Guidance for Air Dispersion Modeling

San Joaquin Valley Air Pollution Control District

Working Draft

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Special Thanks to
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Guidance for Air Dispersion Modeling

1. INTRODUCTION

The modeling guidelines contain hereafter are based on a document entitled "Provision Of Services To Develop Guidance For Air Dispersion Modeling" developed by Dr. Jesse Thé of Lakes Environmental Software. Contents of this document were updated/changed to conform to the San Joaquin Valley APCD's, henceforth known as the District, requirements.

The "Guidance for Air Dispersion Modeling" (GADM) is designed to provide guidance on methods for air dispersion modeling in the San Joaquin Valley. The use of additional air dispersion models, namely the United States Environmental Protection Agency (U.S. EPA) SCREEN3 for screening analyses and the U.S. EPA ISCST3, AERMOD and ISCST3 / ISC-PRIME for refined analyses, enable more representative assessments that make use of current science. This document is intended to provide insight into recommended modeling approaches and provide consistency in the modeling methods used.

The GADM is not designed to provide theoretical background on the models it discusses. Technical documents covering these topics can be easily obtained from several U.S. EPA sources and are further References in this document. This document will provide details on performing a successful modeling study including:

- Model Background and Applicability
- Model Selection and Study Approach
- Tiered Approach to Assessing Compliance
- Model Input Data Requirements
- Geographical Information
- Meteorological Data Requirements and Acquisition
- Information/Parameters for Inclusion in an Assessment

2. APPLICATION OF MODELS

2.1 Modeling Overview

Air dispersion modeling is the mathematical estimation of pollutant impacts from emissions sources within a study area. Several factors impact the fate and transport of pollutants in the atmosphere including meteorological conditions, site configuration, emission release characteristics, and surrounding terrain, amongst others.

2.2 Preferred Models

Preferred Models are defined as standard models that are expected to be used for air quality studies. Alternative models may be used if conditions warrant their use. These are outlined in Section 2.5. The U.S. EPA preferred models include SCREEN3 for screening analyses and ISCST3 or AERMOD or ISC-PRIME for refined modeling analyses. A brief overview of each of these models can be found below. For appropriate model selection, please review the section that outlines:

Please Note: EPA has approved AERMOD as the preferred model; ISCST3 will no longer be accepted after 12/2006 unless approved by the District.

- AERMOD (which includes PRIME algorithms for downwash)
- ISCST3 and ISC-PRIME
- SCREEN3

2.2.1 AERMOD

The American Meteorological Society/EPA Regulatory Model Improvement Committee (AERMIC) Regulatory Model, AERMOD[1,2,3] was specially designed to support the U.S. EPA's regulatory modeling programs. AERMOD is the next-generation air dispersion model that incorporates concepts such as planetary boundary layer theory and advanced methods for handling complex terrain. AERMOD was developed to replace the Industrial Source Complex Model-Short Term (ISCST3) as U.S. EPA's preferred model for most small-scale regulatory applications.[4,5] The latest versions of AERMOD also incorporate the Plume Rise Model Enhancements (PRIME) building downwash algorithms, which provide a more realistic handling of downwash effects than previous approaches.

The PRIME model was designed to incorporate two fundamental features associated with building downwash:

1. Enhanced plume dispersion coefficients due to the turbulent wake.
2. Reduced plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake.

    - AERMOD contains basically the same options as the ISCST3 model with a few exceptions, which are described below:
    - Currently, the model only calculates concentration values. Dry and wet deposition algorithms were not implemented at the time this document was written.
    - AERMOD requires two types of meteorological data files, a file containing surface scalar parameters and a file containing vertical profiles. These two files are produced by the U.S. EPA AERMET meteorological preprocessor program[4].
    - For applications involving elevated terrain, the user must also input a hill height scale along with the receptor elevation. The U.S. EPA AERMAP terrain-preprocessing

[1] U.S. Environmental Protection Agency, 1998. Revised Draft - User's Guide for the AMS/EPA Regulatory Model – AERMOD. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
[2] Paine, R.J., R.W. Brode, R.B. Wilson, A.J. Cimorelli, S.G. Perry, J.C. Weil, A. Venkatram, W.D. Peters and R.F. Lee, 2003. AERMOD: The Latest Features and Evaluation Results. Paper # 69878 to be presented at the Air and Waste Management Association 96th Annual Conference and Exhibition, June 22-26, 2003. Air and Waste Management Association, Pittsburgh, PA 15222.
[3] Cimorelli, A.J., S.G. Perry, A. Venkatram, J.C. Weil, R.J. Paine, R.B. Wilson, R.F. Lee, W.D. Peters, R.W. Brode, J.O. Paumier, 2002: AERMOD: Description of Model Formulation. U.S. Environmental Protection Agency, EPA-454/R-02-002d (draft dated October 31, 2002). Available from http://www.epa.gov/scram001.
[4] U.S. Environmental Protection Agency, 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models (Revised), Volume 1. EPA-454/B-95-003a. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
[5] U.S. Environmental Protection Agency, 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II – Description of Algorithms. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. Available from website http://www.epa.gov/scram001 as of January 2003.

program[6] can be used to generate hill height scales as well as terrain elevations for all receptor locations.

The options AERMOD has in common with ISCST3 and ISC-PRIME are described in the next section.

2.2.2 ISCST3 and ISC-PRIME Overview

The ISCST3 dispersion model is a steady-state Gaussian plume model, which can be used to assess pollutant concentrations, and/or deposition fluxes from a wide variety of sources associated with an industrial source complex. The ISCST3 dispersion model from the U.S. EPA was designed to support the EPA's regulatory modeling options, as specified in the Guidelines on Air Quality Models (Revised)[7].

The PRIME algorithms have been integrated into the ISCST3 (Version 96113) model. This integrated model is called ISC-PRIME[8]. The ISC-PRIME model uses the standard ISCST3 input file with a few modifications in the Source Pathway section. These modifications include three new inputs, which are used to describe the building/stack configuration.

To be able to run the ISC-PRIME model, you must first perform building downwash analysis using Building Profile Input Program (BPIP). PRIME. For more information on building downwash please refer to Section 4.6 - Building Impacts.

Some of the ISCST3/ISC-PRIME modeling capabilities are:

- ISC-PRIME model may be used to model primary pollutants and continuous releases of toxic and hazardous pollutants.
- ISC-PRIME model can handle multiple sources, including point, volume, area, and open pit source types. Line sources may also be modeled as a string of volume sources or as elongated area sources.
- Source emission rates can be treated as constant or may be varied by month, season, hour-of-day, or other optional periods of variation. These variable emission rate factors may be specified for a single source or for a group of sources.
- The model can account for the effects of aerodynamic downwash due to nearby buildings on point source emissions.
- The model contains algorithms for modeling the effects of settling and removal (through dry deposition) of large particulates and for modeling the effects of precipitation scavenging for gases or particulates.
- Receptor locations can be specified as girded and/or discrete receptors in a Cartesian or polar coordinate system.

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[6] U.S. Environmental Protection Agency, 1998. Revised Draft - User's Guide for the AERMOD Terrain Preprocessor (AERMAP). Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[7] U.S. Environmental Protection Agency, 1986. Guidelines on Air Quality Models (Revised) and Supplement A. EPA-450/2-78-027R. U.S. Environmental Protection Agency, Research Triangle Park, NC.

[8] U.S. Environmental Protection Agency, 1997. Addendum to ISC3 User's Guide – The Prime Plume Rise and Building Downwash Model. Submitted by Electric Power Research Institute. Prepared by Earth Tech, Inc., Concord, MA.

- ISC-PRIME incorporates the COMPLEX1 screening model dispersion algorithms for receptors in complex terrain.
- ISC-PRIME model uses real hourly meteorological data to account for the atmospheric conditions that affect the distribution of air pollution impacts on the modeling area.
- Results can be output for concentration, total deposition flux, dry deposition flux, and/or wet deposition flux. Until AERMOD has incorporated deposition, ISC-PRIME would be the preferred model for applications such as risk assessment where deposition estimates are required.

Unlike AERMOD, the ISC models do not contain a terrain pre-processor. As a result, receptor elevation data must be obtained through alternative means. The use of an inverse distance algorithm for interpolating representative receptor elevations is an effective method.

2.2.3 SCREEN3 Overview

The SCREEN3 model was developed to provide an easy-to-use method of obtaining pollutant concentration estimates. These estimates are based on the document "Screening Procedures for Estimating The Air Quality Impact of Stationary Sources"[9].

SCREEN3, version 3.0 of the SCREEN3 model, can perform all the single source short-term calculations in the EPA screening procedures document, including:

- Estimating maximum ground-level concentrations and the distance to the maximum.
- Incorporating the effects of building downwash on the maximum concentrations for both the near wake and far wake regions.
- Estimating concentrations in the cavity recirculation zone.
- Estimating concentrations due to inversion break-up and shoreline fumigation.
- Determining plume rise for flare releases.

EPA's SCREEN3[10] model can also:

- Incorporate the effects of simple elevated terrain (i.e., terrain not above stack top) on maximum concentrations.
- Estimate 24-hour average concentrations due to plume impaction in complex terrain (i.e., terrain above stack top) using the VALLEY model 24-hour screening procedure.
- Model simple area sources using a numerical integration approach.
- Calculate the maximum concentration at any number of user-specified distances in flat or elevated simple terrain, including distances out to 100 km for long-range transport.

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[9] U.S. Environmental Protection Agency, 1992: Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised, October 1992 (EPA-450/R-92-019),
User's Guide for the Industrial Source Complex (ISC2) Dispersion Models: Volume II—Description of Model Algorithms. U.S. Environmental Protection Agency, OAQPS, Research Triangle Park, NC 27711. Publication No. EPA-450/4-92-008b.
[10] U.S. Environmental Protection Agency, 1995. SCREEN3 Model User's Guide. EPA-454/B-95-004. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

- Examine a full range of meteorological conditions, including all stability classes and wind speeds to find maximum impacts.
- Include the effects of buoyancy-induced dispersion (BID).
- Explicitly calculate the effects of multiple reflections of the plume off the elevated inversion and off the ground when calculating concentrations under limited mixing conditions.

2.3 ISC and AERMOD Model Comparison

The ISC and AERMOD models share several similarities:

- Both are steady state plume models
- AERMOD input and output are intentionally similar to ISC for ease of use

AERMOD is a next-generation model, and while input and output may share similarities in format, there are several differences as detailed in the table below.

Table 2.1 – Differences between ISCST3 and AERMOD

ISCST3	AERMOD
Plume is always Gaussian	Plume is non-Gaussian when appropriate
Dispersion is function of six stability classes only	Dispersion is function of continuous stability parameters and height
Measured turbulence cannot be used	Measured turbulence can be used
Wind speed is scaled to stack height	Calculates effective speed through the plume
Mixing height is interpolated	Mixing height is calculated from met data
Plume either totally penetrates the inversion, or not at all	Plume may partially penetrate the inversion at the mixing height
Terrain is treated very simplistically	More realistic terrain treatment, using dividing streamline concept
Uses single dispersion for all urban areas	Adjusts dispersion to size of urban area
Cannot mix urban and rural sources	Can mix urban and rural sources

2.4 Alternative Models

The following list contains alternative models that are currently accepted by the San Joaquin Valley APCD for consideration. Please see Appendix A of the *Guideline on Air Quality Models (*published as Appendix W of 40 CFR Part 51) for terms of appropriate use and required supporting explanations.

- ADAM - *Air Force Dispersion Assessment Model*
- ADMS - *Atmospheric Dispersion Modeling System*
- AFTOX - *Air Force Toxics Model*
- ASPEN - *Assessment System for Population Exposure Nationwide*
- CAMx - *Comprehensive Air Quality Model with Extensions*
- CMAQ - *Community Modeling Air Quality*
- DEGADIS - *Dense Gas Dispersion Model*

- HGSYSTEM - Collection of programs designed to predict source-term and subsequent dispersion of accidental chemical releases
- HOTMAC - 3-dimensional Eulerian model for weather forecasting;
- HYROAD - Hybrid Roadway Model
- OZIPR - A one-dimensional photochemical box model
- OBODM - *Open Burn/Open Detonation Model*
- PLUVUEII - Visual Range Reduction and Atmospheric Discoloration Model
- REMSAD - *Regulatory Modeling System for Aerosols and Deposition*
- SCIPUFF - Second-order Closure Integrated PUFF Model
- SDM - *Shoreline Dispersion Model*
- SLAB - Model Treats Denser-Than-Air Releases
- UAM-V - *Photochemical Modeling System*

2.5 Model Validations

The U.S. EPA ISCST3 / ISC-PRIME and AERMOD models are some of the most studied and validated models in the world. Studies have typically demonstrated good correlation with real-world values. AERMOD particularly handles complex terrain very well, closely matching the trends of field observations from validation studies.

ISC-PRIME differs from ISCST3 primarily in its use of the PRIME downwash algorithm. A model evaluation study was carried out under the auspices of the Electric Power Research Institute (EPRI). The report[11] is available from EPRI and from the U.S. EPA SCRAM website http://www.epa.gov/scram001. The report analyzed comparisons between model predictions and measured data from four databases involving significant building downwash. This is in addition to 10 additional databases that were used during the development of ISC-PRIME. The study found that ISC-PRIME performed much better than ISCST3 under stable conditions, where ISCST3 predictions were very conservative (high). In general, ISC-PRIME was unbiased or somewhat over predicting. Also, ISC-PRIME showed a statistically better performance result than ISCST3 for each database in the study.

The U.S. EPA performed the evaluation of AERMOD. A summary of the evaluation studies was prepared by Paine, et al.[12] This and more detailed reports can be found at the U.S. EPA SCRAM website. Five databases were used during the development of the model. Five additional non-downwash databases were used in the final evaluation. For cases involving building downwash, four developmental databases were used to check the implementation of PRIME into AERMOD as it was accomplished. Three additional databases were reserved for the final evaluation. AERMOD remained unbiased for complex terrain databases as well as flat terrain, while ISCST3 severely over-predicted for complex terrain databases.

[11] Paine, R.J. and F. Lew, 1997. Results of the Independent Evaluation of ISCST3 and ISC-PRIME. EPRI Paper No. TR2460026, WO3527-02, Final Report. Electric Power Research Institute, Palo Alto, CA 94304.
[12] Paine, R.J., R.W. Brode, R.B. Wilson, A.J. Cimorelli, S.G. Perry, J.C. Weil, A. Venkatram, W.D. Peters and R.F. Lee, 2003. AERMOD: The Latest Features and Evaluation Results. Paper # 69878 presented at the Air and Waste Management Association 96th Annual Conference and Exhibition, June 22-26, 2003. Air and Waste Management Association, Pittsburgh, PA 15222.

3. A TIERED APPROACH FOR ASSESSING COMPLIANCE WITH AIR STANDARDS & GUIDELINES

Air dispersion modeling guidance will enable more representative analyses that make use of current science. The refined models include the following U.S. EPA air dispersion models:

- ISCST3 / ISC-PRIME
- AERMOD (which includes PRIME algorithms for downwash)
- AERSCREEN and/or SCREEN3 (Dependent on AERSCREEN availability)

A tiered approach to air dispersion modeling is commonly used and is presented in Figure 3.1. This approach focuses on the required level of effort according to site requirements. It should be noted that any of the 3 tiers may be performed and linear progression through each Tier is not necessary. For example, a refined analysis following Tier 3 can be performed without first executing a Tier 1 study.

Tier 1 is a screening level analysis using the U.S. EPA SCREEN3 model, which includes all potential worst-case meteorological conditions. If an air quality study passes appropriate standards and/or guidelines there is no need for additional modeling.

Note: At the time of writing this document, AERSCREEN remains unavailable and is currently in development. As a result, the proposed multi-tier approach should incorporate SCREEN3, and its potential substitution with AERSCREEN when it becomes reliably available.

Tier 2 is a refined modeling analysis that makes use of regional meteorological data. Pre-processed regional meteorological data sets are available from the San Joaquin Valley APCD's web site http://www.valleyair.org.

Tier 3 consists of refined modeling analyses that incorporate local (1 year of on site) meteorological data. This data typically must be pre-processed by the modeler or a meteorological data provider such as the National Weather Service (NWS). Local (1 year of on site) meteorological data sets include site-specific parameters and meteorological characteristics that directly represent the site of consideration with a greater level of detail than most regional data sets. Tier 3 also encompasses modeling analyses that make use of any alternative models.

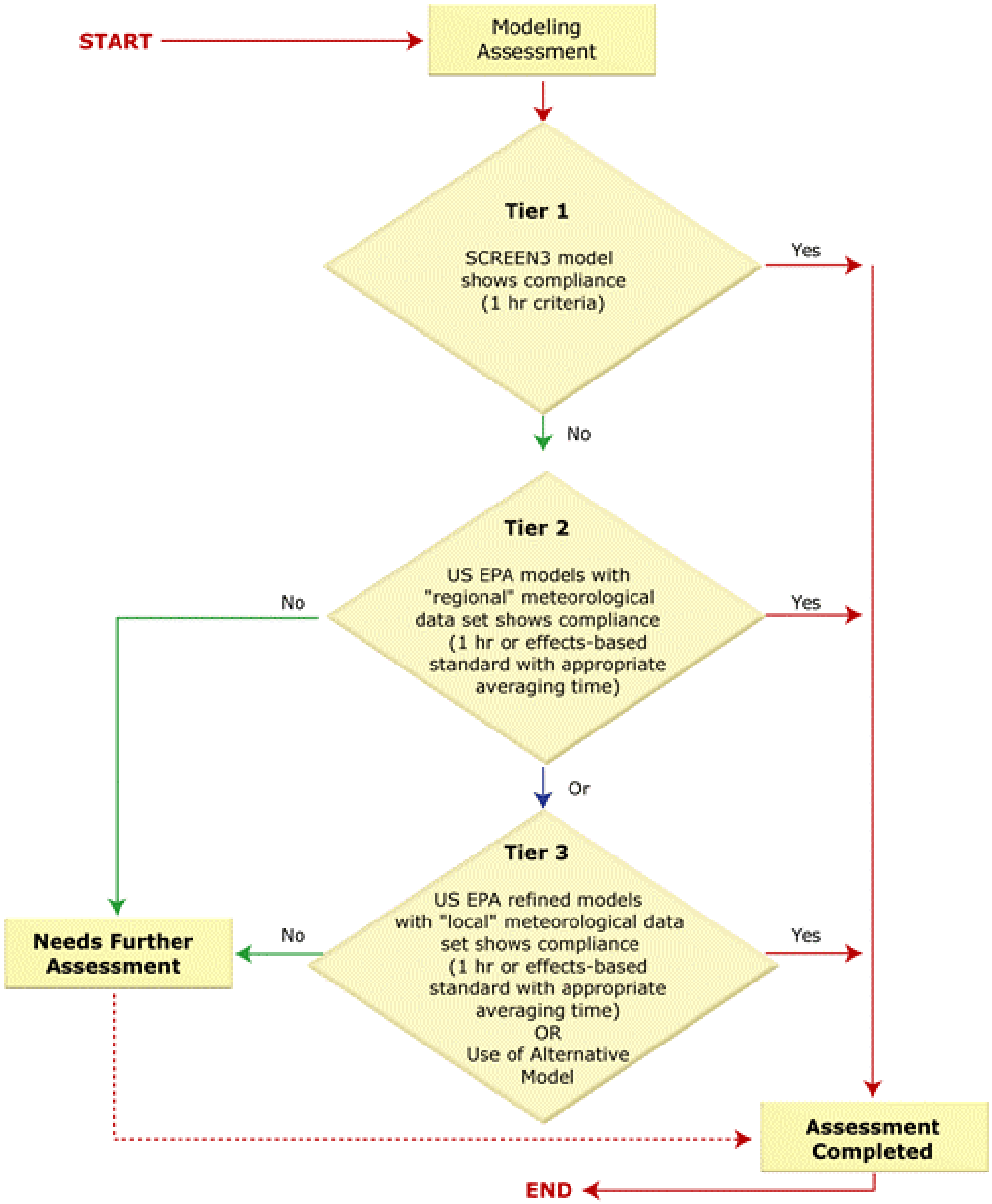

Figure 3.1– Sample options in tiered approach

4. MODEL INPUT DATA

4.1 Comparison of Screening and Refined Model Requirements

Screening model requirements are the least intensive but produce the most conservative results. The SCREEN3 model has straightforward input requirements and is further described in the following section.

Refined air dispersion modeling using the U.S. EPA AERMOD or ISCST3 / ISC-PRIME models can be broken down into a series of steps. These are outlined in Sections 4.1.2 and 4.1.3.

A general overview of the process typically followed for performing an air dispersion modeling assessment is present in Figure 4.1 below. The figure is not meant to be exhaustive in all data elements, but rather provides a picture of the major steps involved in an assessment.

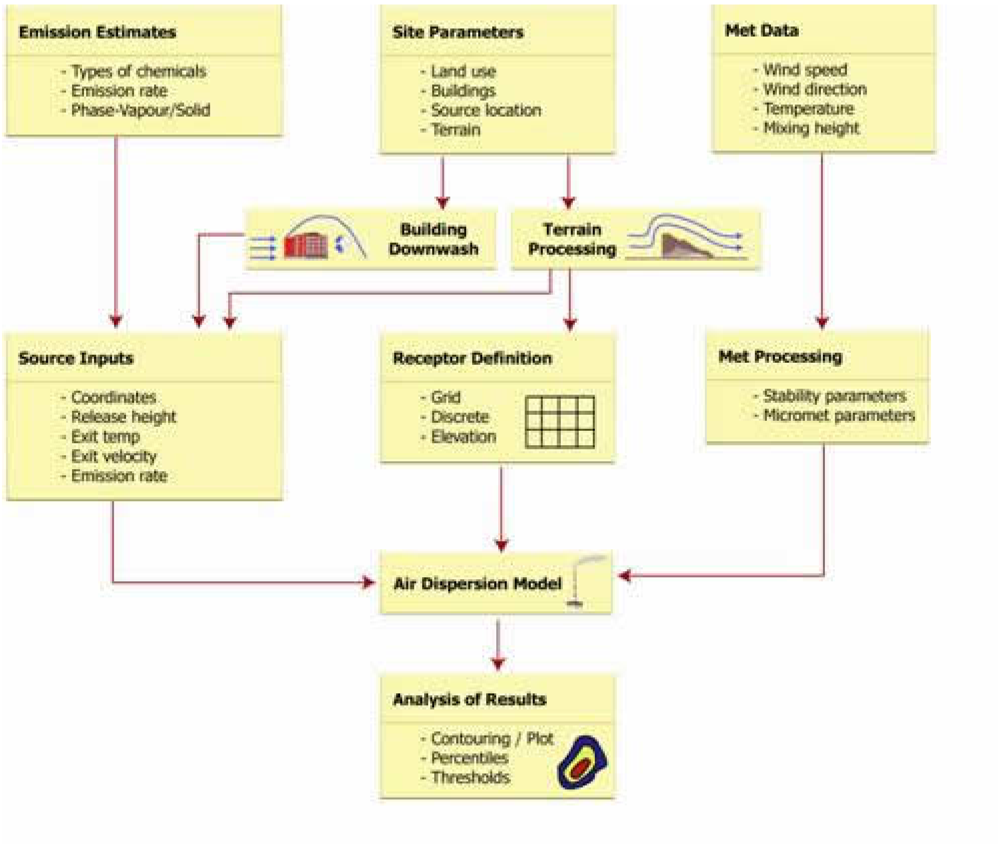

Figure 4.1 - Generalized process for performing a refined air dispersion modeling assessment.

4.1.1 SCREEN3 Air Dispersion Modeling

The SCREEN model[13] was developed to provide an easy-to-use method of obtaining pollutant concentration estimates. To perform a modeling study using SCREEN3, data for the following input requirements must be supplied:

- Source Type (Point, Flare, Area or Volume)
- Physical Source and Emissions Characteristics. For example, a point source requires:
  - Emission Rate
  - Stack Height
  - Stack Inside Diameter
  - Stack Gas Exit Velocity
  - Stack Gas Exit Temperature
  - Ambient Air Temperature
  - Receptor Height Above Ground
- Meteorology: SCREEN3 can consider all conditions, or a specific stability class and wind speed can be provided.
- Building Downwash: If this option is used then building dimensions (height, length and width) must be specified.

[13] U.S. Environmental Protection Agency, 1995. SCREEN3 Model User's Guide. EPA-454/B-95-004. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

- Terrain: SCREEN3 support flat, elevated and complex terrain. If elevated or complex terrain is used, distance and terrain heights must be provided.
- Fumigation: SCREEN3 supports shoreline fumigation. If used, distance to shoreline must be provided.

As can be seen above, the input requirements are minimal to perform a screening analysis using SCREEN3. This model is normally used as an initial screening tool to assess single sources of emissions. SCREEN3 can be applied to multi-source facilities by conservatively summing the maximum concentrations for the individual emissions sources. The refined models discussed in the following sections, have much more detailed options allowing for greater characterization and more representative results.

4.1.2 AERMOD Air Dispersion Modeling

The supported refined models have many input options, and are described further throughout this document as well as in their own respective technical documents[14,15,16,17]. An overview of the modeling approach and general steps for using each refined model are provided below. The general process for performing an air dispersion study using AERMOD includes:

- Meteorological Data Processing - AERMET
- Obtain Digital Terrain Elevation Data (If terrain is being considered)
- Building Downwash Analysis (BPIP-PRIME) – Project requires source and building information
- Final site characterization – complete source and receptor information
- AERMAP – Perform terrain data pre-processing for AERMOD air dispersion model if required.
- AERMOD – Run the model.
- Visualize and analyze results.

As can be seen above, the AERMOD modeling system is comprised of 3 primary components as outlined below and illustrated in Figure 4.2:

1. AERMET – Meteorological Data Preprocessor
2. AERMAP – Digital Terrain Preprocessor
3. AERMOD – Air dispersion model

[14] Cimorelli, A.J., S.G. Perry, A. Venkatram, J.C. Weil, R.J. Paine, R.B. Wilson, R.F. Lee, W.D. Peters, R.W. Brode, J.O. Paumier, 2002: AERMOD: Description of Model Formulation. U.S. Environmental Protection Agency, EPA-454/R-02-002d (draft dated October 31, 2002). Available from http://www.epa.gov/scram001.

[15] U.S. Environmental Protection Agency, 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models (Revised), Volume 1. EPA-454/B-95-003a. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[16] U.S. Environmental Protection Agency, 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II – Description of Algorithms. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. Available from website http://www.epa.gov/scram001 as of January 2003.

[17] U.S. Environmental Protection Agency, 1997. Addendum to ISC3 User's Guide – The Prime Plume Rise and Building Downwash Model. Submitted by Electric Power Research Institute. Prepared by Earth Tech, Inc., Concord, MA.

To successfully perform a complex terrain air dispersion modeling analysis-using AERMOD, you must complete the processing steps required by AERMET and AERMAP. See Section 6.3 for more information on meteorological data.

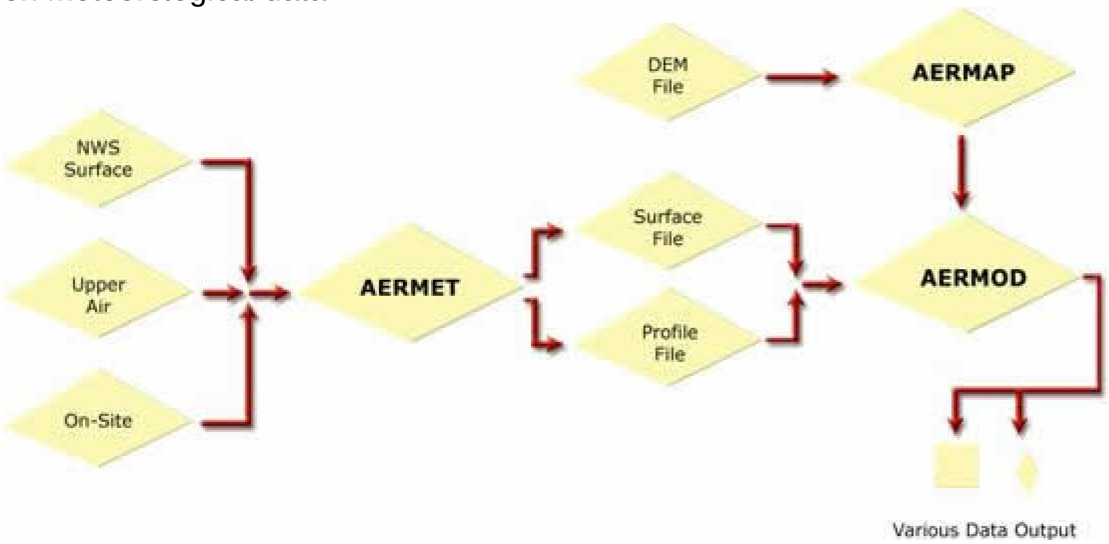

Figure 4.2 - The AERMOD air dispersion modeling system.

4.1.3 ISC-PRIME Air Dispersion Modeling

The ISC-PRIME model has very similar input requirements when compared with AERMOD. These include:

- Meteorological Data Processing - PCRAMMET
- Obtain Digital Terrain Elevation Data (If terrain is being considered)
- Building Downwash Analysis (BPIP-PRIME) – Project requires source and building information
- Final site characterization – complete source and receptor information
- ISC-PRIME – Run the ISC-PRIME model.
- Visualize and analyze results.

As can be seen above, the ISC and AERMOD models follow a very similar approach to perform an air dispersion-modeling project. The primary difference in running ISC and AERMOD models is that ISC does not require a terrain preprocessor, such as AERMAP. Furthermore, ISC relies on a different meteorological preprocessor known as PCRAMMET. The components of meteorological data pre-processing using PCRAMMET are illustrated in Figure 4.3 below. For a complete outline on how to obtain meteorological data, please see Section 6.3.

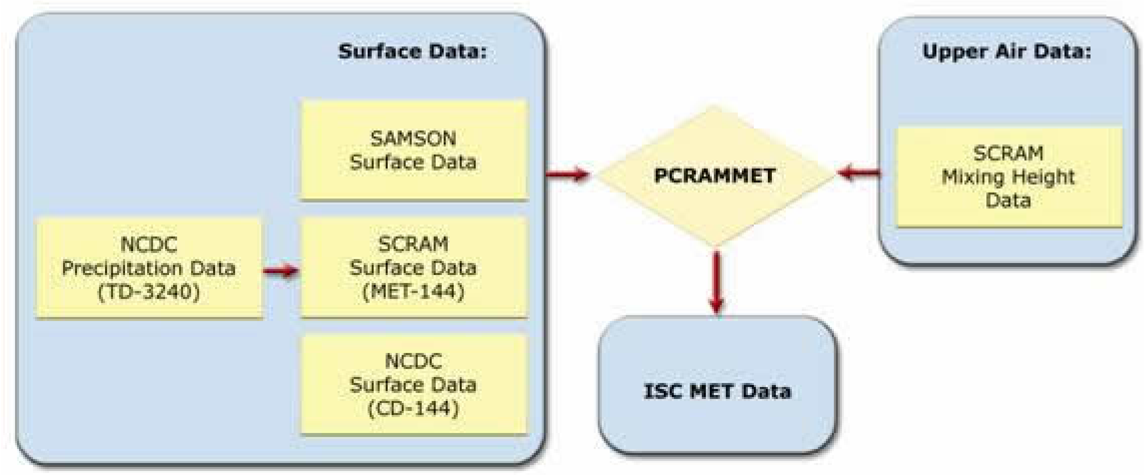

Figure 4.3 - Meteorological data pre-processing flow diagram for the U.S. EPA ISC models.

4.2 Regulatory and Non-Regulatory Option Use

The ISC-PRIME and AERMOD models contain several regulatory options, which are set by default, as well as non-regulatory options. Depending on the model, the non-regulatory options can include:

- No stack-tip downwash (NOSTD)
- Missing data processing routine (MSGPRO)
- Bypass the calms processing routine (NOCALM)
- Gradual plume rise (GRDRISM)
- No buoyancy-induced dispersion (NOBID)
- Air Toxics Options (TOXICS)
- By-pass date checking for non-sequential met data file (AERMOD)
- Flat terrain (FLAT) (AERMOD)

The use of any non-regulatory default option(s) must be justified through a discussion in the modeling report and approved by the District in advance.

It is advisable to discuss the use of any non-regulatory options in modeling assessments with the San Joaquin Valley APCD before submission of a refined modeling report.

4.3 Coordinate System

Any modeling assessment will require a coordinate system be defined in order to assess the relative distances from sources and receptors and, where necessary, to consider other geographical features. Employing a standard coordinate system for all projects increases the efficiency of the review process while providing real-world information of the site location. The AERMOD model's terrain pre-processor, AERMAP, requires digital terrain in Universal Transverse Mercator (UTM) coordinates. The UTM system uses meters as its basic unit of measurement and allows for more precise definition of specific locations than latitude/longitude.

For more information on coordinate systems and geographical information inputs, see Section 5.

4.4 Averaging Times

A key advantage to the more refined air dispersion models is the ability to compare effects-based standards with appropriate averaging times. Effects-based averaging times means that a contaminant could be assessed using modeled exposure concentrations over the most appropriate averaging period for that contaminant. Refined models allow the input of variable emission rates, where appropriate, for assessing concentrations over longer averaging times.

The ability to assess local air quality using a more appropriate effects-based averaging time means the refined air dispersion models provide a more representative assessment of health and environmental impacts of air emissions from a facility.

4.5 Defining Sources

4.5.1 Selection, Description and Parameters

The U.S. EPA SCREEN3, ISCST3, ISC-PRIME and AERMOD models support a variety of source types that can be used to characterize most emissions within a study area. The following sections outline the primary source types and their input requirements for both screening and refined models. Detailed descriptions on the input fields for these models can be found for SCREEN3 in U.S. EPA[18], for ISC-PRIME in U.S. EPA[19,20], and for AERMOD in U.S. EPA[21].

4.5.1.1 Point Sources

Point sources are typically used when modeling releases from sources like stacks and isolated vents. Input requirements for point sources include:

SCREEN3

- Emission Rate: The emission rate of the pollutant.
- Stack Height: The stack height above ground.
- Stack Inside Diameter: The inner diameter of the stack.
- Stack Gas Exit Velocity [m/s or lb/h] or Stack Gas Exit Flow Rate [m3/s or ACFM]: Either the stack gas exit velocity or the stack gas exit flow rate should be given. The exit velocity can be determined from the following formula:

$$Vs = 4*V/(\pi*(d_s\hat{}2))$$

[18] U.S. Environmental Protection Agency, 1995. SCREEN3 Model User's Guide. EPA-454/B-95-004. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[19] U.S. Environmental Protection Agency, 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models (Revised), Volume 1. EPA-454/B-95-003a. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[20] U.S. Environmental Protection Agency, 1997. Addendum to ISC3 User's Guide – The Prime Plume Rise and Building Downwash Model. Submitted by Electric Power Research Institute. Prepared by Earth Tech, Inc., Concord, MA.

[21] Cimorelli, A.J., S.G. Perry, A. Venkatram, J.C. Weil, R.J. Paine, R.B. Wilson, R.F. Lee, W.D. Peters, R.W. Brode, J.O. Paumier, 2002: AERMOD: Description of Model Formulation. U.S. Environmental Protection Agency, EPA-454/R-02-002d (draft dated October 31, 2002). Available from http://www.epa.gov/scram001.

Where,
V_s = Exit Velocity
V = Flow Rate
d_s = Stack Inside Diameter

- Stack Gas Temperature: The temperature of the released gas in degrees Kelvin.
- Ambient Air Temperature: The average atmospheric temperature (K) in the vicinity of the source. If no ambient temperature data are available, assume a default value of 293 degrees Kelvin (K). For non-buoyant releases, the user should input the same value for the stack temperature and ambient temperature.
- Receptor Height Above Ground: This may be used to model impacts at “flagpole” receptors. A flagpole receptor is defined as any receptor located above ground level, e.g., to represent the roof or balcony of a building. The default value is assumed to be 0.0 m (i.e., ground-level receptors).
- Urban/Rural Option: Specify either Urban or Rural conditions to use the appropriate dispersion coefficient. Section 5.4.5 provides guidance on determining rural or urban conditions.

AERMOD/ISCST/ISC-PRIME

- Source ID: An identification name for the source being defined, up to 8 characters in length.
- X Coordinate: The x (east-west) coordinate for the source location in meters (center of the point source).
- Y Coordinate: Enter here the y (north-south) coordinate for the source location in meters (center of the point source).
- Base Elevation: The source base elevation. The model only uses the source base elevation if Elevated terrain is being used.
- Release Height above Ground: The source release height above the ground in meters.
- Emission Rate: The emission rate of the pollutant in grams per second.
- Stack Gas Exit Temperature: The temperature of the released gas in degrees Kelvin.
- Stack Gas Exit Velocity: The stack gas exit velocity in meters per second or the stack gas flow rate (see above section on SCREEN3).
- Stack Inside Diameter: The inner diameter of the stack.

4.5.1.2 Area Sources

Area sources are used to model low level or ground level releases where releases occur over an area (e.g., landfills, storage piles, slag dumps, and lagoons). SCREEN3 allows definition of a rectangular area while the ISC-PRIME and AERMOD models accept rectangular areas that may also have a rotation angle specified relative to a north-south orientation, as well as a variety of other shapes.

SCREEN3

- Emission Rate: The emission rate of the pollutant. The emission rate for area sources is input as an emission rate per unit area (g/(s-m^2)).
- Source Release Height: The source release height above ground.
- Larger Side Length of Rectangular Area: The larger side of the rectangular source in meters.
- Smaller Side Length of Rectangular Area: The smaller side of the rectangular source in meters.
- Receptor Height Above Ground [m or ft]: This may be used to model impacts at "flagpole" receptors. A flagpole receptor is defined as any receptor that is located above ground level, e.g., to represent the roof or balcony of a building. The default value is assumed to be 0.0 m (i.e., ground-level receptors).
- Wind Direction Search Option: Since the concentration at a particular distance downwind from a rectangular area is dependent on the orientation of the area relative to the wind direction, the SCREEN model provides the user with two options for treating wind direction. The regulatory default option is "yes" which results in a search of a range of wind directions. See U.S. EPA[22] for more detailed information.

AERMOD/ISC-PRIME

- Source ID: An identification name for the source being defined, up to 8 characters in length.
- X Coordinate: The x (east-west) coordinate for the vertex (corner) of the area source that occurs in the southwest quadrant of the source. Units are in meters.
- Y Coordinate: The y (north-south) coordinate for the vertex (corner) of the area source that occurs in the southwest quadrant of the source. Units are in meters.
- Base Elevation: The source base elevation. The model only uses the source base elevation if elevated terrain is being used. The default unit is meters.
- Release Height above Ground [m]: The release height above ground in meters.
- Emission Rate [g/(s-m^2)]: Enter the emission rate of the pollutant. The emission rate for Area sources is input as an emission rate per unit area. The same emission rate is used for both concentration and deposition calculations.
- Options for Defining Area: In ISC-PRIME the only option for defining the area is a rectangle. The maximum length/width aspect ratio for area sources is 10 to 1. If this is exceeded, then the area should be divided to achieve a 10 to 1 aspect ratio (or less) for all sub-areas. See

[22] U.S. Environmental Protection Agency, 1995. Quality Assurance Handbook for Air Pollution Measurement Systems. Vol. IV, Meteorological Measurements. EPA/600/R-94/038d, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. Also available from the following website as of February 2003: http://www.epa.gov/scram001.

U.S. EPA[23] for more details on inputting area data. In addition to the rectangular area, AERMOD can have circular or polygon areas defined (see U.S. EPA[24] for details).

Note: There are no restrictions on the location of receptors relative to area sources. Receptors may be placed within the area and at the edge of an area. The U.S. EPA models (ISCST3, ISC-PRIME, and AERMOD) will integrate over the portion of the area that is upwind of the receptor. The numerical integration is not performed for portions of the area that are closer than 1.0 meter upwind of the receptor. Therefore, caution should be used when placing receptors within or adjacent to areas that are less than a few meters wide.

4.5.1.3 Volume Sources

Volume sources are used to model releases from a variety of industrial sources, such as building roof monitors, fugitive leaks from an industrial facility, multiple vents, and conveyor belts.

SCREEN3

- Emission Rate: The emission rate of the pollutant in grams per second (g/s).
- Source Release Height: The source release height above ground surface.
- Initial Lateral Dimension: See Table 4.1 below for guidance on determining initial dimensions. Units are meters.
- Initial Vertical Dimension: See Table 4.1 below for guidance on determining initial dimensions. Units are meters.
- Receptor Height Above Ground [m or ft]: This may be used to model impacts at “flagpole” receptors. A flagpole receptor is defined as any receptor, which is located above ground level, e.g., to represent the roof or balcony of a building. The default value is assumed to be 0.0 m (i.e., ground-level receptors).

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[23]) U.S. Environmental Protection Agency, 1995. User’s Guide for the Industrial Source Complex (ISC3) Dispersion Models (Revised), Volume 1. EPA-454/B-95-003a. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[24] Cimorelli, A.J., S.G. Perry, A. Venkatram, J.C. Weil, R.J. Paine, R.B. Wilson, R.F. Lee, W.D. Peters, R.W. Brode, J.O. Paumier, 2002: AERMOD: Description of Model Formulation. U.S. Environmental Protection Agency, EPA-454/R-02-002d (draft dated October 31, 2002). Available from http://www.epa.gov/scram001.

Table 4.1 Summary of Suggested Procedures for Estimating Initial Lateral Dimension ($_{yo}$) and Initial Vertical Dimension ($_{zo}$) for Volume and Line Sources.	
Type of Source	**Procedure for Obtaining Initial Dimension**
Initial Lateral Dimension	
Single Volume Source	S_{yo} = (side length)/4.3
Line Source Represented by Adjacent Volume Sources	S_{yo} = (side length)/2.15
Line Source Represented by Separated Volume Sources	S_{yo} = (center to center distance)/2.15
Initial Vertical Dimension	
Surface-Based Source (h_e ~ 0)	S_{zo} = (vertical dimension of source)/2.15
Elevated Source (h_e > 0) on or Adjacent to a Building	S_{zo} = (building height)/2.15
Elevated Source (h_e > 0) not on or Adjacent to a Building	S_{zo} = (vertical dimension of source)/4.3

AERMOD/ISCST3/ISC-PRIME

- Source ID: An identification name for the source being defined, up to 8 characters in length.
- X Coordinate: The x (east-west) coordinate for the source location in meters. This location is the center of the volume source.
- Y Coordinate: The y (north-south) coordinate for the source location in meters. This location is the center of the volume source.
- Base Elevation: The source base elevation. The model only uses the source base elevation if elevated terrain is being used. The default unit is meters.
- Release Height above Ground: The release height above ground surface in meters (center of volume).
- Emission Rate [g/s]: The emission rate of the pollutant in grams per second. The same emission rate is used for both concentration and deposition calculations.
- Length of Side: The length of the side of the volume source in meters. The volume source cannot be rotated and has the X side equal to the Y side (square).
- Building Height (If On or Adjacent to a Building): If your volume source is elevated and is on or adjacent to a building, then you need to specify the building height. The building height can be used to calculate the Initial Vertical Dimension of the source. Note that if the source is surface-based, then this is not applicable.
- Initial Lateral Dimension [m]: This parameter is calculated by choosing the appropriate condition in Table 4.1 above. This table provides guidance on determining initial dimensions. Units are in meters.
- Initial Vertical Dimension [m]: This parameter is calculated by choosing the appropriate condition in Table 4.1 above. This table provides guidance on determining initial dimensions. Units are in meters.

4.5.1.4 Line Sources

Examples of line sources are conveyor belts and rail lines. SCREEN3, AERMOD and ISC-PRIME do not have a default line source type. However, ISCST3 / ISC-PRIME and AERMOD can simulate line sources through a series of volume sources. If line sources are necessary, please follow the methodology outlined in the "Line Source Represented by Separated Volume Sources" as described in Volume II of the U.S. EPA User's Guide for the Industrial Source Complex (ISC3) Dispersion Models[25].

For consideration of traffic related pollutants, a traffic air dispersion model such as CAL3QHCR or CALINE4 may need to be considered. Further details on these models can be found in Appendix A: Alternative Models.

4.5.1.5 Flare Sources

Flare sources are used as control devices for a variety of sources. SCREEN3 supports flares directly through its flare source type. ISCST3 / ISC-PRIME and AERMOD do not have a specific source type option for flare sources, but the method described below can be applied to treat flares in ISC-PRIME or AERMOD.

SCREEN3

- Emission Rate: The emission rate of the pollutant in grams per second (g/s).
- Flare Stack Height: The stack height above ground.
- Total Heat Release Rate: The heat release rate in calories per second (cal/s) for the flare.
- Receptor Height Above Ground: This may be used to model impacts at "flagpole" receptors. A flagpole receptor is defined as any receptor, which is located above ground level, e.g., to represent the roof or balcony of a building. The default value is assumed to be 0.0 m (i.e., ground-level receptors).

Note 1: EPA's SCREEN model calculates plume rise for flares based on an effective buoyancy flux parameter. An ambient temperature of 293K is assumed in this calculation and therefore no ambient temperature is input by the user. It is assumed that 55% of the total heat is lost due to radiation. Plume rise is calculated from the top of the flame, assuming that the flame is bent 45 degrees from the vertical. SCREEN calculates and prints out the effective release height for the flare.

Note 2: For Flare releases, EPA's SCREEN model assumes a stack gas exit velocity (V_S) of 20 m/s, an effective stack gas exit temperature (T_S) of 1,273K, and calculates an effective stack diameter based on the heat release rate.

[25] U.S. Environmental Protection Agency, 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II – Description of Algorithms. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. Available from website http://www.epa.gov/scram001 as of January 2003.

AERMOD/ISC-PRIME

Flare sources can be treated in a similar way as point sources, except that there are buoyancy flux reductions associated with radiative heat losses and a need to account for flame length in estimating plume height[26]. Input requirements are similar to those for a point source, except that the release height must be calculated as an effective release height and stack parameters need to be estimated to match the radiative loss reduced buoyancy flux.

Due to the high temperature associated with flares, the effective release height of the plume can be calculated as follows[26]:

$$H_{sl}=H_s+(4.56x10^{-3})*((H_r/4.1868)^\wedge 0.478) \text{ (m)}$$

where:
H_{sl} = effective flare height (m)
H_s = stack height above ground (m)
H_r = net heat release rate (J/s)

The net heat release rate is computed as follows:

$$H_r=44.64*V*[S_{\{i=1 \text{ to } n\}}\{_iH_i*(1-F_i)\}]$$

where:
V = volumetric flow rate to the flare (m^3/s)
f_i = volume fraction of each gas component
H_i = net heating value of each component (J/g-mole)
F_r= fraction of radiative heat loss

The fraction of radiative heat loss depends on the burning conditions of the flare. If there is radiative heat loss information specific to the flare in question it should be used. The Alberta Environment as a default has recommended a radiative heat loss of 25%[27].

The stack parameters can be estimated by matching the buoyancy flux from the flare. The buoyancy flux from the flare is:

$$F = (g*H_r)/(\pi*\rho*T*C_p) = 8.8 *(10^\wedge-6)*H_r$$

where:
g = acceleration due to gravity (m/s2)
ρ = density of air (kg/m^3)
T = air temperature (°K)
C_p = specific heat of dry air constant (J/(Kg °K)

[26] U.S. Environmental Protection Agency, 1992. Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants (Revised). EPA-454/R-92-024. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
[27] Alberta Environment, 2003. Emergency/Process Upset Flaring Management: Modeling Guidance. Science and Standards Branch, Alberta Environment, Edmonton, Alberta.

Buoyancy flux for stack releases is:

$F = g*V_s*(r_s\^2)*(T_s-T)/T_s$

where:
V_s = exit velocity (m/s)
r_s = stack inner radius (m)
T_s = stack exit temperature (°K)

Using an estimated stack gas exit temperature (1,273 °K is used in SCREEN3) and the actual exit velocity to the flare, an effective stack radius can be calculated for input to AERMOD and ISC-PRIME.

4.5.2 Source Grouping

Source groups enable modeling results for specific groups of one or more sources. The default in AERMOD and ISCST3/ISC-PRIME is the creation of a source group "ALL" that considers all the sources at the same time.

Analysis of individual groups of sources can be performed by using the SRCGROUP option. One example may be assigning each source to determine the maximum concentration generated by each individual source.

4.5.3 Special Considerations

During some air quality studies, modelers may encounter certain source configurations that require special attention. Some examples include horizontal sources or emissions from storage tanks. The following sections outline modeling techniques on how to account for the special characteristics of such scenarios.

4.5.3.1 Multiple Stacks

When the plumes from multiple closely spaced stacks or flues merge, the plume rise can be enhanced. Briggs[28] has proposed equations to account for this. The reader is referred to that document for further details. Most models do not explicitly account for enhanced plume rise from this cause, and most regulatory agencies do not permit it to be accounted for in regulatory applications of modeling, with one exception. That exception is the case of a single stack with multiple flues/multiple stacks very close together (less than one stack diameter apart). In these cases, the multiple plumes may be treated as a single plume. To do this, a pseudo stack diameter is used in the calculations, such that the total volume flow rate of the stack gases is correctly represented.

4.5.3.2 Horizontal Sources and Rain Caps

Both horizontal flues and vertical flues with rain caps have little or no initial vertical velocity. Plume rise calculations in most models (including AERMOD and ISCST3) take into account both rise due to vertical momentum of the plume as it leaves the stack and the buoyancy of the plume. This may

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[28] Briggs, G.A., 1974. Diffusion Estimation for Small Emissions. In ERL, ARL USAEC Report ATDL-106. U.S. Atomic Energy Commission, Oak Ridge, TN.

result in an over prediction of the plume rise, and resulting under prediction of ground-level concentrations, in these models.

This problem can be alleviated by modifying the source input parameters to minimize the effects of momentum while leaving the buoyant plume rise calculations unchanged. An approach to modeling this is to modify the source input parameters to minimize the effects of momentum while leaving the buoyant plume rise calculations unchanged. The U.S. EPA outlines such an approach in its Model Clearinghouse Memo 93-II-09[29], and expressed, in part, in Tikvart[30]. This approach is to reduce the stack gas exit velocity to 0.001 m/s, and calculate an equivalent diameter so that the buoyant plume rise is properly calculated. To do this, the stack diameter is specified to the model such that the volume flow rate of the gas remains correct. In the case of horizontal flues, there will be no stack tip downwash, so that option should be turned off for that case. In the case of vertical flues with rain caps, there will be frequent occurrences of stack tip downwash, however the effect of the stack tip downwash (reduction of the plume height by an amount up to three times the stack diameter) may be underestimated in the model. This can be corrected, somewhat conservatively, by turning off the stack tip downwash option and lowering the specification of the stack height by three times the actual stack diameter (the maximum effect of stack tip downwash).

With the above references in mind, it should be noted that lower exit velocities could cause issues with PRIME. This exit velocity still effectively eliminates momentum flux and can produce parameters that will not impede model execution. Furthermore, for cases where exit temperature significantly exceeds ambient temperature then the District may consider use of effective diameter or effective temperature values to account for buoyancy flux. This should be reviewed with the District prior to submission.

A sample step-by-step approach is as follows. In this discussion,

V = actual stack gas exit velocity
V’ = stack gas exit velocity as entered into the model (AERMOD or ISCST3)
D = actual stack inside diameter
D’ = stack inside diameter as input to the model
H = actual stack height
H’ = stack height input to the model
For the source of consideration, modify its parameters as follows:

1. Set V’=0.01 m/s
2. Set D’=D*SQRT(V/V’)
3. If the source is a vertical stack with a rain cap, account for the frequent stack tip downwash by reducing the stack height input to the model by three times the actual stack diameter: H’=H-3D

[29] U.S. EPA, 1993. Model Clearinghouse Memo 93-II-09. A part of the Model Clearinghouse Information Storage and Retrieval System (MCHISRS). Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711

[30] Tikvart, J.A., 1993. “Proposal for Calculating Plume Rise for Stacks with Horizontal Releases or Rain Caps for Cookson Pigment, Newark, New Jersey,” a memorandum from J.A. Tikvart to Ken Eng, U.S. EPA Region 2, dated July 9, 1993. Available from website http://www.epa.gov/scram001/guidance/mch/cfym89.txt, as of April 2003.

4.5.3.3 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 occur from a vent, with some additional contribution from hatches and other fittings. In the case of floating roof tanks, most of the pollutant emissions occur 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 impacts from emissions from various types of storage tanks are outlined below.

Fixed roof tanks:
Model fixed roof tanks as a point (stack) source (representing the vent), which is usually in the center of the tank, and representing the tank itself as a building for downwash calculations.

Floating roof tanks:
Model floating roof tanks as a circle of eight (or more) point sources, representing the tank itself as a building for downwash calculations. Distribute the total emissions equally among the circle of point sources.

All tanks:
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 is done in ISCST3 and AERMOD by inputting a value of 0.0 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. Since all downwash effects are being calculated as building downwash, the additional stack tip downwash calculations would be inappropriate. Since the maximum stack tip downwash effect is to lower plume height by three stack diameters, a very small stack diameter effectively eliminates the stack tip downwash.

Table 4.2 - Stack parameter values for modeling tanks.

Velocity	Diameter	Temperature
Near zero i.e. 0.001 m/s	Near zero i.e. 0.001m	Ambient – 0.0 sets models to use ambient temperature

4.5.4 Variable Emissions

The ISCST3 and AERMOD models both contain support for variable emission rates. This allows for modeling of source emissions that may fluctuate over time. Emission variations can be characterized for across many different periods including hourly, daily, monthly and seasonally.

4.5.4.1 Wind Erosion

Modeling of emissions from sources susceptible to wind erosion, such as coal piles, can be accomplished using variable emissions.

The ISCST3 and AERMOD models allow for emission rates to be varied by wind speed. This allows for more representative emissions from sources that are susceptible to wind erosion, particularly waste piles that can contribute to particulate emissions. Once a correlation between emissions and wind speed categories is established, the models will then vary the emissions based on the wind conditions in the meteorological data.

4.5.4.2 Non-Continuous Emissions

Sources of emissions at some locations may emit only during certain periods of time. Emissions can be varied within the ISCST3 and AERMOD models 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. Model inputs for variable emissions rates can include the following time periods:

- Seasonally
- Monthly
- Hourly
- By Season and hour-of-day
- By Season, hour-of-day, and day-of-week
- By Season, hour, week

4.5.5 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 emission of uncombusted waste through the emissions sources. As a result, over short periods of time, upset emissions are often expected to be greater than normal source emissions[31].

These emission differences can be accounted for by the application of variable emission factors.

4.5.5.1 Seasonal Variations

Industrial processes often fluctuate depending on supply and demand requirements. This affects some sectors seasonally, particularly facilities involved in food processing. For example, soup production makes use of agricultural produce which is at its highest in the late summer. Production schedules for soup production typically ramp up resulting in different emissions during the late summer and early fall, than at mid to late winter.

These emission differences can be accounted for by the application of variable emission factors, with control over the following time periods:

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[31]) U.S. 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.

- By Season and hour-of-day
- By Season, hour-of-day, and day-of-week
- By Season, hour, week

4.6 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 that are observed. There has long been a “rule of thumb” that a stack should be at least 2.5 times the height of adjacent buildings. Beyond that, much of what is known of the effects of buildings on plume transport and diffusion has been obtained from wind tunnel studies and field studies.

When the airflow meets a building (or other obstruction), it is forced up and over the building. On the lee side of the building, the flow separates, leaving a closed circulation containing lower wind speeds. Farther downwind, the air flows downward again. In addition, there is more shear and, as a result, more turbulence. This is the turbulent wake zone (see Figure 4.4).

If a plume gets caught in the cavity, very high concentrations can result. If the plume escapes the cavity, but remains in the turbulent wake, it may be carried downward and dispersed more rapidly by the turbulence. This can result in either higher or lower concentrations than would occur without the building, depending on whether the reduced height or increased turbulent diffusion has the greater effect.

The height to which the turbulent wake has a significant effect on the plume is generally considered to be about the building height plus 1.5 times the lesser of the building height or width. This results in a height of 2.5 building heights for cubic or squat buildings, and less for tall, slender buildings. Since it is considered good engineering practice to build stacks taller than adjacent buildings by this amount, this height came to be called “good engineering practice” (GEP) stack height.

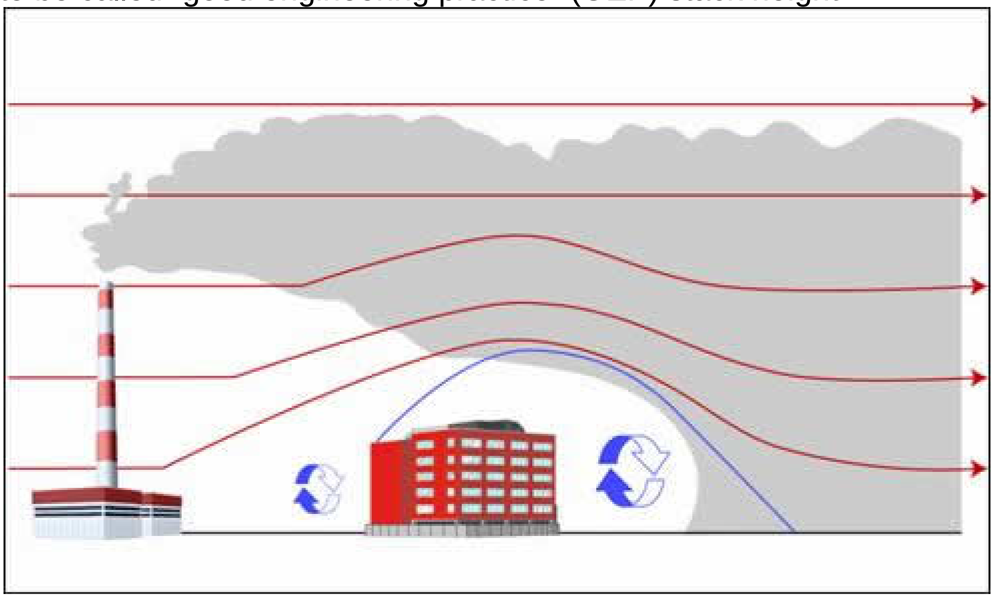

Figure 4.4 - The building downwash concept where the presence of buildings forms localized turbulent zones that can readily force pollutants down to ground level.

4.6.1 Good Engineering Practice (GEP) Stack Heights and Structure Influence Zones

The U.S. EPA[32] states that "If stacks for new or existing major sources are found to be less than the height defined by the EPA's refined formula for determining GEP height, then air quality impacts associated with cavity or wake effects due to the nearby building structures should be determined."

The U.S. EPA's refined formula for determining GEP stack height is:

GEP Stack Height = H + 1.5L

where,
GEP = Good Engineering Practice
H = Building/Tier Height measured from ground to the highest point
L = Lesser of the Building Height (PB) or Projected Building Width (PBW)

Building downwash for point sources that are within the Area of Influence of a building should be considered. For U.S. EPA regulatory applications, 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 (5) times the lesser of the building height or the projected width of the building.

$Distance_{stack\text{-}bldg} <= 5L$

For point sources within the Area of Influence, building downwash information (direction-specific building heights and widths) should be included in your modeling project. Using BPIP-PRIME, you can compute these direction-specific building heights and widths.

Structure Influence Zone (SIZ): For downwash analyses with direction-specific building dimensions, wake effects are assumed to occur if the stack is within a rectangle composed of two lines perpendicular to the wind direction, one at 5L downwind of the building and the other at 2L upwind of the building, and by two lines parallel to the wind direction, each at 0.5L away from each side of the building, as shown above. L is the lesser of the height or projected width. This rectangular area has been termed a Structure Influence Zone (SIZ). Any stack within the SIZ for any wind direction is potentially affected by GEP wake effects for some wind direction or range of wind directions. See Figure 4.5 and Figure 4.6.

[32]) U.S. Environmental Protection Agency, 1990. Stack Heights, Section 123, Clean Air Act, 40 CFR Part 51. U. S. Environmental Protection Agency, Research Triangle Park, NC.

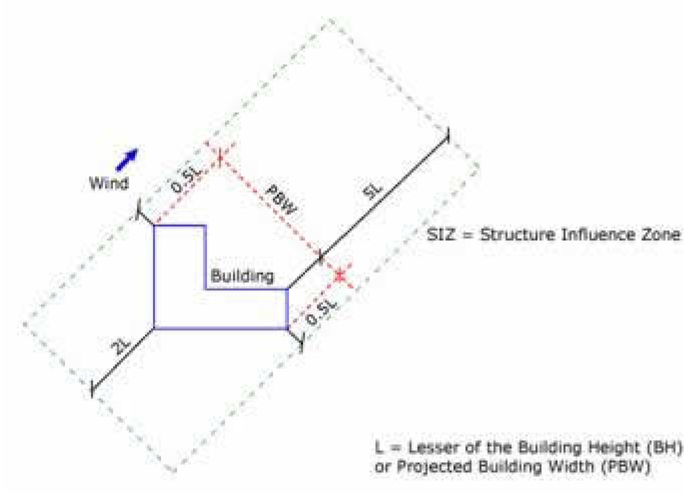

Figure 4.5 - GEP 5L and Structure Influence Zone (SIZ) Areas of Influence (after U.S. EPA(24)).

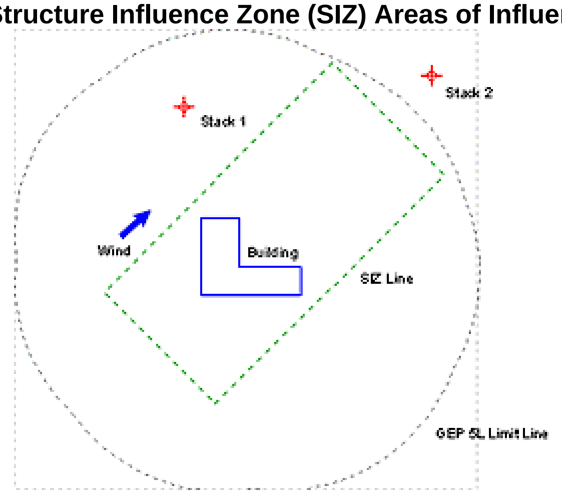

Figure 4.6 -GEP 360° 5L and Structure Influence Zone (SIZ) Areas of Influence (after U.S. EPA(24)).

4.6.2 Defining Buildings

The recommended screening and refined models all allow for the consideration of building downwash. SCREEN3 considers the effects of a single building while AERMOD and ISCST3/ISC-PRIME can consider the effects of complicated sites consisting of up to hundreds of buildings. This results in different approaches to defining buildings as outlined below.

4.6.2.1 SCREEN3 Building Definition

Defining buildings in SCREEN3 is straightforward, as only one building requires definition. The following input data is needed to consider downwash in SCREEN3:

- Building Height: The physical height of the building structure in meters.
- Minimum Horizontal Building Dimension: The minimum horizontal building dimension in meters.
- Maximum Horizontal Building Dimension: The maximum horizontal building dimension in meters.

For Flare releases, SCREEN assumes the following:

- an effective stack gas exit velocity (V_s) of 20 m/s,
- an effective stack gas exit temperature (T_s) of 1,273 K, and
- an effective stack diameter based on the heat release rate.

Since building downwash estimates depend on transitional momentum plume rise and transitional buoyant plume rise calculations, the selection of effective stack parameters could influence the estimates. Therefore, building downwash estimates for flare releases should be used with extra caution[33].

If using Automated Distances or Discrete Distances option, wake effects are included in any calculations made. Cavity calculations are made for two building orientations, first with the minimum horizontal building dimension along wind, and second with the maximum horizontal dimension along wind. The cavity calculations are summarized at the end of the distance-dependent calculations (see SCREEN3 User's Guide[33] Section 3.6 for more details).

4.6.2.2 AERMOD and ISC-PRIME Building Definition

The inclusion of the PRIME (Plume Rise Model Enhancements) algorithm[34] to compute building downwash has produced more accurate results in air dispersion models. Unlike the earlier algorithms used in ISC3, the PRIME algorithm:

1. accounts for the location of the stack relative to the building;
2. accounts for the deflection of streamlines up over the building and down the other side;
3. accounts for the effects of the wind profile at the plume location for calculating plume rise;
4. accounts for pollutants captured in the recirculation cavity to be transported to the far wake downwind (this is ignored in the earlier algorithms); and
5. avoids discontinuities in the treatment of different stack heights, which were a problem in the earlier algorithms.

Refined models allow for the capability to consider downwash effects from multiple buildings. AERMOD and ISCST3/ISC-PRIME require building downwash analysis to first be performed using BPIP-PRIME[34]. The results from BPIP-PRIME can then be incorporated into the modeling studies for consideration of downwash effects.

The U.S. EPA Building Profile Input Program – Plume Rise Model Enhancements (BPIP-PRIME) was designed to incorporate enhanced downwash analysis data for use with the U.S. EPA ISC-PRIME and current AERMOD models. Similar in operation to the U.S. EPA BPIP model, BPIP-PRIME uses the same input data requiring no modifications of existing BPIP projects. The following information is required to perform building downwash analysis within BPIP:

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[33] U.S. Environmental Protection Agency, 1995. SCREEN3 Model User's Guide. EPA-454/B-95-004. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
[34] Schulman, L.L., D.G. Strimaitis and J.S. Scire, 2000: Development and evaluation of the PRIME plume rise and building downwash model. Journal of the Air & Waste Management Association, 50:378-390.

- X and Y location for all stacks and building corners.
- Height for all stacks and buildings (meters). For building with more than one height or roofline, identify each height (tier).
- Base elevations for all stacks and buildings.

The BPIP User's Guide[35] provides details on how to input building and stack data to the program.

The BPIP model is divided into two parts.

- Part One: Based on the GEP technical support document[36], this part is designed to determine whether or not a stack is subject to wake effects from a structure or structures. Values are calculated for GEP stack height and GEP related building heights (BH) and projected building widths (PBW). Indication is given to which stacks are being affected by which structure wake effects.
- Part Two: Calculates building downwash BH and PBW values based on references by Tikvart[37,38] and Lee[39]. These can be different from those calculated in Part One. The calculations are performed only if a stack is being influenced by structure wake effects.

In addition to the standard variables reported in the output of BPIP, BPIP-PRIME adds the following:

- BUILDLEN: Projected length of the building along the flow.
- XBADJ: Along-flow distance from the stack to the center of the upwind face of the projected building.
- YBADJ: Across-flow distance from the stack to the center of the upwind face of the projected building.

For a more detailed technical description of the EPA BPIP-PRIME model and how it relates to the EPA ISC-PRIME model see the Addendum to ISC3 User's Guide[40].

[35] U.S. Environmental Protection Agency, 1995. User's Guide to the Building Profile Input Program, EPA-454/R-93-038, Office of Air Quality Planning and Standards, Research Triangle Park, N.C.
[36] U.S. Environmental Protection Agency, 1985. Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) – Revised EPA-450/4-80-023R, U.S. Environmental Protection Agency, Research Triangle Park, NC.
[37] Tickvart, J. A., May 11, 1988. Stack-Structure Relationships, Memorandum to Richard L. Daye, U.S. EPA.
[38] Tickvart, J. A., June 28, 1989. Clarification of Stack-Structure Relationships, Memorandum to Regional Modeling Contacts, Regions I-X, U.S. EPA.
[39] Lee, R. F., July 1, 1993. Stack-Structure Relationships – Further clarification of our memoranda dated May 11, 1988 and June 28, 1989, Memorandum to Richard L. Daye, U.S. EPA.
[40] Schulman, et al., 1997. Addendum - User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume 1. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

4.7 Multiple Pollutants

4.7.1 Standard Approaches to Modeling Multiple Pollutants from Multiple Sources

Industrial processes often emit multiple pollutants through one or several emission sources. The U.S. EPA models are not equipped to automatically perform modeling of different pollutants that may share the same emission source but have unique emission rates.

Traditional approaches to this scenario resulted in modelers performing separate model runs for each specific pollutant type, even though all other model site parameters remain the same.
For projects consisting of many pollutants, this approach results in the modeler needing not only to be extremely organized but also requiring high levels of computer resources as the project would need to be run separately for each pollutant scenario.

An alternative approach is applying unitized emission rate and summation concepts, which drastically reduce the computational time for large multiple pollutant projects.

4.7.1.1 Standard Approaches to Modeling Multiple Toxic Pollutants from Multiple Sources

For industrial processes that emit multiple pollutants through one or several emission sources, the following approach should be followed.

1. Dispersion modeling should be conducted as outlined in this guidance document.
2. All chemical analysis / risk calculations should be processed through the CARB HARP program.
3. Exceptions (Must be give prior approval by the District):
    a. Analysis of multiple pollutants that only affects one acute toxicological endpoint or the same endpoints
    b. Analysis of multiple pollutants that only affects one chronic toxicological endpoint or the same endpoint and do not have a chronic inhalation value.
    c. One dispersion modeling run for Acute HI, Chronic HI, and One for Cancer using a toxicity based emission rate. The output from the model will be expressed as risk.
        i. Toxicity Based Emission Rate (TBER) is calculated for each pollutant to be assessed. Then the TBERs are summed and entered as the actual emission rate.

    Example Acute TBER:
    TBER = Emission Rate (Lb/Hr) / Reference Exposure Level (REL) X 0.126 (G/sec conversion factor)

4.7.2 Unitized Emission Rate and Summation Concepts

It is a well-known fact that air dispersion modeling is a non-linear process. The modeled site may have random meteorological variations, the dispersion process is non-linear, and the terrain elevations at the site may assume unlimited shapes. However, once the calculations to a receptor in space are complete, all chemical concentration levels are proportional to their source release rate. Figure 4.7 helps visualize this concept, by describing an emission rate of 1 g/s.

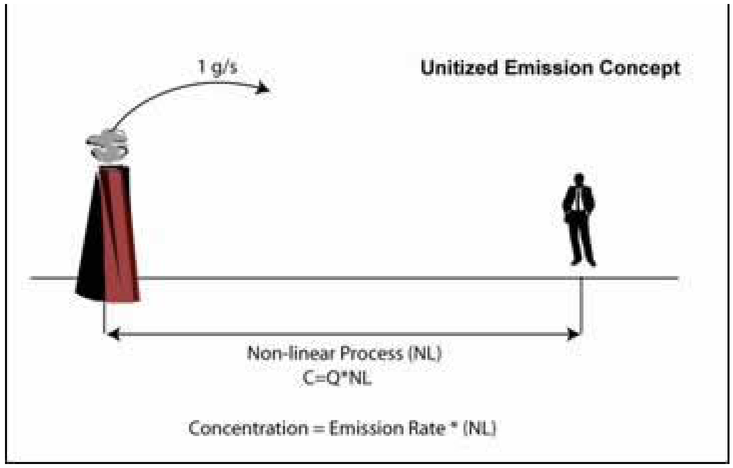


Figure 4.7 - Unitized Emission Rate Concept (1 g/s).

The Unitized Emission Rate Concept only applies to single sources. For assessments with multiple sources the authors recommend that each source be modeled independently, using unitized emission rate (1 g/s). The concentration at the receptor can then be multiplied by the actual chemical emission rate, and the final result from all the sources will be superimposed. This is called the Summation Concept, where the concentration and deposition fluxes at a receptor are the linear addition of the resulting values from each source. Figure 4.8 depicts the Summation concept.

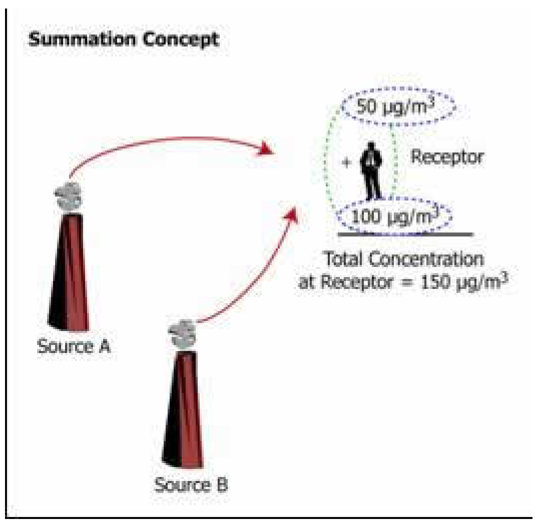


Figure 4.8 - The Summation Concept for two sources.

A post-processor is needed to effectively process model results that have been performed using unitized emission rate and summation concepts. Final output will provide results for pollutant specific scenarios from multiple sources.

5. GEOGRAPHICAL INFORMATION INPUTS

5.1 Comparison of Screening and Refined Model Requirements

Geographical information requirements range from basic for screening analyses to advanced for refined modeling. SCREEN3 makes use of geographical information only for terrain data for complex or elevated terrain where it requires simply distance from source and height in a straight-line. The AERMOD and ISCST3/ISC-PRIME models make use of complete three-dimensional geographic data with support for digital elevation model files and real-world spatial characterization of all model objects.

5.2 Coordinate System

5.2.1 Local

Local coordinates encompass coordinate systems that are not based on a geographic standard. For example, a facility may reference its coordinate system based on a local set datum, such as a predefined benchmark. All site measurements can relate to this benchmark which can be defined as the origin of the local coordinate system with coordinates of 0,0 m. All facility buildings and sources could then be related spatially to this origin.

However, local coordinates do not indicate where in the actual world the site is located. For this reason, it is advantageous to consider a geographic coordinate system that can specify the location of any object anywhere in the world with precision. The coordinate system most commonly used for air dispersion modeling is the Universal Transverse Mercator system.

5.2.2 UTM

As described earlier, the Universal Transverse Mercator (UTM) coordinate system uses meters as its basic unit of measurement and allows for more precise definition of specific locations than latitude/longitude.

Ensure all model objects (sources, buildings, receptors) are defined in the same horizontal datum. Defining some objects based on a NAD27 (North American datum of 1927) while defining others within a NAD83 (North American datum of 1983) can lead to significant errors in relative locations.

5.3 Terrain

5.3.1 Terrain Concerns in Short-Range Modeling

Terrain elevations can have a large impact on the air dispersion and deposition modeling results and therefore on the estimates of potential risk too human health and the environment. Terrain elevation is the elevation relative to the facility base elevation.

The following section describes the primary types of terrain. The consideration of a terrain type is dependant on your study area, and the definitions below should be considered when determining the characteristics of the terrain for your modeling analysis.

5.3.2 Flat and Complex Terrain

The models consider three different categories of terrain as follows:
Complex Terrain: as illustrated in Figure 5.1, where terrain elevations for the surrounding area, defined as anywhere within 50 km from the stack, are above the top of the stack being evaluated in the air modeling analysis.

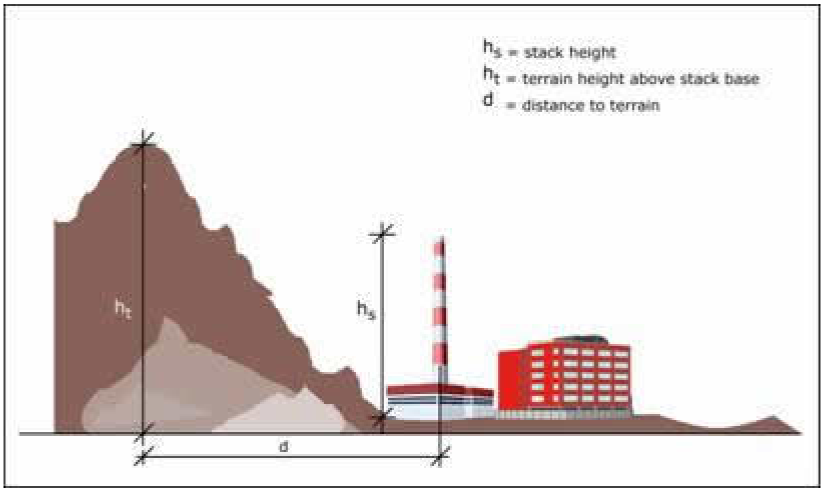


Figure 5.1 - Sample complex terrain conditions.

Simple Terrain: where terrain elevations for the surrounding area are not above the top of the stack being evaluated in the air modeling analysis. The "Simple" terrain can be divided into two categories:

- Simple Flat Terrain is used where terrain elevations are assumed not to exceed stack base elevation. If this option is used, then terrain height is considered to be 0.0 m.
- Simple Elevated Terrain, as illustrated in Figure 5.2 is used where terrain elevations exceed stack base but are below stack height.

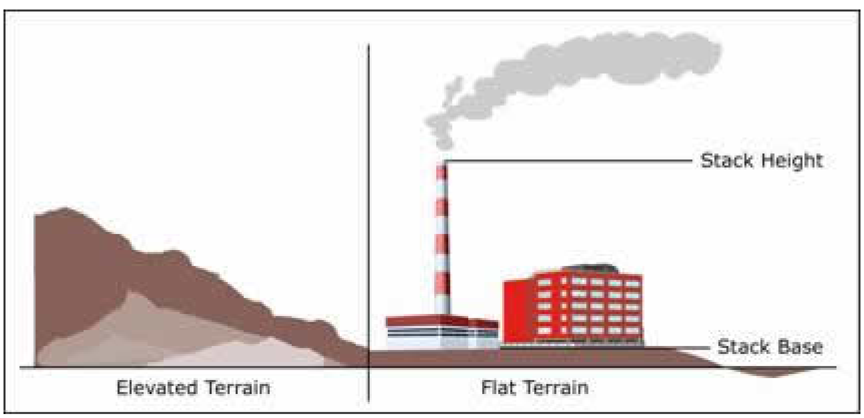


Figure 5.2 – Sample elevated and flat terrain conditions.

5.3.3 Criteria for Use of Terrain Data

Evaluation of the terrain within a given study area is the responsibility of the modeler. At first glance it may be inferred that much of San Joaquin Valley is flat, but it should be remembered that complex terrain is any terrain within the study area that is above the source release height.

The appropriate terrain environment can be determined through the use of digital elevation data or other geographic data sources. It should be noted that the refined models, ISCST3/ISC-PRIME and AERMOD, have similar run times regardless of whether or not terrain data is used. However AERMAP, the terrain pre-processor for AERMOD, does require additional time. If analysis of the terrain environment is performed using digital terrain data, minimal resources are required to execute a model run using that digital terrain dataset.

5.3.4 Obtaining Terrain Data

Terrain data that are input into the AERMOD and ISCST3/ISC-PRIME models should be provided in electronic form. Digital elevation terrain data is available for the San Joaquin Valley from a variety of vendors in several different formats.

Digital elevation model (DEM) data covering San Joaquin Valley is available for free from Lakes Environmental's Web GIS.

5.3.5 Preparing Terrain Data for Model Use

AERMAP is the digital terrain pre-processor for the AERMOD model. It analyzes and prepares digital terrain data for use within an air dispersion modeling project. AERMAP requires that the digital terrain data files be in native (non SDTS) USGS 1-degree or 7.5-minute DEM format.

5.4 Land Use Characterization

Land use plays an important role in air dispersion modeling from meteorological data processing to defining modeling characteristics such as urban or rural conditions. Land use data can be obtained from digital and paper land-use maps.

These maps will provide an indication into the dominant land use types within an area of study, such as industrial, agricultural, forested and others. This information can then be used to determine dominant dispersion conditions and estimate values for parameters such as surface roughness, albedo, and Bowen ratio.

- Surface Roughness Length [m]: The surface roughness length, also referred to surface roughness height, is a measure of the height of obstacles to the wind flow. Surface roughness affects the height above local ground level that a particle moves from the ambient airflow above the ground into a “captured” deposition region near the ground. This height is not equal to the physical dimensions of the obstacles, but is generally proportional to them. Table 5.1 lists typical values for a range of land-use types as a function of season.

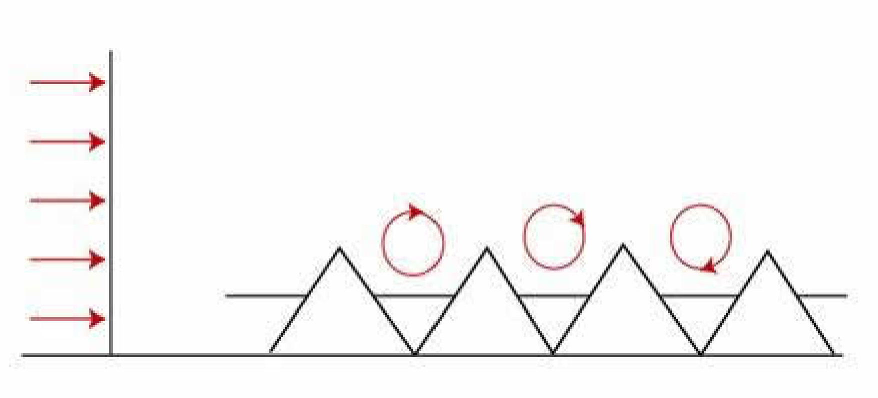


Figure 5.3 - For many modeling applications, surface roughness can be considered to be on the order of one tenth of the height of the roughness elements.

The following method was proposed in the U.S. EPA OSW Human Health Risk Assessment Protocol[41] to determine the surface roughness length for use with the ISC-PRIME/ISCST3 model at the application site:

1. Draw a radius of 3 Km from the center of the stack(s) on the site map.
2. Classify the areas within the radius according to the land use type categories listed in Table 5.1 (e.g., water surface, deciduous forest, etc.).
3. Calculate the wind rose directions from the 5 years of meteorological data to be used for the risk analysis.
4. Divide the area into 16 sectors of 22.5 degrees, corresponding to the wind rose directions.
5. Identify a representative surface roughness length for each sector, based on an area-weighted average of the land use within the sector.
6. Calculate the site surface roughness by computing an average surface roughness length weighted with the frequency of wind direction occurrence for each sector.

AERMOD allows wind direction dependent surface characteristics to be used in the processing of the meteorological data. The AERMET procedure also uses the area-weighted average of the land use with 3 km of the site. The selection of wind direction dependent sectors is described in sections 5.4.1 to 5.4.3.

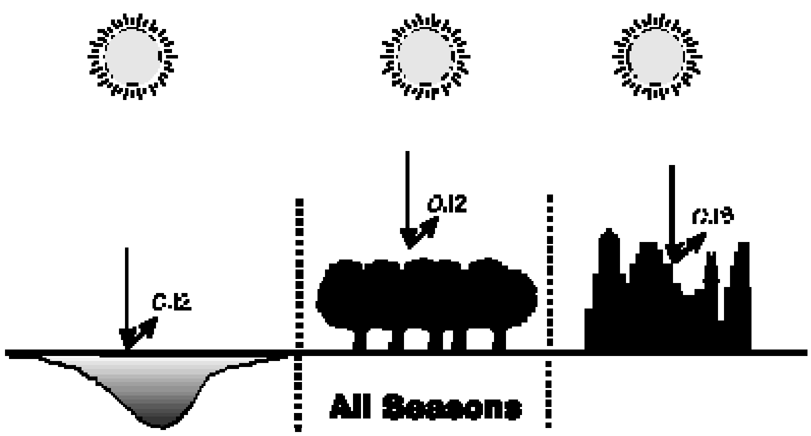
Alternative methods of determining surface roughness height may be proposed. The District should review any proposed values prior to use.

[41] U.S. 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.

Table 5.1 - Surface Roughness Heights for Land Use Types and Seasons (meters)[42]

	SEASONS			
LAND USE TYPE	**Spring**	**Summer**	**Autumn**	**Winter**
Water surface	0.0001	0.0001	0.0001	0.0001
Deciduous forest	1.00	1.30	0.80	0.50
Coniferous forest	1.30	1.30	1.30	1.30
Swamp	0.20	0.20	0.20	0.05
Cultivated land	0.03	0.20	0.05	0.01
Grassland	0.05	0.10	0.01	0.001
Urban	1.00	1.00	1.00	1.00
Desert shrubland	0.30	0.30	0.30	0.15

- Noon-Time Albedo: Noon-time albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Table 5.2 lists typical albedo values as a function of several land use types and season. For practical purposes, the selection of a single value for noon-time albedo to process a complete year of meteorological data is desirable. If other conditions are used, the District should review the proposed noon-time albedo values used to pre-process the meteorological data.



[42] Sheih, C.M., M.L. Wesley, and B.B. Hicks, 1979: Estimated Dry Deposition Velocities of Sulfur Over the Eastern U.S. and Surrounding Regions. Atmos. Environ., 13, 361-368.

Table 5.2 - Albedo of Natural Ground Covers for Land Use Types and Seasons[43]

LAND USE TYPE	SEASONS			
	Spring	Summer	Autumn	Winter
Water surface	0.12	0.10	0.14	0.20
Deciduous forest	0.12	0.12	0.12	0.50
Coniferous forest	0.12	0.12	0.12	0.35
Swamp	0.12	0.14	0.16	0.30
Cultivated land	0.14	0.20	0.18	0.60
Grassland	0.18	0.18	0.20	0.60
Urban	0.14	0.16	0.18	0.35
Desert shrubland	0.30	0.28	0.28	0.45

- Bowen Ratio: The Bowen ratio is a measure of the amount of moisture at the surface. The presence of moisture at the earth's surface alters the energy balance, which in turn alters the sensible heat flux and Monin-Obukhov length. Table 5.3 lists Bowen ratio values as a function of land-use types, seasons and moisture conditions. Bowen ratio values vary depending on the surface wetness. Average moisture conditions would be the usual choice for selecting the Bowen ratio. If other conditions are used the District should review the proposed Bowen ratio values used to pre-process the meteorological data.

Table 5.3 - Daytime Bowen Ratios by Land Use, Season, and Precipitation Conditions[44]

LAND USE TYPE	SEASONS			
	Spring	Summer	Autumn	Winter
Dry Conditions				
Water (fresh and salt)	0.1	0.1	0.1	2.0
Deciduous forest	1.5	0.6	2.0	2.0
Coniferous forest	1.5	0.6	1.5	2.0
Swamp	0.2	0.2	0.2	2.0
Cultivated land	1.0	1.5	2.0	2.0
Grassland	1.0	2.0	2.0	2.0
Urban	2.0	4.0	4.0	2.0
Desert shrubland	5.0	6.0	10.0	2.0

[43]) Iqbal, M., 1983. An Introduction to Solar Radiation. Academic Press, New York, NY.
[44] Paine, R.J., 1987. User's Guide to the CTDM Meteorlogical Preprocessor (METPRO) Program. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

LAND USE TYPE	SEASONS			
	Spring	Summer	Autumn	Winter
Average Conditions				
Water (fresh and salt)	0.1	0.1	0.1	1.5
Deciduous forest	0.7	0.3	1.0	1.5
Coniferous forest	0.7	0.3	0.8	1.5
Swamp	0.1	0.1	0.1	1.5
Cultivated land	0.3	0.5	0.7	1.5
Grassland	0.4	0.8	1.0	1.5
Urban	1.0	2.0	2.0	1.5
Desert shrubland	3.0	4.0	6.0	6.0

LAND USE TYPE	SEASONS			
	Spring	Summer	Autumn	Winter
Wet Conditions				
Water (fresh and salt)	0.1	0.1	0.1	0.3
Deciduous forest	0.3	0.2	0.4	0.5
Coniferous forest	0.3	0.2	0.3	0.3
Swamp	0.1	0.1	0.1	0.5
Cultivated land	0.2	0.3	0.4	0.5
Grassland	0.3	0.4	0.5	0.5
Urban	0.5	1.0	1.0	0.5
Desert shrubland	1.0	5.0	2.0	2.0

5.4.1 Wind Direction Dependent Land Use

AERMET also provides the ability to specify land characteristics for up to 12 different contiguous, non-overlapping wind direction sectors that define unique upwind surface characteristics. The following properties of wind sectors must be true:

- The sectors are defined clockwise as the direction from which the wind is blowing, with north at 360°.
- The sectors must cover the full circle so that the end value of one sector matches the beginning of the next sector.
- The beginning direction is considered part of the sector, while the ending direction is not.

Each wind sector can have a unique albedo, Bowen ratio, and surface roughness. Furthermore, these surface characteristics can be specified annually, seasonally, or monthly to better reflect site conditions.

5.4.2 Mixed Land Use Types

Study areas may contain several different regions with varying land use. This can be handled by AERMET through the use of wind sector specific characterization, as described in the previous section.

For models such as ISCST3/ISC-PRIME that do not take advantage of sector-specific characterization, the most representative conditions should be applied when land use characteristics are required.

The approach taken by the District is to take a weighted average over a radius of 3 km from the facility in all directions.

This is performed by assessing the land use across the facility study area and applying the appropriate values to the land characteristic parameters. A weighted average is then computed based on the area of each land use category.

5.4.3 Seasonal Land Use Characterization

Land use characteristics can be susceptible to seasonal variation. For example, winter conditions can bring increased albedo values due to snow accumulation.

AERMET allows for season-specific values for surface roughness, albedo, and Bowen ratio to be defined. Other models, such as ISCST3/ISC-PRIME, do not support multiple season surface characteristics to be defined. In such a case, the most representative conditions should be applied when land use characteristics are required.

5.4.4 Standard and Non-Default Surface Characteristics

The generation of local meteorological data files can incorporate site-specific surface characteristics. It should be noted that any local meteorological files generated for air dispersion modeling should provide a clear reasoning for the values used to describe surface characteristics. The District should review any proposed surface characteristics prior to submission of a modeling report.

5.4.5 Defining Urban and Rural Conditions

The classification of a site as urban or rural can be based on the Auer method specified in the EPA document *Guideline on Air Quality Models (40 CFR Part 51, Appendix W)*[45]. From the Auer's method, areas typically defined as Rural include:

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

[45] U.S. Environmental Protection Agency, 2001. Appendix W to Part 51 Guideline on Air Quality Models, 40 CFR Part 51. U. S. Environmental Protection Agency, Research Triangle Park, NC.

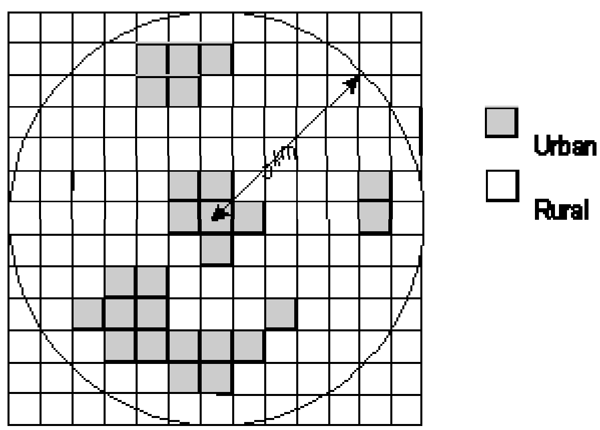
• Water surfaces

Auer defines an area as Urban if it has less than 35% vegetation coverage or the area falls into one of the following use types:

Urban Land use		
Type	**Use and Structures**	**Vegetation**
I1	Heavy industrial	Less than 5%
I2	Light/moderate industrial	Less than 5%
C1	Commercial	Less than 15%
R2	Dense single / multi-family	Less than 30%
R3	Multi-family, two-story	Less than 35%

Follow the Auer's method, explained below, for the selection of either urban or rural dispersion coefficients:

Step 1: Draw a circle with a radius of 3 km from the center of the stack or centroid of the polygon formed by the facility stacks.
Step 2: If land use types I1, I2, C1, R2, and R3 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.
To verify if the area within the 3 km radius 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 than the area is classified as urban; otherwise the area is rural.(35)



An alternative approach to Urban/Rural classification is the Population Density Procedure: Compute the average population density, p, per square kilometer with Ao as defined above,

(a) If p > 750 people/km^2, select the Urban option,
(b) If p <= 750 people/km2, select the Rural option.

Of the two methods above, the land use procedure is considered a more definitive criterion. The population density procedure should be used with caution and should not be applied to highly industrialized areas where the population density may be low and thus a rural classification would be indicated, but the area is sufficiently built-up so that the urban land use criteria would be satisfied. In this case, the classification should already be Urban and urban dispersion parameters should be used.

6. METEOROLOGICAL DATA

6.1 Comparison of Screening and Refined Model Requirements

Meteorological data is essential for air dispersion model modeling as it describes the primary environment through which the pollutants being studied migrate. Similar to other data requirements, screening model requirements are less demanding than refined models.

SCREEN3 provides 3 methods of defining meteorological conditions:

- Full Meteorology: SCREEN will examine all six stability classes (five for urban sources) and their associated wind speeds. SCREEN examines a range of stability classes and wind speeds to identify the "worst case" meteorological conditions, i.e., the combination of wind speed and stability that results in the maximum ground level concentrations.
- Single Stability Class: The modeler can select the stability class to be used (A through F). SCREEN will then examine a range of wind speeds for that stability class only.
- Single Stability Class and Wind Speed: The modeler can select the stability class and input the 10-meter wind speed to be used. SCREEN will examine only that particular stability class and wind speed.

6.2 Preparing Meteorological Data for Refined Modeling

AERMOD and ISC models require actual hourly meteorological conditions as inputs. The refined models require pre-processed meteorological data that contains information on surface characteristics and upper air definition. This data is typically provided in a raw or partially processed format that requires processing through a meteorological pre-processor. The ISC models make use of a pre-processor called PCRAMMET, while AERMOD uses a pre-processor known as AERMET described further in the following sections.

6.2.1 Hourly Surface Data

Hourly surface data is supported in several formats including:

1. CD-144 – NCDC Surface Data: This file is composed of one record per hour, with all weather elements reported in an 80-column card image. Table 6.1 lists the data contained in the CD-144 file format that is needed to pre-process your meteorological data.

Table 6.1 – CD-144 Surface Data Record (80 Byte Record)	
Element	**Columns**
Surface Station Number	1-5
Year	6-7
Month	8-9
Day	10-11
Hour	12-13
Ceiling Height (Hundreds of Feet)	14-16
Wind Direction (Tens of Degrees)	39-40
Wind Speed (Knots)	41-42
Dry Bulb Temperature (°Fahrenheit)	47-49
Opaque Cloud Cover	79

2. MET-144 – SCRAM Surface Data: The SCRAM surface data format is a reduced version of the CD-144 data with fewer weather variables (28-character record). Table 6.2 lists the data contained in the SCRAM file format.

Table 6.2 - SCRAM Surface Data Record (28 Byte Record)	
Element	**Columns**
Surface Station Number	1-5
Year	6-7
Month	8-9
Day	10-11
Hour	12-13
Ceiling Height (Hundreds of Feet)	14-16
Wind Direction (Tens of Degrees)	17-18
Wind Speed (Knots)	19-21
Dry Bulb Temperature (° Fahrenheit)	22-24
Total Cloud Cover (Tens of Percent)	25-26
Opaque Cloud Cover (Tens of Percent)	27-28

The SCRAM data does not contain the following weather variables, which are necessary for dry and wet particle deposition analysis:

1. Surface pressure: for dry and wet particle deposition;
2. Precipitation type: for wet particle deposition only; or
3. Precipitation amount: for wet particle deposition only.

3. SAMSON Surface Data: The SAMSON data contains all of the required meteorological variables for concentration, dry and wet particle deposition, and wet vapor deposition.
If the processing of raw data is necessary, the surface data must be in one of the above formats in order to successfully pre-process the data using PCRAMMET or AERMET.

6.2.2 Mixing Height and Upper Air Data

Upper air data, also known as mixing height data, are required for pre-processing meteorological data required to run the ISC-PRIME models. It is recommended that only years with complete mixing height data be used. In some instances, mixing height data may need to be obtained from more than one station to complete multiple years of data.
Mixing height data are available from:

1. SCRAM BBS –download free of charge, mixing height data for the U.S. for years 1984 through 1991.
2. WebMET.com –download free of charge, mixing height and upper air data from across North America, including Ontario.

Table 6.3 lists the format of the mixing height data file used by PCRAMMET.

Table 6.3 - Upper Air Data File (SCRAM / NCDC TD-9689 Format)

Element	Columns
Upper Air Station Number (WBAN)	1-5
Year	6-7
Month	8-9
Day	10-11
AM Mixing Value	14-17
PM Mixing Value (NCDC)	25-28
PM Mixing Value (SCRAM)	32-35

AERMOD requires the full upper air sounding, unlike ISCST3/ISC-PRIME, which only require the mixing heights. The upper air soundings must be in the NCDC TD-6201 file format or one of the FSL formats.

6.2.3 AERMET and the AERMOD Model

The AERMET program is a meteorological preprocessor that prepares hourly surface data and upper air data for use in the U.S. EPA air quality dispersion model AERMOD. AERMET was designed to allow for future enhancements to process other types of data and to compute boundary layer parameters with different algorithms.

AERMET processes meteorological data in three stages:

1. The first stage (Stage1) extracts meteorological data from archive data files and processes the data through various quality assessment checks.
2. The second stage (Stage2) merges all data available for 24-hour periods (surface data, upper air data, and on-site data) and stores these data together in a single file.

3. The third stage (Stage3) reads the merged meteorological data and estimates the necessary boundary layer parameters for use by AERMOD.

Out of this process two files are written for AERMOD:

1. A Surface File of hourly boundary layer parameters estimates;
2. A Profile File of multiple-level observations of wind speed, wind direction, temperature, and standard deviation of the fluctuating wind components.

6.2.4 PCRAMMET and the ISC Models

The PCRAMMET program is a meteorological preprocessor, which prepares NWS data for use in the various U.S. EPA air quality dispersion models such as ISCST3/ISC-PRIME.

PCRAMMET is also used to prepare meteorological data for use by the CAL3QHCR model, and for use by the CALPUFF puff dispersion model when used in screening mode.

The operations performed by PCRAMMET include:

- Calculating hourly values for atmospheric stability from meteorological surface observations;
- Interpolating the twice daily mixing heights to hourly values;
- Optionally, calculating the parameters for dry and wet deposition processes;
- Outputting data in the standard (PCRAMMET unformatted) or ASCII format required by regulatory air quality dispersion models.

The input data requirements for PCRAMMET depend on the dispersion model and the model options for which the data is being prepared. The minimum input data requirements for PCRAMMET are:

- The twice-daily mixing heights,
- The hourly surface observations of: wind speed, wind direction, dry bulb temperature, opaque cloud cover, and ceiling height.

For dry deposition estimates, station pressure measurements are required. For wet deposition estimates, precipitation type and precipitation amount measurements for those periods where precipitation was observed are required.

The surface and upper air stations should be selected to ensure they are meteorologically representative of the general area being modeled.

6.3 Regional Meteorological Data

The District has prepared regional meteorological data sets for use in Tier 2 modeling in several formats:

- Regional pre-processed model ready data for AERMOD, with land characteristics for CROP, RURAL and URBAN conditions.
- Regional Merge files enabling customized surface characteristics to be specified and processed through AERMET Stage3.
- Hourly surface data and upper air data files allowing for complete processing through AERMET.

The above data sets are available online and provide a unique, easily accessible resource for air dispersion modelers in the San Joaquin Valley. The availability of standard meteorological data will reduce inconsistencies in data quality and requests to the regulatory agency on obtaining data. The surface meteorological sites used were Bakersfield, Fresno, Hanford, Madera, Modesto, and Stockton. The following meteorological elements were used in AERMET processing for the 5 year period from 2000 to 2004: ceiling height, wind speed, wind direction, air temperature, total cloud opacity and total cloud amount.

The upper air station used was Oakland, CA. Table 6.4 gives the locations of the surface meteorological sites and lists the upper air station used for each site. The locations of the upper air sites are given in Table 6.5.

Table 6.4 - Surface meteorological sites location and upper air stations to use.

Surface station	ID	Latitude	Longitude	Height above sea level, m	State	UA to use
Bakersfield	23155	35 ^{o} 26’ N	119 ^{o} 03’ W	149.0 m	CA	See Table 6.5
Fresno	93193	36 ^{o} 47’ N	119 ^{o} 43’ W	101.5 m	CA	See Table 6.5
Hanford	53119	36 ^{o} 19’ N	119 ^{o} 38’ W	75.9 m	CA	See Table 6.5
Madera	93242	36 ^{o} 59’ N	120 ^{o} 07’ W	77.1 m	CA	See Table 6.5
Modesto	23258	37 ^{o} 37’ N	120 ^{o} 57’ W	22.3 m	CA	See Table 6.5
Stockton	23237	37 ^{o} 53’ N	121 ^{o} 14’ W	7.9m	CA	See Table 6.5

Note: Anemometer height is 10 meters for all stations

Table 6.5 - The location of upper air sites

UA station	ID	Latitude	Longitude
Oakland	23230	37^{o} 43’ N	122^{o} 13’ W

6.3.1 Pre-Processing Steps

The regional data for AERMOD is provided in 2 forms:

- Merged: Data has been processed through Stage2 of AERMET (AERMET stages are described in Section 6.2.3) to produce a “Merge” file. This file can then be processed through AERMET Stage3 with custom surface condition data to produce a meteorological data set specific to the site for use with AERMOD (Tier 3).

- Regional: Data has been processed through Stage3 of AERMET with predefined Land Use characteristics for "Urban", "Rural", and Crop" environments. The data is ready for use with AERMOD (Tier 2).

6.3.1.1 Regional Meteorological Data Processing Background

Regional meteorological datasets are generated in AERMET, Stage3 processing step, using different wind independent surface conditions. It is assumed that surface conditions are the weighted average over a radius of 3 km from the meteorological station split into 8 sectors. See Appendix E for a detailed description of each of the dataset processed. The surface conditions needed are the albedo (A), the Bowen ratio (Bo) and the surface roughness (Zo). These parameter values are found in Appendix E and were derived from data in Tables 4.1, 4.2b (albedo for average conditions) and 4.3 of the AERMET User's Guide[46].

6.3.2 Availability and Use of District Meteorological Data

The District meteorological datasets in pre-processed format are freely available online on the District Web Page.

The District meteorological data provides a standard data set that can be used for air quality studies using AERMOD. The regional data sets should not be modified. Use of custom meteorological data that is locally representative of site conditions can be created and applied for Tier 3 modeling analyses.

The application of the regional meteorological data sets across the San Joaquin Valley is described in Table 6.9. This table lists the major regions in the valley for which each of the meteorological data sets is most applicable. A map of the districts can be found in Figure 6.1.

Table 6.9 - Application of regional meteorological data sets for the San Joaquin Valley

Meteorological Data Set	Region	Area
Stockton	Northern	Northern ± 2/3 of San Joaquin County and Northeast corner of Stanislaus County
Modesto	Northern	Bottom ± 1/3 of San Joaquin County and Northeast corner of Merced County (North of the City of Merced)
Madera	Northern	All of Madera County
	Central	Northwest corner of Fresno County
Fresno	Central	Middle Section of Fresno County
Hanford	Central	Southwest corner of Fresno County
	Southern	All of Kings and Tulare Counties
Bakersfield	Southern	All of Kern County

[46] U.S. Environmental Protection Agency, 1998. Revised Draft - User's Guide for the AERMOD Meteorological Preprocessor (AERMET). Office of Air Quality Planning and Standards, Research Triangle Park, NC.

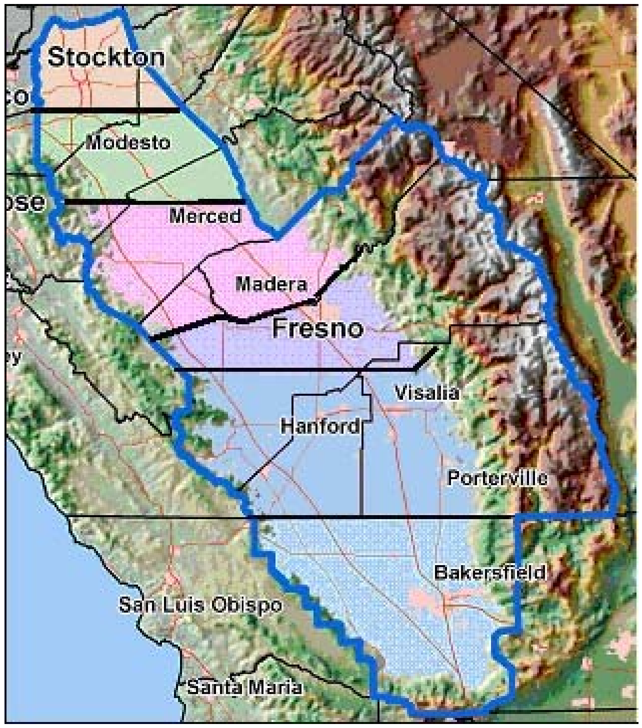


Figure 6.1 – San Joaquin Valley Meteorological Dataset Regions.

6.4 Data Assessment: Reliability, Completeness and Representativeness

Meteorological data quality is of critical importance, particularly for reliable air dispersion modeling using refined models such as AERMOD. Meteorological data should be collected, processed and analyzed throughout the entire creation phase for completeness and quality control. Missing meteorological data and calm wind conditions can be handled in an approach similar to that used for the generation of the regional meteorological data sets. For all calm conditions (where the wind speed and wind direction are equal to zero) the wind direction is set to a missing value. Hours with zero or very low wind speeds are set to minimum speeds of ≈ 1 m/s.

For each meteorological element linear interpolation was then applied if the number of the missing hours is up to six in a row. Missing data at the very beginning and at the very end of the data set are left as “missing” (no extrapolation is applied). If the number of consecutive hours with missing values for the element is more then 6, the values are left as ”missing”.

There are four factors that affect the representativeness of the meteorological data. These are: 1) the proximity of the meteorological site to the area being modeled, 2) the complexity of the terrain, 3) the exposure of the meteorological measurement site and 4) the time period of the data collection. It should be emphasized that representativeness (both spatial and temporal) of the data is the key requirement. One factor alone should not be the basis for deciding on the representativeness of the data.

The meteorological data that is input to a model should be selected based on its appropriateness for the modeling project. More specifically, the meteorological data should be representative of the wind flow in the area being modeled, so that it can properly represent the transport and diffusion of the pollutants being modeled.

6.5 Expectations for Local Meteorological Data Use

Local meteorological data must be quality reviewed and the origin of the data and any formatting applied to the raw data must be outlined. The regulatory agency should review the plans to use local meteorological data prior to submission of a modeling report.

The sources of all of the data used including cloud data and upper air data must be documented. The proponent also needs to describe why the site chosen is representative for the modeling application. This would include a description of any topographic impacts or impacts from obstructions (trees, buildings etc.) on the wind monitor. Information on the heights that the wind is measured is also required. The time period of the measurements along with the data completeness and the percentage of calm winds should be reported.

In preparing regional meteorological data sets, the District treated calms winds and missing data as described in Section 6.4. A discussion of the data QA/QC along with the treatment of calm wind and missing data is needed if local meteorological data is processed.

Wind roses showing the wind speed and directions should be provided with the modeling assessment. If wind direction dependent land use was used in deriving the final meteorological file, the selection of the land use should be described.

7. RECEPTOR LOCATIONS

The ISC and AERMOD series of air dispersion models compute the concentrations of substances based on user-specified spatial points. Modelers commonly refer to these points as receptors. Receptor selection is critical to capturing the maximum point of impact and proper placement of receptors can be achieved through several approaches. The types of receptors and receptor grids are described below followed by a discussion on the grid extents and receptor densities required to capture maximum concentrations.

7.1 Receptor Types

The refined models, AERMOD and ISCST3/ISC-PRIME, support a variety of receptor types that allow for considerable user control over calculating pollutant concentrations. The major receptor types and grid systems are described in the following sub-sections. Further details on additional receptor types can be found in the appropriate documentation for each model.

7.1.1 Cartesian Receptor Grids

Cartesian receptor grids are receptor networks that are defined by an origin with receptor points evenly (uniform) or unevenly (non-uniform) spaced receptor points in x and y directions. Figure 7.1 illustrates a sample uniform Cartesian receptor grid.

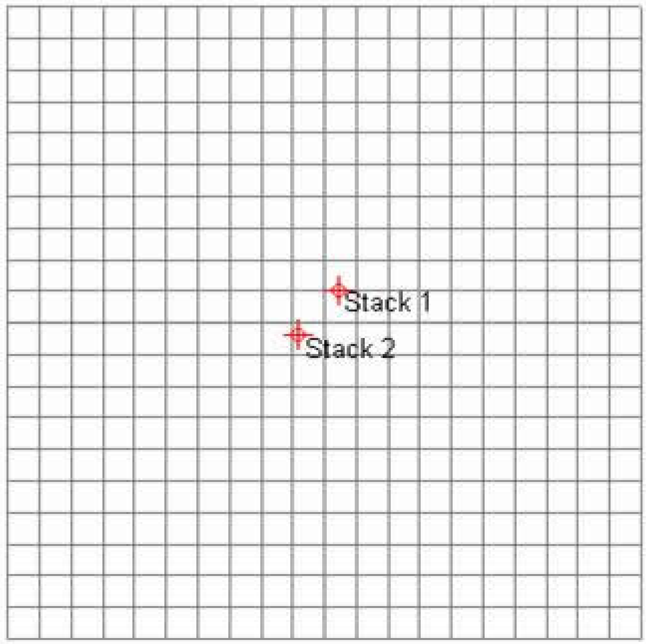


Figure 7.1 – Example of a Cartesian grid.

7.1.2 Polar Receptor Grids

Polar receptor grids are receptor networks that are characterized by an origin with receptor points defined by the intersection of concentric rings, which have defined distances in meters from the origin, with direction radials that are separated by specified degree spacing. Figure 7.2 illustrates a sample uniform polar receptor grid.

Polar grids are a reasonable choice for facilities with only one source or one dominant source. However, for facilities with a number of significant emissions sources, receptor spacing can become too coarse when using polar grids. As a result, polar grids should generally be used in conjunction with another receptor grid, such as a multi-tier grid, to ensure adequate spacing.

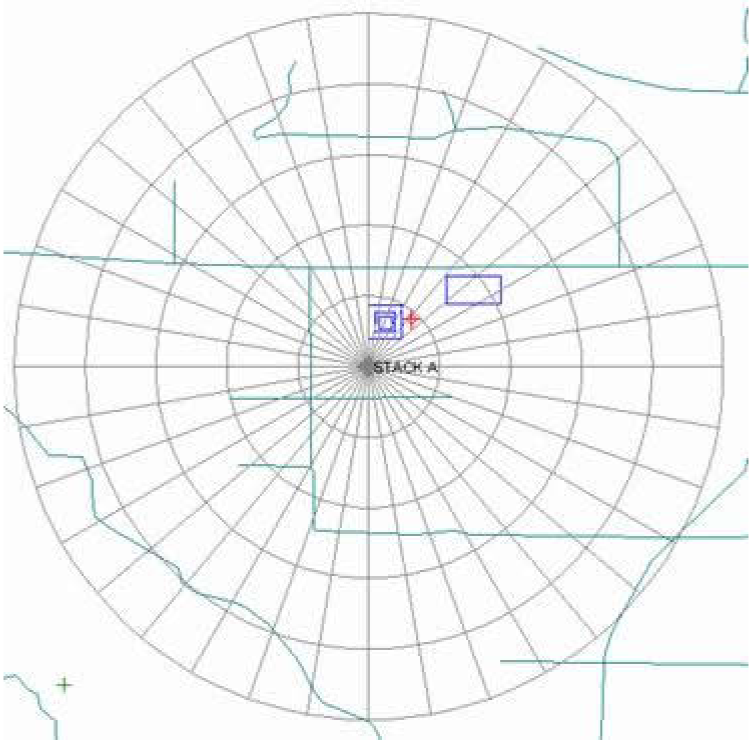


Figure 7.2 – Example of a polar grid.

7.1.3 Multi-Tier Grids

Each receptor point requires computational time. Consequently, it is not optimal to specify a dense network of receptors over a large modeling area; the computational time would negatively impact productivity and available time for proper analysis of results. An approach that combines aspects of coarse grids and refined grids in one modeling run is the multi-tier grid.

The multi-tier grid approach strives to achieve proper definition of points of maximum impact while maintaining reasonable computation times without sacrificing sufficient resolution. Figure 7.3 provides an example of a multi-tier grid.

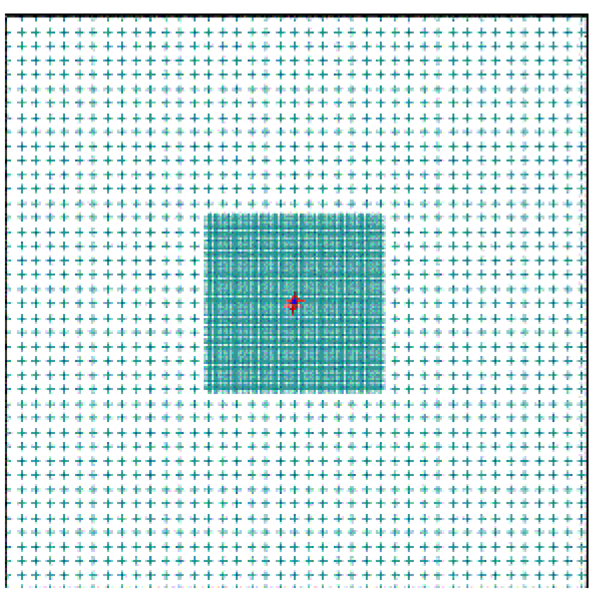


Figure 7.3 - Sample Multi-Tier Grid with 2 tiers of spacing.

7.1.4 Fenceline Receptors

With the exception of self-contamination scenarios, dispersion modeling for on-site receptors, or within the property boundary, is not necessary. As a result property boundaries are typically delineated in projects and model results are not required for those areas. However, receptors must be placed along the plant boundary to demonstrate compliance at the nearest reportable geographical locations to the sources.

A receptor network based on the shape of the property boundary that has receptors parallel to the boundaries is often a good choice for receptor geometry. The receptor spacing can then progress from fine to coarse spacing as distance increases from the facility, similar to the multi-tier grid.

7.1.5 Discrete & Sensitive Receptors

Receptor grids do not always cover precise locations that may of interest in modeling projects. Specific locations of concern can be modeled by placing single receptors, or additional refined receptor grids, at desired locations. This enables the modeler to achieve data on specific points for which accurate data is especially critical. In particular, for elevated receptors the maximum concentrations can be larger than found at ground level.

Common locations of sensitive receptors can include, among others, the following:

- Apartments
- Residential zones
- Schools
- Apartment buildings
- Day care centers
- Air intakes on nearby buildings
- Hospitals
- Parks
- Care Facilities

Depending on the project resolution and location type, these can be characterized by discrete receptors, a series of discrete receptors, or an additional receptor grid.

7.2 Minimum Receptor Requirements for Capturing and Assessing Maxima

Receptor definition must ensure coverage to capture the maximum pollutant concentration. For facilities with more than one emission source, the receptor network should include Cartesian or multi-tier grids to ensure that maximum concentrations are obtained. Screening model runs (i.e., SCREEN3, AERSCREEN) for the most significant sources on a facility can be used to determine the extent of the receptor grids. Tall stacks could require grids extending 1 to 3 km while ground level maxima for emissions from shorter stacks (10 - 20 m Ht.) might be obtained using grids extending a km or less from the property line.
The model could be first run with a coarser grid and then run with finer grids in the areas showing the highest impacts. If this method were used, finer grids, as described above, should be used for all

areas with high concentrations not just the single highest area. Figure 7.4 and 7.5 illustrates the application of the District's recommended receptor densities to a sample site.

The densities of the receptors can progress from fine resolution near the source, centroid of the sources, or most significant source (not from the property line for polar grid) to coarser resolution farther away. Model runs with the below receptor densities would ensure that maximum ground level off property concentrations are captured:

Receptors should also be placed along the property boundaries. The spacing of these receptors depends on the distance from the emission sources to the facility boundaries. For cases with emissions from short stacks or vents and a close property line, a receptor spacing of 25 m might be required. For other distances the spacing described below could be used.

Discrete receptors are required at locations where there are elevated points of impact such as apartment buildings and air intakes on nearby buildings. These are needed to ensure that maximum impacts are obtained. Other discrete receptors are required for sensitive receptors such as schools and hospitals.

The below are minimal requirements to aid the modeler in defining adequate receptor coverage. The final extent and details are the responsibility of the modeler who must demonstrate that the maximum has been reached and ensure the levels have dropped well below the standard and/or the guideline of the contaminant being studied. Certain stack characteristics, such as tall stacks, may inherently require larger receptor coverage.

7.2.1 Polar Grid

- 36 Directional Radials
- 10 Directional Increments
- Radial Distance
  - 25m
  - 50m
  - 100m
  - 250m
  - 500m
  - 1000m

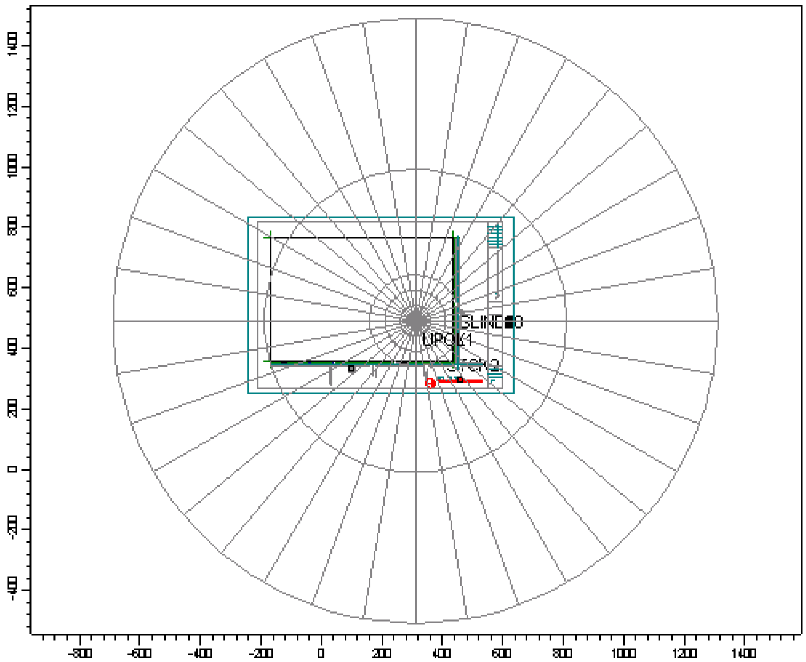


Figure 7.4 – Sample Polar Grid receptor grid layout.

7.2.2 Cartesian Grid

- 25 m spacing on the Facility Boundary
- 25 m Spacing from Facility Boundary to 100
- 50 m spacing from 100 to 250 m
- 100 m spacing from 250 to 500 m
- 250 m spacing from 500 to 1000 m
- 500 m spacing from 1000 to 2000 m

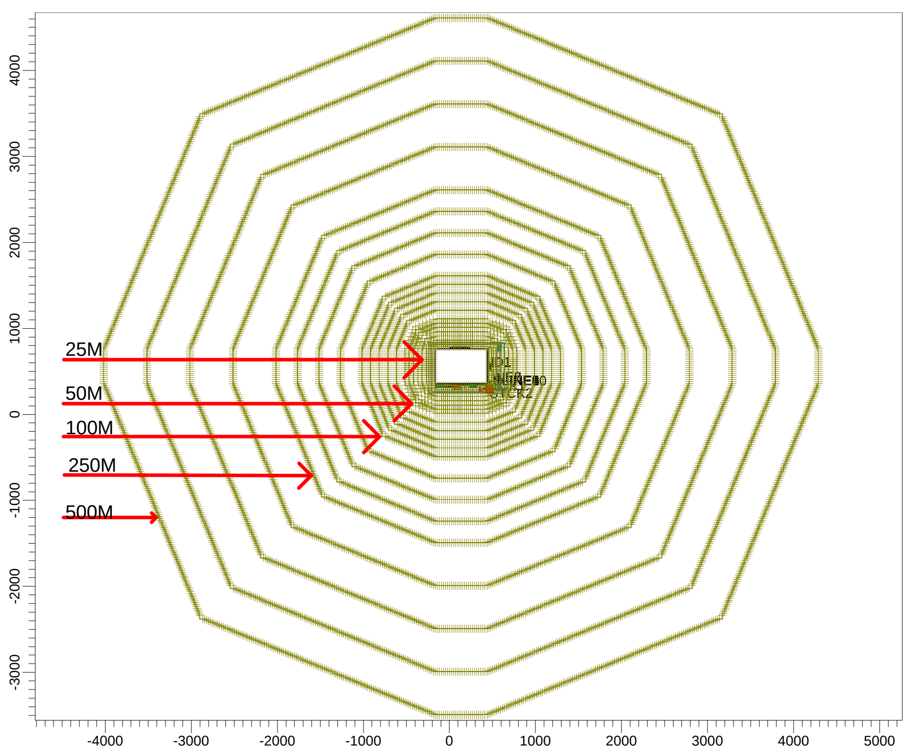


Figure 7.4 – Sample Cartesian Grid receptor grid layout.

8. OTHER MODELING CONSIDERATIONS

8.1 Explanation for Alternative Model Use

Due to some limitations inherent in AERMOD (and most other plume models), there are some situations where the use of an alternative model may be appropriate. Acceptable Alternative Models and their use are further described on EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) web page.

AERMOD is a steady-state plume model. For the purpose of calculating concentrations, the plume is assumed to travel in a straight line without significant changes in stability as the plume travels from the source to a receptor. At distances on the order of tens of kilometers downwind, changes in stability and wind are likely to cause the accuracy to deteriorate. For this reason, AERMOD should not be used for modeling at receptors beyond 50 kilometers. AERMOD may also be inappropriate for some near-field modeling in cases where the wind field is very complex due to terrain or a nearby shoreline.

AERMOD does not treat the effects of shoreline fumigation. Shoreline fumigation may occur along the shore of the ocean or large lake. When the land is warmer than the water, a sea breeze forms as the warmer, lighter air inland rises. As the stable air from over the water moves inland, it is heated from below, resulting in a turbulent boundary layer of air that rises with downwind distance from the shoreline. The plume from a stack source located at the shoreline may intersect the turbulent layer and be rapidly mixed to the ground, a process called "fumigation," resulting in high concentrations. In these and other situations, the use of alternative models may be desired.

The use of any alternative model should first be reviewed by the District for suitability to the study application. If an alternative model is used the reasons and argument for its use over a preferred model must be discussed. An understanding of the alternative model, its data requirements, and the quality of data applied with the model must be demonstrated.

8.2 Use of Modeled Results in Combination with Monitoring Data

Monitoring and modeling should be considered complementary assessment tools to assess potential impacts on the local community.

Monitoring data could be used to provide verification of model results if sufficient monitoring data is available at locations impacted by facility emissions. Decisions on the adequacy of the monitoring data would be made on a case-by-case basis. Comparisons between measured and modeled results would depend on the amount of monitored data available. Pre-consultation with the District is advisable if a comparison of model results with monitoring data is undertaken.

If model results do not agree with measured data, the facility source characteristics and emission data should be reviewed.

For cases where reliable information is available on the emission rates and source characteristics for a facility, modeled results can identify maximum impact areas and concentration patterns that could assist in locating monitoring sites. Model runs using a number of years of meteorological data would show the variations in the locations and the magnitude of maximum concentrations and can also provide information on the frequency of high concentrations.

The U.S. EPA Guideline on Air Quality Models states that modeling is the preferred method for determining concentrations and that monitoring alone would normally not be accepted for determining emission limitations.

When monitoring data are used to verify modeling results for averaging times from 1 to 24 hours, more robust comparisons would be achieved using a percentile of the data rather than only the maximum concentrations. Percentile comparisons reduce the impacts of outliers in either the monitoring or the model results. For some contaminants, the impact of background sources on measured concentrations might need to be taken into consideration.

8.3 Information for Inclusion in a Modeling Assessment

A suggested checklist of parameters designed to provide an overview of all information that should be submitted for a refined air dispersion modeling assessment is outlined in Appendix B.

The checklist should not be considered exhaustive for all modeling studies – it provides the essential requirements for a general assessment. All sites can have site-specific scenarios that may call for additional information and result in a need for different materials and data to be submitted.

It is the responsibility of the submitter to ensure proper completion and analysis of any air dispersion modeling assessment delivered for review.

9. GLOSSARY OF TERMS

AERMAP: The terrain preprocessor for AERMOD. AERMAP allows the use of digital terrain data in AERMOD.
AERMET: The meteorological preprocessor for AERMOD.
AERMIC: American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee.
AERMOD: A new air dispersion model developed by AERMIC. It is intended to replace the ISCST model.
Air Emissions: Release of pollutants into the air from a source.
Albedo: Portion of the incoming solar radiation reflected and scatter back to space.
Ambient Air: Air that is accessible to the public.
AMS: American Meteorological Society.
AP-42: EPA Document Number AP-42, Compilation of Air Pollutant Emission Factors, Environmental protection Agency, Research Triangle Park, North Carolina. Supplements are published regularly. This document includes process description and emission factors for a broad range of criteria pollutant emission sources.
Background Concentration: Concentration already present and due to natural or man-made sources.
Calm: Cessation of horizontal wind.
Complex Terrain: Terrain exceeding the height of the stack being modeled.

Dalton's Law of Particles Pressures: Each gas in a gaseous mixture exerts pressure independently of the others. The partial pressure of each gas is proportional to its volume fraction in the mixture.
DEM: Digital Elevation Model. Digital files that contain terrain elevations typically at a consistent interval across a standard region of the Earth's surface.
Dispersion Model: A group of related mathematical algorithms used to estimate (model) the dispersion of pollutants in the atmosphere due to transport by the mean (average) wind and small scale turbulence.
Diurnal: Daytime period.
Emission Factor: An estimate of the rate at which a pollutant is released to the atmosphere
Episode: High increase in pollution levels caused by stagnation.
Flagpole Receptor: Any receptor located above ground level.
Fugitive Dust: Dust discharged to the atmosphere in a stream such as that from unpaved roads, storage piles and heavy construction operations.
GMT: Greenwich Mean Time, the time at the 0 ° meridian.

Graham's Law: The diffusion rate of the gas on another is inversely proportional to the square root of their densities.

$$\frac{Dg_1}{\sqrt{\rho g_2}} = \frac{Dg_2}{\sqrt{\rho g_1}}$$

HAP: Hazardous air pollutant.
Henry's Law: The weight of a gas dissolved in a liquid is proportional to the pressure that it exerts above the liquid.

$C_g = k_H * P_g$
Where,
C_g = Concentration of gas in liquid
k_H = Henry's Constant
P_g = Gas Pressure above the liquid

Henry's Constant: Constant that correlates the Pressure of gas, above the liquid, and its concentration on the liquid.
Inventory: A compilation of source, control device, emissions and other information relating to sources of a pollutant or group of pollutants.
Inversion: An increase in ambient air temperature with height. This is the opposite of the usual case.
IRIS: Integrated Risk Information System Database.
ISCST: Industrial Source Complex – Short Term Dispersion Model.
Lee side: The lee side of a building is the side that is sheltered from the wind.
Mixing Height: Top of the neutral or unstable layer and also the depth through which atmospheric pollutants are typically mixed by dispersive processes.
Monin-Obukhov Length: A constant, characteristic length scale for any particular example of flaw. It is negative in unstable conditions (upward heat flux), positive for stable conditions, and approach infinity as the actual lapse rate for ambient air reaches the dry adiabatic lapse rate.
MSDS: Material Safety Data Sheet.
NWS: National Weather Service. A U.S. government organization associated with the National Oceanic and Atmosphere Administration.
Pasquill Stability Categories: A classification of the dispersive capacity of the atmosphere, originally defined using surface wind speed, solar insolation (daytime) and cloudness (night time). They have since been reinterpreted using various other meteorological variables.

PCRAMMET: Meteorological program used for regulatory applications capable of processing twice-daily mixing heights (TD-9689 FORMAT) and hourly surface weather observations (CD-144 format) for use in dispersion models such as ISCST, CRSTER, MPTER and RAM.
Potential Temperature: Useful concept in determining stability in the atmosphere. It identifies the dry adiabatic to which a temperature and pressure is related.

If θ increases with height→stable→atmosphere

If θ decreases with height→unstable→atmosphere

$$\theta = T * (P/P_o)^{0.286}$$

Where:

T = temperature [degrees kelvin]

P_o = reference pressure = 1000 milli-bar

P = point pressure [milli-bar]

The temperature a gas would have if it were compressed, or expanded, adiabatically from a given state (P,T) to a pressure of 1000mb.

Preferred Model: A refined model that is recommended for a specific type of regulatory application.
Primary Pollutant: Substance emitted from the source.
Regulatory Model: A dispersion model that has been approved for use by the regulatory offices of the U.S. EPA, specifically one that included in Appendix A of the Guideline on Air Quality Models (Revised), such as the ISC model.
Screening Technique: A relatively simple analysis technique to determine if a given source is likely to pose a threat to air quality. Concentration estimates from screening techniques are conservative.
Simple Terrain: An area where terrain features are all lower in elevation than the top of the stack of the source.
Stagnation: A calm lasting more then 36 hours.
Upper Air Data (or soundings): Meteorological data obtained from balloon-borne instrumentation that provides information on pressure, temperature, humidity and wind away from the surface of the earth.
U.S. EPA: United States Environmental Protection Agency.
Vertical Potential Temperature Gradient: The change of potential temperature with height, used in modeling the plume rise through a stable layer, and indicates the strength of the stable temperature inversion. A positive value means that potential temperature increases with height above ground and indicates a stable atmosphere.
Wind Profile Component: The value of the exponent used to specify the profile of wind speed with height according to the power law.
Worst Case: The maximum exposure, dose, or risk that can conceivably happen to specific receptors.

APPENDIX A:

1.0 Permit Health Risk Assessments
1.1 Exposure Duration Adjustment

(Adjusted Cancer Duration)

HRA Exposure	**Permit Duration**
70 Yrs	Unlimited
30 Yrs	5 Yrs
9 Yrs	1 Yr

Example:

$$\frac{\text{HRA Exposure}}{70} \times \text{Risk (70yr)} = \text{Adjusted Cancer Risk}$$

If the project does not pass after the 9 yr exposure adjustment, the project is unacceptable as proposed and other modifications to the equipment must be proposed.

1.2 Food Grade Products and Pre-Cleaned Material

This section is intended to clarify the exemption for those processes / emission units that process food grade product(s) or pre-cleaned material.

1.2.1 Definitions:

These definitions only apply to section and should not be used to make other determinations except for those defined in the applicability section below.

Food Grade: is defined as a product that is determined to be suitable for human consumption, i.e. recycling cereal.

Pre-cleaned: is defined as material that has been preprocessed to remove dust / soil, i.e. pre-cleaned grain or rice.

1.2.2 Applicability

This section applies **only** to those emission units that emit particulate matter 10 microns (PM10) or smaller and comply with the following:

- Process food-grade material or;
- Process pre-cleaned material and;
- PM10 emissions are solely from the material being processed and not from material that has adhered to the surface.

1.2.3 Conclusion:

Units that comply with the above criteria are considered to have NO or almost zero risk based on the following.

- Food-grade material has been tested / certified by FDA or their agents to be safe / acceptable for human consumption with no or minimal risk.
- Material that is pre-cleaned is assumed to have had all PM10 (dust / soil) removed. Therefore, has eliminated the exposure to heavy metals.

1.3 Soil Remediation

This section is intended to clarify the procedures for soil remediation projects that do not have source test data (inlet or outlet concentration). This procedure should be used only when source test data is not available.

1.3.1 Applicability:

The procedure described in this section applies to soil remediation projects that do not have inlet or outlet concentration data available.

1.3.2 Pollutant(s) Concentration:

To determine the maximum allowed concentration, the District assumes that the Total Petroleum Hydrocarbon (THP) concentration is the same for the pollutant of concern. This is done as worst-case and will be modified to reflect the allowable concentration based on the following calculations:

For this example we will assume the project is for a gasoline remediation project with a TPH of 1000ppmv and the pollutant of concern would be Benzene. As noted above we will assume that the THP and Benzene concentrations are the same.

- Use the Convert.xls spreadsheet (Provided on Request), WTPERC tab, and enter the required information, see below. This will calculate the quantity of Benzene emitted based on the volatile organic compound (VOC) limit given by the processing engineer and the weight percent (Wt. %) calculated.
- Use the Prior spreadsheet (Provided on Request) to determine the project Prior score.
  - .1 If the prior score is less than one no further analysis is required.
  - .2 If the prior score is greater than one go to the next step.
- Run the ISCST3 or SCREEN3 model as normal.
- Using the CARB HARP program, calculate the risk for Benzene.
  - .1 If the risk is less than 1 in a million no further assessment is required.
  - .2 If the risk is equal or greater than 10 in a million go to the next step.
- Determine the maximum concentration that would be acceptable using the following calculation.

$$\left(\frac{TPH\ ppmv}{MaxRisk}\right) = \left(\frac{X}{AllowableRisk}\right) \text{or}$$

$$X = \left(\frac{(TPH\ \ ppmv * AllowableRisk)}{MaxRisk}\right)$$

$$\begin{aligned}
&\text{TPH} && = 1000\text{ppmv} \\
&\text{MaxRisk} && = \text{Maximum calculated risk} \\
&\text{X} && = \text{Allowable ppmv} \\
&\text{Allowablerisk} && = \text{Allowable Risk (10 in one million)}
\end{aligned}$$

- Determine the maximum percentage of benzene to TPH allowed. This value will be placed on the ATC/PTO to ensure the emissions unit / facility doesn't exceed the District's level of significance.

  (Allowable ppmv / TPH ppmv) * 100 = XX.X % benzene allowed

1.3.3 Conclusion:

If the quantity of the pollutant emitted is below 1 for the prior score (emission unit and facility) or the risk is below the 10 in one million and the hazard indices are less than or equal to 1 (emission unit and facility), using the maximum TPH, the following condition is not be required. Please note other conditions may be needed based on source configuration in order to ensure compliance with the calculated risk.

- The Benzene concentration of the (effluent or influent) shall not exceed **XX.X** % of the TPH.
- The emission unit **cannot** be operated within 100 meter of a multistory building (Only for Unspecified Location permit).

1.4 Unspecified Location Units

This section is intended as an interim procedure for emission units seeking an unspecified location permit. This procedure should be used until a formal policy is approved.

1.4.1 Applicability

The procedure described in this section applies to emission units requesting an unspecified location permit within a specific regional location(s) or District wide.

1.4.2 Unspecified Location Permit for District Wide Operation

The most common unspecified location permits issued are for those units operating throughout the San Joaquin Valley. For these units the following procedure should be used to assess their impact to the public.

- The RMR should be conducted using the worst-case meteorological data set available. For this reason the Fresno Air Terminal year 1989 (FAT89.asc) data set should be used.
- The RMR should be run using a standard receptor grid, refer to Section 7 of this document. This will ensure that the dispersion model finds the maximum concentration.
- The maximum concentration should be used to calculate the maximum possible risk that may occur. Using the maximum concentration will ensure that the worst-case scenario is assessed, i.e. if the emission unit is stationed for any length of time at the distance the maximum concentration was found.

1.4.3 Unspecified Location Permit for Regional Operation

For those emission units permitted to only operate within a specific regional location the procedure is the same except for the meteorological data set. The meteorological data set used should be the worst-case for that region or location.

1.4.4 Risk Greater Than District's Level of Significance

If the risk is greater than the District's level of significance (10 in one million or 1 for the HIs) then the emission unit is **not** eligible for an unspecified location permit and the following procedure will be used to assess the impact.

- The applicant will be required to give specific receptor distances for each operational site.
- Each site will be evaluated individually to determine the maximum impact.
    - If the maximum impact is greater than the District's significance level then operational limits will be included in the Conclusion section of the RMR.
- In the Conclusion section of the RMR each operational site should be listed with any operational limitations.
- The Screen Database should be updated with the maximum impact found at any operational site.

1.4.5 Conclusion:

The following permit conditions may need to be added to the ATC/PTO. Please note that condition 1 must be on **all** unspecified location permits.

- The emission unit **cannot** be operated within 100 meter of a multistory building.
- The emission unit shall only be operated at **List operational Sites**. (Only if required)
- The emission unit shall not be operated more than **XXX** hrs/day or **XXX** Hr/yr (Only if required).

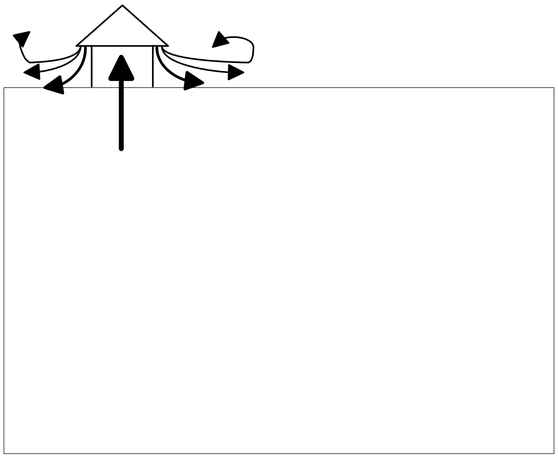
1.5 Stacks w/ Rain Caps & Open Doors

This section is intended to provide guidance for modeling a stack with a rain cap and modeling openings as a volume source.

1.5.1 Stack with a Rain Cap (Area Source):

When emissions are released through a stack with a rain cap, the rain cap redirects the vertical release into a horizontal release, see below. Therefore converting the point source into an area source.

To model the area source, we must determine the length of sides for the area source. To do this we must determine the distance to the two nearest edges of the building from the center of the rain cap, see diagram on the next page.



1.5.2 Openings (Volume Source):

When determining how to model opening we must first determine how the emissions are being emitted from the opening. In most cases, we don't have a profile of the emissions (% of substance and heat at different levels) being release. But we can assume that emissions are being release at all levels of the opening and that the emissions are going out some distance from the opening before they are mixed with the outside air. When we consider these parameter we can see that the opening resembles a volume source which has height, width and length, (3-Dimensions).

Based on these assumptions, we can say that the height of the volume is equal to the height of the opening, the width of the volume is equal to the width of the opening and the length of the volume is equal to the distance from the opening to the nearest edge of the building.

Area Source: (Stack w/ Rain Cap)

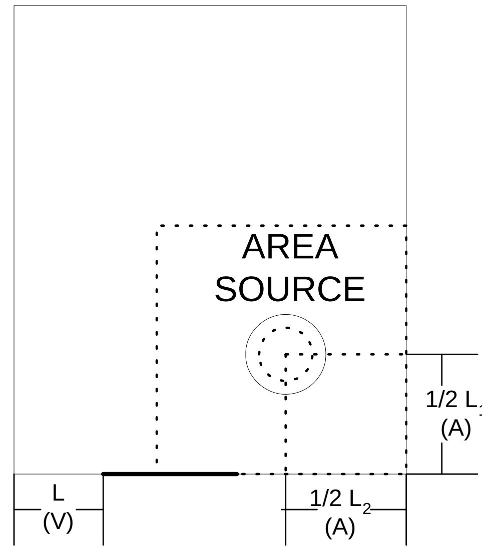
Height = H(A) - Building Ht.
Length = 2 x L_1
Width = 2 x L_2

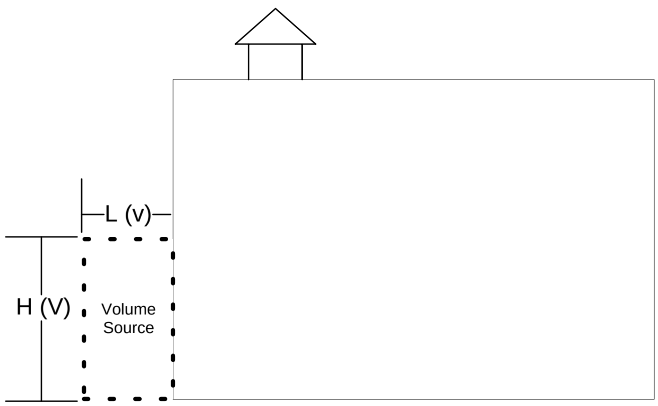
Note: L1 and L2 are the Distances to the nearest building edges.

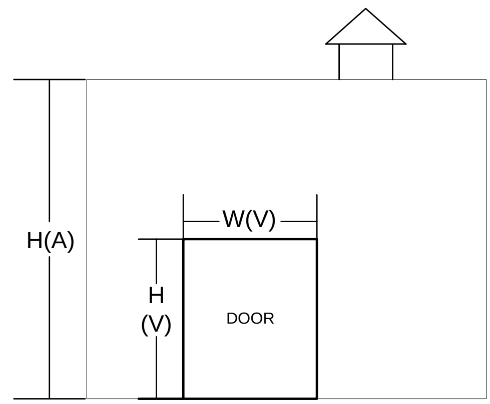
Volume Source: (Open Door)

Height = H (V) - Height of the Door
Length = L(V) - Distance from the door to the nearest building edge.
Width = W(V) - Width of the door

Note: The above values need to be adjusted as instructed by the Modeling Guidelines.







1.6 Dairy Operations

AB 700 removed the exemption from air permitting that dairies had previously. As a result, existing dairies are currently being permitted. New dairies will be permitted in the future, and existing permitted dairies will doubtless be modified. Current San Joaquin Valley Unified Air Pollution Control District policy as incorporated in APR 1905 requires that a Risk Management Review (RMR) be performed for new sources and modification of existing sources. The purpose of the RMR is to ensure ongoing compliance with the Air Toxics “Hot Spots” Information and Assessment Act of 1987 (AB 2588). Therefore, Technical Services will perform RMRs for dairy permitting projects as appropriate. The following procedure defines the methodology for completing an RMR (including a health risk assessment as necessary) for a dairy.

All emission factors for the air toxics discussed below are based upon the total number of cattle. (Note that this includes heifers, milk cows, dry cows, and calves.) If the analysis is for a new facility or a modification that increases the amount of livestock at the dairy, the analysis is straightforward and based on the total number of livestock or the amount increased. If the modification will not increase the number of livestock, there will be no increase in emissions or risk. If the analysis indicates a significant risk, have the District review the analysis to determine if alternative emission factors may be used.

1.6.1 Emissions Estimate

1.6.1.1 Ammonia

Emissions from Ammonia can be calculated by using the emission factors found in Table 1.6.1.1 – 1 and the following equation:

Equation 1:

$$\text{Emissions} = \sum_{i}^{6} \text{EF X \# Head}$$

Where:

Emissions	=	Sum of emissions (based on each type of animal selected from Table 1.6.1.1-1)
EF	=	Emission Factor in lb/head per yr based on the type of animal being evaluated, see Table 1.6.1.1-1
# Head	=	Total number of animals being evaluated based on EF selected

Cow Emission Factors (EF) (lbs-NH3/hd-yr)			
Type of Cow	**Open Corral Housing**	**Freestall Housing**	**Source**
Milking Cow	74.0	74.0	SJVAPCD
Dry Cow	50.0	50.0	SJVAPCD
Heifer (15-24 months)	35.0	35.0	SJVAPCD
Heifer (7-14 months)	30.6	30.6	SJVAPCD
Heifer (4-6 months)	27.7	27.7	SJVAPCD
Calf (under 3 months)	26.0	26.0	SJVAPCD

Table 1.6.1.1 - 1

1.6.1.2 Hydrogen Sulfide

No emissions from Hydrogen Sulfide have been determined.

1.6.1.3 Particulate Matter

A dairy will emit a variety of air toxic pollutants and particulate matter (PM_{10}) emissions. Use the tables below to estimate annual and short-term air toxic pollutants and PM_{10} emissions. Toxic pollutants emitted as particulate matter are determined by using ARB's speciation profile "Livestock Operations Dust", Table 1.6.1.3 –3.

Equation 2:

$$\text{Emissions} = \sum_{i}^{6} \text{EF X \# Head}$$

Where:

Emissions	=	Sum of emissions (based on each type of animal selected from Table 1.6.1.3 – 2)
EF	=	Emission Factor in lb/head per yr based on the type of animal being evaluated, see Table 1.6.1.3 – 2
# Head	=	Total number of animals being evaluated based on EF selected

PM_{10} Emission Factor (EF) (lbs- PM_{10}/hd-yr)			
Type of Cow	**Type of Housing**	**EF**	**Source**
Milk & Dry Cow	Freestalls w/ Exercise Pens	1.37	SJVAPCD
Milk & Dry Cow	Open Corrals **w/no** shade structure	5.46	SJVAPCD
Milk & Dry Cow	Open Corrals **with** shade structures	4.55	SJVAPCD
Calves	Individual pens	1.37	SJVAPCD
Feedlot Cattle and all Heifers	Open corrals **w/no** shade structure	10.55	CARB/SJVAPCD
Feedlot Cattle and all Heifers	Open corrals **with** shade structure	9.67	CARB/SJVAPCD

Table 1.6.1.3 – 2

Dairy Toxic Emission Factors (PM)

Total PM10:	**1**	**lbs/yr**
	1.000	**lbs/hr**

Enter the PM10 emissions.

Component	CAS Number	Percent of Total PM10	Annual Emissions (lbs/yr)	Hourly Emissions (lb/hr)
Aluminum	7429905	2.2887	0.023	0.02288700
Lead	7439921	0.0033	0.000	0.00003300
Manganese	7439965	0.0603	0.001	0.00060300
Mercury	7439976	0	-	-
Nickel	7440020	0.0026	0.000	0.00002600
Crystalline Silica	7631869	7.0553	0.071	0.07055300
Silver	7440224	0.0013	0.000	0.00001300
Antimony	7440360	0	-	-
Arsenic	7440382	0.0005	0.000	0.00000500
Barium	7440393	0.0465	0.000	0.00046500
Cadmium	7440439	0.0009	0.000	0.00000900
Hexavalent Chromium	18540299	0.0004	0.000	0.00000400
Cobalt	7440484	0.0003	0.000	0.00000300
Copper	7440508	0.0085	0.000	0.00008500
Vanadium	7440622	0.0114	0.000	0.00011400
Zinc	7440666	0.0235	0.000	0.00023500
Ammonia	7664417	0.4493	0.004	0.00449300
Bromine	7726956	0.0039	0.000	0.00003900
Selenium	7782492	0.0006	0.000	0.00000600
Chlorine	7782505	0.6411	0.006	0.00641100

Sulfates	9960	0.7932	0.008	0.00793200

Note: These emission factors are based on the Air Resources Board's Profile No. 423, Livestock Operations Dust. All Silicon is assumed to be Crystalline Silica. Since this assumption is extremely conservative, any decisions based on this assumption must be carefully considered. Five percent of the chromium is assumed to be hexavalent chromium.

Table 1.6.1.3 - 3

1.6.1.4 Volatile Organic Compounds

These tables are based upon the data and procedures that were used to establish the District's volatile organic compound (VOC) emission factor for dairies. These emission factors consists of the following five separate components: enteric emissions from cows and feed, ethylamines from specific dairy processes, VOCs (except volatile fatty acids and amines) from specific dairy processes, VOCs (except volatile fatty acids and amines) from lagoons and storage ponds, and volatile fatty acids. (No emission factors were developed for phenols; land application; and feed storage, settling basins, composting, and manure disturbance. If these specific issues arise, please consult with District.) The other emission factor estimates are discussed below.

1.6.1.4.1 *Enteric Emissions from Cows and Feed*

This emission factor relies upon data collected in a study conducted by the University of California at Davis. This study entailed housing animals in an environmental chamber to simulate various processes that occur at a dairy and sampling the air in the chamber. Air samples were analyzed using gas chromatography/mass spectrometry (Method TO-15) and Proton Transfer Reaction Mass Spectrometry (PTR-MS). Only limited amounts of Method TO-15 data are currently available to the District. The VOC emission factor was based on the PTR-MS data. None of these data are available. When these data become available in the future, emissions for this category will be included.

1.6.1.4.2 *Ethylamines from Specific Dairy Processes*

Ethylamine data from a study conducted by Dr. C. E. Schmidt, a private consutant, under contract to the Central California Ozone Study. A Surface Isolation Flux Chamber was used to collect samples at 13 different locations at a dairy in Merced, California. The sampling sites represented different processes within the dairy. Samples collected by the flux chamber were analyzed using Method TO-15. Multiple samples were collected at each area. The flux rates by component measured at each location were averaged to obtain an average for each area. The sum of the emission rates for each area was calculated and normalized to obtain an annual emission rate for each compound for each cow. (Emission rates for compounds that are VOCs were used to calculate a VOC emission rate. For example, emissions of acetone were not included in this total.) Ethylamine emissions were separated from the total for VOCs and included as a separate category. Ethylamine is not a toxic air pollutant. Therefore, it was not included in the spreadsheet.

1.6.1.4.3 *VOCs (Except VFAs and Amines) from Miscellaneous Dairy Processes*

A flux chamber study conducted by Dr. Schmidt was used to estimate VOC emissions from the following processes: separator solids, solids in storage piles, bedding pile solids, freestall bed, primary lagoon, flushed lane (pre-flushed), flushed lane (post-flushed), feed lane (pile), turnouts, heifer pens, and milk parlor. (Lagoon emission factors from this study were not used.) Total annual emissions for a dairy can be calculated by multiplying the emission factor by the number of cows at the dairy. The District did not use the emission estimates for lagoons. As discussed above, the emission factors were based on multiple measurements for each of the processes using a flux chamber an analyzed using Method TO-15. An average for each process was calculated. The process averages were summed to calculate a total VOC emission rate. The available TO-15 results were disaggregated by compound to determine an emission factor for all toxic air pollutants measured. The District's Technical Service staff reviewed the data to ensure that the results were treated consistently with guidance from the Air Resources Board for source test data. The emission factors for each species are given in Table 1.6.1.4.3-1 below.

Dairy Toxic Emission Factors Misc. Processes (VOC)

Total Number of Cows: **1**

Enter the Total Number of Cows.

Component	CAS Number	Alternative Name	Toxic Emissions Factors for Miscellaneous Processes (lb/Head/yr)	Annual Emissions (lbs/yr)	Hourly Emissions (lb/hr)
Xylenes	1210		1.999E-02	0.020	0.000002
Formaldehyde	50000		4.423E-03	0.004	0.000001
Carbon tetrachloride	56235		6.523E-04	0.001	0.000000
2-propanol	67630	Isopropyl Alcohol	1.799E-02	0.018	0.000002
Chloroform	67663		1.453E-03	0.001	0.000000
Benzene	71432		3.544E-03	0.004	0.000000
Chloromethane	74873	Methyl Chloride	8.816E-03	0.009	0.000001
Chloroethane	75003	Ethyl Chloride	2.659E-03	0.003	0.000000
Acetaldehyde	75070		2.680E-02	0.027	0.000003
Carbon disulfide*	75150		2.769E-02	0.028	0.000003
Bromoform	75252		0.000E+00	-	-
Trichlorofluoromethane*	75694	Freon 11	1.196E-06	0.000	0.000000
Tetraethyl lead	78002	Lead Compounds	0.000E+00	-	-
2-Butanone	78933	Methyl Ethyl Ketone	1.623E-01	0.162	0.000019
1,1,2-Trichloroethane	79005		2.516E-03	0.003	0.000000
Trichloroethene	79016	Trichloroethylene	0.000E+00	-	-
1,1,2,2-Tetrachloroethane	79345		9.710E-05	0.000	0.000000
Methyl methacrylate	80626		0.000E+00	-	-
Hexachlorobutadiene	87683		0.000E+00	-	-
Napthalene	91203		1.293E-02	0.013	0.000001
1,2-Dichlorobenzene	95501		6.095E-03	0.006	0.000001
1,2,4-Trimethylbenzene	95636		0.000E+00	-	-
1,2-Dibromo-3-chloropropane	96128		5.489E-04	0.001	0.000000
1,2,3-Trichloropropane	96184		3.073E-03	0.003	0.000000
Isopropylbenzene	98828	Cumene	6.241E-04	0.001	0.000000
Ethylbenzene	100414		3.859E-03	0.004	0.000000
Styrene	100425		3.992E-03	0.004	0.000000
Benzyl chloride	100447		3.210E-03	0.003	0.000000
1,4-Dichlorobenzene	106467	p-Dichlorobenzene	5.769E-03	0.006	0.000001
1,2-Dibromoethane	106934	Ethylene Dibromide (EDB)	3.404E-03	0.003	0.000000

1,2-Dichloroethane	107062	Ethylene Dichloride (EDC)	6.555E-04	0.001	0.000000
Acrylonitrile	107131		2.697E-03	0.003	0.000000
Vinyl acetate	108054		2.188E-02	0.022	0.000002
Methyl Isobutyl Ketone	108101	Hexone	7.883E-03	0.008	0.000001
Toluene	108883		1.193E-02	0.012	0.000001
Chlorobenzene	108907		3.025E-03	0.003	0.000000
Hexane	110543		9.030E-03	0.009	0.000001
Cyclohexane	110827		7.594E-02	0.076	0.000009
1,2,4-Trichlorobenzene	120821		8.663E-03	0.009	0.000001
Butyraldehyde	123728		1.265E-03	0.001	0.000000
1,4 Dioxane	123911		1.567E-02	0.016	0.000002
Tetrachloroethene*	127184	Perchloroethylene	7.236E-03	0.007	0.000001
1,3-Dichlorobenzene	541731		5.450E-03	0.005	0.000001
1,1,1,2-Tetrachloroethane	630206		0.000E+00	-	-
t-1,4-Dichloro-2-butene	764410		9.921E-03	0.010	0.000001
Crotonaldehyde	4170303		1.572E-03	0.002	0.000000

Table 1.6.1.4.3-1

1.6.1.4.4 *VOCs (Except VFAs and Amines) from Lagoons and Storage Ponds*

Dr. Charles Krauter of California State University at Fresno conducted studies at two dairies in the Valley. Measurements were taken at upwind and downwind locations and analyzed using Method TO-15. The Industrial Source Complex – Short-Term (ISCST3) model was used to back-calculate emissions. These data were used to determine emission factors for lagoons and storage ponds. The Technical Services staff was unable to review the raw data because they were not available. The resulting emission factors are included in Table 1.6.1.4.4-1 below.

Dairy Toxic Emission Factors for Lagoons (VOC)

Total Number of Cows: **1,000**

Enter the Total Number of Cows.

Component	CAS Number	Toxic Emissions Factors for Miscellaneous Processes (lb/Head/yr)	Annual Emissions (lbs/yr)	Hourly Emissions (lb/hr)
Xylenes	1210	0.011	11.00	0.00126
carbon tetrachloride	56235	0.020	20.00	0.00228
isopropyl alcohol	67630	-	-	-
Chloroform	67663	0.010	10.00	0.00114
Benzene	71432	0.010	10.00	0.00114
1,1,1-trichloroethane	71556	0.040	40.00	0.00457
bromomethane	74839	-	-	-
chloromethane	74873	-	-	-
chloroethane	75003	-	-	-
vinyl chloride	75014	-	-	-
methylene chloride	75092	-	-	-
Carbon disulfide	75150	-	-	-

tribromomethane	75252	0.444	444.00	0.05068
bromodichloromethane	75274	-	-	-
1,1-dichloroethane	75343	-	-	-
1,1-dichloroethene	75354	-	-	-
Trichloromonofluoromethane	75694	0.022	22.00	0.00251
1,1,2-trichloro-1,2,2-trifluoroethane	76131	0.020	20.00	0.00228
1,2-dichloropropane	78875	-	-	-
Methyl Ethyl Ketone (2-butanone)	78933	0.244	244.00	0.02785
1,1,2-trichloroethane	79005	-	-	-
Trichloroethylene	79016	0.010	10.00	0.00114
1,1,2,3,4,4-hexachloro-1,3-butadiene	87683	-	-	-
1,2-dichlorobenzene	95501	1.413	1,413.00	0.16130
1,2,4-trichlorobenzene	95636	0.010	10.00	0.00114
Ethylbenzene	100414	-	-	-
Styrene	100425	0.014	14.00	0.00160
1,4-Dichlorobenzene	106467	0.025	25.00	0.00285
1,2-dibromoethane	106934	-	-	-
1,3-Butadiene	106990	0.010	10.00	0.00114
1,2-dichloroethane	107062	-	-	-
vinyl acetate	108054	0.100	100.00	0.01142
Methyl Isobutyl Ketone	108101	0.057	57.00	0.00651
Toluene	108883	0.120	120.00	0.01370
Chlorobenzene	108907	-	-	-
n-hexane	110543	-	-	-
Cyclohexane	110827	0.010	10.00	0.00114
propylene	115071	0.130	130.00	0.01484
1,2,4-trimethylbenzene	120821	-	-	-
1,4-dioxane	123911	-	-	-
dibromochloromethane	124481	-	-	-
Tetrachloroethylene	127184	-	-	-
cis-1,2-dichloroethene	540590	-	-	-
1,3-dichlorobenzene	541731	0.025	25.00	0.00285

Table 1.6.1.4.4-1

1.6.1.5 *Volatile Fatty Acids (VFAs)*

VFAs are not air toxics and will not be included in the analysis.

1.6.2 Determine Source Parameters

Dairy emissions should be modeled as area sources. Lagoon emissions should be modeled from individual lagoons based on the area of the lagoons. For example, total lagoon emissions are 1,000 lb/yr. There are two lagoons. One has an area of 1,000 square meters, and the other has an area of 500 square meters. Emissions would be distributed between the two lagoons based on the area. Thus, the emissions from the larger lagoon would be 667 lbs/yr, and those from the smaller one would be 333 lbs/yr. A similar approach should be used to define emission estimates for housing areas, milking parlors, and other areas at the dairy where emissions from miscellaneous processes would occur. A release height of 1 meter should be used for all emissions.

1.6.3 Receptor Locations

The usual procedure for identifying off-site residential and business receptors for modeling should be used. However, on-site residences will be modeled for dairies because the residents at the dairy (other than employees) will not be protected by occupational safety and health regulations.

2.0 CEQA Health Risk Assessments (HRA)
2.1 Long Term Operational Impacts

All stationary and non-permitted sources that emit a listed toxic air contaminate (TAC) and has a risk value developed by the Office of Environmental Health Hazard Assessment (OEHHA) should be considered in the HRA unless other wise directed by the District.

2.1.1 Emission Sources

When making an air quality assessment for a CEQA project, the District considers all sources of potential emissions whether they are not permitted or to be permitted in the future. If the modeling submitted does not include sources that may be permitted in the future, the district would have to assume that the impact from HAP emissions for a project is significant (cancer risk greater than 10 in a million and/or hazard indices greater than 1).

2.1.2 Prioritization

Prior to conducting or the District requiring a health risk assessment (HRA) an applicant may perform a prioritization on <u>all sources</u> of emissions to determine if an HRA will be needed or required. A prioritization is a screening tool that identifies whether a source has the possibility to exceed a prioritization score of 10 and therefore having the potential to have an impact that may exceed the District's level of significance.

If a source conducts a prioritization for a proposed project the following must be considered:

- The near receptor (residential or offsite worksite) must be used to represent all other receptors; irrelevant of the direction of the receptor to the propose project.
- Emissions should represent the worst case emissions estimate
- The prioritization method should follow those in ARB's Prioritization Guideline document approved for the Air Toxic "Hot Spots" Information and Assessment Act.

2.1.3 Screening HRA Tools

The District has develop screen tool to that can be used instead of performing a refined health risk assessment (HRA) as long as the risk from these screening tools are below the District's significance level. If the total risk from the screen tools are greater than the District's significance level a refined HRA will be required.

Current Tools Available:

- Hwy Truck Travel
- Diesel IC Engines
- Truck Idling
- Truck Travel (50 meter segments)
- Gasoline Stations
- Fast Food

2.2.1 Permitted Sources

The CEQA Initial Study or EIR may exclude sources that are permitted, as long as it is assumed that the risk from those sources may be significant. In addition, any sources that are not permitted must still be modeled and any risk is assumed to be over the District's level of significance and mitigated, see examples below.

Example #1:
An Initial Study or EIR identifies sources (Diesel IC engines > 50HP) that will require District permits and there are no other sources of toxic pollutants identified. In this case, there would be no need to have an HRA performed since the District's permitting process will determine the risk from the project and limit the use, if needed, to ensure that the risk is below the District's levels of significance.

Example #2:
An Initial Study or EIR identifies sources (Diesel IC engines > 50HP and a concrete batch plant) that will require District permits. It may seem that there are only permitted sources associated with this proposed project, but there are other sources of toxic pollutants that must be evaluated. Specifically, emissions from truck travel and idling from the transporting of materials in and out of the facility. Therefore, the following options are available:

1) They can conduct an HRA and include all sources (Permitted and Non-permitted)
2) They can conduct an HRA and include only Non-permitted sources. They would then assume that the risk from Non-permitted sources are above the District's significance level and mitigate all the risk determined from the HRA.

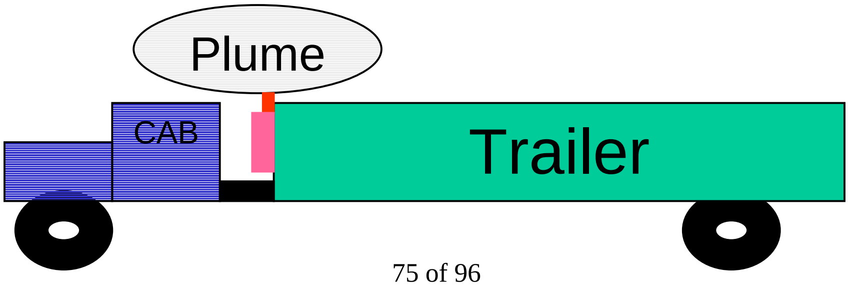
2.3 Mobile/ Non-Permitted Sources

When determining which source(s) to include in the HRA the following should be considered:

2.3.1 Transportation Refrigeration Unit (TRU)

If there is a location (store, pad etc.) where there may be the possibility of a refrigeration storage unit (fast food, mini-mart, liquor store etc.) then modeling of a TRU should be considered.

Modeling Parameters:
1. A TRU can be characterized as:
   (a) Operating at least 30 minutes each trip and making at least one trip /week.
   (b) Rated at 50 BHP with 0.76 g PM/BHP-Hr or 38g/Hr
   (c) Height = 13 ft
   (d) Diameter = 0.04445 m
   (e) Temperature = 501 K
   (f) Velocity = 49 m/s
   (g) Modeled as point source

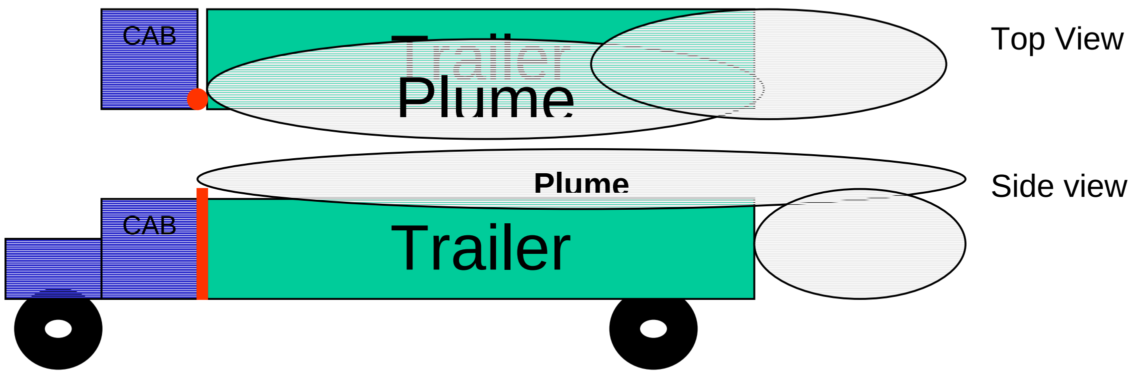


2.3.2 Truck Travel and Idling

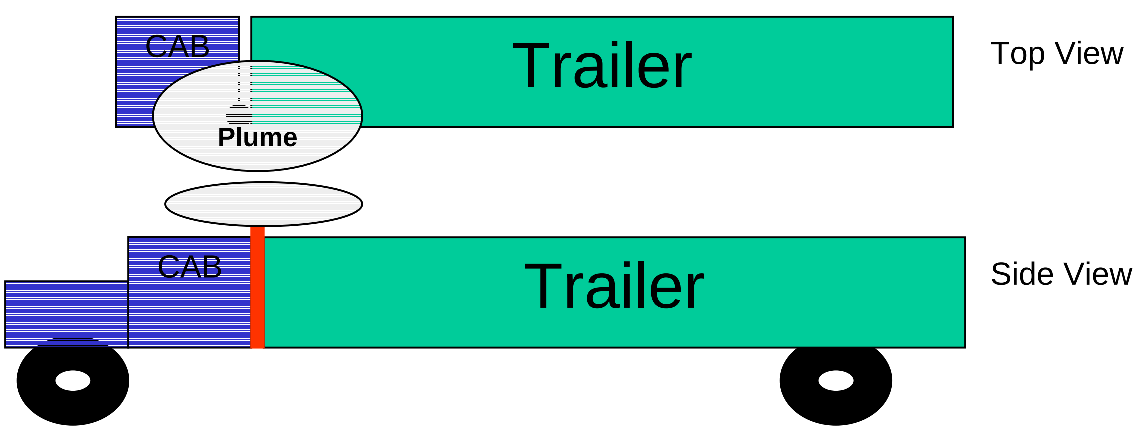
Emissions from trucks traveling or idling should be considered when performing a CEQA HRA when those emissions occur on the proposed facility property, i.e. as soon as the truck enters the driveway of a proposed facility. Emissions that occur on the road/Hwy should not be considered in this analysis. Idling is limited to 5 minutes at any location, as recommended by the state ATCM for idling trucks (http://www.arb.ca.gov/toxics/idling/idling.htm).

Modeling Parameters:

1. Truck Traveling
   a. Height = 6 ft
   b. Width = 12 ft (width of a truck)
   c. Length = based on path of travel
   d. EF = 0.67 g/mile EMFAC 76
   e. Modeled as a line of volume sources along shortest truck route from road entrance to destination.
   f. Driving at no more than 15 mph on the facility



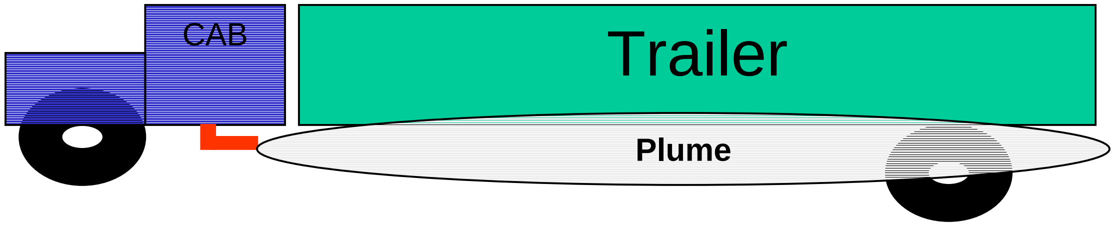
2. Truck Idling – Vertical (Point Source)
   a. Height = 12.6 ft
   b. Diameter = 0.1 meter
   c. Velocity = 51.71 m/s @ 1500 rpm
   d. Temperature = 366 K
   e. EF = 2.57 g/hr EPA 420 – F 98 – 014 "Idling Vehicle Emissions"



3. Truck Idling – Horizontal

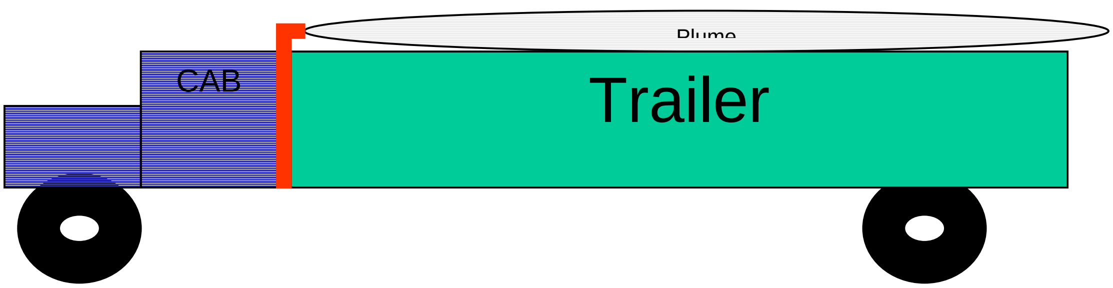
Low Level - (Point Source)

a. Ht = 0.6 ft
b. Diameter = 0.1 m
c. Temperature = 366 K
d. Velocity = 0.001 m/s @ 1500 rpm
e. EF = 2.57 g/hr   EPA 420 – F 98 – 014 "Idling Vehicle Emissions"



High Level - (Point Source)

a. Height = 12.6 ft
b. Diameter = 0.1 m   (0.0762m – 0.125 m, Ave = 0.1)
c. Temperature = 366 K
d. Velocity = 0.001 m/s
e. EF = 2.57 g/hr   EPA 420 – F 98 – 014 "Idling Vehicle Emissions"



2.3.3 Gasoline Dispensing Facility (GDF)

There are four sources of emission that have been identified by CARB in the Gasoline Service Station Industrial Wide Risk Assessment Guidelines (http://www.arb.ca.gov/ab2588/rrap-iwra/GasIWRA.pdf). Note: VOC emission rate scenarios can be found in appendix A and VOC speciation profile for toxic compounds can be found in Section VI.A of the above document.

1. Loading (Tank) – Point Source
   a. VOC = 0.084 lb/1000 gal (scenario 6B)
   b. Modeling Parameters:
      i. Height – 3.66
      ii. Temperature = 291 K
      iii. Diameter = 0.0508 m
      iv. Velocity = 0.00035 m/sec

2. Breathing (Tank) – Point Source
   a. VOC = 0.025 lb/1000 gal (scenario 6B)
   b. Modeling Parameters:
      i. Height = 3.66
      ii. Temperature = 288.71 K
      iii. Diameter = 0.0508 m
      iv. Velocity = 0.000106 m/sec

3. Refueling – Volume Source
   a. VOC = 0.74 lb/1000 gal (scenario 6B)
   b. Modeling Parameters:
      i. Height = 4 m
      ii. Length = 13 m
      iii. Lateral = 3.02
      iv. Vertical = 1.86

4. Spillage – Volume Source
   a. VOC = 0.42 lb/1000 gal (scenario 6B)
   b. Modeling Parameters:
      i. Height = 4 m
      ii. Length = 13 m
      iii. Lateral = 3.02
      iv. Vertical = 1.86

2.3.4 Restaurant and Fast Food Cooking Emissions

2.3.4.1 Restaurants Cooking Emissions (Other than Fast Food)

To assist with calculating emissions from restaurant cooking operations the District recommends that the following emission factors and activity levels be used to estimate emissions.

- Toxic emissions from restaurants* = 0.016 lb of PAH for each ton of food cooked
- Activity Level = 322 lbs of food per week

*(Model these emissions as benzo(a)pyrene in HARP.)

The emission factor and activity level were taken from the District's area source methodology for "Commercial Cooking Operations"[47].

2.3.4.2 Fast Food Cooking Emissions (Only)

To assist with calculating emissions from fast food cooking operations the District recommends that the following activity levels and emission factors be used to estimate emissions.

[47] Pechan (2005). Appendix A - Documentation for the draft 2002 non-point source national emission inventory for criteria and hazardous air pollutants (march 2005 version). Emissions Inventory Group, U.S. EPA. Pages A28 – A34

District Default Values						
Usage Data			**Average Lb/week**			
Facility Type	Description	Controls*	Hamburger	Poultry w/ skin	Poultry w/o skin	Pork
1	CD-Charbroiler	**86%**	**800**		**265**	
2	Flat Griddle	**0%**	**360**		**110**	**110**
3	UF-Charbroiler	**0%**	**270**	**145**		
4	Flat Griddle	**0%**			**110**	**110**
*w/ District Required Control Equipment						

Toxic Emission Factors		**Lb/Ton of meat**							
		Hamburger		Poultry w/ skin		Poultry w/o skin		Pork	
Facility Type	Description	PAH wo/Na-phthalene	Naph-thalene	PAH wo/Na-phthalene	Naph-thalene	PAH wo/Na-phthalene	Naph-thalene	PAH wo/Na-phthalene	Naph-thalene
1	CD-Charbroiler	0.000724	0.046	0	0	0.00046	0.018	0	0
2	Flat Griddle	0.000054	0.012	0	0	0.000044	0.018	0.000044	0.002
3	UF-Charbroiler	0.000702	0.038	0.00046	0.018	0	0	0	0
4	Flat Griddle	0	0	0	0	0.000044	0.018	0.000044	0.002

Emission Summary		Hamburger		Poultry w/ skin		Poultry w/o skin		Pork	
Facility Type	Description	PAH wo/Na-phthalene	Naph-thalene	PAH wo/Na-phthalene	Naph-thalene	PAH wo/Na-phthalene	Naph-thalene	PAH wo/Na-phthalene	Naph-thalene
1	CD-Charbroiler	2.11E-03	1.34E-01	0.00E+00	0.00E+00	4.44E-04	1.74E-02	0.00E+00	0.00E+00
2	Flat Griddle	5.05E-04	1.12E-01	0.00E+00	0.00E+00	1.26E-04	5.15E-02	1.26E-04	5.72E-03
3	UF-Charbroiler	4.93E-03	2.67E-01	1.73E-03	6.79E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	Flat Griddle	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-04	5.15E-02	1.26E-04	5.72E-03

Emission Summary		Total (Lb/Yr)		Total (Lb/Hr)	
Facility Type	Description	PAH wo/Na-phthalene	Naph-thalene	PAH wo/Na-phthalene	Naph-thalene
1	CD-Charbroiler	2.55E-03	1.51E-01	2.91E-07	1.73E-05
2	Flat Griddle	7.57E-04	1.70E-01	8.64E-08	1.94E-05
3	UF-Charbroiler	6.66E-03	3.35E-01	7.61E-07	3.82E-05
4	Flat Griddle	2.52E-04	5.72E-02	2.87E-08	6.53E-06

This worksheet allows the user to enter the proposed quantity for each type of meat cooked by type of operation. If the user is uncertain which type of operation will be used for a single proposed fast food location then the emissions from the highest priority operation with the District's default values should be used.

Examples:

1) Proposed site has two fast food locations. The user will use Facility Type 1 and 2.
2) Proposed site has four fast food locations. The user will use Facility Type 1,2,3, and 4.
3) Proposed site has six fast food locations. The user will use Facility Type 1,2,3, and 4 for the first four locations. For all other locations Facility Type 4 should be used.

Stack Parameters (All Facility Types are modeled as noted below):
Height = 5ft above roof height
Temperature = 200 F
Velocity = 1210 ft/min
Diameter = 1 ft

2.3.5 Dairies

2.3.5.1 Source

When modeling dairy operations only those sources that will be permitted need to be included.

2.3.6 Other Source

Other sources that emit TAC emissions are listed below; the list is not intended to be an all-inclusive listing. Please consult the District to determine if apiece of equipment needs to be included in the HRA if not listed below.

1) Emergency IC engines for backup power
2) Dry Cleaners
3) Forklifts
4) Charcoal Broilers

2.4 Health Risk Assessment Risk Calculation

The HRA guidelines promulgated by the California Office of Environmental Health Hazard Assessment (OEHHA) states the use of the latest version of the Hot Spots Analysis and Reporting Program (HARP) and OEHHA risk assessment health values (http://www.arb.ca.gov/toxics/healthval/healthval.htm).

Therefore the District requests the use of the latest version of HARP http://www.arb.ca.gov/toxics/harp/harp.htm released by the Air Resources Board for performing a health risk assessment.

Please note: The District requires that all input files used to conduct the Health Risk Assessment (HRA) be submitted in electronic format. Providing electronic input files to the District for Modeling facilitates the District's confirmation of the HRA in a timely manner.

2.5 Receptors

A receptor is defined as a point where an actual person (residential or worker) maybe located for a given period of time. The period of time is based on the type of assessment that is being performed. For Example, if you were going to place a receptor in a river to determine short-term (1 hour) exposure that maybe appropriate. To place a receptor on the river to determine long-term (1 year) exposure would not. It is reasonable to assume that a person may be on the river for an hour but not for 24 hours per day, 7 days per week, for 70 years in the same locate, unless the person lives or work on the river.

2.5.1 Worker Receptors

2.5.1.1 Offsite

Offsite worksites that are not directly associated (owned) with the operation of the proposed project are considered to be offsite worksites for the purposes of modeling. These receptors should be included in any modeling runs.

2.5.1.2 Onsite

Onsite worker receptors are not included in any modeling runs unless the following is true:

- The worker is living onsite and is not being paid to live onsite. The worker will be modeled for a 70 yr exposure.

2.6 Sensitive Receptors

2.6.1 Offsite

All sensitive receptors should be included in any modeling runs within 2 km of the proposed site, unless otherwise determined by the District. A sensitive offsite receptor is defined as the following:

- Schools
- Daycare facilities
- Hospitals
- Care facilities (adult/elderly)
- Residential (if not covered by another grided receptor)

2.6.2 Onsite

Onsite sensitive receptors are defined as the following:

- Schools
- Daycare facilities
- Hospitals
- Care facilities (adult/elderly)
- Residential
    - Worker Family
    - Workers not paid to live onsite
    - Family members 18 or older

The family members of a facility owner are not included in the HRA unless the child is 18 or older. In this case, the child is of legal age and a parent can not waive his/her rights. If this person does not what to be included in the HRA the form in Appendix C must be sent and returned in order for that person to exclude from the assessment.

2.7 Alternative Modeling Procedures
2.7.1 Diesel "Only" Facilities

A Diesel "Only" Facility is defined as a facility where emissions from other sources of toxic pollutants will not contribute significantly (greater than 1 in one million) to the overall risk. Proposed projects that have other significant sources of toxic emissions will need to follow section 4.1.1 "Additional Toxic Sources" to address toxic emissions from these sources.

The following procedure may be used to assess risk for facilities for which diesel particulate matter (DPM) is the predominant toxic air contaminant:

1. Model DPM emissions using AERMOD or ISCST3 to determine annual average ground-level concentrations. Create a plot file for the annual average ground-level concentrations of DPM.

2. Open the plot file using Microsoft EXCEL or another spreadsheet program.

3. Copy the data from the plot(s) into Excel.

4. Multiply each annual average DPM ground-level concentrations by the following factor:

$$SlopeFactor \times \frac{C_{air} \times DBR \times A \times EF \times ED \times 10^{-6}}{AT}$$

Where:

Slope Factor = 1.1;

DBR = 393;

A = 1;

EF = 350 d/y;

ED = 70 yr;

10^{-6} = micrograms to milligrams conversion; and

AT = 25,550 days

$$1.1 \times \frac{C_{air} \times 393 \times 1 \times 350 \times 70 \times 10^{-6}}{25{,}550} = 4.1453E-04$$

$$* \, AdjustmentFactor = 4.1453E-04$$

5. The resultant will be cancer risk for each source and receptor combination modeled.
6. If additional sources of toxic pollutants are model see section 2.8 for more details on how to sum the risk from those sources and receptor combinations to these.

*For worksites a DBR of 149 L/Kg should be used. This equates to an Adjustment Factor of 1.5716E-04.

2.8 Additional Toxic Sources

Addition sources of toxic pollutants that need to be assessed should follow the procedure laid out below:

1. Calculate risk from all other toxic pollutants emitted by sources at the proposed facility using the Hot Spots Analysis and Reporting Program (HARP). Export the risks calculated as *.csv files using the export feature in the HARP risk assessment module.
2. Copy the cancer risks for the other pollutants into the spreadsheet where DPM cancer risks have been calculated.

3. Add cancer risks for DPM to those for other pollutants that were calculated using HARP to determine total cancer risk. Note: Ensure that receptor locations in both runs match before coping data into the spreadsheet.

4. Acute and chronic non-carcinogenic risks should be taken directly from the HARP model run. (Acute and chronic non-carcinogenic risks are not calculated for DPM. However, contact the District for guidance if the chronic hazard index for other toxic air contaminants is greater than 0.5.)

APPENDIX B:
REFINED AIR DISPERSION MODELING CHECKLIST

This checklist is designed to provide an overview of the type of information that should be submitted for a refined air dispersion modeling assessment.

This checklist should not be considered exhaustive for all modeling studies – it provides the essential requirements for a general assessment. All sites can have site-specific scenarios that may call for additional information and result in a need for different materials and data to be submitted.
It is the responsibility of the submitter to ensure proper completion and analysis of any air dispersion modeling assessment delivered for review.

General Information

Submittal Date:
Facility Name:
Facility Location:
Modeler Name:

Air Dispersion Model Options

1. Model Selection:
   AERMOD – most recent version
   Other Model – Specify Name, Version and Reason for Use:

2. Regulatory Options Used:
   Yes.
   No. Provide justification for use of non-regulatory options. Note that use of non-regulatory options requires prior approval from the regulatory agency.

3.Dispersion Coefficients:
   Urban
   Rural
   Urban or Rural conditions can be determined through the use of an Auer Land Use or Population Density analysis.

4.Coordinate System
   UTM Coordinates
   Local Coordinates
   Other

AERMOD requires UTM coordinates be used to define all model objects. Use of an alternative coordinate system requires pre-consultation with the regulatory agency.

Source Information

1. Source Summary

Summarize the locations, emission rates and release parameters for all point, area, and volume sources included in the modeling analysis. Information required is summarized in the tables below, each of which can be repeated as often as needed:

Point Sources Summary

Source Name:
Location:
X (m):
Y (m):
Name of Pollutant Modeled Emission Rate [g/s]
1)
2)
3)
4)
5)
Note: If additional pollutants are modeled, provide a tabular emission summary similar to the above for all pollutants.
Stack Height [m]:
Stack Diameter [m]:
Stack Exit Temperature [K]:
Stack Exit Velocity [m/s]:
Horizontal Stack
Rain Cap Present
If the stack is either horizontal in orientation or has a rain cap, stack parameters must be adjusted as per guidance.

Area Sources Summary

Source Name:
Location (Southwest Vertex):
X(m):
Y(m):
Name of Pollutant Modeled Emission Rate [g/(s-m2)]
1)
2)
3)
4)
5)
Note: If additional pollutants are modeled, provide a tabular emission summary similar to the above for all pollutants.
Source Height [m]:
Easterly Dimension [m]:
Northerly Dimension [m]:
Initial Vertical Dimension [m]:
Angle From North [degrees]:

Volume Sources Summary

Source Name:
Location (Center of Source):
X(m):
Y(m):
Name of Pollutant Modeled Emission Rate [g/s]
1)
2)
3)
4)
5)
Note: If additional pollutants are modeled, provide a tabular emission summary similar to the above for all pollutants.
Source Height (m):
Initial Horizontal Dimension (m):
Initial Vertical Dimension (m):

2. Source Parameter Selection

Summarize the reasoning for all emission rate and source parameter values used assumptions, locations, emission rates and release parameters for all point, area, and volume sources included in the modeling analysis.

3. Variable Emissions Potential Emissions during Abnormal Operations Start-Up or Shutdown

If variable emission rates are used, such as potential emissions during abnormal operations start-up or shutdown, summarize time variations for each relevant source, the period of emissions, and a description of the condition.

4. Building Downwash – Is the stack(s) located within 5L of a structure that is at least 40% of the stack height (L is the lesser of the height or the maximum projected building width for a structure).

- No.
- Yes. Perform a building downwash analysis using the current version of the Building Profile Input Program – PRIME (BPIP-PRIME) and include results in air dispersion modeling assessment.

5. Scaled Plot Plan

- Provide a scaled plot, preferably in electronic format, displaying source, structure and related locations including:
    - Emission Release Locations
    - Buildings (On site and neighboring)
    - Tanks (On site and neighboring)
    - Property Boundary

- Model Receptor Locations
- Sensitive Receptors

Receptor Information

1. The following minimal receptor configuration must be met:

- Receptor definition must ensure coverage to capture the maximum pollutant concentration. Please refer to Section 7.2 of this document for a complete discussion of receptor approaches. Model runs using those receptor densities would ensure that maximum ground level off property concentrations are captured:

2. Fenceline Receptors

- Receptors must have no more than 50 meter spacing along property lines, unless approved by the District.

3. Sensitive Receptors

- If applicable, provide a summary describing the location and nature of any nearby sensitive receptors (e.g. apartments, schools, etc.).

4. Capture of Maximum

- Demonstrate that the maximum has been reached and ensure the levels have dropped well below the standard and/or the guideline of the contaminant being studied. Describe the receptor coverage used to achieve this requirement.

Terrain Conditions

1. Does the modeled area contain elevated or complex terrain?

- No.
- Yes.
  In both cases, provide a discussion on the approach used to determine terrain characteristics of the assessment area.

2. Digital Terrain Data

- CDED 1-degree
- CDED 15-minute
- USGS 7.5-minute Ontario dataset
- Other:

3. Elevation data import

- Describe the technique used to determine elevations of receptors and related model entities such as sources.

Meteorological Data

1. Was Pre-processed Regional Meteorological data used?

- No.
- Yes. Specify what data set was used and note the period of the record used:

2. Was a Regional Meteorological Merge data file used?

- No.
- Yes. Specify the Meteorological Data Set Merge file used and summarize land characteristics specified in its processing. This information should be reviewed by the District prior to submission of a modeling report.

3. Were hourly surface data and upper air Regional Meteorological data files used?

- No.
- Yes. Specify the Meteorological Data files used and summarize all steps and values used in processing these standard meteorological data files. This information should be reviewed by the District prior to submission of a modeling report.

4. Was local meteorological data used?

- No.
- Yes. Specify the source, reliability, and representativeness of the local meteorological data as well as a discussion of data QA/QC and processing of data. State the time period of the measurements, wind direction dependent land use (if used), and any topographic or shoreline influences. This information should be reviewed by the District prior to submission of a modeling report.

5. Wind Information – the following items should be provided and discussed where applicable:

- Speed and direction distributions (wind roses)
- Topographic and/or obstruction impacts
- Data completeness
- Percentage of calms

6. Temperature, clouds, and upper air data – the following items should be provided and discussed where applicable:

- Data completeness
- Mixing layer heights, diurnal and seasonal variations

7. Turbulence – the following should be provided and discussed if site data is being used:

- Direct measurements – frequency distributions, diurnal and seasonal variations

Results – Dispersion Model Predictions

1. Model files – the following electronic model input and output files are to be provided:

- BPIP-PRIME Input and Output files.
- ISCST3/ISC-PRIME or AERMOD Input and Output files.
- ISCST3/ISC-PRIME or AERMOD Plot files
- SCREEN3 Input and Output files if applicable

2. Meteorological Data – the following electronic meteorological data files must be provided:

- Pre-processed data files.
- If files other than the Regional Pre-processed meteorological data files were used, you must include all meteorological data files as well as the AERMET input and output files.

3. Terrain Data

- If elevated or complex terrain was considered, include the digital elevation terrain data files.

4. Plots and Maps – include the following:

- Drawing/site plan with modeling coordinate system noted (digital format preferred).
- Plots displaying concentration/deposition results across study area.

5. Emission Summary

- An emission summary table should be provided.

6. Discussion – The results overview should include a discussion of the following items, where applicable:

- The use of alternative models
- Use of any non-default model options
- Topographic effects on prediction
- Predicted 30-minute average.
- 1-hour, 24-hour or other averaging period maximum if used
- Comparison with existing standard

APPENDIX C:
(Onsite Resident Risk Notification Letter)

San Joaquin Valley Unified
Air Pollution Control District

Notice To Onsite Residence of
Possible Exposure to Toxic Pollutants
(Owner Family Only)

This is to notify ____________________________ that ___________________________
(Resident Name) (Company Name)

located at ___________________________CA. emits pollutants that may adversely expose the above person(s) to concentrations that may cause carcinogenic (Cancer), acute and/or chronic non-carcinogenic (i.e. nausea, eye and repertory irritation) effects.

By signing and returning this notice you are affirming that you understand the above and that you will not be included in the assessment of risk for the proposed new or modified facility.

____

Signature

____

Date

APPENDIX D:

(Population Data For Urban Modeling Runs)

CITY NAME	2005 Estimated Population
Arvin, California	14,724
Atwater, California	27,107
Avenal, California	16,631
Bakersfield, California	295,536
Ceres, California	40,571
Chowchilla, California	16,525
Clovis, California	86,527
Coalinga, California	17,350
Corcoran, California	22,456
Delano, California	45,531
Dinuba, California	19,308
Dos Palos, California	5,036
Exeter, California	9,974
Farmersville, California	9,918
Firebaugh, California	7,001
Fowler, California	4,713
Fresno, California	461,116
Galt, California	23,173
Gustine, California	5,324
Hanford, California	47,485
Hidden Hills, California	1,994
Huron, California	7,187
Kerman, California	11,223
Kingsburg, California	11,148
Lathrop, California	13,116
Lindsay, California	10,767
Livermore, California	78,409
Livingston, California	12,585
Lodi, California	62,133
Los Banos, California	33,506
McFarland, California	11,875
Madera, California	52,147
Manteca, California	62,651
Mendota, California	8,942
Merced, California	73,767
Modesto, California	207,011
Newman, California	9,623
Parlier, California	13,025
Patterson, California	15,500
Porterville, California	44,959
Reedley, California	22,368

Ripon, California	13,658
Riverbank, California	19,727
Sanger, California	22,041
San Joaquin, California	3,579
Selma, California	22,261
Shafter, California	14,569
Stockton, California	286,926
Taft, California	9,106
Tulare, California	50,127
Turlock, California	67,669
Visalia, California	108,669
Wasco, California	23,874
Woodlake, California	7,215

APPENDIX E
(Meteorological Station Characteristics):