AMBIENT IMPACT ANALYSIS GUIDELINE

A Guideline for Performing Stationary Source Air Quality Modeling in Connecticut

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Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

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1.0 <u>INTRODUCTION</u>

This Ambient Impact Analysis Guideline (AIAG) has been written as a detailed supplement to the modeling procedures contained in the Environmental Protection Agency's (EPA's) Guideline on Air Quality Models (GAQM), as incorporated in Appendix W of 40 CFR Part 51, and certain EPA clarification/guidance memorandums which supplement Appendix W. EPA's guidance addresses a broad range of modeling issues such as model selection, input data requirements, and technical considerations that are appropriate for assessing impacts from stationary sources, mobile sources, photochemical processes, and long-range transport. This guidance document focuses on modeling procedures that pertain to short-range (i.e., <50 kilometers (km)) stationary source modeling in Connecticut. The Connecticut Department of Energy and Environmental Protection (CTDEEP) will, from time to time, update this guidance document to reflect any substantive changes to EPA or CTDEEP preferred modeling techniques. Readers should check EPA's and CTDEEP's websites to ensure that modeling analyses are conducted in accordance with the latest revisions to modeling guidelines. **Users of this document are encouraged to contact CTDEEP staff before undertaking any regulatory modeling analysis in Connecticut. Applicants and their consultants are also encouraged to check the Support Center for Regulatory Atmospheric Modeling (SCRAM) website for any new or revised versions of the AERMOD modeling system, and EPA policy guidance documents before undertaking New Source Review (NSR) National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) Permit Modeling Analyses in Connecticut.**

The latest version of Connecticut's AIAG is available on the CTDEEP Air Quality Modeling website at:
[DEEP: Air Permitting - Air Quality Modeling](#)

1.1 WEB - BASED MODELING GUIDANCE

In addition to this document in portable document format, the CTDEEP website include links to pre-processed meteorological data, criteria air pollutant data bases, and links to other relevant CTDEEP and EPA modeling guidance and support documents not explicitly contained herein.   Our web-based interface has been created to enhance efficiency and consistency in regulatory modeling.   The public and regulated-community are encouraged to use our web-based modeling guidance and data bases at their convenience.

Guidance documents and data bases currently available on the website are:

- Connecticut's AIAG;
- EPA's Appendix W Guideline on Air Quality Models and associated modeling guidance updates;
- links to EPA's SCRAM website that contains general modeling guidance, recommended models and their users' guides, and relevant dispersion model pre-processors programs;
- latest available five years of pre-processed AERMOD ready hourly meteorological data sets; and
- measured ambient monitoring data for use as background concentrations including:
  - o most recent design value concentrations at CTDEEP operated monitoring locations for all criteria pollutants,
  - o 99th and 98th percentile season by hour of day monitored values for 1-hour SO_2 and NO_2 respectively; 98th percentile seasonal $PM_{2.5}$ 24-hour average measured values, and
  - o five years of hourly background ozone data used for approved Tier3 NO_2 modeling.

1.2 SUMMARY/OVERVIEW

Section 22a-174-3a of the Regulations of Connecticut State Agencies (RCSA) requires the owner of certain stationary sources of air pollution to apply for and obtain a permit prior to the construction, modification, and operation of the source. Permit applicability is defined in RCSA section 22a-174-3a (a). RCSA section 22a-174-3a(d)(3)(B) and (C) requires the owner of any source for which an application for an air permit has been submitted to demonstrate that the operation of the source will not cause or contribute significantly to a violation of any federal or state air quality standard or prevention of significant deterioration (PSD) increment. RCSA section 22a-174-3a(i)(2), requires this demonstration to include estimates of air quality impacts that follow procedures approved by the CTDEEP Commissioner. This document describes the current, approved procedures for performing stationary source air quality impact analyses. The recommended procedures conform to EPA's modeling guidance contained in [Appendix W of 40 CFR Part 51](#).

Section 2 contains model applicability rules including major and minor source emission threshold requirements for PSD and NAAQS modeling.

Section 3 contains the air quality criteria including the NAAQS, PSD increments, and Significant Impact Levels (SILs) for all regulated pollutants.

Section 4 contains Good Engineering Practice (GEP) Stack Height recommended analyses, modeling analyses that include user-supplied input data to characterize the source of emissions, meteorology, and receptor geometry and background air quality. This section details the recommendations on the preparation and use of model input data, interpretation of results via a three-step process that includes a screening assessment, modeling of the subject source alone, compliance demonstration with the SILs, and, if necessary, defining the significant impact area (SIA). Section 4 defines the multi-source refined modeling and inventory requirements for NAAQS and PSD modeling analyses.

Background air quality procedures and analyses for all regulated pollutants are provided in Section 5.

Analysis and interpretation of modeled results and compliance demonstration with the NAAQS and PSD increments are presented in Section 7.

A list of referenced literature is provided in Section 8.

2.0 <u>MODEL APPLICABLITY</u>

As mentioned in Section 1.2 above, RCSA section 22a-174-3a(d)(3)(B) and (C) requires the owner of any source applying for an air permit to demonstrate that the operation of the source will not cause or contribute significantly to a violation of any federal or state air quality standard or PSD increment. RCSA section 22a-174-3a(i) requires this demonstration to include estimates of air quality impacts that follow procedures approved by the CTDEEP Commissioner. Definitions applicable for estimating air quality impacts can be found in RCSA section 22a-174-1. Owners of sources that are not required to obtain an air permit, such as sources that limit their emissions under RCSA section 22a-174-3b, are not subject to the modeling requirements of RCSA section22a-174-3a.

3.0 <u>AIR QUALITY CRITERIA</u>

3.1 NATIONAL AMBIENT AIR QUALITY STANDARDS

Table 3-1 displays the National Ambient Air Quality Standards that have been established for the criteria air pollutants.   In addition, a single Connecticut Ambient Air Quality Standard (CAAQS) was established for total Dioxin (see RCSA section 22a-174-24(m)) that is also listed in Table 3-1. Each NAAQS is defined in terms of pollutant, averaging time, and level above which health is at risk (primary standard).

Compliance with each NAAQS is determined by adding the appropriate modeled predicted impacts to background design values (for the applicable pollutant, short and long term averaging times), and comparing the combined values from each receptor modeled to the NAAQS (see Table 3-1 footnotes). The modeled impacts used in this determination represent impacts not only from the applicant source, but also other nearby sources, if required, (source inputs are reviewed and approved CTDEEP), plus background levels, which are also provided by CTDEEP, unless monitoring is required.

If there are violations with any applicable NAAQS, applicants must demonstrate that a source does not cause or significantly contribute to any violation in order for a permit to be issued.

TABLE 3-1
National and Connecticut Ambient Air Quality Standards

	Primary Standards		
Pollutant	**Level**	**Averaging Time**	**Notes on demonstrating compliance with NAAQS via modeling**
Carbon Monoxide (CO)	10,000 µg/m^3	8-hour	Not to be exceeded more than once per year
	40,000 µg/m^3	1-hour	Not to be exceeded more than once per year
Dioxin	1.0 picogram/m^3	Annual Average	Not to be exceeded
Lead (Pb)	0.15 µg/m^3 [1]	Rolling 3-Month Average	Not to be exceeded
Nitrogen Dioxide (NO$_2$)	100 µg/m^3	Annual (Arithmetic Mean)	Not to be exceeded
	188 µg/m^3	1-hour	The 5-year average (1-year for on-site met. data) of the 98th percentile of 1-hour maximum daily concentrations
Particulate Matter (PM$_{10}$)	150 µg/m^3	24-hour	Not to be exceeded more than once per year on average over 5 years (1-year for on-site met. data).
Particulate Matter (PM$_{2.5}$)	12.0 µg/m^3	Annual (Arithmetic Mean)	Not to be exceeded. See Section 4.4.

[1] National lead standard, rolling 3-month average, signed October 15, 2008.

	35 µg/m^3	24-hour	The 5-year average (1-year for on-site met. data) of the 98th percentile of the 24-hour concentrations. See Section 4.4.
Ozone (O$_3$)	0.070ppm	8-hour [2]	O$_3$ – See Section 4.4.
Sulfur Dioxide (SO$_2$)	196µg/m^3	1-hour	The 5-year average (1-year for on-site met. data) of the 99th percentile of the 1-hour maximum daily concentrations

[2] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.070 ppm (effective October 26, 2015).

3.2 PREVENTION OF SIGNIFICANT DETERIORATION

Connecticut's NSR PSD program is implemented by CTDEEP as a federally approved program. The objectives of the PSD program are: to ensure that economic growth will occur in harmony with the preservation of existing clean air resources; to protect public health and welfare at air quality levels that are cleaner than the NAAQS; and to preserve and protect air quality in natural recreational, scenic or historical areas including but not limited to national parks and wilderness areas. Additional PSD requirements for a new major source or major modification also include an analysis of impairment of visibility, soils, and vegetation. These objectives are mainly accomplished by not allowing significant incremental degradation of air quality beyond baseline concentrations in an area. A Baseline concentration is essentially the ambient concentration level of an air pollutant at the time of the first PSD permit application submittal affecting an area.

PSD applicability determination is based on whether a source is a new major stationary source or if a modification to an existing source is considered a major modification. However, the PSD program also requires an assessment of minor source growth on increment consumption. An increment is the maximum allowed increase in SO$_2$, NO$_2$, PM$_{10}$, and PM$_{2.5}$ concentrations above the baseline concentration in an area. Connecticut's approach to tracking increment consumption from minor sources is to require every permitted source to demonstrate compliance with the existing increments regardless of its level of annual emissions.

CTDEEP maintains PSD inventories for each pollutant for the purpose of tracking PSD increment consumption. An applicant must assess PSD increment consumption from the subject source and from the inventory of nearby increment consuming sources. The baseline concentration for PSD modeling purposes is defined as the minor source baseline date. These dates are June 7, 1988 for NO$_2$ and PM$_{10}$, December 17, 1984 for SO$_2$, and August 24, 2014 for PM$_{2.5}$. Table 3-2 displays the current PSD increments that have been promulgated for the aforementioned criteria pollutants.

TABLE 3-2
Class II PSD Increments ($\mu g/m^3$)

POLLUTANT	Annual[1]	24-Hour[2]	1-Hour
SO_2[3]	20	91	*
NO_2	25		*
PM_{10}	17	30	
$PM_{2.5}$	4	9	

[1] Not to be exceeded

[2] Not to be exceeded more than once per year

[3] Compliance with the annual and 24-hour SO_2 PSD increments are required until a 1-hour SO_2 increment is promulgated

3.3 SIGNIFICANT IMPACT LEVELS

Significant Impact Levels (SILs) are used to determine if a new or modified stationary source may cause or contribute to a violation of the NAAQS or PSD increments. If a new or modified stationary source's predicted impacts are greater than or equal to the SIL values listed in Table 4-3, then a cumulative impact analysis is required. A cumulative impact analysis takes into account other nearby sources within the Significant Impact Area (SIA) of the proposed or modified stationary source as well as existing ambient pollution background levels. Modeled impacts from a source of air pollution are considered significant if they equal or exceed the SIL values listed in Table 3-3.

Model results should be compared to the SILs based on 5 years of NWS met data (1-year for site-specific met data, or 3 years of prognostic met data) in the following manner:

- for 1-hour NO_2 ((Tier1 Full Conversion), or Tier2 (ARM2) Screening Methods)) and SO_2: the highest of multi-year averages of the maximum modeled daily 1-hour concentrations predicted each year at each receptor;

- for 24-hour PM_{10}: the highest first high 24-hour average concentrations predicted at each receptor;

- for 24-hour $PM_{2.5}$: the highest of multi-year averages of the maximum modeled 24-hour concentrations predicted at each receptor;

- for annual $PM_{2.5}$ & NO_2: the highest of multi-year averages of the maximum modeled annual concentration predicted at each receptor, and

- for 1-hour and 8-hour CO: the highest-first-high 1-hour and 8-hour average concentrations predicted at each receptor.

If maximum source impacts are predicted to be below the SIL values shown in Table 3-3, additional multi-source modeling may not be required and compliance with the applicable NAAQS or PSD increment is demonstrated.

TABLE 3-3
Class II Significant Impact Levels (µg/m³)[1]

POLLUTANT	Annual	24-Hour	8-Hour	3-Hour	1-Hour
SO_2	1.0	5.0		25.0	7.8[2]
NO_2	1.0				7.5[3]
PM_{10}	1.0	5.0			
$PM_{2.5}$[4]	0.2	1.2			
CO			500		2,000

[1] Source impacts must be less than the appropriate significance impact levels to be considered "insignificant or de minimis".

[2] On August 23, 2010, EPA recommended a SIL of 3ppb (7.8µg/m³) for the 1-hour SO_2 NAAQS.

[3] On June 28, 2010, EPA recommended a SIL of 4ppb (7.5µg/m³) for the 1-hour NO_2 NAAQS.

[4] On April 17, 2018, EPA issued Guidance on Significant Impacts Levels for Ozone and Fine Particulates in the Prevention of Significant Deterioration Permitting Program.

4.0 MODELING ANALYSES FOR NAAQS/PSD COMPLIANCE DEMONSTRATION

This section provides applicants detailed requirements and procedures for performing an ambient impact analysis for the purpose of demonstrating compliance with the NAAQS and PSD increments. CTDEEP intends to update this document periodically; however, applicants are encouraged to consult with CTDEEP prior to conducting ambient impact analyses to confirm that guidance given herein reflects all current state and federal modeling requirements.

The latest version of EPA's approved regulatory air dispersion model (AERMOD) is required to predict ambient impacts from proposed new and modified existing permitted stationary sources in Connecticut. EPA's AERMOD screening model AERSCREEN is used to perform screening modeling analyses to determine worst-case operating conditions from proposed new and modified existing sources, and to test for adverse impacts from minor sources. AERMOD is the recommended refined single and multi-source dispersion model, to predict ambient impacts on flat, simple, intermediate, and complex terrain within 50 kilometers (km) of the source modeled. AERSCREEN and AERMOD input requirements, modeling procedures, and analyses are discussed in more detail below.

4.1 SCREENING MODELING ANALYSIS

AERSCREEN is the preferred regulatory screening model for air permitting applications that is used to estimate ambient impacts from point, area, volume sources, and flares out to a distance of 50 km. AERSCREEN is a single-source screening version of AERMOD that produce conservative impact estimates that has the capability to handle building downwash without the need for refined meteorological data.

As noted in Section 1.2 above, all sources seeking a permit under Section 22a-174-3a are required to demonstrate compliance with applicable state and federal NAAQS and PSD increments using methods approved by the Commissioner. The discussion that follows describes procedures that new minor sources and minor modifications can follow to fulfill this NSR permitting requirement.

Screening modeling is conducted to assess worst case impacts from new minor sources or minor modifications whose annual allowable emissions fall within ranges shown Table 4-1.

TABLE 4-1
Screening Modeling Allowable Emissions Thresholds (TPY)

Pollutant	≥1 & < 10	≥ 3 & <15	≥ 5 & < 40	≥ 5 & < 100
NO$_2$			X	
SO$_2$		X		
PM$_{10}$		X		
PM$_{2.5}$	X			
CO				X

Each source should be modeled at a minimum of 50, 75 and 100% loads when determining if maximum impacts are below the CTDEEP's Screening Adverse Impact Levels (AILs). Sources within these emissions ranges can demonstrate compliance with the NAAQS and PSD increments by simply demonstrating that the maximum predicted impacts (without the addition of background concentrations) are below the AILs shown in Table 4-2.

TABLE 4-2
Adverse Impact Levels (µg/m^3)[1]

Pollutant	Annual average	24-hour average	8-hour average	1-hour average
NO$_2$	12.5			24
SO$_2$				25
PM$_{10}$		18.7		
PM$_{2.5}$	1.8	4.3		
CO			1,250	

[1] CTDEEP's Screening Adverse Impacts Levels were originally derived from CTDEP's 1979, 1991, and 1996 Stationary Source Stack Height Guideline, based on 12.5% of the NAAQS

Short Stacks with Emissions Less Than Screening Emissions Thresholds

A short stack for any new or modified permitted source that emit below emission ranges shown in Table 4-1 of less than 10 meters or 1.3x the height or maximum projected width of a controlling nearby building that causes severe downwash impacts, whichever is greater, is required to perform screening modeling. Such a source may opt-out of screening modeling by increasing the stack height to the greater of:

- 10 meters, or
- lesser of 1.3x the height or maximum projected width of a controlling nearby premise building.

If a source cannot demonstrate that maximum impacts are below the AILs in Table 4-2, either reduce emissions below the emissions ranges shown in Table 4-1, or perform refined modeling to determine compliance with the applicable NAAQS or PSD increments (see Section 4.2).

4.1.1 Screening Modeling Inputs

NAAQS, PSD increments and SILs cover a variety of averaging periods depending on the air pollutant of concern. General input requirements can be found in the AERSCREEN user's guide. Additional screening modeling guidance is discussed in the remainder of this section.

Emissions

A source should be modeled (at a minimum) at its 50, 75 and 100% proposed or modified maximum allowable hourly and annual emission rates with stack parameters corresponding to the modeled load rates in order to determine the maximum short-term screening impacts. Annual and daily emissions may be scaled as a surrogate for allowable hourly emissions to show compliance with short term standards for minor sources that will have federal and or state enforceable permit emission limits. However, consultation with CTDEEP modeling staff is recommended prior to undertaking such minor source screening modeling using annual or daily emissions as a surrogate for maximum allowable hourly emissions.

Stack Parameters

The following inputs parameters must be used in AERSCREEN:

- stack location coordinates;
- pollutant specific proposed/modified maximum allowable hourly emission rate;
- stack base elevation (height of stack base above mean sea level);
- stack height - height of stack-top above stack base;
- stack top exit temperature of effluent exiting the stack;
- stack gas velocity of effluent exiting the stack;
- stack inside diameter at top of stack;
- worst case building dimensions;
- urban or rural option, and
- minimum distance to "ambient air"

Building Downwash/Cavity Considerations

The presence of structures in the vicinity of a stack can influence the behavior of the plume emitted from that stack. In order to determine the extent to which local structures effect plume dispersion, a GEP stack height analysis must be performed. EPA's "Guideline for the Determination of GEP Stack Height" (EPA, 1985) is the recommended procedure to assess whether emissions from a stack will be influenced by the turbulent wake zones created by nearby buildings or terrain. If a stack height is less than its formula GEP height, then the stack is considered to be subject to building downwash. There can be some building downwash even for stacks above formula GEP height. According to Appendix W section 7.2.2.1: "Since the definition of GEP stack height defines excessive concentrations as a maximum ground-

level concentration due in whole or in part to downwash of at least 40 percent in excess of the maximum concentration without downwash, the potential air quality impacts associated with cavity and wake effects should also be considered for stacks that equal or exceed the EPA formula height for GEP."

The building height, the maximum horizontal dimension, and minimum horizontal dimension of all nearby buildings on or near the premise should be used in the AERSCREEN model. In some instances it may be necessary to run the model multiple times for the same source (stack) in order to assess impacts from multiple structures on or off the premise. Building dimensions can be input to AERSCREEN individually in the interactive input stream of the model or the EPA BPIP model can be run to assist the user in complex building situations.

When documenting a GEP stack height analysis, a scaled plot plan of the facility that shows the location of each structure and stack, an aerial photograph, or a GOOGLE Earth/Map overhead snapshot view showing the facility layout must be included. The facility layout should also include: a north arrow, an accurate scale ruler, all structure heights, and horizontal dimensions, the facility boundaries and any fenced areas in/around the facility. Great care must be taken with photo-copied plot plans, or GOOGLE Earth Maps to ensure that the scale is accurate and correct across the entire plot plan.

Screening Receptors

Screening receptors should be selected based on detailed horizontal and vertical resolution of the terrain surrounding the source being modeled. When running AERSCREEN applicants must download terrain data in National Elevation Dataset (NED) in GeoTIFF format from the United States Geological Survey (USGS, 2002) for input to the model. The reference datum for NED is usually NAD83 and therefore the user must be extremely careful not to mix coordinate systems such as inputting the stack coordinates in NAD27 and generating receptors in NAD83. Note that AERSCREEN has default receptor spacing of 25m out to a user specified downwind distance (i.e., probe distance). The probe distance input to the model must be set to a distance that captures the maximum impact of the source being modeled. The recommended probe distance should be no less than 5km up to 10km. In the event that screening modeling results show that concentrations are not decreasing at the outer extent of the receptor network at 10km, then the grid must be extended further until concentrations begin to decrease. Since AERSCREEN has the ability to determine if the stack effluent will be re-circulated into the part of the building wake known as the cavity zone, additional receptors must be placed inside the cavity zone, where the public has access defined as "ambient air". This approach to developing a receptor network requires that the user accurately represent the location of the source and receptor network origin.

Screening Meteorological Data

Meteorological data is generated via inputs to the AERSCREEN model which in turn executes the MAKEMET program (a tool which generates a set of screening modeling met data based on user input data). It is recommended that the user specify the default values for minimum/maximum ambient temperatures, minimum wind speed, and anemometer height. In addition, the user should direct AERSCREEN to specify the default surface characteristics based on either the AERMET seasonal tables (which requires the user to specify a single dominant land use type in the area surrounding, the source being modeled, and average moisture type), or site specific surface characteristics generated by AERSURFACE.

4.1.2 Screening Modeling Results

NAAQS, PSD increments and SILs cover a variety of averaging periods depending on the air pollutant in question. Therefore, EPA developed conversion factors to adjust screening modeling results to get the appropriate averaging time depending on the pollutant being modeled. In 2011, EPA revised and hard coded the screening conversion factors in AERSCREEN to produce 1-hour screening concentration values to get the appropriate averaging time depending on the pollutant being modeled shown Table 4-3.

TABLE 4-3
Screening Conversion Factors

1-Hour Conversion Factor	Averaging Time
1.0	3-hour
0.9	8-hour
0.6	24-hour
0.1	Annual

AERSCREEN calculates impacts from single sources only. Therefore, if two or more sources are being permitted or modified on the same premise, conduct screening modeling for each source separately, add each sources' impact, and then compare the total impacts to Table 4-2. If the impacts are less than the values shown in Table 4-2, then compliance with the NAAQS and PSD increments is demonstrated and refined modeling is not required.

4.2 REFINED MODLEING PROCEDURES

Refined modeling is required for all sources whose allowable annual emissions are above the screening modeling emission ranges listed in Table 4-1. Refined modeling is also required for sources that cannot demonstrate compliance with the AILs listed in Table 4-2 in a screening analysis.

4.2.1 AERMOD Modeling System Programs

AERMOD is an all-terrain steady-state dispersion model for determining ambient impacts within 50 km of a stationary source. AERMOD is based on Gaussian and planetary boundary layer concepts, and is designed for flat, simple, intermediate, and complex terrain applications. Therefore, applicants must use AERMOD if refined modeling is required in order to obtain a new or modified air permit in Connecticut. The AERMOD modeling system, including preprocessors, users' guides, and associated guidance documents are available for download on EPA's SCRAM website. The AERMOD modeling system includes the use of the following programs:

- **AERMOD** - regulatory refined dispersion model requires that various user-selected parameters, as well as incorporates the data created in AERMAP and AERMET;
- **AERMAP** - terrain pre-processor for AERMOD;
- **AERMET** - meteorological pre-processor for AERMOD;

- **AERMINUTE** - a program that uses 1-minute and 5 minute archived wind data to calculate hourly wind speed and direction for input to AERMET;
- **AERSURFACE** - utility program designed to calculate estimates of surface characteristics based on Land Use/Land Cover (LULC) information for input to AERMET, and
- **BPIPPRIM** - multi-building dimensions program incorporating the GEP technical procedures for PRIME downwash applications.

4.2.2 AERMOD Input Requirements

AERMOD Control Options

Control options contain the keywords that effectively execute AERMOD to calculate maximum impacts based on such options as urban/rural dispersion, type of pollutant, averaging times, and terrain height. The following AERMOD default regulatory control options are required in order to demonstrate compliance with both the NAAQS and PSD increments:

- use elevated terrain algorithms;
- stack-tip downwash (except for building downwash cases);
- calm and missing meteorological data processing routines;
- use of a 4-hour half-life for exponential decay of SO_2 (for urban sources only);
- vertical potential temperature gradients, and
- ARM2 for 1-Hour and Annual NO_2 modeling.

Source Emissions

CTDEEP requires that sources should input the proposed and or permitted maximum allowable hourly emission rates for compliance with the applicable NAAQS and PSD increments with averaging times of less than a year. The maximum allowable annual emission rates may be used to show compliance for annual average based standards.

Source Parameters

The following input source location and parameters are required to be modeled in AERMOD:

- stack location - X coordinate (UTM-X grid in meters), Y coordinate (UTM-Y grid in meters);
- stack base elevation - height (m) of stack base above mean sea level;
- pollutant emission rate (g/s);
- stack height - height of stack-top above stack base (m);
- stack top exit temperature - temperature (^{o}K) of effluent exiting the stack;
- stack gas velocity - (m/s) of effluent exiting the stack, and
- stack diameter - at the inside top of stack (m).

BPIPPRIM – Building Downwash

CTDEEP recommends procedures described in the EPA's "Guideline for Determination of Good Engineering Practice Stack Height" (EPA, 1985) for GEP stack height calculations.   To address building downwash, a GEP stack height must be determined for each source to be modeled at the applicant's premise.   The lesser of actual or GEP stack height should be used for modeling each source.   The latest version of EPA's Building Profile Input Program for PRIME (BPIPPRIM) must be used to generate wind-direction-specific building dimensions for calculating downwash impacts in AERMOD from each source subject to building downwash.

AERMAP – Receptor Data

AERMAP is the terrain pre-processor that creates an elevation and height scale (the terrain height and location that has the greatest influence on dispersion) for each "ambient air" receptor, except where the atmosphere over land owned or controlled by the stationary source where the owner or operator of the source employs "measures, which may include physical barriers, that are effective in deterring or precluding access to the land by the general public" [1] across the modeling domain.   AERMAP automatically selects the closest node elevation in each quadrant with respect to the receptor or source and then weights that elevation with respect to the distance from the receptor or source.   The closer the node elevation, the more weight it is given. Conversely, further distances are weighted less.

The latest version of AERMAP is designed to process National Elevation Dataset (NED) data, which is available on the U.S. Geological Survey (USGS) website.   Applicants should use at least 1 arc second (30 meter resolution), preferably 1/3 arc second (10 meter) resolution NED data to develop a Cartesian type receptor grid to determine all near and far field receptor elevations.   The goal of designing a receptor network is to convincingly capture the area of maximum impacts.   As an initial starting point, construct a Cartesian receptor grid centered on the source with 50m receptor spacing out to a distance of 2km.   For a distance from the source of 2km to 5km, place receptors with 500m spacing, and for a distance from the source of 5km to 10km, use 1km spacing.   CTDEEP recommends a maximum receptor spacing of 25m for calculating impacts in cavity regions of structures and within property boundaries (that have public access), or around facility property or fence-line (where public access is prohibited).   If modeling results show significant impacts at 10km, then the grid should be extended to a distance of insignificant impacts, using 2km spacing out to 20km and 5km spacing beyond 20km.   Additional 1km receptor grid(s) in 50m increment spacing should also be developed around maximum impacts beyond the inner receptor grids of 2km to identify the point of maximum impact.   Additional discrete receptors may also be required at locations designated as sensitive, such as schools and hospitals, or in environmental justice communities, which provide enhanced public participation requirements, and may require additional information about potential environmental and health impacts.

AERMET – Meteorological Data

Meteorological data for refined modeling must be representative of wind flow and dispersion characteristics that affect source emissions across the modeling domain.   AERMET uses meteorological measurements of several boundary layer parameters to compute vertical profiles of: wind direction, wind speed, temperature, vertical potential temperature gradient, vertical turbulence (sigma-w), and horizontal turbulence (sigma-theta), and radiation measurements.   One year of site-specific meteorological data is

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[1] Draft Guidance, Revised Policy On Exclusions from "Ambient Air" EPA, November 9, 2018

always preferred to off-site NWS data for dispersion modeling near a source (EPA's Meteorological Monitoring Guidance, 2000). However, applicants may use the most recent five years of NWS data or three years of prognostic meteorological data to adequately characterize year-to-year meteorological variability, in lieu of one year of site–specific data. For a more detailed discussion of data representativeness considerations, see Section 3.1.1 of the AERMOD Implementation Guide, and Section 8.4 of EPA's Appendix W of 40 CFR Part 51 Guideline on Air Quality Models.

AERMET is designed to accept data from any of the following sources:

- upper air sounding data from the NWS upper air station in Albany, NY for inland areas and Brookhaven, NY for coastal areas:
- hourly surface site-specific wind, temperature, turbulence, pressure, and radiation measurements (if available);
- hourly surface data from the most representative NWS ASOS sites, and
- hourly prognostic meteorological data.

AERMET has the capability of accepting hourly averaged 1-minute and 5-minute NWS wind data output from the above mentioned AERMINUTE program to reduce the number of calm hours. AERMET produces a profile file that consists of single and multiple-level observations of wind speed, wind direction, temperature, site-specific turbulence data such as standard deviation of the fluctuating wind direction, and vertical wind speed. AERMET also produces an hourly surface file of boundary layer parameter estimates and surface characteristics (albedo, Bowen ratio, and surface roughness length) of the area being modeled. The user must first specify monthly (seasonal) variations of these surface characteristics for up to 12 different contiguous non-overlapping sectors. Each wind sector can have a unique albedo (r), Bowen ratio (B_o), and surface roughness (Z_o) value.

AERMET processes meteorological data in three stages:

- **Stage 1** extracts upper air and surface meteorological data from archived files and processes the data through various quality assessment checks;
- **Stage 2** merges available data (including the hourly averaged 1 and 5-minute wind data generated by AERMINUTE) for 24-hour periods (surface data, upper air data, and on-site data) and stores these data together into a single intermediate file; and
- **Stage 3** reads in upper air and surface merged met data, user input settings of 0.5 m/s for minimum wind speed and adjust surface friction velocity (U*) option for NWS data (keep in mind that for site-specific met data, measured turbulence data is used in lieu of the adjust U* option), and surface characteristics (from AERSURFACE output discussed below) calculates the necessary boundary layer parameters used by AERMOD.

AERSURFACE – Surface Characteristics

The AERSURFACE pre-processor tool is used to obtain realistic and reproducible surface characteristic values for input to AERMET. Surface characteristics generated for AERMET via AERSURFACE should reflect the land use characteristics where the meteorological data are collected. The preprocessor uses publicly available national land cover datasets and look-up tables of surface characteristics that vary by land cover type and season. The latest version of AERSURFACE requires the input of land cover

data from the USGS National Land Cover Data 1992 archives (NLCD92) to determine the land cover types for user-specified locations.   Future revisions to AERSURFACE will be able to accept more current NLCD data.   The following methodologies are recommended to derive the three aforementioned surface characteristics:

- **Surface roughness length** is determined based on an inverse-distance weighted geometric mean for a default upwind distance of 1km relative to the meteorological site and divided up by sectors to account for variations in land cover; however, the sector widths should be no smaller than 30°. Sectors are defined clockwise, as the direction from which the wind is blowing from with north at 0°/360°.   For each of the sectors, the various land use data points (pixels) are summed and the percentage of occurrence for each of the land-cover categories is calculated as shown in Table 4-4;
- **Bowen ratio** is based on a simple un-weighted geometric mean for a representative domain, with a default of 10km by 10km region centered on the meteorological site, and
- **Albedo** is based on a simple un-weighted arithmetic mean for the same 10km by 10km domain defined by the Bowen ratio.

Applicants are encouraged to follow Section 3.1.2 in EPA's latest version of the AERMOD Implementation Guide to determine surface characteristics around the subject source.   Section 5.1 of the AERMOD Implementation Guide, Section 7.2.1.1 of Appendix W (EPA 2017), and Table 4-4 should be followed to determine urban/rural dispersion coefficients based on land use within 3km around the subject source.   The preferred method to determine urban/rural dispersion coefficients in AERMOD is based on population density and/or total population across the modeling domain along the coastline due to the Long Island Sound body of water.

TABLE 4-4
USGS NLCD Land Cover Categories

Classification	Class Number	Land Cover Category
Water	11	Open Water
	12	Perennial Ice/Snow
Developed	21	Low Intensity Residential
	22	High Intensity Residential
	23	Commercial/Industrial/Transportation
Barren	31	Bare Rock/Sand/Clay
	32	Quarries/Strip Mines/Gravel Pits
	33	Transitional
Forested Upland	41	Deciduous Forest
	42	Evergreen Forest
	43	Mixed Forest
Shrub land	51	Shrub land
Non-natural Woody	61	Orchards/Vineyards/Other
Herbaceous Upland	71	Grasslands/Herbaceous
Herbaceous Planted/Cultivated	81	Pasture/Hay
	82	Row Crops
	83	Small Grains

	84	Fallow
	85	Urban/Recreational Grasses
Wetlands	91	Woody Wetlands
	92	Emergent Herbaceous Wetlands

Connecticut frequently experiences winter months where only a fraction of the month is snow covered. A review of the climate data for the meteorological station and years to be used in the modeling should be made to determine the number of days per month that experienced snow cover.   If the number of snow cover days exceeds 50%, then the month can be assigned the seasonal category of 4.   If the monthly data show less than or equal to 50% snow cover, then the seasonal category of 3 is appropriate. CTDEEP recommends that the surface characteristics be developed on a monthly basis consistent with Table 4-5 below.

TABLE 4-5
Seasonal Land Use Categories by Month

| CATEGORY	DEFINITION	MONTHS
1	Midsummer with lush vegetation	June – August
2	Autumn with un-harvested cropland	September and October
3	Late autumn after frost and harvest, or winter with no snow	November - March
4	Winter with continuous snow on the ground	December - March
5	Transitional spring with partial green coverage or short annuals	April and May

Depending on the source location, data from the following two upper air sites are required for AERMOD meteorological data processing: 1) Albany upper air sounding data for all sources located >10km away from Connecticut's shoreline; and 2) Brookhaven upper air sounding data for all sources located within 10km along Connecticut's shoreline.

Consistent with the above discussion, CTDEEP has developed AERMOD ready preprocessed NWS ASOS/AWOS meteorological data shown in Figure 4-1 below.   For most permit modeling conducted in Connecticut, applicants may download the available processed AERMOD ready meteorological data posted on our modeling web page at:
http://www.ct.gov/dep/cwp/view.asp?a=2684&q=450396&depNav_GID=1619

We strongly encourage applicants to consult with CTDEEP modeling staff to discuss meteorological data requirements for a specific project.

FIGURE 4-1

ASOS Met Sites in Connecticut
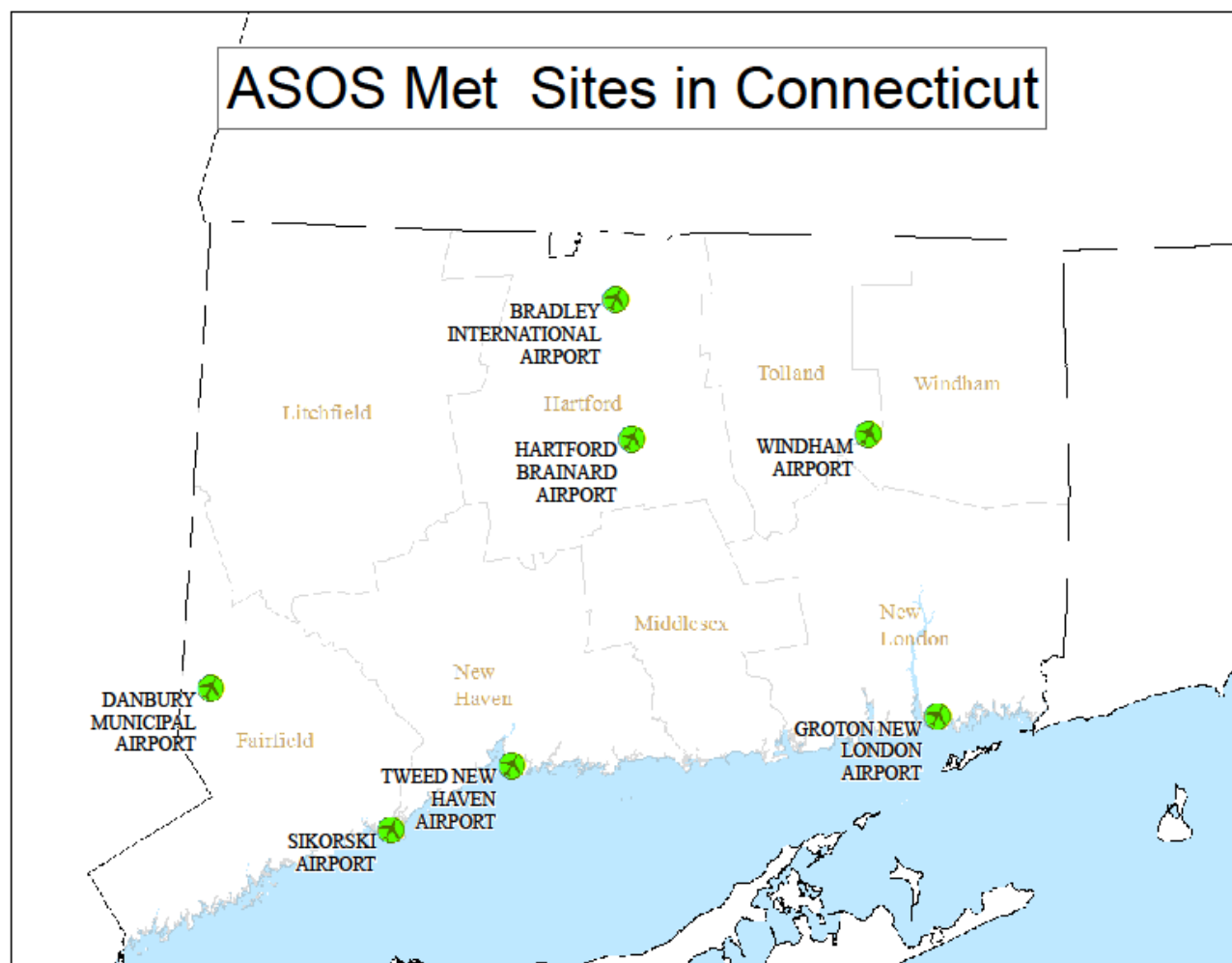
4.2.3 Single Source Refined Modeling

The objectives of the single source refined modeling is: 1) to determine if a new or modified source may cause or significantly contribute to a violation of the NAAQS and PSD increments, and 2) if a new or modified source has model predicted significant impacts in order to determine the significant impact area (SIA) for cumulative modeling.

Significant Impact Area Determination

The SIA is defined as the most distant location where air quality modeling predicts a significant ambient impact for a given pollutant, or the nominal 50 km distance, "**whichever is less".**   The SIA distance is essentially the modeling domain (including all receptors) within the SIA that is used to determine which sources to be included in a cumulative modeling analysis.   If maximum impacts exceed the SIL for any pollutant and averaging time shown in Table 3-3, then a cumulative ambient impact analysis is required.

4.3 1-HOUR NO$_2$ NAAQS COMPLIANCE OPTIONS

The EPA promulgated a new 1-hour NO$_2$ NAAQS based on the 3-year average (for modeling purposes based on the 5-year average) of the 98th percentile annual distribution of the maximum daily 1-hour concentration not to exceed 100ppb (188µg/m^3) in 2010. Due to the complex chemical transformation from sources' NO$_x$ emissions to form NO$_2$ in the atmosphere, and the stringency of the 1-hour NO$_2$ NAAQS, EPA issued several modeling guidance memorandums (EPA 2011 and 2014) regarding options for demonstrating compliance with the 1-hour NO$_2$ NAAQS. These options include a multi-tiered screening modeling approach, certain modeling exemptions for intermittent sources, and start-up/shutdown emissions scenarios. Below is a summary of the multi-tiered screening approach and modeling exemptions to attain the NO$_2$ NAAQS (see section 4.2.3.4 and Figure 4-1 in EPA's Appendix W Revisions to the Guideline on Air Quality Models for a detailed discussion of the NO$_2$ multi-tiered screening approach).

4.3.1 NO$_2$ Screening Methods

Tier 1 is a first tier (most conservative) "full conversion approach" of NO to NO$_2$ without additional modeling inputs or options.

Tier 2 Ambient Ratio Method 2 (ARM2)

The model internally multiplies Tier 1 impacts by ARM2 using default ambient ratios, or source-specific NO$_2$/NO$_x$ in stack ratio (ISR) data. The ARM2 national default minimum and maximum ambient ratios for the primary source is 0.5 and 0.9. For cumulative modeling, sources located within the immediate vicinity (1-3km) of the primary source being modeled is also 0.5. For sources beyond 1-3km of the subject source, the default value is 0.2. Preferably, source-specific NO$_2$/NO$_x$ ISRs may be used if all quality assurance procedures for NO$_2$/NO$_x$ within the typical range of measured ambient ratio values are satisfied, such as: EPA's NO$_2$/NO$_x$ ISR database, manufacturer test data, and peer-reviewed literature to justify a source's anticipated NO$_2$/NO$_x$ ISRs.

Tier 3 Plume Volume Molar Ratio/Ozone Limiting Method (OLM/PVMRM)

PVMRM/OLM screening methods are the most complex of the three tiers that require two additional model inputs: 1) default or source-specific NO$_2$/NO$_x$ ISRs, and 2) hourly ozone background data. Applicants must seek consultation from CTDEEP and EPA Region 1 modeling staff before conducting a Tier 3 NO$_2$ modeling analysis.

4.3.2 NO$_2$ Modeling Exemptions for Intermittent Sources

EPA provides flexibility and discretion to exempt intermittent emissions from ancillary sources such as emergency generators, fire pumps, small boilers, and engines because emission scenarios are not continuous enough to contribute significantly to the annual distribution of the maximum daily 1-hour NO$_2$ concentrations. The CTDEEP will consider an intermittent source on a case-by case basis with permit limits of up to 500 hours per year that could be potentially be exempt from 1-hour NO$_2$ modeling (also applicable for 1-hour SO$_2$ modeling). All other major and (minor sources on a continuous basis) will be required to perform modeling analyses to show compliance with the applicable 1-hour NO$_2$, and SO$_2$ NAAQS. Applicants are strongly encouraged to consult with the CTDEEP modeling staff in order to seek clarification and approval for 1-hour modeling exemptions prior to undertaking modeling analyses.

4.3.3 Startup/Shutdown Scenarios

All major sources and (minor sources on a continuous basis) are subject to perform a modeling analysis to show that startup/shutdown operating scenarios are in compliance with the applicable 1-hour NO_2 and SO_2, NAAQS. Only a limited number minor sources such as emergency generators, fire pumps, aux boilers, small CHP engines, and flares may be exempt due to the infrequent number of startups and shutdowns per year. This type of source(s) limits the number of startups and shutdowns to less than or equal to 500 hours per year may be considered intermittent; and therefore, would not significantly contribute to maximum daily 1-hour NO_2 and SO_2 concentrations. CTDEEP will consider such modeling exemptions only if 500 hour per year or less limitations and restrictions are included and enforced in a new or modified NSR air permit. Applicants are strongly encouraged to consult with the CTDEEP modeling staff in order to seek clarification and approval for 1-hour modeling exemptions prior to undertaking modeling analyses.

4.4 SINGLE SOURCE AIR QUALITY ASSESSMENTS FOR SECONDARILY FORMED PARTICULATE MATTER.

EPA incorporated a two-tiered approach for addressing single-source O_3 and secondary $PM_{2.5}$ impacts in the revised Guideline on Air Quality Models (EPA, 40 CFR Part51, Appendix W 2017). Due to the intensive photochemical modeling systems, the EPA issued guidance on the development of Modeled Emission Rate for Precursors (MERPS) as a Tier 1 Demonstration Tool (reduced form models), entitled *"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"* (EPA 2019). The first tier (Tier 1) utilizes existing empirical relationships between precursor emissions and impacts based on the most recent EPA's photochemical air quality modeling results of hypothetical industrial sources with similar source emissions and atmospheric characteristics.

The CTDEEP considers a Tier 1 demonstration adequate to estimate secondary impacts from new or existing single sources of significant SO_2 and/or NO_x precursor emissions for $PM_{2.5}$ formation. When the secondary air quality impact is combined with the primary air quality impact, if any, the total air quality impact can be compared to the SIL. Two forms of Tier1 demonstration tool are acceptable to determine if a source (the Project) complies with Tier 1 Secondary Impact Assessments. The first equation is the general form. The second equation shows the ratio of the Project's emissions to EPA's hypothetical source emissions multiplied by the hypothetical source impacts to solve for the Project's secondary air quality impact.

$$MERP = Applicable\ SIL\ value\ * \left(\frac{Hypothetical\ Source\ Emissions}{Hypothetcial\ Source\ Modeled\ Impacts}\right).$$

The equation is rewritten for applicants to solve for sources' secondary impacts seeking air permits in Connecticut;

$$Project\ Impacts = \frac{Project\ Emissions}{Hypothetical\ Source\ Emissions} * Hypothetical\ Source\ Modeled\ Impact$$

Where:

$MERP$ = Modeled Emission Rates Precursors of NO_x and VOCs for Ozone, and SO_2 and NO_x for $PM_{2.5}$;

Class II SIL Value = 1.2µg/m^3 and 0.2µg/m^3 for the 24-hour and annual PM$_{2.5}$ SILs; 1.0ppb for O$_3$ SIL;

Project Emissions = Subject Source's Maximum Allowable Annual Precursor Emissions (tpy); or

Hypothetical Source Emissions = Actual Precursor Emissions (tpy) used in EPA's Modeling;

Hypothetical Source Modeled Impacts = EPA's photochemical modeled impacts, and

Project Impacts = PM$_{2.5}$ Secondary Impacts[2], as applicable.

In summary, the Tier 1 demonstration tool provides a simple way for sources to add maximum downwind secondary PM$_{2.5}$ impacts to AERMOD predicted primary impacts and compare total impacts to the applicable PM$_{2.5}$ SILs, NAAQS and PSD Increments. **Connecticut has been classified as non-attainment for Ozone, therefore all major sources must comply with non-attainment new source review (NNSR) requirements[3], and will not be subject to performing a secondary O$_3$ impact analysis.**

4.4.1 Single Source Air Quality PM$_{2.5}$ Tier 1 Impact Assessment

For any new or modified source whose maximum allowable annual PM$_{2.5}$ emissions of >=10tpy, and/or precursor SO$_2$ and NO$_x$ annual emissions are >= 40tpy, a Tier 1 impact assessment is required based on EPA's photochemical hypothetical sources' PM$_{2.5}$ impacts data base. The contribution from both primary and secondary impacts should be compared to the PM$_{2.5}$ SILs shown in Table3-3. If the impacts are above the SILs, then compare the total impacts plus monitored background to determine if a source's total PM$_{2.5}$ ambient impacts comply with the applicable 24-hour and annual NAAQS shown in Table 3-1. Sources that are subject to PM$_{2.5}$ PSD increment modeling are required to combine the primary and secondary impacts (without background) in order to comply with the applicable 24-hour and annual increments shown in Table 3-2. **If MERP analysis shows that a source's impacts are above the applicable PM$_{2.5}$ SILs, then a cumulative modeling analysis will be required to determine compliance with the applicable PM$_{2.5}$ NAAQS and PSD Increments. If there are violations to the PM$_{2.5}$ NAAQS and PSD Increments, then a culpability analysis is required to show that the subject source does not contribute significantly to any violation. Consultation with DEEP modeling staff is recommended before undertaking additional secondary PM$_{2.5}$ assessments.**

4.5 MULTI-SOURCE REFINED MODELING AND INVENTORY REQUIREMENTS

Multi-source modeling analysis is required when single-source refined modeling show significant impacts from a new or modified source seeking a permit. In any NAAQS and PSD increment multi-source modeling analyses, the subject source must use proposed short and long term allowable emission rates. All other existing permitted stationary sources within the subject source's SIA may be modeled using typical representative actual emissions based on the most recent 2-years of normal source operation. For any nearby existing NAAQS and PSD increment consuming sources, source parameters and emission rates can be downloaded from the radius search tool on CTDEEP's web page **(for PSD cumulative modeling, sort the data based on construction date of a facility/source and compare that date to PSD minor-source baseline date for the applicable pollutant to be modeled).** Consultation with CTDEEP

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[2] Only PM$_{2.5}$ secondary impacts are to be added to AERMOD predicted primary PM$_{2.5}$ impacts plus background for NAAQS compliance demonstration, without background for PSD Increments compliance demonstration.

[3] Connecticut is classified as non-attainment for O$_3$; therefore major sources are subject to NNSR permitting requirements by purchasing NO$_x$ and VOC emissions offsets for example.

is strongly recommended prior to performing multi-source modeling to ensure the data is accurate from the point source inventory data base.

The radius search program retrieves the following sources for the pollutant requested:

- For NAAQS modeling:

  o All stacks with actual $PM_{2.5}$ emissions of >= 10 tons per year (TPY) that fall within the radius of significance of the subject source.
  o All stacks with actual SO_2, NO_2, PM_{10}, and CO emissions of >= 15 tons per year (TPY) that fall within the radius of significance of the subject source.

- For PSD Increment modeling:

  o All sources affecting PSD increment (defined in RCSA sections 22a-174-3a(k)(5) and 22a-174-3a(k)(6)) that fall within the radius of significance of the subject source for the applicable pollutant.

For short term compliance demonstrations, assume continuous operation from most nearby sources unless there are enforceable permit conditions limiting hours of operation/year, and defining periods when a nearby source is not in operation. In the event that actual emissions are not available, applicants should use the latest permitted allowable emissions, or estimated emissions from fuel use data in consultation with CTDEEP. **The applicant will be responsible to perform a GEP analysis and input building downwash from facilities included in the multi-source modeling.**

If the SIA of a source extends beyond the Connecticut state line, the applicant must obtain existing source information from the neighboring state, submit a copy of the source emissions data to the CTDEEP, and include these sources in the modeling.

In addition to the inventory provided by CTDEEP for PSD increment modeling, the applicant may be required to address the effects of area-wide emissions growth on increment consumption, particularly when modeled concentrations approach the available increments in areas where existing measured ambient air quality levels are increasing.

4.6 ADDITONAL PSD IMPACT ANALYSES

The Federal PSD program requires that the owner of any new major source or a source undergoing a major modification provide an analysis of additional impacts that would occur as a direct result of the general, residential, commercial, industrial, and/or other growth associated with the construction and operation of the source.

In addition, an analysis of impairment of visibility, soils, and vegetation that would occur as a result of the source is also required (use of VISCREEN for a visibility screening modeling analysis is sufficient as a screening tool for Connecticut sources).   Further guidance relating to these analyses are provided in the EPA documents entitled: "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils and Animals" (EPA, 1980), "PSD Workshop Manual" (EPA, August 1980), and the draft NSR Workshop Manual (EPA, 1990).

4.7 AIR QUALITY RELATED VALUES

The 1990 CAA Amendments gives the Federal Land Manager's (FLMs) "affirmative responsibility" to protect Class I areas from adverse impacts caused by major sources of air pollution, and to provide the appropriate air analysis techniques. If a proposed or modified major source in Connecticut is located within 300 km of the following Class I areas across the northeast such as: Lye Brook Wilderness, Vermont, Great Gulf Wilderness Area New Hampshire, the Presidential Range-Dry River, New Hampshire, and Brigantine National Wildlife Refuge, New Jersey, the applicant should consult with CTDEEP staff, complete the FLM's Request for the Class I Area PSD Model Applicability Form, and send it to the northeast regional FLM's for the purpose of determining if a Class I area Air Quality Related Values (AQRV) analysis is required. A listing of the FLMs for the Class 1 Areas in New England can be found at: https://www.epa.gov/caa-permitting/class-1-federal-land-managers-epa-region-1. CTDEEP and the appropriate FLM will determine if an AQRV modeling demonstration is necessary on a case-by-case basis, considering such factors as:

- current conditions of sensitive AQRV;
- magnitude of emissions;
- distance from the Class I area;
- potential for source growth in an area/region;
- existing/prevailing meteorological conditions, and
- cumulative effects of several sources to AQRV.

If an AQRV refined modeling analysis is required, the applicant, CTDEEP, and the FLM will work together to formulate an appropriate modeling demonstration. For a general description of what is expected of an AQRV analysis, see the latest document entitled Federal Land Managers' "Air Quality Related Values Workgroup (FLAG) Report" at:
http://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf
Additional support can be found on the National Park Service web page at:
http://www.nature.nps.gov/air/Permits/flag/index.cfm.

5.0 BACKGROUND AIR QUALITY

Background air quality levels are added to modeled impacts to determine compliance with the NAAQS for the appropriate pollutant and averaging time. Recommendations for estimating pollutant specific background concentrations from CTDEEP monitoring sites are summarized in this section below. The most recent three years of available data from representative federal reference method (FRM) or equivalent CTDEEP monitoring sites located within or nearest to the modeling domain, should be added to the modeled predicted impacts to demonstrate compliance with the NAAQS. Figure 5-1 below, depicts the current CTDEEP air monitoring network with a listing of parameters measured at each site.

FIGURE 5-1

Air Monitoring Sites in Connecticut
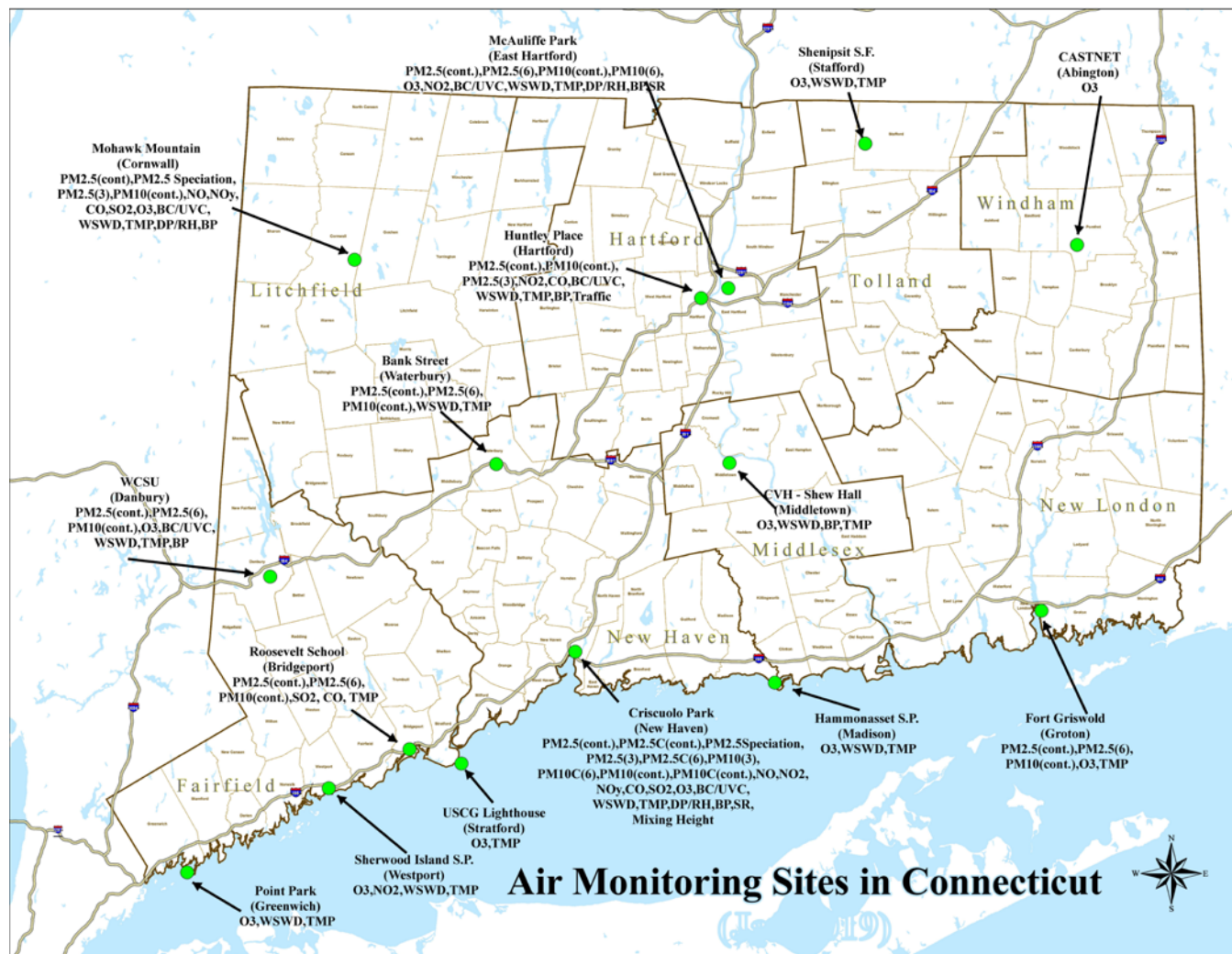
5.1 MONITORED DESIGN CONCENTRATIONS

The monitored design concentrations are added to the modeled results as a conservative approach to estimating total predicted concentrations. Both short and long term monitored design values are calculated based on 3-year average concentrations. However, this does not preempt or alter the Appendix W requirement for use of 5-years of representative NWS meteorological data or at least 1-year of site-specific data for modeling. There may be occasions where a more refined short-term average background estimate is needed in a modeling review, particularly when modeled concentrations plus the design background value exceeds the NAAQS. For modeling reviews that cannot demonstrate compliance using ambient monitored design concentrations as background, more refined approaches may be considered and consultation with the CTDEEP modeling staff is paramount.

Background concentrations for a specific project should be based on one or more monitoring sites that are most representative of background levels expected at the source location. Since AERMOD allows for multi monitoring sites to be used based on wind direction from the subject source to upwind and downwind

monitors, applicants may use multi-monitoring sites to add background to the modeled predicted concentrations to demonstrate compliance with the applicable NAAQS.

Proximity of monitoring site(s) to the source location is the main criteria used to choose the monitoring sites to include in your background estimate. A secondary consideration would involve a comparison of the land use surrounding the source and a monitoring site. If the SIA of a proposed source extends across the Connecticut border to a neighboring state, or the source being modeled is located close to a neighboring state border, the applicant may need to obtain monitored data from the neighboring state in order to establish a representative background value for the project impact area.

Sources subject to federal PSD requirements should contact CTDEEP to determine whether pre- or post-construction monitoring will be required for some pollutants if existing CTDEEP monitored data are deemed non-representative. This determination will be made on a case-by-case basis following EPA's Appendix W and monitoring guidance.

The latest available measured SO_2, NO_2, PM_{10}, $PM_{2.5}$ and CO design concentrations calculated from CTDEEP's FRM ambient monitors are available on the CTDEEP web site at:
http://www.ct.gov/dep/cwp/view.asp?a=2684&Q=421150&depNav_GID=1744

5.1.1 1-Hour SO$_2$ and NO$_2$

The appropriate methodology for incorporating background concentrations in single source and cumulative impact assessments for the 1-hour NO_2 and SO_2 NAAQS are calculated based on the most recently available three (3) year averages of the 98th and 99th percentile of background concentrations by season and hour of day, respectively, excluding periods when the subject source is expected to impact a nearby downwind monitor.

5.1.2 Annual NO$_2$

The annual average NO_2 background concentration is calculated based on the recently available 3-year highest annual average NO_2 monitored concentrations.

5.1.3 PM$_{2.5}$

The representative background monitored 24-hour $PM_{2.5}$ design value is calculated based on the recently available 3-year average of the 98th percentile 24-hour average $PM_{2.5}$ concentrations. The recommended method for incorporating annual background design values is calculated based on the 3-year highest annual average monitored $PM_{2.5}$ concentrations.

5.1.4 PM$_{10}$

The recommended method to determine the background concentration for the 24-hour PM_{10} design value is based on the recently available 3 year average 24-hour highest fourth high concentrations.

5.1.5 CO

The appropriate method to determine background concentrations for the 1-hour and 8-hour CO NAAQS is calculated based on the highest second high design values from the recently available three year 1-hour and 8-hour monitored concentrations, respectively.

5.1.6 Pb

CTDEEP is currently estimating ambient Pb levels from speciated $PM_{2.5}$ data only at the Criscolo Park site in New Haven, CT.   This method of measuring ambient Pb levels will not be considered a federal reference method (FRM) for demonstrating attainment/nonattainment with the newly revised NAAQS of $0.15 \,\mu g/m^3$ (rolling three-month average not to be exceeded over a three-year period), which was effective on January 12, 2009.   A value equal to one half of the NAAQS ($0.075 \,\mu g/m^3$ 3-month average) should be used as background for modeling purposes at all Connecticut locations until FRM measured data become available.

Applicants may use alternative methods to calculate background design values only after a demonstration to CTDEEP that the alternative method is more appropriate to add to modeled impacts.

Notwithstanding the above discussion, CTDEEP has calculated and posted the latest background design values on the modeling web-page for applicants and consultants to use for NAAQS compliance modeling.

5.2 HAZARDOUS AIR POLLUTANTS

Background levels for hazardous air pollutants regulated under Connecticut's hazardous air pollution program are expected to be quite low.   For example, background levels for dioxin (currently the only hazardous air pollutant with a Connecticut Ambient Air Quality Standard (CAAQS)) have been barely detectable.   Therefore, CTDEEP recommends that background levels for hazardous air pollutants for which a CAAQS exists be defined as one half of the standard for these pollutants until more data become available.

6.0 ANALYSIS AND INTERPRETATION OF MODELED RESULTS

6.1 SHORT-TERM AVERAGES

Predicted AERMOD modeled short-term average impacts are based on averaging times of 1, 3, 8, and 24-hours. These values are compared directly to the applicable PSD short term increments or added to background levels for comparison with applicable short term NAAQS.

6.2 LONG-TERM AVERAGES

Predicted long-term average modeled impacts are based on averaging times from one month to a year.

For the lead NAAQS, the largest of the three-month average concentrations is added to a lead background concentration for comparison with the Pb NAAQS, which is a three-month rolling average not to be exceeded.   Using five years of AERMOD model results three-month rolling averages can be calculated from the monthly averages.

Annual average concentrations are predicted by AERMOD for comparison with the applicable annual PSD increments or added to background levels for comparison with the annual NAAQS.

7.0 <u>PRESENTATION OF COMPLIANCE DEMONSTRATION</u>

Air quality dispersion modeling analyses are performed to demonstrate compliance with all applicable NAAQS and Class II PSD increments in Connecticut. Once compliance with all of the applicable standards has been demonstrated, the applicant must submit a detailed report that clearly describes the modeling procedures, methodologies, analyses, results, and data bases used in the process. Applicants should submit the final modeling report as part of the permit application.

The final modeling report submitted to CTDEEP should have, at a minimum, the following contents:

- scope of the project;
- modeling approach;
- models used to demonstrate compliance;
- land use analysis;
- meteorological data;
- building related input data (GEP analysis);
- receptor grid/surrounding terrain;
- preparation of input parameters;
- selection of modeled load cases;
- background data used/processed;
- all other analyses/data needed to demonstrate compliance;
- tables of stack inputs (physical stack parameters, emission rates, flows) for all modeled sources;
- tables that list the maximum impact depending on the pollutant/averaging period (highest for SILs, 98th and 99th percentiles for the 1-hour NO_2 and SO_2 NAAQS respectively, H2H for 24-hour PSD increments, H2H for 24-hour PM_{10} NAAQS, 24-hour average 98th percentile for $PM_{2.5}$ NAAQS, and highest annual impacts for all pollutants' NAAQS and PSD increments), the corresponding receptor location (Easting/Northing coordinates) and elevation, and the meteorological period associated with the maximum impact for each pollutant/averaging period, and
- comparison of final modeling results to applicable NAAQS and Class II PSD increment standards.

Applicants must also submit copies of the following electronic files: all dispersion model input/output files; input/output files from the applicable AERMOD preprocessors used such as AERMAP, AERSURFACE, AERMET, AERMINUTE and BPIPRIME; any raw meteorological data used; any post-processor programs used to calculate ambient impacts or background data such as access data bases, excel spreadsheets, and or computer code such as PYTHON and or FORTRAN. Please include a directory of file(s) submitted files, and a "Readme" text file describing file naming conventions that are clearly identified.

8.0 REFERENCES

CTDEEP, 2009: Ambient Impact Analysis Guideline. A Guideline for Performing Stationary Source Air Quality Modeling in Connecticut.

EPA, 1980: A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals. EPA Publication No. EPA 450/2-81-078. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, August 1980: Prevention of Significant Deterioration 40 CFR 52.21, August 7, 1980

EPA, 1985: Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) – Revised. EPA Publication No. EPA-450/4-80-023R. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 1990: New Source Review Workshop Manual Prevention of Significant Deterioration and Nonattainment Area Permitting (draft, October, 1990). Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 1992: Screening Procedures for Estimating the Air Quality Impact of Stationary Sources Revised October 1992. EPA 454/R-92-019. Office of Air Quality Planning and Standards, Office of Air and Radiation U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 2000: Meteorological Monitoring Guidance for Regulatory Modeling Applications (EPA-454/R-99-005), Office of Air Quality Planning & Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 2010: Guidance Concerning the Implementation of the 1-hour NO_2 NAAQS for the Prevention of Deterioration Program. Memorandum dated June 28, 2010, Office of Air Quality Planning & Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 2010: Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the Prevention of Deterioration Program. Memorandum dated August 23, 2010, Office of Air Quality Planning & Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 2011: Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard. Memorandum (March 1, 2011), Office of Air Quality Planning & Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC.

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