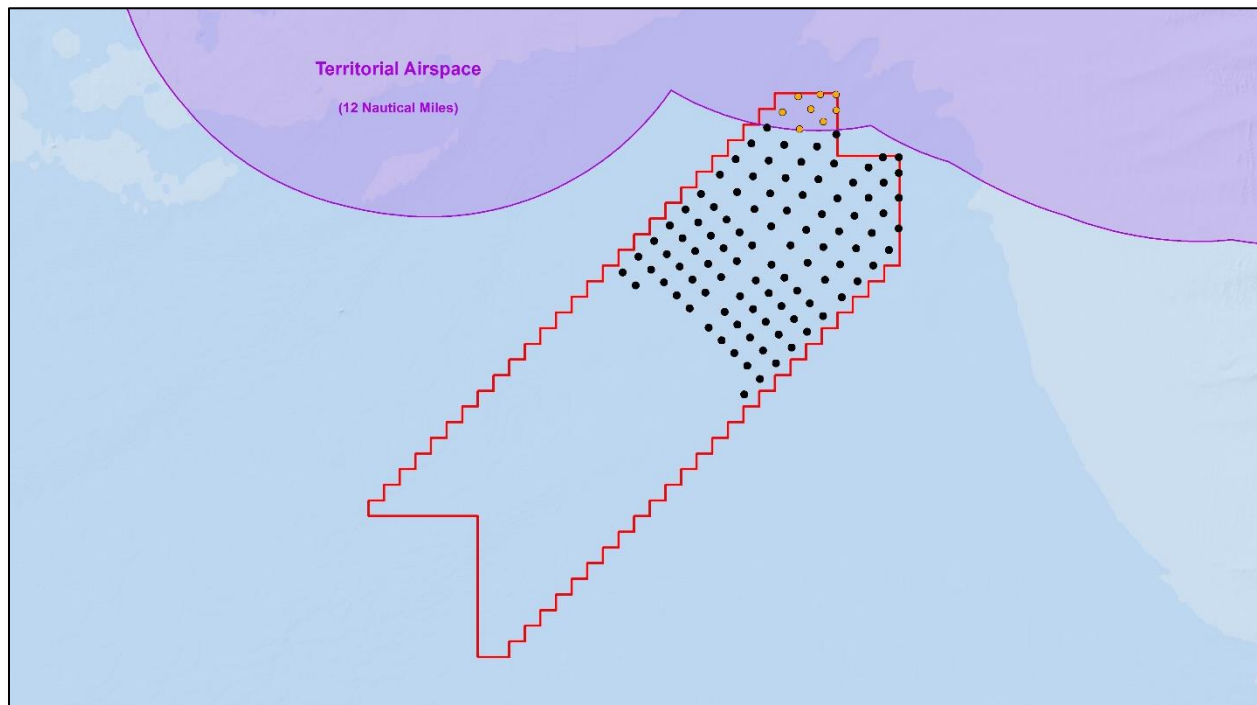


Figure 2: Territorial Airspace overlying the Lease Area

⁴ As described in FAA Order 7400.2L 5-1-4(a) "Scope"

⁵ National Oceanic and Atmospheric Administration (NOAA) defines territorial waters as 12 nautical miles measured from the official U.S. baseline – a recognized low-water line along the coast. NOAA publishes this boundary in a publicly available [Web Map Service](#).



Controlled Airspace

Class E, East Coast Low Area, and Atlantic Low Area

Controlled airspace defines the volumes of airspace within which air traffic control services are provided. These segments of airspace often define different operating requirements that are imposed upon pilots, including weather, communication, and equipment minimums. Controlled airspace overlies all of the proposed wind turbines and has varying “floors” to define the vertical start of the airspace. These floors range from 1,200 to 5,500 feet AMSL (*Figure 3*).

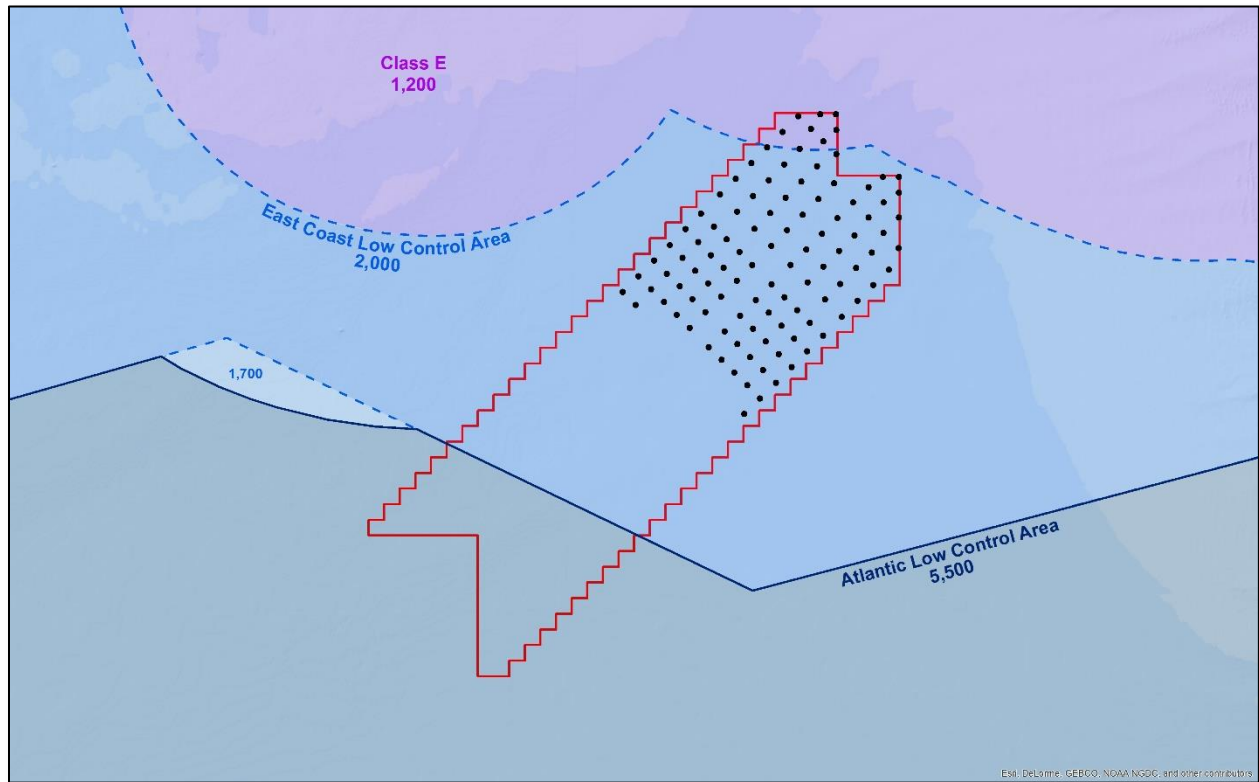


Figure 3: Controlled Airspace overlying the Lease Area



Special-Use and Other Airspace

Warning Area W-105A

W-105A defines a block of airspace ranging from the surface up to 50,000 feet AMSL (dark blue, **Figure 4**) and is meant to notify “nonparticipating pilots” of the likelihood of hazardous operations which could pose a danger to unaware pilots. This airspace overlies 90 of the proposed wind turbine locations and the southern majority of the Lease Area.

Air Defense Identification Zone (ADIZ)

All international flights entering the United States domestic airspace must provide the appropriate documentation prior to entering the ADIZ. Being located in proximity to this boundary is not likely to have a physical impact on aviation operations.

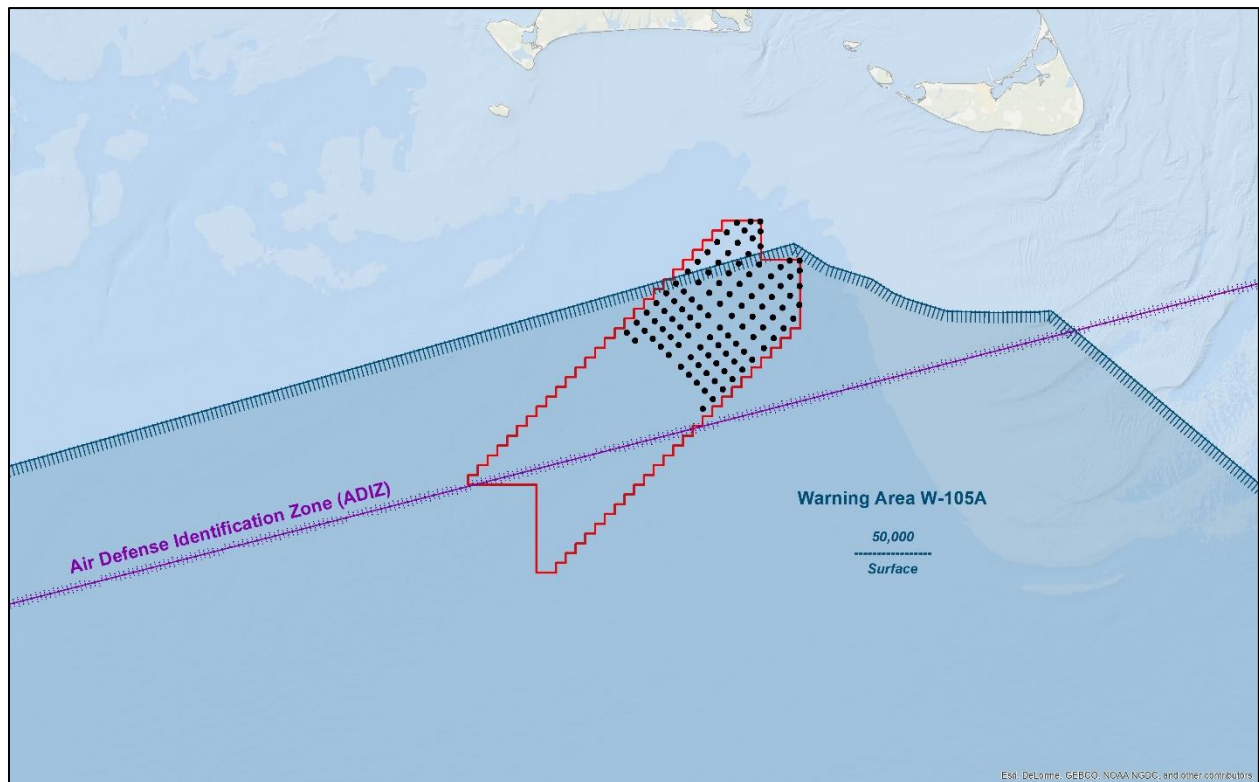


Figure 4: Warning Area W-105A (blue) and Air Defense Identification Zone (ADIZ) (purple)



Historical Air Traffic Operations

In order to identify the number of operations that could be effected by aviation impacts resulting from the proposed wind turbines, Capitol Airspace analyzed historical air traffic data. This data was obtained from the National Offload Program (NOP) through a Freedom of Information Act (FOIA) request and contained more than 30 million radar returns.⁶ These radar returns were associated with 255,577 different radar tracks.

Historical FAA air traffic data indicates that 3,628 radar tracks had at least one radar return at or below 5,000 feet AMSL and within 2 statute miles of the Lease Area (**Table 1** & **Figure 5**).⁷ 3,288 (90.6%) of these flights transited the airspace at altitudes between 1,500 and 5,000 feet AMSL. Further, many of the identified radar returns occurred at or below mean sea level. These results appeared to be erroneous. Removal of these erroneous flights decreased the total flight count for flights at or below 1,500 feet AMSL and within 2 statute miles of the Lease Area to 31.

Considering the nature of historical operations identified in FAA’s dataset, it is unlikely that any aviation impacts resulting from the proposed wind development would affect a significant volume of operations.

Airspace Analyzed <i>(within 2 Statute Miles of Lease Area)</i>	Number of Radar Tracks		
	Grouped by Transponder Code		Total
	Discrete (Non-1200)	Non-Discrete (1200)	
5,000 feet AMSL and Below	3,517	111	3,628
1,500 feet AMSL and Below	265	75	340 <i>(green tracks, Figure 5)</i>
1,500 feet AMSL and Below <i>(excluding radar returns at or below mean sea level)</i>	17	14	31 <i>(blue, Figure 5)</i>

Table 1: Historical radar tracks identified within 2 statute miles of Lease Area

⁶ Historical air traffic data requested from the FAA included radar returns identified within 40 nautical miles of 40° 55’ 45.223”N, 70° 29’ 46.780”W, at or below 5,000 feet AMSL, and occurring between October 1, 2016 and September 30, 2017.

⁷ As a result of the radar’s automation system, many of the non-discrete radar tracks are duplicative. Capitol Airspace considered a radar track to be duplicative if it started or ended within 90 seconds of a similar non-discrete radar track.

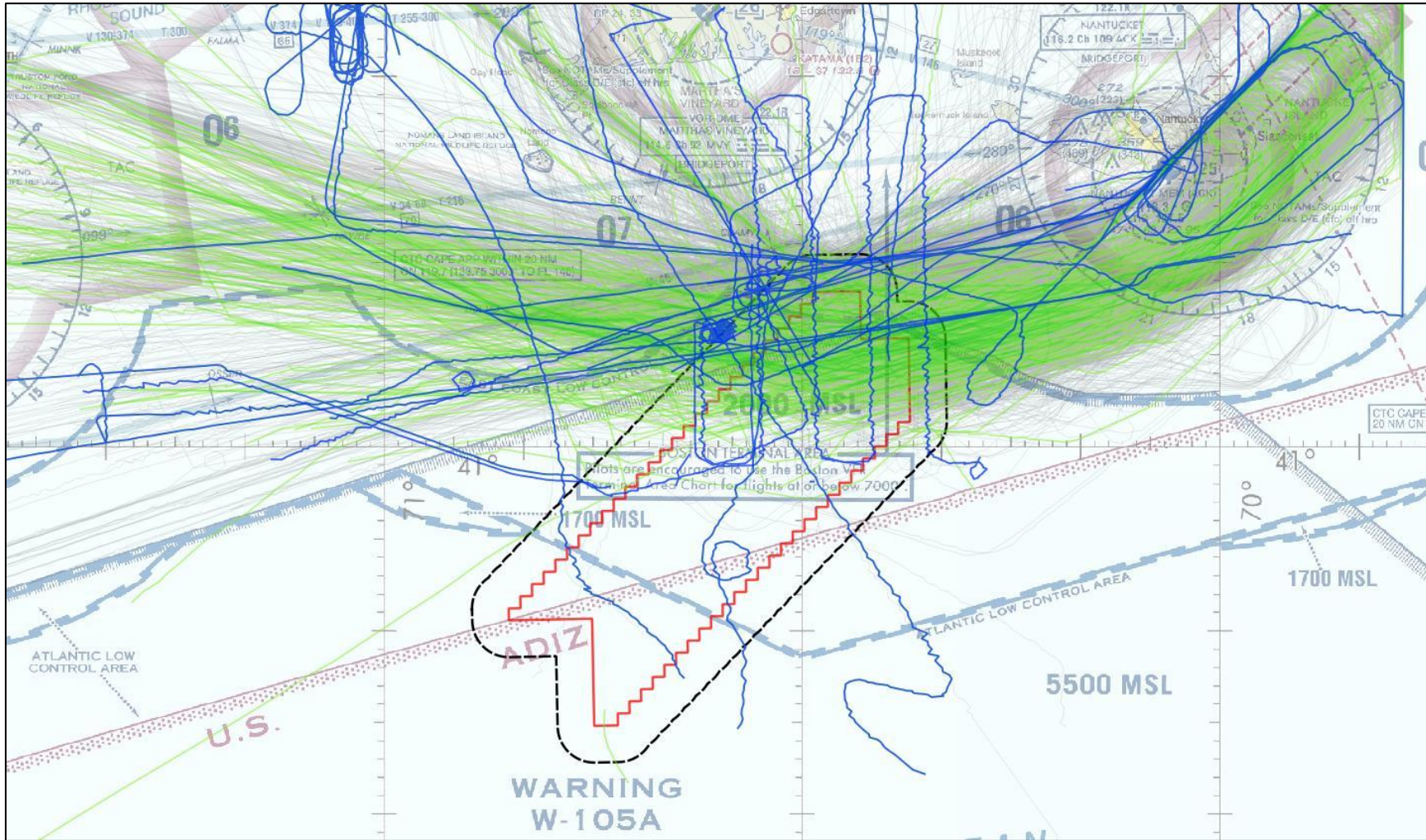


Figure 5: Historical air traffic evaluated within two statute miles of the Lease Area and at 5,000 feet AMSL or below



14 CFR Part 77 Imaginary Surfaces

The FAA uses level and sloping imaginary surfaces to determine if a proposed structure is an obstruction to air navigation. Structures that are identified as obstructions are then subject to a full aeronautical study and increased scrutiny. However, exceeding a Part 77 imaginary surface does not automatically result in the issuance of a determination of hazard. Proposed structures must have airspace impacts that constitute a substantial adverse effect in order to warrant the issuance of determinations of hazard.

Public-use airport 14 CFR Part 77.17(a)(2) and Part 77.19 imaginary surfaces (e.g., [Figure 6](#)) do not overlie the lease area. However, at 696 feet, proposed wind turbines will exceed 14 CFR Part 77.17(a)(1) – a height of 499 feet at the site of the object – and would be identified as obstructions during an aeronautical study.

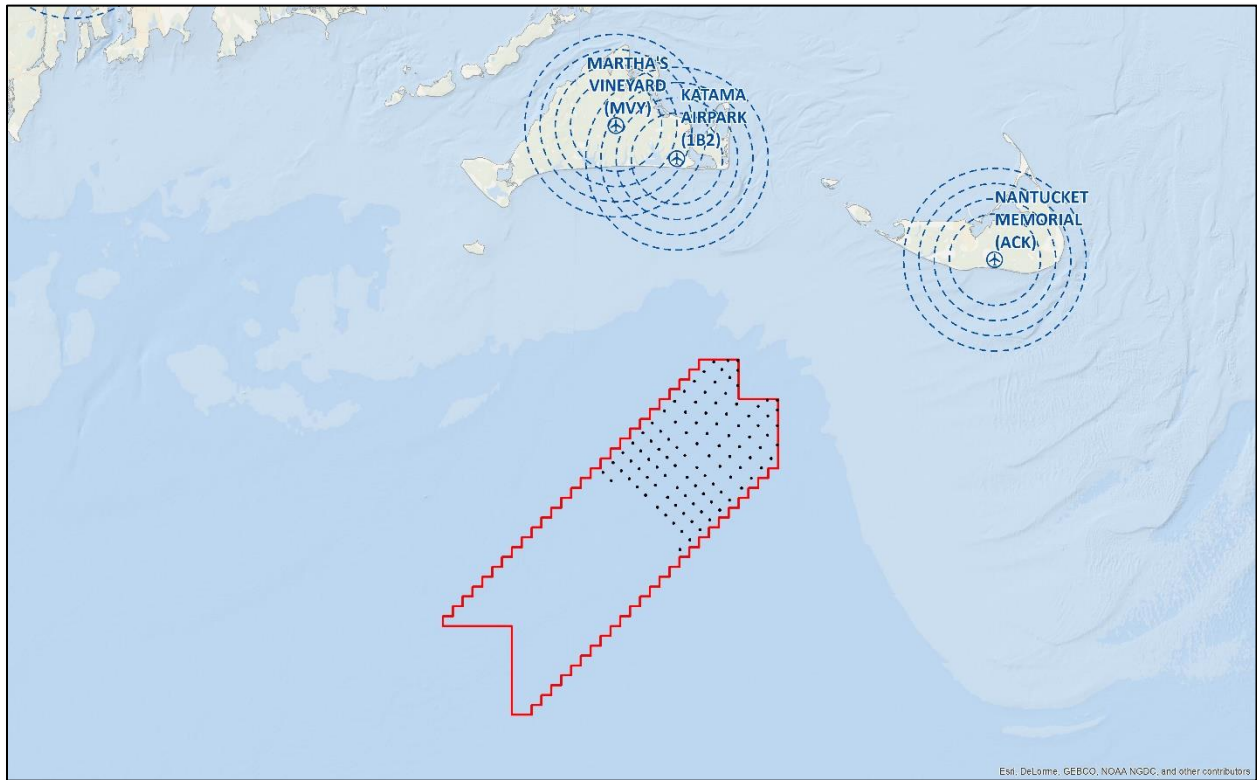


Figure 6: 14 CFR Part 77.17(a)(2) (dashed blue) imaginary surfaces in proximity to the Lease Area



Visual Flight Rules (VFR) Operations

Aircraft operating under visual flight rules (VFR) are required to see and avoid terrain, obstacles, and other air traffic. During periods of marginal weather (low clouds and/or visibility), obstacles may not be easily discernible and can be difficult to avoid. Within the United States, obstacles that exceed obstruction standards are typically required to be marked and lighted to increase their conspicuity. These requirements apply to all structures in excess of 499 feet.

Since the Lease Area is located offshore, it is unlikely that the proposed wind turbines would have an impact on regular VFR operations such as airport traffic patterns (e.g., [Figure 7](#)) and VFR routes. However, offshore aviation activities such as aerial fish spotting may occur in proximity to the proposed wind turbines.

In order to increase pilot awareness of the proposed wind turbines, Capitol Airspace recommends that Vineyard Wind LLC request the issuance of a Notice to Airmen (NOTAM) indicating the location and height of the wind project. Additionally, consideration should be given to installing a lighting system in accordance with guidelines defined for offshore wind turbines.⁸

These two recommended options are likely to aid in mitigating any impact on VFR operations within the vicinity of the proposed wind project.

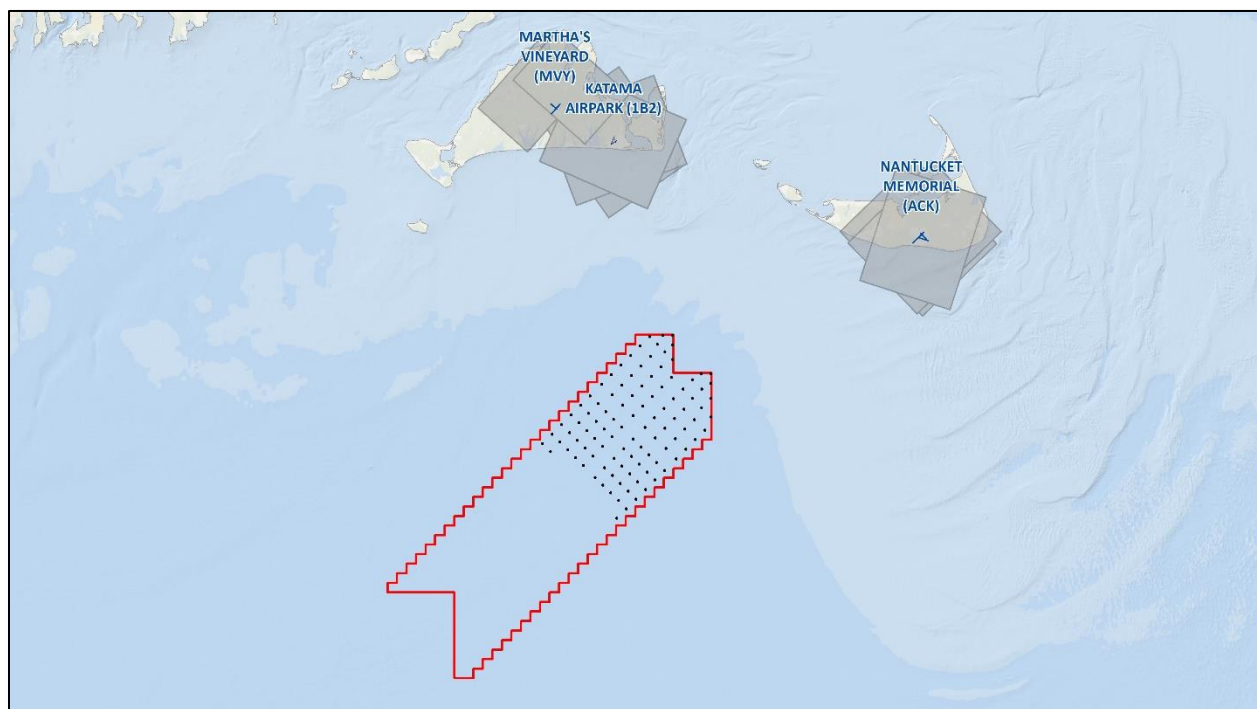


Figure 7: Category D VFR Traffic Pattern Airspace (gray) in proximity to the Lease Area

⁸ FAA Advisory Circular 70/7460-1L contains marking and lighting standards for onshore wind turbines. It is believed that the FAA and the Bureau of Ocean Energy Management (BOEM) are collaborating to publish marking and lighting standards for offshore wind turbines.



Instrument Departures

In order to ensure that aircraft departing during marginal weather conditions do not fly into terrain or obstacles, the FAA publishes instrument departure procedures that provide obstacle clearance to pilots as they transition between the terminal and enroute environments. These procedures contain specific routing and minimum climb gradients to ensure clearance from terrain and obstacles.

Proposed structures that exceed instrument departure procedure obstacle clearance surfaces would require an increase to minimum climb gradients and/or change to routing. However, instrument departure procedure obstacle clearance surfaces (e.g., **Figure 8**) are in excess of other lower surfaces and should not limit 696 foot wind turbines within the Lease Area.

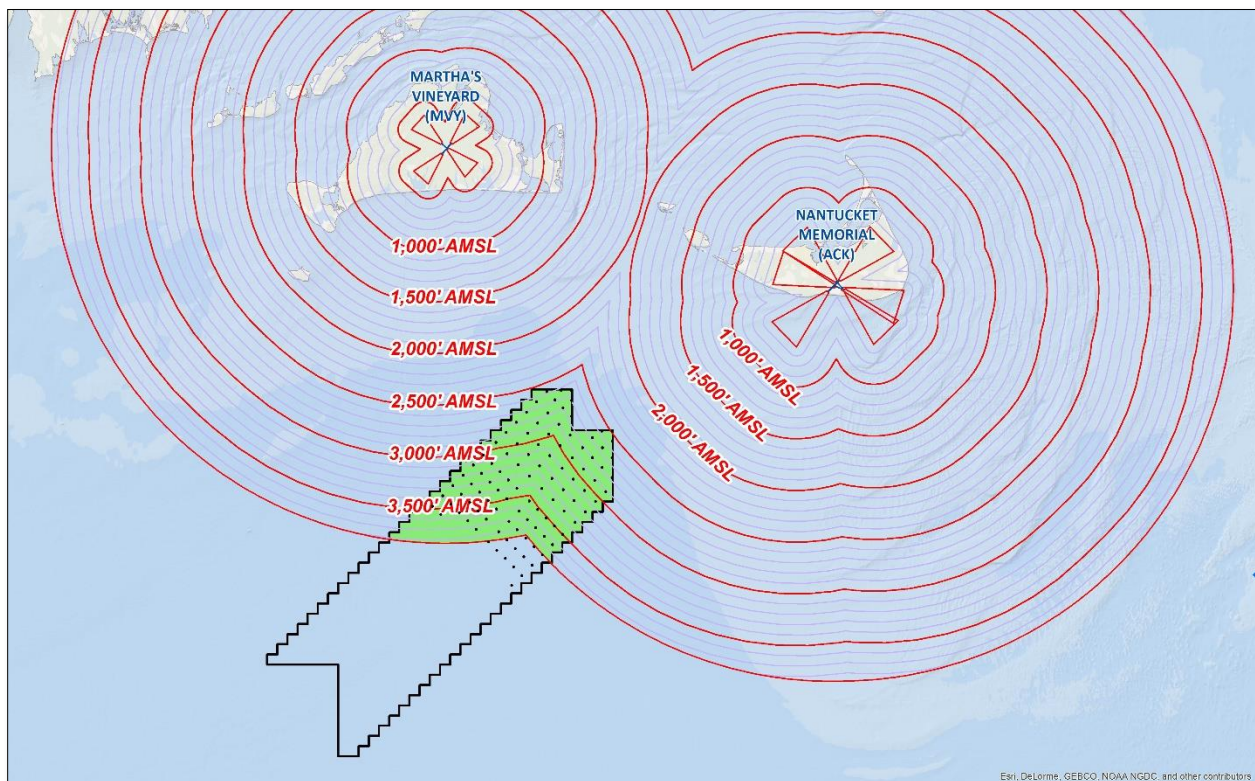


Figure 8: Martha's Vineyard Airport (MVY) and Nantucket Memorial (ACK) obstacle departure procedure assessment



Instrument Approaches

Pilots operating during periods of reduced visibility and low cloud ceilings rely on terrestrial and satellite based navigational aids (NAVAIDs) in order to navigate from one point to another and to locate runways. The FAA publishes instrument approach procedures that provide course guidance to on-board avionics that aid the pilot in locating the runway. Capitol Airspace assessed a total of 13 published instrument approach procedures at two public-use airports in proximity to the Vineyard wind project:

Nantucket Memorial (ACK)

- ILS or Localizer Approach to Runway 06
- ILS or Localizer Approach to Runway 24
- RNAV (GPS) Approach to Runway 06
- RNAV (GPS) Approach to Runway 15
- RNAV (GPS) Approach to Runway 24
- RNAV (GPS) Approach to Runway 33
- VOR Approach to Runway 24

Martha's Vineyard (MVY)

- ILS or Localizer Approach to Runway 24
- RNAV (GPS) Approach to Runway 06
- RNAV (GPS) Approach to Runway 15
- RNAV (GPS) Approach to Runway 24
- RNAV (GPS) Approach to Runway 33
- VOR Approach to Runway 06

Proposed wind turbines that exceed instrument approach procedure obstacle clearance surfaces would require an increase to their minimum altitudes. Increases to these altitudes, especially critical *decision altitudes (DA)* and *minimum descent altitudes (MDA)*, can directly impact the efficiency of instrument approach procedures.

Nantucket Memorial Airport (ACK)

RNAV (GPS) Approach to Runway 06 (Figure 9) / RNAV (GPS) Approach to Runway 24, ILS or Localizer Approach to Runway 06 / ILS or Localizer Approach to Runway 24

For each of these instrument approach procedures, the *UFTAC* minimum holding altitude is 2,300 feet AMSL. The associated obstacle clearance surfaces range from 1,300 to 2,300 feet AMSL and are the lowest height constraint in a very small eastern section of the Lease Area. However, these surfaces should not limit 696 foot wind turbines within the Lease Area (green, [Figure 9](#)).

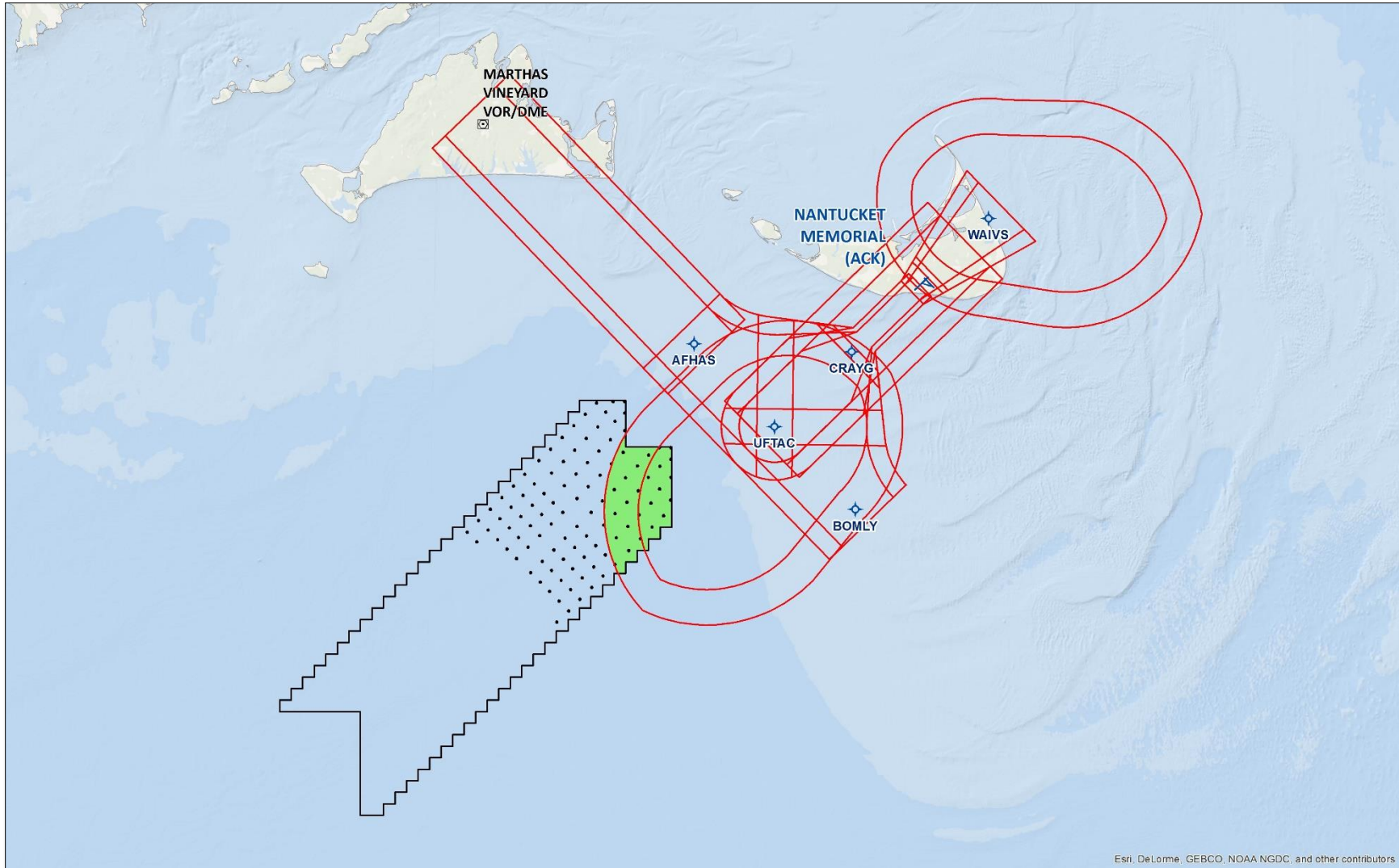


Figure 9: Nantucket Memorial Airport (ACK) RNAV (GPS) Approach to Runway 06



Minimum Vectoring/IFR Altitudes

The FAA publishes minimum vectoring altitude (MVA) and minimum instrument flight rules (IFR) altitude charts that define sectors with the lowest altitudes at which air traffic controllers can issue radar vectors to aircraft based on obstacle clearance. The FAA requires that sectors have a minimum of 1,000 feet of obstacle clearance in non-mountainous areas and normally 2,000 feet in mountainous areas.

Proposed structures that exceed minimum vectoring/IFR altitude sector obstacle clearance surfaces would require an increase to the lowest altitudes useable by air traffic controllers for vectoring aircraft.

Cape (K90) Terminal Radar Approach Control (TRACON)

*Sector A*⁹

The minimum vectoring altitude is 1,500 feet AMSL; the associated obstacle clearance surface (hatched purple, [Figure 10](#)) is 549 feet AMSL and is the lowest height constraint overlying northern sections of the Lease Area.

Providence (PVD) TRACON

*Sector C*¹⁰

The minimum vectoring altitude is 1,500 feet AMSL; the associated obstacle clearance surface (hatched purple, [Figure 11](#)) is 549 feet AMSL and is the lowest height constraint overlying the northern section of the Lease Area.

Boston (ZBW) Air Route Traffic Control Center

Sectors bBOS04, bBOS06, and bBOS07

These sectors' minimum vectoring altitudes range from 2,300 to 5,800 feet AMSL overlying the project; the associated obstacle clearance surfaces range from 1,349 to 4,849 feet AMSL and are some of the lowest height constraints overlying the southern majority of the Lease Area.

At 696 feet, as many as 52 of the proposed wind turbines would require an increase to Cape (K90) TRACON and/or Providence (PVD) TRACON minimum vectoring altitudes. However, historical air traffic data obtained from the FAA NOP indicates that this impact is not likely to affect a significant volume of operations (defined as an average of one or more flights per week). As a result, both air traffic control facilities may be amenable to modifying their minimum vectoring altitude charts in order to accommodate the proposed wind development.

⁹ Cape (K90) TRACON may utilize one of four different minimum vectoring altitude charts including K90_ACK_MVA_2014, K90_FMH_MVA_2014, K90_ACK_CENRAP_MVA_2014, and K90_FMH_CENRAP_MVA_2014. Each minimum vectoring altitude chart utilizes similar Sector A boundaries.

¹⁰ Providence (PVD) TRACON may utilize one of two different minimum vectoring altitude charts including PVD_PVD_MVA_2015 and PVD_MVA_MULTI_2015. Each minimum vectoring altitude chart utilizes similar Sector C boundaries.

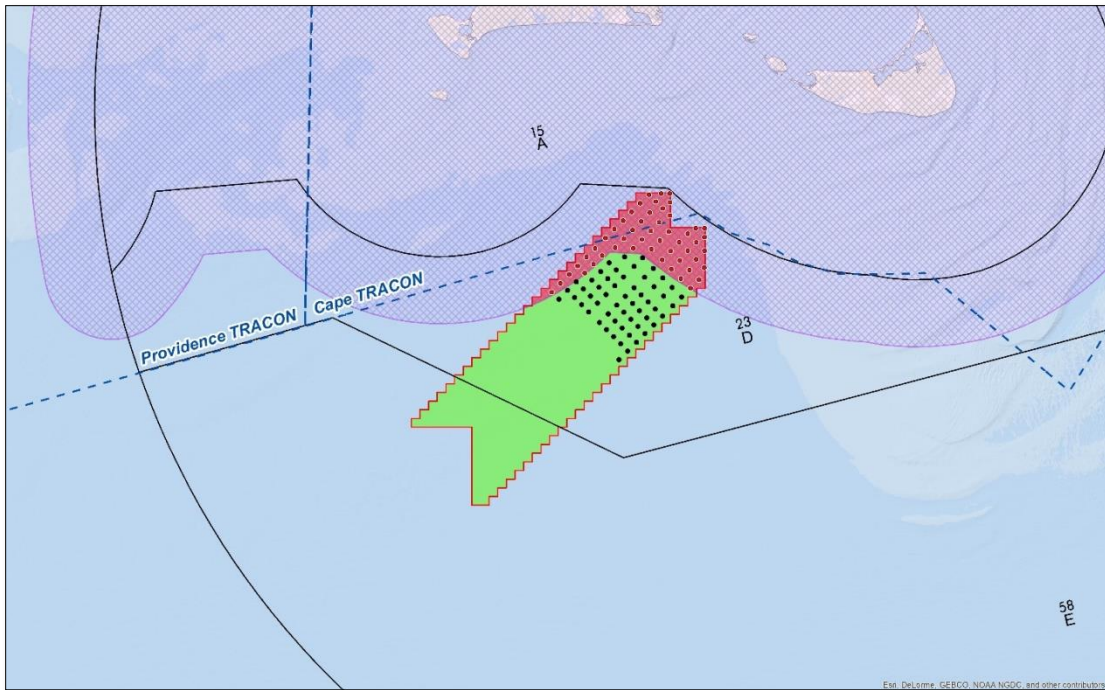


Figure 10: Cape (K90) TRACON CENRAP minimum vectoring altitude sectors (black) with Sector A obstacle evaluation area (hatched purple)

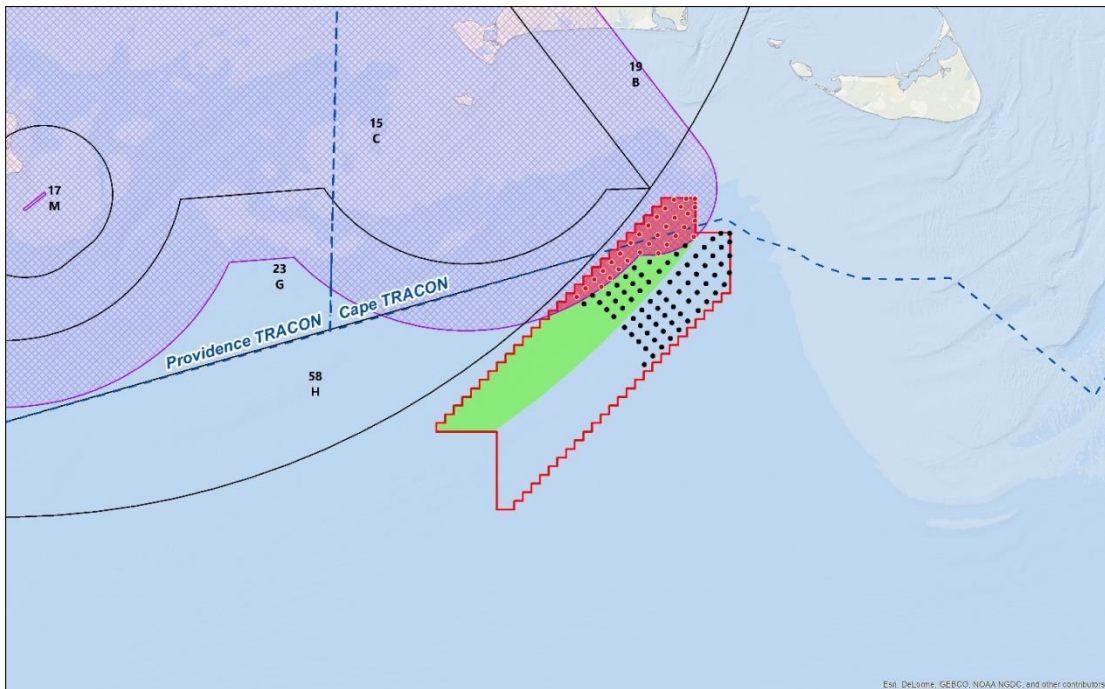


Figure 11: Providence (PVD) TRACON MULTI minimum vectoring altitude sectors (black) with Sector C obstacle evaluation area (hatched purple)



Conclusion

Various segments of airspace overlie the Lease Area, including: United States territorial airspace ([Figure 2](#)), different levels of controlled airspace ([Figure 3](#)), and special-use airspace ([Figure 4](#)). Depending on the nature of operations occurring within these blocks of airspace, obstacles located within or below these segments of airspace can cause a compression of airspace, increased minimum altitudes, or pose a hazard to the special operations occurring within special-use airspace.

In order to identify the nature of operations occurring in proximity to the Lease Area, Capitol Airspace analyzed one year's worth of historical air traffic data. This data indicated that 90.6% of flights identified within 2 statute miles of the Lease Area were operating at higher altitudes (*between 1,500 and 5,000 feet AMSL*). Considering the nature of historical operations identified in FAA's dataset, it is unlikely that any aviation impacts resulting from the proposed wind development would affect a significant volume of operations.

Within territorial waters, wind turbines must be submitted to the FAA so that an aeronautical study can be conducted. At 696 feet, proposed wind turbines will exceed 14 CFR Part 77.17(a)(1) – a height of 499 feet at the site of the structure – and will be determined to be obstructions. However, heights in excess of this surface are feasible provided the proposed wind turbines do not exceed FAA obstacle clearance surfaces requiring procedural changes that would affect a significant volume of operations.

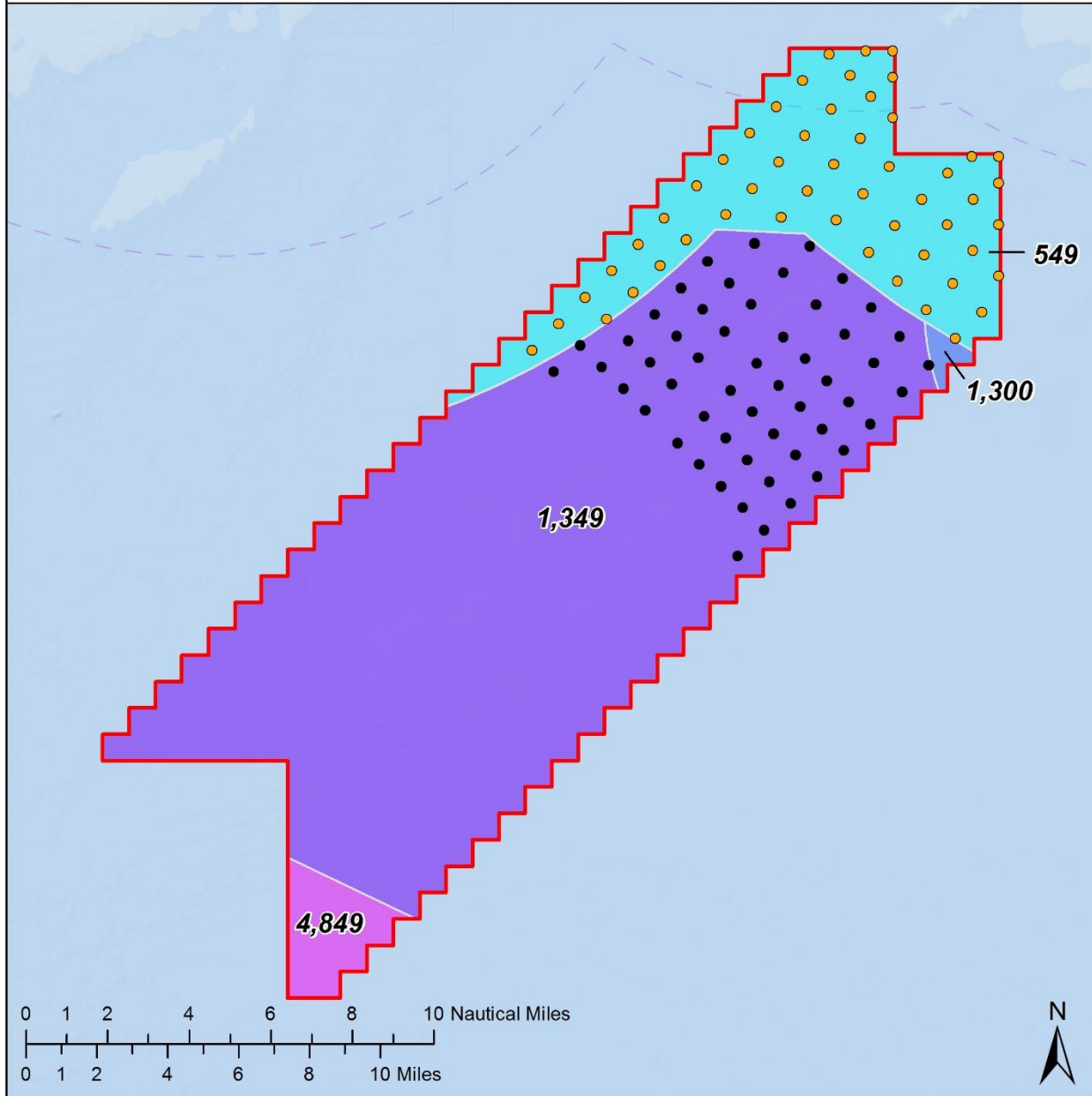
FAA obstacle clearance surfaces overlying the Vineyard wind project are a constant 549, 1,300, 1,349, or 4,849 feet AMSL ([Figure 13](#)) and are associated with Nantucket Memorial Airport instrument approach procedures ([Figure 9](#)), Cape (K90) TRACON and Providence (PVD) TRACON minimum vectoring altitude sectors, and Boston (ZBW) ARTCC minimum IFR altitude sectors ([Figure 10](#) & [Figure 11](#)).

At 696 feet, as many as 52 of the proposed wind turbines will require an increase to Cape (K90) TRACON and Providence (PVD) TRACON minimum vectoring altitudes. However, considering the historical operations transiting this airspace, as well as flights transiting in close proximity to the Lease Area ([Table 1](#) & [Figure 5](#)), it is unlikely that the increase to minimum vectoring altitudes would affect a significant number of operations.

If you have any questions regarding the findings of this study, please contact [Ron Morgan](#) or [Joe Anderson](#) at (703) 256-2485.



Proposed structures that exceed 14 CFR Part 77.17(a)(1) - a height of 499 feet AGL at the site of the object - will automatically be determined to be obstructions during an aeronautical study.



<p>Legend <i>All heights above mean sea level (AMSL)</i></p> <table border="0"> <tr> <td>Obstacle Clearance Surface</td> <td>Proposed Location</td> </tr> <tr> <td> 549 Feet AMSL</td> <td> Does Not Exceed</td> </tr> <tr> <td> 1,300 Feet AMSL</td> <td> Exceeds</td> </tr> <tr> <td> 1,349 Feet AMSL</td> <td></td> </tr> <tr> <td> 4,849 Feet AMSL</td> <td></td> </tr> <tr> <td> Territorial Water Boundary (Derived from NOAA Dataset)</td> <td></td> </tr> </table>		Obstacle Clearance Surface	Proposed Location	549 Feet AMSL	Does Not Exceed	1,300 Feet AMSL	Exceeds	1,349 Feet AMSL		4,849 Feet AMSL		Territorial Water Boundary (Derived from NOAA Dataset)		<p>Vineyard Wind Project - Lease Area Composite Height Constraint Map</p>	
Obstacle Clearance Surface	Proposed Location														
549 Feet AMSL	Does Not Exceed														
1,300 Feet AMSL	Exceeds														
1,349 Feet AMSL															
4,849 Feet AMSL															
Territorial Water Boundary (Derived from NOAA Dataset)															
<p>Plot Date: 6 December 2017</p>		<p>Figure 13</p>													
<p>Coordinate System: NAD 1983 UTM Zone 19N</p>															
<p>janderson</p>															