GUIDANCE AND PROCEDURE FOR PERFORMING AIR QUALITY IMPACT MODELING IN NEW HAMPSHIRE

Prepared by the
New Hampshire Department of Environmental Services
Air Resources Division
29 Hazen Drive
Concord, NH 03302-0095

December 2019

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I.   Introduction and Model Selection

For certain new or modified air pollutant emission sources requiring an air permit under the New Hampshire Code of Administrative Rules Governing the Control of Air Pollution Chapter [Env-A 600 Statewide Permit System](), a demonstration must be made that the impact from their emissions meets applicable ambient air quality standards. This demonstration is most often made using an air quality dispersion modeling analysis. Env-A 606 **Air Pollution Dispersion Modeling Impact Analysis** details the requirements for when an air quality dispersion modeling analysis is required for stationary sources. A modeling analysis may also be used to show compliance with the Ambient Air Limits (AALs) established in Chapter [Env-A 1400 Regulated Toxic Air Pollutants]() (RTAPs). Both sections of the Rules should be consulted to determine whether modeling is necessary for a particular source. A copy of the Rules is available on the New Hampshire Department of Environmental Services (NHDES) website. Please note that NHDES provides copies of the rules on its website for the convenience of interested persons. Official texts of all New Hampshire state agency certified administrative rules are maintained by the [Office of Legislative Services, Administrative Rules Office]().

This document was developed by NHDES to assist permit applicants, consultants, and other parties who are involved in stationary source permitting and air quality analysis. It outlines the accepted procedures for performing such analyses in New Hampshire and conforms with EPA modeling guidance as contained in 40 CFR 51, Appendix W [Guideline on Air Quality Models](), January 17, 2017.

Appendix W recommends AERMOD as the primary air pollution dispersion modeling tool for predicting air quality impacts for permitting purposes. The model and its associated processors are frequently updated, so applicants should regularly check EPA's [Support Center for Regulatory Atmospheric Modeling]() (SCRAM) website for the most recent versions and information. The most recent version of AERMOD (or any other model or processor) must be used for modeling in New Hampshire (with exceptions for grace periods, if applicable). For all modeling applications in New Hampshire, AERMOD should be run in regulatory default mode and with the rural dispersion option. Although NHDES encourages the use of AERMOD, the screening version of the model, known as AERSCREEN, may also be used.

The use of models other than AERMOD and AERSCREEN must be approved by NHDES. Appendix W should be used to select any additional models needed to address visibility, mobile source impacts, reactive plumes, long-range transport, and other such issues. Use of additional models for these purposes must be approved in advance by NHDES. The use of "Alternative" models, that is, models not listed as "recommended" by Appendix W (See Appendix A to Appendix W for a listing of recommended models) must be approved by EPA Region 1 in consultation with the EPA Model Clearinghouse. NHDES will help facilitate this process, should it be necessary.

This document assumes that the reader has a basic understanding of air quality dispersion modeling, the air permitting process, and air quality criteria. Any questions or issues regarding model applicability, proper model inputs, or interpretation of results should be discussed with NHDES staff prior to performing any modeling.

II.   Air Quality Criteria

The following sections outline the National Ambient Air Quality Standards (NAAQS), federal Prevention of Significant Deterioration (PSD) Increments, and Significant Impact Levels (SILs). In addition, New Hampshire Ambient Air Limits (AALs) have been established for a set of Regulated Toxic Air Pollutants (RTAPs). An emission source cannot receive a permit from NHDES if it is predicted to cause or contribute to a violation of a federal or state air quality standard.

A.   National and New Hampshire Ambient Air Quality Standards

The NAAQS are shown in Table 1 below. New Hampshire has adopted the NAAQS in Chapter Env-A 300 Ambient Air Quality Standards. Currently, modeling for $PM_{2.5}$ is only required for PSD projects in New Hampshire. The criteria pollutant lead is also a New Hampshire RTAP and should be evaluated under Env-A 1400. Primary NAAQS are designed to protect human health with an adequate margin of safety, while secondary standards protect human welfare (by preventing damage to buildings, crops, and animals, for example). It should be noted that EPA is required to review, and if appropriate, revise the NAAQS every five years. NHDES will revise its rules and guidance as necessary.

Table 1 - National Ambient Air Quality Standards

Pollutant	Primary/Secondary	Ave. Time	NAAQS
Carbon Monoxide (CO)	Primary	1-hour	35 ppm (40,000 $\mu g/m^3$)
		8-hour	9 ppm (10,000 $\mu g/m^3$)
Lead	Primary and Secondary	Rolling 3-month	0.15 $\mu g/m^3$
Nitrogen Dioxide (NO_2)	Primary	1-hour	100 ppb (188 $\mu g/m^3$)
	Primary and Secondary	Annual	53 ppb (100 $\mu g/m^3$)
Ozone (O_3)	Primary and Secondary	8-hour	0.070 ppm
Particulate Matter less than 2.5 microns ($PM_{2.5}$)	Primary and Secondary	24-hour	35 $\mu g/m^3$
	Primary	Annual	12.0 $\mu g/m^3$
	Secondary	Annual	15.0 $\mu g/m^3$
Particulate Matter less than 10 microns (PM_{10})	Primary and Secondary	24-hour	150 $\mu g/m^3$
Sulfur Dioxide (SO_2)	Primary	1-hour	75 ppb (196 $\mu g/m^3$)
	Secondary	3-hour	0.5 ppm (1,300 $\mu g/m^3$)

Notes:
ppm = parts per million
ppb = parts per billion
$\mu g/m^3$ = micrograms per cubic meter

B.   PSD Increments

PSD applies to new major air pollutant emission sources or major modifications at existing sources for pollutants where the area in which the source is located is in attainment or unclassifiable with the NAAQS. PSD increments represent the maximum allowable increase in concentration (due to a new emission source or a modification to an existing source) over a baseline concentration. A baseline concentration is the ambient concentration at the time

when the first PSD application was submitted for the area in question, i.e., the baseline date.

NHDES evaluates impacts against the increments when a new emission source is being constructed, or when an existing source is making a modification. NHDES evaluates increment consumption for new and modified sources which meet modeling thresholds in New Hampshire, not just sources subject to PSD review. For non-PSD projects, increment consumption only needs to be evaluated for those pollutants and averaging periods that have a corresponding NAAQS. For PSD projects, however, the full set of increments, as specified in 40 CFR 52.21(c) and shown below in Table 2, would need to be evaluated. As an example, only the 3-hour SO_2 increment would need to be evaluated for a non-PSD project, but the 3-hour, 24-hour, and annual SO_2 increments would need to be evaluated for a PSD project.

Table 2 gives the PSD increments for Class II and Class I areas. Class I areas are defined as areas of special national or regional value from a natural, scenic, recreational, or historic perspective. New Hampshire's Class I areas are the Great Gulf Wilderness and the Presidential Range - Dry River Wilderness located in the White Mountain National Forest near Mt. Washington. The remainder of the state is classified as a Class II area. The Lye Brook Wilderness Area, located in the Green Mountains of Vermont, is a Class I area in fairly close proximity to New Hampshire.

Table 2 - Class II and Class I PSD Increments

Pollutant	Averaging Period	Class II Increment ($\mu g/m^3$)	Class I Increment ($\mu g/m^3$)
Sulfur Dioxide (SO_2)	3-hour	512	25
	24-hour	91	5
	Annual	20	2
Particulate Matter (PM_{10})	24-hour	30	8
	Annual	17	4
Particulate Matter ($PM_{2.5}$)	24-hour	9	2
	Annual	4	1
Nitrogen Dioxide (NO_2)	Annual	25	2.5

Note:
Increments have not yet been set for 1-hour SO_2 or 1-hour NO_2.

Table 3 provides the baseline dates for all applicable areas in the state.

Table 3 - Increment Baseline Dates

Pollutant	Baseline Dates		
	Seven Southern Counties	Grafton & Carroll Counties	Coos County
SO_2	May 14, 1986	April 22, 1988	December 16, 2009
PM_{10}	February 9, 1987	April 22, 1988	December 16, 2009
$PM_{2.5}$	-	-	December 16, 2009
NO_2	March 21, 1988	April 22, 1988	December 16, 2009

Notes:

For each county/pollutant combination, the baseline date was set by the first completed PSD application received by NHDES. The seven southern counties include Belknap, Cheshire, Hillsborough, Merrimack, Rockingham, Strafford and Sullivan. Increment tracking has not yet been triggered for $PM_{2.5}$ in counties other than Coos. $PM_{2.5}$ increment tracking will be triggered in these counties on the date that the first permit application is received for a project that is subject to PSD for $PM_{2.5}$.

C.   Significant Impact Levels (SILs)

SILs can be used to evaluate whether impacts due to a project's emissions are "significant," therefore requiring a detailed modeling analysis. This will be described in more detail later in this guidance. The SILs can also be used to determine if an emission source contributes significantly to a modeled violation of a NAAQS and whether additional criteria pollutant sources identified as nearby in accordance with 40 CFR 51 Appendix W (frequently referred to as "interactive sources"; this will be discussed further in Section III.B below) need to be included in the modeling analysis. The SILs should not be confused with PSD increments. Table 4 presents the Significant Impact Levels for Class II and Class I areas.

Table 4 - Significant Impact Levels

Pollutant	Averaging Period	Class II Area SIL ($\mu g/m^3$)	Class I Area SIL ($\mu g/m^3$)
Carbon Monoxide (CO)	1-hour	2,000	-
	8-hour	500	-
Sulfur Dioxide (SO_2)	1-hour	7.8*	-
	3-hour	25	1.0
	24-hour	5	0.2
	Annual	1	0.1
Particulate Matter (PM_{10})	24-hour	5	0.32
	Annual	1	0.16
Particulate Matter ($PM_{2.5}$)	24-hour	1.2	0.07
	Annual	0.2	0.06
Nitrogen Dioxide (NO_2)	1-hour	7.5*	-
	Annual	1	0.10

*Note: Interim 1-hour SO_2 and NO_2 SILs were established by EPA on August 23, 2010 (for SO_2) and June 29, 2010 (for NO_2).

Final 1-hour SO_2 and NO_2 SILs have not yet been promulgated, and the interim SILs have not been adopted into Env-A 606.

D.   New Hampshire Ambient Air Limits

In Env-A 1400, NHDES establishes AALs for RTAPs. The complete list of RTAPs and their associated AALs can be found in Table 1450-1 of Env-A 1400. It should be noted that lead, which is a criteria pollutant, is also a New Hampshire RTAP and should be evaluated against the AALs.

III.   Modeling Applicability

To determine modeling applicability for a proposed air pollutant emission source or modification, the applicant should first determine the estimated emissions for the proposed project and then use the modeling applicability criteria in Env-A 606.06 **Specific Sources, Devices, and Emissions Included in an Air Pollution Dispersion Modeling Analysis** to determine which devices and criteria pollutants must be included in the air dispersion modeling analysis. Note that if the project involves the construction of a new major PSD source or a major modification at an existing major PSD source, $PM_{2.5}$ and PM_{10} emissions should include **filterable** and **condensable** components. The NHDES permit engineer assigned to the application will assist the applicant in determining modeling applicability.

Modeled emission sources typically include: 1) the subject emission source, that is, a proposed brand new facility or an existing facility where a new device is proposed (a new boiler, for example) and 2) interactive emission sources. Interactive sources are nearby sources whose emissions may have a cumulative effect on air quality along with the subject source. Subject sources and interactive sources are described below. Please note that for conciseness, the following discussion assumes that all devices/pollutants need to be modeled per the modeling applicability criteria described earlier. In practice, each case will be project-specific and the determination of which devices/pollutants to include will be made in consultation between the applicant and NHDES.

A.   Subject Emission Source

For emission sources that emit criteria pollutants, when a new device is proposed for installation, it should be modeled along with all other existing **permitted** devices at the facility that emit criteria pollutants (except when evaluating a proposed new device's emissions against the SILs - this will be discussed later in this guidance). For example, if an existing facility proposes to install a new boiler, and this facility already has two boilers permitted by NHDES, then the impacts of all three boilers should be accounted for in the modeling analysis. Non-permitted devices, such as small boilers or hot water heaters, do not need to be included for criteria pollutants. Modeling for a source subject to Env-A 606.02(a)(4), that is, a stationary source with emissions of RTAPs that is using the air dispersion modeling compliance method, shall include emissions from each source or device at the stationary source which emits the same regulated toxic air pollutant for which the analysis is being performed.

B.   Interactive Emission Sources

For an analysis of criteria pollutants, NHDES may require the modeling of interactive emission

sources (i.e., permitted sources beyond the subject source's property) if significant impacts are predicted from the proposed new facility, device, or modification. The determination of which, if any, interactive sources to include in a modeling analysis will be made in consultation between the applicant and NHDES. This determination is primarily based on the significant impact area[1] of the proposed new facility, device, or increase in emissions and other factors such as the distance between the subject source and potential interactive sources, the source type and size, the concentration gradient in the vicinity of the subject source, the monitored background, and the likelihood of modeled violations of air quality standards. Model inputs for any required interactive sources (coordinates, emission rates, stack parameters, downwash inputs, etc.) will be provided to the applicant by NHDES.

IV.   Model Inputs

A.   Meteorological Data

NHDES has ready-to-use, pre-processed meteorological data files (in the form of AERMET .SFC and .PFL files) which are available upon request. There are eight sets of surface meteorological files which are representative of different areas of the state. Figure 1 shows the part of the state that each set of files applies to. The physical location of the subject source (i.e. the proposed new or modified source) determines which data set should be used. For example, if the subject source is located in Bow, then Concord meteorological data would be used (see Figure 1). Three of the met data sets - Whitefield, Manchester and Portsmouth - are used to represent the immediately surrounding towns; this is shown in blue in Figure 1. The use of any meteorological data set other than those provided by NHDES must be approved by NHDES in advance.

Profile base elevations for the met data sets are also needed in order to run AERMOD. Table 5 provides this data.
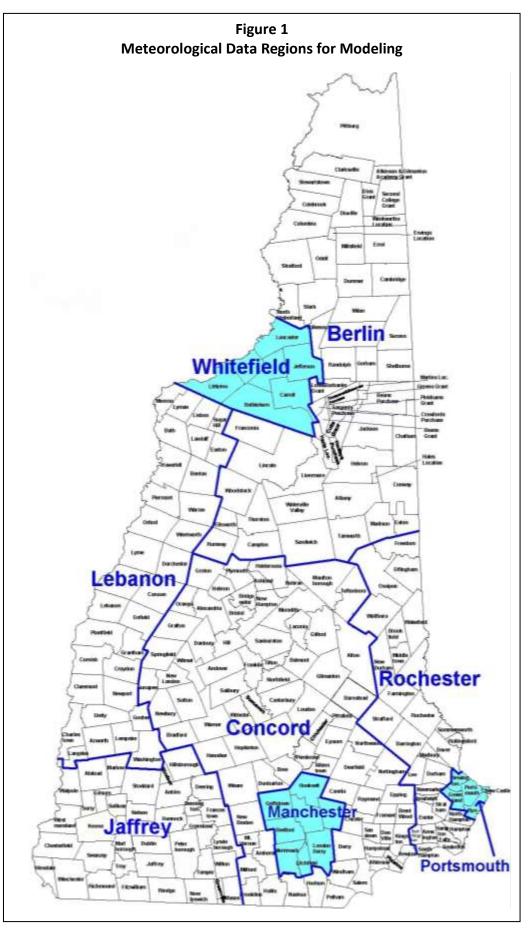
If source-specific on-site meteorological data is available, then this data may be used for modeling with advance approval by NHDES. If on-site met data are used, then all of the raw data (AERMET and AERSURFACE input files, etc.) must be provided for NHDES review and approval.

EPA also offers the Mesoscale Model Interface Program (MMIF), which can convert prognostic meteorological model output fields to a format that can be used for input to dispersion models such as AERMOD. However, because there are representative meteorological observations available for all of New Hampshire, it is expected that the use of MMIF for projects in New Hampshire would be extremely rare. NHDES should be contacted in advance of any modeling if the use of MMIF is proposed.

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[1] The significant impact area, or SIA, is generally defined by a circle around the emissions point whose radius is the distance between the emissions point and the furthest receptor at which a significant impact is predicted.

Table 5 - Meteorological Site Base Elevations

Site	Anemometer Base Elevation (ft)
Berlin	1,125
Concord	339
Jaffrey	1,006
Lebanon	566
Manchester	229
Portsmouth	109
Rochester	324
Whitefield	1,047

Figure 1
Meteorological Data Regions for Modeling

B.   Receptor Placement

Receptor grids should be designed to ensure that the maximum predicted impacts are captured. NHDES favors Cartesian receptor grids and recommends that nested Cartesian networks be developed with denser spacing closer in to the modeled source(s). In order to manage file size and computer run time, coarser spacing may be used for grids at distances further from the modeled source(s). However, to ensure that the true maximum predicted impacts are captured, it may be necessary to perform a second set of model runs with denser receptor spacing in areas where maximum impacts were predicted by the first set of runs, especially if those maximum predicted impacts occurred in areas of less dense receptor spacing. A set of receptors should also be placed along the facility's property line (for NH RTAPs) or ambient air boundary (for criteria pollutants) at a maximum interval of 20 meters (other important information regarding ambient air boundaries and property lines will be discussed later in this guidance). Since AERMOD contains the PRIME downwash algorithm and can calculate impacts in the near-wake region of structures, a receptor spacing of no more than 20 meters is recommended in the immediate vicinity of stacks and nearby buildings. Special attention should also be paid to sensitive receptors such as schools, playgrounds, hospitals, and senior housing developments.

Please note that NHDES discourages the use of polar grid receptor networks because of the gaps in coverage that they can leave, especially at further distances along the radials where the distance between radials can be significant. Cartesian grids provide more thorough and evenly-spaced coverage, even in areas of less dense receptor spacing.

The AERMAP processor should be used to determine receptor elevations and associated hill heights for all receptors. AERMAP can use digital elevation model (DEM) data or National Elevation Dataset (NED) data. NHDES recommends the use of NED data since it is more recent and considered to be more accurate than DEM data. NED data are available from the USGS National Map Basic website. Helpful instructions for accessing and working with this data are provided on EPA's SCRAM website.

C.   Background Concentrations

Modeled impacts are evaluated against the NAAQS by adding the background level (for the appropriate pollutant and averaging time) to the modeled level and comparing the sum to the standard. NHDES will provide the appropriate background air quality data to the applicant on a project-specific basis. Special considerations may apply when specifying background data for evaluating 1-hour NAAQS for NO_2 and SO_2. Please see a more detailed discussion of 1-hour NO_2 and SO_2 background values later in this guidance. Sources subject to federal PSD requirements should contact NHDES to determine the need for pre-construction or post-construction ambient air monitoring.

V.   General Modeling Procedures

A.   Good Engineering Practice (GEP) Stack Height Determination

For stacks that are on or close to a building or other solid structure, GEP stack height is determined as follows:

GEP stack height = H_b + 1.5 L

Where:
H_b = Height of the building relative to the stack base elevation
L = Lesser of H_b or the maximum projected width (usually the diagonal of the building)

GEP should be determined for all buildings and solid structures that are within 5L of the stack. Since there is potential for downwash even for stacks that are greater than GEP height, projected building heights and widths should be included for all stacks with structures located within 5L. NHDES recommends the use of BPIP for the determination of GEP and the calculation of projected heights and widths. For PSD permits and SIP revisions, any enforceable emissions limits must not be based on stack heights greater than GEP stack height, even if the physical stack height is greater than GEP.

B.   Load Conditions

Maximum air quality impacts are most often associated with a device or process operating at its highest design capacity. Occasionally, however, maximum impacts may be predicted when a device or process is operating at less than 100% load because of the reduced plume rise associated with lower operating loads. Therefore, additional load cases (for example, 75% and 50% loads) should be analyzed where appropriate. Some emission sources (e.g. boilers and engines) may run at reduced loads as part of normal operation; other types of devices may always run at maximum capacity. Therefore, the NHDES permit engineer assigned to the project will work with the applicant to determine an appropriate set of load cases to include in the air dispersion modeling analysis.

C.   Stack Discharge Configuration

Horizontal and capped stacks should be modeled with the AERMOD POINTHOR and POINTCAP keywords, respectively.

D.   Fugitive Emissions Sources

Fugitive emissions are those emissions that are not captured and vented through a stack (e.g. lagoons, open storage piles, general building ventilation). These types of emissions sources can be difficult to characterize and are often modeled using the AERMOD area or volume source types. NHDES should be contacted in advance of modeling if fugitive emissions are a concern. The fact that emissions are not exhausted through a stack or vent does not necessarily preclude a device from undergoing a dispersion modeling analysis.

E.   AERMOD Modeling Domain

The modeling domain must be large enough to include all sources and receptors, and must also accommodate any significant terrain elevations. Significant terrain elevations include all the terrain that is at or above a 10% slope from each and every receptor, as per the [AERMAP User's Guide](#). To ensure that all significant terrain points have been addressed in the modeling, additional NED or DEM files may be needed (although this will lengthen the AERMAP run time). Applicants should consult the AERMAP User's Guide for an explanation of significant terrain and how it is determined.

F.   Screening Modeling

AERSCREEN has been approved by EPA for providing a conservative estimate of air quality impacts. Although AERSCREEN was developed as a simplified version of AERMOD, NHDES has found that it takes the same amount of time and effort to set up and run the model as AERMOD. For this reason, and due to the fact that AERSCREEN produces very conservative results, NHDES strongly encourages the use of AERMOD for permit modeling purposes (AERSCREEN, which can be used with screening meteorology, is useful in areas with limited meteorological data. However, meteorological data is readily available for all of New Hampshire, thereby limiting any benefit of using AERSCREEN over AERMOD.).

G.   Evaluation of Modeled Impacts

1.   Criteria Pollutants

As described earlier in this guidance, criteria pollutant impacts for sources in New Hampshire are evaluated against the NAAQS, SILs, and the PSD increments. For an initial assessment of modeled criteria pollutant results, the maximum (high 1st high) predicted impacts from the proposed new facility, device, or modification may be compared with the SILs (note: when evaluating impacts against the SILs, high 1st high results may be used for both short-term and annual averaging periods). If maximum predicted impacts are less than the SILs for a given pollutant, then no further evaluation is required for that pollutant, so long as the SILs have been justified to be appropriate for the case-specific situation.

For proposed new facilities, devices, or modifications that are significant (i.e., impacts above SILs), NHDES should be consulted to determine whether or not interactive sources should be included in the criteria pollutant modeling. Interactive sources, which were described earlier in this guidance, have the potential to contribute to impacts from the subject source and, conversely, may be causing modeled NAAQS or increment violations at receptors where the subject source may be contributing.

The combined impacts of the subject source and any applicable interactive sources should be added to the appropriate pollutant background concentrations for evaluation against the NAAQS. Also, predicted increment-consuming impacts (including interactive sources) should be evaluated against the increments. Background concentrations should **not** be added to modeled results for increment evaluation. In addition, emissions at the time of baseline can be

accounted for in the increment evaluation. This is frequently done by modeling the existing baseline device(s) at a negative emission rate to represent the baseline contribution (negative emission rates **cannot** be used, however, with the OLM or PVMRM methods for NO_2, which are discussed later in this guidance).

For short-term averaging periods (24 hours or less) the modeled high 2nd high value can be used for evaluating model impacts against the NAAQS and increments (however, please see the separate discussion for 1-hour NO_2 and SO_2 NAAQS later in this guidance and the sentences that follow for PM_{10} and $PM_{2.5}$). For 24-hour PM_{10}, the $(n+1)^{th}$ high value can be used where n is the number of meteorological years modeled. For a typical 5-year set of National Weather Service (NWS) meteorological data, the modeled high 6th high PM_{10} impact would be used in the evaluation. For the 24-hour $PM_{2.5}$ NAAQS, the high 8th high is used since the NAAQS for 24-hour $PM_{2.5}$ is based on the 98th percentile (note, however, that the high 2nd high is used to evaluate the $PM_{2.5}$ increment). Please refer to Section 2.1.6 of the [AERMOD User's Guide](#) for specific recommendations for particulate matter processing. For annual averaging periods, the modeled high 1st high results are evaluated against the NAAQS and increments.

Criteria pollutant impacts for the source of interest do **not** need to be evaluated in areas of that facility's property where the public is precluded from access. However, as mentioned earlier in this guidance, receptors should be placed along the ambient air boundary at 20-meter intervals. Further, criteria pollutant impacts from the source of interest should be evaluated on other facilities' properties even if the other facilities preclude public access to their properties. Please note that a further discussion of public access and what is considered "ambient air" is provided later in this guidance.

2. RTAPs

Predicted RTAP impacts should be evaluated against the AALs described earlier in this guidance. Note that RTAP impacts need only be evaluated against the AALs for areas at and beyond the emission source's compliance boundary as defined in Env-A 1401.03(g). The compliance boundary generally corresponds to the facility's property line. However, receptors must be placed on any areas within the property line that are leased to another ownership entity. As mentioned earlier in this guidance, receptors should be placed at 20-meter intervals along the compliance boundary.

Modeled high 1st high impacts are always used when evaluating RTAP impacts against the AALs.

3. Additional Analyses

For sources subject to PSD review, the following three additional analyses must be addressed as part of the overall air quality analysis:

- Growth
- Soils & Vegetation
- Visibility

Each of these topics are discussed briefly in the paragraphs below:

The growth analysis constitutes an estimate of emissions associated with the industrial, commercial, or residential growth that is expected to occur in the area due to the proposed new source or modification. NHDES and EPA Region 1 should be consulted to determine the assumptions and methodologies that will be used in a growth analysis. Many times, however, the growth associated with a project (the installation of a new boiler, for example) is negligible.

For soils and vegetation, NHDES recommends the methodologies in EPA's December 12, 1980 document [A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals](). NHDES and EPA Region 1 should be consulted prior to performing an air quality analysis for soils & vegetation so that methodologies and assumptions can be agreed upon.

For the visibility analysis, a 3-tiered screening approach may be used as follows:

- A Level 1 screening analysis using the [VISCREEN]() model (for near field) or [CALPUFF]() (for far field) with conservative assumptions.
- A Level 2 screening analysis using VISCREEN or CALPUFF with more refined assumptions.
- A Level 3 analysis using a sophisticated model (e.g. [PLUVUEII]()) and detailed assumptions.

Note that PLUVUEII and CALPUFF are alternative models to those listed in Appendix W, so their use would have to be justified in conjunction with NHDES and EPA Region 1. NHDES and EPA Region 1 should be consulted prior to performing a visibility analysis so that methodologies and assumptions can be agreed upon.

VI. NO_2 and SO_2 Modeling

In 2010, EPA promulgated new NAAQS for NO_2 and SO_2. For both of these pollutants, the new NAAQS are based on a 1-hour averaging period, which presents unique challenges when evaluating new and modified emission sources against these standards. EPA has released a series of memoranda to clarify the applicability of Appendix W guidance for modeling 1-hour NO_2 and SO_2 impacts for evaluation against the 1-hour NAAQS. These memoranda are listed below, starting with the most recent:

- [Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard,]() September 30, 2014
- [Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard](), March 1, 2011
- [Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard](), August 23, 2010
- [Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard](), June 28, 2010

Appendix W is the definitive source for regulatory NO_2/SO_2 modeling methods; however, applicants performing modeling for the 1-hour NO_2 and SO_2 NAAQS for emission sources in New Hampshire may consult the guidance outlined in the above memoranda, with input from

NHDES as appropriate. Highlights of these clarification memoranda are outlined in the sections below.

A.   1-hour NO$_2$

Modeling for NO$_2$ requires special consideration because, as stated in the EPA guidance, NO$_2$ concentrations are largely driven by the ambient chemical environment and the initial ratio of NO$_2$/NO$_x$ emissions.

1.   NO$_2$ Modeling Screening Techniques

In the NO$_2$ memoranda described above, EPA has outlined a 3-tier approach for evaluating modeled NO$_2$ concentrations. NHDES has adopted this approach, which is described in further detail below. Note that for the Tier 3 methods, it is not appropriate to model negative emission rates (e.g. for an increment consumption analysis).

Tier 1: The Tier 1 approach assumes full conversion of NO$_x$ to NO$_2$; that is, NO$_x$ emissions are modeled with a refined Appendix W method (i.e., AERMOD) and the resulting concentrations are compared directly to the NAAQS for NO$_2$. This approach is considered to be the most conservative of the tiered methods and, in general, it can be applied without further consultation with NHDES.

Tier 2: This tier consists of the ARM2 (Ambient Ratio Method 2) approach as described below.

The ARM2 approach was embedded into the AERMOD model starting with version 13350 and consists of an equation based on analysis of NO$_2$/NO$_x$ ratios from EPA's AQS (Air Quality System) record of monitored ambient air quality data. In general, the ARM2 approach may be applied without further consultation with NHDES so long as the national default minimum and maximum NO$_2$/NOx ratios of 0.5 and 0.9 are used. NHDES must be consulted on the use of ratios other than the national defaults. ARM2 should be applied to the modeled concentration and the resulting modeled concentration should be added to the monitored background NO$_2$ value (which does not get adjusted) for comparison against the NAAQS.

Tier 3: Tier 3 consists of two options for a detailed screening method, OLM (ozone limiting method) and PVMRM (plume volume molar ratio method). Both of these methods require the ISR (in-stack NO$_2$/NO$_x$ ratio) as input to the model. Source-specific ISRs are preferred when available. However, given the scarcity of this data, EPA has established a generally accepted ISR of 0.5 for the primary source and any sources in the immediate vicinity of the primary source, and 0.2 for more distant sources (usually more than 1-3 km away from the primary source). Use of either of the Tier 3 options requires consultation with NHDES (and EPA Region 1 for PSD projects). NHDES can provide hourly monitored ozone data, which can be used for the OLM or PVMRM options. Per the June 28, 2010 EPA memorandum, it is recommended that the OLMGROUP ALL option be routinely used to reflect that multiple modeled sources will compete for available ozone in proportion to their contribution to the NO$_x$ concentration at a given receptor.

2.   *Specifying Background Concentrations*

In the September 30, 2014 memorandum, EPA reaffirms its 2-tier approach for combining modeled NO_2 concentrations with monitored ambient background concentrations to obtain a cumulative modeled NO_2 concentration for evaluation against the NAAQS. These two tiers are described below.

Revised Tier 1: The monitored design value, based on three years of monitored data, should be combined with the modeled design value, based on five years of NWS data or one or more years of on-site met data. In general, no particular consultation with NHDES is required for the use of this method when applying background concentrations. (Note: the original Tier 1 method consisted of adding the overall maximum monitored value to the modeled design value, but this method was found to be overly conservative in most cases.)

Tier 2: This method employs a multi-year average of the 98th percentile of the available background concentrations by season and hour of day and is discussed in detail in the March 1, 2011 memorandum. A brief description of deriving a multi-year average of the 98th percentile by season and hour of day is provided below using Hour 1 for the summer season (June, July, August) as an example.

- Using three years (files) of hourly 1-hour observations, sort each file first by hour of day and then by date.
- For the first year's file, find the 3rd largest Hour 1 value out of the 92 possible Hour 1 values for June, July, and August (this could be accomplished in a spreadsheet using the Excel LARGE function). Repeat for the other two year's files.
- Take the average of the resulting three 3rd highest Hour 1 values. This yields the multi-year average of the 98th percentile for Hour 1 for the summer season.

This process would have to be repeated for each hour of day for each season. Recent versions of AERMOD are designed to accept an input table of background values by hour of day and season. NHDES should be consulted when using this Tier 2 method for specifying background concentrations (NHDES has a preprocessed set of NO_2 values by hour of day and season that it can provide to applicants; other data sets will require pre-approval). AERMOD version 13350 and later also has the capability of accepting background data from multiple monitors and will automatically apply the background from the appropriate downwind monitor based on the hourly wind direction from the met file. This approach, however, is not generally applicable to sources in New Hampshire and NHDES should be consulted if the use of this method is proposed.

3.   *Other Considerations*

When evaluating modeled NO_2 concentrations against the interim 1-hour NO_2 SIL, the SIL should be compared with the highest of the 5-year averages of the maximum 1-hour NO_2 concentrations predicted each year at each receptor (for five years of NWS data) or the highest modeled 1-hour NO_2 concentration predicted across all receptors based on one year of on-site met data (or the highest of the multi-year averages of the maximum modeled 1-hour NO_2

concentrations predicted each year at each receptor based on two to five years of on-site met data). Please see pages 2 and 3 of the March 1, 2011 memorandum. In the same memorandum, EPA states that a cumulative impact assessment for 1-hour NO_2 may be limited to only those receptors at which the new or modified source is significant, provided that the original receptor grid was adequate to capture all areas of potential significance.

Given the probabilistic form of the 1-hour NAAQS, the assumed continuous operation of intermittent sources at their maximum potential emission rates could lead to overestimation of the source's actual impact. Therefore, EPA finds it reasonable and appropriate to only consider those sources that are continuous or frequent enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations. NHDES feels that most types of sources included in a criteria pollutant analysis (e.g. boilers, prime power engines) will be modeled as operating continuously at their maximum potential and/or permitted emission rates. Devices or scenarios that are felt by the applicant to be intermittent enough not to contribute to the annual distribution of daily maximum 1-hour concentrations must be discussed with NHDES (and EPA Region 1 for PSD projects) and the decision on whether to include them in the modeling will be made on a case by case basis. For more information, please see the section entitled *Treatment of Intermittent Emissions* starting on page 8 of the March 1, 2011 memorandum.

B.   1-hour SO_2

In the March 1, 2011 memorandum, EPA states: "Note that while the discussion of NO_x chemistry options in this memo is exclusive to the 1-hour NO_2 standard, the discussion of other topics in this memo should apply equally to the 1-hour SO_2 standard, accounting for the slight differences in the form of the 1-hour NO_2 and SO_2 standards." Therefore, with the exception of the Tier 1 through 3 screening techniques for NO_2 modeling, the topics discussed in the section above for 1-hour NO_2 are generally applicable when modeling for the 1-hour SO_2 standard. As with 1-hour NO_2, NHDES (and in the case of PSD projects, EPA Region 1) should be consulted in cases where the applicant wishes to use multiple background monitors or proposes to exclude from modeling those devices or scenarios that are felt to be intermittent.

VII.   Single-Source Ozone and Secondary $PM_{2.5}$

In developing its revisions for the January 2017 update of Appendix W, EPA determined that, with the advances made in chemical transport modeling science, it is now reasonable to provide more specific, generally-applicable guidance on assessing the impact of single-source emissions on ozone and secondary $PM_{2.5}$. In New Hampshire, new sources and modifications subject to PSD review must be evaluated for secondary $PM_{2.5}$. Since New Hampshire is located in the Ozone Transport Region (OTR), non-attainment New Source Review (NNSR) applies for ozone. NNSR does not have specific modeling requirements, and the NHDES permit engineer assigned to the project will assist the applicant with the NNSR aspects of the air permit.

EPA has provided tools and guidance documents to assist with performing analyses for reactive pollutants, and NHDES recommends that these methodologies be followed. A listing of these tools is provided below:

- Appendix W Section 5.0, *Models for Ozone and Secondarily Formed Particulate Matter.*

- [Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM$_{2.5}$ under the PSD Permitting Program](#), April 30, 2019.
- [Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program](#), April 17, 2018.
- [Use of Photochemical Grid Models for Single-Source Ozone and secondary PM$_{2.5}$ impacts for Permit Program Related Assessments and for NAAQS Attainment Demonstrations for Ozone, PM$_{2.5}$ and Regional Haze](#), August 4, 2017.
- [Guidance for PM$_{2.5}$ Permit Modeling](#), May 20, 2014.

NHDES and EPA Region 1 must be consulted prior to performing any single-source secondary PM$_{2.5}$ modeling in New Hampshire.

VIII.   Modeling for Class I Areas

Per the PSD regulations at 40 CFR 52.21, the responsible Federal Land Manager (FLM) must be notified if a proposed source or modification subject to PSD review may affect a Class I area (Class I areas were described earlier in this guidance). "May affect" is generally taken to mean that the proposed source or modification is within 100 km of a Class I area. Note that FLM notification may also be required for "very large sources" located at distances greater than 100 km from a Class I area - please see page 8 of the [2010 FLAG (Federal Land Managers' Air Quality Related Values Workgroup) Report](#). The FLM responsible for New Hampshire's Class I areas, and Lye Brook Wilderness in Vermont, is the U.S. Forest Service. If the FLM and NHDES determine that Class I area modeling must be performed, the following analyses are required:

- NAAQS and Increment.
- Air Quality Related Values (AQRVs).

Each of these is described in the following sections.

A.   NAAQS and Increment

AERMOD is the Appendix W-approved model for predicting pollutant concentrations within 50 km of an emissions source. Therefore, for new sources or modifications within 50 km of a Class I area, AERMOD should be used and the modeled results compared with the Class I SILs in Table 4 and then, where necessary and applicable, the NAAQS in Table 1 and the Class I Increments in Table 2. For sources or modifications that are more than 50 km from a Class I area, AERMOD should be used to predict pollutant concentrations at a nominal distance of 50 km. If the maximum predicted impacts are less than the Class I SILs for a given pollutant, then no further analysis is required for that pollutant. If maximum predicted impacts are above the SILs at 50 km, then there is no single prescribed model for predicting pollutant concentrations at distances greater than 50 km. In this case, NHDES and EPA Region 1 should be consulted on an appropriate technique for performing the modeling analysis.

B.   Air Quality Related Values

Air Quality Related Values are resources at a Class I area that may be adversely affected by a

change in air quality. AQRVs include, for example, visibility, vegetation, soils and surface waters. NHDES and the responsible FLM should be consulted in advance of performing a Class I AQRVs analysis, and applicants will typically be asked to follow the general procedures in the 2010 FLAG Report.

IX.   Ambient Air Considerations for NAAQS Modeling

On December 2, 2019, EPA released its [Revised Policy On Exclusions from "Ambient Air."](#) In this policy, EPA and stakeholders recognize the advances in technology (surveillance cameras, drones, etc.) and the variety of ambient air situations that have arisen since the 1980 description of "ambient air" in the letter from Administrator Douglas Costle to Senator Jennings Randolph (sometimes informally referred to as the "Costle memo"). The definition of ambient air in the Costle memo included the interpretation that the public must be precluded by means of a fence or other physical barrier for an area to be excluded from ambient air. In its December 2, 2019 policy, EPA has revised its interpretation to mean that "the atmosphere over land owned or controlled by the stationary source may be excluded from ambient air where the source employs measures, which may include physical barriers, that are effective in precluding access to the land by the general public."

In keeping with EPA's revised ambient air policy, NHDES will carefully assess measures proposed by a source to preclude public access under specific, factual circumstances. Determinations of the adequacy of those measures will be made on a case-by-case basis after consideration of information in the relevant administrative record.

X.   Reporting

A.   Preparation of a Modeling Protocol

To expedite the permitting process and ensure that modeling analyses are performed in accordance with Appendix W and this guidance document, NHDES requires by Rule the submittal of a modeling protocol (see Env-A 606.04(b)). The protocol should document the input parameters, models, and assumptions that will be used in the analysis. The modeling protocol may be provided in the form of a checklist, an example of which is shown in [Appendix A](#). A more detailed modeling protocol is required for more complex PSD projects and projects proposing to use alternative methodologies. Applicants submitting analyses for PSD sources should contact NHDES for the specific modeling protocol requirements.

The submittal of electronic modeling files along with the modeling protocol can greatly assist NHDES with its review and can help expedite the protocol review process. Electronic modeling files submitted during this stage can be considered preliminary or draft, but their submittal can uncover errors or inaccurate assumptions during the early phases of a project rather than later.

B.   Modeling Report

Any modeling analysis prepared by an applicant or consultant should be presented in a clear, concise manner and a modeling report should be provided to NHDES for review. The report should include sufficient information and assumptions such that NHDES can duplicate the

documented results. All modeling files should also be submitted to expedite NHDES' review. The requirements for modeling reports submitted to NHDES are summarized in sections below. Proper submittal of modeling results allows for faster review time with little or no delay in the permitting process.

At a minimum, a modeling report should address the following items:

1.   *Emission Rates and Stack Parameters*

Emission rates for all criteria pollutants and/or RTAPs that were evaluated should be listed for each source modeled and, as applicable, criteria pollutant emissions from any interactive sources. The basis of the emission rates (emission factors, stack test data, etc.) and the methodologies used in the emission rate calculations should be clearly explained and referenced. Stack parameters (including stack height, diameter, exit velocity, volumetric flow, and exhaust temperature) should be listed for each emissions point. A discussion of the load cases that were analyzed should be included, and the stack discharge configuration (vertical, horizontal, capped, etc.) should also be documented. Methods and assumptions for modeling fugitive emissions sources should be documented, if applicable.

2.   *Buildings and Structures*

Scaled maps or drawings should be provided to show all buildings and solid structures that were assessed in the modeling. The peak height of each structure should be listed in the report or shown by means of a scaled profile drawing. The locations of the buildings and structures should be clearly shown with respect to the modeled stack locations.

3.   *Location Map and Site Plan*

A location map showing the source location relative to nearby roads and landmarks should be submitted. A scaled site plan should also be provided, showing the property line and/or ambient air boundary of the facility, along with stack and structure locations.

4.   *Receptor Grid*

The receptor locations used in the modeling should be described in detail or shown by means of a map or drawing. The methodology used to develop terrain elevations for the receptors should also be described. The source of the elevation data should be referenced.

5.   *Meteorological Data*

The meteorological data used in the modeling should be documented in the report and the source of the data should be referenced, especially if the data were not provided by NHDES.

6.   *Background Air Quality Data*

The criteria pollutant background concentrations that were used in the assessment should be

listed if modeling for NAAQS. As mentioned earlier in this guidance, background data are available from NHDES.

7.   GEP Results

All GEP calculations that were made should be clearly documented in the modeling report.

8.   Modeling Impact Results

The results of the dispersion modeling analysis should be thoroughly documented in clear, tabular form. For criteria pollutant analyses that include interactive sources, results should show the contribution from the source(s) of interest alone as well as the overall impacts from all modeled sources.

9.   Electronic Modeling Files

In addition to the modeling report, NHDES requires that all model input/output files be submitted in electronic format (via email, Dropbox, ftp site, CD/DVD, USB drive, etc.). All model runs should be submitted, not just those that resulted in the worst-case impacts. Model input/output files should be submitted for all analyses performed, including the GEP calculations. Filenames should be self-explanatory, or a listing should be provided that describes the content of each file. Sufficient input/output data should be submitted so that the reported results can be verified and reproduced. Review of any modeling submitted to NHDES will not proceed until all data files are made available.

The contacts for the NHDES Air Quality Dispersion Modeling Unit are:

Dave Healy - (603) 271-0871 - david.healy@des.nh.gov
Kathleen Errington - (603) 271-0888 - kathleen.errington@des.nh.gov

Appendix A - Example Permit Modeling Protocol Checklist

1) Dispersion Model to be Used

☐ AERMOD ☐ AERSCREEN ☐ Other: _____

NHDES should be contacted if any other model is to be used besides AERMOD/AERSCREEN.

2) Meteorological Data to be Used

☐ NHDES-Supplied ☐ On-Site/Other ☐ AERSCREEN Default Data

Project city/town location: _____

3) Background Air Quality Data

For criteria pollutants, NHDES will provide background air quality data based on the project's city or town location.

4) Receptor Spacing

Spacing of Inner Grid: _____ meters (20m or less spacing required in building downwash areas)

Spacing of Outer Grid(s): _____ meters

Receptor Spacing along Property Line or Ambient Air Boundary: _____ meters (20m or less spacing required along property lines/ambient air boundaries).

5) Terrain Elevation Data to be Used

☐ USGS NED/DEM (datum year: _____) ☐ Survey Data ☐ Other: _____

6) Stack Orientation

Are all stacks vertical and unobstructed? ☐ Yes ☐ No

7) Interactive Sources for Criteria Pollutant Analyses

Will interactive sources be modeled? ☐ Yes ☐ No

If yes, please provide an approximate Significant Impact Area:

◆ Radius of _____ meters around the subject source

NHDES should be contacted for the most recently updated list of interactive sources.