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## SCAQMD Modeling Guidance for AERMOD

As of December 9, 2006, U.S. EPA promulgated AERMOD as a replacement for ISCST3 as the recommended dispersion model.

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## **AERMOD**

As of December 9, 2006, the U.S. EPA promulgated AERMOD as a replacement for ISCST3 as the recommended air quality dispersion model. All modeling analyses should be conducted using the most recent version of AERMOD available at the time of submittal, unless approval is received prior to submittal to use a previous version of AERMOD. Please see the U.S. EPA's SCRAM webpage (<https://www.epa.gov/scram>) for the latest version of AERMOD and the associated pre-processors. SCAQMD's required modeling options for AERMOD are discussed below.

### **Regulatory Defaults**

AERMOD should be executed with the U.S. EPA regulatory default option, which is required by SCAQMD. If the default option is not utilized, the report should contain a discussion to justify this change and include all supporting data and information.

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## Urban Dispersion Option

AERMOD should be executed using the urban modeling option, which is SCAQMD policy for all air quality impact analyses in its jurisdiction. All sources should be modeled with urban effects using the population of the County where the project is located. Table A below lists the various County populations within SCAQMD jurisdiction. If the rural modeling option is utilized, the report should include a discussion to support this change based on the U.S. EPA procedure outlined in Section 7.2.1.1 of 40 CFR Part 51, Appendix W ([https://www3.epa.gov/ttn/scram/appendix\\_w/2016/AppendixW\\_2017.pdf](https://www3.epa.gov/ttn/scram/appendix_w/2016/AppendixW_2017.pdf)) (January 2017).

Table A: County Population to Use in AERMOD

County	Population
Los Angeles	9,818,605
Orange	3,010,232
Riverside	2,189,641
San Bernardino	2,035,210

**Note:** County Population data based on 2010 census data from the U.S. Census Bureau.

## Building Downwash

Building downwash effects must be included and should be modeled using BPIP-PRIME (BPIP-PRM (<https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#bpipprm>)).

## Averaging Times

When using AERMOD to determine the maximum annual concentration of criteria pollutants such as NO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, and SO<sub>2</sub>, SCAQMD requires that each calendar year is run separately. Some software GUI's have the functionality to output maximum annual concentrations by individual year through the use of POST files.

1-hour NO<sub>2</sub>, 24-hour PM<sub>10</sub>, 24-hour PM<sub>2.5</sub>, and 1-hour SO<sub>2</sub> National Ambient Air Quality Standards (NAAQS) have special processing requirements and specific keywords need to be used in AERMOD to generate the correct concentrations. Please refer to the AERMOD User's Guide ([https://www3.epa.gov/ttn/scram/models/aermod/aermod\\_userguide.pdf](https://www3.epa.gov/ttn/scram/models/aermod/aermod_userguide.pdf)) for the correct keywords to use in AERMOD.

When using AERMOD to determine cancer risks or chronic health indexes, it is appropriate to estimate the maximum annual concentration for the entire 5-years of meteorological data provided. Please use the averaging time keyword PERIOD for calculating long-term health risks.

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## Receptor Grid

To identify the maximum impacted receptors, a uniform Cartesian grid with a spacing of 100 meters or less must be used for all distances less than 1 kilometer. All receptors should be identified in UTM coordinates. The size of the modeling domain and placement of the receptors should be at such a distance and resolution to identify the maximum impacts to the surrounding areas and the significant concentration gradients from the source under review. Table B below can be used as an example for receptor spacing within the modeling domain. Note that some modeling analyses will require remodeling with a finer grid resolution if additional areas of concern are identified in the coarse grid modeling.

Table B: Example of Nested Grid Receptor Spacing\*

Distance from Source	Receptor Spacing
< 500 meters	50 meters or less
500 meters to 1 kilometer	100 meters or less
1 kilometer to 5 kilometers	250 meters or less
5 kilometers to 10 kilometers	500 meters or less

10 kilometers to 50 kilometers	1,000 meters or less
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\*This table is an example of a nested table grid typically used in a SIL or NAAQS/CAAQS analysis.

Discrete Cartesian receptors on the ambient air boundary (which can be considered the property or fenceline boundary) must be placed along the boundary following the maximum spacing requirements shown in Table C below. Receptors inside the facility's ambient air boundary should be removed. Sensitive receptors must be identified by exact UTM coordinates using discrete Cartesian receptors. Elevations must be provided for all receptors within the modeling domain.

Table C: Maximum Receptor Spacing Requirements for Ambient Air Boundary Receptors

Area of Facility	Maximum Ambient Air Boundary Receptor Spacing
Area < 4 acres	20 meters
4 acres ≤ Area < 10 acres	30 meters
10 acres ≤ Area < 25 acres	50 meters
25 acres ≤ Area < 100 acres	75 meters
Area ≥ 100 acres	100 meters

**WARNING:** According to the section 4.1 of the AERMOD Implementation Guide ([https://www3.epa.gov/ttn/scram/models/aermod/aermod\\_implementation\\_guide.pdf](https://www3.epa.gov/ttn/scram/models/aermod/aermod_implementation_guide.pdf)) (revised August 3, 2015), for cases in which receptor elevations are lower than the base elevation of the source, AERMOD will predict concentrations that are less than what would be estimated from an otherwise identical flat terrain situation. While this is appropriate and realistic in most

cases, for cases of down-sloping terrain where the plume is terrain-following, AERMOD will tend to underestimate concentrations when terrain effects are taken into account. In order to avoid underestimating concentrations in such situations, SCAQMD recommends the following:

1. If all receptor elevations are lower than the base elevation of the source, the non-default option within AERMOD should be applied to assume flat, level terrain.
2. If some receptors are lower and some receptors are higher than the base elevation of the source, AERMOD should be run twice – once using the default option and the second time using the non-default option. The maximum ground-level concentration from both runs should be reported.

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### **Flagpole Receptor Heights**

All receptors should be set to the elevation, so that only ground-level concentrations are analyzed. Please use the Control pathway keyword ELEV within AERMOD. Flagpole receptors are only necessary for analyses that have instances where sensitive receptors are located on patios/decks at nearby high-rise apartment buildings.

### **Elevations**

The AERMOD modeling system includes AERMAP (<https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#aermap>), which is a terrain data pre-processor. Terrain data, available from the United States Geological Survey (USGS), is used by AERMAP to produce terrain base elevations for each receptor and source and a hill height scale value for each receptor. AERMAP must be used to develop the terrain data required for AERMOD. It is highly recommended that National Elevation Dataset (NED) data in GeoTIFF format be used as input into AERMAP instead of Digital Elevation Model (DEM) data, as is recommended in the U.S. EPA's AERMOD Implementation Guide due to the DEM data set being static and not updated by USGS for a number of years. A resolution of 1 arc-second (approx. 30 meters) or 1/3 arc-second (approx. 10 meters) are acceptable. Elevations should be imported for all modeled sources, receptors, and buildings in the modeling analysis.

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## Conversion of NO<sub>x</sub> to NO<sub>2</sub>

Methodologies for modeling the conversion of NO<sub>x</sub> to NO<sub>2</sub> should follow the Tiers laid out in U.S. EPA's Appendix W, Section 4.2.3.4. They are as follows:

- Tier 1: Assume 100% conversion of NO<sub>x</sub> to NO<sub>2</sub>, no additional steps or data needed.
- Tier 2: ARM2 ratio. The minimum and maximum NO<sub>2</sub>/NO<sub>x</sub> ratios should use U.S. EPA default values (0.5 and 0.9, respectively). Note that the previous ARM methodology (0.80 for 1-hour and 0.75 for annual averaging times) will **no longer be accepted as of October 1, 2017**.
- Tier 3: OLM and PVMRM. The U.S. EPA default values for the NO<sub>2</sub>/NO<sub>x</sub> In-Stack Ratio (ISR) and NO<sub>2</sub>/NO<sub>x</sub> Equilibrium Ratio (0.5 and 0.9, respectively) should be used. Non-default ISR values can be used if technical justification is provided, such as stack test results, manufacturer test data, or U.S. EPA's ISR database. As discussed in U.S. EPA's Appendix W, PVMRM is most appropriate for analyses with relatively isolated and elevated sources. OLM is more appropriate for analyses with area sources, near-surface releases, or where plume overlap from multiple sources will occur. When using OLM, use the option OLMGROUP ALL in AERMOD.

Please contact the SCAQMD's permit modeling contact (see "More Information" box on the right) for questions regarding the most recent and updated methodologies for NO<sub>2</sub> modeling, including which options are most appropriate for your source. Hourly ozone data for the South Coast Air Basin are available to download through SCAQMD's website.

## Shoreline Fumigation and Inversion Break-Up

Sources with tall stacks located on the Pacific Coast shoreline and subject to the PSD program (SCAQMD Reg. XVII) should evaluate impacts resulting from shoreline fumigation and inversion break-up. Currently, AERMOD cannot be used to evaluate these effects. AERSCREEN (<https://www.epa.gov/scram/air-quality-dispersion-modeling-screening-models#aerscreen>) must be used to evaluate shoreline fumigation and inversion break-up for the short-term averaging periods.

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## **Meteorological Data**

Meteorological data files for AERMOD applications have been processed by SCAQMD staff and are available on our website (/home/air-quality/air-quality-data-studies/meteorological-data/data-for-aermod). Modeling for criteria pollutants and HRA's should use the most recently available and meteorologically-appropriate 5-year data set, as is required for AERMOD applications by U.S. EPA's Appendix W, Section 8.4. Considerations for choosing a meteorological station includes the source's meteorological conditions (such as prevailing winds, mixing heights, etc.), terrain, surrounding land use and surface characteristics, and proximity. This means that the closest meteorological station to the source under review is not always the most representative meteorologically. Modeling protocols and reports should include the technical justification on the most meteorologically-appropriate station for your source. Technical justification includes comparisons of the surrounding land use, surface characteristics (such as surface roughness), wind roses, significant terrain features, etc.

## **Surface Characteristics**

When using AERMET to process meteorological data for AERMOD, values for three surface characteristics (surface roughness, albedo, and Bowen ratio) must be determined. When using the SCAQMD provided AERMOD-ready meteorological data, this information is not necessary as the surface characteristics have already been incorporated into the AERMET processed meteorological data. However, if AERMET will be used to develop a project-specific meteorological data set for use in AERMOD, then AERSURFACE (<https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#aersurface>) should be used to determine the surface characteristics to be used in AERMET. Please consult SCAQMD modeling staff before processing any project-specific meteorological data.

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## **Background Concentration**

When conducting air dispersion modeling for demonstrating compliance against the National Ambient Air Quality Standards (NAAQS) and/or California Ambient Air Quality Standards (CAAQS), background concentrations are required to be included in the analysis for all attainment pollutants. Background concentrations, as described in the U.S. EPA's Appendix W, Section 8.3.1.1,



refers to the "...portion of the background attributable to natural sources, other unidentified sources in the vicinity of the project, and regional transport contributions from more distant sources" where "...the ambient concentrations from these sources are typically accounted for through use of ambient monitoring data...". Monitoring data for the South Coast Basin can be obtained via the SCAQMD's Historical Data by Year (</home/air-quality/air-quality-data-studies/historical-data-by-year>), CARB's Air Quality Data (<https://www.arb.ca.gov/adam/index.html>), or U.S. EPA's Air Data (<https://www.epa.gov/outdoor-air-quality-data>) webpages. When selecting a monitoring station to represent the background present at the source under consideration, please refer to section 8.3.2 of the U.S. EPA's Appendix W for guidance. Generally, the closest upwind monitor should be selected, with preference to the monitor that has the most similar characteristics to the area for the source under consideration.

The exceptions for including background concentrations is the PM10 CAAQS and PM2.5 NAAQS and CAAQS, due to the nonattainment status for the South Coast Basin. Modeled maximum 24-hour and annual concentrations should be compared directly to the significant change thresholds of 2.5 and 1.0 micrograms/cubic meter, respectively.

The most recent 3 years of available monitoring data should be used to develop background concentration values. For all CAAQS and most NAAQS pollutants, the maximum value from the most recent 3 years should be used. The exceptions to this is for the NAAQS pollutants with special design values. This includes 1-hour NO<sub>2</sub> (3 year average of the 98th percentile of the daily maximum 1-hour average) and 1-hour SO<sub>2</sub> (3 year average of the 99th percentile of the daily maximum 1-hour average).

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## **Variable Emissions**

All applicants conducting dispersion modeling and HRAs for permitting purposes should model the sources under consideration as a continuous operation (24 hours/day, 7 days/week, and 52 weeks/year), unless there are existing permit conditions that restrict the operating hours or the applicant is willing to take conditions in their permit that restrict the hours of operation.

For Rule 1401 compliance demonstrations, non-continuous operations should be accounted for through the use of variable emission factors (AERMOD keyword EMISFACT) or emission scalars, as they are sometimes also referred to. See section 3.3.11 of the AERMOD User's Guide for more information on variable emission factors. Emission scalars should be applied as specified in the Variable Emissions section of the HARP2 User's Guide. This will require two runs within AERMOD. The model run for the

long-term health risks (chronic and cancer) should be run with adjusted emission scalars (to sum the annual emissions up to 31,536 kg/yr). The emission rate (Qs) specified for the source should be 1 g/s. However, the emission scalar will take into account the adjustment. For example, a facility operating 16 hours/day, 7 days/week, 52 weeks/year would specify an emission factor of 1.5 (EMISFACT HROFDY 1.5) for hours when the source is operating, and an emission factor of 0 (EMISFACT HROFDY 0) for hours when the source is not operating. The model run for the short-term health risks (acute) should be run with a value of 1 g/s when the source is operating, and 0 g/s when the source is not operating.

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### **Submittal Requirements for all Criteria Pollutants and HRA Modeling Analyses for Permit Applications**

All criteria pollutant analyses and Health Risk Assessments (HRAs) in support of permit applications require the submittal of an air quality dispersion modeling report that details the assumptions, technical justifications, results, source parameters, and other relevant data used in the modeling analysis.

This includes a discussion of:

- Project description
- Description of the source(s) under review, including operating schedules and existing permit conditions
- Purpose of modeling analysis including applicable SCAQMD rules
- Models used and version numbers (ex., AERMOD Version 16216r, HARP2 Version 17052, etc.), not the software GUI name and version, i.e. Lakes, Breeze, BEEST, etc.
- Model options utilized
- Averaging times utilized
- Sources modeled and how the sources were characterized in the model

- Tables containing the source parameters should be included
- Emission rates
- Modeling domain extent
- Receptor grid type and spacing
- Location of nearby sensitive and off-site worker receptors
- Nearby terrain and elevation considerations, such as elevation data sets and the resolution used, coordinate system, datum, complex terrain, etc.
- A description of how the representative meteorological station was selected
- Selection of background concentrations and nearby sources, if applicable
- Contact information (name, email, and phone number) for the applicant and/or modeling contact
- Any other applicable information to the modeling analysis and HRA

SCAQMD staff's responsibility is to review the applicant's submitted modeling analyses and reports, and contact the applicant if there are any deficiencies in the submittal. If any deficiencies are found by SCAQMD staff, it is the responsibility of the applicant to make corrections to the analysis and/or report, and resubmit the revisions to SCAQMD for staff final approval. Please be aware that any deficiencies found will result in delays to the final modeling approval.

Modeling reports need to include all electronic modeling files generated as part of the analysis, including (in the native format, not Word or PDF documents):

- AERMOD input and output files
- Plot files (\*.plt) separated by individual averaging time and source groups

- Should **not** be concatenated into one file
- BPIPPRM input and output files
- AERMAP input and output files
- USGS elevation input file (\*.tif or \*.dem)
- Meteorological files (\*.sfc and \*.pfl)
- Emission calculation spreadsheets
  - Excel spreadsheets with formulas that include emission rate assumptions
  - For HRAs, please include the annual average emission rate in pounds/year and the maximum 1-hour emission rate in pounds/hour
- All HARP2 generated files and subfolders
- And other files as needed
  - background concentrations
  - hourly ozone files
  - hourly emission files
  - nearby source information
  - spreadsheets with risk calculations if not using HARP2
  - README files for projects with multiple modeling scenarios

Printouts of electronic modeling files within reports are **highly discouraged**, as the same information is contained in the electronic modeling files that are required for submittal. Electronic files can be submitted via CD or USB thumb drive with the modeling report. Due to SCAQMD's internal firewall, transfers of data via FTP sites are not recommended.

All modeling projects that are subject to the Prevention of Significant Deterioration (PSD) program (SCAQMD Reg. XVII) are **highly encouraged** to submit a modeling protocol for SCAQMD staff's review and approval prior to conducting modeling or submitting an air quality modeling report. In addition, modeling projects that deviate from SCAQMD's modeling recommendations listed above are highly encouraged to submit a modeling protocol for review prior to submitting an air quality modeling analysis. While a protocol review might add more time to the front end of a project, this will help ensure that the alternative modeling methodology is approved prior to the actual modeling being conducted. If the modeling does not follow SCAQMD's recommendations below and a protocol is not submitted, this could lead to additional review time by SCAQMD staff, as well as re-modeling if SCAQMD staff does not agree with the technical justification for the use of the non-recommended options.

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## Resources

All applicants conducting air quality dispersion modeling and HRAs for permit applications should familiarize themselves with the following resources:

- U.S. EPA's Support Center for Regulatory Atmospheric Modeling (<https://www.epa.gov/scram>) (SCRAM) website
- 40 CFR Part 51, Appendix W (<https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance>): Guidelines on Air Quality Models (commonly referred to as U.S. EPA's Appendix W)
- AERMOD Modeling System (<https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod>), including the AERMOD User's Guide and AERMOD Implementation Guide
- AERSCREEN (<https://www.epa.gov/scram/air-quality-dispersion-modeling-screening-models#aerscreen>)
- Office of the Environmental Health Hazard Assessment (<https://oehha.ca.gov/air>) (OEHHA)

- **OEHHA's Air Toxics Hot Spots Program Guidance Manual for the Preparation of Risk Assessments** (<https://oehha.ca.gov/air/crnrr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0>)
- **California Air Resources Board** (<https://ww2.arb.ca.gov/homepage>) (CARB)
- **HARP2** (<https://www.arb.ca.gov/toxics/harp/harp.htm>)
- **SCAQMD Rules** (<http://www.aqmd.gov/home/regulations/rules/scaqmd-rule-book>) 1303, 1401, 1703, and 2005
- **SCAQMD Risk Assessment Procedures** (<http://www.aqmd.gov/home/permits/risk-assessment>) for Rules 1401 and 212
- **National Ambient Air Quality Standards** (<https://www.epa.gov/criteria-air-pollutants/naaqs-table>) (NAAQS)
- **California Ambient Air Quality Standards** (<https://www.arb.ca.gov/desig/desig.htm>) (CAAQS)

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### **MATES III (/home/air-quality/air-quality-studies/health-studies/mates-iii)**

MATES III is an air toxics monitoring and evaluation study conducted in the South Coast Air Basin.

### **Re-Adoption of Proposed Rule 1315 (/home/research/documents-reports/lead-agency-scaqmd-projects/aqmd-projects---year-2011/re-adoption-of-proposed-rule-1315)**

Final program environmental assessment for re-adoption of proposed rule 1315

### **Air Quality Modeling (/home/rules-compliance/ceqa/air-quality-modeling)**

Review of computer models available to assist the CEQA practitioner in calculating air quality impacts.

### **Meteorological Data (/home/air-quality/air-quality-data-studies/meteorological-data)**

Atmospheric dispersion models require meteorological data (i.e., winds, air temperature, atmospheric stability, mixed layer heights, etc.) to simulate the transport ...

## **More Information**

### **Contact**

- Melissa Sheffer (mailto:msheffer@aqmd.gov) Ph: 909-396-2346

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