PERMIT MODELING GUIDANCE

June 2007

The following guidance has been prepared by the Engineering Division of the Bay Area Air Quality Management District (BAAQMD) to give the Permit applicant specific assumptions, requirements, conventions, and procedures for the preparation of a modeling analysis. Modeling is required under certain provisions of BAAQMD regulations related to permit applications and new source review. The intent of the modeling analysis is to demonstrate that the proposed source emissions will not interfere with the attainment or maintenance of the National Ambient Air Quality Standards (NAAQS), and, if applicable, will not cause an exceedance of a Prevention of Significant (PSD) increment. For BAAQMD purposes, NAAQS is defined to include both California and federal standards. Because this guidance cannot cover every aspect of the analysis needed for a proposed source without becoming unwieldy, **the applicant should submit a modeling plan (protocol) for BAAQMD comment before beginning the analysis. Please contact Glen Long at (415) 749-4659 or email at glong@baaqmd.gov or Jane Lundquist at (415) 749-4675 or email at jlundquist@baaqmd.gov *before* submitting a modeling protocol.**

A. Determine which Pollutants Require Air Quality Analyses(Reg. 2-2-304, 2-2-305, and 2-2-306)

1) New Major Facilities (Reg. 2-2-304.1 and 2-2-220)

   a) If major facility is one of the 28 PSD source categories listed in Section 169 (1) of the federal Clean Air Act, then SO_2, NOx, PM_{10}, and CO emissions are significant if greater than or equal to 100 tons per year

   b) If the major facility is not one of the 28 categories listed in Section 169 (1) of the federal Clean Air Act, then SO_2, NOx, PM_{10}, and CO emissions are significant if greater or equal to 250 tons per year.

2) Major Modification of a Major Facility (Reg. 2-2-304.2 and 2-2-221). Emissions are significant as defined below:

   a) For SO_2: Net emissions greater than 40 tons/year.

   b) For PM_{10}: Net emissions greater than 15 tons/year.

   c) For NO_x: Emissions calculated as NO2 greater than 40 tons/year.

   d) For CO: Emissions greater than 100 tons/year.

3) Non-Criteria Pollutants (Reg. 2-2-306) If any criteria pollutant is greater than 100 tons/year and any non-criteria pollutant emissions increases minus reductions since December 1, 1982 are in excess of the amounts in Table 1.

Table 1
Non-Criteria Significant Emissions Levels. (Reg. 2-2-301)

	Annual Average ton/yr	Daily Average lb/day
Lead	0.6	3.2
Asbestos	0.007	.04
Beryllium	0.0004	.002
Mercury	0.1	.5
Fluorides	3	16
Sulfuric Acid Mist	7	38
Hydrogen Sulfide	10	55
Total Reduced Sulfur	10	55
Reduced Sulfur Compounds	10	55

B. Description of the Proposed Source

1. The applicant should present a clear description of the physical setting of the proposed source, including:

   a) A discussion of the surrounding land use, points of scenic interest, sensitive receptors, and local meteorology

   b) A full size 7 1/2' USGS map showing the plant location, fence lines, and model receptor locations within 5 km of the source, or a map created from USGS Digital Line Graph files. All sources should be specified in the NAD27 UTM coordinate system. Relative coordinates, rather than actual UTM coordinates, are not acceptable.

   c) A plot plan of the plant site to scale, indicating heights of nearby structures above a common reference point.

2. Provide a detailed description of all emissions units including:

   a) Maximum emission rate for each source and each appropriate averaging time, including fugitive emissions.

   b) Stack parameters (diameter, height, exit velocity, stack gas temperature, stack base height above sea level).

3. Calculate the proposed source GEP stack height. GEP is considered to be the greater of:

   a) 65 meters

   b) Height = h + 1.5L where h = height of nearby structure, and L = lesser of height or projected width dimension of nearby structure. Nearby is defined as the distance up to 5 times the lesser of the height or the width dimension of the structure but not greater than 0.8 km.

   c) The height demonstrated by a fluid model or a field study approved by the APCO which ensures that the emissions from the stack do not result in excessive concentrations as a result of building downwash effects. Excessive is defined

as pollutant concentrations greater than 140% of those in the absence of the obstacle.

C. Air Quality Impact Analysis - Screening

1. For most applications, a screening modeling analysis is recommended before attempting a more refined analysis. Screening models use relatively simple model inputs to provide upper bound estimates of the air quality impact from a specific source.

2. A discussion of acceptable screening models can be found in the EPA document "Guideline on Air Quality Models." (Reg. 2-2-603)

3. Screening models normally do not assess the rate of chemical transformations or deposition. However, for significant emissions of NO_x: Assume 100% conversion to NO_2, or use the tiered screening approach referenced in the refined analysis section.

4. Dispersion modeling must use the actual or GEP stack height, whichever is lower.

5. Elements of short term modeling analyses usually include:

   a) Using worst case emissions for appropriate averaging times.

   b) Using the following atmospheric assumptions:

      1) Wind profile exponents of .07, .07, .10, .15, .35, .55 for the rural mode, and .15, .15, .20, .25, .30, .30 for the urban mode.
      2) Gradual plume rise option.
      3) A 600 meter mixing depth.
      4) An ambient temperature of 293 K.
      5) Stack-tip downwash effects included.
      6) Buoyancy-induced dispersion option used.

   c) For a simple terrain analysis (up to stack height): use the SCREEN3 or ISC3 models. If synthetic meteorological data is used with the ISC3 model, the 54 wind speed/ stability classifications from the SCREEN3 model must be used..

   d) A complex terrain analysis (terrain above stack height): use the SCREEN3, VALLEY, CTSCREEN, RTDM, or COMPLEX I (ISC3) models with the rural mode option. For urban areas, use CTSCREEN, SHORTZ, or LONGZ. Receptors should be plotted on the USGS map.

   e) A building downwash analysis is necessary if the stack is less than GEP. The building downwash screening procedure is discussed in the SCREEN3 Model User's Guide. This procedure includes analysis of source impacts within both the cavity and wake regions.

   f) A fumigation analysis should address (all that apply) Type 1 (inversion breakup) and Type 3 (shoreline fumigation). A discussion on fumigation analyses can be found in "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised," EPA, October 1992 (EPA-454/R-92-019. Additional information for the analysis techniques may be found for:

1) Type 1: In the Workbook of Atmospheric Dispersion Estimates (Turner, 1970).
2) Type 3: In papers by Lyons and Cole, Journal of Applied Meteorology, April 1973, pp 494-510; Misra and Onlock papers, eg. Atmospheric Environment, Vol. 16 No. 3, pp 479-489; and the paper Hanna et. al., APCA Journal, Oct 1985, pp 1039-1047

Type 3 fumigation must be evaluated for sources if they are within 3 km of a large body of water. Worst case meteorology should be assumed to be F Stability and a stack height wind speed of 2.5 meter/sec unless on-site measurements show differently. When using SCREEN3 to evaluate Type 3 fumigation, all ranges of the TIBL factor(2-6) must be addressed. For multiple sources, if all plumes are below the height of a given TIBL, then shoreline fumigation impacts are not relevant for that TIBL. If some of the sources have plume heights below the TIBL, their impacts must still be addressed and added to those sources with plume heights above the TIBL. This is accomplished via running the ISCST3 model (ignoring terrain) and finding the maxima 1-hr average ground-level plume centerline concentration(s) at a downwind distance equal to the shortest shoreline fumigation distance.

g) Careful placement of model receptors. Model receptors should be located so as to exhibit the maximum impact from the source(s). For example, this may require positioning receptors at plume centerline height for elevated terrain, or aligning receptors downwind of a line of sources, or setting receptors no more than 100 meters apart in the area of maximum concentrations determined from a previous model run. Receptors should also be placed far enough away from the source to be able to determine the impact area (discussed in Section E). Only NAD27 UTM coordinates are to be used when specifying a receptor location.

6. Screening analyses generally calculate one-hour concentrations. To generate averaging times greater than one hour, the following multiplying factors may be used:

Averaging Time	Multiplying Factor
3 hours	0.9
8 hours	0.7
24 hours	0.4
annual	0.1

7. If the results of the screening model analyses indicate that any increment or ambient air quality standards may be threatened, a more refined modeling analysis should be conducted. However, if the input data needed for a refined analysis is not available, then a screening analysis may be all that can be done. For example, it would be inappropriate to use a refined model that requires one year of on-site meteorological data at a site where none has been collected and where the terrain is complex enough that data from distant sites are not appropriate.

D. Air Quality Impact Analysis - Refined

1. Refined modeling techniques require more detailed and precise meteorological input data, provide more detailed treatment of physical and

chemical atmospheric processes, and produce more accurate concentration estimates.

2. Elements of refined modeling techniques include:

   a) Improving the meteorological data
      1) Using at least one year of on-site meteorological data or multiple years of data collected at a nearby site. Contact the BAAQMD to determine if appropriate meteorological data are available.
      2) Determining whether urban or rural dispersion coefficients should be used through a land use analysis (Auer, JAM May 1978, p. 636).
      3) Using multiple wind sites to determine a wind field.

   b) Using chemical and physical transformations.
      1) For conversion of NO to NO2, use the tiered screening approach as described in "Supplement C To The Guideline On Air Quality Models (Revised)," EPA, August 1995 (EPA-450/2-78-027R-C)
      2) An atmospheric chemistry submodel may be needed to predict secondary particulate formation from acid gases. In urban areas, a half-life of 4 hours may be applied to SO_2 emissions.

   c) Improving the emissions inventory
      1) Measuring the NO/NO2 fraction in the stack.

   d) Use wind directions specific building downwash information. The EPA model Building Profile Information Program (BPIP) may be used to generate input into the ISC3 model.

   e) Using more refined models
      1) Refined Gaussian models are discussed in the "Guidelines on Air Quality Models."
      2) Use a trajectory model.
      3) Use a grid-based model.
      4) Perform wind tunnel or fluid model studies.

E. Determine the Impact Area (Reg. 2-2-219)

1. The impact area is a circular area whose radius is equal to the greatest distance from the source to which approved dispersion modeling show the proposed emissions will have a significant impact. See Table 2 for a list of significance levels.

Table 2
Significance Levels for Air Quality Impacts (Reg. 2-2-233)

	Annual $\mu g/m^3$	24-hour $\mu g/m^3$	8 hour $\mu g/m^3$	3 hour $\mu g/m^3$	1 hour $\mu g/m^3$
PM_{10}	1.0	5	-	-	-
SO_2	1.0	5	-	25	-
NO_2	1.0	-	-	-	19
CO	-	-	500	-	2000

2. An impact area is predicted for each averaging period for each pollutant with significant emissions. The largest impact area for a given pollutant is selected as the impact area to be used in the air quality analyses.

3. An impact area may need to be determined.

   a) To establish a baseline date and a baseline area for sources of PM_{10}, NO_2, and SO_2 (Section F).

   b) To determine the additional emission inventories that may be needed (Section G).

   c) To determine if the background air quality data used in the analysis are from a monitoring site sufficiently close to the proposed new source (Section H).

   d) To demonstrate that the emissions increase will not interfere with attainment or maintenance of the CO NAAQS in any contiguous air basin (Section I.5). (Reg. 2-2-305)

F. Establishing the Baseline Date and Baseline Area

1. For pollutants for which PSD increments have been established (NO_2, SO_2, and PM_{10}), when dispersion modeling shows the 1 $\mu g/m^3$ annual increase impact area to lie within a designated Section 107 (of the Clean Air Act) area, then the baseline date will be triggered for the whole 107 area. Table 3 below shows the pollutant, major source baseline date, trigger date, and minor source baseline date.

Table 3 PSD Baseline Dates

Pollutant	Major Source Baseline Date	Trigger Date	Minor Source Baseline Date
SO_2	January 6, 1975	August 7, 1977	March 25, 1980
NO_2	February 8, 1988	February 8, 1988	July 1, 1988
PM_{10}	January 6, 1975	August 7, 1977	By County: San Francisco: March 25, 1980 San Mateo: March 25, 1980 Napa: July 29, 1983 Contra Costa: February 8, 1985 Santa Clara: March 2, 2000 Alameda: June 18, 2001 Other Counties: Not yet set

2. After the baseline date has been triggered, all actual increases in emissions will contribute to PSD increment consumption within the baseline area.

G. Establishing Additional Emission Inventories

1. The applicant may need to prepare additional emission inventories.

   a) An emissions inventory of all increment-consuming sources within the impact area.

b) An emissions inventory for large increment-consuming major sources within 50 km of the impact area that may cause significant impacts in the impact area.

c) An emissions inventory for sources that are permitted but no yet operating that may have an effect on air quality in the impact area.

d) An emissions inventory which can be used to demonstrate that ambient air monitors were properly located.

2. In addition to preparing the above emissions inventories, the applicant should include a plot map showing the location of all increment-consuming sources from section G.1.a&b above which impact the proposed source impact area.

H. Determining Existing Ambient Concentrations

1. The applicant must provide at least one year of continuous ambient air quality monitoring data before submittal of the permit unless exempted under Section 2-2-111.

a) Section 111 may exempt the applicant from the monitoring requirement if the air quality impacts of the proposed new source or the existing air quality are less than the concentrations given in Table 4.

Table 4
PSD Monitoring Exemption Air Quality Conc. in $\mu g/m^3$.

Carbon Monoxide: 8-hr average	575
PM_{10}: 24-hour average	10
Sulfur dioxide: 24-hr average	13
Lead: 3-month average	0.1
Mercury: 24-hr average	0.25
Beryllium: 24-hr average	0.0001
Fluorides: 24-hr average	0.25
Vinyl chlorides: 24-hr average	15
Total reduced sulfur: 1-hr average	10
Hydrogen sulfide: 1-hr average	0.2
Reduced sulfur compounds: 1-hr average	10
Nitrogen dioxide: annual average	14

2. BAAQMD air monitoring data may be substituted for the above requirements if the applicant can demonstrate that the monitors are suitably located to be representative of or more conservative of the maximum concentrations within the impact area.

a) Alternatively, existing ambient air quality can be estimated by using nearby air quality data and superimposing the modeled impact of sources near the proposed source. EPA's "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised," EPA, October 1992 (EPA-454/R-92-019) has a good discussion of this method starting on page 4-37.

b) To reduce the influence of annual variations in meteorology, the most recent three years of air quality data should be used. Within that period, the highest,

2nd high concentration should be used as background for comparison with national standards. However, the highest concentration within that period should be used as background for comparison with State standards.

3. If on-site monitoring is conducted, the applicant must meet the quality assurance requirements of Appendix B to 40 CFR Part 58 during the operation of the monitoring station.

4. Meteorological data collection is generally required when conducting on-site air quality monitoring and should be used in the subsequent dispersion modeling analyses. See the District's Meteorological Monitoring Guidelines for more information.

I. Comparison with Standards & Increments

1. For comparison with the NAAQS, the modeled concentrations should include emissions from both the source and nearby permitted-sources not yet operating. The modeled concentrations are then added to the monitored air quality concentrations to determine whether any standards would be violated.

2. For comparison with the PM_{10}, SO_2, and NO_2 increments, the modeled concentrations should include new emissions from the source, all emission increases within the impact area since the baseline date, and emissions from major sources outside the impact area (since the baseline date) that could contribute at least 1 $\mu g/m^3$ annual average within the impact area.

3. The modeling results and comparison with increments and standards should be presented in a clear and concise tabular form.

4. The modeling results must demonstrate that the proposed source emissions will not interfere with the attainment or maintenance of any federal ambient air quality standard and will not cause an exceedance of a PSD increment. (See Table 5 below for PSD increments).

Table 5
PSD Increments-Maximum Allowable Increase ($\mu g/m^3$).

Pollutant	Ave. Time	Class I	Class II	Class III
PM_{10}	Annual	4	17	34
	24-hr	8	30	60
NO_2	Annual	2.5	25	50
SO_2	Annual	2	20	40
	24-hr	5	91	182
	3-hr	25	512	700

5. Regulation 2-2-305 requires that the emissions increase will not interfere with the attainment or maintenance of the CO NAAQS in any contiguous air basin. A satisfactory analysis could show that the source impact decreases to less than 500 $\mu g/m^3$ eight-hour average for CO within the BAAQMD.

   Alternatively, the applicant could show that the sum of the source impact and an appropriate background concentration in the contiguous air basin, are less than the NAAQS.

6. If the air quality analyses show violations of the State ambient air quality standard, the source impact must be less than the following instrument threshold concentrations.

   a) SO_2: one-hour of 1 pphm (26 $\mu g/m^3$).

   b) NO_x as NO_2: one-hour of 1 pphm (19 $\mu g/m^3$).

   c) CO: one-hour of 1 ppm (1150 $\mu g/m^3$).

   d) PM_{10}: 24-hour of 5 $\mu g/m^3$.

J. Additional Impacts Analysis (required for all PSD analyses)

1. The primary intent of this analysis is to provide environmental impact information to the public regarding the air quality related impairments to soils, vegetation, and visibility produced by the source and the associated growth that it generates in accordance with Section 2-2-417.

2. Applicants must prepare an additional impacts analysis for each attainment pollutant emitted in significant amounts.

3. The three components of the analysis are:

   a) Growth Analysis
      1) First, project the industrial, commercial, and residential growth that is expected to result from the proposed source (temporary or mobile emissions may be ignored).
      2) Then estimate the air pollution emissions from the resulting growth, including both applicable criteria and non-criteria pollutants.
      3) Finally, perform a modeling analysis which includes both the above emissions and the direct emissions from the proposed source.
      4) It is important that the growth analysis is completed first, as it provides essential information to the other two analyses.

   b) Soils and Vegetation Analysis
      1) If calculated impacts are found to be above damage thresholds to sensitive species, then the applicant needs to provide an analysis of the effects of maximum concentrations of pollutants on the types of soils and

vegetation found within the impact area, emphasizing the sensitive species.

c) Visibility Analysis

1) The applicant must include an analysis of the impairment to visibility within the nearest Class I area that would occur as a result of the proposed new source.

2) Use the screening methods contained in the EPA document "Workbook for Plume Visual Impact Screening and Analysis (Revised)" (EPA-454/R-92-023). Assume flat terrain between the source and the Class I area when performing a Level 1 analysis.

K. Special Emphasis for Sources Near Class I Areas

1. A Class I increment analysis must be performed for any PSD source which increases NO_2 or PM_{10} concentrations by 1 $\mu g/m^3$ or more (24-hour average) in a Class I area.

2. Analyses for sources whose Impact Area extends into a Class I area must be conducted with special care because of lower allowable increment values and greater detail required in the Additional Impacts analysis section. Class I areas within the BAAQMD or within 100 km of its boundary are Point Reyes National Wilderness, Pinnacles National Monument, and Ventana National Wilderness.