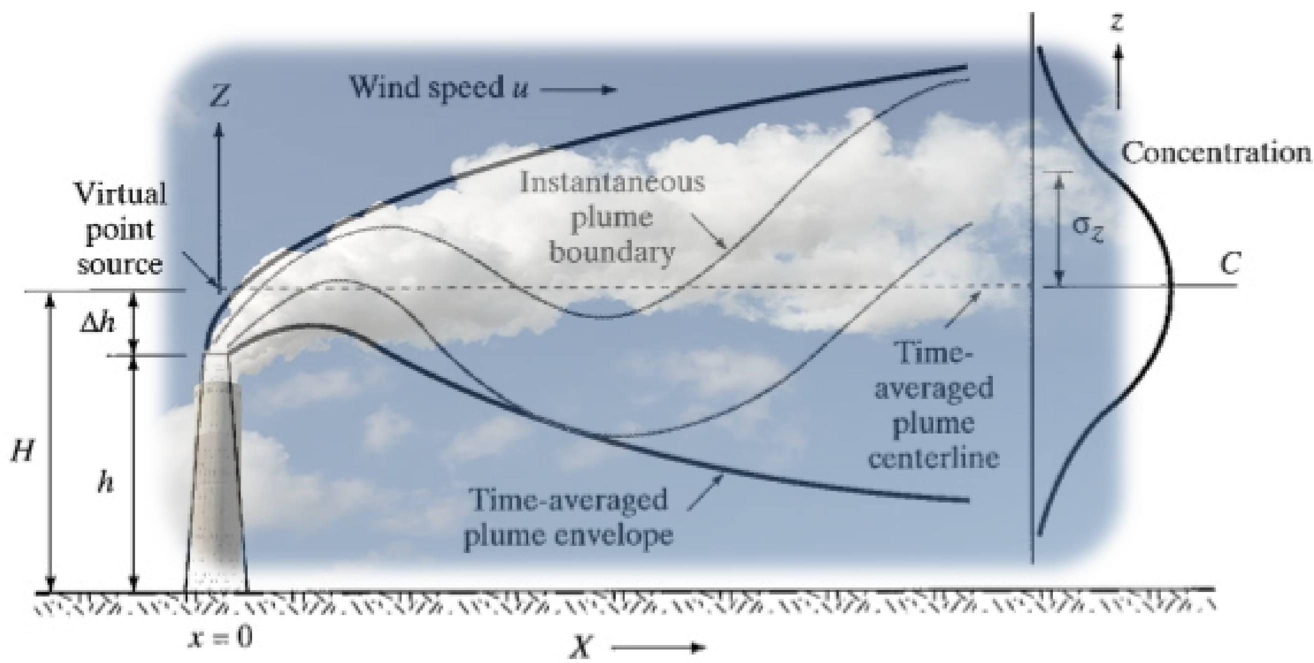
air pollution control district
SANTA BARBARA COUNTY

Modeling Guidelines for Air Quality Impact Assessments



February 2025

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1. Introduction

This document explains the requirements for performing air quality impact assessments for the Santa Barbara County Air Pollution Control District (District) using AERMOD. It is assumed that the reader has some modeling experience with this program; therefore, this document is not intended as a user's guide for AERMOD. The AERMOD user's guide, written by U.S. Environmental Protection Agency (EPA), is noted in the References section of this document and should be consulted for troubleshooting or when background information is needed.

1.1 Applicability

An air quality impact assessment (AQIA) must be completed for any of the following situations:

1. An AQIA is required as part of the District's New Source Review (NSR) permitting program according to District Rule 802.F. for any new or modified stationary source that meets at least one of the following criteria:
    a. The source has a potential to emit of any pollutant or its precursors which is equal to or greater than any threshold shown in Table 4 of District Rule 802; or
    b. The Control Officer determined that the new or modified stationary source has the potential to cause or contribute to a violation of any ambient air quality standard or increment; or
    c. The new or modified stationary source has the potential to emit more than 20 pounds per hour of any attainment pollutant or total suspended particulates (TSP).
2. An AQIA is necessary as part of the California Environmental Quality Act (CEQA) process.

An AQIA can consist of modeling one or multiple pollutants and averaging periods for an increment analysis, ambient air quality standard (AAQS) analysis, or both. Typically, both an increment analysis and an AAQS analysis are required for the District's NSR permitting program, while only an AAQS analysis is required for the CEQA process. Confirm the modeling requirements with the District before submitting the AQIA.

1.2 Prevention of Significant Deterioration Modeling for Major Sources

Contact the District prior to performing Prevention of Significant Deterioration (PSD) modeling for a major source. Information on PSD modeling is provided at EPA's *Clean Air Act Permit Modeling Guidance* webpage, noted in the References section of this document.

EPA Guidance Documents regarding PSD modeling are listed below:

- EPA's July 29, 2022 *Guidance for Ozone and Fine Particulate Matter Modeling*, available at: https://www.epa.gov/system/files/documents/2022-08/2022%20Guidance%20O3%20and%20Fine%20PM%20Modeling.pdf
- EPA's August 2016 *SO_2 NAAQS Designations Modeling Technical Assistance Document (Draft),* available at: https://www.epa.gov/sites/production/files/2016-06/documents/so2modelingtad.pdf
- EPA's August 23, 2010 *Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the Prevention of Significant Deterioration Program* and August 23, 2010 *Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard*, both available here: https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/20100823_page_1-hr_so2_naaqs_psd_program.pdf

- EPA's June 29, 2010 *Guidance Concerning the Implementation of the 1-hour NO_2 NAAQS for the Prevention of Significant Deterioration Program* available at: https://www.epa.gov/sites/production/files/2015-07/documents/appwno2.pdf

2. Emissions

2.1 Pollutants and Averaging Periods

2.1.1 Criteria Pollutants

Table 2.1.1-1 displays the criteria pollutant[1] and averaging period combinations that may be required to be modeled in the AQIA. The state and national ambient air quality standards are displayed for reference; for most pollutants and averaging periods, modeling is only required for one of the standards. However, **SO_2 and NO_2 must be modeled for comparison to both the 1-hour state standard and 1-hour national standard**. See Section 4.1 of this document for more information. Contact the District to confirm which pollutants and averaging periods should be included in the AQIA.

Table 2.1.1-1: Air Quality Standards and Increments for Criteria Pollutants

***Pollutant*:**	**Maximum Allowable Increase – Increments** (µg/m³)		**Ambient Air Quality Standard** (µg/m³)	
Averaging Period	Class I Area[1]	Class II Area[2]	California	National
Total Suspended Particulates:				
Annual Average	5	19	—	—
24-Hour Maximum	10	37	—	—
Sulfur Dioxide:				
Annual Average	2	20	—	26
24-Hour Maximum	5	91	105	—
3-Hour Maximum	25	512	—	—
1-Hour Maximum	—	—	655	196
Nitrogen Dioxide:				
Annual Average	2.5	25	57	100
1-Hour Maximum	10	100-188	339	188
Carbon Monoxide:				
8-Hour Maximum	200	2,500	10,000	10,000
1-Hour Maximum	800	10,000	23,000	40,000
Reactive Organic Compounds:				
3-Hour Maximum	3	40-160	—	—
Particulate Matter (< 10 µm):				
Annual Average	4	17	20	—
24-Hour Maximum	8	12-30	50	150
Particulate Matter (< 2.5 µm):				
Annual Average	1	4	12	9
24-Hour Maximum	2	9	—	35

[1] Although lead is a criteria pollutant, it is addressed below in Section 2.1.2, Other Pollutants.

[1] "Class I Area" means any area having air quality or air quality related values requiring special protection, and which has been designated Class I by a federal or state authority empowered to make such designation.

[2] "Class II Area" means any area not designated as a Class I or Class III Area pursuant to 40 CFR 51.166(e).

2.1.2 Other Pollutants

Table 4*, Air Quality Impact Analysis Thresholds*, in the District's Rule 802 includes criteria and non-criteria pollutants. District Rule 805 contains standards and increments for only the pollutants shown in Table 2.1.1-1. Other pollutants with a State or Federal Air Quality Standard are listed in Table 2.1.2-1. If a health risk assessment (HRA) is also being performed, then a separate analysis for H_2S is not required. The AAQS for H_2S is equal to the acute reference exposure level for H_2S. Furthermore, if a HRA is performed, then a separate analysis for vinyl chloride is not required.

For toxic air contaminants included in Table 4 of District Rule 802, but not included in Table 2.1.2-1 below, a health risk assessment is required in lieu of an AAQS analysis. For other pollutants that are not toxics, the AQIA is required for informational purposes only.

Table 2.1.2-1: Air Quality Standards for Other Pollutants

Pollutant	Averaging Period	Air Quality Standard ($\mu g/m^3$)
Lead	30-Day Average	1.5
Beryllium	30-Day Average	0.01
Vinyl Chloride	24-Hour	26
Hydrogen Sulfide	1-Hour	42

Please contact the District for the applicable requirements for municipal waste combustors.

2.2 Emission Sources

Contact the District to confirm which emission sources should be included in the AQIA. Sections 2.2.1 through 2.2.3 below explain the requirements for different types of AQIAs.

2.2.1 NSR AQIA with Only New Equipment

An AQIA for an NSR project at a stationary source with no existing equipment must include all permitted emitting equipment at its maximum potential to emit (PTE), which is calculated as part of the NSR permitting process. Emissions from permit-exempt equipment are not included in NSR AQIAs. Both an increment analysis and an AAQS analysis are required.

2.2.2 NSR AQIA with Existing Equipment

For an NSR project at a stationary source with existing equipment, an increment analysis and an AAQS analysis are required. The entire project emissions must be evaluated in the AQIA. The project emissions include the PTE for the newly-permitted equipment, as well as emissions from any equipment that is already under a District permit, if the District determines that those emissions are also part of the project. Any increase in emissions from the existing operating conditions (averaged over the three consecutive years immediately preceding the date of application) is considered part of the project and must be included in the AQIA for existing equipment that will emit more air pollution as a result of the project. Other existing equipment emissions may also be required to be included in the AQIA if the District determines that they are related to the new project (e.g., a steam generator installed within the past three years that the District understands to be part of the project).

Existing equipment at the stationary source that is determined by the District to not be part of the project should not be included in the AAQS analysis or the increment analysis. The air quality impacts of existing equipment not related to the project are accounted for in the background concentration in the AAQS analysis.

2.2.3 CEQA AQIA

Increment analyses are not required for CEQA AQIAs; only AAQS analyses are required for CEQA. For the CEQA AAQS analysis, all emissions from the NSR AAQS analysis must be included. Just as for District NSR AQIAs, emissions from existing equipment at the stationary source beyond the historical baseline level must be included in the CEQA AAQS analysis. In addition, ongoing (i.e., not construction-related) permit-exempt emissions must be included. For example, ongoing fugitive dust emissions (e.g., from driving on unpaved roads), combustion emissions from vehicles, and combustion emissions from drill rigs (e.g., at an oil and gas lease) must be included in the CEQA AAQS analysis. Additionally, all operational mobile emissions in a 1,000-foot line extending outside the property boundary must be modeled. An AQIA for CEQA should *not* include emissions from site grading, paving, welding, or other activities associated with construction. Emissions from oil and gas well drilling must be included in the CEQA analysis; the District does not consider drilling wells on an oil and gas lease to be a construction activity because it occurs over the life of the project.

2.3 Emission Calculations

Once the applicant has determined which emission sources, pollutants and averaging periods must be evaluated in the AQIA, the emissions must be calculated. Detailed emission calculation spreadsheets, containing all calculation assumptions, for each pollutant and averaging period must be submitted to the District with the AQIA. All calculations within spreadsheets must contain formulas (i.e., spreadsheets showing only values in the cells will be returned to the applicant for revision).

Because AERMOD requires the emission rates to be entered in units of grams per second (g/s), it is useful to first calculate the emissions on an annual, 24-hour, 8-hour, 3-hour or 1-hour basis, and then convert to g/s. The *maximum* possible emissions during each averaging period should be used to model the impacts. For example, an emergency flare is installed at an oilfield, resulting in SO_2 emission higher than normal during certain short term operations. The worst case short term flaring scenario is when produced sour gas is routed to the emergency flare for a maximum of 5 minutes in a day. For modeling purposes, the 24-hour, the 3-hour and the 1 hour-SO_2 mass emissions from the flare are all equal (e.g., 1 lb) because the flaring event occurs within 5 minutes. However, the emission rate (g/s) varies for each averaging period.

If the ratio of $PM_{2.5}$ to PM_{10} is not known, all PM_{10} can be assumed to be $PM_{2.5}$. This is a conservative assumption that should be refined if the $PM_{2.5}$ impacts exceed an AAQS or increment threshold. The use of a $PM_{2.5}/PM_{10}$ ratio less than 1 requires justification from the applicant and is subject to approval by the District.

3. Air Dispersion Model

The District requires that EPA's AERMOD be used to perform the air dispersion modeling for AQIAs, except for offshore platforms. The current version of AERMOD at the time of writing this document is dated 24142. The AERMOD executable is available for free from EPA. There are also many software options that incorporate AERMOD in a more user-friendly interface, such as Lakes Environmental's (Lakes') AERMOD View and Providence/Oris' BEEST. While the District does not recommend any one particular software product, the District primarily uses Lakes' AERMOD View. The use of Lakes'

AERMOD View by the applicant may help with the ease of review and sharing of files. Furthermore, **the District will not accept AQIAs performed using HARP 2.**

Because there are multiple pollutants and averaging periods required for AQIAs, it is helpful to create a separate AERMOD project file for each pollutant and averaging period. However, if the maximum g/s emission rate for a pollutant on an annual and 24-hour basis were the same, for example, it would save time to run the two averaging periods within the same AERMOD project file.

3.1 Offshore Modeling

In general, the District requires AERMOD for offshore modeling (e.g., offshore platforms, marine vessels). Hourly meteorological data are needed from both offshore and onshore locations. Applicants should contact the District if they have a project that requires offshore modeling.

3.2 Control Options

AERMOD contains several regulatory options, which are set by default, as well as non-regulatory options. The District requires that the regulatory options are used. The use of any non-regulatory default options must be justified with a discussion in the AQIA report and approved by the District.

3.2.1 Conversion of NO_X to NO_2

Although the NO_2 National Ambient Air Quality Standard (NAAQS) is based on NO_2 concentrations, the majority of nitrogen oxides (NO_X) emissions are in the form of nitric oxide (NO) rather than NO_2. The resultant NO_2 concentrations are largely driven by the ambient chemical environment (i.e., the reaction of NO with ambient ozone to form NO_2) and the initial NO_2/NO_X ratio of the emissions (i.e., the in-stack ratio). The EPA outlines a three-tiered approach to estimating modeled NO_2 concentrations.

For most projects, the District recommends using the Tier 2 Ambient Ratio Method Version 2 (ARM2), which uses the EPA polynomial equation to predict NO_2/NO_X ratios and does not require additional site-specific information. Please contact the District for approval prior to using any other Tier or method.

EPA provides additional clarification on the conversion of NO_X species to NO_2 in the following document:

- EPA's December 2015 *Technical support document (TSD) for NO2-related AERMOD modifications*, available at: https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/AERMOD_NO2_Changes_TSD.pdf.

The California Air Pollution Control Officers Association (CAPCOA) provides guidance on demonstrating compliance with the 1-hour NAAQS, but does not discuss the new Tier 2 ARM2 or Tier 3 PVMRM2:

- CAPCOA's October 2011 Guidance Document, *Modeling Compliance of The Federal 1-Hour NO2 NAAQS,* available at: http://www.valleyair.org/busind/pto/tox_resources/CAPCOANO2GuidanceDocument10-27-11.pdf.

The methods available in AERMOD to account for the conversion of NO_X species to NO_2 are described in Sections 3.2.1.1 through 3.2.1.4 below.

3.2.1.1 Tier 1

Tier 1 assumes full conversion of NO_X species to NO_2 (i.e., 100 percent of NO_X emissions = NO_2 emissions). This method is the most conservative. No special parameters or options are required to be selected.

3.2.1.2 Tier 2 ARM2 (Recommended by the District)

The Tier 2 Ambient Ratio Method Version 2 (ARM2) must be selected prior to running AERMOD. This option may only be selected if the user specifies that NO_2 is the pollutant being modeled in AERMOD. The ARM2 applies a 6^{th} order polynomial equation to predict the NO_2/NO_X ratio.

For more information on the Tier 2 ARM2, see EPA's *Technical support document (TSD) for NO2-related AERMOD modifications* and Section 3.2.4, Input parameters for NO_2 conversion options, of the AERMOD user's guide, noted in the References section of this document.

The ARM2 options in AERMOD have the following parameters:

- Minimum NO_2/NO_X Ratio: Use the default value of 0.50.
- Maximum NO_2/NO_X Ratio: Use the default value of 0.90.

3.2.1.3 Tier 3

The three Tier 3 methods for estimating the conversion of NO_X to NO_2 are the Ozone Limiting Method (OLM), the Plume Volume Molar Ratio Method Version 2 (PVMRM2), and the Generic Reaction Set Method (GRSM).

The Tier 3 methods require background ozone concentrations. Other parameters for the Tier 3 methods are:

- Equilibrium NO_2/NO_X Ratio: The default value used by the model is 0.90. A user-specified value can be defined here between 0.10 and 1.00.
- Default In-Stack NO_2/NO_X Ratio: A default value of 0.50 will be used for all sources unless a user-specified value is provided for the source in the NO_2 Ratios screen of the Source Pathway dialog. The default value specified will also be used if the user did not specify a value for a specific source in Source Pathway - NO_2 Ratios.

3.2.2 Special Processing Options for the AAQS Analysis for NO_2

To meet the 1-hour NAAQS, the 3-year average of the annual 98^{th} percentile of the 1-hour daily maximum concentrations must not exceed 100 ppb (188 $\mu g/m^3$). If Lakes' AERMOD View is used to complete the AQIA, select the option for 1-hour NO_2 NAAQS processing in the Control pathway, which will prompt the model to display the 8^{th} Highest High (98^{th} percentile) of the maximum daily 1-hour results. If Lakes' AERMO View is not used, the user may directly enter the appropriate keywords/parameters in the AERMOD input file. See Section 3.2.15, Processing for 1-hour NO_2 and SO_2 NAAQS, of the AERMOD user's guide for more information on the NO_2 processing in AERMOD.

3.2.3 Special Processing Options for SO_2

To meet the 1-hour NAAQS, the 3-year average of the annual 99^{th} percentile of the 1-hour daily maximum concentrations must not exceed 75 ppb (196 $\mu g/m^3$). If Lakes' AERMOD View is used to complete the AQIA, select the option for 1-hour SO_2 NAAQS processing in the Control pathway, which will prompt the model to display the 4^{th} Highest High (99^{th} percentile) of the maximum daily 1-hour results. If Lakes' AERMOD View is not used, the user may directly enter the appropriate keywords/parameters in the AERMOD input file. For more information on specific modeling guidance for the 1-hour SO_2 NAAQS, see EPA's Memorandum, *Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard*, noted in the References section of this document. See Section 3.2.15, Processing for 1-hour NO_2 and SO_2 NAAQS, of the AERMOD user's guide for more information on the SO_2 processing in AERMOD.

The 3-hour increment threshold for SO_2 is not to be exceeded more than once a year. For that reason, report the 2nd Highest High for the 3-hour SO_2 value. In Lakes' AERMOD View, the 2nd Highest High can be selected under the Output Options, Tabular Outputs Screen. If Lakes' AERMOD View is not used, the user may directly enter the appropriate keywords/parameters in the AERMOD input file.

In addition to the special processing options noted above, AERMOD will automatically apply a 4-hour half-life decay coefficient for urban SO_2 sources.

3.2.4 Special Processing Options for the AAQS Analysis for $PM_{2.5}$

To meet the 24-hour NAAQS for $PM_{2.5}$, the 3-year average of the annual 98th percentile of the 24-hour concentration must be equal to or less than 35 µg/m^3. If Lakes' AERMOD View is used to complete the AQIA, select the option for 24-hour $PM_{2.5}$ NAAQS processing in the Control pathway, which will prompt the model to display the 8th Highest High (98th percentile) of the 24-hour results averaged over 5 years (assuming a 5-year meteorological data set is used). In addition, select the Annual averaging time, which will provide the 1st Highest High of the annual results averaged over 5 years (assuming a 5-year meteorological data set is used). If Lakes' AERMOD View is not used, the user may directly enter the appropriate keywords/parameters in the AERMOD input file. See Section 3.2.14.1, Processing for fine particulate matter (PM-2.5), of the AERMOD user's guide for more information on the $PM_{2.5}$ processing in AERMOD.

3.2.5 Annual Averaging Period Options

The annual standards listed in Table 1 of District Rule 805 for "Annual Arithmetic Mean" must be compared to the annual average concentration from each individual year of met data. **Run the annual averaging period by selecting the ANNUAL averaging time options.** In addition, **select the "Report Maximum Annual Average for Each Met Year"** that is available in Lakes' AERMOD View (or use the appropriate AERMOD keywords if a different interface is used to run AERMOD). This option will allow the modeler to compare the highest annual average from an individual year to the annual standards in Table 1 of District Rule 805. Do not select the PERIOD option in AERMOD, which computes a single multi-year average concentration. The PERIOD option may give slightly different results than the multi-year average of individual ANNUAL mean concentrations due to differences in the number of calms and/or missing data from year to year. The ANNUAL average output is based on the average of the ANNUAL values across the years of meteorological data processed.

3.3 Defining Urban and Rural Conditions

The Auer method for classifying a site as urban or rural is specified in EPA's *40 CFR Part 51 Appendix W*, noted in the References section of this document. Follow the Auer method, explained below, for the selection of either urban or rural dispersion coefficients:

1. Draw a circle with a radius of 3 km from the center of the emission source or centroid of the polygon formed by the facility emission sources.

2. If the industrial, commercial, dense single/multi-family, and multi-family two-story land use types account for 50% or more of the area within the circle, then the area is classified as urban; otherwise, the area is classified as rural.
3. To verify if the area within the 3 km circle is predominantly rural or urban, overlay a grid on top of the circle and identify each square as primarily urban or rural. If more than 50% of the total number of squares is urban, then the area is classified as urban; otherwise, the area is rural. See Figure 3.3-1 for an example of this grid method.

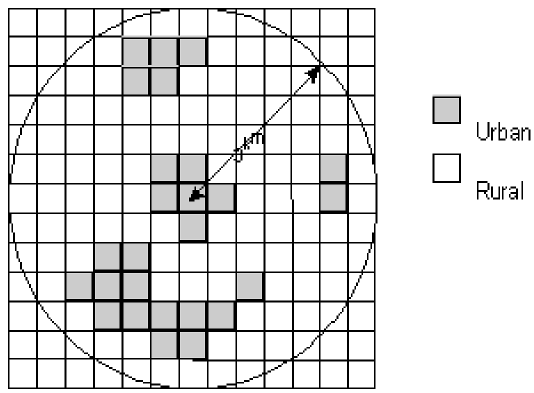

Figure 3.3-1: Auer Method for Determining Urban or Rural Dispersion

From the Auer method, areas typically defined as rural include:

- Residences with large grass lawns and trees
- Large estates
- Metropolitan parks and golf courses
- Agricultural areas
- Undeveloped land
- Water surfaces

Auer defines an area as urban if it has less than 35% vegetation coverage or if the area falls into one of the land use types described in Table 3.3-1.

Table 3.3-1: Urban Land Use

Use and Structures	Vegetation Coverage
Heavy industrial	Less than 5%
Light/moderate industrial	Less than 5%
Commercial	Less than 15%
Dense single/multi-family	Less than 30%
Multi-family two-story	Less than 35%

After the site classification has been determined, apply it to all sources (i.e., do not model some sources as rural and other sources as urban). If the urban option is selected, enter the population of the city where the project is located. If the facility is located in an unincorporated area, use the closest city listed in Table 3.3-2. The default value of 1 meter for urban surface roughness length is appropriate for most urban sites. Use of any value other than 1 meter for the urban surface roughness is considered a non-regulatory option, and requires appropriate documentation and justification.

Table 3.3-2: Population Data for Urban Dispersion Modeling

City Name	Population in 2020
Buellton	5,161
Carpinteria	13,264
Goleta	32,690
Guadalupe	8,057
Lompoc	44,444
Santa Barbara	88,665
Santa Maria	109,707
Solvang	6,126

3.4 UTM Coordinate System

The coordinate system that should be used in AERMOD is Universal Transverse Mercator (UTM). Ensure all modeled sources, buildings, and receptors are defined in the same datum. In the AQIA report, state the datum used in the model.

3.5 Source Parameters

The primary source types and their input requirements are outlined in Sections 3.5.1 through 3.5.5. Detailed descriptions of the input fields are found in the AERMOD user's guide, noted in the References section of this document. All source parameter units specified in brackets are the default units in the AERMOD executable.

After entering all the source information into AERMOD, the user should create a separate source group for each source, as well as including a source group containing all the sources in the model. The source group of all sources will allow the impact from all sources to be easily identified. The separate source groups for each source will help identify the air quality impact driving devices.

3.5.1 Point Sources – POINT, POINTCAP, POINTHOR

A point source is the most common type of release and is characterized by a traditional stack or isolated vent. Examples of point sources include combustion equipment with stacks and closed fixed roof tanks. AERMOD includes three options for point sources: the POINT source is used for a non-capped vertical stack; the POINTCAP source is used for a vertical stack with a rain cap; and the POINTHOR source is used for a horizontal stack.

The point source parameter inputs are:

- X Coordinate [m]: Easting UTM at the center of the point source.
- Y Coordinate [m]: Northing UTM at the center of the point source.
- Release Height [m]: Source release height (or stack height) above the ground.
- Stack Diameter [m]: Inner diameter of the stack.
- Exit Velocity [m/s]: Stack gas exit velocity.
- Stack Temperature [K]: Stack gas exit temperature.
- Emission Rate [g/s]: Pollutant emission rate.

3.5.2 Area Sources – AREA, AREAPOLY, AREACIRC

Area sources are used to model releases that occur over an area with a consistent release height. Examples of area sources include landfills, open tanks, slag dumps and lagoons. AERMOD includes three options for specifying the shape of an area source: the AREA source is used to specify rectangular areas that may also have a rotation angle specified relative to a north-south orientation; the AERAPOLY source is used to specify an area source as an irregularly-shaped polygon; and the AREACIRC source is used to specify a circular-shaped area source. All three of the area source types use the same calculations for estimating impacts from area sources, and are merely different options for specifying the shape of the area source.

The source parameter inputs for each of the area source types are described in Sections 3.5.2.1 through 3.5.2.3 below.

3.5.2.1 AREA Sources Options

AERMOD accepts rectangular areas that may have a rotational angle specified relative to a north-south orientation. The AREA source parameter inputs are:

- X Coordinate [m]: Easting UTM for the southwest corner of the area source.
- Y Coordinate [m]: Northing UTM for the southwest corner of the area source.
- Release Height [m]: Release height above ground. For example, a tank open to the atmosphere would have a release height equal to the height of the liquid level in the tank.
- Xinit [m]: Length of X side of the area (in the east-west direction if Angle is 0 degrees).
- Yinit [m]: Length of Y side of the area (in the north-south direction if Angle is 0 degrees). This parameter is optional; if no value is entered, AERMOD sets Yinit equal to Xinit.
- Szinit [m]: Initial vertical dimension of the area source plume. For more passive area source emissions, such as evaporation or wind erosion, the Szinit parameter is typically omitted, which is equivalent to using a Szinit of 0 meters.
- Angle [degrees]: Orientation angle for the rectangular area from North, measured positive in the clockwise direction. If the Angle is not zero, the model will rotate the AREA source clockwise around the southwest corner.
- Emission Rate [$g/s/m^2$]: Pollutant emission rate. Note that the g/s emission rate must be divided by the area of the area source to calculate the emission rate in units of $g/s/m^2$.

The only option for defining the area is a rectangle or square. The maximum length/width aspect ratio for area sources is 10 to 1. If the aspect ratio is greater than 10, use the AREAPOLY source type. See Section 3.3.2.4, AREA source inputs, of the AERMOD user's guide for more information on the AREA source inputs.

3.5.2.2 AREAPOLY Sources Options

The AREAPOLY source type is used to specify an area source as a polygon with at least 3 but no more than 20 sides or vertices. This source type option provides the user with flexibility for specifying the shape of an area source. The AREAPOLY source parameter inputs are:

- X Coordinate [m]: Easting UTM for the first vertex point of the area source.
- Y Coordinate [m]: Northing UTM for the first vertex point of the area source.

- Release Height [m]: Release height above ground. For example, a tank open to the atmosphere would have a release height equal to the height of the liquid level in the tank.
- Number of Vertices: Number of vertices (or sides) of the area source polygon.
- Xv(1), Xv(2) … Xv(i) [m]: Easting UTM values of the vertices of the area source polygon. Xv(1) must match the X coordinate identified for the source.
- Yv(1), Yv(2) … Yv(i) [m]: Northing UTM values of the vertices of the area source polygon. Yv(1) must match the Y coordinate identified for the source.
- Szinit [m]: Initial vertical dimension of the area source plume. For more passive area source emissions, such as evaporation or wind erosion, the Szinit parameter is typically omitted, which is equivalent to using a Szinit of 0 meters.
- Emission Rate [$g/s/m^2$]: Pollutant emission rate. Note that the g/s emission rate must be divided by the area of the area source to calculate the emission rate in units of $g/s/m^2$.

3.5.2.3 AREACIRC Sources Options

The AREACIRC source type is used to specify an area source as a circular shape. AERMOD will automatically generate a regular polygon of up to 20 sides to approximate the circular area source. The polygon will have the same area as that specified for the circle. The AREACIRC source parameter inputs are:

- X Coordinate [m]: Easting UTM at the center of the area source.
- Y Coordinate [m]: Northing UTM at the center of the area source.
- Release Height [m]: Release height above ground. For example, a tank open to the atmosphere would have a release height equal to the height of the liquid level in the tank.
- Radius [m]: Radius of the circular area source.
- Number of Vertices: Number of vertices (or sides) of the area source polygon. This parameter is optional; if no value is entered, AERMOD will generate a polygon with 20 sides.
- Szinit [m]: Initial vertical dimension of the area source plume. For more passive area source emissions, such as evaporation or wind erosion, the Szinit parameter is typically omitted, which is equivalent to using a Szinit of 0 meters.
- Emission Rate [$g/s/m^2$]: Pollutant emission rate. Note that the g/s emission rate must be divided by the area of the area source to calculate the emission rate in units of $g/s/m^2$.

3.5.3 OPENPIT Sources

The OPENPIT algorithm uses an effective area for modeling emissions from open pits, based on meteorological conditions. AERMOD then treats the effective area as an area source to determine the impact of emissions. The OPENPIT source parameter inputs are:

- X Coordinate [m]: Easting UTM for the southwest corner of the open pit.
- Y Coordinate [m]: Northing UTM for the southwest corner of the open pit.
- Release Height [m]: Average release height above the base of the pit. The release height cannot exceed the effective depth of the pit, which is calculated by the model based on the length, width and volume of the pit. A release height of 0 indicates emissions that are released from the base of the pit. For example, an asphalt holding pit that is 1 meter in depth, filled with an average height of 0.6 meters of asphalt, would have a release height of 0.6 m.

- Xinit [m]: Length of X side of the open pit (in the east-west direction if Angle is 0 degrees). Note that the minimum Xinit in Lakes Environmental's AERMOD View interface is 1 m; however, this is not a limitation in the AERMOD executable, and other user interfaces may allow for smaller Xinit values.
- Yinit [m]: Length of Y side of the open pit (in the north-south direction if Angle is 0 degrees). Note that the minimum Yinit in Lakes Environmental's AERMOD View interface is 1 m; however, this is not a limitation in the AERMOD executable, and other user interfaces may allow for smaller Yinit values.
- Pitvol [m^3]: Volume of the open pit. Note that the minimum Pitvol in Lakes Environmental's AERMOD View interface is 1 m^3; however, this is not a limitation in the AERMOD executable, and other user interfaces may allow for smaller Pitvol values.
- Angle: Orientation angle for the rectangular area from North, measured positive in the clockwise direction. If the Angle is not zero, the model will rotate the OPENPIT source clockwise around the southwest corner.
- Emission Rate [$g/s/m^2$]: Pollutant emission rate. Note that the g/s emission rate must be divided by the area of the open pit source to calculate the emission rate in units of $g/s/m^2$.

The only option for defining the open pit is a rectangle or square. The maximum length/width aspect ratio for open pit sources is 10 to 1. Because the open pit algorithm generates an effective area for modeling emissions from the pit, and the size, shape and location of the effective area is a function of wind direction, an open pit cannot be divided into a series of smaller sources. If the aspect ratio is greater than 10, the user should model the pit as a rectangular shape of equal area. See Section 3.3.2.7, OPENPIT source inputs, of the AERMOD user's guide for more information on the OPENPIT source inputs.

3.5.4 VOLUME Sources

The VOLUME source type is used to model releases that occur over a three-dimensional volume. Examples of volume sources include fugitive leaks from piping, multiple vents, wipe cleaning and general solvent usage. The VOLUME source parameters inputs are:

- X Coordinate [m]: Easting UTM at the center of the volume source.
- Y Coordinate [m]: Northing UTM at the center of the volume source.
- Release Height [m]: Release height above ground at the center of volume. For example, a building with solvent releases from various open windows and doors should be modeled as a volume source with a release height equal to half the building height.
- Length of Side [m]: Length of the side of the volume source. The volume source cannot be rotated, and the X side is equal to the Y side (i.e., a square surface area).
- Syinit [m]: The initial lateral dimension (Syinit or σ_{Yint}), is calculated by dividing the Length of Side in meters by 4.3. However, if a series of adjacent volume sources is used to represent a line source, the initial lateral dimension is calculated as shown in Table 3.5.4-1. See Appendix C for additional information on modeling adjacent volume sources.
- Szinit [m]: The initial vertical dimension (Szinit or σ_{Zint}), is calculated differently for different types of volume sources, explained in Table 3.5.4-2.
- Emission Rate [g/s]: Pollutant emission rate.

A volume of irregular shape (i.e., not a square surface area) can be approximated by dividing the volume source into multiple smaller volume sources. The user should create volume sources that cover approximately the same area where the emissions actually occur.

Table 3.5.4-1: Summary of Suggested Procedures for Estimating Initial Lateral Dimensions for Volume Sources

Type of Source	Procedure for Obtaining Initial Lateral Dimension
Single Volume Source	$\frac{\text{(Length of Side)}}{4.3}$
Line Source Represented by Adjacent Volume Sources[2]	$\frac{\text{(Length of Side)}}{2.15}$
Line Source Represented by Separated Volume Sources[3]	$\frac{\text{(Center to Center Distance)}}{2.15}$

Table 3.5.4-2: Summary of Suggested Procedures for Estimating Initial Vertical Dimensions for Volume Sources

Type of Source	Procedure for Obtaining Initial Vertical Dimension
Surface-Based Source ($h_e \sim 0$)	$\frac{\text{(Vertical dimension of source in meters)}}{2.15}$
Elevated Source ($h_e > 0$) on or adjacent to a building	$\frac{\text{(Building height in meters)}}{2.15}$
Elevated Source ($h_e > 0$) NOT on or adjacent to a building	$\frac{\text{(Vertical dimension of source in meters)}}{4.3}$

3.5.5 LINE Sources

The LINE source type is typically used to model releases from mobile emissions along rail lines and roadways. See Appendix C for more information on modeling roadways. AERMOD allows a LINE source to be entered by specifying one line segment with a start point, end point and width. AERMOD uses the same algorithms for LINE sources that are used for AREA sources, and will give identical results for equivalent source parameter inputs. The LINE source parameter inputs are:

- X Coordinate [m]: Easting UTM for the start of the line source.
- Y Coordinate [m]: Northing UTM for the start of the line source.
- X End [m]: Easting UTM for the end of the line source.
- Y End [m]: Northing UTM for the end of the line source.
- Release Height [m]: Source release height above the ground.
- Width [m]: Width of the source (minimum width is 1 m).

[2] See Figure 1-8 (a) of USEPA's *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II – Description of Model Algorithms.* Figure 1-8 (a) is reproduced in Appendix C of this document.

[3] See Figure 1-8 (b) of USEPA's *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II – Description of Model Algorithms.* Figure 1-8 (b) is reproduced in Appendix C of this document.

- Szinit [m]: Initial vertical dimension of the line source.
- Emission Rate [$g/s/m^2$]: Pollutant emission rate. Note that the g/s emission rate must be divided by the area of the line source to calculate the emission rate in units of $g/s/m^2$.

UTM coordinates for the start and end points should reflect the center of the width of the line. The Szinit parameter may be important for a line source that is meant to represent mechanically generated emission sources, such as mobile sources. In these cases, the emissions may be turbulently mixed near the source by the process that is generating the emissions, and therefore occupy some initial vertical depth.

3.6 Building Impacts

Buildings and other structures near a relatively short stack can have a substantial effect on plume transport and dispersion, and on the resulting ground-level concentrations. Building downwash for point sources that are within the area of influence of a building must be considered when running AERMOD. A building is considered sufficiently close to a stack to cause wake effects when the distance between the stack and the nearest part of the building is less than or equal to five times the lesser of the building height or the projected building width (PBW), as described in Equation 3.6-1.

$$\boldsymbol{D \leq 5L} \qquad \textbf{Eq. 3.6-1}$$

where: D = shortest distance from the exhaust stack to the building

L = lesser of the building height and projected building width (PBW)

PBW = maximum cross-sectional length of the building;
for rectangular buildings, PBW = $\sqrt{(length^2 + width^2)}$

The PBW is the maximum length of a building that could affect air flow around and over the structure. For more information on building downwash and PBW, see EPA's *Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document For the Stack Height Regulations)*, noted in the References section of this document.

AERMOD requires the user to input the UTM coordinates for all building corners and the height of each building. For buildings with more than one height or roofline, the UTM coordinates and height are required for each building tier.

3.7 Terrain

All sources, buildings and receptors are required to have a base elevation, which is affected by the terrain of the site. Terrain elevations can have a large impact on the air dispersion modeling results. Elevation data can be obtained from digital elevation map (DEM) files by running AERMAP in AERMOD.

Alternatively, if the site will be graded and post-grading elevations are known, those elevations should be entered when defining the source parameters and building information in AERMOD. Do not import source and building elevation data from the DEM file(s) when running AERMAP if graded elevations are used. Furthermore, the AQIA report must clearly identify that graded elevations were used, and include a spreadsheet with the graded elevations. The preferred format for submitting these graded elevations to the District is the Lakes' AERMOD View source file (*_Sources.xlsx) and the building file (*_Buildings.xlsx) that are generated when the user exports the source data and the building data from AERMOD View. If Lakes' AERMOD View was not used for the AQIA, spreadsheets should be submitted to the District that show the graded elevations for each source and building with the corresponding Source IDs and Building IDs.

3.8 Meteorological Data

District-processed AERMOD meteorological data should be used, and is available online at the District's *Meteorological Data* webpage, noted in the References section of this document, as well as in Table 3.8-1 below. All years of data should be used when running AERMOD. Please contact the District if you have any questions about which meteorological data to use or if you wish to use alternative meteorological data. For approval to use alternative meteorological data, submit a justification for the data use, including information regarding representativeness and quality assurance, along with the meteorological data to the District for review.

The PROFBASE parameter is used to specify the base elevation above mean sea level of the primary met tower. The elevations of the Santa Barbara County sites are displayed in Table 3.8-1. All coordinates in Table 3.8-1 are in the NAD83 datum.

Table 3.8-1: Meteorological Data Sets in Santa Barbara County

Met Data Set Name	Latitude (degrees)	Longitude (degrees)	Elevation (m)	Met Data Files
Carpinteria	34.403	-119.458	137	Carp19-23.zip
Ellwood	34.431	-119.912	5	Ellwood19-23.zip
Goleta	34.446	-119.828	14	Goleta19-23.zip
Las Flores Canyon	34.490	-120.047	184	LFC19-23.zip
Lompoc H Street	34.638	-120.458	41	LompocHSt19-23.zip
Paradise Road	34.542	-119.791	371	Paradise19-23.zip
SB National Guard	34.428	-119.691	20	SBNG19-23.zip
Santa Barbara Airport[1]	34.424	-119.842	4	SBA19-23Ustar.zip
Santa Maria Airport[1]	34.894	-120.452	80	SMX19-23Ustar.zip
Santa Ynez Airport[1]	34.606	-120.075	210	SQA19-23Ustar.zip
Vandenberg Airport[1]	34.717	-120.567	112	VBG19-23Ustar.zip

[1] The Santa Barbara Airport, Santa Maria Airport, Santa Ynez Airport and Vandenberg Airport meteorological data sets were processed using the U star adjustment option (ADJ_U*). The ADJ_U* option was used for these data sets because they do not include turbulence, or sigma-theta, measurements. AERMOD automatically detects that the meteorological data was processed using the ADJ_U* option.

The locations of the sites listed in Table 3.8-1 above are mapped on aerial photo imagery in Figure 3.8-1 below.

Figure 3.8-1: Locations of Meteorological Data Stations in Santa Barbara County

3.9 Receptors

The receptor network must provide adequate coverage to capture the maximum pollutant concentrations. The receptor network shall include property boundary receptors, a Cartesian grid and Class I receptors (if applicable). The flagpole height of all receptors shall be set to 0 meters.

3.9.1 Property Boundary Receptors

Receptors shall be placed along the property boundary with a maximum spacing of 25 meters. The spacing of these receptors depends on the distance from the emission sources to the facility boundaries. For facilities with emissions only from short stacks or vents and a close property line, receptor spacing as fine as 10 meters may be required. For larger facilities, like oil and gas leases, a spacing of 25 meters is more practical. The District may require a second run with finer property boundary receptor spacing if maximum pollutant concentrations are identified at or near the property boundary.

3.9.2 Cartesian Receptor Grids

AERMOD can create grids of Cartesian receptors that are defined by an origin with receptor points in x and y directions. The following grid spacing is required for most projects:

- No larger than 25-meter spacing from the property boundary out to 200 meters in all directions.
- No larger than 50-meter spacing between 200 meters and 500 meters from the property boundary.
- No larger than 100-meter spacing between 500 meters and 2000 meters from the property boundary.

If there are significant impacts near the edge of the grid, the grid must be extended farther. Furthermore, if it appears that the grid receptors are not close enough to capture the maximum pollutant concentrations, the District may require the AQIA to be rerun with a finer grid. For facilities with a large number of emitting sources and a large property boundary, fine grid spacing will significantly impede the model run time. It may be necessary to run the AQIA with a coarse grid to determine the areas of highest concentration and then rerun the AQIA with finer grids in those areas. If this method is used, finer grids shall be used for all areas with high concentrations, not just the single area with the highest concentration. AERMOD allows for multiple grids to be included in one dispersion run.

3.9.3 Class I Receptors

If the project is in a Class I Impact Area[4], or if the District determines the project has the potential to impact a Class I Area, the NSR increment analysis must include an evaluation of the Class I Area impacts; therefore, the applicant must include receptors in the Class I Area in the model. Contact the District to confirm whether or not a Class I Area increment analysis is required.

Class I Areas include national parks, national wilderness areas, and national monuments. These areas are granted special air quality protections under Section 162(a) of the federal Clean Air Act. The only Class I Area in Santa Barbara County is the San Rafael Wilderness in the northeastern section of the county. The Class I Impact Area extends 10 kilometers from the wilderness in all directions, as shown in Figure 3.9.3-1.

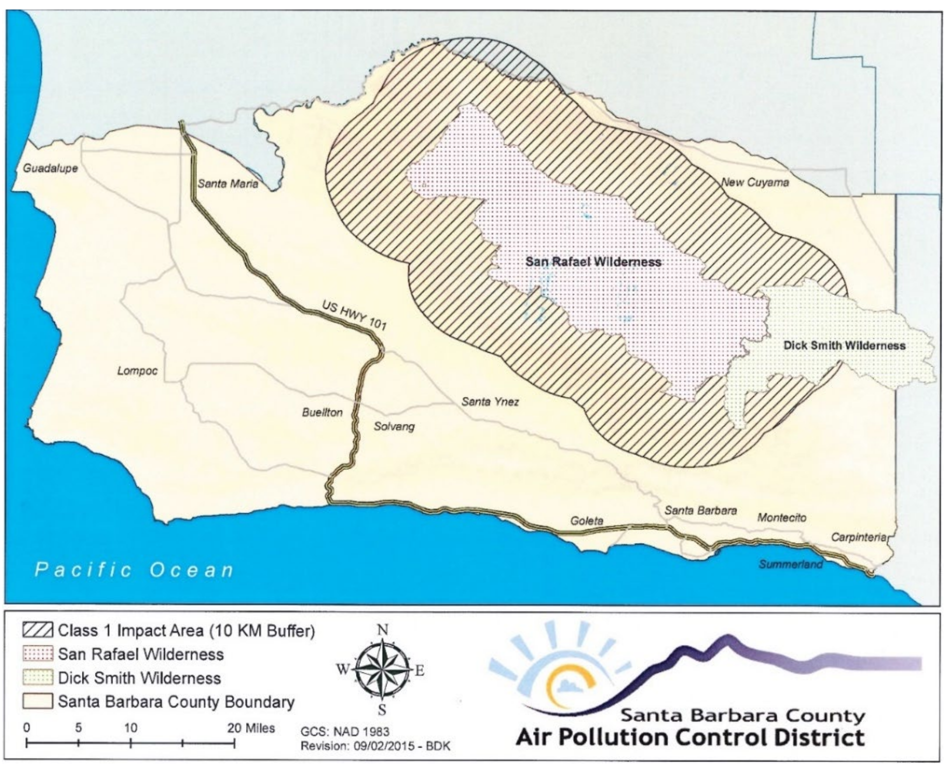

Figure 3.9.3-1: Class I Impact Area

[4] "Class I Impact Area" means all lands outside of a Class I Area but within 10 kilometers (6.2 miles) of the boundary of a Class I Area, or other areas established by the Control Officer based on standard meteorological techniques such as hourly wind roses, frequency distribution of atmospheric wind classes, morning and afternoon mixing depths and any other meteorological or geographical considerations needed to establish the Class I Impact Area.

The District has generated Class I receptors 25 meters apart around the entire San Rafael Wilderness boundary in UTM coordinates, in the NAD83 datum. The list of Class I receptors is available in Zone 10 and Zone 11, in a simple *.xlsx* format and in a *.csv* format compatible with Lakes' AERMOD View. Table 3.9.3-1 contains links to download the receptor lists. This information is also available online at the District's *AQIA: Class I Area* webpage, noted in the References section of this document.

Table 3.9.3-1: Class I Receptor Lists

Format	Zone	
	10	11
Excel spreadsheet	Class_I_Receptors_Zone10.xlsx	Class_I_Receptors_Zone11.xlsx
Lakes' receptor file	Class_I_Receptors_Zone10.csv	Class_I_Receptors_Zone11.csv

4. Results

Once all the AERMOD runs are complete, the results should be compiled into tables for ease of review. Explanations of how each concentration was determined from the AERMOD output files should be included in the AQIA report.

4.1 Ambient Air Quality Standard Analysis

For an ambient air quality standard (AAQS) analysis, the reportable concentration for each pollutant and averaging period modeled by AERMOD should be added to the background concentration for that pollutant and averaging period. This sum is then compared to the AAQS. The form, or reportable concentration, for the standards that must be analyzed are shown in Table 4.1-1.

The highest modeled result (i.e., 1st Highest High) is not required to be compared to the NAAQS for all averaging periods and pollutants. For example, the reportable concentration for the 24-hour averaging period for $PM_{2.5}$ is the 98th percentile, multi-year average. This means that the 8th Highest High can be reported and compared to the NAAQS for $PM_{2.5}$ for the 24-hour averaging period. California Ambient Air Quality Standards (CAAQS) for CO, SO_2 (1-hour and 24-hour), NO_2, and particulate matter (PM_{10} and $PM_{2.5}$), are values that are not to be exceeded. This means that the 1st Highest High is reported and compared to the CAAQS. Because the form, or reportable concentration, of the CAAQS is different from the NAAQS for 1-hour SO_2 and 1-hour NO_2, and the concentration for the NAAQS is lower than the CAAQS, it is possible for the 1-hour SO_2 or 1-hour NO_2 to meet either one of the standards but exceed the other. Therefore, SO_2 and NO_2 must be modeled for comparison to both the 1-hour CAAQS and the 1-hour NAAQS.

The NAAQS for $PM_{2.5}$ is based on the annual mean, averaged over 3 years.[5] The NAAQS for SO_2 and NO_2 are based on the highest annual average from an individual year, rather than an average across the years modeled.

For convenience, **the modeler may choose to report the most conservative result, the highest modeled concentration (i.e., 1st Highest High) for the specified averaging period**. This option may be preferable in situations with very low concentrations, as it will avoid the requirement of multiple runs for

[5] Modeling "rolling 3-year averages," using years 1 through 3, years 2 through 4, and years 3 through 5 is not required. According to EPA, "The 5-year average based on use of representative NWS meteorological data, the average across one or more (up to 5) complete years of available site specific data, or the average across 3 years of prognostic meteorological data serves as an unbiased estimate of the 3-year average for purposes of modeling demonstrations of compliance with the NAAQS."

the same pollutant and averaging period (e.g., 1 hour SO_2 is run only once and the 1^{st} Highest High is compared to the lowest AAQS, 196 $\mu g/m^3$). When this option is used, the result must be clearly presented as the 1^{st} Highest High, with language explaining that performing separate runs for the NAAQS and CAAQS is not necessary due to the low concentration.

Table 4.1-1: Reporting Results for the AAQS Analysis

Pollutant	Averaging Period	CAAQS ($\mu g/m^3$)	NAAQS[1] ($\mu g/m^3$)	Form Description	Form (Reportable Concentration)
SO_2	1-hour	655	196	CAAQS: Not to be exceeded	1^{st} Highest High
				NAAQS: 99^{th} percentile of 1-hour daily maximum concentrations, multi-year average	4^{th} Highest High[2]
	24-hour	105	—	CAAQS: Not to be exceeded	1^{st} Highest High
	Annual	—	26	NAAQS: Annual average over 3 years[3]	1^{st} Highest High
NO_2	1-hour	339	188	CAAQS: Not to be exceeded	1^{st} Highest High
				NAAQS: 98^{th} percentile of 1-hour daily maximum concentrations, multi-year average	8^{th} Highest High[4]
	Annual	57	NA	CAAQS: Annual average for individual year	1^{st} Highest High
CO	1-hour	23,000	NA	CAAQS: Not to be exceeded	1^{st} Highest High
	8-hour	10,000	NA	CAAQS: Not to be exceeded	1^{st} Highest High
PM_{10}	24-hour	50	NA	CAAQS: Not to be exceeded	1^{st} Highest High
	Annual	20	—	CAAQS: Annual average for individual year	1^{st} Highest High
$PM_{2.5}$	24-hour	—	35	NAAQS: 98^{th} percentile, multi-year average	8^{th} Highest High[5]
	Annual	12	9	CAAQS: Annual average for individual year	1^{st} Highest High
				NAAQS: Annual average over 3 years[3]	1^{st} Highest High

[1] "NA" is shown if a lower or equivalent state standard exists for that pollutant and averaging period. "—" is shown if no federal standard exists for that pollutant and averaging period.

[2] For more information about the reportable concentration for the 1-hour SO_2 NAAQS and method to obtain it, see Section 3.2.3 of this document.

[3] Modeling "rolling 3-year averages," using years 1 through 3, years 2 through 4, and years 3 through 5 is not required. According to EPA, "The 5-year average based on use of representative NWS meteorological data, the average across one or more (up to 5) complete years of available site specific data, or the average across 3 years of prognostic meteorological data serves as an unbiased estimate of the 3-year average for purposes of modeling demonstrations of compliance with the NAAQS."

[4] For more information about the reportable concentration for the 1-hour NO_2 NAAQS and method to obtain it, see Section 3.2.2 of this document.

[5] For more information about the reportable concentration for the 24-hour $PM_{2.5}$ NAAQS and method to obtain it, see Section 3.2.4 of this document.

Santa Barbara County is currently in nonattainment status for PM_{10} on both an annual and 24-hour basis. Because the background concentrations for annual PM_{10} and 24-hour PM_{10} are above the AAQS, all projects emitting PM_{10} will result in a PM_{10} concentration in exceedance of the AAQS. The District has determined that projects will not contribute significantly to an exceedance of an AAQS if the project's contribution is less than ten percent of the AAQS. Therefore, the District typically approves projects with annual and 24-hour PM_{10} impacts less than ten percent of the AAQS.

4.1.1 Background Concentration

The background concentrations of each pollutant in ambient air can be obtained by analyzing data from sources such as CARB's Air Quality Data Statistics, the District's Annual Air Quality Reports, and the EPA's Air Data, all of which are noted in the References section of this document. The methods by which the background concentrations were determined should be clearly explained and the sources should be referenced in the AQIA report, with supporting documentation submitted to the District. The background concentrations for different AAQS are not all determined in the same manner. Table 4.1.1-1 describes the appropriate methodology to determine the background concentration for each AAQS. However, for convenience, **the modeler may choose to use the more conservative method of reporting the background concentration as the highest recorded concentration (i.e., 1st Highest High) for the most recent three years of data for the specified averaging period**.

If the EPA's Air Data is used to determine the background concentrations, exceptional events[6] may be excluded from the data set. The pre-generated .csv data files available for download on the EPA's Air Data website contain a column that indicates whether exceptional events are included or excluded from the data (or if there were no exceptional events during that year for a given pollutant).

Please note that although older EPA guidance recommended the use of the maximum 24-hour monitored $PM_{2.5}$ concentration, current guidance[7,8] recommends that the three-year average of 98th percentile 24-hour monitored $PM_{2.5}$ concentrations be used to determine compliance with the NAAQS. However, as previously mentioned in this section, the modeler may choose to use the more conservative method of reporting the background concentration as the highest recorded concentration from the most recent three years of data.

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[6] Exceptional events are unusual or naturally occurring events that can affect air quality but are not reasonably controllable using techniques that tribal, state or local air agencies may implement; exceptional events may include wildfires, high wind dust events, prescribed fires, stratospheric ozone intrusions, and volcanic and seismic activities. More information about exceptional events may be found here: https://www.epa.gov/air-quality-analysis/treatment-air-quality-data-influenced-exceptional-events-homepage-exceptional.

[7] U.S. Environmental Protection Agency. Memorandum. May 20, 2014. *Guidance for $PM_{2.5}$ Permit Modeling*. https://www3.epa.gov/ttn/scram/guidance/guide/Guidance_for_PM25_Permit_Modeling.pdf.

[8] U.S. Environmental Protection Agency. Memorandum. February 10, 2020. DRAFT *Guidance for Ozone and Fine Particulate Matter Permit Modeling*. https://www3.epa.gov/ttn/scram/guidance/guide/Draft_Guidance_for_O3_PM25_Permit_Modeling.pdf.

Table 4.1.1-1: Background Concentrations for the AAQS Analysis

Pollutant	Averaging Period	Form Description	Background Concentration
SO_2	1-hour	CAAQS: Not to be exceeded	Highest recorded hourly concentration from the most recent three years of data
		NAAQS: 99th percentile of 1-hour daily maximum concentrations, multi-year average	Average of the 4th highest hourly concentrations for the most recent three years of data
	24-hour	CAAQS: Not to be exceeded	Highest recorded daily concentration from the most recent three years of data
	Annual	NAAQS: Annual average over three years	Maximum average annual concentration over three years of data
NO_2	1-hour	CAAQS: Not to be exceeded	Highest recorded hourly concentration from the most recent three years of data
		NAAQS: 98th percentile of 1-hour daily maximum concentrations, multi-year average	Average of the 8th highest hourly concentrations for the most recent three years of data
	Annual	CAAQS: Annual average for individual year	Maximum average annual concentration from the most recent three years of data
CO	1-hour	CAAQS: Not to be exceeded	Highest recorded hourly concentration from the most recent three years of data
	8-hour	CAAQS: Not to be exceeded	Highest recorded 8-hour concentration from the most recent three years of data
PM_{10}	24-hour	CAAQS: Not to be exceeded	Highest recorded daily concentration from the most recent three years of data
	Annual	CAAQS: Annual average for individual year	Maximum average annual concentration from the most recent three years of data
$PM_{2.5}$	24-hour	NAAQS: 98th percentile, multi-year average	Average of the 8th highest daily concentrations for the most recent three years of data
	Annual	CAAQS: Annual average for individual year	Maximum average annual concentration from the most recent three years of data
		NAAQS: Annual average over 3 years	Maximum average annual concentration over three years of data

4.2 Increment Analysis

The increment analysis is only required for the District's NSR permitting program, not the CEQA process. The reportable concentration modeled by AERMOD for each pollutant and averaging period in the Class I and Class II Impact Areas should be compared to the maximum allowable increase or "increment" threshold for the corresponding class. The forms or reportable concentrations for the increment analysis, with the applicable increment threshold, are described in Table 4.2-1. For increments based on EPA's current thresholds, the 2nd Highest High may be reported for short term averaging periods[9]. For all other increments, the 1st Highest High must be reported. However, for convenience, **the modeler may choose to report the most conservative result, the highest modeled concentration (i.e., 1st Highest High) for the specified averaging period**. When this option is used, the result must be clearly presented as the 1st Highest High.

The applicant may consume the full increment range for 1-hour NO_2, 3-hour ROC and 24-hour PM_{10}; mitigation fees for consuming part or all of the increment are required and discussed in Section F.3 of the District's Rule 805, noted in the References section of this document.

Table 4.2-1: Reporting Results for the Increment Analysis

Pollutant	Averaging Period	Class I Increment (µg/m³)	Class II Increment (µg/m³)	Form Description	Form (Reportable Concentration)
TSP	24-hour	10	37	Not to be exceeded	1st Highest High
	Annual[1]	5	19	Annual average for individual year	1st Highest High
SO_2	3-hour	25	512	Not to be exceeded more than once per year	2nd Highest High
	24-hour	5	91	Not to be exceeded more than once per year	2nd Highest High
	Annual	2	20	Annual average for individual year	1st Highest High
NO_2	1-hour	10	100-188	Not to be exceeded	1st Highest High
	Annual	2.5	25	Not to be exceeded	1st Highest High
CO	1-hour	800	10,000	Not to be exceeded	1st Highest High
	8-hour	200	2,500	Not to be exceeded	1st Highest High
ROC	3-hour	3	40-160	Not to be exceeded	1st Highest High
PM_{10}	24-hour	8	12-30	Not to be exceeded more than once per year	2nd Highest High
	Annual	4	17	Annual average for individual year	1st Highest High
$PM_{2.5}$	24-hour	2	9	Not to be exceeded more than once per year	2nd Highest High
	Annual	1	4	Annual average for individual year	1st Highest High

[1] The form of the annual increment threshold for TSP is the "Annual Geometric Mean." AERMOD calculates the annual arithmetic mean, not the annual geometric mean. However, the District will accept the annual arithmetic mean as an approximation of the annual geometric mean.

[9] Section 163(a) of the Clean Air Act stipulates that EPA's short-term increments "can be exceeded during one such period per year".

5. Air Quality Impact Assessment Report

The applicant is required to perform the AQIA and submit the AQIA report and electronic files for the District's review. The District will assess fees for the AQIA review on the cost reimbursement basis specified in District Rule 210, Section C.1.

The required elements of the AQIA report are discussed in Sections 5.1 through 5.7 below. The District's *Modeling Protocol Tables for AQIA Report*, noted in the References section of this document, must be completed and submitted with the AQIA report. The *Modeling Protocol Tables for AQIA Report* consists of the *AERMOD Options Table*, *Source Parameters Table*, *Source Groups Table*, and *Building Parameters Table*, discussed further in the sections below.

5.1 Facility Information

Report the following information regarding the facility and its surroundings:

- Facility name
- Stationary source identification number (SSID)
- Location (street address and UTM coordinates, including datum)
- Description of facility operations
- Table of the emissions for the modeled pollutants and averaging periods

Provide both a plot plan and an aerial photo map with the following labeled:

- Facility boundary
- Buildings (labeled by ID or name)
- Emitting sources (labeled by AERMOD Source ID or name)

5.2 Source and Emission Inventory Information

The *Modeling Protocol Tables for AQIA Report* includes the *Source Parameters Table* and *Source Groups Table*, discussed in Sections 5.2.1 and 5.2.2 below. Documentation (e.g., manufacturer's specifications, source test reports, photos/diagrams showing volume/area sources with written description explaining choice of parameters) of source parameters is required.

5.2.1 Source Parameters Table

The *Source Parameters Table* must be completed and submitted with the AQIA report in electronic format, containing the following information for each emitting source:

- Source (i.e., stack or release point) identification number
- Source name/description
- Source type (point, area, open pit, volume, line)
- Source UTM coordinates
- Source emission rate for each pollutant and averaging period to be modeled
- Source modeling parameters (e.g., for point sources, release height, inner diameter, exit velocity, and temperature)

5.2.2 Source Groups Table

The *Source Groups Table*, part of the *Modeling Protocol Tables for AQIA Report*, must be completed and submitted with the AQIA report in electronic format. First, answer the yes/no question in row 5: Will only the District default source groups be included in the model? The District default is to include one source group per AERMOD Source ID. The modeler may choose to include multiple Source IDs in a single source group **if emissions are spread evenly throughout those sources** (e.g., roadway sources).[10]

If only the District default source groups will be used, the table of source group names and AERMOD Source IDs does not need to be completed. However, if multiple sources will be grouped, the table must be completed. Note that if multiple Source IDs are grouped, the emission rates must be divided by the number of sources in that group to avoid overestimating the risk from those sources.[10]

5.2.3 Device Operation Schedule Table

Submit a *Device Operation Schedule Table* with the AQIA report, with the following information for each device:

- Device name and identification number (use District device IDs when available)
- Device description
- Number of operating hours per day and per year, including which hours the device operates in a 24-hour day
- Number of operating days per week, including which days (i.e., Monday through Sunday) the device operates in a 7-day week
- Number of operating days or weeks per year
- AERMOD Source ID(s) used to model the emissions from the device

5.3 Emission Quantification

Report the following information for each device in table format:

- Emission control equipment and efficiency by source (and by pollutant, if efficiency varies by pollutant)
- Emission rates for each pollutant, grouped by source, including the following information:
    - Device name and identification number
    - Pollutant name
    - Emission factors for each pollutant
    - Emissions in g/s for each modeled averaging period, including explanations of the assumptions used for each averaging period

[10] One exception to this guidance is landfill fugitive emissions modeled in a group of AREA sources. Other exceptions may also be approved by the District on a case by case basis. For a group of AREA sources, the total emission rate in units of g/s must be divided by the total surface area of all grouped sources, and then apportioned to each source based on the ratio of its surface area to the total surface area of all grouped sources. Contact the District with questions about source grouping.

5.4 Model Information

The *AERMOD Options Table*, part of the District's *Modeling Protocol Tables for AQIA Report*, lists all the options that are required for the air dispersion modeling. The table includes the District default values (if applicable), an empty column for the facility's values, references to the sections of the AQIA Modeling Guidelines with more information, and a column with additional notes about some of the modeling options. The completed table must be submitted with the AQIA report.

The report should clearly state the following:

- Name and version number of the software used to run AERMOD
- Selected control options
- List of electronic input/output file names for air dispersion and risk assessment (see Section 5.12 of this document)

5.5 Building Parameters

Parameters for buildings and other structures impacting building downwash must be submitted in electronic format in the *Building Parameters Table* (part of the *Modeling Protocol Tables for AQIA Report*).

5.6 Summary of Results

5.6.1 Results of the AAQS Analysis

Present the AAQS results in table format, including the following information:

- Reportable concentrations modeled by AERMOD for the project for each appropriate pollutant and averaging period reported according to Table 4.1-1 of this document
- Receptor numbers corresponding to where the reported concentrations occur
- Location (UTM coordinates) of receptors where the reported concentrations occur (may be included in separate table)
- Background concentrations for each appropriate pollutant and averaging period
- Sum of the background concentration and modeled project impacts
- AAQS for each appropriate pollutant and averaging period

An example AAQS results table is shown below in Table 5.5.1-1.

Table 5.5.1-1: Example AAQS Modeling Results

Pollutant	Averaging Period	Receptor Number	Modeled Impact Conc.[1] ($\mu g/m^3$)	Ambient Background ($\mu g/m^3$)	Total Conc. ($\mu g/m^3$)	AAQS ($\mu g/m^3$)	Percent of AAQS
SO_2	1-hour	565	24.8	16.3	41.1	655	6.3%
	1-hour[2]	567	20.4	13.1	33.5	196	17%
	24-hour	2356	1.97	5.2	7.2	105	6.9%
	Annual	2725	0.29	2.6	2.9	80	3.6%
NO_2[3]	1-hour	743	92.7	98.0	190.7	339	56%
	1-hour[4]	689	81.5	92.1	173.6	188	92%
	Annual	2725	1.84	14.4	16.2	57	28%
CO	1-hour	784	443.5	3565	4009	23,000	17%
	8-hour	653	212.9	1311	1524	10,000	15%
PM_{10}	24-hour	845	7.86	76.2	84.0	50	168%
	Annual	365	1.76	24.2	26.0	20	130%
$PM_{2.5}$	24-hour[5]	448	1.71	17.3	19.0	35	54%
	Annual	365	0.27	7.0	7.3	12	61%

[1] Unless otherwise noted, all values reported are the 1st Highest High.

[2] This 1-hour SO_2 concentration is reported as the 4th Highest High (i.e., the 99th percentile, five-year average) for the NAAQS analysis.

[3] The 1-hour and annual NO_2 concentrations were determined using the ARM2.

[4] This 1-hour NO_2 concentration is reported as the 8th Highest High (i.e., the 98th percentile, five-year average) for the NAAQS analysis.

[5] The 24-hour $PM_{2.5}$ concentration is reported as the 8th Highest High (i.e., the 98th percentile, five-year average).

5.6.2 *Results of the Increment Analysis*

Present the increment results in table format, including the following information:

- Reportable concentrations modeled by AERMOD for the project for each appropriate pollutant and averaging period reported according to Table 4.2-1 of this document
- If required, the reportable concentrations modeled by AERMOD for the project for each appropriate pollutant and averaging period in the Class I Impact Area
- Receptor numbers corresponding to where the reported concentrations occur
- Location (UTM coordinates) of receptors where the reported concentrations occur (may be included in separate table)
- Increment threshold for each appropriate pollutant and averaging period

An example increment analysis results table is shown below in Table 5.5.2-1.

Table 5.5.2-1: Example Increment Analysis Modeling Results for Class II Impacts

Pollutant	Averaging Period	Receptor Number	Modeled Impact Concentration[1] ($\mu g/m^3$)	Class II Increment ($\mu g/m^3$)	Percent of Maximum Increment
TSP	24-hour	845	7.86	37	21%
	Annual	365	1.76	19	9%
SO_2	3-hour[2]	1121	13.1	512	3%
	24-hour[2]	3546	1.23	91	1%
	Annual	2725	0.29	20	1%
NO_2[3]	1-hour	853	98.1	100-188[4]	52%
	Annual	2725	1.84	25	7%
CO	1-hour	784	443.5	10,000	4%
	8-hour	653	212.9	2,500	9%
ROC	3-hour	986	152.3	40-160[4]	95%
PM_{10}	24-hour[2]	778	6.8	12-30[4]	23%
	Annual	365	1.76	17	10%
$PM_{2.5}$	24-hour[2]	778	1.93	9	21%
	Annual	365	0.27	4	7%

[1] Unless otherwise noted, all values reported are the 1st Highest High.

[2] The modeled concentration reported is the 2nd Highest High.

[3] The 1-hour and annual NO_2 concentrations were determined using the ARM2.

[4] The applicant may consume the full increment range pursuant to the requirements of Rule 805, Section F.3.

5.7 Air Quality Impact Driver Tables

For any AAQS or increment that is exceeded or within five percent of the standard/threshold, provide a table of the air quality impacts for each pollutant and averaging period from each source included in the model. If there are many sources included in the model, include those sources that contribute at least five percent of the air quality impacts in the table. This will allow the District to identify which devices are contributing most to the air quality impacts. For each table, include a statement indicating which of the devices or operations contributes most to the air quality impacts.

5.8 Required Files

The following files are required to be submitted electronically:

- AQIA report (*.pdf)
- Modeling Protocol Tables for AQIA Report (*.xlsx)
- Emission calculations spreadsheet (*.xlsx)
- Surface meteorological data file (*.sfc)
- Profile meteorological data file (*.pfl)

- Digital elevation map files (*.dem)
- AERMAP receptor file (*AERMAP.rec or *.rou)
- AERMAP source file (*AERMAP.src or *.sou)
- BPIP input file (*BPIP.inp or *.bpi)
- BPIP summary file (*.sum)
- BPIP output file (*BPIP.out or *.pro)
- AERMOD input file for each pollutant/averaging period (*AERMOD.inp or *.adi)
- AERMOD output file for each pollutant/averaging period (*AERMOD.out or *.ado)
- AERMOD error file (*.err)
- Plotfiles for each source group (*.plt)

If the AQIA or AQIA report fail to comply with these guidelines, the AQIA and AQIA report will be returned, with District comments, to the applicant for revision.

6. References

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7. Contacts

For questions about the District's requirements for modeling, contact the District at:

phone: 805-961-8800
email: toxics@sbcapcd.org

For questions about AERMOD, contact EPA's Region IX Modeling Contacts:
https://www.epa.gov/scram/air-modeling-regional-contacts

Appendix A – Variable Emissions Modeling

During some air quality studies, modelers may encounter certain emitting scenarios that warrant the use of variable emissions modeling. This appendix outlines modeling procedures for non-continuous operating schedules.

AERMOD includes options for modeling source emissions that fluctuate over time. With the variable emissions option, the modeler can select the hours of operation and the emission rate for each individual source. Emission variations can be characterized across many different periods, including but not limited to: hourly, daily, monthly and seasonally. If variable emissions are used, the applicant must submit documentation with the HRA that justifies using that variable emission scenario. **The District may require permit conditions to enforce the operating hours, days, months, etc. selected in the variable emission scenario.**

A.1 Non-Continuous Emissions

Emissions can be modeled with varying rates over time within AERMOD by applying factors to different time periods. For example, for a source that is non-continuous, a factor of 0 is entered for the periods when the source is not operating or is inactive, and a factor of 1 is entered for the periods when the source is operating. Model inputs for variable emissions rates can include the following time periods:

- Seasonally
- Monthly
- Hour of day
- Wind speed
- Season and hour of day
- Season, hour of day, day of week
- Season, hour of day, 7 days of the week
- Hour of day, day of week
- Hour of day, 7 days of the week
- Month, hour of day, day of week
- Month, hour of day, 7 days of the week

A.2 Plant Shutdowns and Start-Ups

Plant start-ups and shutdowns can occur periodically due to maintenance or designated vacation periods. The shutdown and subsequent startup processes impact emissions over the related time periods. As an example, process upsets in the combustion units or air pollution control system can also impact emissions; these upsets can often result in the release of uncontrolled emissions through the emissions sources. As a result, over short periods of time, upset emissions are often expected to be greater than normal source emissions[1]. AERMOD can account for these differences in emission rates by using variable emission factors.

[1] EPA - Office of Solid Waste and Emergency Response, July 1998. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA530-D-98-001A. U. S. Environmental Protection Agency, Research Triangle Park, NC.

Example Variable Emissions Scenario: A turbine operates from 6AM to 8PM (1 hour for startup, 1 hour for shutdown, and 12 hours of normal operation) every day. The startup/shutdown emissions are twice that of normal operating emissions. The emission rate during normal operation should be entered in g/s in the source parameters window in AERMOD. The emission rate factors that reflect this operating schedule should be entered in the variable emissions scenario in AERMOD as shown in Table A.2-1.

It is important to note that the hours of the day displayed in AERMOD correspond to the hour ending at the time displayed. Therefore, hour 7 corresponds to the hour from 6AM to 7AM, and hour 20 corresponds to the hour from 7PM to 8PM.

Table A.2-1: Example Variable Emission Scenario (Hour of Day)

Hour of Day	Emission Rate Factor by Hour	Hour of Day	Emission Rate Factor by Hour
1	0	13	1
2	0	14	1
3	0	15	1
4	0	16	1
5	0	17	1
6	0	18	1
7	2	19	1
8	1	20	2
9	1	21	0
10	1	22	0
11	1	23	0
12	1	24	0

Appendix B – Modeling Specific Source Types

This appendix will be updated with additional source types in the future.

B.1 Liquid Storage Tanks

Storage tanks are generally of two types—fixed roof tanks and floating roof tanks. In the case of fixed roof tanks, most of the pollutant emissions escape from a vent, with some additional contribution from hatches and other fittings. In the case of floating roof tanks, most of the pollutant emissions escape through the seals between the roof and the wall and between the deck and the wall, with some additional emissions from fittings, such as ports and hatches.

Approaches for modeling emission impacts from various types of storage tanks are outlined in Sections B.1.1 and B.1.2 below.

B.1.1 Fixed Roof Tanks

Model a fixed roof tank as a point source (i.e., a stack). The point source location and release height should represent the tank vent, which is usually in the center of the tank. The tank should also be represented as a building for downwash modeling. Table B.1.1-1 shows the values that should be entered for the velocity, diameter and temperature.

Table B.1.1-1: Stack Parameters for Modeling Tanks

Velocity	Diameter	Temperature
Near zero, i.e., 0.001 m/s	Nero zero, i.e., 0.001 m	Ambient – a value of 0 prompts the model to use the ambient temperature

There is virtually no plume rise from tanks. Therefore, the stack parameters for the stack gas exit velocity and stack diameter should be set to near zero for the stacks representing the emissions. In addition, stack temperature should be set equal to the ambient temperature. This can be accomplished in AERMOD by inputting a value of 0 for the stack gas temperature.

Note that it is very important for the diameter to be at or near zero. With low exit velocities and larger diameters, stack tip downwash will be calculated. A very small stack diameter effectively eliminates the stack tip downwash. Because all downwash effects are being modeled with the building downwash algorithm, the additional stack tip downwash calculations would be inappropriate.

B.1.2 Floating Roof Tanks

Model a floating roof tank as an area source. The area source inputs should represent the diameter of the tank and the height of the tank. The tank should also be represented as a building for downwash modeling if there are nearby point sources that may be affected.

Appendix C – Modeling Emissions from Roadways

Roadways may be modeled as LINE sources, RLINE sources, a series of VOLUME sources, or a series of AREA sources. LINE sources are recommended for modeling vehicle exhaust emissions in urban areas and in rural areas where the elevation may have significant impacts on the dispersion results. The RLINE source may be used to model vehicle exhaust emissions in rural areas with minimal elevation changes. Adjacent VOLUME sources are recommended for modeling fugitive dust from haul roads.

Groups of idling vehicles may also be modeled as one or more VOLUME sources. In those cases, the initial dimensions of the source, dispersion coefficients, and release heights should be calculated assuming that the vehicles themselves are inducing no turbulence. Source characterization should be based on the type of vehicles idling; e.g., if the vehicles idling are primarily heavy-duty trucks, then the release height would be 4 meters. Furthermore, sources should be placed in the location(s) where the majority of emissions occur. For example, if buses enter and exit a bus terminal from a single driveway, the bus exhaust emissions should be modeled using one or more VOLUME sources at the location of that driveway, rather than spreading the emissions across the entire terminal yard.

C.1 Modeling Roadways with LINE Sources

AERMOD can represent rectangular area sources using the LINE or AREA keywords. The three area source types and the LINE source type use the same numerical integration algorithm for estimating impacts from area sources. These are merely different options for specifying the shape of the area source. The LINE source type utilizes the same routines as the AREA source type and will give identical results for equivalent source inputs.

Sources that may be modeled as LINE sources may include roadways and areas within which emissions occur relatively evenly. USEPA recommends that the LINE source keyword be used for modeling roadway sources as it greatly simplifies defining the physical location and orientation of sources. The LINE source type option allows users to specify line-type sources based on a start-point and end-point of the line and the width of the line.

The LINE source parameter inputs are:

- Emission Rate [g/s]: Pollutant emission rate.
- UTM coordinates of midpoint of the start and end of the lines (X1,Y1; X2,Y2) [m].
- Width [m]: Width of the source; e.g., the width of a lane or multiple lanes, depending on how the source is defined.
- Szinit [m]: Initial vertical dimension coefficient. Default: 1.2 m for light-duty vehicles; 3.2 m for heavy-duty vehicles.
- Release Height [m]: Release height above the ground. Default: 1.3 m for light-duty vehicles; 3.4 m for heavy-duty vehicles.

The District's recommended method for calculating LINE source modeling parameters is described in Sections C.1.1 through C.1.3 below.

C.1.1 Determining Width for LINE Sources

To estimate the width of the LINE source for a roadway, use one of the following options:

1. The width of the traveled way, typically 3.7 m (12 ft) per lane for a high-speed, high volume roadway and 3.3 m (11 ft) per lane for an arterial/collector; or
2. The width of the traveled way (all travel lanes) + 6 meters.

C.1.2 Determining Szinit for LINE Sources

To account for the effects of vehicle-induced turbulence, assume the **Top of Plume Height is 1.7 times the average vehicle height**. For light-duty vehicles, this is about 2.6 meters, using an average vehicle height of 1.53 meters (5.0 feet). For heavy-duty vehicles, this is about 6.8 meters, using an average vehicle height of 4.0 meters (13.1 feet). Since most roadways will experience a combination of light-duty and heavy-duty traffic, the <u>Top of Plume Height should be a combination of their respective values.</u> There are two options available to estimate the Top of Plume Height:

1. Estimate the Top of Plume Height using an emissions-weighted average[1]. For example, if light-duty and heavy-duty vehicles contribute 40 percent and 60 percent of the emissions of a given volume source, respectively, the Top of Plume Height would be calculated as: (0.4 * 2.6) + (0.6 * 6.8) = 5.1 meters.
2. Alternatively, the Top of Plume Height may be estimated using a traffic volume weighted approach based on light-duty and heavy-duty vehicle fractions.

The initial vertical dimension coefficient, **Szinit, is then estimated by dividing the Top of Plume Height by 2.15**. For typical light-duty vehicles, this corresponds to a Szinit of 1.2 meters. For typical heavy-duty vehicles, the value of Szinit is 3.2 meters.

C.1.3 Determining Release Height for LINE Sources

The release height, which is the height at which wind effectively begins to affect the plume, may be estimated as the midpoint of the Top of Plume Height. In other words, the **release height is the Top of Plume Height multiplied by 0.5**. As noted above, most roadways will experience a combination of light-duty and heavy-duty traffic. For each roadway source, the **release height should be based on the same Top of Plume Height used for calculating its Szinit, as described above**. This value is 1.3 m for light-duty vehicles, and it is 3.4 m for heavy-duty vehicles.

An alternate method to determine source parameters that vary with different fractions of light-duty and heavy-duty traffic is to create two overlapping versions of each roadway source, corresponding to either light-duty or heavy-duty traffic. These two sources would be superimposed in the same space, but would have emission rates, initial vertical dimensions and release heights that are specific to light-duty or heavy-duty vehicles.

C.2 Modeling Roadways with RLINE Sources

The AERMOD RLINE source algorithm is used to model near-surface releases from mobile sources and can be used to represent a travelled roadway with either single or multiple lanes of traffic. The AERMOD model simulates mobile source emissions using Romberg numerical integration of POINT sources, with the number of points included in the integration determined by error analysis.

[1] If multiple pollutants are being modeled and the emission factors vary significantly for different vehicle types, then determine the Top of Plume Height based on the traffic volume weighted approach.

Beginning with AERMOD version 24142, the RLINE source type is a regulatory option and can be used with the DFAULT option.

The RLINE source parameter inputs are:

- Emission Rate [g/s]: Pollutant emission rate.
- Width [m]: Width of the source; e.g., the width of a lane or multiple lanes, depending on how the source is defined.
- Szinit [m]: Initial vertical dimension coefficient. Default: 1.2 m for light-duty vehicles; 3.2 m for heavy-duty vehicles.
- Release Height [m]: Release height above the ground. Default: 1.3 m for light-duty vehicles; 3.4 m for heavy-duty vehicles.

The District's recommended method for calculating RLINE source modeling parameters is described in Sections C.2.1 through C.2.3 below.

C.2.1 Determining Width for RLINE Sources

To estimate the width of the RLINE source for a roadway, use one of the following options:

1. The width of the traveled way, typically 3.7 m (12 ft) per lane for a high-speed, high volume roadway and 3.3 m (11 ft) per lane for an arterial/collector; or
2. The width of the traveled way (all travel lanes) + 6 meters.

C.2.2 Determining Szinit for RLINE Sources

To account for the effects of vehicle-induced turbulence, assume the **Top of Plume Height is 1.7 times the average vehicle height**. For light-duty vehicles, this is about 2.6 meters, using an average vehicle height of 1.53 meters (5.0 feet). For heavy-duty vehicles, this is about 6.8 meters, using an average vehicle height of 4.0 meters (13.1 feet). Since most roadways will experience a combination of light-duty and heavy-duty traffic, the Top of Plume Height should be a combination of their respective values. There are two options available to estimate the Top of Plume Height:

1. Estimate the Top of Plume Height using an emissions-weighted average[2]. For example, if light-duty and heavy-duty vehicles contribute 40 percent and 60 percent of the emissions of a given volume source, respectively, the Top of Plume Height would be calculated as:
   (0.4 * 2.6) + (0.6 * 6.8) = 5.1 meters.
2. Alternatively, the Top of Plume Height may be estimated using a traffic volume weighted approach based on light-duty and heavy-duty vehicle fractions.

The initial vertical dimension coefficient, **Szinit, is then estimated by dividing the Top of Plume Height by 2.15**. For typical light-duty vehicles, this corresponds to a Szinit of 1.2 meters. For typical heavy-duty vehicles, the value of Szinit is 3.2 meters.

C.2.3 Determining Release Height for RLINE Sources

The release height, which is the height at which wind effectively begins to affect the plume, may be estimated as the midpoint of the Top of Plume Height. In other words, the **release height is the Top of**

[2] If multiple pollutants are being modeled and the emission factors vary significantly for different vehicle types, then determine the Top of Plume Height based on the traffic volume weighted approach.

Plume Height multiplied by 0.5. As noted above, most roadways will experience a combination of light-duty and heavy-duty traffic. For each roadway source**,** the **release height should be based on the same Top of Plume Height used for calculating its Szinit, as described above**. This value is 1.3 m for light-duty vehicles, and it is 3.4 m for heavy-duty vehicles.

An alternate method to determine source parameters that vary with different fractions of light-duty and heavy-duty traffic is to create two overlapping versions of each roadway source, corresponding to either light-duty or heavy-duty traffic. These two sources would be superimposed in the same space, but would have emission rates, initial vertical dimensions and release heights that are specific to light-duty or heavy-duty vehicles.

C.3 Modeling Roadways with VOLUME Sources

Another option for modeling roadways is to use VOLUME sources. However, when modeling highways and intersections, LINE sources may be easier to characterize than VOLUME sources. Furthermore, the VOLUME source type requires significantly longer computational time compared to the LINE or RLINE source types, as more sources are required to simulate the same distance.

The VOLUME source algorithms are applicable to line sources with some initial plume depth, such haul roads, areas designated for truck or bus queuing or idling, driveways and pass-throughs in transit or freight terminals, and locomotive emissions. USEPA recommends modeling fugitive dust from haul roads as adjacent VOLUME sources, unless there are receptors located within the volume source exclusion area, which is further explained in Section C.3.3.

The goal of using VOLUME sources to represent a roadway is to create a uniform emissions characterization. Ensure that VOLUME sources are not spaced too widely along the roadway. Adjacent VOLUME sources should overlap and the distance between the center of one VOLUME source to the next should be equal to the width of each source, as described in the AERMOD user's guide and represented in Figure 1-8(a) of USEPA's September 1995 *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II – Description of Model Algorithms* (and reproduced on the following page). Any other approximation of roadways with VOLUME sources will result in nearby receptors being over or under-estimated depending on their proximity to the center of the volume source.

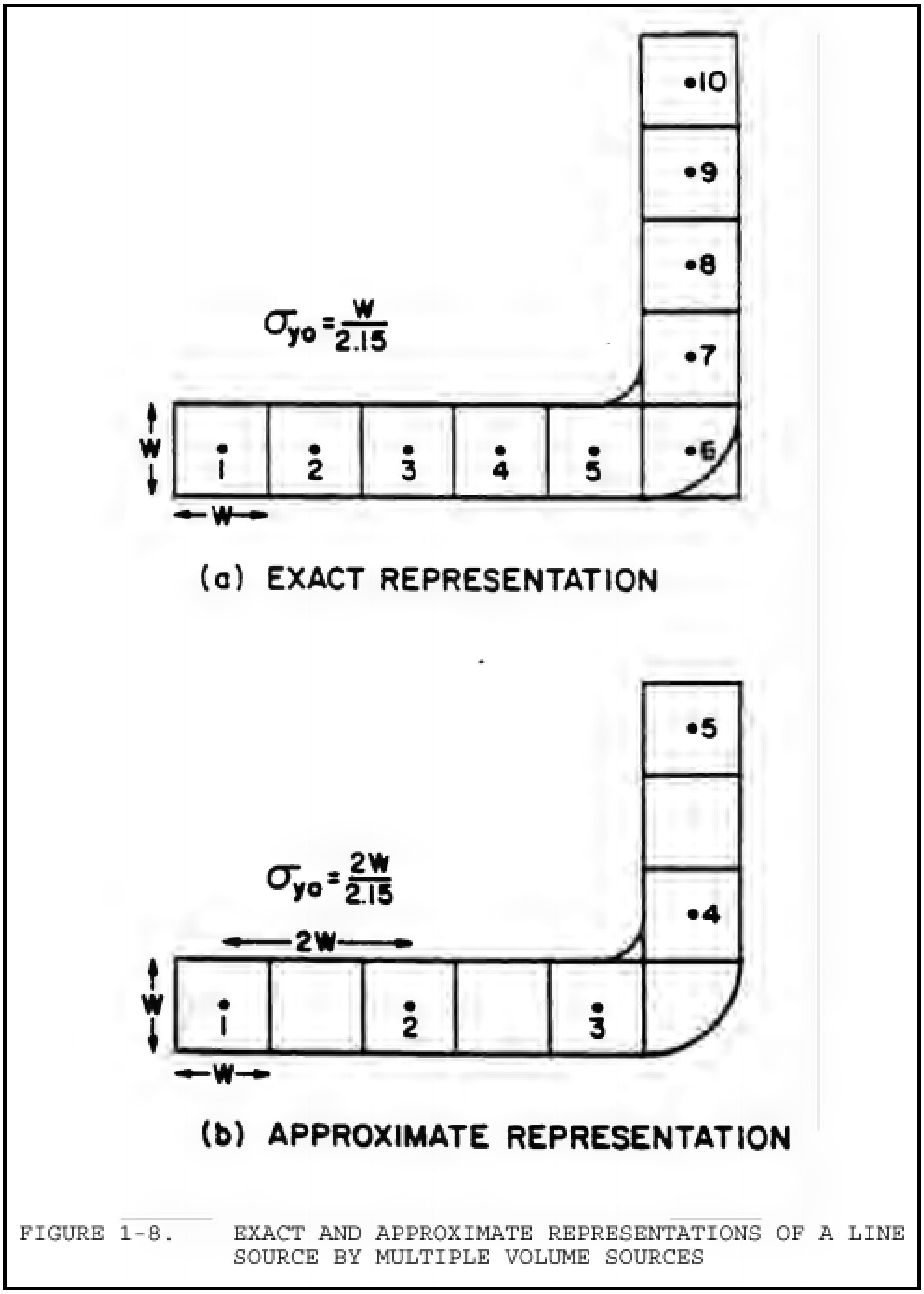

Figure C.3-1: Exact and Approximate Representations of a Line Source by Multiple Volume Sources (Figure 1-8 Reproduced from Section 1.2.2 of USEPA's September 1995 *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II – Description of Model Algorithms*)

The VOLUME source parameter inputs are:

- Emission Rate [g/s]: Pollutant emission rate.
- X Coordinate [m]: Easting UTM at the center of the volume source.
- Y Coordinate [m]: Northing UTM at the center of the volume source.
- Syinit [m]: Initial lateral dimension of the volume.
- Szinit [m]: Initial vertical dimension of the volume.
- Release Height [m]: Release height above ground at the center of volume.

The District's recommended method for calculating VOLUME source modeling parameters is described in Sections C.3.1 through C.3.3 below.

C.3.1 Determining Syinit for VOLUME Sources

USEPA recommends that Syinit is calculated by dividing the Plume Width by 2.15, where the Plume Width is calculated as:

- Plume Width for Single Lane Roadways = Vehicle Width + 6m;
- Plume Width for Two-Lane Roadways = Road Width + 6m for two-lane roadways. Two-lane roadways are for cases with heavy two-way traffic where the combined plume needs to be approximated; not typically used for haul roads.

C.3.2 Determining Szinit for VOLUME Sources

To account for the effects of vehicle-induced turbulence, assume the **Top of Plume Height is 1.7 times the average vehicle height**. For light-duty vehicles, this is about 2.6 meters, using an average vehicle height of 1.53 meters (5.0 feet). For heavy-duty vehicles, this is about 6.8 meters, using an average vehicle height of 4.0 meters (13.1 feet). Since most roadways will experience a combination of light-duty and heavy-duty traffic, the <u>Top of Plume Height should be a combination of their respective values.</u> There are two options available to estimate the Top of Plume Height:

1. Estimate the Top of Plume Height using an emissions-weighted average[3]. For example, if light-duty and heavy-duty vehicles contribute 40 percent and 60 percent of the emissions of a given volume source, respectively, the Top of Plume Height would be calculated as: (0.4 * 2.6) + (0.6 * 6.8) = 5.1 meters.
2. Alternatively, the Top of Plume Height may be estimated using a traffic volume weighted approach based on light-duty and heavy-duty vehicle fractions.

The initial vertical dimension coefficient, Szinit, is then estimated by dividing the Top of Plume Height by 2.15. For typical light-duty vehicles, this corresponds to a Szinit of 1.2 meters. For typical heavy-duty vehicles, the value of Szinit is 3.2 meters.

C.3.3 Determining Release Height for VOLUME Sources

The release height, which is the height at which wind effectively begins to affect the plume, may be estimated as the midpoint of the Top of Plume Height. In other words, the **release height is the Top of Plume Height multiplied by 0.5**. As noted above, most roadways will experience a combination of

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[3] If multiple pollutants are being modeled and the emission factors vary significantly for different vehicle types, then determine the Top of Plume Height based on the traffic volume weighted approach.

light-duty and heavy-duty traffic. For each roadway source, the **release height should be based on the same Top of Plume Height used for calculating its Szinit, as described above**. This value is 1.3 m for light-duty vehicles, and it is 3.4 m for heavy-duty vehicles.

In addition, when the source-receptor spacing in AERMOD is shorter than the distance between adjacent volume sources, AERMOD may produce aberrant results. Therefore, ensure that no receptors are placed within a distance of (2.15 x Syinit + 1 meter) of the center of a VOLUME source, known as the "receptor exclusion zone."[4] As a practical recommendation, when using VOLUME sources to simulate a roadway where receptors are placed five meters from the edge of the roadway, the width of a volume source should be less than eight meters. This will ensure that no receptors fall within the receptor exclusion zone. If the width of the roadway is larger than eight meters, it is recommended that additional VOLUME sources be defined (e.g., separate each lane of traffic), or LINE sources be used.

C.4 References for Appendix C

- U.S. Environmental Protection Agency. September 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models Volume II – Description of Model Algorithms. https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=0000324F.TXT.
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- U.S. Environmental Protection Agency. November 2024. *AERMOD Implementation Guide*. https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_implementation_guide.pdf.

[4] Ambient air receptors, including Cartesian grid receptors and property boundary receptors must not be excluded. If any ambient air receptors fall within the "receptor exclusion zone" and using adjacent VOLUME sources results in aberrant modeled concentrations, then the LINE source type must be used instead of adjacent VOLUME sources.

Appendix D – Placement of Portable Equipment

Modeling portable equipment presents the challenge of determining the appropriate locations to model the equipment and distributing emissions to these locations in a representative and health protective manner. If portable equipment will operate at specific locations on a consistent schedule, the portable equipment's emissions can be modeled at multiple locations using an appropriate variable emission scenario for each AERMOD source. More information on variable emissions modeling can be found in Appendix A of this document.

If there is no consistent operational schedule for the portable equipment, use the following methodology to apportion the emissions:

1. The annual emissions should be distributed evenly throughout all locations where the equipment emits throughout the year.
2. When determining the short-term (i.e., 24-hour, 8-hour, 3-hour and 1-hour) impacts, the model should first be run with the short-term emissions from any portable equipment set to zero. After the point of maximum impact (PMI) is determined, a second analysis should be performed with the short-term emissions for all portable equipment assigned to the closest location to the PMI that the equipment will operate.
3. If there is concern that emissions from the portable equipment may be the main contributor to a short-term averaging period concentration for any of the pollutants, a third short-term modeling run should be performed. In this modeling run, the portable equipment should be placed at the location closest to the property boundary that it will operate. The short-term impacts at the PMI from this run should be compared to the short-term impacts at the PMI for the second modeling run as described in Step 2, with the higher of the two values reported as the PMI for that pollutant and averaging period.

An example of the methodology described above is well drilling at an oil and gas facility. In this example, a total of 50 wells will be drilled over a 10-year period:

1. One volume source is modeled at each well location. The average annual emissions for each volume source are equal to the total well drilling emissions over the lifetime of the project divided by 10 years and by 50 wells.
2. Next, the short-term impacts are analyzed without any short-term emissions from well drilling. The initial PMI for each pollutant and averaging period for this analysis is determined, and then the short-term emissions for each pollutant are assigned to the well located closest to the PMI for that pollutant and averaging period, as there will be only one drilling rig in operation at a time. For this second analysis, the closest well location to the PMI for 24-hour PM_{10} is approximately 300 meters from the property boundary, and the resulting 24-hour PM_{10} concentration at the PMI is 3.7 $\mu g/m^3$.
3. Additionally, a 24-hour PM_{10} modeling run is performed with the maximum 24-hour well drilling PM_{10} emissions assigned to the well located closest to the property boundary, which is approximately 60 meters from the property boundary. The resulting 24-hour PM_{10} concentration at the PMI is 3.0 $\mu g/m^3$. Therefore, the reported modeled 24-hour PM_{10} concentration is the PMI from the second analysis, 3.7 $\mu g/m^3$, which must be added to the background concentration for comparison to the AAQS. **This same methodology must be implemented for each pollutant and short-term averaging period.**

Appendix E – Default DICE Stack Parameters

The table below contains default stack parameters for stationary diesel-fired internal combustion engines (DICE). These default parameters were developed by the California Air Pollution Control Officers Association (CAPCOA) and the California Air Resources Board (CARB) as documented in their July 2024 *Non-Vehicular Diesel Engine Risk Assessment Guidance*, available here: https://ww2.arb.ca.gov/sites/default/files/classic/ab2588/2024%20DICE%20Screening%20Risk%20Guidelines.pdf. Stack data was provided by six air districts in California for a total of 5,190 diesel engines; the engines were divided into 19 horsepower classes and the median stack parameter values for each horsepower class were selected. **These default stack parameters are only to be used when engine-specific data is unknown.** If the release type is unknown, a capped stack should be assumed.

Table E-1: Default Stationary DICE Stack Parameters

Engine Size (bhp)	Stack Temp (K)	Stack Inner Diameter (m)	Release Height (m)	Exit Velocity (m/s)
≤50	813	0.06	2.1	47.1
51-100	797	0.07	2.4	56.9
101-150	755	0.09	2.4	53.0
151-175	795	0.10	2.4	46.9
176-200	761	0.10	2.9	55.5
201-275	780	0.11	3.0	56.4
276-300	789	0.13	3.0	57.4
301-400	780	0.13	3.0	63.9
401-500	770	0.15	3.1	59.4
501-600	786	0.15	3.4	69.8
601-750	764	0.20	3.7	57.8
751-825	755	0.20	3.7	55.8
826-1150	775	0.25	3.8	53.5
1151-1500	750	0.25	4.3	52.2
1501-1850	751	0.30	4.9	57.4
1851-2500	750	0.36	5.3	51.8
2501-3500	747	0.46	6.1	45.1
3501-4500	753	0.51	7.6	45.6
>4500	786	0.58	7.6	40.0