US Wind Offshore Wind Project

ESS Group

Offshore Ocean City, Maryland

Obstruction Evaluation & Airspace Analysis

November 9, 2021

Capitol Airspace Group

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Summary

Capitol Airspace conducted an obstruction evaluation and airspace analysis for the US Wind project off the shore of Ocean City, Maryland. The purpose for this analysis was to identify obstacle clearance surfaces established by the Federal Aviation Administration (FAA) that could limit the placement of 817 and 938-foot tall wind turbines. At the time of this analysis, 125 wind turbine locations had been identified (black points, ***Figure 1***). This analysis assessed height constraints overlying each location as well as an approximately 125-square-mile study area (black outline, ***Figure 1***) to aid in identifying optimal wind turbine locations.

The Bureau of Ocean Energy Management (BOEM) is responsible for regulating renewable energy activities on the outer continental shelf in accordance with 30 CFR Part 585. As part of the application process for leases, grants, and easements, BOEM may require the inclusion of an aeronautical study to determine the proposal's impact on airspace use and safety. If a project is determined to have an unacceptable impact on civil aviation or military activities, it could result in denial of the application.

14 CFR Part 77 applies to all structures within US territorial airspace. 14 CFR Part 77.9 requires that that all structures exceeding 200 feet above ground level (AGL) be submitted to the FAA so that an aeronautical study can be conducted. The FAA's objective in conducting aeronautical studies is to ensure that proposed structures do not affect the safety of air navigation or the efficient utilization of navigable airspace by aircraft. The result of an aeronautical study is the issuance of a determination of 'hazard' or 'no hazard' that can be used by the proponent to obtain necessary local construction permits. It should be noted that the FAA has no control over land use in the United States and cannot enforce the findings of its studies. For the portions of the project that lie outside of U.S. territorial airspace and in BOEM jurisdiction, BOEM will consult with the FAA for airspace impacts.

The lowest obstacle clearance surfaces overlying the US Wind offshore wind project range from 849 to 4,849 feet above mean sea level (AMSL) and are associated with minimum vectoring altitude sectors and minimum instrument flight rules (IFR) altitude sectors. At 938 feet tall, wind turbines in the western and central sections of the study area, including 104 proposed locations, would exceed these surfaces and require an increase to minimum vectoring altitudes. If the FAA determines that these impacts would affect as few as one radar vectoring operation per week, it could result in determinations of hazard.

Military warning areas overlie the US Wind offshore wind project and could result in military objections to proposed wind development.

This study did not consider electromagnetic interference on FAA communication or surveillance radar systems. Impact on these systems could be used as the basis for determinations of hazard regardless of the lack of impact on the physical airspace surfaces described in this report.

Methodology

Capitol Airspace studied the proposed project based on location information provided by ESS Group. 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 IFR altitude charts, as well as military airspace and training routes.

Capitol Airspace evaluated all 14 CFR Part 77 imaginary surfaces, published instrument approach and departure 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 7400.2N Procedures for Handling Airspace Matters
- FAA Order 8260.3E United States Standard for Terminal Instrument Procedures
- FAA Order 8260.58B United States Standard for Performance Based Navigational (PBN) Instrument Procedure Design
- Technical Operations Evaluation Desk Guide for Obstruction Evaluation/Airport Airspace Analysis (1.6.1)
- United States Government Flight Information Publication, US Terminal Procedures
- National Airspace System Resource Aeronautical Data

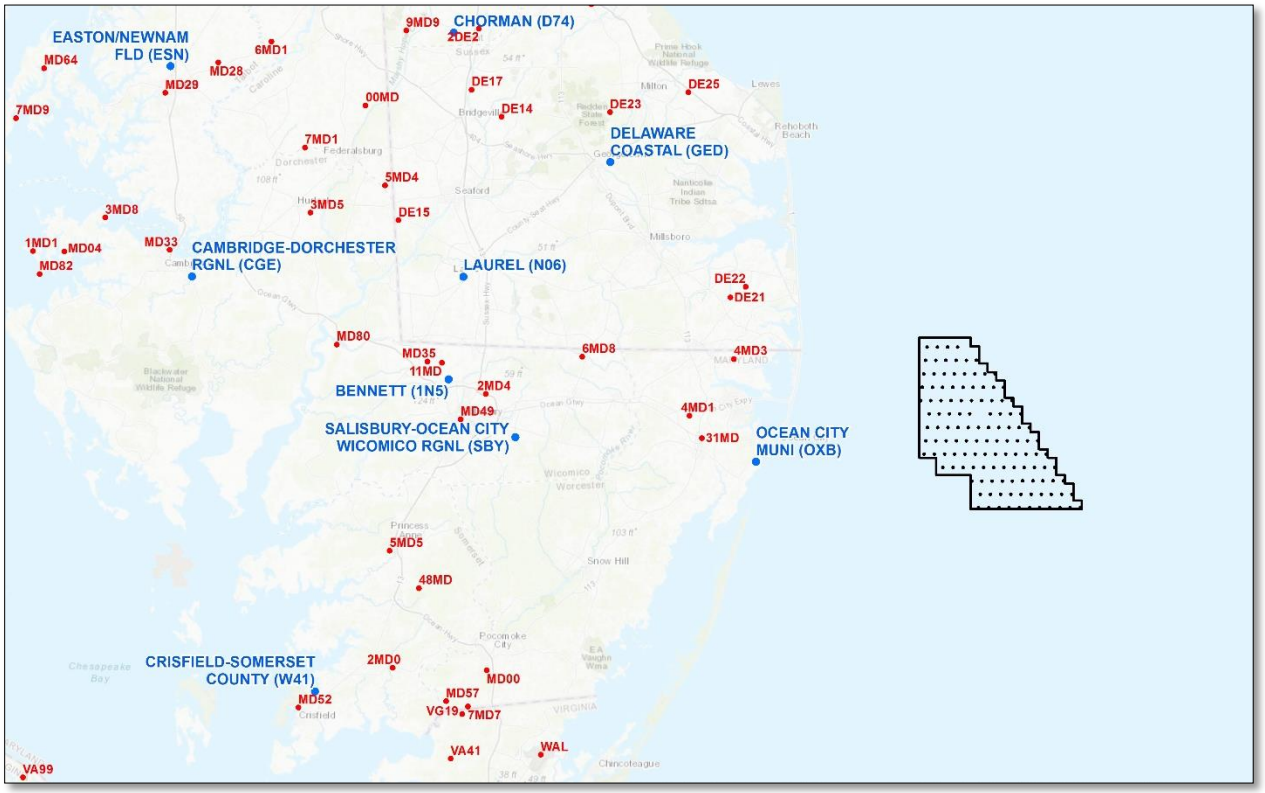


Figure 1: Public-use (blue) and private-use (red) airports in proximity to the US Wind offshore wind project

Study Findings

Territorial Airspace

The FAA conducts aeronautical studies for structures proposed within any state, territory, or possession of the United States, within the District of Columbia, or within territorial waters[1] surrounding the United States.[2] Although an offshore wind project may be located outside of territorial waters, BOEM may require an aeronautical study as part of the application process.

Wind turbines in the northern and western sections of the study area, including 32 proposed locations, will be located within territorial waters (purple, ***Figure 2***) and must be submitted to the FAA.

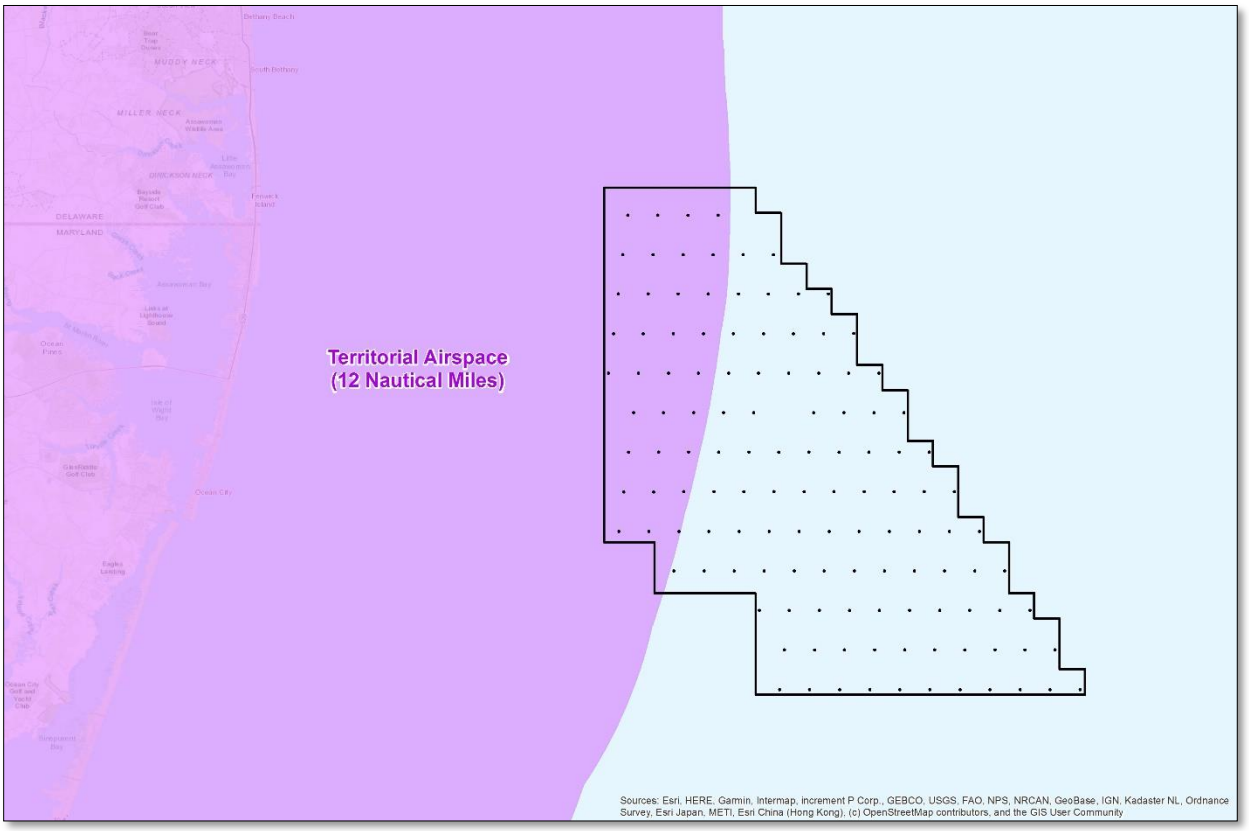


Figure 2: Territorial Airspace overlying the US Wind offshore wind project

[1] The 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***.

[2] As described in FAA Order 7400.2N 5-1-4(a) "Scope."

14 CFR Part 77.17(a)(2) Obstruction Standard and 77.19/21/23 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.

Military and public-use airport 14 CFR Part 77.17(a)(2) and 77.19/21/23 imaginary surfaces do not overlie the US Wind offshore wind project (e.g., ***Figure 3***). However, at all proposed heights, wind turbines will exceed 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and will be identified as obstructions regardless of location.

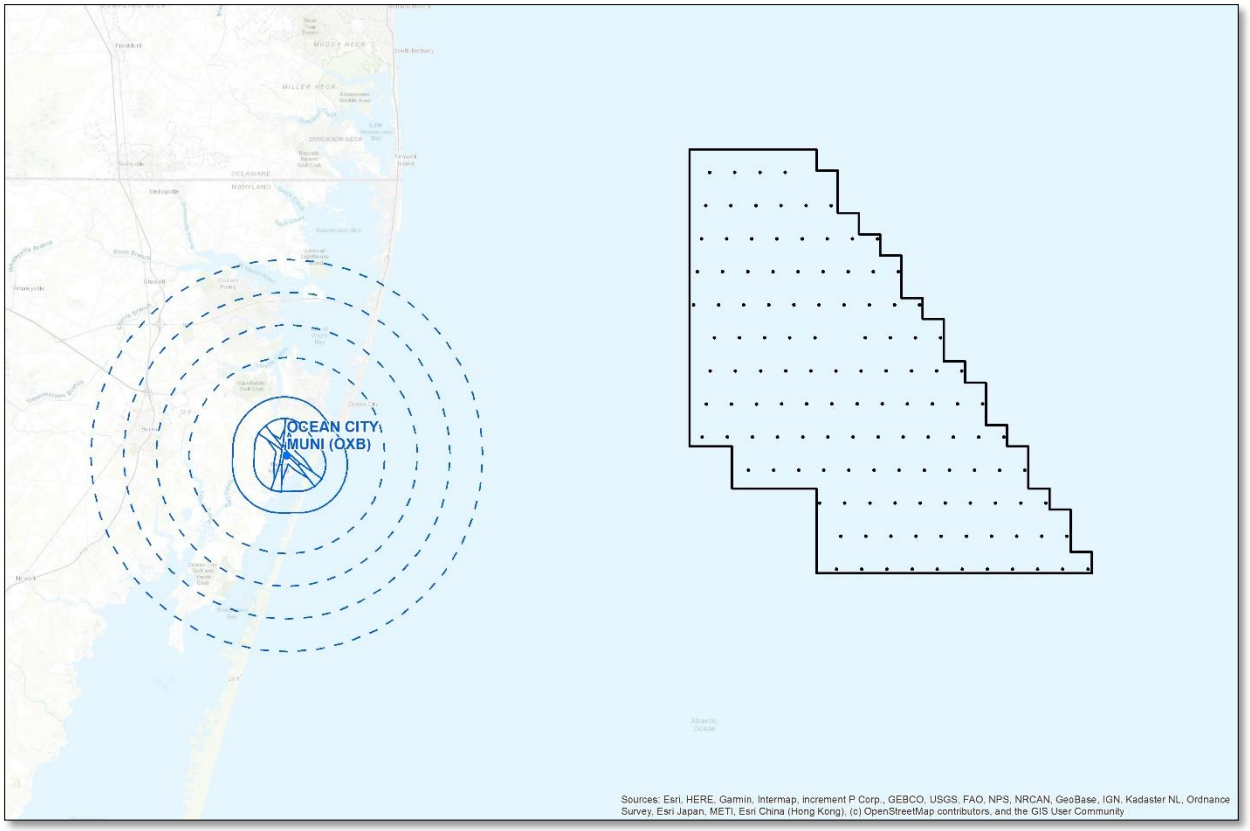


Figure 3: 77.17(a)(2) obstruction standard (dashed blue) and 77.19 imaginary surfaces (solid blue)

Visual Flight Rules (VFR) Traffic Pattern Airspace

VFR traffic pattern airspace is used by pilots operating during visual meteorological conditions (VMC). The airspace dimensions are based upon the category of aircraft which, in turn, is based upon the approach speed of the aircraft. 14 CFR Part 77.17(a)(2) and 77.19 (as applied to a *visual* runway) imaginary surfaces establish the obstacle clearance surface heights within VFR traffic pattern airspace.

VFR traffic pattern airspace (***Figure 4***) does not overlie the US Wind offshore wind project and should not limit 817 or 938-foot tall wind turbines within the defined study area.

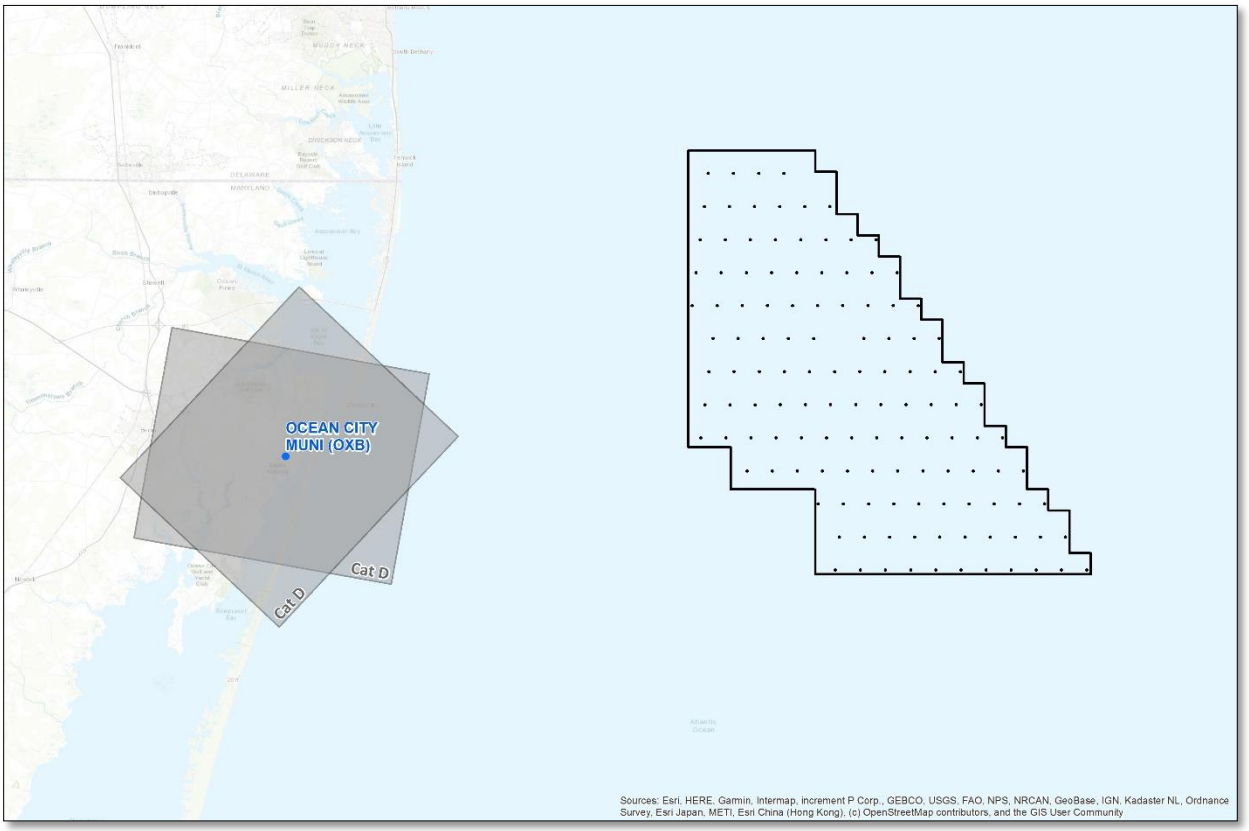


Figure 4: VFR traffic pattern airspace in proximity to the US Wind offshore wind project

Visual Flight Rules (VFR) Routes

During periods of marginal VMC – low cloud ceilings and one statute mile visibility – pilots often operate below the floor of controlled airspace. Operating under these weather conditions requires pilots to remain within one statute mile of recognizable landmarks such as roads, rivers, and railroad tracks. The FAA protects for known and regularly used VFR routes by limiting structure heights within two statute miles of these routes to no greater than 14 CFR Part 77.17(a)(1) – a height of 499 feet AGL at the site of the object.

There is no dataset that identifies VFR routes or their utilization. However, the US Wind offshore wind project is not located within two statute miles of landmarks that could be used as VFR routes (hatched purple, ***Figure 5***). Therefore, VFR routes should not limit wind development within the defined study area.

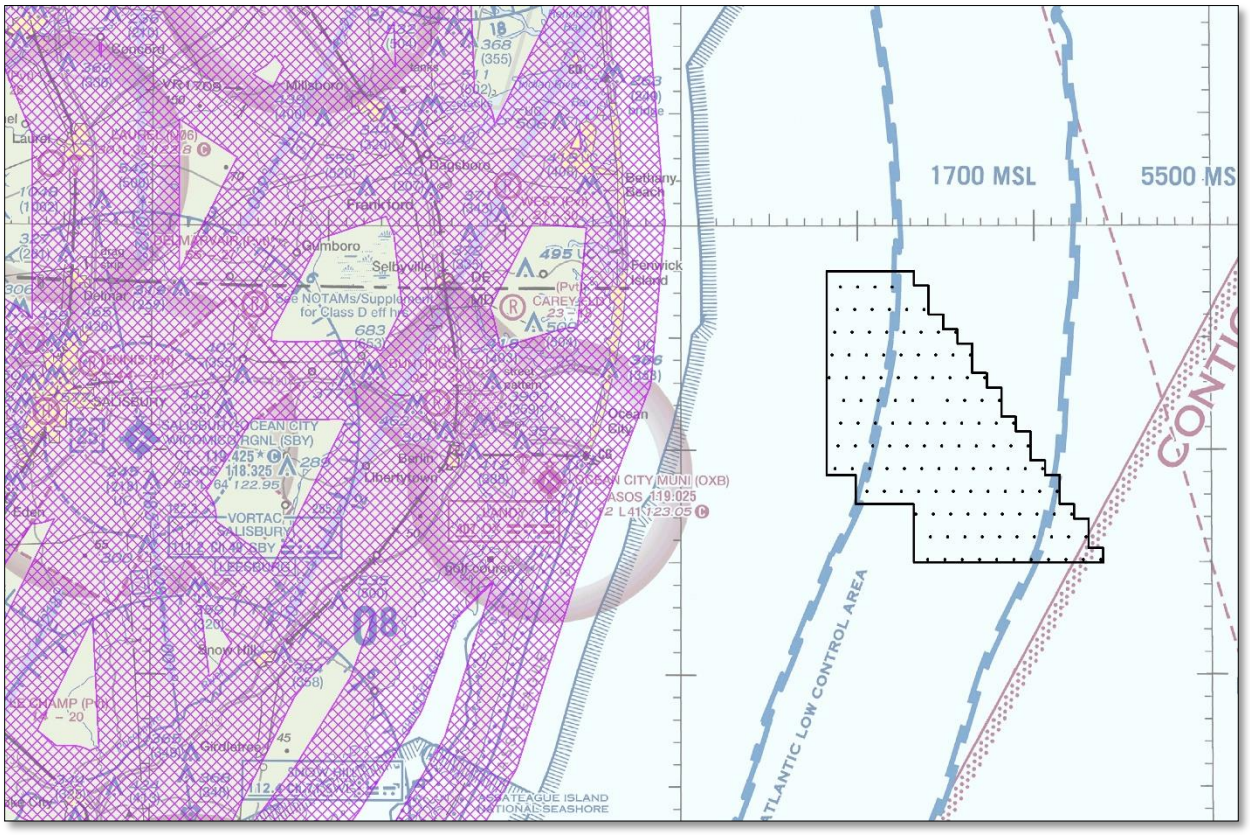


Figure 5: Potential VFR routes in proximity to the US Wind offshore wind project

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 instrument departure procedure minimum climb gradients. If the FAA determines that this impact would affect as few as one operation per week, it could be used as the basis for determinations of hazard.

Instrument departure procedure obstacle clearance surfaces (e.g., ***Figure 6***) are in excess of other, lower surfaces and should not limit 817 or 938-foot tall wind turbines within the defined study area.

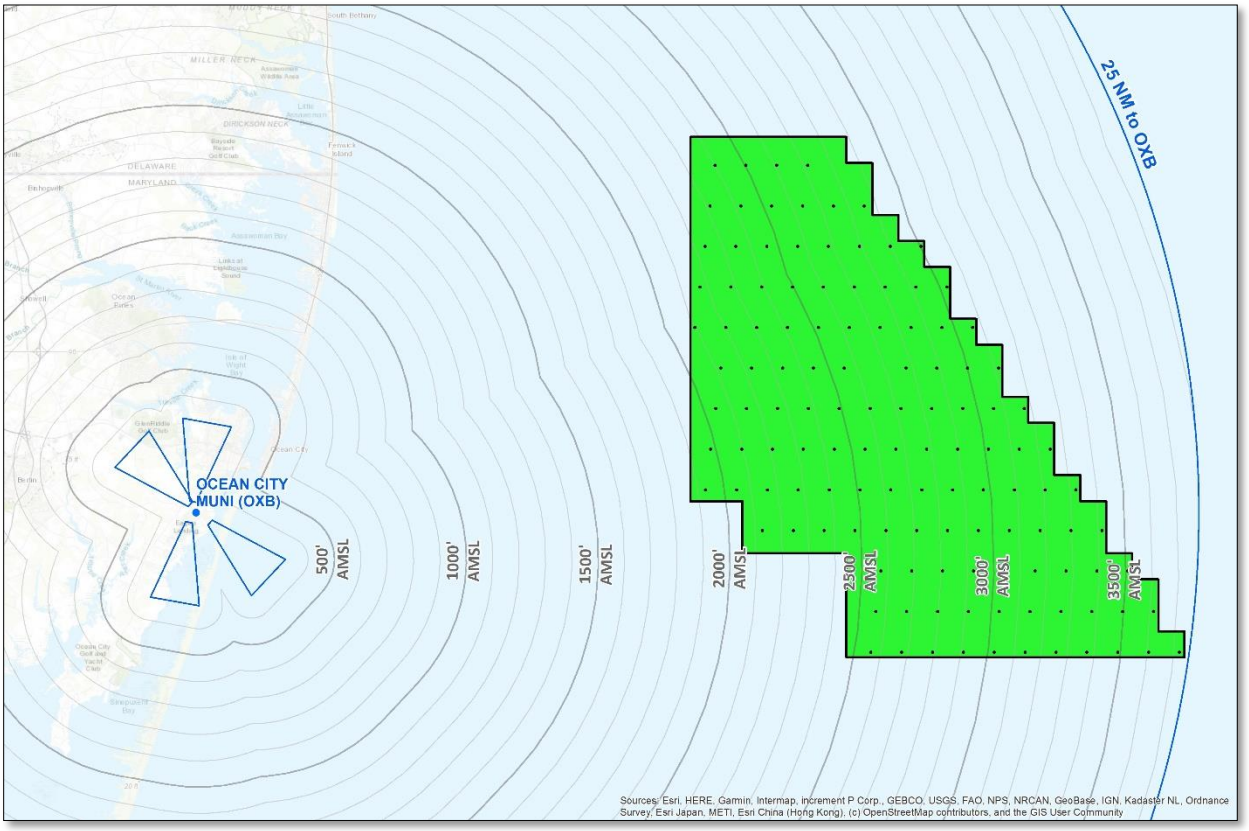


Figure 6: Ocean City Municipal (OXB) diverse departure assessment

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 nine published instrument approach procedures at two public-use airports in proximity to the US Wind offshore wind project: [3]

Delaware Coastal (GED)
RNAV (GPS) Approach to Runway 04
RNAV (GPS) Approach to Runway 22
VOR Approach to Runway 04
VOR Approach to Runway 22

Ocean City Municipal (OXB)
RNAV (GPS) Approach to Runway 02
RNAV (GPS) Approach to Runway 14
RNAV (GPS) Approach to Runway 32
Localizer Approach to Runway 32
VOR-A Circling Approach

Proposed structures 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. If the FAA determines this impact would affect as few as one operation per week, it could be used as the basis for determinations of hazard. [4]

Instrument approach procedure obstacle clearance surfaces (e.g., ***Figure 7***) are in excess of other, lower surfaces and should not limit 817 or 938-foot tall wind turbines within the defined study area (green area, ***Figure 7***).

[3] Capitol Airspace assessed instrument approach procedures within 30 nautical miles (NM) of the study area. Although approach surfaces – including terminal arrival areas (TAA), feeder segments, and initial segments – from airports further than 30 NM may overlie the study area, the obstacle clearance surfaces present a lower risk to projects than the surfaces identified in this report. Therefore, height constraints associated with instrument approach surfaces for airports beyond 30 NM were not considered and are not included in the ***Composite Map***.

[4] Multiple minimum safe altitudes (MSA) overlie the study area. However, in accordance with FAA Order 7400.2N Paragraph 6-3-9(e)(5), minimum safe altitudes (MSA) are for emergency use only and cannot be used as the basis for determinations of hazard. Therefore, height constraints associated with MSAs were not considered and are not included in the ***Composite Map***.

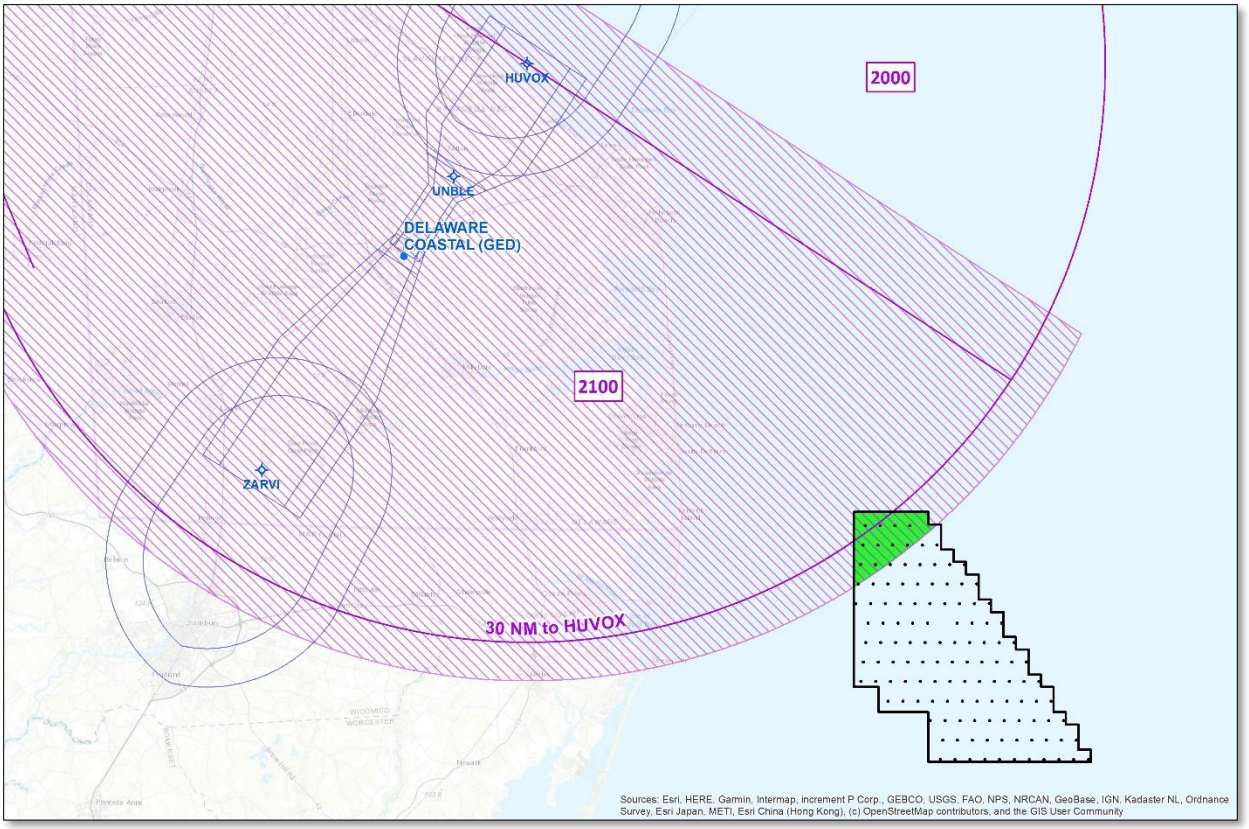


Figure 7: Delaware Coastal (GED) RNAV (GPS) Approach to Runway 22

Enroute Airways

Enroute airways provide pilots a means of navigation when flying from airport to airport and are defined by radials between VHF omni-directional ranges (VORs). The FAA publishes minimum altitudes for airways to ensure clearance from obstacles and terrain. The FAA requires that each airway have a minimum obstacle clearance of 1,000 feet in non-mountainous areas and normally 2,000 feet in mountainous areas.

Proposed structures that exceed enroute airway obstacle clearance surfaces would require an increase to their minimum obstruction clearance altitudes (MOCA) and/or minimum enroute altitudes (MEA). If the FAA determines that this impact would affect as few as one operation per week, it could be used as the basis for determinations of hazard.

Low altitude enroute airway obstacle clearance surfaces (e.g., ***Figure 8***) do not overlie the US Wind offshore wind project and should not limit 817 or 938-foot tall wind turbines within the defined study area.

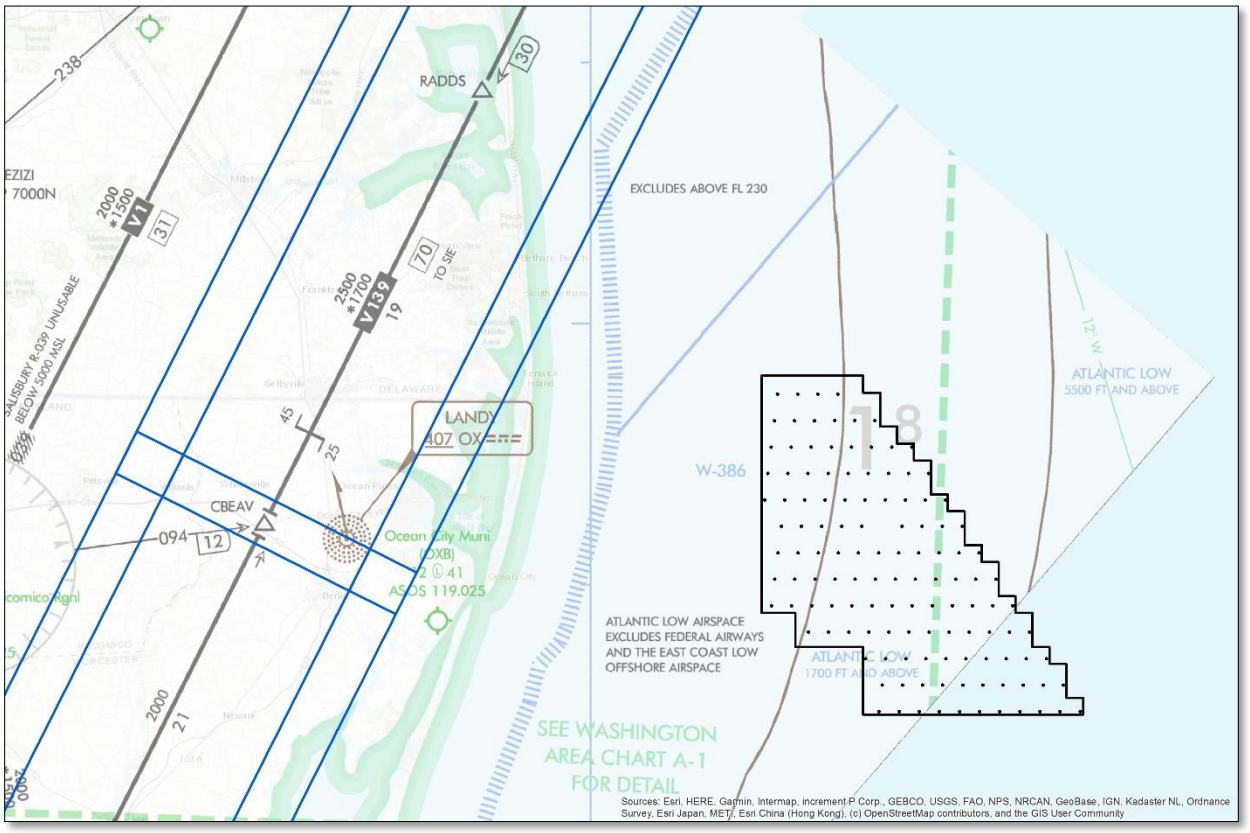


Figure 8: Low altitude enroute chart L-36 with V139 obstacle evaluation areas (blue)

Minimum Vectoring/IFR Altitudes[5]

The FAA publishes minimum vectoring altitude (MVA) and minimum instrument flight rules (IFR) altitude (MIA) 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 obstacle clearance of 1,000 feet in non-mountainous areas and normally 2,000 feet in mountainous areas.

Proposed structures that exceed MVA/MIA sector obstacle clearance surfaces would require an increase to the altitudes usable by air traffic control for vectoring aircraft. If the FAA determines that this impact would affect as few as one operation per week, it could result in determinations of hazard.

Potomac (PCT) Terminal Radar Approach Control (TRACON)

Sector NHK-F (PCT_MVA_FUS3_2019 & PCT_MVA_FUS5_2019)

The MVA is 1,800 feet AMSL. The obstacle clearance surface is 849 feet AMSL (hatched purple, ***Figure 9***) and is the lowest height constraint overlying the western and central sections of the study area. USGS elevation data indicates that this surface could limit 938-foot tall wind turbines in these areas (orange area, ***Figure 9***), including 104 proposed locations.

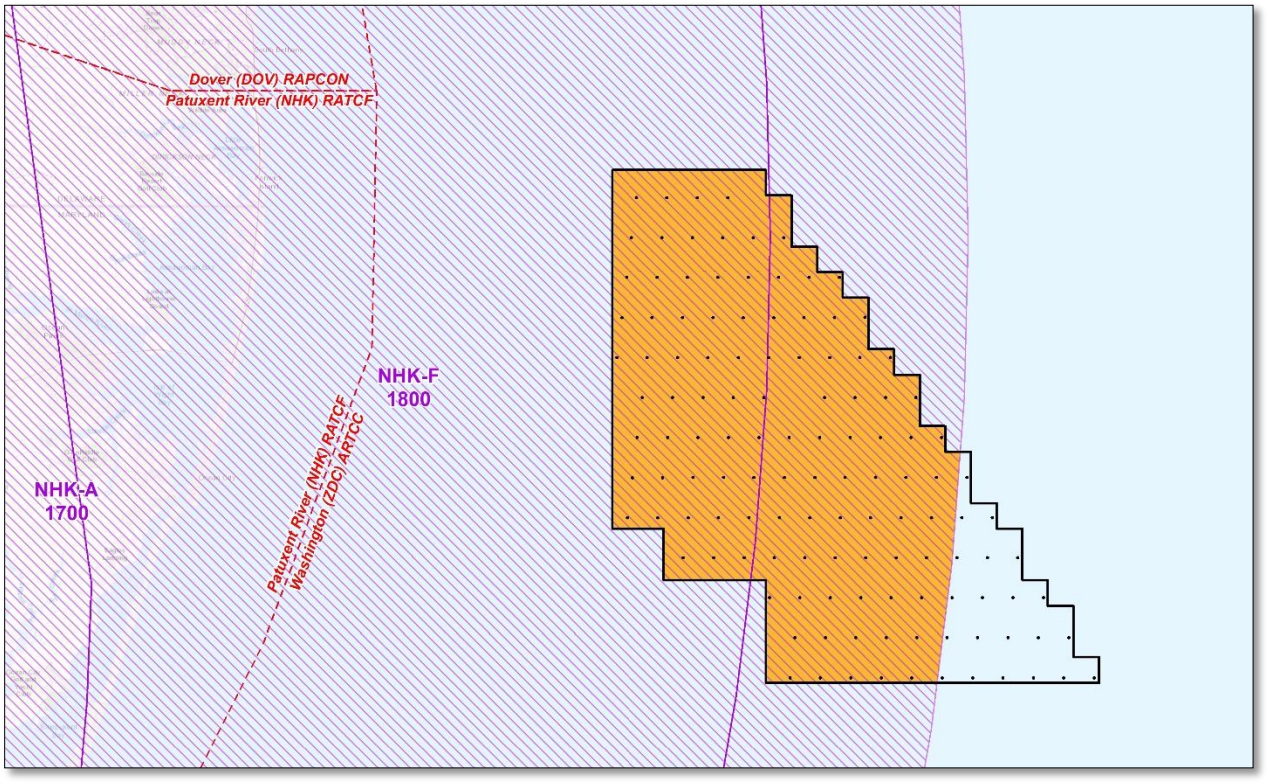


Figure 9: Potomac (PCT) TRACON FUSION 5 MVA sectors (purple) with Sector NHK-F obstacle evaluation area (hatched purple)

[5] The study area is in proximity to Dover (DOV) Radar Approach Control (RAPCON) and Patuxent (NHK) Navy Radar Air Traffic Control Facility (RATCF) airspace. However, Department of Defense (DoD) MVA charts, including those for Navy RATCF, Army Radar Approach Control Facilities (ARAC), and Air Force RAPCON facilities, are not publicly released. Capitol Airspace requests these charts from the DoD and assesses for them when copies are provided. However, unreleased or updated charts could result in lower height constraints than those depicted in this report.

Washington (ZDC) Air Route Traffic Control Center (ARTCC)

Sector WNVF00 (ZDC_TAV_2020)

The MIA is 5,800 feet AMSL. The obstacle clearance surface is 4,849 feet and is the lowest height constraint overlying the southeastern section of the study area. However, USGS elevation data indicates that this surface should not limit 817 or 938-foot tall wind turbines within the defined study area (green area, ***Figure 10***).

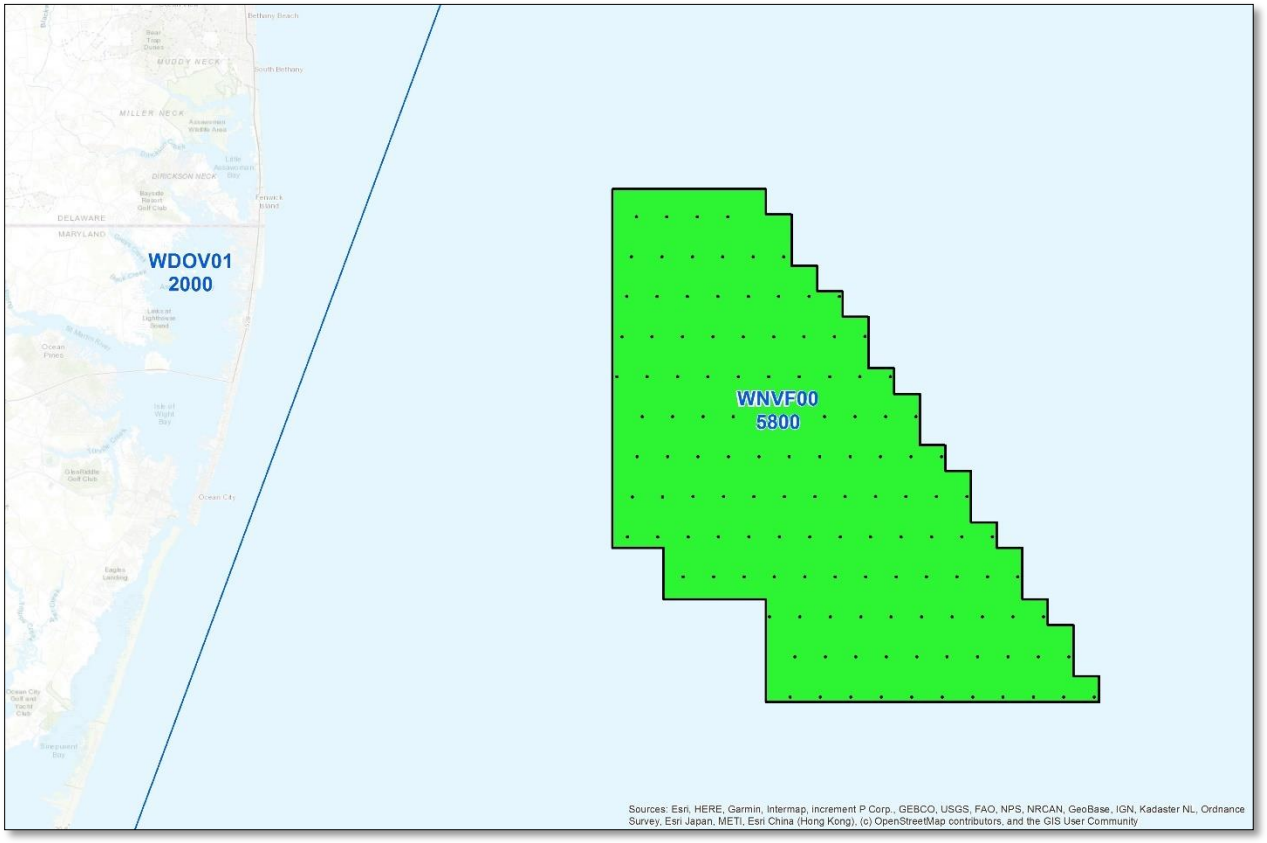


Figure 10: Washington (ZDC) ARTCC MIA Sectors (blue)

Terminal and Enroute Navigational Aids

The FAA has established protection areas in order to identify proposed structures that may have a physical and/or electromagnetic effect on navigational aids (NAVAIDs). The protection area dimensions vary based on the proposed structure type as well as the NAVAID type. Proposed structures located within these areas may interfere with NAVAID services and will require further review by FAA Technical Operations. If further review determines that proposed structures would have a significant physical and/or electromagnetic effect on NAVAIDs, it could result in determinations of hazard.

NAVAID protection areas do not overlie the US Wind offshore wind project (***Figure 11***). As a result, it is unlikely that proposed wind turbines would have a physical or electromagnetic effect on terminal or enroute NAVAIDs.

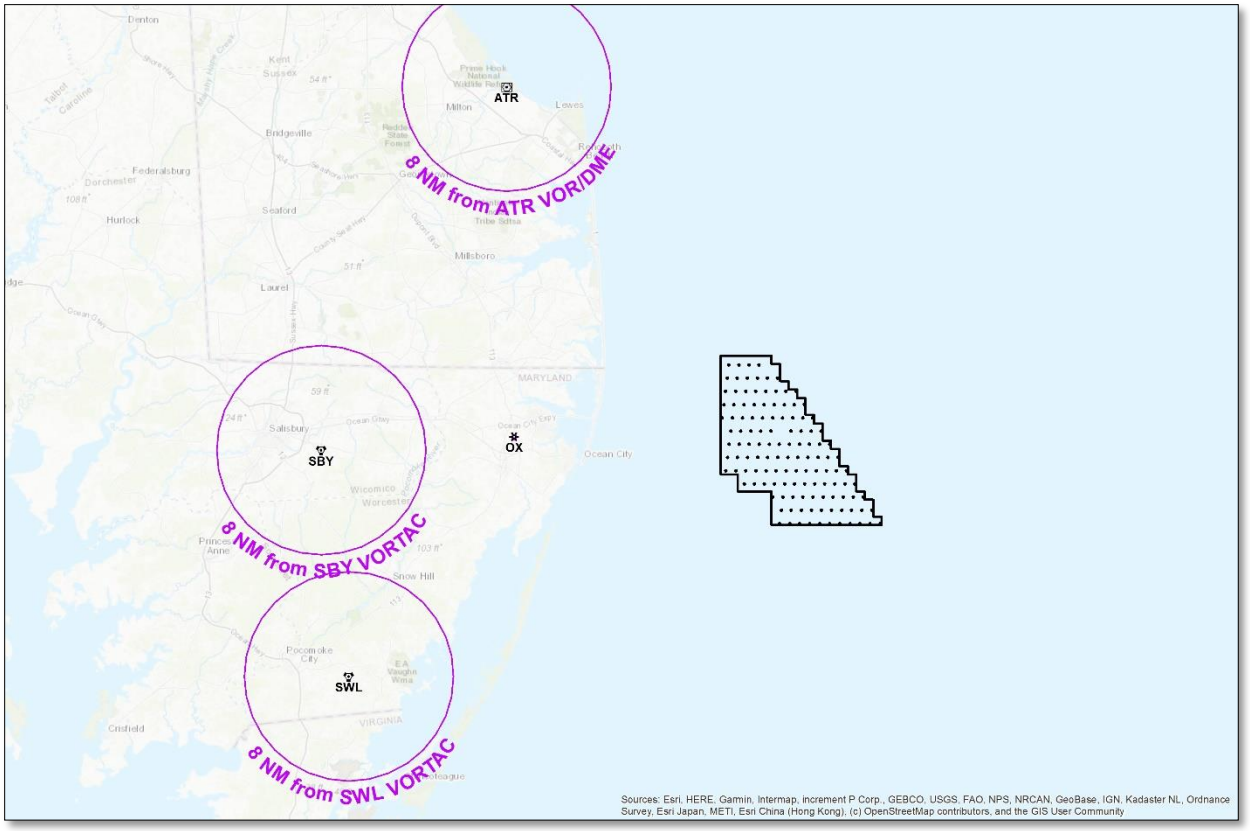


Figure 11: NAVAID protection areas in proximity to the US Wind offshore wind project

Military Airspace and Training Routes

Although the FAA does not consider impact on military airspace or training routes, they will notify the military of proposed structures located within these segments of airspace. Impact on these segments of airspace can result in military objections to the proposed development. If the planned development area is located on federal land, impact on military airspace or training routes may result in the denial of permits by the Bureau of Land Management.

Warning areas (W) overlying the US Wind offshore wind project (***Figure 12***):

U.S. Navy, Fleet Area Control and Surveillance Facility, Virginia Capes (FACSFAC VACAPES)

Route/Airspace	*Minimum Altitude*
W-386	Surface

Due to the low altitudes associated with this segment of airspace, wind development could have an impact on its operations. If the U.S. Navy uses this segment of airspace regularly, they may object to proposed wind development within the boundaries. Under the provisions of the 2018 National Defense Authorization Act (NDAA), the Military Aviation and Installation Assurance Siting Clearinghouse (Clearinghouse) may issue a Notice of Presumed Risk to National Security (NPR) letter to initiate mitigation discussions. These discussions are facilitated through the Clearinghouse and with the affected bases or organizations with operational interests. Per the legislative directive, NPR letters are provided to the Governor of the State(s). The Clearinghouse typically attempts to notify developers shortly before the issuance of an NPR letter.

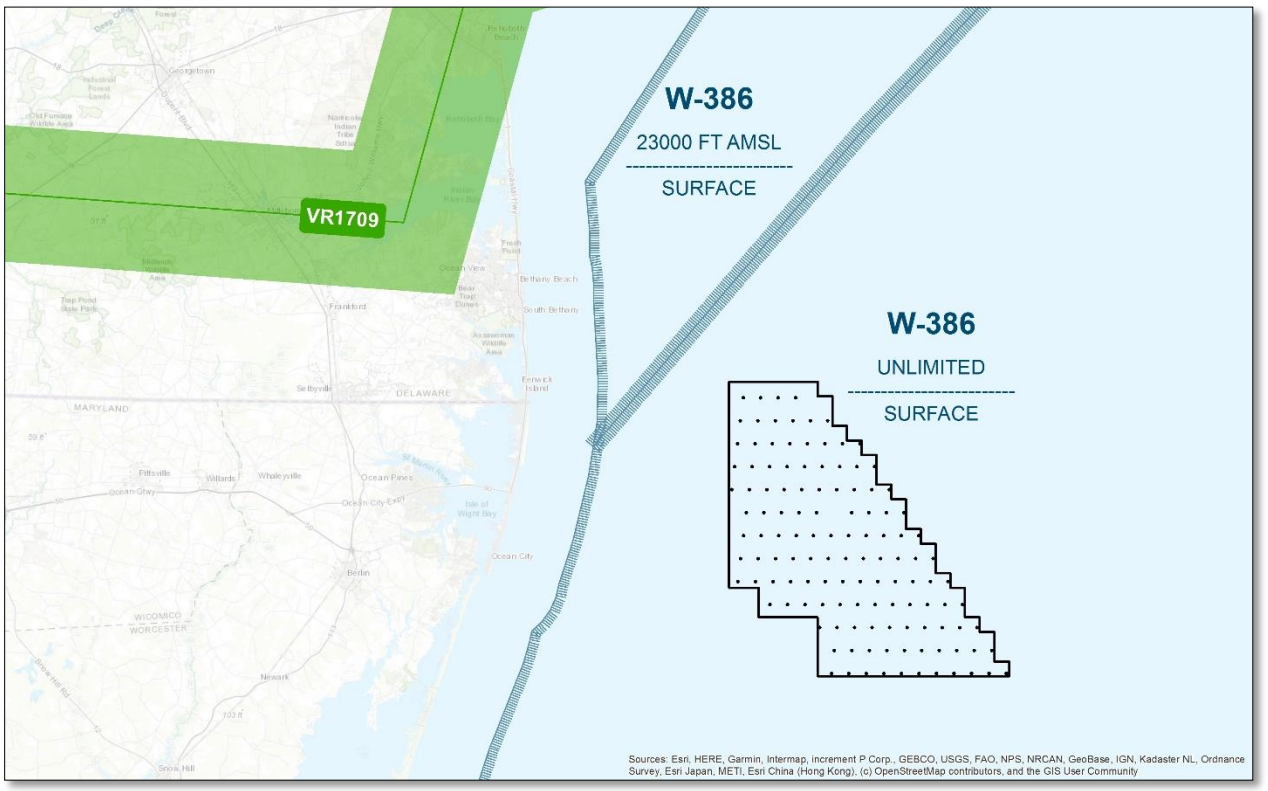


Figure 12: Military airspace in proximity to the US Wind offshore wind project

Conclusion

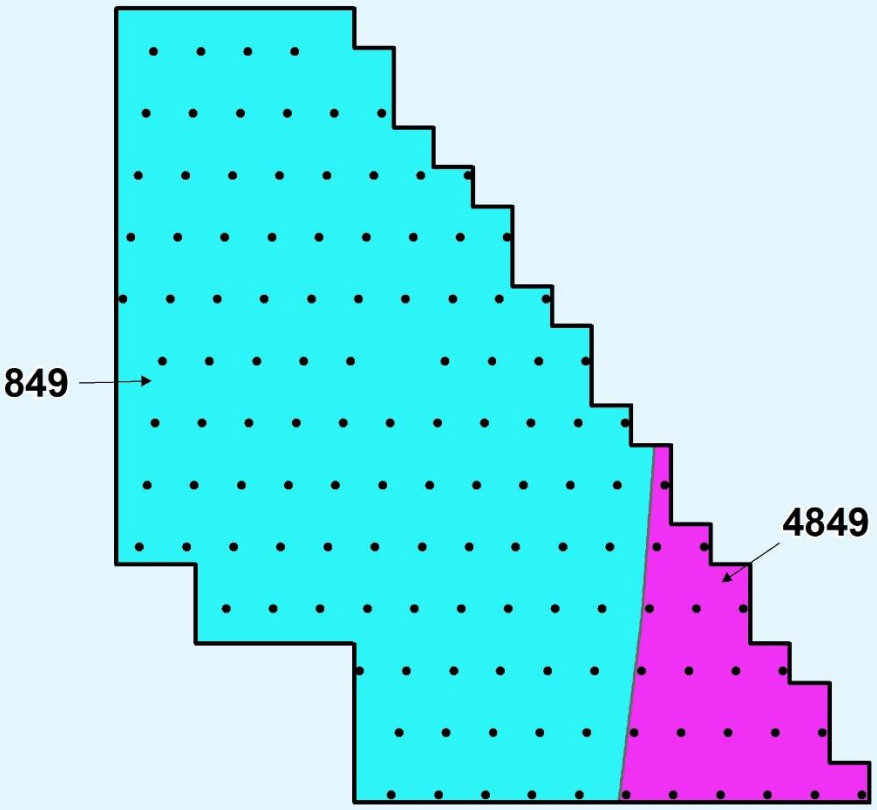
At 817 and 938 feet tall, wind turbines throughout the proposed study area will exceed 14 CFR Part 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and will be identified as obstructions regardless of their location. However, heights in excess of 499 feet AGL are feasible provided proposed wind turbines do not exceed FAA obstacle clearance surfaces.

The lowest obstacle clearance surfaces overlying the US Wind offshore wind project range from 849 to 4,849 feet AMSL (***Figure 13***) and are associated with MVA and MIA sectors. At 938 feet tall, wind turbines in the western and central sections of the study area (orange area, ***Figure 14***), including 104 proposed locations, will require an increase to the Potomac (PCT) TRACON Sector NHK-F MVA. If the FAA determines that this impact would affect as few as one radar vectoring operation per week, it could result in determinations of hazard.

The W-386 warning area overlies the wind project (***Figure 12***). Impacts on this segment of airspace could result in military objections to proposed wind development.

If you have any questions regarding the findings of this study, please contact ***Dan Underwood*** or ***Taylor Couch*** 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 be identified as obstructions regardless of location.



0 1 2 4 6 8 10 Nautical Miles
0 1 2 4 6 8 10 Miles

N

Obstacle Clearance Surface
Height - AMSL Feet
849
4,849
Lease Area
Proposed Wind Turbine

All heights above mean sea level (AMSL)

US Wind Offshore Wind Project
Composite Height Constraint Map

Plot Date:
9 November 2021

Figure 13

Coordinate System:
NAD 1983 UTM Zone 18N

Taylor Couch

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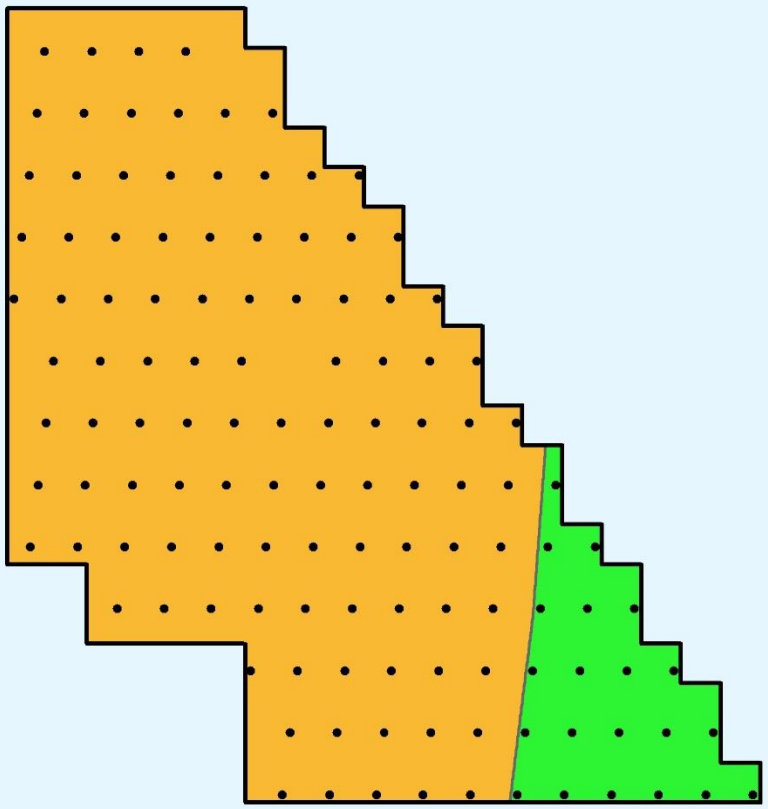
Proposed structures that exceed 14 CFR Part 77.17(a)(1) - a height of 499 feet AGL at the site of the object - will be identified as obstructions regardless of location.



0 1 2 4 6 8 10 Nautical Miles
0 1 2 4 6 8 10 Miles

N

Clearance
Height - AMSL Feet
- 938' Wind Turbines Exceed
- No Wind Turbines Exceed
- Lease Area
- Proposed Wind Turbine

US Wind Offshore Wind Project
Above Mean Sea Level (AMSL) Clearance Map

Plot Date:
9 November 2021

Figure 14

Coordinate System:
NAD 1983 UTM Zone 18N

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