Maryland Offshore Wind Project

Outer Continental Shelf Air Permit Application

August 2023
Revised November 2023
Addendum – January 2024

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5.0 AIR QUALITY MODELING ANALYSIS

Impacts of criteria pollutant emissions from the Project were modeled for comparison to the NAAQS and PSD increments. The guidance of the USEPA Guideline on Air Quality Models (40 CFR Part 52, Appendix W) was used as well as MDE guidance where applicable.

In the New Source Review (NSR) Workshop Manual (EPA, 1990) the dispersion modeling analysis is separated into two distinct phases: 1) the preliminary analysis, and 2) a full impact analysis. In the preliminary analysis, the potential emissions from the project are modeled to determine the criteria pollutants which need a full impact analysis. Those pollutants for which the modeled maximum impact are below the SILs would not require a full impact analysis.

The modeling methodology used for assessing the Proposed Facility's air quality impact is detailed in the following:

- Revised Air Quality Modeling Protocol submitted to the MDE on March 10, 2023.

- Responses to MDE's comments letter (dated July 27, 2023) to the revised version of the Air Quality Modeling Protocol submitted on March 10, 2023.

A copy of US Wind's response to MDE comments can be found in the agency correspondence (Appendix B-3).

5.1 Background Ambient Air Quality

The model results from the preliminary analysis are added to the background concentration before comparison to the NAAQS. Background concentrations are based on monitoring locations in Maryland, Virginia, Delaware, and New Jersey. In each state there are major cities and rural areas. The setting for the Project is adjacent to the beaches along the Delaware and Maryland shores where there are no significant stationary emission sources. Given the over-water environment of the Lease Area, utilization of these predominantly urban and suburban monitoring locations for the background concentrations is conservative in nature.

The air quality modeling protocol (Appendix B-3) provides the description and locations of the background air quality monitors. The background concentration from the nearest monitor for each pollutant are presented in Table 5-1.

5.1.1 Monitoring Waiver

A waiver from pre-construction ambient air quality monitoring may be granted when an applicant makes an acceptable showing that:

1. Representative existing ambient air monitoring data exists in the affected area and is of the quality and nature which demonstrates the current conditions of the area's air quality; or
2. Representative ambient air monitoring data exists from a prior time period which can be demonstrated to be conservative (i.e., higher) in establishing the current conditions of the area's air quality.

To determine whether pre-construction monitoring should be considered, the maximum impacts attributable to the proposed project are assessed against significant monitoring concentrations (SMC). The SMC for the applicable averaging periods for CO, SO_2, NO_2, and PM10 are provided in 40 CFR §52.21(i)(5)(i). A preconstruction air quality analysis using continuous monitoring data may be required for pollutants subject to PSD review per 40 CFR §52.21(m). If either the predicted modeled impact from an emissions increase or the existing ambient concentration is less than the SMC, an applicant may be exempt from pre-construction ambient monitoring. Regardless of this point, US Wind is not relying upon an SMC, or another exemption, from the requirement to collect and evaluate ambient air quality data. Specifically, US Wind asserts that the existing ambient monitoring program operated by MDE, DNREC, and NJDEP is sufficient to meet the needs of any pre-construction monitoring requirements and thus may be used in lieu of source specific preconstruction monitoring requirements.

See also, 40 CFR 52.21.1670 ("applicant makes an acceptable showing that representative existing ambient monitoring data exists in the affected area of the quality and nature which demonstrates the current conditions of the air quality of the area"); and New Source Review Workshop Manual (Draft, October 1990) at C.18 ("To be acceptable, such data must be judged by the permitting agency to be representative of the air quality for the area in which the proposed project would construct and operate"). As discussed in Section 5.1, representative data satisfying these requirements exists.

US Wind is requesting a waiver from the requirement to perform pre-application ambient air quality monitoring for CO, NO_2, PM10, and PM2.5 because there exists acceptable quality assured ambient air quality data from alternate locations that satisfy the requirements of 40 CFR 52.21.1670. Further, US Wind is requesting an exemption from the requirement to perform pre-application ambient monitoring for SO_2 and lead because they will be emitted in amounts less than the SERs; for fluorides, hydrogen sulfide, total reduced sulfur, and reduced sulfur compounds because they are not anticipated to be emitted from the Project; and for H_2SO_4 because there is no approved monitoring technique available.

5.2 Modeling Methodology

5.2.1 Model Selection

The USEPA guideline model for the modeling of the Project is the Offshore and Coastal Dispersion Model (OCD) (v5). The model, as described in 40 CFR Part 50, Appendix W and the OCD User's Guide is downloaded from the USEPA website SCRAM for use along with several preprocessors. It is a straight line steady-state Gaussian model which predicts hourly average concentrations based on hourly input meteorology and hourly emissions from the modeled sources.

The air quality model for over-water impacts is the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) Modeling System with meteorological data prepared using the AERCOARE meteorological data preprocessor program. AERCOARE is used to implement the Coupled Ocean-Atmosphere Response Experiment (COARE) bulk flux algorithm. US Wind requested from USEPA to use AERMOD in conjunction with AERCOARE prepared meteorological data (AERCOARE-AERMOD) as an alternative model for assessing compliance with air quality standards for the Project emission sources located over water in lieu of the OCD model, which is the Guideline on Air Quality Models (40 CFR 51 Appendix W) preferred model for over-water dispersion. The revised air quality modeling protocol submitted to MDE on March 10, 2023 includes a detailed description of the AERCOARE-AERMOD modeling methodology.

5.2.2 Meteorological Data

For any air quality modeling analysis conducted using the AERMOD model, two meteorological datasets are required: 1) hourly surface data and 2) upper air sounding data. According to the Guideline on Air Quality Models (Revised) (2017), the meteorological data used in an air quality modeling analysis should be selected based on its spatial and climatological representativeness of a proposed facility site and its ability to accurately characterize the transport and dispersion conditions in the area of concern. The spatial and climatological representativeness of the meteorological data are dependent on four factors:

1. The proximity of the meteorological monitoring site to the area under consideration;
2. The complexity of the terrain;
3. The exposure of the meteorological monitoring site; and,
4. The period of time during which data were collected.

The modeling analysis used prognostic meteorological data. This is appropriate because there is no representative National Weather Service (NWS) station and given the offshore nature of the Projects it is infeasible to collect adequately representative site-specific data. In addition, there are only two active buoys that collect meteorological data in the area, the Ocean City Inlet Buoy and the Delaware Bay 26 NM Buoy (ID #44009), which is 19 miles offshore of Ocean City. To run AERCOARE, the overwater meteorological file contains the necessary hourly observations to estimate surface fluxes using the COARE algorithm, plus additional variables that are directly passed through to AERMOD. Buoy data can be used with AERCOARE, provided that it meets

USEPA completeness requirements described under section 8.4.3 of Appendix W (at least 90% annual and at least 90% per calendar quarter, on average, across the 5 years processed).

The minimum set of overwater observations for the COARE algorithm must include wind speed, air temperature, sea temperature, and relative humidity. As an alternative to measured data, the USEPA MMIF program can also be applied to create an overwater meteorological file suitable for AERCOARE using simulations from WRF.

As discussed in the air quality modeling protocol (Appendix B-3), US Wind assessed a recent five year period (2017-2021) of meteorological data collected at the Ocean City Inlet Buoy and the Delaware Bay 26 NM Buoy, offshore of Ocean City. Neither of these buoys collect the relative humidity data that are necessary inputs to AERCOARE. In addition, the annual capture statistics were calculated from the period 2017-2021 and it was determined that the primary meteorological variables had capture statistics ranging from 88.6 to 92.7% for the Ocean City Inlet Buoy and from 38% to 64% for the Delaware Bay Buoy. Thus, the meteorological data from the nearest buoys does not meet the USEPA minimum criteria for completeness requirements on an annual basis. Based on the poor capture criteria statistics and absence of relative humidity data, the two buoys are not suitable for use with the AERCOARE model.

As such, US Wind has requested and received prognostic (i.e., WRF data) data from USEPA Office of Air Quality Planning and Standards (OAQPS). USEPA processed the WRF data using the MMIF (Version 4.0) to convert the WRF prognostic meteorological data (2019-2021) into a format suitable for dispersion modeling applications. The USEPA utilized the default settings for AERCOARE processing as provided in the User's Manual to the Mesoscale Model Interface Program, Version 4.0 (June 9, 2022). Note that setting options specific to AERMET processing, such as AER_MIXHT and AER_MIN_SPEED, are not applicable to AERCOARE processing.

US Wind ran AERCOARE using the following settings recommended in USEPA's AERCOARE User's Guide, as specified below:

1. The default threshold wind speed will be used to identify calm hours (i.e., WSCALM = 0.5 m/s). Wind speeds below this value will be considered calms;
2. Mixing heights provided by WRF-MMIF will be used, instead of calculated by AERCOARE. The default minimum mixing height of 25 meters will be assigned;
3. Warm layer and cool-skin effects will not be considered; and
4. Friction velocity will be determined from wind speed only; wave-height will not be considered.

Use of prognostic meteorological data requires concurrence from the appropriate reviewing authority and collaborating agencies that the data are of acceptable quality and representative of the modeling application. A concurrence request for approval from the USEPA and MDE is provided in the agency correspondence in Appendix B-2. The output from AERCOARE was used as the meteorological database for the modeling analysis and consists of a surface data file and a vertical profile data file.

5.2.3 AERMOD Model Options

AERCOARE-AERMOD (version 23132) was used for the modeling of the proposed Project's potential emissions to determine the maximum ambient air concentrations. The regulatory default option was used in the dispersion modeling analysis.

5.2.4 Good Engineering Practice Stack Height

Section 123 of the Clean Air Act (CAA) Amendments required the USEPA to promulgate regulations to assure that the degree of emission limitation for the control of any air pollutant under an applicable State Implementation Plan (SIP) was not affected by (1) stack heights that exceed Good Engineering Practice (GEP) or (2) any other dispersion technique. The USEPA provides specific guidance for determining GEP stack height and for determining whether building downwash will occur in the Guidance for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations), (EPA-450/4-80-023R, June, 1985). GEP is defined as "…the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, and wakes that may be created by the source itself, nearby structures, or nearby terrain obstacles."

The GEP definition is based on the observed phenomenon of atmospheric flow in the immediate vicinity of a structure. It identifies the minimum stack height at which significant adverse aerodynamics (downwash) are avoided. The USEPA GEP stack height regulations specify that the GEP stack height be calculated in the following manner:

$$H_{GEP} = H_B + 1.5L$$

Where: H_B = the height of adjacent or nearby structures, and
L = the lesser dimension (height or projected width of the adjacent or nearby structures).

Structure downwash would be incorporated into the AERMOD model by specifying a structure height and width that are nearby a specific source and could influence dispersion from that source. The main structure for scenarios that could influence dispersion is the OSS platform. While the AERMOD model does not incorporate platform downwash using a platform downwash algorithm based on laboratory experiments, US Wind used PRIME, considering the platform as a solid structure which would result in conservative, overprediction of concentrations. The final design of the OSS has not yet been determined but based on information provided by US Wind to BOEM in the Construction and Operations Plan (COP), the

OSS topside dimensions are anticipated to range from 30 m by 43 m and 50 m high up to 40 m by 80 m and 60 m high. The air quality modeling was prepared based on a platform dimension of 40 m by 80 m with design heights ranging from 50 m to 60 m. The maximum modeled concentrations from either platform design height were then selected as worst-case impacts. The structure dimensions and associated downwash are conservative in that it assumes a solid foundation down to sea level, instead of the OSS being several meters above sea level on the monopile foundations.

A source layout with the location of the modeled vessel exhaust stack and platform structure is provided in Figure 5-1. This figure also provides a rendering of a sample OSS platform on a monopile foundation. The exhaust location for all vessel types and engine exhausts were placed at the single point of release as shown on Figure 5-1. This approach is conservative as it assumes that all vessel engine exhausts would consistently be subject to building downwash in the same direction for the entire three (3) year length of the modeling assessment. It is expected that vessels may be oriented in any direction from the OSS. Thus, assuming that the vessels are always located adjacent to the OSS in the same orientation, would result in worst-case impacts as the vessels exhaust plumes could be entrained in the building cavity recirculation region in the same direction for the entire period of the modeling assessment.

The vessel exhaust location was modeled at the corner of the OSS to provide a worst-case assessment of building downwash as this location would be expected to result in the maximum length of the cavity circulation region downwind of the OSS. The PRIME algorithm utilized by AERMOD is based on a cavity length that is directly proportional to the building width[1]. Thus, the building corner on the lee side of a building results in the maximum cavity recirculation length. These downwash dimensions were also assigned to the jack-up vessels and the supply barges as these vessels will likely be attached or near the OSS structure during construction and large-scale repairs during O&M and therefore be potentially influenced by its wake effects. The diesel electric generator may be located on top of the OSS platform and therefore may be subject to its influence as well. The crew transport vessels are assumed to be transiting to or from the platform such that their emissions release point is mostly independent of the platform wake, and therefore downwash effects were not assigned to these vessels. Table A-45 provides a detailed matrix of emission sources and if downwash was modeled for each scenario. In summary, downwash dimensions were assigned to all vessels involved in OSS construction that may be attached to or near the OSS platform.

5.2.5 Receptor Grid

When assessing compliance with NAAQS and Class II PSD increments, the receptors in closest proximity to the emission sources are mostly over water. There cannot possibly be any

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[1] Earth Tech, Development and Evaluation of the PRIME Plume Rise and Building Downwash Model (published in Journal of the AWMA).
https://gaftp.epa.gov/Air/aqmg/SCRAM/models/other/iscprime/primpldn.pdf

residences over water, and the public is extremely unlikely to remain for any extended period in any of the overwater locations being modeled. The standards were established to be protective of public health based on repeated or prolonged exposure, and the possibility of repeated or prolonged exposure does not exist miles offshore.

Class II Modeling Receptor Grid

For NAAQS and PSD Class II increment modeling, a polar grid of receptors was utilized in which receptors are placed in 10-degree increments around the ring. Receptor ring spacing were 25 m out to 1000 m, 250 m out to 2,500 m, 500 m out to 5,000 m, 2.5 km out to 10 km, and 5 km out to 50 km. Based on the results of the modeling with maximum impacts located within 1000 m, the receptor field did not need refined to ensure that the maximum impacts from the different construction and O&M activities are being captured. It should be noted that the receptors are nearly entirely over water, in locations where there are no residences, and where the public is unlikely to remain for any extended period of time.

The modeled receptors varied based on the type of construction and O&M activity. For example, during construction, it is assumed that a 500-meter exclusion zone will be established to keep the public away from the immediate area of the activity. The details of the safety zone are provided in the Project's *Navigation Safety Risk Assessment* (US Wind, May, 2022) that has been provided to the BOEM as part of the Construction and Operations Plan (COP). The receptor field was placed adjacent to the activity in areas where the public could have access. For the purposes of modeling, it is assumed that the construction vessels are located at the center of the receptor grid and the exclusion zone is 500 m in all directions.

Class I Modeling Receptor Grid

For PSD Class I modeling, receptors were placed at a distance of 50 km in those directions to Class I areas downwind of the Project to conservatively model the impacts at the Brigantine NWR. Per MDE request, receptors were also placed in an arc of receptors in those directions to the locations of Shenandoah National Park Class I area that are located within 300 km of the Project. A ring of polar receptors was placed 50 km from the centroid of the WDA and receptors were placed at each degree This methodology resulted in 26 receptor locations at 50 km downwind of the Project in the direction of the Brigantine NWR and 22 receptor locations at 50 km downwind of the Project in the direction of locations within Shenandoah National Park that are within 300 km of the Project. The receptors were placed with base elevations that are representative of the minimum and maximum heights within the Class I areas. Note that Brigantine NWR was modeled at sea level as this Park is located on the New Jersey Coastline and is flat.

The modeled Class I receptors are representative of downwind directions to both the Brigantine and Shenandoah Class I areas. US Wind notes that this methodology for preparing the first-tier

Class I PSD screening analysis is consistent with the Class I PSD increment demonstrations prepared in New Jersey for the Brigantine NWR as discussed in NJDEP Technical Manual 1002, Section A.6.1[2]. This methodology is also consistent with the USEPA guidance for Class I analyses for PM2.5 impacts as discussed in "Final Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program[3]" (MERPS Guidance). The USEPA Guidance specifies that PM2.5 primary impacts should be assessed with AERMOD for receptors located 50 km downwind of the source.

5.3 NO_2 Modeling

The following tiered screening options were applied for the various analyses per the guidance specified in the "Revisions to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter", published final in the Federal Register on January 17, 2017, and the USEPA Memorandum "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard" section entitled Approval and Application of Tiering Approach for NO_2 (found on pages 5 through 8 of the memorandum). Section 5.2.4 of the USEPA's Guideline on Air Quality Models, Appendix W to 40 CFR Part 51, recommends a three-tiered screening approach to estimate ambient concentrations of NO_2:

- Tier 1 – assume complete conversion of all emitted NO to $NO_{2;}$
- Tier 2 – multiply Tier 1 results by a representative equilibrium NO_2/NO_x ratio; and
- Tier 3 – perform a detailed analysis on a case-by-case basis.

The 1-hour NO_2 modeling analysis utilized the USEPA Tier 3 modeling approach for 1-hour NO_2 modeling assessment results using the AERMOD Plume Volume Molar Ratio Method (PVMRM) that adjusts NO_x emissions to estimate more realistic ambient NO_2 concentrations by modeling the conversion of NO_x to NO_2. Note that the Tier 2 screening approach using the Ambient Ratio Method 2 (ARM2) is too conservative for this Project.

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[2] If the source is greater than 50 km from the Class I area, impacts can be conservatively predicted at an arc of receptors 50 kilometers from the source in the radial direction of the Brigantine Wilderness Area.
https://dep.nj.gov/wp-content/uploads/boss/technical-manuals/tm1002_2021.pdf

[3] The modeled maximum secondary PM2.5 impacts at or greater than 50 km would be used in combination with primary PM2.5 impacts estimated with AERMOD at 50 km downwind of the source for comparison to the EPA recommended PM2.5 Class I SIL value. If the results of the initial screening step show an exceedance of the PM2.5 Class I SIL value, a second more refined screening step would involve selecting the highest modeled secondary PM2.5 impact at or less than the downwind distance of the Class I area relative to the project source. That value would be combined with primary PM2.5 impacts estimated with AERMOD at 50 km downwind and compared with the EPA recommended PM2.5 Class I SIL.
https://www.epa.gov/sites/default/files/2020-09/documents/epa-454_r-19-003.pdf

PVMRM incorporates three sets of data into the calculation of 1-hour NO_2 concentrations. Those are source-specific in-stack NO_2/NO_x emission rate ratios, an ambient NO_2/NO_x concentration ratio, and hourly average background ozone concentrations.

The PVMRM option for modeling conversion of NO to NO_2 incorporated a default NO_2/NO_x ambient equilibrium concentration ratio of 0.90.

5.3.1 In Stack NO_2/NO_x Concentration Ratio

NO_x consists primarily of nitric oxide (NO) and NO_2, plus small amounts of other compounds. Combustion sources produce NO_x by the following three mechanisms:

1. Thermal NOx is produced by the thermal dissociation and subsequent reaction of nitrogen and oxygen (O_2) molecules in the combustion air;
2. Fuel NOx is produced by the reaction of fuel-bound nitrogen compounds with O_2 molecules in the combustion air; and,
3. Prompt NO_x is produced by the formation of hydrogen cyanide (HCN) via the reaction of nitrogen radicals and hydrocarbons (HC), followed by the oxidation of HCN to NO.

NO_2 is produced by the oxidation of NO by O_2. This oxidation reaction is favored by a high O_2 concentration. Since the reaction is exothermic, NO_2 formation is also favored by low temperature. Hence, rapid cooling of combustion products in the presence of a high O_2 concentration will promote conversion of NO to NO_2. Essentially all of the NO_x formed by distillate oil combustion sources is thermal NO_x because this fuel has little or no chemically bound fuel nitrogen. NO_x from fuel combustion typically consists of 90 to 95 percent NO. The balance is primarily NO_2.

The USEPA NO_2/NO_x In-Stack Ratio (ISR) Database[4] was reviewed to determine representative NO_2/NO_x ratios for diesel engines. The USEPA ISR database includes NO_2/NO_x ratios that range from 0.02 to 0.09 for diesel engines that are representative of the envelope of vessels for Project construction/O&M that were modeled for the Project. The envelope of diesel engines do not include any units with advanced add-on emission controls, such as selective catalytic reduction. Therefore, in reviewing USEPA's ISR database, the uncontrolled engine data were considered. Thus, based upon the maximum NO_2/NO_x ratio provided in the USEPA data, a conservative in-stack NO_2/NOx ratio of 0.10 for the diesel engines was used in the 1-hour NO_2 modeling analysis.

5.3.2 1-hour NO_2 Background Concentrations

Pollutant background concentrations are required to appropriately assess the ambient air quality concentrations that may contribute to the total ambient pollutant concentrations.

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[4] https://www.epa.gov/scram/nitrogen-dioxidenitrogen-oxide-stack-ratio-isr-database

Background concentrations are added to model-predicted concentrations to calculate the total concentrations for comparison to the NAAQS. Criteria pollutant background concentration values are derived from ambient air quality data monitored at stations that are determined to be representative of expected background concentrations at the proposed source location and potential impact area. In order to conduct NAAQS assessments, background values must be combined with modeled results to compare to the 1-hour NO_2 NAAQS.

Based on review of the locations of Maryland, Delaware, and New Jersey ambient air quality monitoring sites, the closest "regional" monitoring site was used to represent the current background NO_2 air quality in the site area. Background data for NO_2 from 2019-2021 was obtained from a monitoring station located in Millville, New Jersey (EPA AIRData # 34-011-0007).

The March 1, 2011 Fox memorandum "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS (USEPA, March 1, 2011) provides guidance for incorporating background concentrations in the impact assessment for the 1-hour NO_2 standard.

"We believe that an appropriate methodology for incorporating background concentrations in the cumulative impact assessment for the 1-hour NO_2 standard would be to use multiyear average of the 98th-percentile of the available background concentrations by season and hour-of-day…"

"…we recommend that background values by season and hour-of-day used in the context should be based on the 3rd highest values for each season and hour of day combination…"

This seasonal and hour of day methodology is proposed was used. The background values were first divided by season for each year. Those seasonal groups were further binned into 24-hour groups for a total of 96 bins of values (product of 4 seasons and 24 hours) for each year (2019, 2020, and 2021). The 3rd highest value from each bin was found per year. Finally, to obtain the values to be summed with the modeled concentrations, the average of those 3rd highest values was taken over three (3) years. This results in 96 values that were used in the modeling analysis. The AERMOD model option (keyword BACKGROUND) was used to sum each modeled concentration with the background concentration that was calculated for that season and hour-of-day.

5.3.3 Hourly Average Background Ozone Concentrations

Based on review of the locations of ambient air quality monitoring sites, the closest "regional" monitoring site was used to represent the current background ozone air quality in the site area. Representative hourly average background ozone concentrations were input to AERMOD. The ozone monitor closest to the proposed Project site was identified. After reviewing monitoring locations and periods of record, a monitor in Lewes, Delaware (USEPA AIRData # 10-005-1003) was used to represent the ozone background values during the three (3) year period 2019–2021, concurrent with the three (3) years of surface meteorological data. When ozone data is missing from the Lewes monitor, missing hours were substituted using data from 2nd nearest monitoring station, located in Seaford, Delaware (10-005-1002).

5.4 Ozone and PM2.5 – Secondary Formation

Although the Project centroid is not in or close to non-attainment areas for ozone or PM2.5, an analysis was performed to evaluate whether the emissions from the Project will impact the non-attainment areas (emissions from the non-attainment area [port activities] will need to be offset). USEPA has recently finalized its Guidance for Ozone and Fine Particulate Matter Permit Modeling (June 29, 2022). This Guidance relies upon the Tier 1 Demonstration for Modeled Emission Rates for Precursors of Ozone and PM2.5 (MERPS). A MERPS analysis was performed to determine if enough annual emissions will cause an impact in the non-attainment areas.

Additionally, USEPA has recently (November 2022) issued “Photochemical Model Estimated Relationships Between Offshore Wind Energy Project Precursor Emissions and Downwind Air Quality (O_3 and PM2.5) Impacts”, USEPA-454/R-22-007. This document provides the results of photochemical model analysis for the area near the Project, at the location of the project centroid (i.e., Source #5 referenced in the document). Because the activities of this wind energy application are close to shore, it is not expected that high concentrations of chemically produced ozone or particles will occur at the near shore. The transfer coefficients for Source #5 and the potential Project air emissions were used to calculate the secondary formation of PM2.5 for inclusion into modeling assessment for comparison to SILs, increments, and the NAAQS. The detailed summary of the maximum secondary formation for PM2.5 and ozone are provided in Table 5-2.

5.5 Project OCS Sources and Modeled Emission Units

All emission units considered OCS sources and all potential emissions associated with the OCS source(s) were included in the modeling. See Section 2.0 for a detailed explanation of the Project OCS source(s) and potential emissions. The vessel list and associated information for each vessel is presented in Appendix A. Additionally, a description of the modeled emission source names (i.e., AERMOD Source IDs) is provided in Appendix A, Tables A-2 through A-15.

5.5.1 OCS Sources

A number of vessels would be required to support activities carried out during the construction and O&M phases of the Project. Specific vessels are required for surveying activities, foundation installation, OSS installation, cable installation, WTG installation, and support activities. The vessels would vary in size and complexity based on their function on the Project. The vessels employed on the Project will be required to comply with applicable USCG and Jones Act regulations for conducting operations in U.S. waters. All foreign flag vessels employed on the Project will, in addition to meeting applicable USCG and Jones Act requirements, be required to meet International Maritime Organization (IMO) and International Marine Contractors Association (IMCA) requirements. The specific vessels selected to perform the required tasks during construction will be dependent upon availability at the commencement of each activity. US Wind will secure vessel supply in advance to prevent any delays to the construction schedule.

Because construction activity is expected to occur over a 3 to 4 year period, and numerous individual vessel activities would occur over this time period, the short-term (i.e., 1-hour, 3-hour, 8-hour, and 24-hour) and annual construction activities that result in maximum air emissions are modeled for comparison to NAAQS and PSD increments. With this modeling methodology, any combination of construction activities that would result in lower emissions would have less of an air quality impact than from the maximum emissions scenarios.

The proposed peak year of construction and commissioning, corresponding to the maximum annual potential to emit subject, captures all of the activities that could potentially occur within the 25 NM OCS area and as such, was included in the annual modeling analyses. For the peak year of construction, commissioning (including any overlapping O&M), the following activities may be taking place in various areas of the WDA simultaneously:

- Monopile (MP) Foundation Installation;
- Scour protection installation;
- WTG Installation;
- WTG Commissioning;
- OSS Installation;
- OSS Commissioning;
- Inter-Array Cable Installation;
- Offshore Export Cable Installation; and
- Overlapping O&M activities.

O&M phase emissions would consist of the following activities:

- Vessel transit within the OCS area;
- Onsite maneuvering at the WTGs and OSSs; and
- Onsite diesel generators.

Activities would occur throughout the 25 NM OCS area and will be transient. For example, the monopile foundation installation would occur over the course of two days for a specific WTG location. Then, the group of ships responsible for the monopile installation would move to the next WTG position and begin installation of another monopile. For simplification of the modeling given this spatial and temporal uncertainty regarding vessel locations, the modeling was conducted based on the assumption that these activities occur at the same location for the entire modeled period. Thus, all of the emission sources were modeled at one single location with the same coordinates. However, when this conservative assumption resulted in overly conservative modeling results, each vessel during transit was modeled as a line source, consisting of a series of point sources.

5.5.2 Exhaust Stack Configuration and Emission Parameters

As described elsewhere in this application, vessel and equipment specifications will change during development and construction of the Project. Vessel availability at the time of construction or O&M cannot be foreseen with any certainty, given the rapidly changing nature of the offshore wind industry and limitations on vessel use associated with the Jones Act. Vessel data will remain highly speculative throughout the permitting of the Projects. Vessel selection will not be refined until much closer to the start of construction, and vessels may be changed out even after construction begins. Therefore, modeling uses currently best-available information on representative vessel types, with typical or fleet- average emission rates. Overall, the use of the maximum design scenario associated with the Projects' PDE serves to ensure a reasonably conservative estimate of emission rates and impacts from the Project.

US Wind has provided estimates of source parameters (exit velocity, stack diameter, stack exit temperature) in Appendix A, Tables A-42 through A-44 for the types of ships that may be used for the construction and O&M activities. Appendix A also lists the individual vessel and equipment types associated with each of the activity types that were modeled. This general modeling conservatism is consistent with the PDE concept and allows for a demonstration of compliance with the applicable NAAQS standards and PSD Increments.

US Wind is aware of various stack configurations on offshore wind vessels and accounted for various configurations by utilizing the vertical component of the exhaust velocity in the AERMOD analyses, which are provided in Table A-42 for each vessel engine. The stack configuration for most of the larger vessels is based on a 45 degree angle from vertical and a vertical orientation for the smaller vessels. The modeled stack orientation and exit velocity for the vessels are provided in Table A-42. Figure 5-2 provides photos of the exhaust orientations for various vessels in the offshore wind construction fleet.

For tilted stacks, the vertical component and horizontal component of the velocity are modeled using trigonometry based on the stack angle from vertical. To calculate the vertical component of the exit velocity for tilted stacks, the actual exit velocity is multiplied by the cosine of the angle from vertical using the following formula:

V_v = cosine of the stack angle from vertical * V

Where:

V_v = Vertical Component of Velocity (m/s)
V = Stack Exit Velocity (m/s)

Example: a stack tilted at an angle of 45 degrees from vertical with an exit velocity of 10 m/s would be modeled with a vertical velocity of 7.07 m/s (cosine 45 degrees (0.707) * 10 m/s). Consistent with the methodology in the Air Quality Modeling Protocol for averaging periods longer than 1-hour, the maximum source operation time for any given mode of operation and construction or O&M activity was modeled using the maximum hourly emissions rate that is scaled by the number of hours that source could be in operation by the number of hours in the averaging period. Tables A-42 through to A-44 provide detailed emissions for each pollutant and averaging period and a sample calculation is provided in Table A-42. US Wind notes that a propulsion or auxiliary engine can only be in one mode of operation at a time. For example, for a 24-hour PM averaging modeling demonstration, it would be inappropriate and would not occur in practice for an engine to be operating for 24-hours in both transiting mode and in maneuvering mode. The emissions were required to be scaled to take into consideration the actual amount of time that an engine can be operated in either a transit or maneuvering mode over the course of the averaging period.

5.5.3 Short-Term Averaging Periods

Nearly all construction, commissioning, and O&M activities will take place for only a few hours or days at any one WTG or OSS position, and most emissions sources will be in-motion. Generally, groups of vessels will work together to perform discrete activities such as WTG installation, scour protection, etc. As such, there is a temporally and spatially varying aspect to be considered. Techniques to address this variability depend on the applicable standard, pollutant, and averaging time. US Wind notes that the peak impacts will be entirely over water miles from shore, where there cannot possibly be any residences, and where the public is extremely unlikely to remain for any extended period.

5.5.3.1 Spatial Variability

As an initial conservative approach for modeling against short-term standards, all vessel transit emissions were modeled at a single location. This initial approach to transit emission is overly conservative, because impacts from vessel at any one location will last for a few seconds to minutes and will not impact short-term concentrations. The transiting vessels are traveling at a (relatively) high speed in a straight line over a long distance from one location to another. Additionally, maneuvering vessels were modeled at a single point, collocated with the transit emissions, as in initial conservative approach. The maneuvering vessels are moving at relatively low speed in one general area and are not anticipated to be stationary or otherwise moored or anchored. Because transit emissions will only occur at any one location for a few seconds, those emissions would not reasonably contribute to 1-hour, 3-hour, 8-hour, or 24-hour average ambient concentrations at any one location. However, as an initial conservative approach given the temporal and spatial uncertainly of transit and maneuvering emissions, all of the emissions were assumed from a single point. Furthermore, the maximum of either the transiting emissions or maneuvering emissions was modeled for comparison to the 1-hour averaging periods. This assumption results in a conservative analysis of groups of vessels that may either be transiting or maneuvering in any single hour.

When the initial conservative approach to transit emissions resulted in overly conservative modeling results, US Wind modeled the transit emissions as a series of point sources (i.e., 1-hour NO_2, 24-hour PM) as discussed within the Air Quality Modeling Protocol (Appendix B-3). Additionally, for 1-hour NO_2 modeling, the construction and O&M scenario vessels were modeled with both vessel operational modes and the maximum impact from either vessel operational scenario (i.e., transiting or maneuvering) was then selected as the worst-case emissions scenario.

The AERMOD model allows for modeling multiple line source at a time, and the averaging period may be 1-hour to annual. Therefore, for any refined modeling of the transit emission, the transiting sources were modeled as a set of individual point sources along the length of the transit route. The total aggregate emissions of the individual point sources are the same as the total line source emissions calculated for the vessel activity. The point sources representing the line source are spaced approximately 0.6 mile (1 km) apart. This representation of the line sources will allow for consistent modeling of 1-hour, 3-hour, 8-hour, 24-hour, and annual averages. The line source geometry was developed by conservatively assuming that all transiting vessels would follow the exact same route from the Sparrows Point route starting at a point 25 NM from the Project Centroid until the vessel reaches the Project Centroid. This methodology is conservative as it assumes that all transiting vessel emissions occur simultaneously both temporally and spatially (i.e., they are overlapping point sources). The AERMOD model source IDs for vessel transiting emissions are provided in the air quality modeling files and use the same naming convention as provided in Table A-45.

Table 5-3 provides a summary of the refinements made to the 1-hour NO_2 and 24-hour PM modeling for the SILs, PSD increment, and NAAQS compliance demonstrations. Note that refined modeling was not necessary for CO, SO_2, annual NO_2, and annual PM2.5.

5.5.3.2 Temporal Variability

US Wind used the following approach for modeling short-term standards:

- Model each construction/O&M operation (i.e., including all the vessels and engines that would be in a single area at the same time), at a single location.
- Model as if the operation takes place at that single location for the entire modeling period (three years of meteorological data); and

- Separate modeling for individual construction/O&M scenarios. The conservatism associated with the single operating scenario occurring year-round at one spot renders modeling overlapping construction and O&M scenarios as unnecessary and overly conservative, as discussed further below.

The source operation resulting in the highest total impact at any receptor represents the worst-case impact. Each construction and O&M scenario was initially modeled with all vessels associated with a scenario. This is a conservative assumption provided that all of the vessels would not be expected to operate together within an hourly or daily period based on need, availability, logistics, and safety. Each scenario includes engines that would be in a single area at the same time. This conservative assumption resulted in overly conservative impacts for 1-hour NO_2 and 24-hour PM. As such, US Wind refined the modeling for these pollutants to only include those vessels and engines that would be expected to operate together over an hourly or daily basis. Appendix A provides information regarding the vessel operations, emission points, and exhaust parameters for each scenario. Table A-45 provides a detailed matrix of emission sources and operating scenarios for each modeled pollutant and averaging period. The modeled scenarios included the following activities: foundation installation, WTG installation, WTG commissioning, OSS installation, inter-array cable installation, export cable installation, and O&M. This matrix was based on US Wind's determination of the feasibility that a vessel may be in operation simultaneously with another vessel, while taking into consideration need, availability, logistics, and security. For example, multiple towing tugs during WTG installation would not be needed simultaneously as determined by US Wind's construction management team. Oftentimes, US Wind determined that a duplicate vessel type could be excluded from the modeling analysis for short-term averaging periods.

The likelihood that any two construction/O&M scenarios could overlap in space and time is negligible and would likely not occur in practice. Thus, the chances of overlapping plumes is small, and combined with the additional levels of conservatism described above represent a possibility of overlapping (i.e., cumulative) impacts that is exceedingly small. To support the statement that overlapping impacts are unlikely, US Wind provides the following:

1. The concentration gradient associated with individual source operations is limited and localized. The location of maximum modeled impacts for individual source operations are similar provided that sources have similar stack heights and exhaust parameters given that they are combustion sources (i.e., engines).
2. The entire construction operation covers hundreds of positions over 10,000s of acres, and will take more than 3 years year to complete. The construction/O&M scenarios with substantial emissions each take less than 2 to 3 days or less to complete. Unless specifically scheduled to occur near each other, the chances of operations with substantial emissions occurring in nearby positions is very low.

3. US Wind has no intention of scheduling major construction operations near each other. For safety and logistics reasons, US Wind would avoid having large groups of vessels operating near one another.
4. The chance of an O&M activity having overlapping impacts with a construction activity is minimal as construction activities would not be anticipated nearby to an operating wind turbine.
5. Construction activities will happen only once per location. For O&M, the vessel's position will not be the same visit to visit. Some inspections will not involve disembarking at the WTG or OSS; the vessel will instead slowly circumnavigate the WTG or OSS while crew visually inspect for damage or wear. When crew are disembarking from service vessels, the vessel will approach from different directions depending on the wind and ocean conditions. After transfer of crew, the vessel will then back away from the WTG or OSS and station nearby while the crew is working. The vessel would station itself at a different location each time depending on the wind and ocean conditions.
6. The timing and order of the O&M activities will not be in a set pattern, and the schedule will change regularly based on weather conditions. Each construction activity will happen for a single stretch of time, which for activities such as foundation installation is a few days or less. Construction activities at any one position will be scheduled based on the weather and based on shifting logistics for the entire construction effort.

5.6 Maximum Modeled Project Concentrations

Table 5-4 presents the maximum modeled air quality concentrations as calculated by AERMOD for the modeled construction and O&M scenarios discussed in Section 5.5. As shown in Table 5-4, the maximum concentrations for selected construction and O&M scenarios exceed the applicable SILs for 1-hour and annual NO_2, 24-hour PM10, and 24-hour and annual PM2.5.

Under longstanding USEPA guidance and interpretations, the SILs are used to determine if a source makes or could make a significant contribution to a predicted violation of a NAAQS or PSD increment. If a source is predicted to have maximum impacts that are below the SILs, then a cumulative (or "full") impact analysis that includes other facilities is not required, and the impacts of the project are considered to be *de minimis* or insignificant. By showing that maximum predicted Project impacts will be below the corresponding SILs for CO and SO_2, the Project is exempt from the requirement to conduct any additional analyses to demonstrate compliance with the NAAQS for these pollutants.

5.6.1 Area of Impact Determination

Under PSD regulations, an air quality dispersion modeling analysis is required to ensure that CO, PM10, PM2.5, SO_2, and NO_2 emissions from the proposed Project will be compliant with NAAQS and applicable PSD increments.

As shown in Table 5-4, concentrations of 24-hour PM10, 24-hour and annual PM2.5, and 1-hour and annual NO_2 have been determined to be significant. Therefore, they are the only pollutants/averaging periods determined to have an area of impact (AOI), thus requiring additional impact assessments.

The areas of impact for the aforementioned pollutants under normal operations are as follows:

- 24-hour PM10 AOI = 1,250 meters;
- Annual PM2.5 AOI = 1,500 meters.
- 24-hour PM2.5 AOI = 5,000 meters;
- Annual NO_2 AOI = 7,500 meters; and
- 1-hour NO_2 AOI = 50,000 meters.

The additional impact assessment required for these pollutants and averaging periods is a multiple source NAAQS and PSD Class II increment modeling assessment as detailed in Sections 5.8 and 5.9.

5.7 Class I Impacts

There is one (1) Class I area within 300 km of the Project centroid: The Brigantine Wilderness area located in the Edwin B. Forsythe National Wildlife Refuge in New Jersey, approximately 126 kilometers north-northeast of the Project. The Federal Land Manager (FLM) for this Class I area was notified on June 16, 2023 (provided in Appendix B-4) to determine if assessments of impacts in the Class I area would be required.

In addition to the Brigantine Wilderness area per an MDE request, the northeast corner of the Shenandoah National Park in Virginia was included in the Class I PSD increment assessment.

Based on the spatial limitations of the AERMOD model, a PSD Class I increment analysis was conservatively performed at a distance of 50 km from the centroid of the OCS area. Air quality concentrations of NO_2, SO_2, and PM10/PM2.5 in the Brigantine Wilderness Area and Shenandoah National Park were determined using the AERMOD model. For PSD Class I modeling, receptors were placed at a distance of 50 km in those directions to the Class I areas downwind of the Project to conservatively model the impacts at the Brigantine NWR and Shenandoah National Park Maximum concentrations were then compared to the PSD Class I SILs and increments as shown in Table 5-5.

As documented by USEPA for Source #5[5] (the WDA) as further discussed in Section 5.4, the primary PM2.5 coefficients (($\mu g/m^3$)/tpy) by distance from the source (km) are 67% lower at a

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[5] USEPA,2022: Photochemical Model Estimated Relationships Between Offshore Wind Energy Project Precursor Emissions and Downwind Air Quality (O3 and PM2.5) Impacts November 2022)

distance of 100 kilometers than a modeled distance of 50 km. The USEPA document also details that concentrations are over 94% lower at a distance of 300 km compared to the concentrations modeled at 50 km. Thus, the modeled concentrations are expected to be much lower at the actual distances to the Class I areas than the concentrations modeled using the conservative first tier PSD Class I increment assessment at a distance of 50 km.

The results of the modeling indicate that the maximum impacts are less than the PSD Class I SILs for all pollutants and averaging periods. Similarly, the maximum modeled impacts are lower than the PSD Class I increments for all pollutants and averaging periods. It should be noted that the modeling results are highly conservative since they reflect the concentrations at a distance of 50 kilometers from the Facility rather than the nearest Class I area that is actually at a distance of approximately 126 km.

5.8 NAAQS Analysis

Modeled concentrations are greater than the SILs for pollutants subject to PSD review. Thus, NAAQS analyses for those pollutants were performed. The first step of conducting the NAAQS analysis is to determine the pollutant specific area(s) of impact of the proposed Project. The area of impact corresponds to the distance at which the model calculated pollutant concentrations fall below the SILs. The area of impact results are provided in Section 5.6. The NAAQS analysis used the same refinements for 1-hour NO_2 and 24-hour PM that were used in the PSD SILs demonstration that is discussed in Sections 5.3 and 5.6. The NAAQS analysis is based on the modeling methodology provided in Section 5.2 and the source emissions discussed in Section 5.5. The second step is obtaining off-site major source inventories within the area of impact plus a distance ranging from 10 km to 20 km from the source.

Off-site major sources were not necessary to be included in a multisource cumulative NAAQS assessment for the following reasons. Per 40 CFR Part 51, Appendix W Section 8.3.3, specific modeling should be performed for sources in the vicinity of the proposed Project for emissions sources that are not adequately represented by ambient monitoring data. Based on a review of MDE and DNREC major source air permits within 50 km of the Project centroid, there are no major air emissions sources in the vicinity of the Project with emissions of NO_x or PM10/PM2.5. Given that the monitor sites selected for this analysis have greater concentrations of existing emissions sources in close proximity than do the receptors of maximum concentration for each NAAQS modeled pollutant, it was not necessary to add in any offsite (i.e., nearby) emissions sources into the analysis. Review of MDE and DNREC permitting records indicates that there are no large emissions sources in the Ocean City area that could potentially add to the modeled concentrations of project sources, and thus, impacts of existing emission sources should be adequately captured by the conservative background monitors used for this analysis.

The maximum modeled concentrations were then added to the representative background concentrations for comparison to the NAAQS. The background data used for this analysis are described in Section 5.1. For the PM2.5 impacts, the Project's direct PM2.5 emissions are modeled using the AERCOARE/AERMOD system and secondary impacts are accounted for using the methodology in Section 5.4. The PM2.5 direct and secondary impacts are combined with background concentrations for comparison to the PM2.5 NAAQS.

The results of the NAAQS modeling analysis for each construction and O&M scenario are presented in Table 5-6. As shown in Table 5-6, the Project impacts, plus background, do not exceed or threaten to exceed the NAAQS.

5.9 PSD Increment Analysis

5.9.1 Class II Increment

The Project is located in a PSD Class II area. As discussed in Section 5.8, the maximum modeled impacts for NO_2, PM10, and PM2.5 were determined to be above the SILs. Thus, an analysis of the need to model offsite major PSD sources permitted or modified after the PSD baseline dates was conducted. As detailed in Section 5.8, a review of the MDE and DNREC permitting databases indicates that there are no PSD increment consuming sources within 50 km of the Project. Thus, the PSD increment modeling did not include offsite (i.e., nearby) sources.

The PSD increment analysis used the same refinements for 24-hour PM that were used in the PSD SILs demonstration that is discussed in Sections 5.3 and 5.6. The PSD increment analysis is based on the modeling methodology provided in Section 5.2 and the source emissions discussed in Section 5.5. The results of the PSD Class II increment analysis provided in Table 5-7 demonstrate that the emissions from the Project would not cause or contribute to air pollution in violation of any of the applicable PSD II increments. Note that PSD Class II increments are not provided in Table 5-7 for 1-hour NO_2 as the USEPA has not prescribed a PSD increment for this pollutant and averaging period.

5.9.2 Class I Increment

There is one (1) Class I area within 300 km of the Project centroid: the Brigantine Wilderness area located in the Edwin B. Forsythe National Wildlife Refuge in New Jersey, approximately 126 kilometers north of the Project. In addition to the Brigantine Wilderness area per an MDE request, the northeast corner of the Shenandoah National Park in Virginia was included in the Class I PSD increment assessment. Based on the spatial limitations of the AERMOD model, a PSD Class I increment analysis was conservatively performed at a distance of 50 km from the centroid of the OCS area.

The results of the modeling provided in Table 5-5 indicate that the maximum impacts are less than the PSD Class I SILs for all pollutants and averaging periods using conservative first Tier Class I PSD increment modeling methodology. As shown in Table 5-8, the maximum modeled impacts are lower than the PSD Class I increments for all pollutants and averaging periods. The first tier assessment demonstrates that the Project is in compliance with the PSD Class I increments. Thus, additional PSD Class I increment modeling is not necessary using second tier methodology and/or offsite PSD increment consuming sources.

5.10 Additional Impact Analyses

In addition to assessing impacts on the NAAQS and PSD increments, facilities subject to PSD review must assess the potential impact for the area as a result of growth, and the potential impacts to soils, vegetation, and visibility in the area surrounding the proposed facility.

5.10.1 Assessment of Impacts Due to Growth

Elements of the growth analysis include: 1) a projection of the associated industrial, commercial, and residential growth that would occur due to the construction and operation of the source, and 2) an estimate of the air emissions generated by the associated growth. As discussed below, for PSD air permit application purposes, the Project is anticipated to cause limited associated growth. Project-related activities and infrastructure that could potentially result in direct or indirect impacts to population, economy, and employment resources were discussed in Section Volume II of the Project's Construction and Operations Plan (COP). The analysis found that the Project will support an estimated 18,717 job-years during the construction and commissioning phase and an estimated additional 3,702 job-years in the operations and maintenance phase.

The Project presents an opportunity for the region, and Maryland in particular, to benefit from the economic activity related to the creation of a new industry. US Wind is focused on building out a local supply chain to benefit the Project and the broader US offshore wind industry. US Wind believes that a diverse, well-compensated, and well-trained workforce delivers a higher-quality product and service, which is why US Wind is committed to creating full and equitable business opportunities for minority, women-owned, veteran-owned, and HUBZone businesses in the development of the Project.

Population impacts to the communities could result from the short-term influx of construction personnel. The total population change would equal the total number of non-local construction workers plus any family members that may accompany them. Based on populations within the study area, the temporary addition of the non-local workforce for the duration of construction would not result in a sizeable population change. The temporary increase in population would be distributed throughout the study area and would have no permanent impact on the population. Additionally, given the population in the study area, the number of workers needed for operation of the US Wind onshore and offshore facilities would not result in a sizeable population change.

Due to the number of new individuals expected to move into the area to support the Project and the significant level of existing commercial activity in the area, new commercial construction is not foreseen to be needed to support the Project's work force.

For reasons described above, no significant emissions from secondary growth are anticipated to occur during either the construction and commissioning phase or the operations and maintenance phase. Therefore, the air quality impacts of the modest residential, commercial, or industrial growth associated with the Project will be insignificant.

Finally, the use of wind to generate electricity results in a net reduction of regional air pollution over the life of the Project through displacement of electricity generated by power plants fueled with fossil fuels. Because the air emissions from the proposed facility will not result in excessive PSD increment consumption, increment is available for new industry desiring to locate in the area. Therefore, the proposed facility should have no effect on future industrial, commercial, or residential growth in the region.

5.10.2 Assessment of Impacts on Soils and Vegetation

A component of the PSD review includes an analysis to determine the potential air quality impacts on sensitive vegetation types that may be present in the vicinity of the proposed Project. The evaluation of potential impacts on vegetation was conducted in accordance with "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals" (USEPA, 1980). This assessment compares the maximum-modeled Project impacts plus background to pollutant-specific concentration levels. These pollutant-specific concentration levels are minimum pollutant concentration levels at which damage to the natural vegetation and predominant crops could occur. Therefore, if the maximum-modeled concentrations are less than the pollutant-specific concentration levels, then no damage to vegetation will be anticipated.

Screening concentrations used in this assessment represent the minimum ambient concentrations reported in the scientific literature for which adverse effects (e.g., visible damage or growth retardation) to plants have been reported. Of the pollutants emitted by the proposed facility that triggered PSD review, vegetative screening concentrations are available for CO and NO_2. Screening concentrations for particulate matter are not currently available. Most of the designated vegetation screening levels are equivalent to or exceed NAAQS and/or PSD increments, so that satisfaction of NAAQS and PSD increments assures compliance with sensitive vegetation screening levels.

Table 5-9 presents a comparison of maximum modeled concentrations from the Project (including ambient background levels) for the two constituent pollutants of concern (i.e., NO_2 and CO) with their respective vegetation screening concentrations. This table demonstrates that modeled concentrations are well below levels at which even sensitive vegetation would be affected.

The Project is located on open water, miles from the nearest land (and therefore the nearest vegetation). Therefore, the nearest vegetation with any commercial or recreational value is miles away, and there is no reasonable opportunity for emissions from the Project to have any impact on soils or vegetation. Further, the over-water modeling results show that vegetative screening thresholds shown in Table 5-9 could not be exceeded, even over water. Therefore, air emissions from the Projects will not negatively impact soils or vegetation.

5.10.3 Impact on Visibility

An assessment of the Project's potential impact on visibility from its emissions within the nearest surrounding area (i.e., Ocean City, MD) was performed using the USEPA VISCREEN model (version 13190). In order to assess the potential impact on regional visibility, the conservative Level–1 screening analysis using the VISCREEN model was conducted. The screening procedure involves calculation of three plume contrast coefficients using emissions of NO_2, PM/PM10, and sulfates (H_2SO_4). The Level-1 screening procedure determines the light scattering impacts of particulates, including sulfates and nitrates, with a mean diameter of two micrometers with a standard deviation of two micrometers. It was conducted assuming that all emitted particulate would be as PM10, which results in a conservative assessment of visibility impact. These coefficients consider plume/sky contrast, plume/terrain contrast, and sky/terrain contrast. The modeling was based on a 25 km visual background range indicated on Figure 9 – Regional Background Values, in the visibility assessment procedure described in the "Workbook for Plume Visual Impact Screening and Analysis" (USEPA, 1988).

A Level-1 screening analysis was performed for the maximum potential to emit emissions from either the construction and commissioning or O&M periods. The visibility assessment was performed for an observer at the scenic vista distance of 27 kilometers from the Project. A stable or "F" stability and the wind speed 1.0 meters per second were used. The results of the analysis are presented in Table 5-10, which indicate that Project will not impact visibility in the coastal communities in proximity to the Project.

5.10.4 Shoreline Fumigation

Coastal (i.e., shoreline) fumigation is a dispersion process during which a plume, released offshore in a stable or near stable layer, intersects with the unstable thermal internal boundary layer (TIBL) formed over land, is drawn into the TIBL towards the ground, and leads to higher ground level concentrations than in if the TIBL were not present. The TIBL is a convective boundary layer which forms over the land when the air temperature overland is warmer than the water surface temperature. The air circulation below the TIBL is unstable due to convective heating. As a plume enters the unstable circulation within the TIBL, fumigation occurs resulting in concentrations higher than otherwise would occur at the same location without the presence of shoreline fumigation conditions.

Over water, a low-level stable air mass (inversion) can form when the water surface is colder than the air above it. With an onshore flow, this stable air mass may be heated from below once it crosses the coastline. This heating happens most often during the daytime, particularly on sunny days when the denser, cooler from the over the water displaces the lighter, warmer air over land. Differences between the physical properties of land and water can lead to the development of an internal boundary layer formed below the higher atmospheric boundary layer near the shoreline. Above the TIBL the air mass is generally stable, whereas below the TIBL the air is unstable. Shoreline fumigation results when a plume is first emitted into the stable layer and transported with relatively little diffusion until the plume TIBL. Figure 5-3 provides a theoretical drawing of shoreline fumigation.

Coastal fumigation in the USEPA preferred model, OCD, is calculated by Turner (1970) using a complete vertical mixing assumption. Complete vertical mixing through the TIBL occurs as soon as the plume intercepts the TIBL. Note that both AERSCREEN (i.e., the screening version of AERMOD) and OCD calculates fumigation impacts based on the Turner (1970) procedures.

In order to trigger coastline fumigation in OCD, it is necessary to estimate the overwater stability class following a classification scheme similar to the Pasquill-Gifford-Turner stability (PG stability) in USEPA models. The Monin-Obukhov lengths (L) are used to estimate stability class. As discussed in the OCD Users Guide, the following Monin Obukhov lengths correspond to each PG stability classification:

- Stability Class B: $-10 \leq L < 0$ meters
- Stability Class C: $-25 \leq L < -10$ meters
- Stability Class D: $|L| > 25$ meters
- Stability Class E: $10 < L \leq 25$ meters
- Stability Class F: $0 < L \leq 10$ meters

Based on the OCD model formulation, fumigation will occur if the following conditions are met (assuming that flow is onshore):

- overwater stability class is E or greater; and
- overland stability class is A, B, or C.

Shoreline fumigation calculations in AERSCREEN and OCD are based on the calculations for inversion break-up fumigation described by Turner (1970). The model formula for calculating ground level air concentrations due to shoreline fumigation is calculated from:

$$X_f = Q \Big/ \left[(2\pi)^{0.5} u \left(\sigma_{ye} + {h_e}/{8}\right)(h_e + 2\sigma_{ze})\right]$$

Where: X_f = Concentration (g/m^3)
Q = emission rate (g/s)
μ = stack top wind speed (2.5 m/s)
he = effective stack height
σ_z = vertical dispersion parameter incorporating buoyancy induced dispersion (m)
σ_y = horizontal dispersion parameter incorporating buoyancy induced dispersion (m)

If the meteorological conditions are met based on stability classification, then an approximation of the ground level concentrations due to shoreline fumigation can be calculated with the equation above.

In order to consider the impact of coastal (i.e., shoreline) fumigation, US Wind is providing an assessment of plume spread (i.e., σ_z and σ_y) using AERMOD debug options. The assessment evaluates impacts on an envelope of vessel sources to demonstrate that shoreline fumigation would not be of concern. US Wind utilized the AERMOD model debug options with the full set of AERCOARE meteorological data. This provides a conservative maximum estimate of potential shoreline fumigation as it assumes that all hours of the 3-year meteorological period would meet the shoreline fumigation stability and onshore flow criteria. US Wind conducted an assessment of the overwater stability using the AERCOARE meteorological data and determined that only 1.2% of the hours have stability classifications of E or F with onshore flow, where there is the potential for shoreline fumigation to occur if the overland stability class is A, B, or C. Thus, assuming that all modeled hours have potential for shoreline fumigation provides a very conservative estimate of the maximum ground level concentrations due to shoreline fumigation.

US wind prepared a fumigation assessment for an envelope of representative vessel operations because the Project will be constructed by numerous vessels with varying engine emissions and stack parameters. As such, US Wind selected frequently occurring small and large vessels used during the construction and operational phase. US Wind utilized the AERMOD debug options to obtain the horizontal and vertical dispersion parameters for each hour of the meteorological dataset. The horizontal and vertical dispersion coefficients are utilized with a normalized emission rate of 1.0 g/s to determine a normalized maximum concentration for each vessel due to shoreline fumigation. Note that the actual vessel stack heights were incorporated as the effective stack height to calculate fumigation concentrations. This is a conservative assumption as it assumes that there is nonexistent momentum and buoyancy plume rise at the plume exhaust point, which results in maximum ground level concentrations from shoreline fumigation.

US Wind prepared the modeling analyses at distances to the shoreline of 26.5 km and 500 meters for comparison purposes. The results of the fumigation calculations are provided in Table

5-11. The results indicate that the potential impacts from shoreline fumigation are nearly two orders of magnitude lower at the actual Project distance to shoreline when compared to a theoretical distance of 500 meters, where shoreline fumigation would lead to higher impacts than would otherwise occur. US Wind also compared the maximum normalized shoreline fumigation results to the maximum normalized results using the full receptor grid and assuming no shoreline fumigation. For all representative vessels, the maximum modeled concentrations are higher in the local area around the sources when compared to the maximum shoreline fumigation results.

Thus, with the Project's location well offshore and outside of the distance where shoreline fumigation is a concern, US Wind has determined that shoreline fumigation is not a concern for this Project and that the maximum modeled concentrations are well offshore and nearby to the WTGs, export cables, and OSSs.

5.11 Modeling Data Files

All modeling data files for the modeling analyses to determine the maximum ambient ground-level concentrations from the proposed facility are available upon request.

Table 5-1: Maximum Measured Ambient Air Quality Concentrations

Pollutant	Averaging Period	2019	2020	2021	Background	Location	NAAQS
		Concentration (µg/m³ unless noted)					
CO (ppm)	1-Hour	1.2	1.8	1.4	**1.8**	Wilmington	35
	8-Hour	1	1.3	0.9	**1.3**	Wilmington	9
NO_2	1-Hour	35	32	34	**33.67**	Millville	188
	Annual	6.31	6.33	6.3	**6.33**	Millville	100
PM10	24-Hour	20	20	44	**44.0**	Hampton	150
PM2.5	24-Hour	19	16	19	**18.00**	Millville	35
	Annual	7.8	8.3	7	**7.70**	Millville	12
SO_2	1-Hour	1	2	1	**1.33**	Lewes	196
	24-Hour	0.4	0.4	0.3	**0.4**	Lewes	365
O_3 (ppb)	8-Hour	58	60	61	**59.67**	Lewes	80

Notes:

1. High second-high short term (1-, 8-, and 24-hour) and maximum annual average concentrations presented for all pollutants other than PM2.5 and 1-hour SO_2 and NO_2.
2. Bold values represent the proposed background values for use in any necessary NAAQS analyses.

Table 5-2. Summary of Secondary Air Quality Impacts

Pollutant	Averaging Period	Ozone Formation Transfer Coefficient (ppb/tpy)		PM2.5 Formation Transfer Coefficient (ug/m^3/tpy)				Maximum Secondary Impact[1] (ppb – ozone, ug/m3 – PM2.5)
		NO_X	VOC	SO_2	NO_X	NH_3	PM2.5	
Ozone	8-hour	2.58 E-04	8.91E-04	NA	NA	NA	NA	1.69E-01
PM2.5	24-hour	NA	NA	3.19E-05	2.65E-05	6.06E-03	8.37E-04	3.26E-02
	Annual	NA	NA	3.05E-06	3.69E-06	1.86E-03	9.49E-05	4.12E-03

[1] Based on maximum potential to emit during construction period.

Table 5-3. Summary of Refined Modeling Procedures

Pollutant and Averaging Period	Regulatory Modeling Demonstration	Refined Modeling Procedures
1-hour NO_2	NAAQS	• Transit emissions were modeled as a series of point sources. • Includes only vessels and engines that would be expected to operate together over an hourly or daily basis[1]. • For 1-hour NO_2 modeling, the construction and O&M scenario vessels were modeled with both vessel operational modes and the maximum impact from either vessel operational scenario (i.e., transiting or maneuvering) was then selected as the worst-case emissions scenario.
24-Hour PM2.5	NAAQS, PSD Class I and II Increment	
24-Hour PM10	NAAQS, PSD Class I and II Increment	
Annual NO_2	PSD Class I Increment	• For Class I increment modeling for the 50 km receptors representative of the downwind locations to the Brigantine NWR, the vessel sources were modeled as an arc of sources at 50 km from the center of the 26 Brigantine NWR receptors. The sources were evenly spaced with 1 kilometer separation. This refined methodology is conservative for the annual NO_2 modeling as it locates all of the annual vessel emissions within 50 km of the Class I receptors. The entire construction operation covers hundreds of positions over 10,000s of acres, and will take more than 3 years year to complete. The vessel emissions will be dispersed throughout the WDA. Thus, the initial assumption that all of the annual emissions are located at a single point is overly conservative, and the assumption that annual emissions are spread throughout the WDA at a 50 km distance from the Class I receptors is a refined methodology. This refined methodology remains as a very conservative first tier Class I PSD increment assessment.

Notes: [1] Refer to Appendix A for details of vessel operational assumptions.

Table 5-4: Maximum Modeled Concentrations for Project Construction and O&M Scenarios for Comparison to PSD Class II SILs

Pollutant	Averaging Period	Recommended Significant Impact Levels for NAAQS Analyses	Scenario	Maximum Modeled SIL Concentration	Exceed SIL?
CO	1-Hour	2,000	Foundation Installation	490.3	NO
			WTG Installation	206.8	NO
			WTG Commissioning	142.7	NO
			OSS Installation	345.0	NO
			Interarray Cable Installation	158.2	NO
			Export Cable Installation	124.5	NO
			O&M	668.0	NO
	8-Hour	500	Foundation Installation	275.1	NO
			WTG Installation	115.6	NO
			WTG Commissioning	72.1	NO
			OSS Installation	165.6	NO
			Interarray Cable Installation	75.2	NO
			Export Cable Installation	52.8	NO
			O&M	289.2	NO
NO_2	1-Hour	7.52	Foundation Installation	179.0	YES
			WTG Installation	85.8	YES
			WTG Commissioning	97.1	YES
			OSS Installation	169.9	YES
			Interarray Cable Installation	107.3	YES
			Export Cable Installation	87.8	YES
			O&M	205.9	YES
	Annual	1	Annual Construction and O&M	6.0	YES
PM2.5	24-Hour	1.2	Foundation Installation	6.4	YES
			WTG Installation	7.2	YES
			WTG Commissioning	3.5	YES
			OSS Installation	7.1	YES
			Interarray Cable Installation	4.7	YES
			Export Cable Installation	3.7	YES
			O&M	5.0	YES
	Annual	0.2	Annual Construction and O&M	0.5	YES

Pollutant	Averaging Period	Recommended Significant Impact Levels for NAAQS Analyses	Scenario	Maximum Modeled SIL Concentration	Exceed SIL?
PM10	24-Hour	5	Foundation Installation	8.7	YES
			WTG Installation	9.6	YES
			WTG Commissioning	4.9	NO
			OSS Installation	9.2	YES
			Interarray Cable Installation	6.5	YES
			Export Cable Installation	4.6	NO
			O&M	7.1	YES
	Annual	1	Annual Construction and O&M	0.5	NO
SO_2	1-Hour	7.82	Foundation Installation	4.6	NO
			WTG Installation	2.9	NO
			WTG Commissioning	0.4	NO
			OSS Installation	3.3	NO
			Interarray Cable Installation	2.6	NO
			Export Cable Installation	3.3	NO
			O&M	3.4	NO
	3-Hour	25	Foundation Installation	2.5	NO
			WTG Installation	1.6	NO
			WTG Commissioning	0.2	NO
			OSS Installation	1.8	NO
			Interarray Cable Installation	1.5	NO
			Export Cable Installation	2.0	NO
			O&M	1.8	NO
	24-Hour	5	Foundation Installation	1.5	NO
			WTG Installation	1.4	NO
			WTG Commissioning	0.1	NO
			OSS Installation	0.6	NO
			Interarray Cable Installation	0.6	NO
			Export Cable Installation	0.8	NO
			O&M	1.2	NO
	Annual	1	Annual Construction and O&M	0.03	NO

Note: All concentration in units of ug/m^3.

Table 5-5: Maximum Modeled Concentrations for Project Construction and O&M Scenarios for Comparison to PSD Class I SILs

Pollutant	Averaging Period	Significant Impact Levels for Increment Analyses	Scenario	Maximum Modeled SIL Concentration	Exceed SIL?
NO_2	Annual	0.1	Annual Construction and O&M	0.09	NO
PM2.5	24-Hour	0.27	Foundation Installation	0.16	NO
			WTG Installation	0.11	NO
			WTG Commissioning	0.05	NO
			OSS Installation	0.20	NO
			Interarray Cable Installation	0.18	NO
			Export Cable Installation	0.19	NO
			O&M	0.14	NO
	Annual	0.05	Annual Construction and O&M	0.008	NO
PM10	24-Hour	0.3	Foundation Installation	0.14	NO
			WTG Installation	0.08	NO
			WTG Commissioning	0.02	NO
			OSS Installation	0.17	NO
			Interarray Cable Installation	0.15	NO
			Export Cable Installation	0.16	NO
			O&M	0.11	NO
	Annual	0.2	Annual Construction and O&M	0.004	NO
SO_2	3-Hour	1	Foundation Installation	0.20	NO
			WTG Installation	0.08	NO
			WTG Commissioning	0.01	NO
			OSS Installation	0.10	NO
			Interarray Cable Installation	0.12	NO
			Export Cable Installation	0.16	NO
			O&M	0.11	NO
	24-Hour	0.2	Foundation Installation	0.03	NO
			WTG Installation	0.01	NO
			WTG Commissioning	0.0004	NO
			OSS Installation	0.01	NO
			Interarray Cable Installation	0.02	NO
			Export Cable Installation	0.03	NO
			O&M	0.02	NO
	Annual	0.1	Annual Construction and O&M	0.0004	NO

Note: All concentration in units of ug/m^3.

Table 5-6: Maximum Modeled Concentrations for Project Construction and O&M Scenarios for Comparison to NAAQS

Pollutant	Averaging Period	Scenario	NAAQS	Background	Maximum Modeled NAAQS Concentration	Total NAAQS Concentration with Background
CO	1-Hour	Foundation Installation	40,000	2,070	490.3	2,560.3
		WTG Installation			206.8	2,276.8
		WTG Commissioning			142.7	2,212.7
		OSS Installation			345.0	2,415.0
		Interarray Cable Installation			158.2	2,228.2
		Export Cable Installation			124.5	2,194.5
		O&M			668.0	2,738.0
	8-Hour	Foundation Installation	10,000	1,495	275.1	1,770.1
		WTG Installation			115.6	1,610.6
		WTG Commissioning			72.1	1,567.1
		OSS Installation			165.6	1,660.6
		Interarray Cable Installation			75.2	1,570.2
		Export Cable Installation			52.8	1,547.8
		O&M			289.2	1,784.2
NO_2	1-Hour	Foundation Installation	188	Variable by Season and Hour of Day	106.9	145.0
		WTG Installation			50.8	92.3
		WTG Commissioning			64.6	84.3
		OSS Installation			88.2	126.3
		Interarray Cable Installation			70.3	113.1
		Export Cable Installation			37.0	85.7
		O&M			142.3	172.3
	Annual	Annual Construction and O&M	100	12	6.0	17.9
PM2.5	24-Hour	Foundation Installation	35	18	3.6	21.6
		WTG Installation			4.0	22.0
		WTG Commissioning			1.8	19.8
		OSS Installation			4.7	22.7
		Interarray Cable Installation			2.6	20.6
		Export Cable Installation			2.0	20.0
		O&M			2.9	20.9
	Annual	Annual Construction and O&M	12	8	0.5	8.2

Pollutant	Averaging Period	Scenario	NAAQS	Background	Maximum Modeled NAAQS Concentration	Total NAAQS Concentration with Background
PM10	24-Hour	Foundation Installation	150	44	8.7	52.7
		WTG Installation			9.6	53.6
		WTG Commissioning			4.9	48.9
		OSS Installation			9.2	53.2
		Interarray Cable Installation			6.5	50.5
		Export Cable Installation			4.6	48.6
		O&M			7.1	51.1
	Annual	Annual Construction and O&M	NA	NA	0.5	NA
SO_2	1-Hour	Foundation Installation	196	3	4.3	7.8
		WTG Installation			2.8	6.3
		WTG Commissioning			0.3	3.8
		OSS Installation			3.1	6.6
		Interarray Cable Installation			2.2	5.7
		Export Cable Installation			2.0	5.5
		O&M			3.0	6.5
	3-Hour	Foundation Installation	1,300	3	2.5	6.0
		WTG Installation			1.6	5.1
		WTG Commissioning			0.2	3.7
		OSS Installation			1.8	5.3
		Interarray Cable Installation			1.5	5.0
		Export Cable Installation			2.0	5.5
		O&M			1.8	5.3
	24-Hour	Foundation Installation	365	1	1.5	2.5
		WTG Installation			1.4	2.5
		WTG Commissioning			0.1	1.1
		OSS Installation			0.6	1.7
		Interarray Cable Installation			0.6	1.6
		Export Cable Installation			0.8	1.8
		O&M			1.2	2.3
	Annual	Annual Construction and O&M	80	1	0.03	1.1

Note: All concentration in units of ug/m^3.

Table 5-7: Maximum Modeled Concentrations for Project Construction and O&M Scenarios for Comparison to PSD Class II Increments

Pollutant	Averaging Period	Scenario	Class II Increment	Maximum Modeled Increment Concentration	Exceed Increment?
NO_2	Annual	Annual Construction and O&M	25	6.0	NO
PM2.5	24-Hour	Foundation Installation	9	6.2	NO
		WTG Installation		6.9	NO
		WTG Commissioning		3.4	NO
		OSS Installation		8.2	NO
		Interarray Cable Installation		4.6	NO
		Export Cable Installation		4.0	NO
		O&M		5.6	NO
	Annual	Annual Construction and O&M	4	0.5	NO
PM10	24-Hour	Foundation Installation	30	6.4	NO
		WTG Installation		7.1	NO
		WTG Commissioning		3.5	NO
		OSS Installation		8.4	NO
		Interarray Cable Installation		4.8	NO
		Export Cable Installation		4.0	NO
		O&M		5.7	NO
	Annual	Annual Construction and O&M	17	0.5	NO
SO_2	3-Hour	Foundation Installation	512	2.5	NO
		WTG Installation		1.6	NO
		WTG Commissioning		0.2	NO
		OSS Installation		1.4	NO
		Interarray Cable Installation		1.2	NO
		Export Cable Installation		1.6	NO
		O&M		1.6	NO
	24-Hour	Foundation Installation	91	1.0	NO
		WTG Installation		1.0	NO
		WTG Commissioning		0.1	NO
		OSS Installation		0.5	NO
		Interarray Cable Installation		0.5	NO
		Export Cable Installation		0.7	NO
		O&M		0.9	NO
	Annual	Annual Construction and O&M	20	0.03	NO

Note: All concentration in units of ug/m^3.

Table 5-8: Maximum Modeled Concentrations for Project Construction and O&M Scenarios for Comparison to PSD Class I Increments

Pollutant	Averaging Period	Scenario	Class I Increment	Maximum Modeled Increment Concentration	Exceed Increment
NO_2	Annual	Annual Construction and O&M	2.5	0.09	NO
PM2.5	24-Hour	Foundation Installation	2	0.13	NO
		WTG Installation		0.09	NO
		WTG Commissioning		0.05	NO
		OSS Installation		0.15	NO
		Interarray Cable Installation		0.15	NO
		Export Cable Installation		0.15	NO
		O&M		0.11	NO
	Annual	Annual Construction and O&M	1	0.008	NO
PM10	24-Hour	Foundation Installation	8	0.10	NO
		WTG Installation		0.06	NO
		WTG Commissioning		0.01	NO
		OSS Installation		0.13	NO
		Interarray Cable Installation		0.12	NO
		Export Cable Installation		0.12	NO
		O&M		0.08	NO
	Annual	Annual Construction and O&M	4	0.004	NO
SO_2	3-Hour	Foundation Installation	25	0.17	NO
		WTG Installation		0.05	NO
		WTG Commissioning		0.003	NO
		OSS Installation		0.08	NO
		Interarray Cable Installation		0.11	NO
		Export Cable Installation		0.14	NO
		O&M		0.09	NO
	24-Hour	Foundation Installation	5	0.02	NO
		WTG Installation		0.01	NO
		WTG Commissioning		0.0003	NO
		OSS Installation		0.01	NO
		Interarray Cable Installation		0.02	NO
		Export Cable Installation		0.02	NO
		O&M		0.01	NO
	Annual	Annual Construction and O&M	2	0.0004	NO

Note: All concentration in units of ug/m^3.

Table 5-9: Total Facility Comparison of Maximum Modeled Concentrations of Pollutants to Vegetation Screening Concentrations

Pollutant	**Averaging Period**	**Maximum Modeled Concentration (µg/m³)**	**Background Concentration (µg/m³)**	**Total Concentration[a] (µg/m³)**	**Vegetation Screening Concentrations[f] (µg/m³)**		
					Sensitive	**Intermediate**	**Resistant**
NO_2	4-Hour 8-Hour Annual	205.9[b,g] 205.9[b,g] 6.0[g]	63.3[c] 63.3[c] 11.9	269.2 269.2 17.9	3,760 3,760 -	9,400 7,520 94	16,920 15,040 -
CO	1-Week	289.2[e]	1,495[d]	1,784.2	1,800,000	-	18,000,000

[a] Total concentration = maximum modeled facility concentration + background concentration.
[b] Maximum modeled concentration conservatively based on 1-hour averaging period.
[c] Maximum background concentration conservatively based on 1-hour averaging period.
[d] Maximum background concentration conservatively based on 8-hour averaging period.
[e] Maximum modeled concentration conservatively based on 8-hour averaging period.
[f] Screening concentrations found in Table 3.1 of “A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals” (EPA, 1980).
gIncludes use of PVMRM.
(-) No screening concentration available.

Table 5-10: VISCREEN Analysis Results

Background	Theta (degrees)	Azimuth (degrees)	Distance (km)	Alpha (degrees)	Delta E[a]		Contrast[b]	
					Criteria	Plume	Criteria	Plume
Inside Surrounding Area								
Sky	10	84	27	84	2	1.719	0.05	-0.005
Sky	140	84	27	84	2	0.564	0.05	-0.007
Terrain	10	84	27	84	2	0.358	0.05	0.003
Terrain	140	84	27	84	2	0.120	0.05	0.002
Outside Surrounding Area								
Sky	10	65	25.2	104	2	1.746	0.05	-0.005
Sky	140	65	25.2	104	2	0.572	0.05	-0.007
Terrain	10	50	23.6	119	2	0.445	0.05	0.003
Terrain	140	50	23.6	119	2	0.149	0.05	0.003

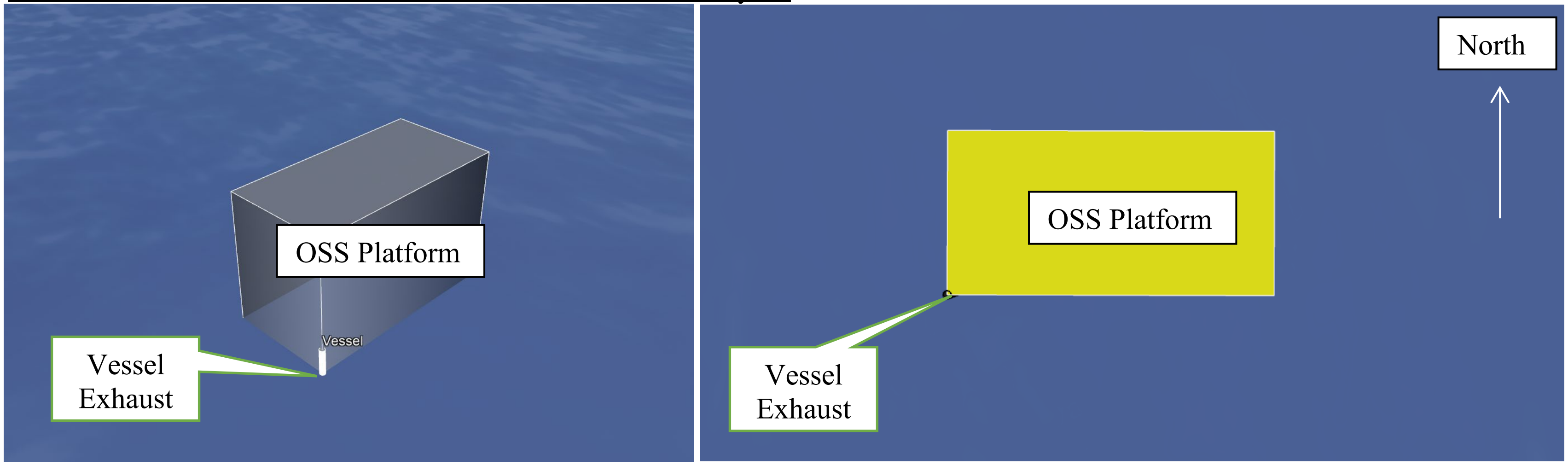
[a] Color difference parameter (dimensionless).
[b] Visual contrast against background parameter (dimensionless).

Table 5-11. Summary of Maximum Modeled 1-hour Shoreline Fumigation Impacts

Vessel	Engine Type	Shoreline Fumigation - Maximum Modeled Normalized Concentration (ug/m^3 per g/s emitted)		No Shoreline Fumigation - Maximum Modeled Normalized Concentration (ug/m^3 per g/s emitted)
		Receptor located at Shoreline	Receptor located 500 meters from Source	
Heavy Lift Vessel	Main	4.9	149.8	11.1
Transport Tug	Main	7.9	523.9	80.4
Operations CTV	Main	7.3	745.0	9.9
Trenching Vessel	Auxiliary	4.1	114.7	176.0

Figure 5-1: Modeled Building Downwash Analysis Source Layout and OSS Platform Drawing

Modeled Platform Vessel Exhaust Stack and OSS Platform Layout

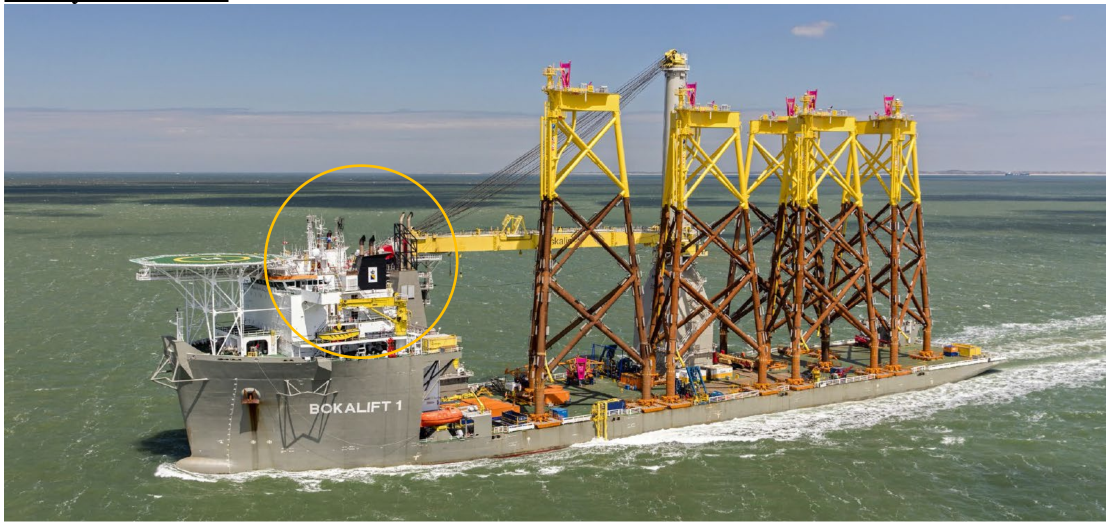


Conceptual OSS atop a monopile foundation

Figure 5-2: Vessel Exhaust Orientations

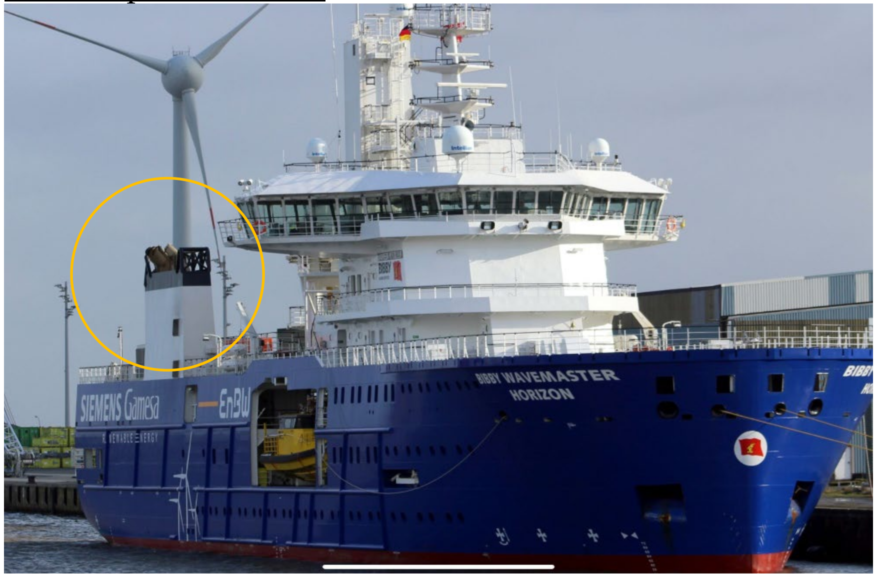
Foundation Installation Vessel

Heavy Lift Vessel



Jack-Up Vessel

Service Operation Vessel

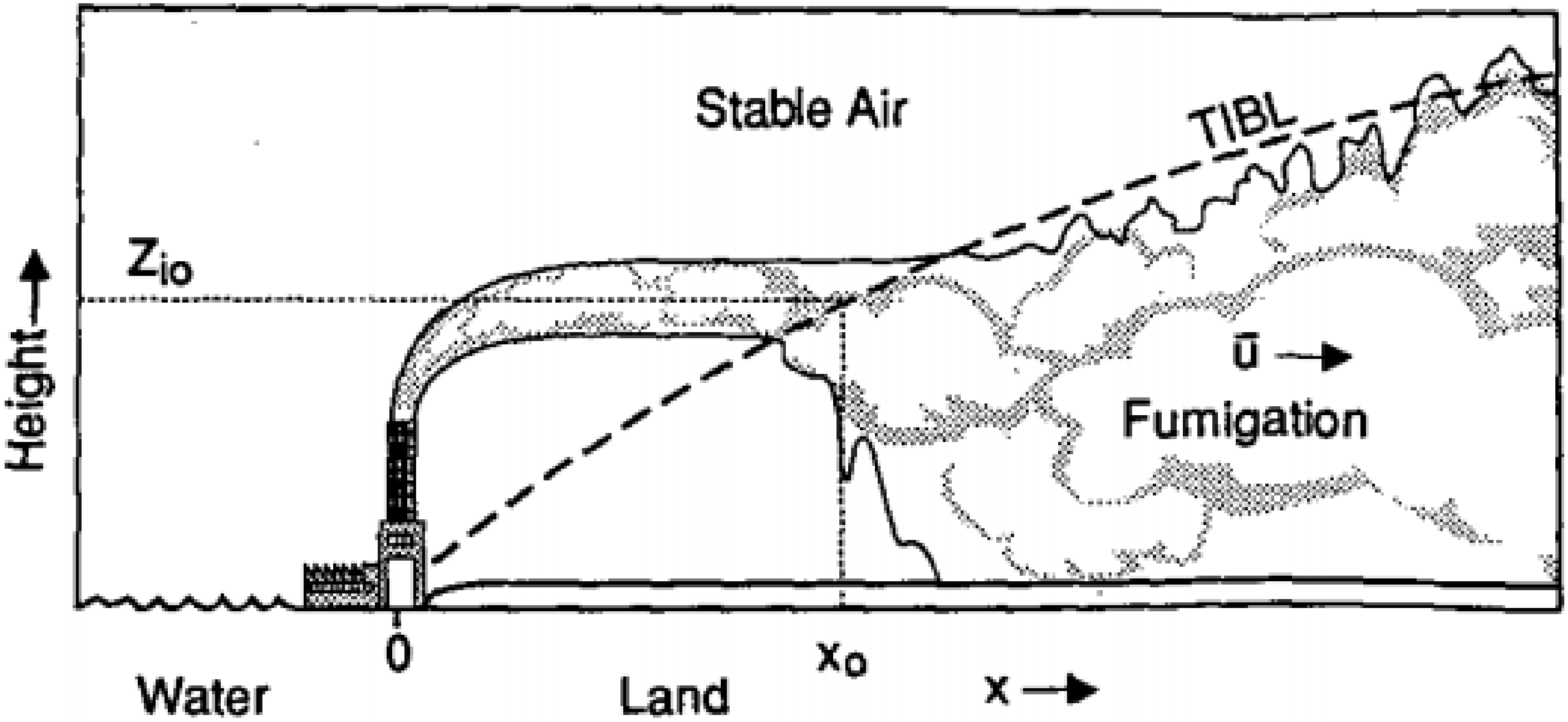


Anchor Handling Tug

Cable Lay Vessel

Note: Stacks shown by yellow highlight

Figure 5-3: Coastal Fumigation



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Appendix A

Detailed Emission Calculations and Modeling Parameters