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June 15, 2021

**VIA ELECTRONIC MAIL**

Members of the City Council
Los Angeles City Council
200 North Spring Street
Los Angeles, CA 90012

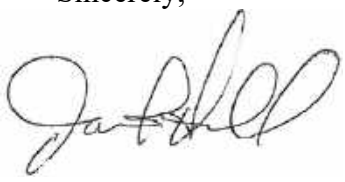
RE: 1309 - 1331 South Pacific Avenue, Case No. CPC-2019-4908-DB-SPR-1A; Environmental No. ENV-2019-4909-CE

Dear Members of the City Council

This firm represents Citizens Protecting San Pedro. Attached please reference materials that were cited or relied upon by the environmental firm SWAPE (which prepared two comments letters in support of the appeal).

I may be contacted at 310-982-1760 or at jamie.hall@channellawgroup.com if you have any questions, comments or concerns.

Sincerely,



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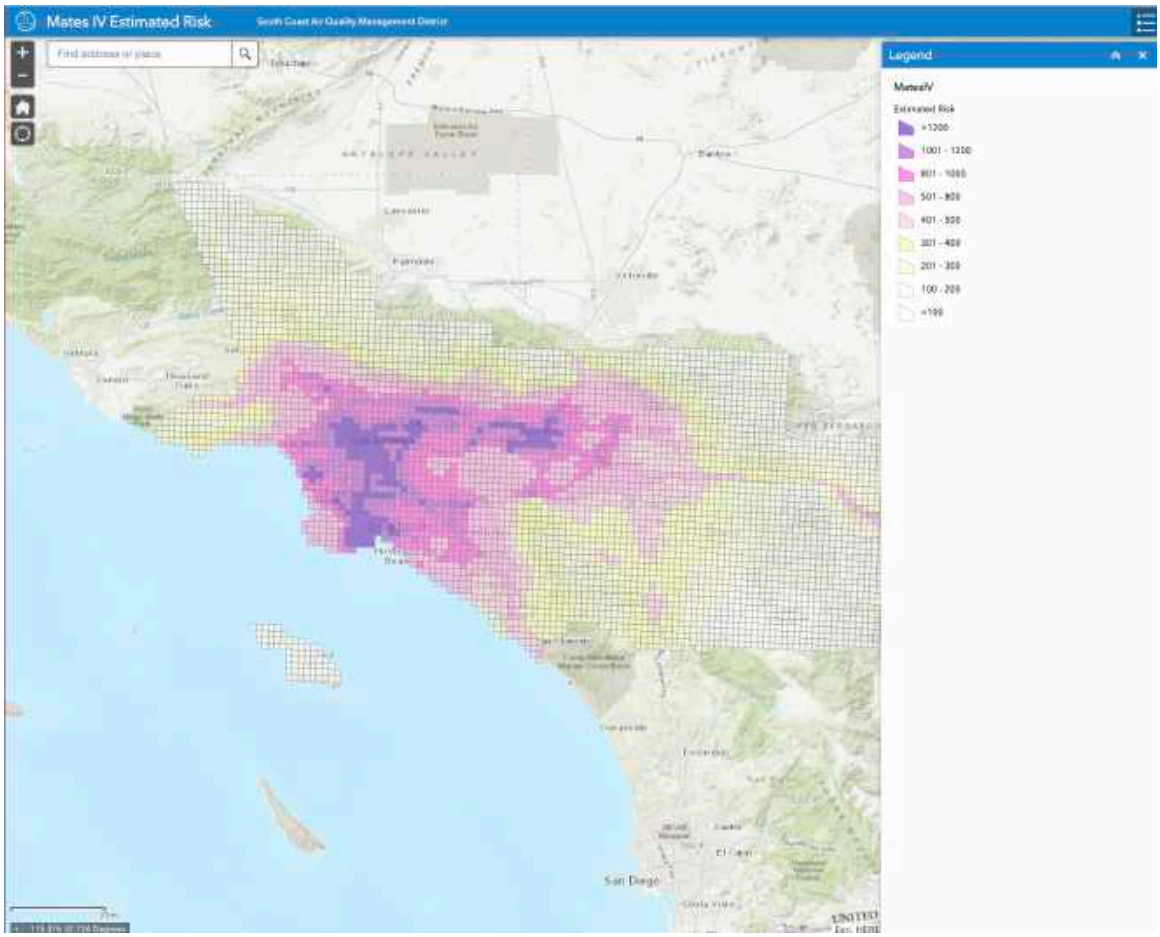
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San Diego

# Health Risk Assessments for Proposed Land Use Projects

CAPCOA Guidance Document

CAPCOA
CALIFORNIA AIR POLLUTION CONTROL OFFICERS ASSOCIATION

Prepared by:
CAPCOA Planning Managers

Approved for Release
July 2009

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## Glossary

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|---|---|
| Acute Hazard Index | Acute Hazard Index is the ratio of the average short term (generally one hour) ambient concentration of an acutely toxic substance(s) divided by the acute reference exposure level set by the Office of Environmental Health Hazard Assessment. If this ratio is above one, then adverse health effects may occur. |
| Background Risk | Background risk is the risk level found throughout an area. This risk is not caused by a particular facility; it is the cumulative risk and may be partly due to air pollution from vehicle traffic. |
| Cancer Risk | Cancer risk is defined as the probability that an individual will contract cancer usually expressed as so many chances per million persons exposed to a specified concentration of carcinogenic substance(s). |
| Chronic Hazard Index | Chronic Hazard Index is the ratio of the average annual ambient concentration of a chronically toxic substance(s) divided by the chronic reference exposure level set by the Office of Environmental Health Hazard Assessment. If this ratio is above one, then adverse health effects may occur. |
| Commenting Agency | A commenting agency is any public agency that comments on a CEQA document, but is neither a lead agency nor a responsible agency. For example, a local air district, as the agency with the responsibility for air pollution control, could review and comment on an air quality analysis in a CEQA document, even though the project was not subject to an air permit or other air pollution control requirements. |
| Cumulative impact | Cumulative impacts represent the risks from all onsite sources and from sources near enough to the project to significantly contribute to the total risk levels. |
| Hot Spots Program | Health and Safety Code §44300-44394, Program which requires existing sources to inventory toxic emissions, prepare risk assessments, notify significantly exposed receptors, and prepare and implement risk reduction plans. |
| Lead Agency | A lead agency is the public agency that has the principal responsibility for carrying out or approving a project that is subject to CEQA. In general, the land use agency is the preferred public agency serving as lead agency, because it has jurisdiction over general land uses. The lead agency is responsible for determining the appropriate environmental document, as well as its preparation. |

| | |
|---|---|
| Receptors | Receptors include sensitive receptors and worker receptors. Sensitive receptors refer to those segments of the population most susceptible to poor air quality (i.e., children, the elderly, and those with pre-existing serious health problems affected by air quality). Land uses where sensitive individuals are most likely to spend time include schools and schoolyards, parks and playgrounds, daycare centers, nursing homes, hospitals, and residential communities (these sensitive land uses may also be referred to as sensitive receptors). Worker receptors refer to employees and locations where people work. |
| Responsible Agency | A responsible agency is a public agency, other than the lead agency, with discretionary approval authority over a project that is subject to CEQA (i.e., project requires a subsequent permit). |
| Risk Assessment | An evaluation that assesses the impact of toxic substances affecting receptors. A risk assessment can include minimal input parameters resulting in conservative results (screening risk assessment) or include increasingly detailed input parameters (refined risk assessment). |
| Source | A source is referred to as the locality where toxic emissions originate and are released into the atmosphere. Sources of emissions are categorized into groups such as point source (e.g., refinery) or line source (e.g., roadway). |
| Type A Project | Land use project that impacts receptors near the project. |
| Type B Project | Land use project with receptors that are impacted by nearby, existing toxics sources. |

# Acronyms

| | |
|---|---|
| ARB: | California Air Resources Board |
| ATCM: | Air Toxic Control Measure |
| CAPCOA: | California Air Pollution Control Officers Association |
| CEQA: | California Environmental Quality Act |
| DPM: | Diesel Particulate Matter |
| EIR: | Environmental Impact Report |
| EPA: | U.S. Environmental Protection Agency |
| HRA: | Health Risk Assessment |
| OEHHA: | California Office of Environmental Health Hazard Assessment |
| PM: | Particulate Matter |
| REL: | Reference Exposure Level |
| TAC: | Toxic Air Contaminant |
| TBACT: | Toxic Best Available Control Technology |

# Executive Summary

This guidance was prepared to assist Lead Agencies in complying with the requirements of the California Environmental Quality Act (CEQA)[1]. CEQA requires environmental impacts of a proposed project be identified, assessed, and avoided or mitigated (as possible) if these impacts are significant. To determine the impact of airborne toxic emissions [i.e., toxic air contaminants (TACs)] for CEQA purposes, health risk assessments must be prepared. This document describes when and how a health risk assessment should be prepared and what to do with the results.

In 2005, the California Air Resources Board (ARB) prepared the ***Air Quality and Land Use Handbook: a Community Health Perspective*** **(ARB Handbook)**[2], to help readers understand the potential cancer risks from some common sources of toxic emissions such as:

- Freeways and High Traffic Volume Roads,
- Goods Distribution Centers,
- Rail Yards,
- Ports,
- Refineries,
- Chrome Platers,
- Dry Cleaners using Perchloroethylene, and
- Gasoline Dispensing Facilities.

The ARB Handbook identified the potential cancer risks at various distances from these sources and recommended buffer distances between those sources and receptors.

Recent air pollution studies have shown an association between respiratory and other non-cancer health effects and proximity to high traffic roadways. Other studies have shown that diesel exhaust and other cancer-causing chemicals emitted from cars and trucks are responsible for much of the overall cancer risk from airborne toxics in California.

While local air districts have ample experience evaluating and mitigating toxic emissions from permitted stationary sources, most have limited experience preparing or reviewing risk assessments associated with multiple toxic sources or assessments for exhaust from mobile sources that are typically found when evaluating health risks to proposed land use projects.

In order to provide consistency to lead agencies, project proponents and the general public throughout the state, the California Air Pollution Control Officers Association (CAPCOA) formed a subcommittee composed of representatives from the Planning Managers Committee and the Toxic Risk Managers Committee to develop guidance on assessing the health risk impacts from and to proposed land use projects. This CAPCOA guidance document focuses on the acute, chronic, and cancer impacts of sources affected by CEQA. It also outlines the

[1] Title 14 California Code of Regulations, Chapter 3. Guidelines for Implementation of the California Environmental Quality Act.

[2] Air Quality and Land Use Handbook: a Community Health Perspective, CARB, April 2005, http://www.arb.ca.gov/ch/handbook.pdf

recommended procedures to identify when a project should undergo further risk evaluation, how to conduct the health risk assessment (HRA), how to engage the public, what to do with the results from the HRA, and what mitigation measures may be appropriate for various land use projects. With respect to health risks associated with locating sensitive land uses in proximity to freeways and other high traffic roadways, HRA modeling may not thoroughly characterize all the health risk associated with nearby exposure to traffic generated pollutants.

This guidance does not include how risk assessments for construction projects should be addressed in CEQA. As this is intended to be a "living document", the risks near construction projects are expected to be included at a later time as the toxic emissions from construction activities are better quantified. State risk assessment policy is likely to change to reflect current science, and therefore this document will need modification as this occurs.

# 1.0 Requirements to Evaluate Health Risks in CEQA

This guidance was prepared to assist Lead Agencies in complying with the requirements of the California Environmental Quality Act (CEQA)[3]. CEQA requires that environmental impacts of proposed projects be identified, assessed, avoided and/or mitigated (as possible) if the environmental impacts are significant.

Section 15126.2(a) requires the following: *"An Environmental Impact Report (EIR) shall identify and focus on the significant environmental effects of the proposed project. In assessing the impact of a proposed project on the environment, the lead agency should normally limit its examination to changes in the existing physical conditions in the affected area as they exist at the time the notice of preparation is published, or where no notice of preparation is published, at the time environmental analysis is commenced. Direct and indirect significant effects of the project on the environment shall be clearly identified and described, giving due consideration to both the short-term and long-term effects. The discussion should include relevant specifics of the area, the resources involved, physical changes, alterations to ecological systems, and changes induced in population distribution, population concentration, the human use of the land (including commercial and residential development), health and safety problems caused by the physical changes, and other aspects of the resource base such as water, historical resources, scenic quality, and public services. The EIR shall also analyze any significant environmental effects the project might cause by bringing development and people into the area affected. For example, an EIR on a subdivision astride an active fault line should identify as a significant effect the seismic hazard to future occupants of the subdivision. The subdivision would have the effect of attracting people to the location and exposing them to the hazards found there."*

This language is included here to clearly show that risk assessments can be required for both projects that will impact nearby receptors (Type A), and projects that will be impacted by nearby sources (Type B).

[3] Pub. Resources Code § 21067; 14 Cal. Code Regs., §§ 15150, 15367.

# 2.0 Overview of the Process

Figure 1 shows an overview of the proposed Health risk Assessment (HRA) process. There are basically two types of land use projects that have the potential to cause long-term public health risk impacts:

**Type A -** Land use projects with toxic emissions that impact receptors, and
**Type B -** Land use project that will place receptors in the vicinity of existing toxics sources.

**Type A** project examples (project impacts receptors):

- combustion related power plants,
- gasoline dispensing facilities,
- asphalt batch plants,
- warehouse distribution centers,
- quarry operations, and
- other stationary sources that emit toxic substances.

**Type B** project examples (project impacted by existing nearby toxic sources):

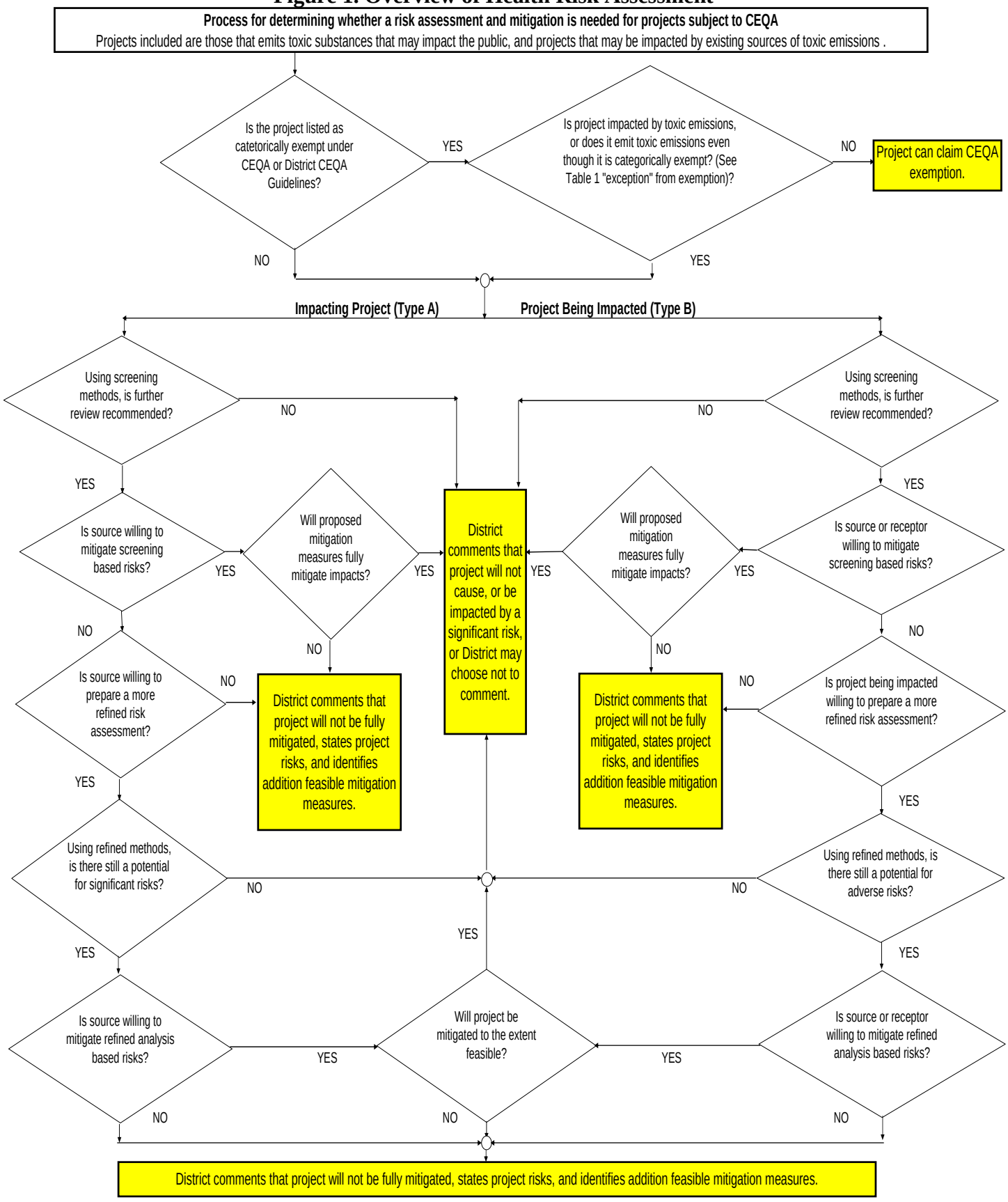
- residential, commercial, and institutional developments proposed to be located in the vicinity of existing toxic emission sources such as:
  - stationary sources,
  - high traffic roads
  - freeways,
  - rail yards, and
  - ports.

The flowchart (Figure 1) shows how to proceed with the CEQA process when either a Type A or Type B related project is proposed. The following summarizes the process for proceeding through the flowchart:

- First determine if the project is categorically exempt from CEQA;
- Next, determine if the project is impacting, or being impacted (Type A or B);
- Using screening methods, calculate acute, chronic, and cancer risk;
- If the screening analysis indicates significant health risk as defined by the lead agency, demonstrate that risks will be mitigated with all feasible measures even though a refined risk assessment may show that less mitigation is needed;
- Or, conduct a refined screening risk assessment; and,
- If the risk continues to be deemed significant by the lead agency even with the refined screening, demonstrate that the risks will be adequately mitigated with feasible measures.

Air districts, in their role as either a responsible agency or a commenting agency, should review the HRA and communicate to the lead agency their evaluation of the risk assessment and whether it is fully described (e.g., methodology, assumptions and resulting risk values) and mitigated with all feasible measures.

## Figure 1. Overview of Health Risk Assessment



# 3.0 Overview of Risk Assessment Methodology and Guidance Documents

This document bases the risk assessment methodology on the procedures developed by the California Office of Environmental Health Hazard Assessment (OEHHA) to meet the mandates of the Air Toxics "Hot Spots" Information and Assessment Act (AB 2588). The Hot Spots program applies to stationary sources and requires affected facilities to prepare a toxic emissions inventory, and if the emissions are significant, that a risk assessment be prepared. The OEHHA procedures can be found at http://www.oehha.ca.gov/air/hot_spots/index.html and describe:

- The toxicity factors associated with various substances,
- How these toxicity factor are to be used to determine the acute, chronic, and cancer risks associated with downwind concentrations of chemicals in the air at various receptors, and
- Dispersion modeling procedures.

# 4.0 CEQA Exemptions

The first step in a risk analysis is to determine if the project is statutorily or categorically exempt from CEQA. There are no exceptions to statutorily exempt projects, however, certain projects that are categorically exempt under the state or air district guidelines, may emit toxic emissions or may be impacted by existing toxic sources. Table 1 shows the exceptions from categorical exemptions where an HRA evaluation is needed. These are situations where a project proponent or lead agency may not rely on a categorical exemption because the health risk may trigger an exception (CEQA §15300.2), preventing their use. In such cases, a negative declaration or environmental impact report should be prepared.

**Table 1**
**Categorical Exemptions Requiring HRA Evaluation[4]**

| Categorical Exemption | Exempt Activity with *Possible Impact* |
|---|---|
| 15301. Existing Facilities | This exemption also allows use of a single-family residence as a day care facility without CEQA review. *However, such uses near existing TAC emissions may warrant further review.* |
| 15302. Replacement or Reconstruction | This exemption allows the replacement or construction of existing schools and hospitals in certain cases without CEQA review. *However, locating new facilities near existing TAC emissions may warrant further review.* |
| 15303. New Construction or Conversion of Small Structures | This exemption class allows small new construction projects to proceed without CEQA review. *However, projects claiming this exemption should be reviewed for possible TAC impacts from ongoing nearby sources.* |
| 15314. Minor Additions to Schools | This exemption class allows small school addition projects to proceed without CEQA review. *However, projects claiming this exemption should be reviewed for possible TAC impacts from ongoing nearby sources.* |
| 15316. Transfer of Ownership of Land in Order to Create Parks | Exemptions in this class should be reviewed for *possible impacts from locating near ongoing sources of TAC.* |
| 15332. In-Fill Development Projects. | This exemption class allows certain in-fill development projects to proceed without CEQA review. *However, projects claiming this exemption should be reviewed for possible TAC impacts from ongoing nearby sources such as high volume roadways and freeways.* |

[4] Although methodology for assessing health risk for construction projects is not included in this document, lead agencies under CEQA are required to identify health risk from construction activities or projects and mitigate if they are deemed significant.

# 5.0 Screening Risk Assessments

Various tools already exist to perform a screening analysis from stationary sources impacting receptors (Type A projects) as developed for the AB2588 Hot Spots and air district permitting programs. Local air districts should be contacted for appropriate screening tools for proposed projects. Screening tools may include: prioritization charts, SCREEN3 and various spreadsheets.

For projects being impacted by existing sources (Type B projects), one screening tool is contained in the ARB Handbook[4]. The handbook includes a table (reproduced in these guidance documents as Table 2) with recommended buffer distances associated with various types of common sources. ARB's Handbook focuses on community health and provides important public health information to land use decision makers. In this document, ARB's primary goal is to provide information that will help keep California's children and other vulnerable populations out of harm's way with respect to nearby sources of air pollution.

For example, as shown in Table 2, ARB recommends avoiding siting new sensitive land uses such as residences, schools, daycare centers, playgrounds, or medical facilities within 500 feet of a freeway, urban roads with traffic volumes exceeding 100,000 vehicles/day, or rural roads with volumes greater than 50,000 vehicles/ day. Therefore, siting a residential project within 500 feet of a freeway, and the associated public health risks, should be disclosed as such in a CEQA document. Re-designing the project so that sensitive receptors are moved greater than 500 feet away from such roadways may mitigate the risk. Other non-sensitive land uses such as commercial uses may be sited in this area. ARB recommends that their guidelines be considered by the decision makers along with housing needs, economic development priorities, and other quality of life issues. It should also be noted that health risk assessments conducted on sensitive land uses in close proximity to freeways and other high traffic roadways may not thoroughly characterize all the health risk associated with nearby exposure to traffic generated pollutants.

**Table 2**
**Recommendations on Siting New Sensitive Land Uses Such As Residences, Schools, Daycare Centers, Playgrounds, or Medical Facilities [5]**

| Source Category | Advisory Recommendations |
|---|---|
| Freeways and high-traffic roads | • Avoid siting new sensitive land uses within 500 feet of a freeway, urban roads with 100,000 vehicles/day, or rural roads with 50,000 vehicles per day. |
| Distribution centers | • Avoid siting new sensitive land uses within 1,000 feet of a distribution center (that accommodates more than 100 trucks per day, more than 40 trucks with operating transport refrigeration units (TRUs) per day, or where TRU unit operations exceed 300 hours per week).<br>• Take into account the configuration of existing distribution centers and avoid locating residences and other new sensitive land uses near entry and exit points. |
| Rail yards | • Avoid siting new sensitive land uses within 1,000 feet of a major service and maintenance rail yard.<br>• Within one mile of a rail yard, consider possible siting limitations and mitigation approaches. |
| Ports | • Avoid siting of new sensitive land uses immediately downwind of ports in the most heavily impacted zones. Consult local air districts or the ARB on the status of pending analyses of health risks. |
| Refineries | • Avoid siting new sensitive land uses immediately downwind of petroleum refineries. Consult with local air districts and other local agencies to determine an appropriate separation. |
| Chrome platers | • Avoid siting new sensitive land uses within 1,000 feet of a chrome plater. |
| Dry cleaners using perchloroethylene | • Avoid siting new sensitive land uses within 300 feet of any dry cleaning operation. For operations with two or more machines, provide 500 feet. For operations with 3 or more machines, consult with the local air district.<br>• Do not site new sensitive land uses in the same building with perc dry cleaning operations. |
| Gasoline dispensing facilities | • Avoid siting new sensitive land uses within 300 feet of a large gas station (defined as a facility with a throughput of 3.6 million gallons per year or greater). A 50 foot separation is recommended for typical gas dispensing facilities. |

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- These recommendations are advisory. Land use agencies have to balance other considerations, including housing and transportation needs, economic development priorities, and other quality of life issues.
- Recommendations are based primarily on data showing that the air pollution exposures addressed here (i.e., localized) can be reduced as much as 80% with the recommended separation.
- The relative risk for these categories varies greatly. To determine the actual risk near a particular facility, a site-specific analysis would be required. Risk from diesel PM will decrease over time as cleaner technology phases in.
- These recommendations are designed to fill a gap where information about existing facilities may not be readily available and are not designed to substitute for more specific information if it exists. The recommended distances take into account other factors in addition to available health risk data (see individual category descriptions).
- Site-specific project design improvements may help reduce air pollution exposures and should also be considered when siting new sensitive land uses.
- This table does not imply that mixed residential and commercial development in general is incompatible. Rather it focuses on known problems like dry cleaners using Perchloroethylene that can be addressed with reasonable preventative actions.
- A summary of the basis for the distance recommendations can be found in the ARB Handbook.

# 6.0 Refined Risk Assessments

If a screening risk assessment shows that a risk is a concern, then a more refined analysis may be prepared. The refined analysis for the project may show lower risks, and provide more accurate information for decision makers. The screening assessment uses more conservative assumptions and thus gives higher risk than refined assessment. Risk assessments are normally prepared in a tiered manner, where progressively more input data is collected to refine the results. These guidelines include the evaluation of both mobile and stationary sources.

Attachment 1 to this document consists of the ***Technical Modeling and Risk Assessment Guidance*** which address various air quality dispersion modeling issues pertinent to California and is based primarily on information found in ARB, EPA and OEHHA guidance.

Appendix A, ***Meteorological Data,*** provides information on preparing meteorological data, mixing height and upper air data and land use characterization.

Appendix B, ***Modeling and Exposure Assessment Input and Output Data,*** is a checklist of parameters designed to provide an overview of all information that should be submitted for a refined air dispersion modeling assessment.

# 7.0 Risk Thresholds

An air district can set CEQA significant risk thresholds (e.g. the excess cancer risk shall be less than ten per million, the acute or chronic hazard index shall be less than one, or other significance levels as arrived at through a public process) that are used on a per-project basis. If the air district's governing board has adopted specific risk thresholds, the lead agency may choose to use them to determine acceptable risk levels. Additionally, clear risk thresholds are helpful when mitigation measures are necessary. The degree of mitigation can be clearly defined when a risk threshold has been determined before a project is proposed.

The absence of a risk threshold does not relieve an agency of its obligation to address toxic emissions from projects under CEQA. The implications of not having a threshold are different depending on the role the agency has under CEQA – whether it is acting as a commenting agency, as a responsible agency, or as a lead agency.

## *7.1 Significant Risk Thresholds - Type A (Impacting Sources)*

For Type A projects, those that generate toxic air contaminants (such as gasoline stations, distribution facilities or asphalt batch plants), air districts are uniform in their recommendation to use the significance thresholds that have been established under each district's "Hot Spots" and permitting programs. For the majority of the air districts the **excess cancer risk** significance threshold is set at **10 in a million**. For toxic air contaminants with acute and chronic, non-carcinogenic health effect, a **hazard index of one** must not be exceeded. Depending on the substances being emitted, a project with a hazard index greater than one could result in adverse health effects of various sorts. It should be noted that a hazard index exceeding one may need additional analysis to determine whether the acceptable level of acute or chronic risk could be higher depending upon the safety factors that were incorporated into the reference exposure levels (RELs) associated with the hazard index results. This additional analysis could be considered an additional refinement tier.

It should be noted that these thresholds may be applied differently for air district permitting, the Hot Spots program, and CEQA. For air district permitting, the thresholds apply only to individual permit units. For the Hot Spots program, the thresholds apply to the entire facility excluding vehicle emissions. Neither the permitting programs nor the Hot Spots program apply to vehicle emissions. For CEQA, the thresholds apply to <u>all</u> facilities including vehicle emissions, and road related emissions.

## *7.2 Significant Risk Thresholds - Type B (Projects Impacted by Existing Sources)*

For Type B projects, those that are impacted by existing sources, air districts are not uniform in their recommendation on what significance threshold should be adopted or what processes should be undertaken when disclosing potential risks.

The CEQA statutes encourage an air district or any lead agency to establish significance thresholds under CEQA for any pollutant. While there are considerations that support the establishment of thresholds, there is no obligation to do so. The absence of a threshold does not relieve agencies of their obligations to address toxic emissions from projects under CEQA. The implications of not having a threshold are different depending on the role the agency has under CEQA – whether it is acting in commenting agency, as a responsible agency, or as a lead agency.

An air district or other lead agency may elect not to establish significance thresholds for a number of reasons.

A lead agency or air district may also determine there is insufficient information to support selecting one specific threshold over another. Air districts have historically recommended CEQA thresholds for air pollutants in the context of the air district's clean air attainment plan, or (in the case of toxic air pollutants) within the framework of a rule or policy that manages risks and exposures due to toxic pollutants.

Significance levels have been approached differently by air districts as enumerated below:

- Thresholds can be based on a specific risk level such that a 10 per million excess cancer risk and an acute and chronic hazard index of one should not be exceeded. These thresholds tend to be consistent with the Hot Spot Program thresholds.
- Thresholds can also be based on the region's existing background cancer risk value if one exists.
    - One option is to establish a risk level equal to a region's background risk level.
    - Another option is to establish a risk level equal to twice a region's background risk level.
    - Still another option is to look at the ambient risk in the immediate vicinity of the project area rather than the regional risk level.
- Case by case thresholds may also be defined.

# 8.0 Mitigation Measures

CEQA requires that adverse environmental impacts of a proposed project be identified, assessed, avoided, and, if deemed significant, mitigated (as feasible) to a level that is considered less than significant. "'Feasible' means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors" (CEQA Guidelines §15364).

In cases where significant adverse impacts are not avoided or substantially lessened, the public agency may approve the project if it first adopts a "statement of overriding considerations." The statement of overriding considerations sets forth the specific reasons why the public agency found the project's benefits outweigh its unavoidable adverse environmental effects (CEQA Guidelines§15043).

In addition to being a CEQA requirement, mitigating public exposure to toxic air pollution is needed to achieve air district goals. All potentially significant emission sources must be mitigated to the greatest extent feasible, including placing people out of harm's way.

Table 3 presents mitigation measures that are currently considered to be feasible to reduce health risk from both Type A and Type B projects. The mitigation measures included in the table are not considered to be exhaustive. The lead agency and project proponents are encouraged to think creatively in devising measures to mitigate air quality impacts. However, the air districts recognize that the final determination of feasibility for a project will be determined by the lead agency. Aside from the mitigation measures shown below, knowing about the regulatory programs to reduce air pollutant emissions through statewide strategies provide information to local air districts and lead agencies to help assess and mitigate cumulative air pollution impacts as well.

## *8.1 Mitigations due to Air Toxic Control Measures*

ARB has been developing Air Toxic Control Measures (ATCMs) for many years. Many of these measures have a phase-in schedule. Implementation of others has already been completed. While cancer and non-cancer risks from the air toxic sources implementing ATCMs are expected to decrease with time, the Office of Environmental Health Hazard Assessment (OEHHA) recommends that it is inappropriate to assume these yet-to-be realized emissions reductions in a health-risk assessment. However, the project proponent is encouraged to become familiar with existing and proposed ATCMs in order to determine if any of the ATCMs affect project-specific emissions.

## *8.2 Mitigating Through Land Use and Design*

To a certain extent, the long-term air quality impact of a project is a function of its design. The layout of streets, the mix of land uses, and the placement of homes and businesses can all affect overall project emissions. Yet in many instances, the air quality impacts of a project are not considered until well after a project has been designed. At such a late stage, it can be very difficult to make any substantial changes to the project to reduce the project's air quality impact.

As indicated throughout the ARB Handbook, land use agencies are strongly encouraged to consult early and often with local air districts. Including air quality considerations during the initial design phase can help an applicant to implement design features that will reduce its air quality impact.

In addition to considering the suitability of the project location, opportunities for mitigation of air pollution impacts through design should be considered. In some cases, control devices and changes in processes may be implemented at the source in order to reduce the risk from toxic air contaminant emissions. Examples of land-use based air quality specific performance standards include the following:

- Placing a process vent away from the direction of nearby receptors, or increasing the stack height so that emissions are dispersed to reduce the emissions impact on the immediate surroundings.
- Limiting the hours of operation of a facility to avoid excess emissions exposure to nearby individuals.
- An ordinance that requires fleet operators to use cleaner vehicles before project approval (if a new business), or when expanding the fleet (if an existing business).
- Providing alternate routes for truck operations that discourage detours into sensitive receptor neighborhoods.

While such measures may reduce the dimensions of a buffer zone, they do not obviate the need to maintain buffer zones to protect public health and safety. This is particularly true in situations where a sensitive receptor is encroaching on an existing source of toxic air contaminant. Also note disclosure statements, community alert procedures, etc., that are targeted at potential receptors are not appropriate mitigations to be used in lieu of buffer zones or technical controls.

Table 3 below contains examples of both project and program-level mitigation measures.

- Project-level mitigation measures are applicable to development which results in the implementation or modification of a land use which creates unacceptable levels of risk. Examples include redesigning the project to locate receptors away from TAC sources, the installation of barriers and/or vegetation and indoor air filtration.

- Program-level mitigation measures, on the other hand, are applicable to long-range community planning such as General Plans, and address land use incompatibility at a much earlier stage. Examples of program-level mitigation measures include rezoning vacant land adjacent to high-volume roadways, ports, railroads or heavy industry to avoid future proposed siting of residential and/or sensitive receptors.

## *8.3 Mitigation Effectiveness*

The mitigation measures identified in Table 3 include both quantifiable and unquantifiable measures.

### 8.3.1 Quantifiable Mitigation Measures

The effect of quantifiable mitigation measures can be modeled or calculated beyond a reasonable doubt. As pertaining to health risk impacts, quantifiable mitigation measures generally result in a measurable reduction of toxic air contaminant emissions (such as DPM), or a measurable decrease in exposure to such emissions through increased buffer distances, reduced exposure durations or control devices having a certified control effectiveness.

Examples of quantifiable mitigation measures include:

- Diesel particulate filters: as of 2008, DPFs reduce the emissions of diesel particulate matter up to 85% as verified by the CARB.
- Increasing the distance between a TAC source and receptor may reduce the receptor's level of exposure to TACs; the effect of this mitigation measure can be estimated through dispersion modeling;
- Idling restrictions can greatly reduce or completely eliminate DPM emissions from stationary trucks; if such restrictions are quantitative and include a concrete limit on the number of minutes a truck (or similar) is allowed to idle, the benefits of this mitigation measure can be modeled.

Several cautionary notes regarding estimating the effectiveness of mitigation measures are warranted:

- Clearly explain the assumptions underlying the environmental document's analysis of mitigation measure effectiveness. The analysis should specifically describe the mitigation measure, identify the source(s) of air pollutants that are expected to be affected by the measure, clearly explain how and to what extent the measure will affect the source(s), and identify the basis for the estimate (empirical observations, computer modeling, case studies, etc.). Critical assumptions should be linked to the mitigation monitoring and reporting program.

- Be specific regarding implementation of mitigation measures. The environmental document should describe each mitigation measure in detail, identify who is responsible for implementing the measure, and clearly explain how and when the measure will be implemented. Methods for assessing the measure's effectiveness once it is in place, and possible triggers for additional mitigation if necessary, may be needed. This level of detail regarding mitigation measure implementation frequently is not addressed until the preparation of the mitigation monitoring and reporting program, which often takes place very late in the environmental review process. In order to reliably assess the effectiveness and feasibility of mitigation

measures, however, air agencies believe it is necessary to consider the specifics of mitigation measure implementation as early in the environmental review process as possible.

- Be sure not to double count the effect of proposed mitigation measures. The project description and assumptions underlying the analysis of project impacts should be carefully considered when estimating the effect of mitigation measures. If certain conditions or behavior are assumed in the impact analysis, then credit may not be claimed when proposing mitigation measures.

- Health risk assessments discussed in this document estimate outdoor risk. While some mitigation measures may reduce risks by filtering outdoor air to be used indoors, they do nothing to reduce the risk assessment values for outdoor air.

### 8.3.2 Unquantifiable Mitigation Measures

In some cases, it simply may not be possible to quantify the effect of proposed mitigation measures. It may be that the specific conditions surrounding a particular project are so unique as to render extrapolation from other examples unreliable. A proposed measure may be innovative, with little precedent. The combined effects of a package of measures may be too difficult to quantify. While a certain degree of professional judgment is usually involved in estimating the effectiveness of mitigation measures, speculative estimates should be avoided. If the project proponent cannot quantify mitigation effectiveness with a reasonable degree of certainty, the environmental document should at least address effectiveness qualitatively. If the lead-agency makes a finding that non-quantified mitigation measures reduce an impact to a level of insignificance, the document should provide a detailed justification of that conclusion.

#### *8.3.2.1 Effects of Vegetation Next to Roadways*

The Sacramento Air District funded a study to measure the removal rates of particulate matter passing through leaves and needles of vegetation. Particles were generated in a wind tunnel and a static chamber and passed through vegetative layers at low wind velocities. Redwood, deodar cedar, live oak, and oleander were tested. The results from this study indicate that all forms of vegetation able to remove 65-85 percent of very fine particles at wind velocities below 1.5 meters per second (roughly 3 miles per hour) with redwood and deodar cedar being the most effective.

This study supports the effectiveness of planting finely needled trees along sources of toxic particulate matter as an air toxics mitigation measure. Though further studies that reflect actual roadway conditions are needed to better quantify the real-world effectiveness of this mitigation measure, projects that propose sensitive receptors adjacent to sources of particulate matter such as freeways, major roadways, rail lines, and rail

yards should consider tiered plantings of redwood and/or deodar cedar in order to reduce toxic exposures.

#### *8.3.2.2 No Idle Zone*

California law currently places restrictions on idling of heavy-duty diesel motor vehicles to reduce health risk impacts from diesel emissions. The 2003 school bus idling airborne toxic control measure (ATCM) requires a driver of a school bus or vehicle, transit bus, or other commercial motor vehicle to manually turn off the bus or vehicle engine upon arriving at a school and to restart no more than 30 seconds before departing. A driver of a school bus or vehicle is subject to the same requirement when operating within 100 feet of a school and is prohibited from idling more than five minutes at each stop beyond schools, such as parking or maintenance facilities, school bus stops, or school activity destinations.

California's more recent anti-idling regulations (with some exemptions) require that drivers of diesel-fueled commercial vehicles weighing more than 10,000 pounds:

- Shall not idle the vehicle's primary diesel engine for greater than 5 minutes at any location,
- Shall not use diesel-fueled auxiliary power units for more than 5 minutes to power a heater, air conditioner, or any ancillary equipment on the vehicle equipped with a sleeper berth, at any location.

Lead agencies may place additional requirements on heavy duty diesel delivery and haul trucks less than 10,000 pounds, and create "no idle" zones at locations where there is a potential for significant health risk. It may not be possible to quantify the emission reductions associated with the creation of a no idling zone. However, this feasible mitigation measure may eliminate idling emissions and may avoid potentially significant health risk impacts.

**Table 3**
**Mitigation Measures**

| Source Category | Mitigation Measure (listed in order of effectiveness by category) |
|---|---|
| Stationary Sources Type A (Sources Impacting receptors) (e.g., Auto body shops, Gas Stations, Manufacturers, Metal Platers, Chemical Producers, Rock Quarries, Incinerators, Power Plants, Diesel Engines) | 1. Move source location to provide effective buffer zone.<br>2. Reduce throughput.<br>3. Install Toxic Best Available Control Technology (TBACT) to reduce the risks to below significance.<br>4. Install other than TBACT air pollution control devices or process operation modifications.<br>5. Address Diesel vehicle engines as listed below. |

| Source Category | Mitigation Measure (listed in order of effectiveness by category) |
|---|---|
| Onsite Diesel Truck Activities (including transport refrigeration units) | Idling Mitigation Measures:<br>1. Move source location to provide effective buffer zone.<br>2. Establish truck parking restrictions.<br>3. Provide utility hook-ups for trucks that need to cool their load.<br>4. Limit truck idling to <5 minutes (State law limits to 5 minutes of idling, and includes various exemptions).<br>5. Require Trucks to operate an Auxiliary Power Unit.<br>6. Require the installation of electrical hookups at loading docks and the connection of trucks equipped with electrical hookups to eliminate the need to operate diesel-powered TRUs at the loading docks.<br>Onsite Truck Traveling Emissions:<br>1. Move source location to provide effective buffer zone.<br>2. Restrict operation to 2007 model year or newer trucks.<br>3. Require or provide incentives to use Diesel Particulate Filters for truck engines.<br>4. Re-route truck traffic by adding alternate access for truck traffic or by restricting truck traffic on certain sensitive routes.<br>5. Improve traffic flow by signal synchronization.<br>6. Implement incentive for improved communications of fluctuating demand forecasts for labor and equipment among carriers and operators. |
| High-traffic road vehicle emissions impacting adjacent receptors | 1. Move receptors or source to provide effective buffer zone between the source and the receptor.<br>2. Improve traffic flow by signal synchronization.<br>3. Plant vegetation between receptor and roadway.<br>4. Construct wall barriers between receptor and roadway.<br>5. Install newer electrostatic filters in adjacent receptor buildings.<br>6. Fund “clean” street sweepers.<br>7. Improve road infrastructure to facilitate improved traffic flow without inducing capacity.<br>8. Improve alternative transportation options |
| Freeway vehicle emissions impacting adjacent receptors | 1. Move receptors or source to provide effective buffer zone between the source and the receptor.<br>2. Plant vegetation between receptor and roadway.<br>3. Construct wall barriers between receptor and roadway.<br>4. Install newer electrostatic filters in adjacent receptor buildings.<br>5. Improve road infrastructure to facilitate improved traffic flow. |
| Marine Vehicles (e.g., recreational boating, commercial marine operations, hoteling operations, loading and unloading services) | 1. Move receptors or source to provide effective buffer zone between the source and the receptor.<br>2. Require or provide incentives to install add-on Diesel Particulate Matter control devices or cleaner engines or boilers.<br>3. Require use of electric power when berthed.<br>4. Require cleaner fuels.<br>5. Limit vessel speed. |

| Source Category | Mitigation Measure (listed in order of effectiveness by category) |
|---|---|
| Railroad (i.e., switch yards, maintenance yards, intermodal centers) | 1. Move receptors or source to provide effective buffer zone between the source and the receptor.<br>2. When ambient temperatures are above 50 deg F, minimize locomotive engine idling by shutting down and re-starting engines.<br>3. Require Idle Reduction Technologies - The rail industry has developed and designed a new Auxiliary Power Unit (APU) system that provides power during idling conditions and shuts down the main locomotive engine. Installing APU system reduces locomotive PM emissions by 84 percent.<br>4. Require new engine technologies be applied to the engines - Modifying fuel injectors, which includes fuel injection pressure, fuel spray pattern, injection rate and timing, has been found to reduce emissions from locomotive diesel engines.<br>5. Require hybrid switcher locomotives.<br>6. Require use of locomotive technology that meets or exceeds the latest EPA emission regulations for locomotives.<br>7. Apply the 1998 Railroad MOU for South Coast Air Basin.<br>8. Apply the 2005 Statewide MOU for Rail Yard Risk Reduction. |

## *8.4 Mitigation Monitoring and Reporting*

### 8.4.1 Primary Mitigation Measures

As part of CEQA environmental review procedures, Pubic Resources Code Section 21081.6 requires a public agency to adopt a monitoring and reporting program for assessing and ensuring efficacy of mitigation measures applied to the proposed project. Specifically, the lead or responsible agency must adopt a reporting or monitoring program for mitigation measures incorporated into a project or imposed as conditions of approval. The program must be designed to ensure compliance during project implementation. As stated in Public Resources Code, Section 21081.6 (a) (1):

*"The public agency shall adopt a reporting or monitoring program for the changes made to the project or conditions of project approval, adopted in order to mitigate or avoid significant effects on the environment. The reporting or monitoring program shall be designed to ensure compliance during project implementation. For those changes which have been required or incorporated into the project at the request of a responsible agency or a public agency having jurisdiction by law over natural resources affected by the project, that agency shall, if so requested by the lead agency or a responsible agency, prepare and submit a proposed reporting or monitoring program."*

This requirement is intended to assure that mitigation measures included as conditions of project approval are indeed implemented. A mitigation monitoring and reporting program should include the following components:

- A description of each mitigation measure adopted by the Lead Agency.
- The party responsible for implementing each mitigation measure.
- A schedule for the implementation of each mitigation measure.
- The agency or entity responsible for monitoring mitigation measure implementation.
- Criteria for assessing whether each measure has been implemented.
- Enforcement mechanism(s).

The mitigation monitoring and reporting program is not required to be included in the environmental document, but its inclusion will encourage the Lead Agency and other entities to specifically consider the feasibility and effectiveness of each mitigation measure while the environmental analysis is still underway. If a responsible agency or any agency having jurisdiction over natural resources affected by the project proposes mitigation measures, the Lead Agency may require that agency to prepare a monitoring and reporting program for those mitigation measures.

### 8.4.2 Contingency Mitigation Measure

A mitigation implemented to reduce health risk for a particular project may degrade or fail over time. Continuous monitoring and enforcement programs are recommended to ensure the ongoing effectiveness of all mitigation measures over the project life. In the instance that one or more mitigation measures fail or become ineffective, they should be replaced with mitigation measures of equal or greater effectiveness.

Examples of health risk mitigation measures subject to degradation and/or failure include:

- Vegetation barriers, which may die due to natural causes or lack of upkeep;
- Particulate filters, which may become clogged, mechanically damaged or simply reach the end of their design life; and,
- Indoor air filtration systems, which may become clogged or fail completely due to lack of regular maintenance.

# 9.0 Public Participation

As emphasized in the ARB Handbook, community involvement is an important part of the overall land use approval process. Public participation is critical when proposed projects could create increased health risk to the individuals or the community. To that extent, engaging community members during the initial phase of the project evaluation process provides a communication conduit between impacted individuals, project proponents and the decision makers. This dialog aims to expand the community's overall understanding of the risk assessment process and the resulting health impact values. While the air district is not typically the lead agency for a project undergoing health risk evaluation, it plays a critical role in working with the impacted community to explain the technical modeling tools and assumptions used to calculate the overall risk values that are ultimately provided to local decision makers for approval action.

Active public participation requires engaging individuals in ways that do not require prior knowledge of air pollution issues impacting their communities. Information should be provided to illustrate how a land use decision can affect the health of the community due to emission impacts from Type A or to Type B projects. Due to the overly technical nature of health risk assessments, air districts need to take specific efforts to develop messages and outreach tools that will assist to convey complex issues to a non-technical community. The outreach process needed to build effective community participation requires data, methodologies and formats customized to the needs of the specific community. Depending on the community characteristics cultural barriers, such as translation to another language, need to be assessed prior to conducting community outreach. More importantly, it requires the strong collaboration of community members and agencies that review and approve projects and land uses of the local community.

The ARB Handbook's Table 7-1, Public Participation Approaches includes some general outreach strategies that air districts might consider in designing an outreach program to increase understanding of the air pollution impacts to specific land use projects. Such a program could consider the preparation and presentation of information in a way that supports sensible decision-making and public involvement. In order to build community trust in the health risk assessments being conducted for proposed development, public participation should occur at the initial phases of project evaluation and continue throughout the approval process.

# 10.0 HRA Issues in the CEQA Process

There are number of issues that have been encountered at the local decision making level that present challenges during the evaluation of health risk impacts from proposed land use projects. To provide more assistance to air districts, lead agencies and community members on how to overcome these challenges, this chapter outlines a few issues that have been encountered during the project evaluation phase, as well as potential solutions to reduce health risk, minimize errors and assist decision makers in their final action.

## *10.1 Smart Growth*

Land use planners, developers, public health agencies and environmentalists alike all struggle with the apparent dichotomy between the public health benefits of limiting development adjacent to freeways and major roadways, and the public health benefits of smart growth strategies which call for development closer in to the urban core, often adjacent to major travel corridors, as a way to reduce overall emissions. Guidance that helps local planners disclose potential risk, and/or seeks to limit development adjacent to freeways and major roadways appears to conflict with smart growth policies, especially when the guidance affects small projects.

A potential solution to this dilemma is the identification and implementation of effective mitigation measures that will help reduce impacts to sensitive receptors, thereby supporting smart growth policies. Table 3 contains program-level TAC mitigation measures. Such measures are applicable to long-range community planning programs such as General Plans and address land use incompatibility at an early stage. These measures are particularly effective in that they can prevent many high-risk projects from being considered or proposed in the first place, thereby eliminating the necessity for project-level mitigation which may not always be feasible or sufficiently effective. Examples of program-level mitigation measures include rezoning vacant land adjacent to freeways, high-volume roadways, ports, railroads or heavy industry to avoid future proposed siting of residential and/or sensitive receptors.

## *10.2 Less than Lifetime Cancer Risk Exposures*

The standard OEHHA 70 year exposure timeframe for HRAs is often vigorously challenged as to whether it is reasonable to base residential cancer risk on a 70 year, 24 hour per day, seven day per week exposure. A 70-year lifetime exposure is a worst-case assumption. Shorter exposure periods can be appropriate depending on the situation. The cancer risks caused by projects impacting offsite workers can be factored in accordance with guidance provide in the State Office of Environmental Health Hazard Assessment provided a document called the *Air Toxic Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments*, August 2003. This guidance document also describes how the exposure period can be reduced from 70 year to shorter periods for Type A projects that will operate for periods less than 70 years. This information is also included in the ***Technical Modeling and Risk Assessment Guidance*** component of this document in Attachment 1.

## *10.3 Mitigating Roadway Toxics*

As discussed above, lead agencies often struggle with requiring mitigation when, due to a lack of a threshold, the roadway toxics impacts are not considered "significant." At other times, lead agencies are eager to require mitigation, but feel most comfortable being able to point to studies that quantify the actual mitigation levels before asking project proponents to bear the additional costs of the mitigation. In addition, lead agencies often do not feel comfortable asking a project to make changes via implementing mitigation when the project complies with existing zoning requirements and does not request exemptions. While this is a contentious issue, districts may choose to suggest mitigation measures regardless of whether a health risk determination was made by the lead agency.

## *10.4 Existing Background Risk*

Often, environmental documents with site specific HRAs contain lengthy discussions comparing a project's health risk to the existing background health risk levels, and often, potential project-specific cancer risk levels are expressed as a percentage of the existing background risk without disclosure of the actual additional risk due to the project. It is the actual additional risk due to the project (Type A), or the risk to the project (Type B) that must be disclosed and compared to CEQA significance thresholds.

## *10.5 Inappropriate Discounting of Risks*

Standardized health risk assessment methodologies have been developed to reduce inconsistencies between HRAs and aid in comparing impacts on receptors. However, in practice inappropriate HRA calculations are still carried out and presented as the basis for public disclosure and notification. Such inappropriate HRA calculations are most often made in an attempt to present reduced risk values compared to the higher results produced by standard methodologies. This is a significant concern, especially with respect to health risks associated with locating sensitive land uses in proximity to freeways and other high traffic roadways, where even the standardized HRA modeling methods may not thoroughly characterize all the health risk associated with nearby exposure to traffic generated pollutants.

Inappropriate HRA methodologies often result in protracted controversy, which is sometimes played out in the public arena - for example, at project approval hearings. To minimize these situations, the HRA preparer should adhere to the standard risk calculation methodologies set forth by OEHHA, the Air Resources Board, and the local air district, and as described in this document.

Examples of some mistakes to avoid are described in the following paragraphs.

- One inappropriate calculation is to calculate the cancer risk using the 70-year exposure timeframe, but then reduce the risk values by dividing the risk values by the number of receptors in the subdivision. Doing so is misleading and not scientifically supported. Potential cancer risk should be expressed as probability per million, based upon OEHHA recommendations.

- For Type A projects, it is also inappropriate to present risk values as a percentage of some existing risk value, such as the existing background risk. Often this is done in an attempt to persuade readers that the project specific risk is of little consequence because the increased risk is small compared to the background risk. In cases where project specific risk is compared to other risks or expressed as a percentage of the existing background, it should be made clear that the project specific risk is in addition to the existing background risk.

- Another inappropriate calculation sometimes included in risk assessments is to base emissions on emission factors that may result from future actions, such as emission reduction rules that have not yet gone into effect, or expected emission reductions due to expected market forces.

## *10.6 Misleading Comparison of Cancer Risks*

Comparing cancer risks can be misleading in a CEQA document. Some CEQA documents discuss a variety of cancers and the prevalence of it in our population. It's sometimes stated, for example, that currently throughout the United States, one in three or four persons will experience cancer sometime during their lifetime. This can be a misleading statistic if it is used to imply that the incremental probability of increased cancer cases due to toxic airborne emissions are very small compared to the overall probability of cancer. For example, a Health Risk Assessment may find that the increased probability of cancer cases is 200 in one million for certain sensitive receptors located near a busy freeway. To compare that HRA result with the overall population's cancer incidence would discount the risk unfairly. The CEQA document should disclose the risk without any such comparisons.

## *10.7 "Experts Disagree"*

When project proponents submit HRAs and related materials that are developed via methodologies not supported by the air district or OEHHA, protracted controversy can result. One air district noted that, despite comment from OEHHA and ongoing district comments on the inappropriate discounting of a project's HRA results, those results remained unchanged in the Final EIR. The Final EIR discussed the nature of the disagreement, citing Section 15151 of the CEQA Guidelines which states that disagreement among experts "does not make an EIR inadequate, but the EIR should summarize the main points of disagreement among experts." Ultimately, the lead agency will make a land use decision based on their understanding. But for sources that need an air district permit, the applicable air district's risk assessment procedures will apply.

# 11.0 Conclusion

The study of the impact of toxic air emissions on sensitive receptors is an evolving one. Air districts in the state of California generally have had a consistent way of performing health risk assessments of stationary sources on nearby sensitive receptors (Type A projects). However, with the publication in 2005 of ARB's Handbook, the issue of the effect of mobile sources on sensitive receptors (Type B projects) required air districts to augment their guidance. This CAPCOA guidance reflects the fact that currently, the various air districts in the state have different approaches to the topic. For example, some districts have developed a threshold of significance for these projects and some have not. Despite these differences, this document offers some common guidance about the need to analyze the impacts, to disclose the risk to decision makers and to mitigate it. As health risk analysis tools, methodology, and protocol as developed, the document will be revised.

**Attachment 1**

# Technical Modeling and Risk Assessment Guidance

Prepared by
CAPCOA Planning Managers
HRA Subcommittee

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# Preface

The document shows how to model emissions of toxic substances from various source types to determine the cancer risk, acute risk, and noncancer chronic risk impacting nearby receptors. It can also be used to determine the impacts to new receptors (such as housing projects) proposed to be built next to existing sources that emit toxic substances. These guidelines were prepared to assist in complying with the requirements of the California Environmental Quality Act (CEQA). CEQA requires that environmental impacts of a proposed project be identified, assessed, and mitigated (as possible) if the environmental impacts are significant.

This document consists of three components:

- Modeling Guidelines,
- Exposure Assessment Guidelines, and
- Appendices describing how to determine the emissions and risks from common source categories. Examples of these sources categories include:
  - Roadways,
  - Facilities with onsite truck travel and idling,
  - Stationary diesel engines, and
  - Fast food and other restaurants.

The modeling guidelines 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. They have been modified to include various air quality dispersion modeling issues pertinent to California, and are based primarily on information found in EPA's Guideline on Air Quality Models (Appendix W of Part 51 of Title 40 of the Code of Federal Regulations). The modeling components are intended to provide insight into recommended modeling approaches and provide consistency in the modeling methods used.

The Exposure Assessment components are based on the procedures developed by the California Office of Environmental Health Hazard Assessment (OEHHA). These calculation methodologies may change over time as the OEHHA refines the methodologies. **It is important that the air district be contacted before any risk assessment calculations are prepared, so that the most current methodologies are applied.**

This document 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 listed as references in this document. This document does provide details on performing a successful modeling study including:

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

## 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 scattered back to space.

**Ambient Air:** Air that is accessible to the public.

**AMS:** American Meteorological Society.

**CAL3QHCR**: CAL3QHCR is derived from CAL3QHC which is also derived from CALINE3. CALINE3 is a Carbon Monoxide (CO) model with queuing, hot spot calculations, and a traffic model to calculate delays and queues that occur at signalized intersections. CAL3QHCR is a more refined version requiring local meteorological data.

**Calm:** Cessation of horizontal wind.

**Complex Terrain:** Terrain exceeding the height of the stack being modeled.

**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.

**Emission Factor:** An estimate of the rate at which a pollutant is released to the atmosphere

**Flagpole Receptor:** Any receptor located above ground level.

| | |
|---|---|
| **Inversion:** | An increase in ambient air temperature with height. This is the opposite of the usual case. |
| **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 flow. 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. |
| **NWS:** | National Weather Service. A U.S. government organization associated with the National Oceanic and Atmosphere Administration. |
| **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. |
| **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 is 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. |
| **Upper Air Data (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. |
| **Worst Case:** | The maximum exposure, dose, or risk that can conceivably happen to specific receptors. |

# Chapter 1. A Tiered Approach to Risk

## 1.0 Modeling and Exposure Assessment Tiers Overview

Risk assessments are normally prepared in a tiered manner, where progressively more input data is collected to refine the results. Both the modeling component and the exposure assessment component are based on a tiered method. This document shows how to:

- Model the downwind concentrations of pollutants using each of the four modeling tiers (levels), then
- Use tiers to prepare the exposure assessment part of the risk assessment.

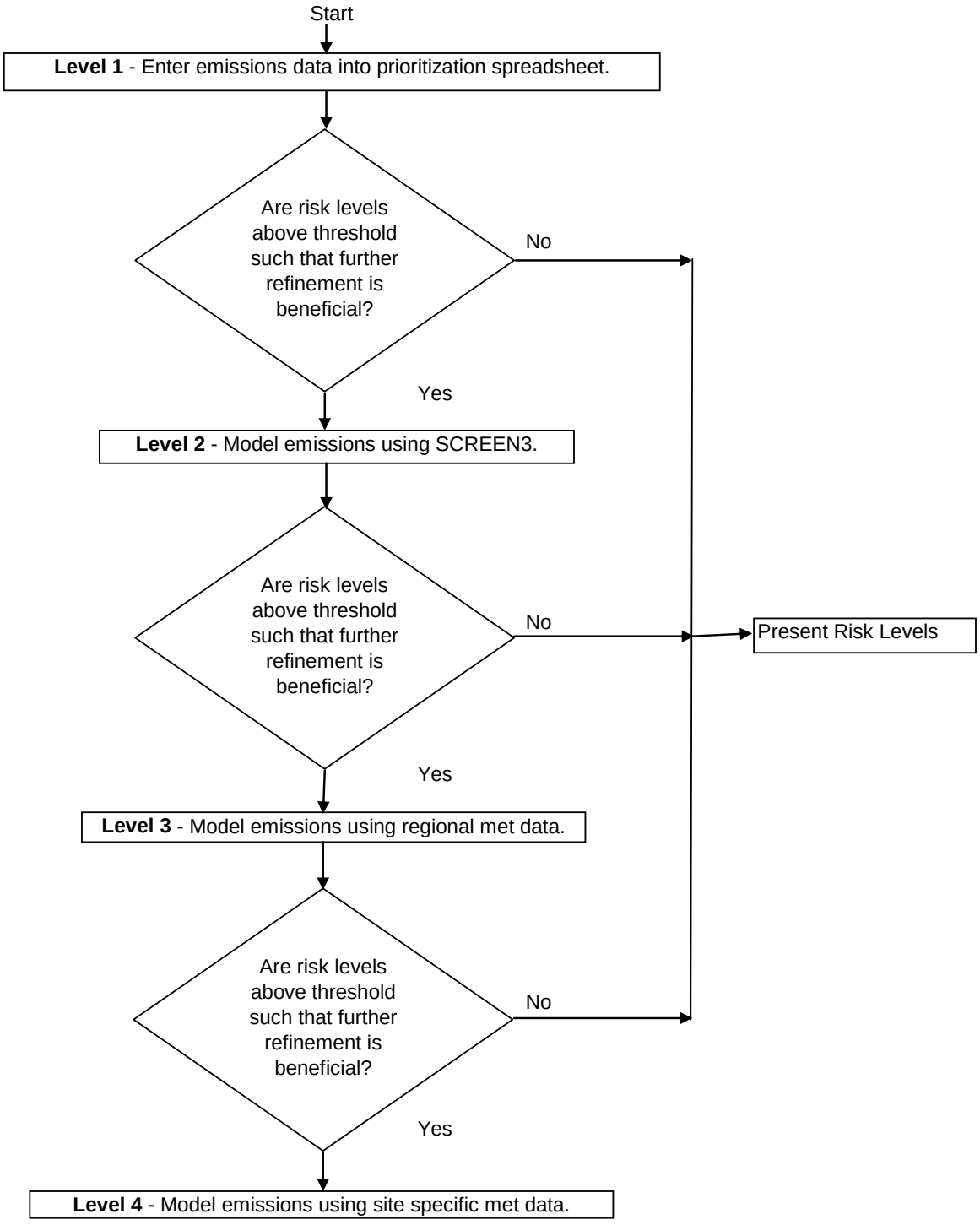
The models described in the document include:

- Screening models:
  - SCREEN3, and
  - AERSCREEN

- Refined models:
  - ISCST3,
  - ISC-PRIME, and
  - AERMOD
  - CAL3QHCR

A tiered approach to air dispersion modeling is presented in Figure 1. The level of effort generally increases with level number. It should be noted that any of the tiers or levels can provide risk assessment results, although the higher the tier or level the more accurate the results. Linear progression through each tier or level is not necessary. For example, a refined modeling analysis can be prepared without first preparing a screening analysis.

**Figure 1 - Tiered approach to modeling for risk assessments:**



## 1.1 Dispersion Models used for each TIER:

### 1.1.1 Level 1 – Prioritization Screening

A Level 1 analysis utilizes the CAPCOA prioritization methodology (http://www.arb.ca.gov/ab2588/RRAP-IWRA/priguide.pdf), or an air district's prioritization procedure to determine the potential impact from a facility's operation based on the quantity of emissions emitted and proximity to a receptor(s) and release height. But before preparing a Level 1 analysis, the air district should be consulted. A prioritization calculation is a screening tool that identifies whether a source has the possibility to exceed a prioritization score that represents the need for further analysis, usually this level is a score of ten

The following input data must be included in a prioritization calculation:

- The nearest receptor (residential or offsite worksite) must be used to represent all other receptors; regardless of the location of the receptor to the proposed project.
- Emissions should represent the "worst case" emissions estimate. Worst case for cancer risk is based on 70 years of exposure. Worst case for acute adverse health effects is based on the hour with the highest emissions. Worst case for chronic adverse health effects is based on the annual average emissions. These emissions should be based on actual expected worst case emissions, rather than a theoretical potential to emit estimate. The emissions should be routine and predictable.
- The prioritization calculations must follow those in the CAPCOA Prioritization Guidelines or the district's prioritization guidelines.

### 1.1.2 Level 2 - SCREEN3 Modeling

A Level 2 analysis is a screening level analysis using the U.S. EPA's SCREEN3 model, which includes all potential worst-case meteorological conditions. If a risk assessment based on SCREEN3 modeling shows risks below significance thresholds, then there is no need for additional modeling.

**Note:** At the time of writing this document, AERSCREEN remains unavailable and is currently in development. When AERSCREEN becomes available, it may be substituted for SCREEN3 in the multi-tier approach.

### 1.1.3 Level 3 – CAL3QHCR, ISCST3, or AERMOD modeling using Regional Met Data

A Level 3 analysis is a more refined analysis using CAL3QHCR, ISCST3, or AERMOD and regional hourly meteorological data. Contact the District regarding the availability of preprocessed meteorological data sets.

### 1.1.4 Level 4 - CAL3QHCR, ISCST3 or AERMOD Modeling using Site Specific Met Data

A Level 4 analysis is a more refined analysis using CAL3QHCR, ISCST3, or AERMOD and site specific hourly meteorological data. Contact the District regarding the availability of preprocessed meteorological data sets. This data typically must be pre-processed by the modeler or a meteorological data provider such as the National Weather Service (NWS). Local 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. A Level 4 analysis also encompasses modeling analyses that make use of any alternative models.

## 1.2 Exposure Assessment Tiers

When substances are emitted that can affect intake pathways other than inhalation, the use of the latest version of the Hot Spots Analysis and Reporting Program (HARP) modeling and risk assessment software is recommended. The latest version of HARP can be downloaded at http://www.arb.ca.gov/toxics/harp/harp.htm. If the emissions consist of only substances that enter the body through the inhalation pathway, other risk assessment methodologies consistent with the methodologies approved for the Air Toxics "Hot Spots" Emissions Inventory and Risk Assessment Program can be used. Most substances enter the body only through the inhalation pathway. Ingestion, dermal absorption, and other pathways are not usually significant pathways for emitted gases. Therefore, if all the substances impacting receptors only enter the body through inhalation, then the risk assessment preparation effort can be minimized. If just one substance can enter the body through another pathway, then a multipathway analysis must be prepared. An exception to this is diesel particulate, which is modeled only through the inhalation pathway.

The toxicity values that are used must be those that the California Office of Environmental Health Hazard Assessment (OEHHA) has identified. These toxicity values can be found at (http://www.arb.ca.gov/toxics/healthval/healthval.htm). If a substance is emitted and toxicity values have not been identified by OEHHA, other sources of data can be applied.

Although more detailed information can be found by directly reviewing the latest OEHHA risk assessment procedures, what follows is a description of the tiers associated with a multipathway exposure assessment. Additional information can be found at ARB's HARP websites and OEHHA's websites.

There are four basic tiers or levels that can be applied in the exposure assessment portion of the risk assessment:

**Tier 1 -Point Estimate, Default Intake Values**
The easiest tier to complete assumes various intake default values, and calculates the risk as a single value rather than a distribution curve.

**Tier 2 -Point Estimate, Site Specific Intake Values**
The next tier requires site specific information to determine intake values, but continues to apply single intake values to the risk values.

**Tier 3 -Distribution Curve Risk Estimate, Default Distribution Curve Intake Values**
The third tier applies default distribution curve values to determine a distribution curve risk result.

**Tier 4 -Distribution Curve Risk Estimate, Site Specific Distribution Curve Intake Values**

The fourth tier applies site specific distribution curve values to determine a distribution curve risk result.

## 1.3 Exposure Duration Adjustment (Cancer Only)

Cancer risk calculations are based on a 70 year lifetime exposure. In some limited cases, it may be appropriate to also use either 9 or 40 years exposure in the calculation. The 9 year exposure scenario is based on exposure to children during the first 9 years of life. Some districts use the 9 year exposure scenario to model short term projects The 40 year exposure scenario can be used to represent the risk to nearby workers. The local district should be contacted before using any exposure duration less than 70 years. In no case should an exposure period of less than 9 years be used.

# Chapter 2. Application of Models

## 2.0 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, but not limited to meteorological conditions, site configuration, emission release characteristics, and surrounding terrain.

## 2.1 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 2.3. The U.S. EPA's preferred models include SCREEN3 for screening analyses and AERMOD for refined modeling analyses. For CEQA, CAL3QHCR, ISCST, and ISC-PRIME may also be used.

For efficient risk assessment processing, the district should be consulted to determine the appropriateness of the model proposed for use. A brief overview of each of these models can be found below. For appropriate model selection, please review the section that outlines:

### 2.1.1 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

[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 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.

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:

- Enhanced plume dispersion coefficients due to the turbulent wake.
- 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 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.

### 2.1.2 ISCST3 & 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].

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[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.

[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.

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 that 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 the Building Profile Input Program (BPIP). For more information on building downwash please refer to Section 3.8 - 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 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 gridded and/or discrete receptors in a Cartesian or polar coordinate system.
- 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.

[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.

## 2.1.3 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.
- 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.

## 2.1.4 CAL3QHCR Overview

"CAL3QHCR is a refined version of the original CALINE (California Line Source Dispersion Model) that was developed as a modeling tool to predict roadside CO concentrations. CAL3QHCR can be used to estimate ambient PM concentrations and to process hourly meteorological data over a year, hourly emissions, traffic volume, and signal data. The model can be obtained from EPA at http://www.epa.gov/scram001/dispersion_prefrec.htm.

[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.

## 2.2 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 – 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 |

## 2.3 Alternative Models

Alternative models may also be accepted to determine health risks for CEQA projects. Please see the Guideline on Air Quality Models (published as Appendix W of 40 CFR Part 51) for terms of appropriate use and required supporting explanations. **Please note,** pre-approval is normally sought from the district before using alternative models.

## 2.4 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.

# Chapter 3. MODEL INPUT DATA

## 3.0 Comparison of Screening and Refined Model Requirements

The use of the screen model requires the least amount of effort to calculate risks but produces the most conservative results. The SCREEN3 model input requirements are described in the next 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 3.2 and 3.3.

A general overview of the process typically followed for performing an air dispersion modeling assessment is present in Figure 3.1 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.

[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.

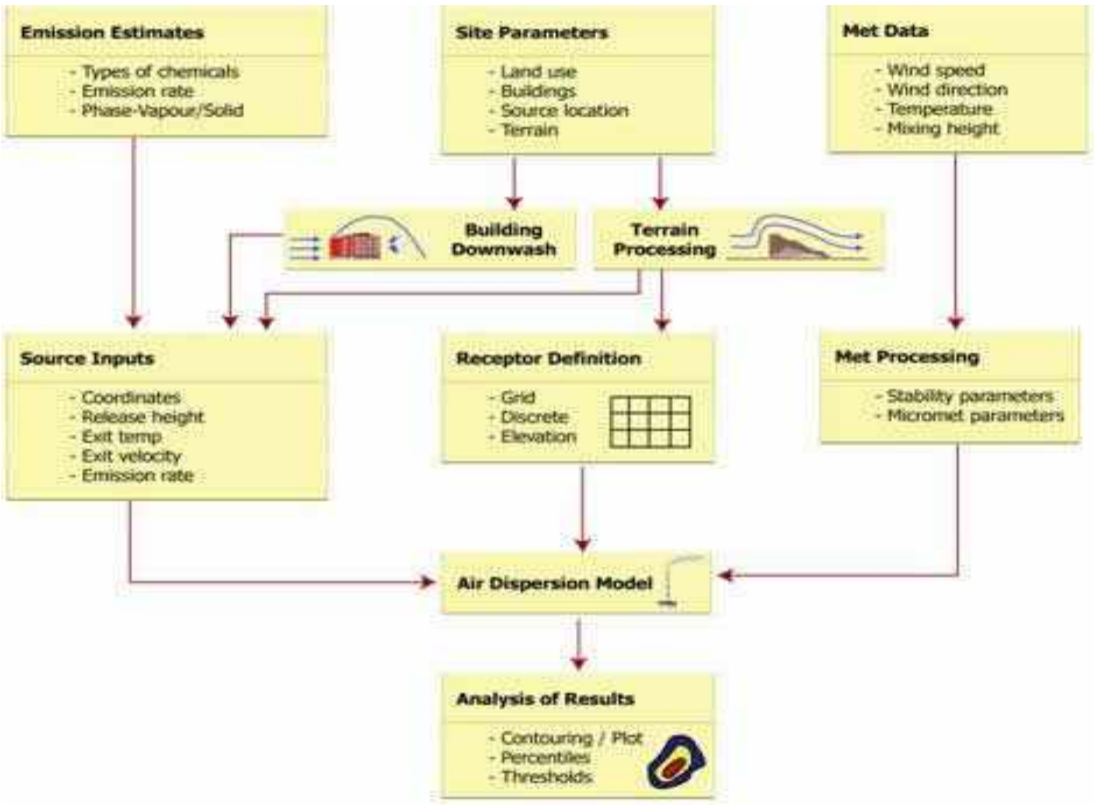


**Figure 3.1 - Generalized process for performing a refined air dispersion modeling assessment.**

## 3.1 SCREEN3

The SCREEN model[13] was developed to provide an easy-to-use method of obtaining pollutant concentration estimates. 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.

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

[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.

    - Receptor Height Above Ground
- Meteorology: SCREEN3 can consider all conditions, or a specific stability class and wind speed can be provided.
    - If a single wind speed/stability combination is used, the predicted concentration should only be used to determine hourly concentration, as the factors used to convert hourly concentration to annual concentrations are only valid when SCREEN3 is ran with full meteorological data selected.
- Building Downwash: If this option is used then building dimensions (height, length and width) must be specified.
- Terrain: SCREEN3 supports 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. The refined models discussed in the next sections, have much more detailed options allowing for greater characterization and more representative results.

## 3.2 AERMOD

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 is used for this)
- Obtain Digital Terrain Elevation Data (If terrain is being considered)
- Building Downwash Analysis (BPIP-PRIME is used for this) – 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.

[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.

As can be seen above, the AERMOD modeling system is comprised of 3 primary components as outlined below and illustrated in Figure 3.2:

- AERMET – Meteorological Data Preprocessor
- AERMAP – Digital Terrain Preprocessor
- AERMOD – Air dispersion model

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

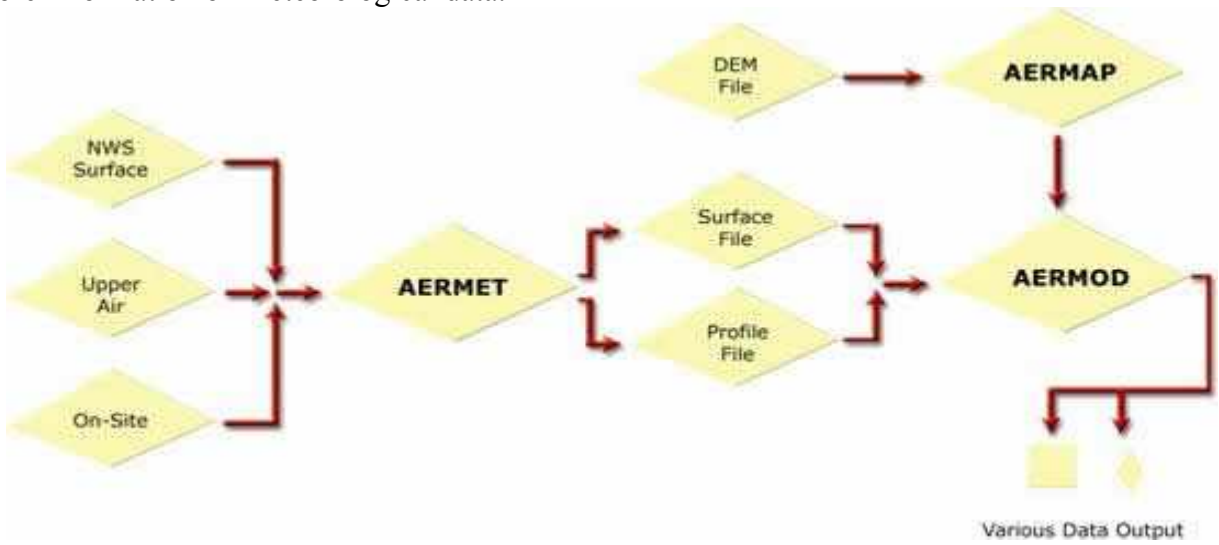


**Figure 3.2 - The AERMOD air dispersion modeling system.**

## 3.3 ISC-PRIME

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 between running the 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 3.3 below. For a complete outline on how to obtain meteorological data, please see Appendix A.

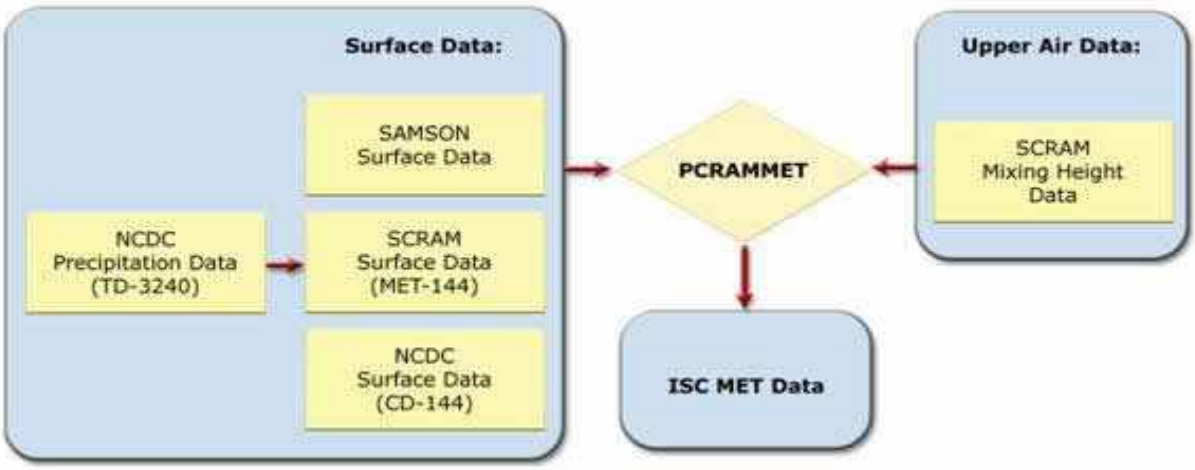


**Figure 3.3 - Meteorological data pre-processing flow diagram for the U.S. EPA ISC models**

## 3.4 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 before performing any modeling runs. Regulatory models that account for elevated terrain should be used when appropriate.

## 3.5 Coordinate System

Any modeling assessment will require a coordinate system to 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 about 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 6.

## 3.6 Averaging Times

A key advantage to the more refined air dispersion models is the ability to compare effects-based standards with appropriate averaging times. OEHHA assigns different exposure periods to different health effects. For example, cancer risks are assessed for "lifetime" exposure. Chronic noncancer health effects are calculated for long-term, but not necessarily lifetime exposures. Acute noncancer health effects are usually based on a maximum 1-hour exposure, but there are some exceptions, such as benzene which is based on a maximum 6 hour exposure. Use of effects-based averaging times enables a contaminant to be assessed using modeled exposure concentrations for the appropriate averaging period for that contaminant and endpoint.

In addition to enabling the use of appropriate model averaging times, refined models allow the input of variable emission rates, where appropriate, for assessing concentrations over different averaging times. That is, a source that operates only during certain hours of the day can be modeled using only those hours of meteorology data.

The ability to assess air quality using the most 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.

## 3.7 Defining Sources

### 3.7.1 Point, Area, Volume, and Flare Emissions Release Parameters Required for each Model

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].

[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.

### 3.7.1.1 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** [g/sec]: The emission rate of the pollutant.
- **Stack Height** [m]: The stack height above ground.
- **Stack Inside Diameter** [m]: The inner diameter of the stack.
- **Stack Gas Exit Velocity** [m/s] or Stack Gas Exit Flow Rate [m3/s]: 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:

  **$V_s = 4*V/(\pi*(d_s\text{^}2))$**

  Where,

  $V_s$ = Exit Velocity
  V = Flow Rate
  $d_s$ = Stack Inside Diameter

- **Stack Gas Temperature** [K]: The temperature of the released gas in degrees Kelvin.
- **Ambient Air Temperature** [K]: 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.

## 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** [m]: The source base elevation. The model only uses the source base elevation if Elevated terrain is being used.
- **Release Height above Ground** [m]: The source release height above the ground in meters.
- **Emission Rate** [g/sec]: The emission rate of the pollutant in grams per second. Stack Gas Exit Temperature [K]: The temperature of the released gas in degrees Kelvin.
- **Stack Gas Exit Velocity** [g/sec]: The stack gas exit velocity in meters per second or the stack gas flow rate (see above section on SCREEN3).
- **Stack Inside Diameter** [m]: The inner diameter of the stack.

### 3.7.1.2 Area Sources

Area sources are used to model releases that occur over an area (e.g., landfills, storage piles, slag dumps, and lagoons). SCREEN3 allows definition of a rectangular area, aligned with the north-

south axes, while the ISC-PRIME and AERMOD models accept rectangular areas that may also have a rotational angle specified relative to a north-south orientation, as well as a variety of other shapes.

## SCREEN3

- **Emission Rate** [g/(s-m$^2$)]: 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** [m]: The source release height above ground.
- **Longer Side Length of Rectangular Area** [m]: The longer side of the rectangular source in meters.
- **Shorter Side Length of Rectangular Area** [m]: The shorter side of the rectangular source in meters.
- **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** [m]: 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 or square. 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 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).

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[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.

[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.

**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.

## 3.7.1.3 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** [g/sec]: The emission rate of the pollutant in grams per second (g/s).
- **Source Release Height** [m]: The source release height above ground surface at the center of the volume.
- **Initial Lateral Dimension** [m]: See Table 3.1 below for guidance on determining initial dimensions. Units are meters.
- **Initial Vertical Dimension** [m]: See Table 3.1 below for guidance on determining initial dimensions. Units are meters.

**Table 3.1 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<br>(Represented by Adjacent Volume Sources) | $S_{yo}$ = (side length)/2.15 |
| Line Source<br>(Represented by Separated Volume Sources) | $S_{yo}$ = (center to center distance)/2.15 |
| **Initial Vertical Dimension** | |
| Surface-Based Source<br>($h_e \sim 0$) | $S_{zo}$ = (vertical dimension of source)/2.15 |
| Elevated Source<br>($h_e > 0$) on or Adjacent to a Building | $S_{zo}$ = (building height)/2.15 |
| Elevated Source<br>($h_e > 0$) 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** [m]: 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 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** [m]: 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) [m]: 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 3.1 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 3.1 above. This table provides guidance on determining initial dimensions. Units are in meters.

### 3.7.2 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 creations 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 a separate source group to determine the maximum concentration generated by each individual source.

### 3.7.3 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 to account for the special characteristics of such scenarios.

### 3.7.3.1 Multiple Stacks

When the plumes from multiple closely spaced stacks or flues merge, the plume rise can be enhanced. Briggs[25] 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.

### 3.7.3.2 Horizontal Sources and Rain Caps

This section is intended to provide guidance for modeling a stack with a rain cap that is located on top of a building.

When emissions are released through a stack with a rain cap, the rain cap redirects the vertical release into a horizontal release, as shown in Figure 3.4.

The presence of a rain cap or any obstacle at the top of the stack hinders the momentum of the exiting gas. Therefore, assuming that the gas exit velocity would be the same as the velocity in a stack without an obstacle is an improper assumption. The extent of the effect is a function of the distance from the stack exit to the obstruction and of the dimensions and shape of the obstruction.

On the conservative side, the stack could be modeled as having a non-zero, but negligible exiting velocity, effectively eliminating any momentum rise. Such an approach would result in final plume heights closer to the ground and therefore higher concentrations nearby.

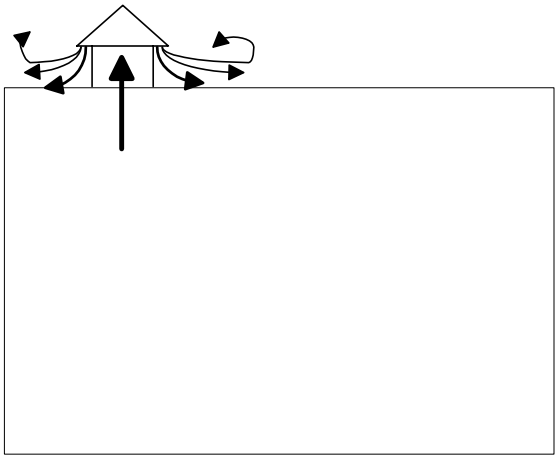

**Figure 3.4**

Plume buoyancy is not strongly reduced by the occurrence of a rain cap. Therefore if the plume rise is dominated by buoyancy, it is not necessary to adjust the stack conditions. (The air dispersion models determine plume rise by either buoyancy or momentum, whichever is greater.)

The stack conditions should be modified when the plume rise is dominated by momentum and in the presence of a rain cap or a horizontal stack. Sensitivity studies with the SCREEN3 model, on a case-by-case basis, can be used to determine whether plume rise is dominated by buoyancy or momentum. The District should be consulted before applying these procedures.

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

- Set exit velocity to 0.001 m/sec
- Turn stack tip downwash off
- Reduce stack height by 3 times the stack diameter

Stack tip downwash is a function of stack diameter, exit velocity, and wind speed. The maximum stack tip downwash is limited to three times the stack diameter in the ISC3 air dispersion model. In the event of a horizontal stack, stack tip downwash should be turned off and no stack height adjustments should be made.

Note: This approach may not be valid for large (several meter) diameter stacks.

An alternative, more refined, approach could be considered for stack gas temperatures which are slightly above ambient (e.g., ten to twenty degrees Fahrenheit above ambient). In this approach, the buoyancy and the volume of the plume remains constant and the momentum is minimized.

- Turn stack tip downwash off
- Reduce stack height by 3 times the stack diameter ($3D_o$)
- Set the stack diameter ($D_b$) to a large value (e.g., 10 meters)
- Set the stack velocity to $V_b = V_o (D_o/D_b)^2$

Where:

$V_o$ and $D_o$ are the original stack velocity and diameter, and
$V_b$ and $D_b$ are the alternative stack velocity and diameter for constant buoyancy.

This approach is advantageous when $D_b >> D_o$ and $V_b << V_o$ and should only be used with District approval.

Reference: Technical Support Document for Exposure and Stochastic Analysis, Office of Environmental Health Hazard Assessment, September 2000, p. 2-39 and p. 2-40.

## 3.7.3.3 Modeling Bay Door or Window Openings (Volume Source)

This section is intended to provide guidance for modeling openings such as doors and windows as a volume source. When determining how to model an opening, first determine how the emissions are being released from the opening. If a profile of the emissions (% of substance and heat at different levels) is not provided, then assume that emissions are being released 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. Thus the release from the opening resembles a volume source where the height is the height of the opening, and the width is the width of the opening, and length is also the width of the opening. Volume source modeling requires the width and length to be equal.

Based on these assumptions, 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, see Figure 3.5.

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.

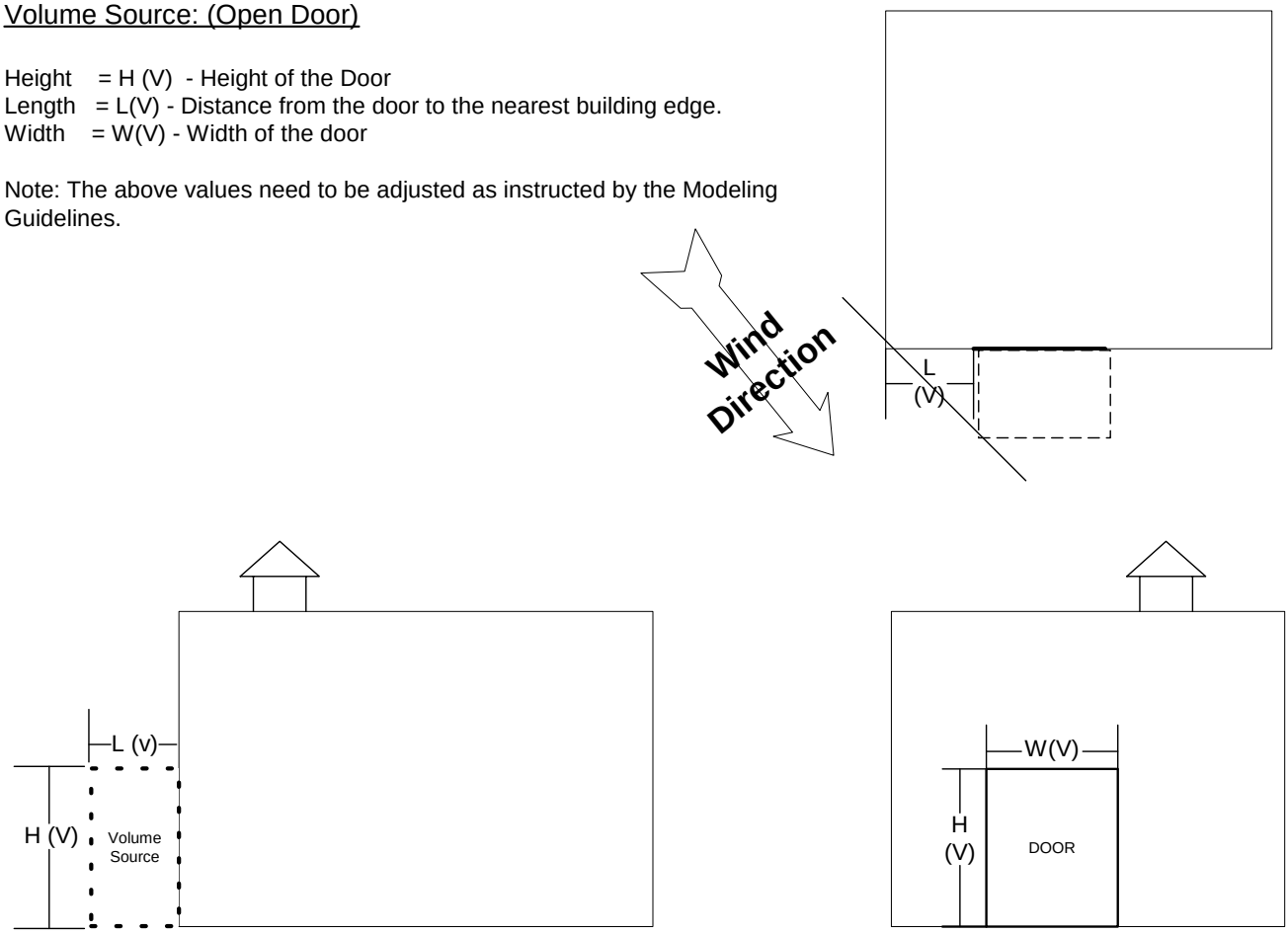


**Figure 3.5**

## 3.7.3.4 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. Additionally, a floating roof tanks can be modeled as a circle (polygon) area source representing the diameter of the tank with a height of the tank.

**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 3.2 - Stack parameter values for modeling tanks**

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

## 3.7.4 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 across many different periods including hourly, daily, monthly and seasonally. For risk assessments, only the annual average or the maximum hourly emission rates are to be modeled. If a variable emission rate is to be used, the District must be consulted.

## 3.7.4.1 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.

## 3.7.4.2 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, and week

### 3.7.4.3 Plant Shutdowns and Start-Ups

Plant start-ups and shutdowns can occur due to maintenance, designated vacation periods, or upset conditions. Emissions during shutdown and startup are usually higher than during normal operation. Process upsets or control equipment breakdowns can also increase emissions. Such upsets can result in the release of uncontrolled emissions. The ISC and AERMOD models allow the use of variable emission rates for hours of the day, day of the week, and season of the year. The example below illustrates the use of this feature to model emissions that vary by the time of the day.

**Example:**
Assume that a gas turbine operates 14 hours per day (1 startup, 1 shutdown, and 12 hours of normal operation

**Given:**
Emission Rate = 1 g/s (emissions rate during normal operation)
Operation Schedule = 6 AM – 8PM
Startup/Shutdown Emissions are twice that of normal operating emissions

The model will adjust the emissions rate using the data found in the table below:

**Calculation**:
Modeled Emissions Rate * Emission Rate Adjustment Factor

Emissions Rate for 1 AM – 6 AM = 1 g/s * 0 = 0 g/s
Emissions Rate for 6 AM – 7 AM = 1 g/s * 2 = 2 g/s
Emissions Rate for 7 AM – 7 PM = 1 g/s * 1 = 1 g/s
Emissions Rate for 7 PM – 8 PM = 1 g/s * 2 = 2 g/s

**Non-Continuous Emissions (Hours of Day):**

| Morning Hours | | Afternoon Hours | |
|---|---|---|---|
| **Hour of the Day** | **Emissions Rate Adjustment Factor** | **Hour of the Day** | **Emissions Rate Adjustment Factor** |
| 1:00 am | 0 | 1:00 pm | 1 |
| 2:00 am | 0 | 2:00 pm | 1 |
| 3:00 am | 0 | 3:00 pm | 1 |
| 4:00 am | 0 | 4:00 pm | 1 |
| 5:00 am | 0 | 5:00 pm | 1 |
| 6:00 am | 2 | 6:00 pm | 1 |
| 7:00 am | 1 | 7:00 pm | 2 |
| 8:00 am | 1 | 8:00 pm | 0 |
| 9:00 am | 1 | 9:00 pm | 0 |
| 10:00 am | 1 | 10:00 pm | 0 |
| 11:00 am | 1 | 11:00 pm | 0 |
| Noon | 1 | Midnight | 0 |

### 3.7.4.4 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:

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

## 3.8 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 3.6).

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.

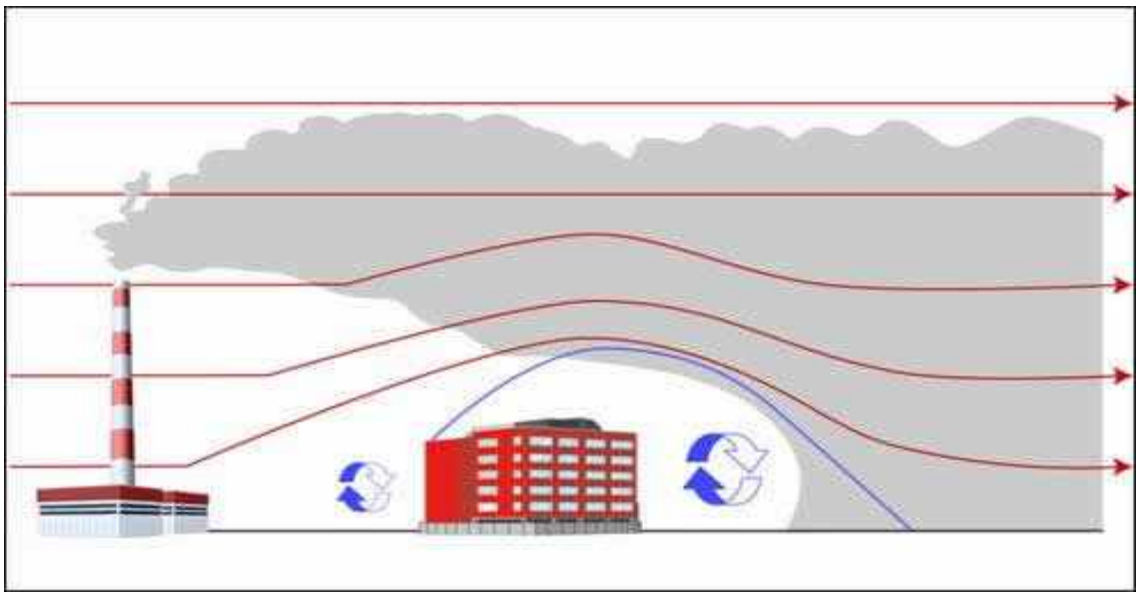

**Figure 3.6 - The building downwash concept where the presence of buildings forms localized turbulent zones that can readily force pollutants down to ground level.**

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

The U.S. EPA[26] 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**

[26] 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.

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 below. 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 3.7 and Figure 3.8.

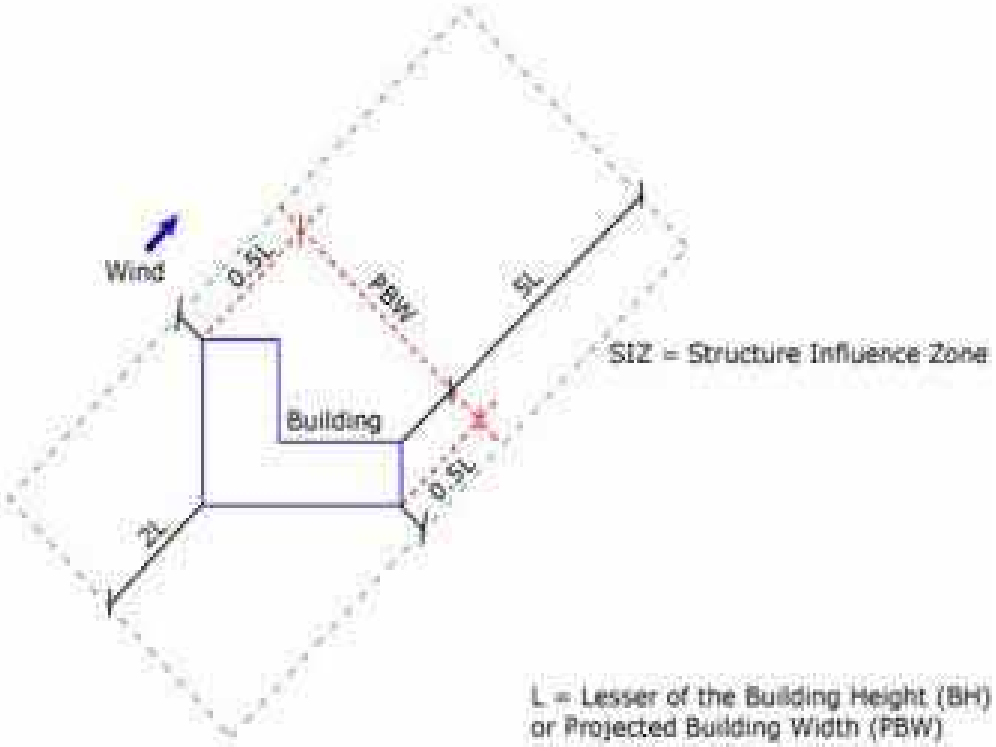


**Figure 3.7 - GEP 5L and Structure Influence Zone (SIZ) Areas of Influence**

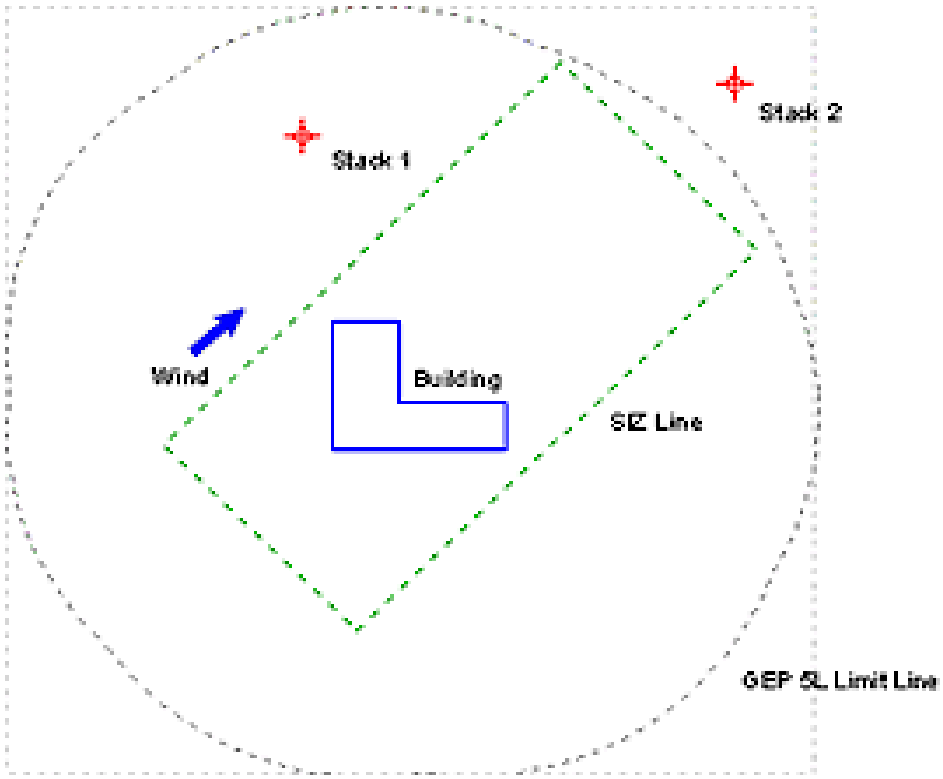


**Figure 3.8 -GEP 360° 5L and Structure Influence Zone (SIZ) Areas of Influence**

## 3.8.2 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.

### 3.8.2.1 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[27].

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[32] Section 3.6 for more details).

### 3.8.2.2 AERMOD and ISC-PRIME Building Definition

The inclusion of the PRIME (Plume Rise Model Enhancements) algorithm[28] to compute building downwash has produced more accurate results in air dispersion models. Unlike the earlier algorithms used in ISC3, the PRIME algorithm:

[27] 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.

[28] 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.

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

Refined models allow for the consideration of downwash effects from multiple buildings. AERMOD and ISCST3/ISC-PRIME require building downwash analysis to first be performed using BPIP-PRIME[28]. 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:

- 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[29] 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[30], 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 Tickvart[31,32] and Lee[33]. 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.

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[29] 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.

[30] 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.

[31] Tickvart, J. A., May 11, 1988. Stack-Structure Relationships, Memorandum to Richard L. Daye, U.S. EPA.

[32] Tickvart, J. A., June 28, 1989. Clarification of Stack-Structure Relationships, Memorandum to Regional Modeling Contacts, Regions I-X, U.S. EPA.

[33] 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.

- 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[34].

## 3.9 Multiple Pollutants

## 3.9.1 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 requires 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.

### 3.9.1.1 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.

- Dispersion modeling should be conducted as outlined in this guidance document using a unit (normalized) emissions rate of 1 g/s, or 1/g/s/$m^2$ for area sources.
- All chemical analysis / risk calculations should be processed through the CARB HARP program http://www.arb.ca.gov/toxics/harp/harp.htm.
- Exceptions (Must be given prior approval by the district):
  - Analysis of multiple pollutants that only affect one acute toxicological endpoint or the same endpoints.
  - Analyses of multiple pollutants that only affect one chronic toxicological endpoint or the same endpoint and do not have a chronic oral value.
  - Analysis of multiple pollutants that are not multi-pathway (only inhalation)
    - One dispersion modeling run for

[34] 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.

- Acute Hazard Index,
- Chronic Hazard Index, and
- Cancer Risk.

## 3.9.2 Unitized (Normalized) 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 vary linearly with their source release rate. Figure 3.9 helps visualize this concept, by describing an emission rate of 1 g/s.

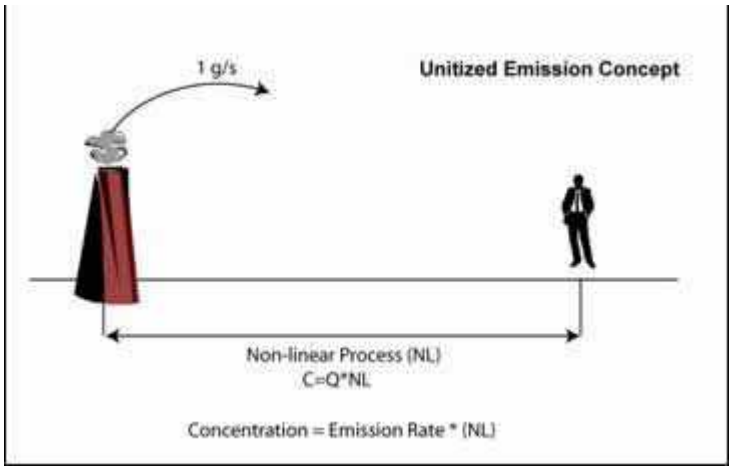



**Figure 3.9 - Unitized Emission Rate Concept (1 g/s)**

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 3.10 depicts the Summation concept.

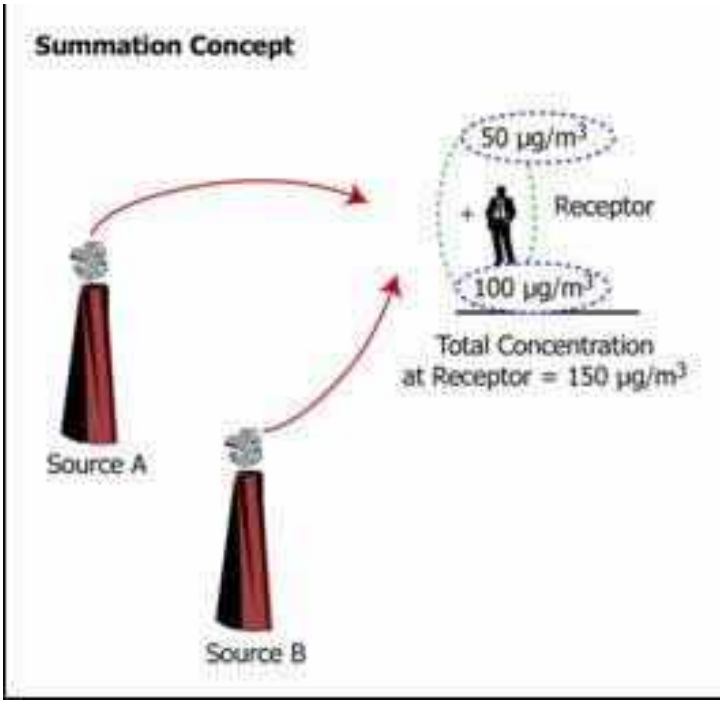



**Figure 3.10 - The Summation Concept for two sources**

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.

## 3.10 Modeling Roads

There are a number of dispersion models that can be used to predict concentrations from roadway emissions. Some models such as CAL3QHCR were developed solely for use in modeling roadway emissions. They use a line source algorithm. CAL3QHCR is a preferred/recommended U.S. Environmental Protection Agency (EPA) model for roadway modeling that uses local meteorology. EPA also recommends the CALINE3 model. But, CALINE3 does not use local meteorology. It is included in CAL3QHCR. The Industrial Source Complex – Short-Term (ISCST3) and the AERMOD models can be used to model roadways as a line of volume sources. AERMOD is the recommended EPA model. However, some Districts still use ISCST3 because they do not yet have the meteorological data needed for AERMOD. The methodology for modeling using AERMOD is the same as that for using ISCST3. The input data is almost identical because AERMOD was designed to use input similar to that used by ISCST3 and to provide similar outputs. The major differences between the inputs to the two models are the meteorological data sets. During the preparation of this guideline, an analysis was conducted to compare concentrations predicted by all three models for a specific example. This analysis showed that all three models provided similar concentration estimates, and that any of the three models could be used effectively to predict pollutant concentrations and the resulting risk from roadway emissions.

In the discussion below, use of CAL3QHCR is described first. That discussion includes a description of data sources to estimate emissions. The same approach can be used to develop emissions estimates for ISCST3/AERMOD.

## 3.10.1 Modeling Roads using CAL3QHCR

### 3.10.1.1 Introduction

This step by step guidance explains how to use the CAL3QHCR line source model to carry out diesel particulate matter air dispersion modeling, and how to calculate potential cancer risk. Nine potential receptors are assumed to lie directly south of an east-west free-flow freeway with a peak hour traffic count of 11,900 vehicles. The freeway is assumed to be 120 feet wide, with an additional 10 feet on each side to account for the wake of moving vehicles[35], making for a total link width of 140 feet.

This example represents one specific scenario. For guidance on other CAL3QHCR modeling scenarios not contained herein, contact your local air district or consult the User's Guide to CAL3QHC, Version 2.0 [36].

### 3.10.1.2 Data Sources

This example scenario relies on basic information needed to complete the site specific HRA. Such information includes:

- meteorological data,
- traffic data (from Caltrans), later developed into hourly data,
- vehicle emissions (derived from EMFAC),
- location of the nearest sensitive receptor to the edge of the travel lane, in addition to the generic receptor locations, if required (for example, at 10, 25, 50, 100, 200, 300, 400 and 500 feet) in X-Y coordinates, and
- roadway orientation in terms of its X-Y coordinates (arbitrary origin / 0,0), including length and width.

The above information, including additional information required by the model, is further discussed in the ensuing sections of this document.

### 3.10.1.3 Finding the Peak Hour Traffic Count

The peak hour traffic count nearest to the proposed receptors is used to develop the hourly traffic count information for input into CAL3QHCR. The peak hour traffic count should be found on Caltrans's website at http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/index.htm. Select back peak hour for projects south or west of the nearest milepost location. For projects north or east of the nearest milepost location, select ahead peak hour.

[35] The mixing zone is an area where dispersion results are considered to be inaccurate.
[36] User's Guide to CAL3QHC Version 2.0, EPA-454/R-92-006 (Revised, with CAL3QHCR addendum), September 1995.

For the scenario considered herein, the Caltrans's data indicates a peak hour traffic count of 11,900 vehicles.

Running EMFAC to Produce Hourly PM10 Emissions and Data on Vehicle Miles Traveled

The most current version of EMFAC should be run to determine preliminary vehicle miles traveled (VMT) and emissions data. The VMT data will be used to develop the hourly traffic count information required by CAL3QHCR, and the PM10 exhaust emissions data will be used to determine the hourly PM10 emissions rates for input into CAL3QHCR.

The EMFAC run should be based on the following parameters:

- Year: first year of project build out,
- Season: annual,
- Burden: standard, and
- Output Frequency: hourly.

The following data from the EMFAC output file will be used:

- VMT/1000 for each hour,
- PM10 emissions for each hour.

Figure 3.11 is a screen shot of the first page of the EMFAC output file. The circled hourly data is the data that will be used.

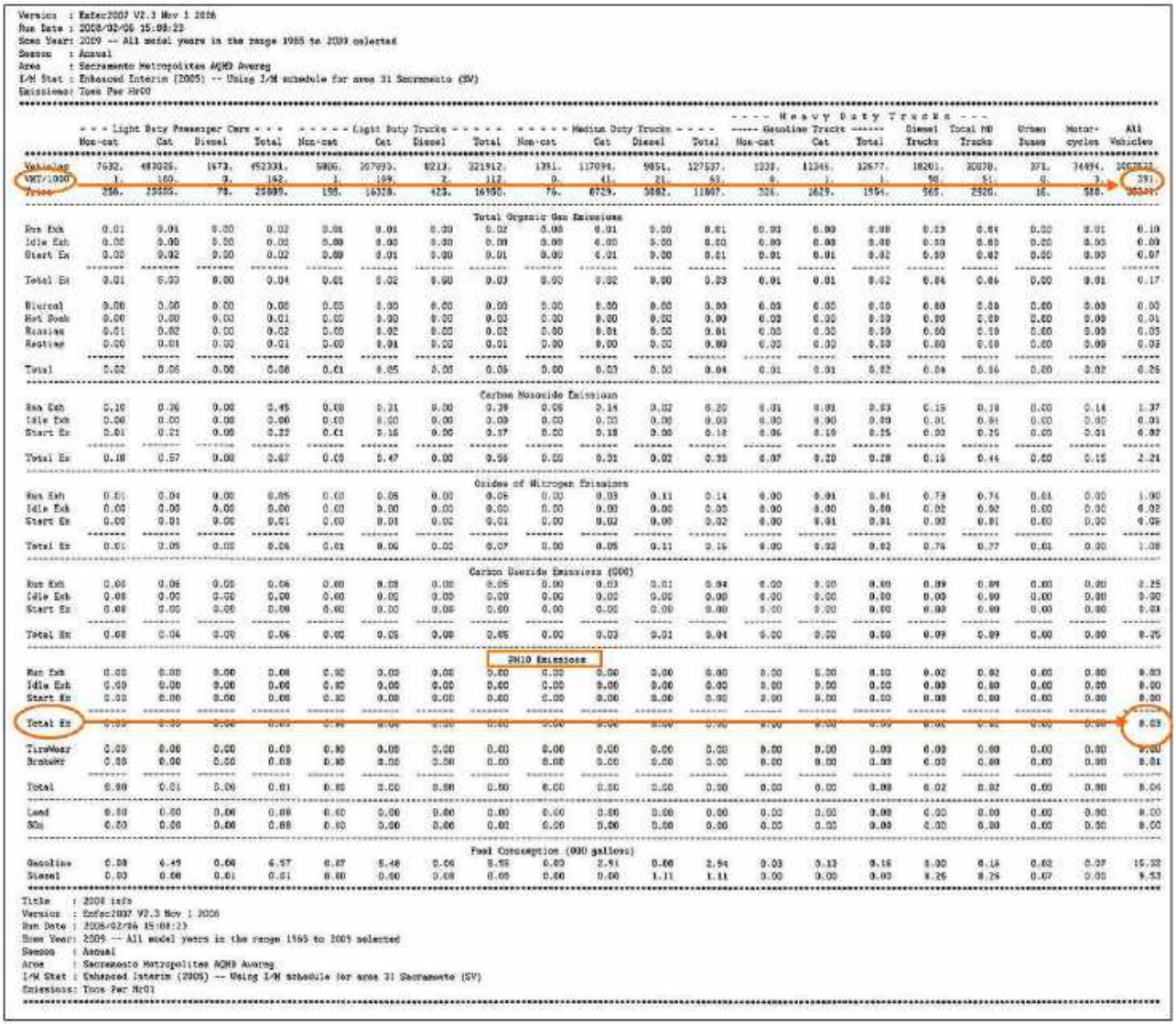
This methodology is a **screening method** to determine the cancer risk from diesel exhaust assuming that all vehicles traveling the roadway segment are diesel vehicles.

A refinement of the emission calculations can be made by using data on percentages of truck traffic from Caltrans and assuming that all trucks are diesel. If better data is not available, 10% is sometimes assumed as the diesel truck fraction of vehicles.

To refine the emissions calculations further to account for diesel emissions from diesel trucks, and to account for the emissions of the highest priority toxic substances (1,3 butadiene, acrolein, acetaldehyde, formaldehyde, and benzene) from all vehicles, the procedure in Appendix B should be followed.

Contact the local district to determine which method should be used to estimate diesel truck travel.

## Figure 3.11: Example Scenario EMFAC Output, Page 1



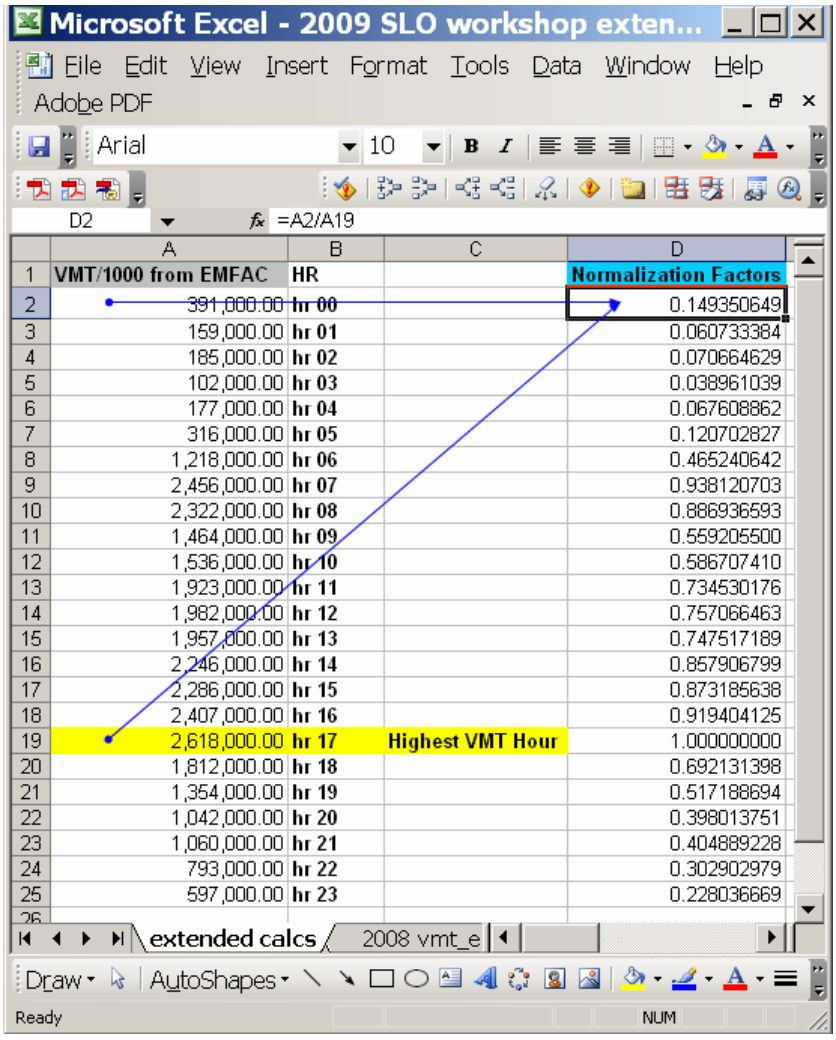
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2008/02/06 15:08:23
Scen Year: 2009 -- All model years in the range 1965 to 2009 selected
Season : Annual
Area : Sacramento Metropolitan AQMD Averag
I/M Stat : Enhanced Interim (2005) -- Using I/M schedule for area 31 Sacramento (SV)
Emissions: Tons Per Hr00

| | Light Duty Passenger Cars | | | | Light Duty Trucks | | | | Medium Duty Trucks | | | | Heavy Duty Trucks | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Non-cat | Cat | Diesel | Total | Non-cat | Cat | Diesel | Total | Non-cat | Cat | Diesel | Total | Gasoline Non-cat | Gasoline Cat | Gasoline Total | Diesel Trucks | Total HD Trucks | Urban Buses | Motor-cycles | All Vehicles |
| Vehicles | 7632. | 487026. | 1473. | 492331. | 5806. | 207895. | 8213. | 221912. | 1351. | 117094. | 9851. | 127537. | 1338. | 11345. | 12677. | 18201. | 30878. | 371. | 34494. | 1097532. |
| VMT/1000 | 1. | 160. | 3. | 162. | 1. | 189. | 2. | 192. | 0. | 41. | 21. | 63. | 0. | 1. | 1. | 50. | 51. | 0. | 3. | 291. |
| Trips | 256. | 25555. | 78. | 25889. | 195. | 16328. | 423. | 16950. | 76. | 6729. | 5802. | 11607. | 526. | 2629. | 3154. | 965. | 2926. | 16. | 588. | 99547. |
| **Total Organic Gas Emissions** | | | | | | | | | | | | | | | | | | | | |
| Run Exh | 0.01 | 0.01 | 0.00 | 0.02 | 0.01 | 0.01 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.00 | 0.01 | 0.10 |
| Idle Exh | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Start Ex | 0.00 | 0.02 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.07 |
| Total Ex | 0.01 | 0.03 | 0.00 | 0.04 | 0.01 | 0.02 | 0.00 | 0.03 | 0.00 | 0.02 | 0.00 | 0.03 | 0.01 | 0.01 | 0.02 | 0.04 | 0.06 | 0.00 | 0.01 | 0.17 |
| Diurnal | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hot Soak | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Running | 0.01 | 0.02 | 0.00 | 0.02 | 0.00 | 0.02 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 |
| Resting | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 |
| Total | 0.02 | 0.05 | 0.00 | 0.06 | 0.01 | 0.05 | 0.00 | 0.05 | 0.00 | 0.03 | 0.00 | 0.04 | 0.01 | 0.01 | 0.02 | 0.04 | 0.06 | 0.00 | 0.02 | 0.25 |
| **Carbon Monoxide Emissions** | | | | | | | | | | | | | | | | | | | | |
| Run Exh | 0.10 | 0.36 | 0.00 | 0.45 | 0.08 | 0.21 | 0.00 | 0.29 | 0.06 | 0.14 | 0.02 | 0.20 | 0.01 | 0.01 | 0.03 | 0.15 | 0.18 | 0.00 | 0.14 | 1.37 |
| Idle Exh | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 |
| Start Ex | 0.01 | 0.21 | 0.00 | 0.22 | 0.01 | 0.16 | 0.00 | 0.17 | 0.00 | 0.18 | 0.00 | 0.18 | 0.06 | 0.19 | 0.25 | 0.03 | 0.25 | 0.00 | 0.01 | 0.69 |
| Total Ex | 0.10 | 0.57 | 0.00 | 0.67 | 0.09 | 0.37 | 0.00 | 0.46 | 0.06 | 0.31 | 0.02 | 0.38 | 0.07 | 0.20 | 0.28 | 0.19 | 0.44 | 0.00 | 0.15 | 2.21 |
| **Oxides of Nitrogen Emissions** | | | | | | | | | | | | | | | | | | | | |
| Run Exh | 0.01 | 0.04 | 0.00 | 0.05 | 0.00 | 0.05 | 0.00 | 0.05 | 0.00 | 0.03 | 0.11 | 0.14 | 0.00 | 0.01 | 0.01 | 0.73 | 0.74 | 0.01 | 0.00 | 1.00 |
| Idle Exh | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.00 | 0.02 |
| Start Ex | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.02 | 0.00 | 0.02 | 0.00 | 0.01 | 0.01 | 0.03 | 0.01 | 0.00 | 0.00 | 0.06 |
| Total Ex | 0.01 | 0.05 | 0.00 | 0.06 | 0.01 | 0.06 | 0.00 | 0.07 | 0.00 | 0.05 | 0.11 | 0.16 | 0.00 | 0.02 | 0.02 | 0.76 | 0.77 | 0.01 | 0.00 | 1.08 |
| **Carbon Dioxide Emissions (000)** | | | | | | | | | | | | | | | | | | | | |
| Run Exh | 0.00 | 0.06 | 0.05 | 0.06 | 0.00 | 0.03 | 0.00 | 0.03 | 0.00 | 0.03 | 0.01 | 0.04 | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 | 0.00 | 0.00 | 0.25 |
| Idle Exh | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Start Ex | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Total Ex | 0.00 | 0.06 | 0.00 | 0.06 | 0.00 | 0.03 | 0.00 | 0.03 | 0.00 | 0.03 | 0.01 | 0.04 | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 | 0.00 | 0.00 | 0.25 |
| **PM10 Emissions** | | | | | | | | | | | | | | | | | | | | |
| Run Exh | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.00 | 0.03 |
| Idle Exh | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Start Ex | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Ex | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.00 | 0.03 |
| TireWear | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BrakeWr | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Total | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.00 | 0.04 |
| Lead | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SOx | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Fuel Consumption (000 gallons)** | | | | | | | | | | | | | | | | | | | | |
| Gasoline | 0.00 | 6.49 | 0.00 | 6.57 | 0.07 | 5.48 | 0.06 | 5.55 | 0.00 | 2.91 | 0.00 | 2.94 | 0.03 | 0.13 | 0.16 | 0.00 | 0.18 | 0.02 | 0.07 | 15.32 |
| Diesel | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.11 | 1.11 | 0.00 | 0.00 | 0.00 | 8.26 | 8.26 | 0.07 | 0.00 | 9.53 |

Title : 2009 info
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2008/02/06 15:08:23
Scen Year: 2009 -- All model years in the range 1965 to 2009 selected
Season : Annual
Area : Sacramento Metropolitan AQMD Averag
I/M Stat : Enhanced Interim (2005) -- Using I/M schedule for area 31 Sacramento (SV)
Emissions: Tons Per Hr01

### 3.10.1.4 Preparing the Hourly Traffic Count Data

To develop hourly traffic count values needed by CAL3QHCR, first find the highest hourly Vehicle Miles Traveled (VMT) count reported by EMFAC. Figure 3.12 shows an example. In this example, the highest hourly VMT count is 2,618,000 miles, which falls on Hour 17, 5:00 pm. Next, divide each hourly VMT value from EMFAC by the highest hourly VMT count (2,618,000 miles). Each result is known as a normalization factor.




| | A | B | C | D |
|---|---|---|---|---|
| 1 | VMT/1000 from EMFAC | HR | | Normalization Factors |
| 2 | 391,000.00 | hr 00 | | 0.149350649 |
| 3 | 159,000.00 | hr 01 | | 0.060733384 |
| 4 | 185,000.00 | hr 02 | | 0.070664629 |
| 5 | 102,000.00 | hr 03 | | 0.038961039 |
| 6 | 177,000.00 | hr 04 | | 0.067608862 |
| 7 | 316,000.00 | hr 05 | | 0.120702827 |
| 8 | 1,218,000.00 | hr 06 | | 0.465240642 |
| 9 | 2,456,000.00 | hr 07 | | 0.938120703 |
| 10 | 2,322,000.00 | hr 08 | | 0.886936593 |
| 11 | 1,464,000.00 | hr 09 | | 0.559205500 |
| 12 | 1,536,000.00 | hr 10 | | 0.586707410 |
| 13 | 1,923,000.00 | hr 11 | | 0.734530176 |
| 14 | 1,982,000.00 | hr 12 | | 0.757066463 |
| 15 | 1,957,000.00 | hr 13 | | 0.747517189 |
| 16 | 2,246,000.00 | hr 14 | | 0.857906799 |
| 17 | 2,286,000.00 | hr 15 | | 0.873185638 |
| 18 | 2,407,000.00 | hr 16 | | 0.919404125 |
| 19 | 2,618,000.00 | hr 17 | Highest VMT Hour | 1.000000000 |
| 20 | 1,812,000.00 | hr 18 | | 0.692131398 |
| 21 | 1,354,000.00 | hr 19 | | 0.517188694 |
| 22 | 1,042,000.00 | hr 20 | | 0.398013751 |
| 23 | 1,060,000.00 | hr 21 | | 0.404889228 |
| 24 | 793,000.00 | hr 22 | | 0.302902979 |
| 25 | 597,000.00 | hr 23 | | 0.228036669 |

Figure 3.12: Example Scenario Development of Normalization Factors

Next multiply each normalization factor times the project's peak hour traffic count provided in this example by Caltrans (11,900 vehicles/hour during hour 17, 5:00 pm), Table 3.3. The results are normalized hourly traffic volumes for input into CAL3QHCR.

| Time of day | Traffic Count (vehicles/hour) |
|---|---|
| Hr 00 | 1777 |
| Hr 01 | 723 |
| Hr 02 | 841 |
| Hr 03 | 464 |
| Hr 04 | 805 |
| Hr 05 | 1436 |
| Hr 06 | 5536 |
| Hr 07 | 11164 |
| Hr 08 | 10555 |
| Hr 09 | 6655 |
| Hr 10 | 6982 |
| Hr 11 | 8741 |
| Hr 12 | 9009 |
| Hr 13 | 8895 |
| Hr 14 | 10209 |
| Hr 15 | 10391 |
| Hr 16 | 10941 |
| **Hr 17** | **11900** |
| Hr 18 | 8236 |
| Hr 19 | 6155 |
| Hr 20 | 4736 |
| Hr 21 | 4818 |
| Hr 22 | 3605 |
| Hr 23 | 2714 |

**Table 3. 3: Example Scenario Normalized Traffic Counts**

## 3.10.1.5 Preparing the Hourly Emissions Data

PM10 emissions data is reported by EMFAC in tons/hour and needs to be converted to grams/hour. The grams/hour values then need to be divided by the overall VMT per hour for each hour (as reported by EMFAC), to obtain grams per vehicle mile needed for input into CAL3QHCR.

## 3.10.1.6 Defining the Calculational Domain for the Input File

The CAL3QHCR input file requires data that defines the calculational domain. The X-Y coordinates at the beginning and at the end of the roadway section need to be defined. These have an arbitrary origin, with the y axis aligned with north.

Additionally, the width (mixing zone) of the roadway needs to be defined. Always allow for an additional 10 feet added to the edge of nearest travel lane to the receptors to account for the wake of moving vehicles.

The minimum roadway length is 10,000 feet.

The elevation of the roadway compared to the surrounding area needs to be specified. For roadways at grade the height is 0; for elevated roadways the relative height is positive; and for depressed roadways the relative height is negative.

The z-coordinate (receptor breathing height) also needs to be defined. The default recommendation is 1.5 meters, or 6 feet.

In this scenario, the freeway is 120 feet wide, and after accounting for the wake, the total link width becomes 140 feet.

The length of the roadway modeled is 10,000 feet, or 5,000 feet on each side from the center point.

The roadway is at grade.

A receptor has been placed at the edge of the roadway to define the roadway dimensions; however the dispersion results for this receptor should be discarded as they are not accurate at roadway edges. See Figure 3.13 below.

Other parameters required by the model need to be defined. Table 3.4 below discusses recommended and/or default parameters. Any changes to the default recommended values should be thoroughly explained.

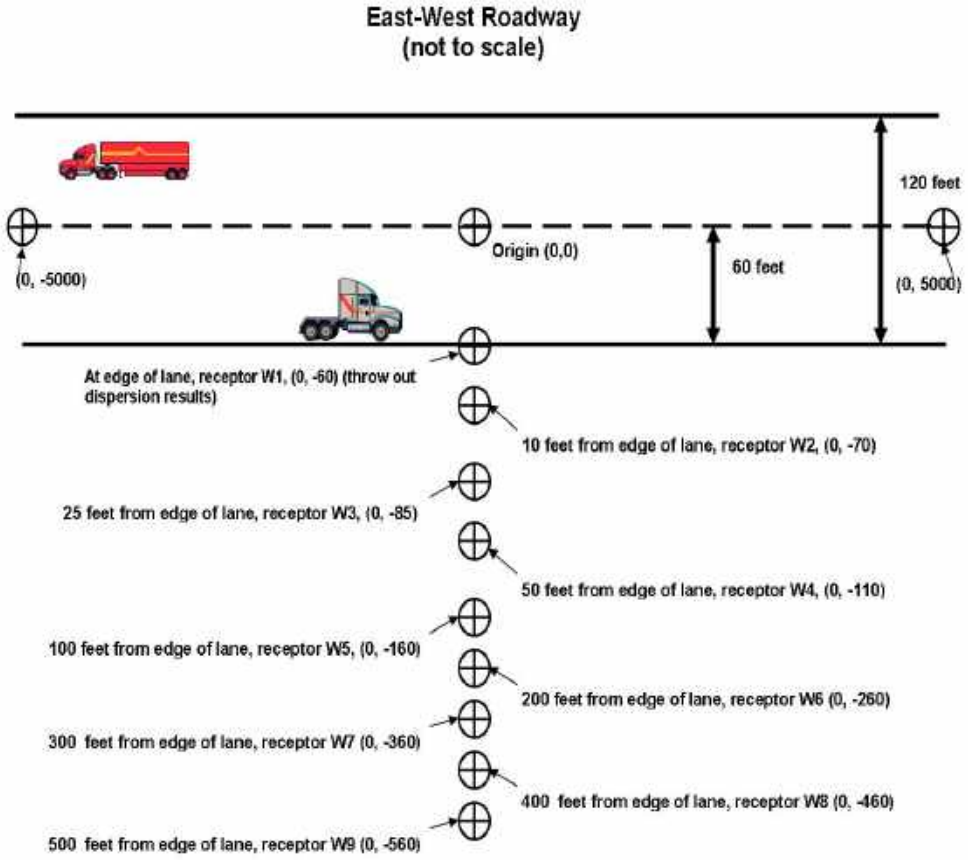



**Figure 3.13: Example Scenario East-West Roadway and Receptors Illustration**

**Table 3.4: Other Recommended Parameters for Input into CAL3QHCR**

| Parameter | Default | |
|---|---|---|
| Calculation averaging time (min) | 60 | |
| Surface roughness (cm, from 3 to 400). For mixed uses and others not listed here, the modeler should make a reasonable assumption. | single family | 108 |
| | offices | 170 |
| | apartments | 370 |
| Settling velocity (cm/s) | 0 | |
| Deposition velocity (cm/s) | 0 | |
| Site setting (U=urban, R=rural) | U | |
| Form of traffic volume, emission rate data (1=one hour's data, 2=one week of hourly data) | 2 | |
| Pollutant (P for PM10 to give output in µg/$m^3$) | P | |
| Hourly ambient background concentration (µg/$m^3$) | 0 | |
| Roadway height indicator (AG=at grade, FL=elevated and filled, BR=bridge, DP=depressed) | AG | |
| Roadway height (ft, 0 if AG, relative height if FL, BR, or DP) | 0 | |

## 3.10.1.7 Preparing the CAL3QHCR Files

## 3.10.2.7.1Downloading CAL3QHCR

Download the CAL3QHCR model from EPA's Preferred/Recommended Dispersion Models website at www.epa.gov/scram001/dispersion_prefrec.htm. There are five files needed to run the program:

- input file (.inp),
- batch file (.bat),
- control file (.ctl),
- meteorological data file (.asc), and
- executable file (.exe).

Decide on a name for the run. The name of the example scenario run is "2009south11900k".

Note that in setting up your run, you will be editing over data already present in the files.

Prepare the Batch File (.bat)**.**
The batch file is the DOS file batch command.

Right click on the file to open it for editing. (Note that opening or double clicking on the file will cause the program to run. If this happens, simply delete the files the program creates and start again.) Once the file is open, type in the name of your run after the word "Copy". Save the file with the name of the run. See Figure 3.14 below for the example scenario batch file.

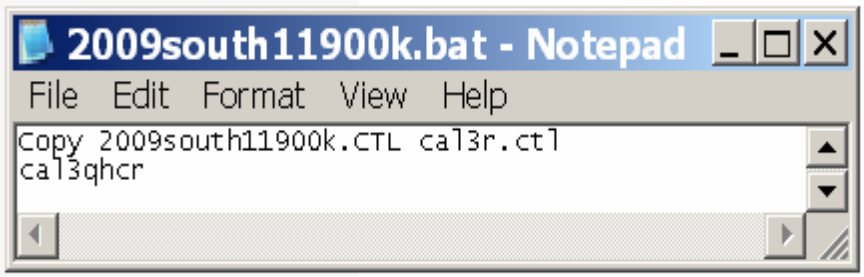



**Figure 3.14: Example Scenario Batch File**

## 3.10.1.7.2Prepare the Control File (.ctl)

CAL3QHCR looks to the control file to find the file names that are read into the program and outputted by the program.

Type the name of your run in front of each file extension, except the .ASC file, where you will type in the meteorological data file name. Save the control file with the name of your run. See Figure 3.15 below for the example scenario control file.

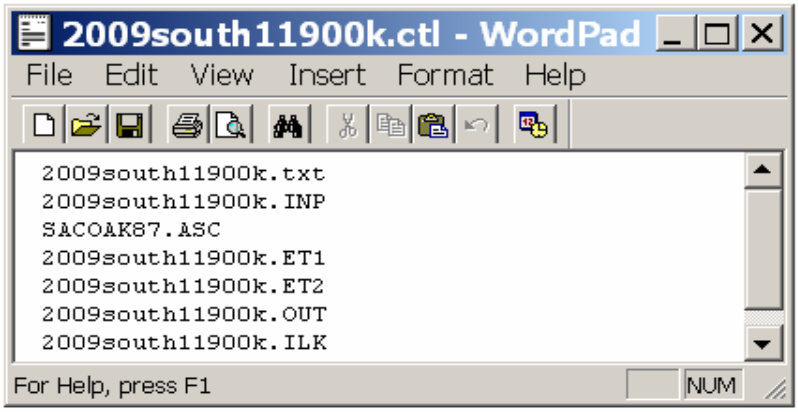



**Figure 3.15: Example Scenario Control File**

## 3.10.1.7.3Meteorological File (.asc)

The meteorological file should be in the .asc format. Contact your local air district for the recommended meteorological file. This file will not be edited.

## 3.10.1.7.4Executable File (.exe)

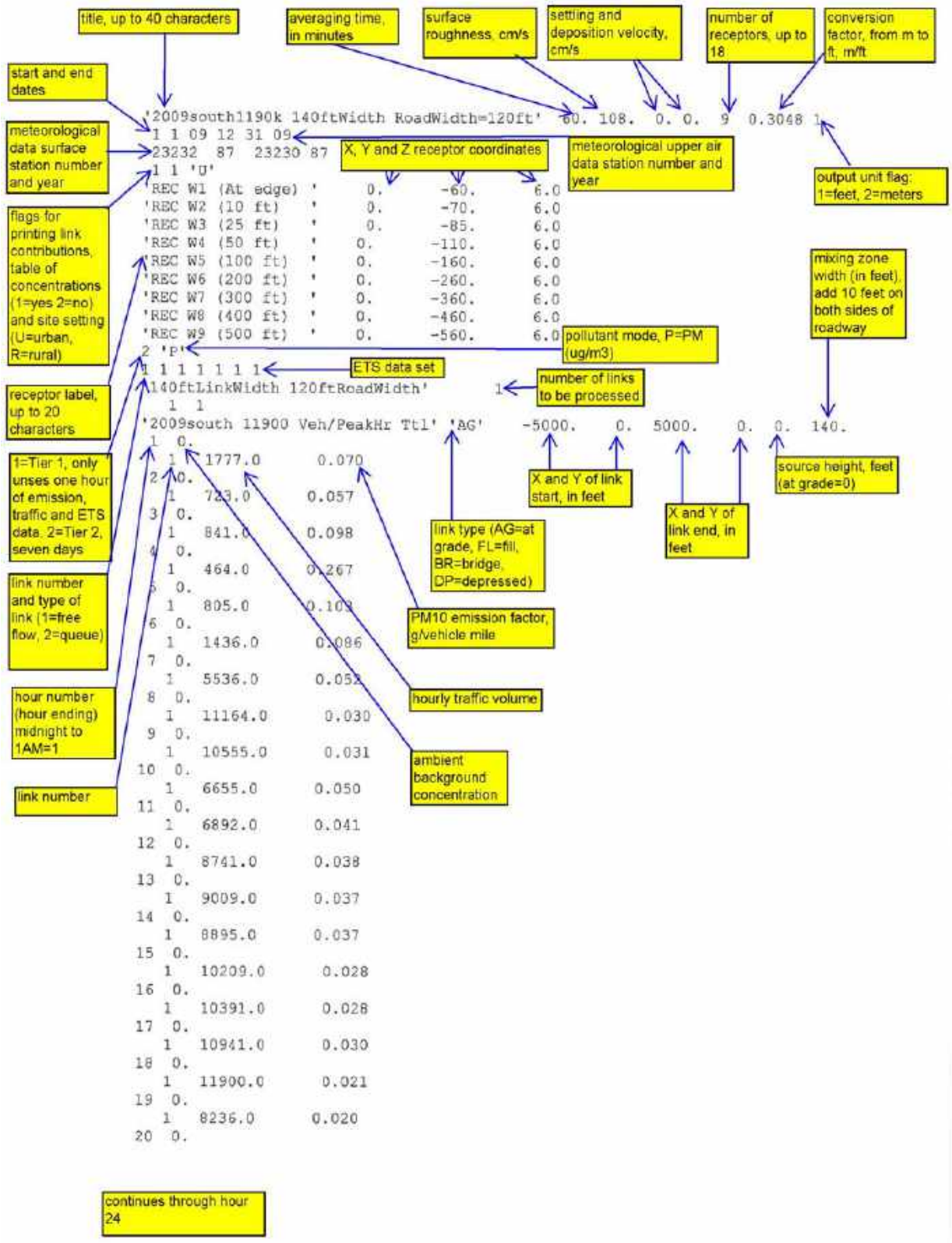
The executable file runs the program. This file will not be edited.

## 3.10.1.7.5Prepare the Input File (.inp)

The input file contains scenario parameters.

Prepare the input by editing over an example file provided with the model download, or by editing over a file provided by the local air district that more closely reflects the setup needed for this type of roadway modeling. Save the input file with the name of your run. See Figure 3.16 below for the example scenario input file and input explanations.

**Figure 3.16: Example Scenario Input File and Input Explanations**




```
'2009south1190k 140ftWidth RoadWidth=120ft'  60. 108.  0. 0.  9  0.3048 1
1 1 09 12 31 09
23232  87  23230 87
1 1 'U'
'REC W1 (At edge) '     0.      -60.      6.0
'REC W2 (10 ft)   '     0.      -70.      6.0
'REC W3 (25 ft)   '     0.      -85.      6.0
'REC W4 (50 ft)   '     0.     -110.      6.0
'REC W5 (100 ft)  '     0.     -160.      6.0
'REC W6 (200 ft)  '     0.     -260.      6.0
'REC W7 (300 ft)  '     0.     -360.      6.0
'REC W8 (400 ft)  '     0.     -460.      6.0
'REC W9 (500 ft)  '     0.     -560.      6.0
2 'P'
1 1 1 1 1 1 1
'140ftLinkWidth 120ftRoadWidth'      1
   1  1
'2009south 11900 Veh/PeakHr Ttl' 'AG'    -5000.    0.   5000.    0.   0.   140.
 1  0.
   1   1777.0       0.070
 2  0.
   1    723.0       0.057
 3  0.
   1    841.0       0.098
 4  0.
   1    464.0       0.267
 5  0.
   1    805.0       0.103
 6  0.
   1   1436.0       0.086
 7  0.
   1   5536.0       0.052
 8  0.
   1  11164.0       0.030
 9  0.
   1  10555.0       0.031
10  0.
   1   6655.0       0.050
11  0.
   1   6892.0       0.041
12  0.
   1   8741.0       0.038
13  0.
   1   9009.0       0.037
14  0.
   1   8895.0       0.037
15  0.
   1  10209.0       0.028
16  0.
   1  10391.0       0.028
17  0.
   1  10941.0       0.030
18  0.
   1  11900.0       0.021
19  0.
   1   8236.0       0.020
20  0.
```

## 3.10.1.8 Running the Model and Calculating Potential Cancer Risk

Double click on the .bat file to run the model. The model will produce a series of files with extensions .ET1, .ET2, .ILK, .OUT, .txt, and .ctl. Open the .txt and check to be sure the run was error-free.

The output file (.OUT) will show, among other information, the highest annual average concentrations. See Figure 3.17 below for the relevant section of the example scenario output file.

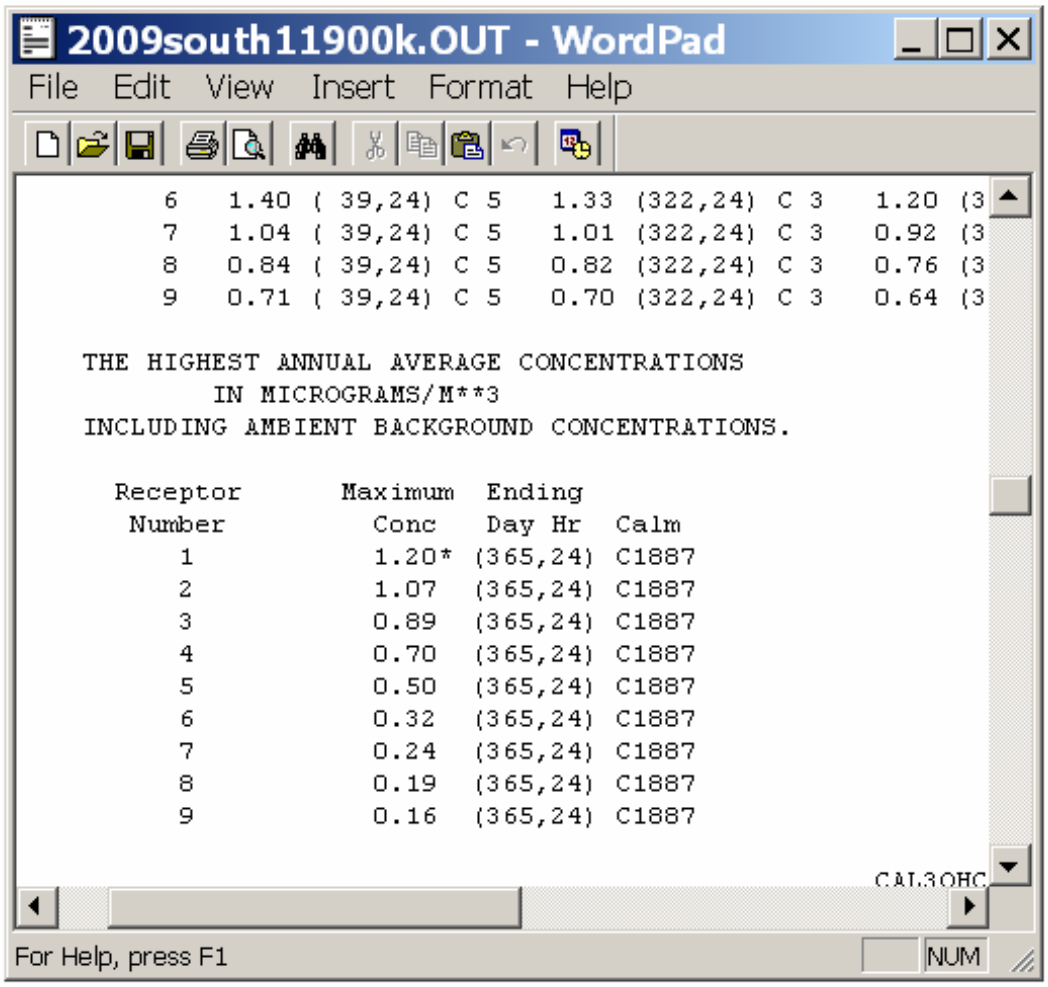



**Figure 3.17: Example Scenario Output File, Highest Annual Average Concentrations**

The example above shows downwind concentrations of diesel particulate matter at various receptor locations. The cancer risk due for diesel particulate is calculated by assuming that only the inhalation pathway applies. The default cancer risk calculation is based on the 80$^{th}$ percentile breathing rate, as recommended by the Office of Environmental Health Hazard Assessment. The cancer risk is calculated for receptor 4 (0.70 ug/m$^3$) as follows:

**Cancer Risk = $S_i$ * $C_i$ * DBR * A * EF * ED / AT**

Where:

| | | | |
|---|---|---|---|
| $S_i$ = | Cancer Potency Slope Factor for DPM | = | 1.1 $(mg/kg\text{-}d)^{-1}$ |
| $C_i$ = | Concentration in the air of DPM | = | 0.70 $ug/m^3$ |
| DBR = | Daily Breathing Rate (default 80th %ile): | = | 302 L/kg-day |
| | (Residential Receptors) | | |
| | (Some districts may require the use of the 95th %ile): | | |
| | | = | 393 L/kg-day |
| A = | Inhalation Absorption Rate | = | 1 |
| EF = | Exposure Frequency: | = | 350 days |
| | (Residential Receptors) | | |
| ED = | Exposure Duration: | = | 70 years |
| | (Residential Receptors) | | |
| AT = | Averaging Time (70 years) | = | 25,550 days |

Cancer Risk:

= $(1.1\ (mg/kg\text{-}d)^{-1})(0.70\ ug/m^3)$(302 L/kg-day)(1)(350 days)(70 years)/(25,550 days)

= 223 per million

## 3.10.1.9 Other CAL3QHCR Features

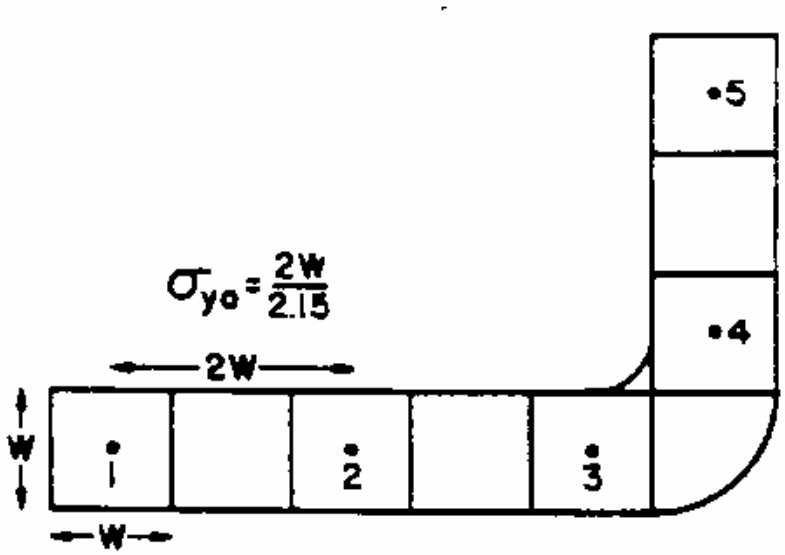
CAL3QHCR offers many other features that allow modeling traffic intersections, traffic signaling, and traffic queuing. Employing these features is quite site-specific. If these features must be employed, the user's guide should be consulted.

## 3.10.2 Modeling Roads using ISCST3 or AERMOD

CAL3QHCR is a roadway model. It can be used only to model highways. Often a project for which a health risk assessment is being prepared has additional sources. For example, a commercial development will have toxic emissions from truck idling, operation of transportation refrigeration units (TRUs), fast food restaurants, gasoline dispensing facilities, and dry cleaning operations. Large commercial operations may also have emergency diesel-fired internal combustion engines. These additional sources could be modeled in ISCST3 or AERMOD and their predicted risks superimposed upon those predicted by CAL3QHCR. Alternatively, all the sources including the roadways could be modeled using ISCST3 and AERMOD. The results of roadway modeling using ISCST3 and AERMOD are consistent with those from using CAL3QHCR. The procedures for using ISCST3 and AERMOD to model emissions from roadways are discussed below.

## 3.10.2.1 Introduction

ISCST3 and AERMOD can be used to predict the concentrations of pollutants emitted from vehicles on roads. These models have 4 basic types of sources (i.e., point, area, volume, and open pit). Emissions from idling vehicles located at a loading dock can be modeled as point sources. Area sources have been used in the past to model emissions from parking lots. The best method for modeling emissions from travelling vehicles is to use a line source or a series of multiple volume sources, as shown below.




View looking down along the length of a road segment ($L_{RS}$)

The following steps can be used to construct a line source that represents diesel PM emissions from diesel trucks traveling along a road segment:

1. Determine the total emissions for the diesel trucks traveling along the road segment.

   $E_T$ = Emissions total for road segment

2. Using the width of the road as the length of the side (W) of a single volume source, determine the number of volume sources along the length of the road by dividing the length of the road by 2W. Round the number of volume sources either up or down.

   W = Width of the road
   $L_{RS}$ = Length of the road segment
   N = Number volume sources
   $N = L_{RS} / 2W$

3. Calculate the initial lateral dispersion:

$\sigma_y = 2W / 2.15$

3. Estimate the initial vertical dispersion using the height of the truck exhaust divided by 4.3.

   $\sigma_z = H / 4.3$
   $= 13 \text{ feet} / 4.3$
   $= 3.01 \text{ feet}$

4. Calculate the emission rate for each volume source by dividing the total emissions for the road segment by the number of volume sources.

   $E_{VS}$ = Emission rate for each volume source
   $E_{VS} = E_T / N$

5. Model each individual volume source using ISCST or AERMOD separately, but as a group, using actual emissions for each volume source.

6. Identify the predicted concentrations at each receptor.

7. Next, calculate the risk at each receptor using the procedure outlined above in Section 3.10.1.8.

## 3.10.2.2 Data Requirements

The data that are required to model roadway emissions using ISCST3 and AERMOD are similar to those required for using CAL3QHCR. They include the following:

- **Meteorological data** – If the air district cannot provide preprocessed meteorological data, then nearby airport or monitored surface data from a meteorological station can be processed for use in ISCST3 or AERMOD. Contact your local district for availability of appropriate met data. Information on processing met data can be found in Appendix A.
- **Traffic data and vehicle emissions** – The same data as discussed above for the CAL3QCHR model are used.
- **Roadway configuration** – The width of the roadway is used as the length of a side for each volume source. Receptors should be located the same as with the CAL3QCHR model.
- **Terrain data** – For ISCST3, elevation data must be entered manually. AERMAP is used to generate the elevations and hill slopes for receptors and sources for input to the AERMOD model. Digital Elevation Model (DEM) files for use in AERMAP are available from a variety of sources.

Third-party software used to prepare the input file for ISCST3, and used to allow the model results to be viewed graphically, can also be used to determine terrain elevations using DEM files.

Once these data are assembled, the model input file can be created.

## 3.10.2.3 Preparing the Model Input File

The input files for ISCST3 and AERMOD are very similar. In the discussion below, only the input file for the ISCST3 model will be described.

The input file must contain the following components or sections:

CO – for overall job control options
SO – for source information
RE – for receptor information
ME – for meteorological data
TG – for a terrain grid (optional)
OU – for output options

Each of these sections is discussed briefly below. For more detailed information, the *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models: Volume I – User Instructions* (EPA-454/B-95-003a) should be consulted.

## 3.10.2.3.1 Control Option Section

Each section begins with a STARTING command and ends with a FINISHED command. Model options that must be specified include: a title; model options such as default or "regulatory" dispersion options, rural or urban dispersion coefficients, and concentration or deposition estimates; the averaging time (period or annual for carcinogenic risk); the pollutant identification; and the RUNORNOT option. The following is a sample input for the example discussed above:

```
CO STARTING
   TITLEONE 2009south1190k
   MODELOPT DFAULT CONC  URBAN
   AVERTIME PERIOD
   POLLUTID DPM
   TERRHGTS ELEV
   FLAGPOLE 1.80
   RUNORNOT RUN
   ERRORFIL Road.err
CO FINISHED
```

In this sample input file, the regulatory default options are used. The model will calculate concentrations of DPM (i.e., diesel particulate matter) using urban dispersion coefficients. The receptors will all be modeled with a default height of 6 ft or 1.8 m. The model will run to completion and will output an error file.

## 3.10.2.3.2 Source Section

As discussed above, a series of volume sources will be modeled to simulate the roadway. The sample input file for this section is the following:

```
SO STARTING
** Source Location **
** Source ID - Type - X Coord. - Y Coord. **
** Line Source represented by Separated Volume Sources
** ------------------------------------------------------------------------
** LINE Source ID = SLINE1
** DESCRSRC 2009south1190k
** Length of Side = 36.58
** Emission Rate = 0.123435368
** Elevated
** Vertical Dimension = 0.85
** SZINIT = 0.20
** Nodes = 2
** 309476.00, 3916500.00, 0.00, 3.66, 0.0
** 312527.00, 3916500.00, 0.00, 3.66, 33.38
** ------------------------------------------------------------------------
   LOCATION L0000001 VOLUME 309494.288 3916500.000 0.00
   LOCATION L0000002 VOLUME 309566.060 3916500.000 0.00
   LOCATION L0000042 VOLUME 312436.939 3916500.000 0.00
   LOCATION L0000043 VOLUME 312508.711 3916500.000 0.00
** End of Line Source
** Source Parameters **
   SRCPARAM L0000001 0.00287058995348837 3.66 33.38 0.85
   SRCPARAM L0000002 0.00287058995348837 3.66 33.38 0.85
   SRCPARAM L0000042 0.00287058995348837 3.66 33.38 0.85
   SRCPARAM L0000043 0.00287058995348837 3.66 33.38 0.85
** Variable Emissions Type: "By Hour-of-Day"
** Variable Emission Scenario: "Scenario 1"
   EMISFACT L0000001 HROFDY 0.53 0.176 0.351 0.528 0.353 0.526
   EMISFACT L0000001 HROFDY 1.227 1.427 1.395 1.418 1.204 1.416
   SRCGROUP SRCGP1 L0000001 L0000002 L0000003 L0000004 L0000005 L0000006
   SRCGROUP SRCGP1 L0000043
SO FINISHED
```

In the above sample input, all lines with "**" are comments. This file was generated using an interface program for the model. In this interface, the information for the line source is input, and the program automatically generates the individual volume sources. As can be seen from the input file, there are 43 separate volume sources in this "line source". The location of the center of each volume source and its base elevation (i.e., 0 m) is given on the LOCATION command. The SRCPARAM commands specify the emission rate, the release height, the initial lateral dimension, and the initial vertical dimension. The average emission rate calculated from the information provided above was used. The program divides the emission rate for the line source by the number of volume sources.

A **release height** of 12 ft or 3.66 m was used to approximate the height of the plume from a heavy-duty diesel truck.

The width of the roadway was used as the **length of the side for each volume source**.

The length of the side is used to calculate an initial lateral dimension. For this example, the **initial lateral dimension** is 34.03 m or 2 x 36.58/2.15. (The initial lateral dimension actually used is 33.38 m to ensure that there are an equal number of volume sources in the length of road. This small difference in the calculated initial lateral dimension and the one actually used would not significantly affect the concentrations estimated.)

Based on this release height, an **initial vertical dimension** of 0.85 m or 3.66/4.3 was used.

Variable emission factors (EMISFACT) by the hour of the day (HROFDAY) were used to adjust the average emission rate by the appropriate factor based upon the discussion above for the CAL3QCHR run.

## 3.10.2.3.3Receptor Section

Receptors were located at the distances specified above in the discussion of CAL3QCHR modeling. The sample input file for this section is the following:

```
RE STARTING
** DESCRREC "FENCEGRD" "Receptors generated from Fenceline Grid"
   DISCCART    312530.00   3916454.00    0.00    1.80
   DISCCART    312505.15   3916454.00    0.00    1.80
** DESCRREC "FENCEPRI" "Cartesian plant boundary Primary Receptors"
   DISCCART    309473.00   3916457.00    0.00    1.80
   DISCCART    312530.00   3916457.00    0.00    1.80
   DISCCART    312530.00   3916543.00    0.00    1.80
   DISCCART    309473.00   3916543.00    0.00    1.80
** DESCRREC "FENCEINT" "Cartesian plant boundary Intermediate Receptors"
   DISCCART    309497.85   3916457.00    0.00    1.80
   DISCCART    309522.71   3916457.00    0.00    1.80
   DISCCART    309473.00   3916478.50    0.00    1.80
RE FINISHED
```

The interface program used allows the automatic creation of a telescopic fenceline grid around a facility. This feature was used to create the receptors in this sample input.

First, primary plant boundary receptors were located around the highway. The “plant boundary” was assumed to be the edge of the roadway (i.e., 10 ft on each side of the road from the roadway’s width).

Intermediate receptors were located at a distance of 25 m between receptors along the edge of the roadway.

Then, tiers of receptors at distances of 10 ft, 25 ft, 50 ft, 100 ft, 200 ft, 300 ft, 400 ft, and 500 ft from the roadway edge were entered.

These grid receptors were converted to discrete receptors, and any extraneous receptors were removed.

Note that specific receptors for residences or other **sensitive receptors** could be modeled directly with the ISCST3/AERMOD model.

The **elevation of receptors** was assumed to be zero.

A **receptor height** of 6 ft or 1.8 m was used to approximate the breathing height.

## 3.10.2.3.4Meteorology Section

The meteorology section specifies the meteorological data to be used. The sample input file for this section is the following:

```
ME STARTING
   INPUTFIL C:\MODELI~1\SACOAK85.asc
   ANEMHGHT 10 METERS
   SURFDATA 23232 1985 SACRAMENTO/EXECUTIVE_ARPT
   UAIRDATA 23230 1985 OAKLAND/WSO_AP
ME FINISHED
```

For this sample input file, the 1985 meteorological data from Sacramento was downloaded from the District's website. In the input file, the name and location of the met data file is specified. The height of the anemometer is given. (Most anemometers at airport weather stations are 10 m high.) And, the station number, year and name of the surface data and upper air stations are identified.

## 3.10.2.3.4Output Section

The output section specifies the files or reports to be output. The sample input file for this section is the following:

```
OU STARTING
** Auto-Generated Plotfiles
   PLOTFILE PERIOD SRCGP1 ROAD.IS\PE00G001.PLT
OU FINISHED
```

ISCST3/AERMOD have a variety of files and reports that can be output. One of the most useful filetypes that can be output is the plotfile. A plotfile has the following information:

```
* ISCST3 (02035): 2009south1190k
* MODELING OPTIONS USED:
*  CONC                    URBAN ELEV  FLGPOL DFAULT
*         PLOT FILE OF PERIOD VALUES FOR SOURCE GROUP: SRCGP1
*         FOR A TOTAL OF  2236 RECEPTORS.
*         FORMAT: (3(1X,F13.5),1X,F8.2,2X,A6,2X,A8,2X,I8.8,2X,A8)
*        X             Y      AVERAGE CONC   ZELEV     AVE     GRP      NUM HRS   NET ID
* ____________ ____________  ____________  ______  ______  ________  ________  ________
  312530.00000 3916454.00000       0.13119    0.00  PERIOD  SRCGP1    00008760     NA
```

For each receptor and each specified source group, this file contains the highest predicted concentration for the specified averaging time. Multiple files can be created for multiple source groups (which can be single sources or multiple sources depending upon those specified by the user) and for each averaging time modeled. These plotfiles can be used to generate a *.XOQ file for input into the Hot Spots Analysis and Reporting Program (HARP). They also can be used by graphics programs incorporated into the model interface programs or software such as SURFER to generate isopleths of concentration for a visual display of the results.

### 3.10.2.4 Analyzing Model Results

Concentrations predicted by ISCST3/AERMOD can be used to estimate risk using the procedure discussed above for cancer risk from emissions of diesel particulate matter. The plotfiles generated by the models can be used to create an input file for HARP. Importing the results into HARP can be useful if there are other sources that may contribute to the total risk (e.g., in the case of a commercial development). All sources can be modeled in ISCST3/AERMOD while only the roadway sources can be modeled in CAL3QCHR.

# Chapter 4. Geographical Information Inputs

## 4.1 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.

## 4.2 Coordinate System

### 4.2.1 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.

### 4.2.2 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. Google Earth may be used to determine the UTMs or latitude/longitude coordinates.

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.

## 4.3 Terrain

### 4.3.1 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 to 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.

### 4.3.2 Flat and Complex Terrain

The models consider three different categories of terrain as follows:
Complex Terrain: as illustrated in Figure 4.1, 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.

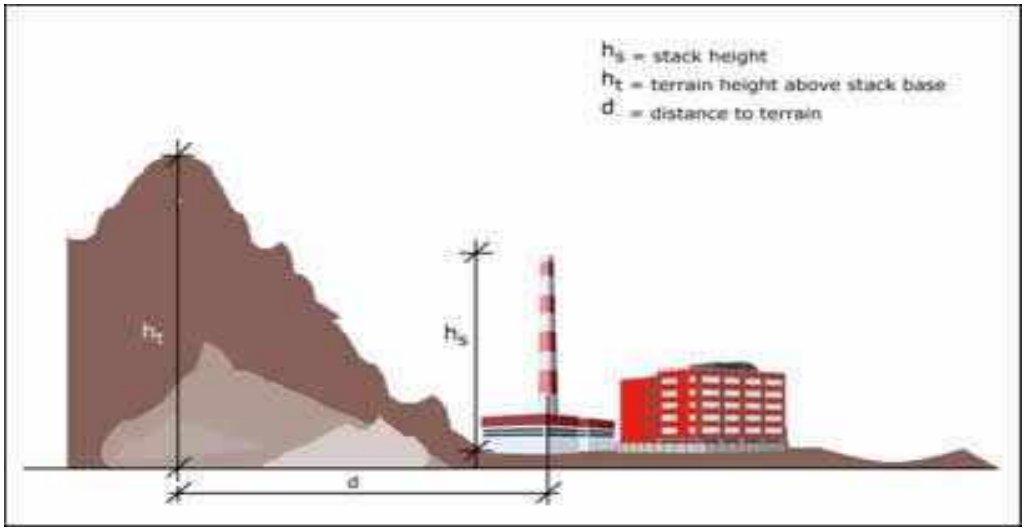



**Figure 4.1 - Complex terrain conditions.**

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 4.2 is used where terrain elevations exceed stack base but are below stack height.

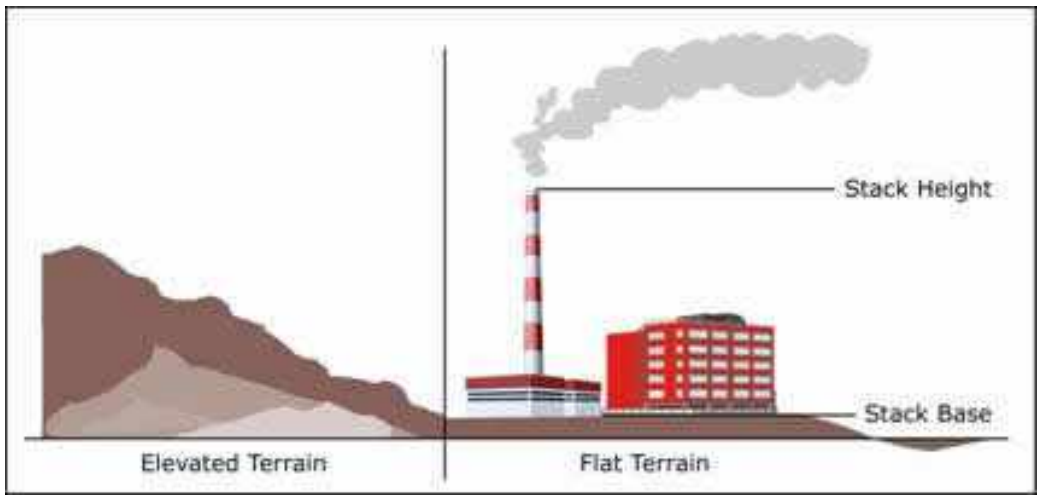



**Figure 4.2 –Elevated and flat terrain conditions.**

## 4.3.3 Criteria for Use of Terrain Data

Evaluation of the terrain within a given study area is the responsibility of the modeler. Complex terrain may need to be considered even in areas that appear to be relatively flat. 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.

### 4.3.4 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 from a variety of vendors in several different formats.

Digital elevation model (DEM) data are available for free from Lakes Environmental's Web GIS web page http://www.webgis.com.

### 4.3.5 Preparing Terrain Data for Model Use

It is strongly suggested that the 7.5-minute data be used in dispersion modeling rather than the coarse resolution 1 degree data. Keep in mind that the USGS DEMs can be in one of two horizontal datums. Older DEMs were commonly in NAD27 (North American Datum of 1927) while many of the latest versions are in NAD83 (North American Datum of 1983).

#### 4.3.5.1 ISC / HARP

The ISCST3 model accepts elevation data for receptors and sources. This data should be obtained from the USGS topographic maps or Digital Elevation Model (DEM) files. USGS DEMs are available for California from ARB at (http://www.arb.ca.gov/toxics/harp/maps.htm) in 7.5-minute format for use in the ARB HARP program and from Lakes Environmental at http://www.webgis.com in 7.5 minute and 1 degree formats.

#### 4.3.5.2 AERMOD

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.

## 4.4 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)*[37]. From the Auer's method, areas typically defined as Rural include:

[37] 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.

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

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

**Table 4.1 - Urban Land use**

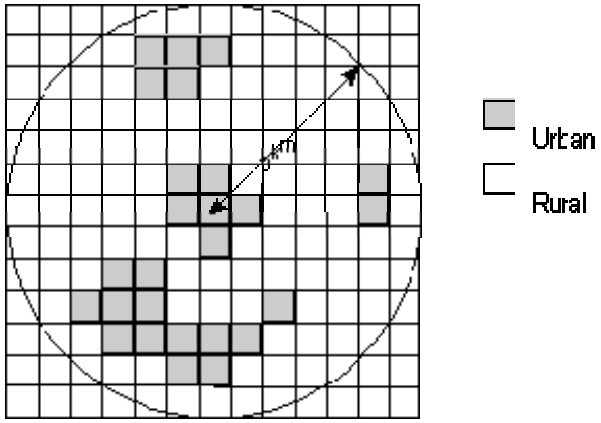
| Type | Use and Structures | Vegetation |
|---|---|---|
| I1 | Heavy industrial | Less than 5% |
| I2 | Light/moderate industrial | Less than 5% |
| C1 | Commercial | Less than 15% |
| R2 | Dense single / multi-family | Less than 30% |
| R3 | Multi-family, two-story | Less than 35% |

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.

- If p > 750 people/$km^2$, select the Urban option,
- If p <= 750 people/$km^2$, 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.

Prior to using either of the above methods, contact the district to determine whether the area in question has already been designated as urban or rural.

# Chapter 5. Meteorological Data

## 5.0 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.

Contact the district for guidance if full meteorology is not being used in SCREEN.

See Appendix A for information on preparing meteorological data for refined modeling (AERMOD and ISC.

# Chapter 6. Receptor Locations

## 6.0 Receptors

A receptor is defined as a point where an actual person (residential or worker) may be located for a given period of time. The period of time is based on the type of assessment that is being performed. When an acute (1-hour or longer, as applicable) risk assessment is to be prepared, all locations where a person could be located for a one hour period needs to be identified. When a cancer or chronic risk assessment is to be prepared, all locations where a person could be located for extended periods of time, such as a residence or workplace, need to be identified.

## 6.0.1 Residential Receptors

Homes, apartments, motels, trailer parks, residential camp grounds, and other places where people reside for long periods are defined as residential receptors. When a cancer risk is prepared, the exposure period should be 70 years. For acute risk assessments, the exposure period should be 1 hour for those substances with acute toxicity values based on one hour exposure periods.

## 6.0.2 Worker Receptors

Worksites, schools, and other locations where people are exposed for long periods of time are defined as worker receptors. When a cancer risk is prepared, the exposure period should be 40 years. For acute risk assessments, the exposure period should be 1 hour for those substances with acute toxicity values based on one hour exposure periods.

## 6.0.3 Offsite Receptors

Offsite receptors are included in risk assessments when they are not employed by the project.

## 6.0.4 Onsite Receptors

Onsite receptors are included in risk assessments if they are persons not employed by the project.

## 6.0.5 Sensitive Receptors

Sensitive receptors are defined as the following:

- Schools
- Daycare facilities other than home based
- Hospitals
- Care facilities (adult/elderly)

At the present time, the risk assessment calculations do not calculate different risk values for sensitive receptors compared to other receptors. However, sensitive receptors must be identified. Contact the district to determine the area in which sensitive receptors must be identified. Some

commonly used criteria are out to a distance of 2 kilometers from a project emission source or within the 1 in a million risk isopleth.

## 6.1 Receptor Grids

### 6.1.1 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 around the origin. Figure 6.1 illustrates a sample uniform Cartesian receptor grid.

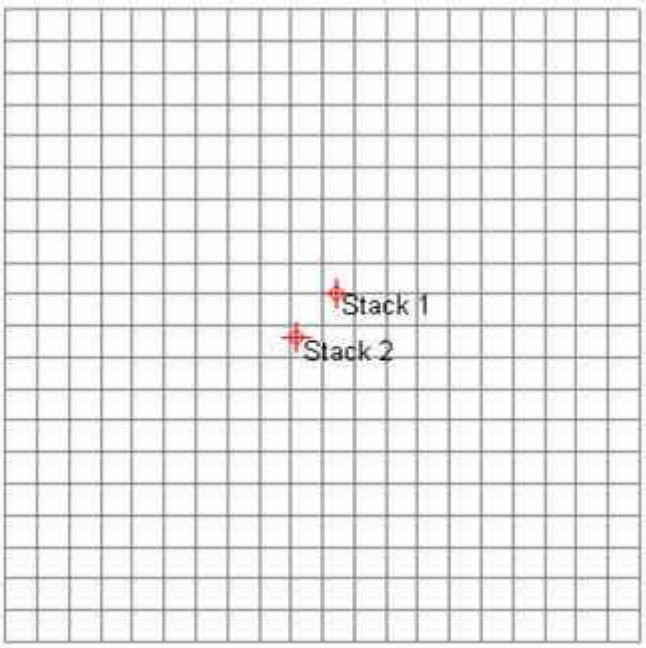



**Figure 6.1 – Example of a Cartesian grid.**

Tall stacks could require grids extending 1 to 3 km, while the grid for shorter stacks (10 to 20 m above ground) might only need to be extended a km or less from the property line.

### 6.1.2 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 6.2 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.

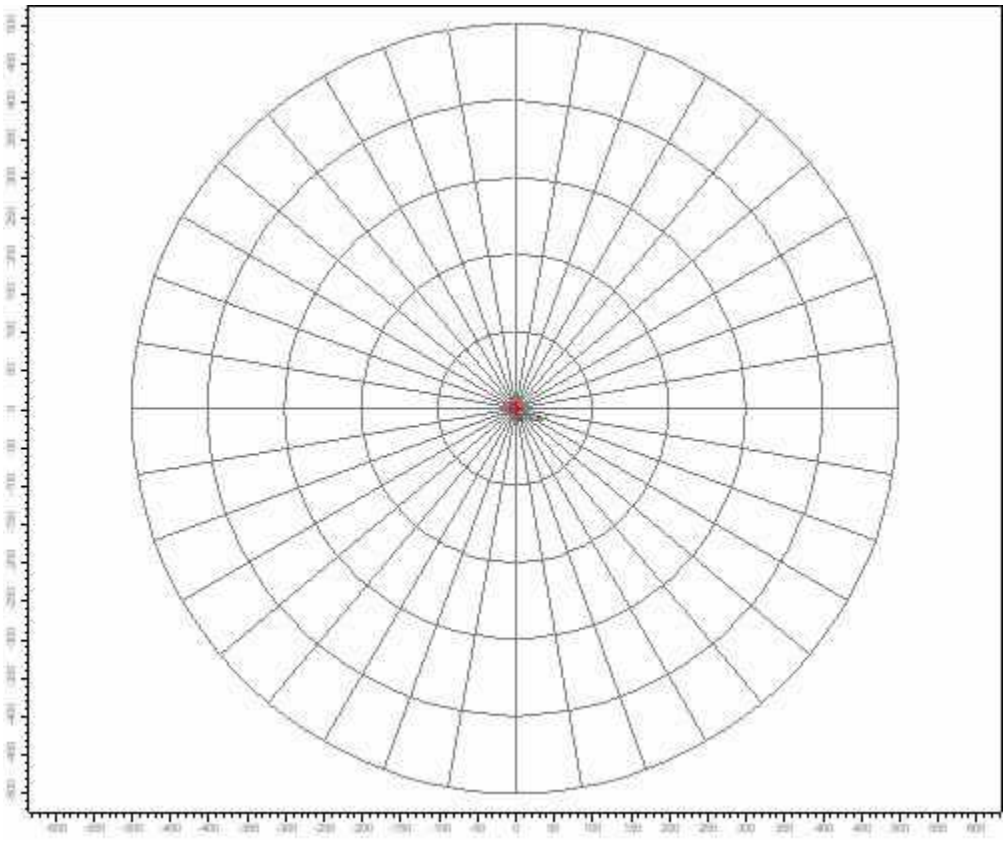


**Figure 6.2 – Example of a polar grid.**

### 6.1.3 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 6.3 provides an example of a multi-tier grid.

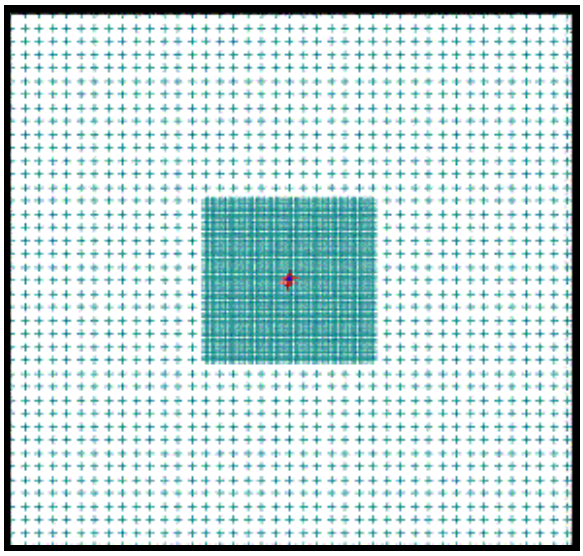


**Figure 6.3 - Sample Multi-Tier Grid with 2 tiers of spacing.**

## 6.1.4 Fence line Receptors

Unless on-site receptors are present, it is not necessary to model the locations within a property boundary. If on-site receptors may be present, contact the District concerning receptor placement. If a fence line receptor point does not represent an existing or reasonably anticipated person, it is not necessary to consider these results to determine the Maximum Exposed Individual (MEI), but fence line exposure should be considered to determine the Point of Maximum Impact (PMI).

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.

## 6.1.5 Discrete & Sensitive Receptors

Receptor grids do not always cover precise locations that may be 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 generate data on specific points for which data is especially critical. Examples of specific locations can include:

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

- Elevated receptors, such as balconies or air intakes on multilevel buildings, as concentrations of toxic substances can be higher there than at ground level.

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.

## 6.2 Variable Receptor Spacing to include the Point of Maximum Impact (PMI)

The receptor grid must be designed to include the Point of Maximum Impact (PMI). 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. An indication as to the PMI can be determined by using SCREEN3 or AERSCREEN applied to the most significant sources at a facility.

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 is used, finer grids, as described above, should be used for all areas with high concentrations, not just the single highest area.

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. Section 6.1.3 shows an example of multiple grid spacing to ensure that the maximum ground level offsite 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 taller stacks and greater distances to the property boundary, a receptor spacing greater than 25 m might be appropriate.

It is the responsibility of the modeler to demonstrate that the PMI has been identified and that the modeling includes all areas where Hazard Indices are above one, and the cancer risk is above ten per million, or other district standards.

### 6.2.1 Example Polar Grid Spacing

- 36 Directional Radials
- Radial Distances:
  - 25 m
  - 50 m
  - 100 m
  - 250 m
  - 500 m

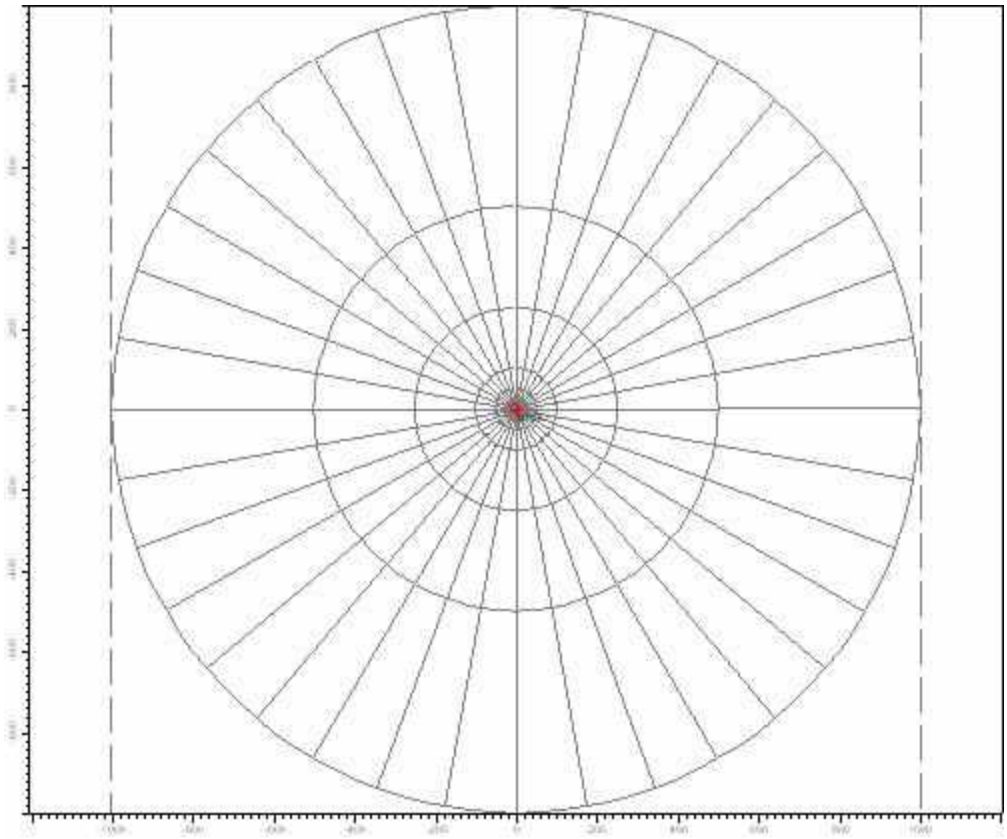


**Figure 6.4 – Sample Polar Grid receptor grid layout.**

# Chapter 7. Other Modeling Considerations

## 7.0 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 will form 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.

## 7.1 Use of Modelled Results in Combination with Monitoring Data

Monitoring and modeling should be considered complementary 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. Advance 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 siting monitors. 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.

## 7.2 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.

## 7.3 Level of Detail of Health Risk Assessments

Generally, a health risk assessment for CEQA purposes must include all sources of emissions that will emanate from a project. This includes existing and proposed facility-wide emissions. This includes all sources of potential emissions whether or not the project is subject to district permitting requirements. Additionally, all substances that the Office of Environmental Health Hazard Assessment has identified as having toxicity values must be included in the health risk assessment; some districts may allow a less detailed risk assessment.

It is not permissible to omit permitted sources in a CEQA risk assessment, even if these sources will be evaluated during the permit process. The permitting process does not evaluate the cumulative risk associated with the entire facility, only the individual permit unit. A challenge to the completeness of the risk assessments can be made if these sources are not included in the analysis.

It is also not permissible to omit criteria pollutants in the facility risk assessment, assuming that these emissions will be evaluated separately. Criteria pollutants have OEHHA approved RELs that must be included in the chronic and acute hazard indices. Again, a challenge to the completeness of the risk assessments can be made if these substances are omitted.

# Chapter 8. Exposure Assessment Procedures

## 8.0 Cancer Risk Assessment Procedure for Inhalation Only Pathway Pollutants

The following procedure may be used to assess the health risks from facilities for which diesel particulate matter is emitted or other substances identified as only entering the body through the inhalation pathway. Risk Assessments involving substances that enter the body through other pathways must be analyzed for each pathway. A risk assessment involving multipathway substances can to be prepared using the HARP program available through the California Air Resources Board.

Cancer Risk Procedure for Inhalation only Substances:

- Model emissions to determine both the:
  - annual average ground-level concentrations, and the
  - one hour maximum concentration (or other period depending on the acutely toxic substance)
- Create a plot file for these ground-level concentrations.
- Open the plot file using Microsoft EXCEL or another spreadsheet program.
- Copy the data from the plot(s) into Excel.
- To determine the cancer risk, apply the following formula to each ground-level concentrations:

**Cancer Risk = $S_i$ * $C_i$ * DBR * A * EF * ED *$10^{-6}$ / AT**

Where:

$S_i$ = Slope Factor for substance i
$C_i$ = Concentration in the air of substance i
DBR = Daily Breathing Rate:

Residential Receptors = 302 L/kg-day (default 80$^{th}$ %ile)
= 393 L/kg-day (95$^{th}$ %ile)

Worker Receptors = 149 L/kg-day

A = Inhalation Absorption Rate = 1

EF = Exposure Frequency:

Residential Receptors = 350 days

Worker Receptors = 245 days

ED = Exposure Duration:

See Section 1.3

AT = Averaging Time = 25,550 days

The result will be cancer risk for each source and receptor combination modeled.

For worker exposures, in addition to adjusting the breathing rate, exposure frequency, and exposure duration for workers bersus residents, the emission rate must be adjusted to ensure that he worker risk is based upon the pollutant concentrations to which the worker is exposed. For additional information, see Section 8.2.2b of OEHHA's Air Toxics Hot Spots Program Risk Assessment Guidelines: The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, August 2003.

## 8.1 Cancer Risk Assessment Procedure for Multi-Pathway Pollutants

The procedure for preparing a multi-pathway risk assessment can be complex. The HARP User Guide and the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines contains a detailed discussion of how to prepare multi-pathway risk assessments. These documents and others can be found on the CARB website at http://www.arb.ca.gov/toxics/harp/docs.htm.

## 8.2 Chronic Noncancer Health Impacts

The procedure for determining the impact of chronically toxic substances is described in detail in the OEHHA state guidelines[38]. Noncancer chronic inhalation impacts are calculated by dividing the annual average concentration by the REL (Reference Exposure Level) for that substance. The REL is defined as the concentration at which no adverse noncancer health effects are anticipated. For a single substance, this result of this calculation is called the Hazard Quotient. The following equation is used to calculate the Hazard Quotient:

**Hazard Quotient = $C_i/REL_i$**

Where:
$C_i$ = Concentration in the air of substance i
$REL_i$ = Chronic noncancer Reference Exposure Level for substance i

For multiple substances, the Hazard Index (HI) is calculated. The HI is calculated by summing the HQs from all substances that affect the same organ system. HQs for different organ systems are not added, for example, do not sum respiratory irritation HQs with cardiovascular effects. The following equation is used to calculate the Hazard Index for the eye irritation endpoint:

Hazard Index ($HI_{eye}$) = $HQ_{\text{substance 1(eye)}} + HQ_{\text{substance 2(eye)}}$

No exposure duration adjustment (e.g., 9/70) should be made for noncancer assessments.

For a chronic noncancer assessment involving multipathway pollutants, the California Air Resources Board HARP model can be used.

## 8.3 Acute Noncancer Health Impacts

The procedure for determining the impact of acutely toxic substances is also described in detail in the OEHHA state guidelines[39]. The calculation of acute noncancer impacts is similar to the procedure for chronic noncancer impacts. In most cases, for a single substance, the acute Hazard Quotient is the highest one hour air concentration divided by the acute REL for that substance. There are a few substances that have acute RELs for exposure periods other than 1 hour. In those cases, the maximum air concentration for the appropriate exposure period (e.g., 8 hours) is divided by the acute REL.

As with the chronic noncancer calculation, for multiple substances that impact the same organ system, the individual substance HQs are summed to determine the HI.

No exposure period adjustments are necessary for acute health impact calculations.

Acute exposures are calculated for the inhalation pathway only.

[38] OEHHA Air Toxics Hot Spots Program Guidance Manual for the Preparation of Risk, June 2002

# Appendix A

# Meteorological Data

# 1.0 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.

Airport surface data is available from the National Climatic Data Center (NCDC) and other sources. Mixing height data or upper air data were available from NCDC. If mixing heights have not been calculated for the year of interest, mixing height software is available from EPA for use in calculating mixing heights from upper air data. AERMET is used to process upper air and surface data for use in AERMOD. Unlike PCRAMMET, AERMET produces 2 files: a surface file (*.sfc) and a profile file (*.pfl).

## 1.1 Surface Data

### 1.1.1 Screening Meteorological Data

Screening surface data may be used in ISC when no applicable surface data is available for the area to be modeled. Most user interface on the market today can generate screening meteorological data for ISC. Please contact the district before using screening meteorological data to ensure that no data is available for the area of concern.

### 1.1.2 Hourly Meteorological Data

Hourly surface data is supported in several formats including:

- 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 1.0 lists the data contained in the CD-144 file format that is needed to pre-process your meteorological data.

### Table 1.0 – 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 |

- 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 1.1 lists the data contained in the SCRAM file format.

### Table 1.1 - 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:
  - Surface pressure: for dry and wet particle deposition;
  - Precipitation type: for wet particle deposition only; or
  - Precipitation amount: for wet particle deposition only.

- SAMSON Surface Data: The SAMSON data contains all of the required meteorological variables for concentration, dry and wet particle deposition, and wet vapor deposition.
- NCDC data can be purchase online from the following web site: http://cdo.ncdc.noaa.gov/qclcd/QCLCD

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.

## 2.0 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 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:

- SCRAM BBS –download free of charge, mixing height data for the U.S. for years 1984 through 1991.
- WebMET.com –download free of charge, mixing height and upper air data from across North America, including Ontario.
- Free Upper air data can be downloaded from following web site (FSL Format) http://raob.fsl.noaa.gov/
- Table 2.1 lists the format of the mixing height data file used by PCRAMMET.

**Table 2.1 - 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.

## 2.1 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:

- The first stage (Stage1) extracts meteorological data from archive data files and processes the data through various quality assessment checks.
- 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.
- 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:

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

## 2.2 PCRAMMET

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.

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.

## 2.3 Regional Meteorological Data

The district has/may prepare regional meteorological data sets for use in Tier 2 modeling in several formats. Please contact the District to determine what data is available:

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

### 2.3.1 Pre-Processing Steps

Regional data for AERMOD can be processed in 2 forms:

- Merged: Data that has been processed through Stage2 of AERMET (AERMET stages are described in Section 7.1.3) 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 that has been processed through Stage3 of AERMET with predefined Land Use characteristics for "Urban" and "Rural" environments. This data is ready for use with AERMOD (Tier 2).

#### 2.3.1.1 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 can be a weighted average over a radius of 3 km from the meteorological station and split into 12 sectors, or processed with other parameters approved by the district. The surface conditions needed are the albedo (A), the Bowen ratio (Bo) and the surface roughness (Zo). These parameter values can be derived from data in Tables 6.1, 6.2, 6.3 and 4.3 of the AERMET User's Guide[1].

[1] 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.

## 2.4 Availability and Use of District Meteorological Data

The district may provide meteorological data sets that can be used for air quality studies using ISCST or AERMOD. The 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 with district approval.

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 by using EPA's missing data guidance document written by Russ Lee or guidance provided by the District.

The following factors determine the appropriateness of a meteorological data set, the:

- proximity of the meteorological site to the area being modeled,
- complexity of the terrain,
- exposure of the meteorological measurement site, and the
- time period of the data collection.

It should be emphasized that both the spatial and temporal aspects of the data set are the key requirement for determining the appropriateness of a meteorological data set. Not one, but all of these factors must be considered.

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.

## 2.5 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 at which 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.

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.

# 3.0 Land Use Characterization (AERMOD only)

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 1.4 lists typical values for a range of land-use types as a function of season.

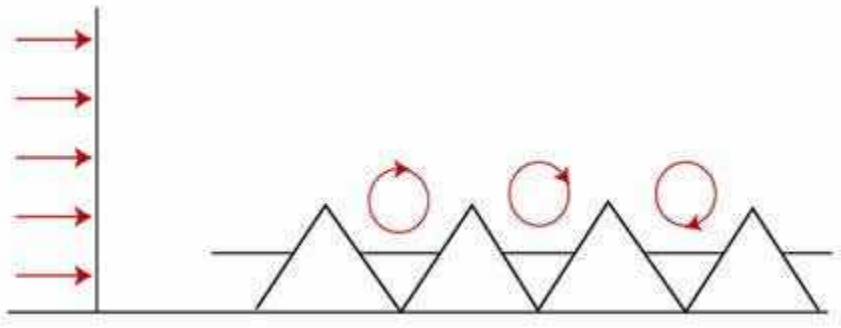


**Figure 1.0 - For many modeling applications, surface roughness can be considered to be on the order of one tenth of the height of the roughness elements.**

EPA has developed a modeling tool called AERSURFACE[2] to aid in obtaining realistic and reproducible surface characteristic values of albedo, Bowen ratio, and surface roughness length, for input to AERMET. The tool uses publicly available national land cover datasets and look-up tables of surface characteristics that vary by land cover type and season. AERSURFACE calculates the following 3 parameters for input into AERMET:

[2] AERSURFACE User's Guide, EPA-454/B-08-001 January 2008, http://www.epa.gov/scram001/dispersion_related.htm#aersurface

- Surface Roughness:
  The determination of the surface roughness length should be based on an inverse distance weighted geometric mean for a default upwind distance of 1 kilometer relative to the measurement site. Surface roughness length may be varied by sector to account for variations in land cover near the measurement site; however, the sector widths should be no smaller than 30 degrees.

- Bowen Ratio:
  The determination of the Bowen ratio should be based on a simple unweighted geometric mean (i.e., no direction or distance dependency) for a representative domain, with a default domain defined by a 10km by 10km region centered on the measurement site.

- Albedo:
  The determination of the albedo should be based on a simple unweighted arithmetic mean (i.e., no direction or distance dependency) for the same representative domain as defined for Bowen ratio, with a default domain defined by a 10km by 10km region centered on the measurement site.

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 within 3 km of the site. The selection of wind direction dependent sectors is described in sections 3.1 to 3.3.

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

## Table 3.1 –USGS NLCD92 Land Cover Categories used in AERSURFACE

| Classification | Class Number | Land Cover Category |
|---|---|---|
| Water | 11 | Open Water |
| | 12 | Perennial Ice/Snow |
| Developed | 21 | Low Intensity Residential |
| | 22 | High Intensity Residential |
| | 23 | Commercial/Industrial/Transportation |
| Barren | 31 | Bare Rock/Sand/Clay |
| | 32 | Quarries/Strip Mines/Gravel Pits |
| | 33 | Transitional |
| Forested Upland | 41 | Deciduous Forest |
| | 42 | Evergreen Forest |
| | 43 | Mixed Forest |
| Shrubland | 51 | Shrubland |
| Non-natural Woody | 61 | Orchards/Vineyards/Other |
| Herbaceous Upland | 71 | Grasslands/Herbaceous |
| Herbaceous Planted/Cultivated | 81 | Pasture/Hay |
| | 82 | Row Crops |
| | 83 | Small Grains |
| | 84 | Fallow |
| | 85 | Urban/Recreational Grasses |
| Wetlands | 91 | Woody Wetlands |
| | 92 | Emergent Herbaceous Wetlands |

## Table 3.2 –AERSURFACE Seasonal Category Description

| Seasonal Category | Season Description | Default Month Assignments |
|---|---|---|
| 1 | Midsummer with lush vegetation | Jun, Jul, Aug |
| 2 | Autumn with unharvested cropland | Sep, Oct, Nov |
| 3 | Late autumn after frost and harvest, or winter with no snow | Dec, Jan, Feb |
| 4 | Winter with continuous snow on ground | Dec, Jan, Feb |
| 5 | Transitional spring with partial green coverage or short annuals | Mar, Apr, May |

**Table 3.3 AERSURFACE Seasonal Values of Surface Roughness for the NLCD92 21-Land Cover Classification System**

| Class Number | Class Name | Seasonal Surface Roughness (m) | | | | |
|---|---|---|---|---|---|---|
| | | *1* | *2* | *3* | *4* | *5* |
| 11 | Open Water | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 12 | Perennial Ice/Snow | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| 21 | Low Intensity Residential | 0.54 | 0.54 | 0.50 | 0.50 | 0.52 |
| 22 | High Intensity Residential | 1 | 1 | 1 | 1 | 1 |
| 23 | Commercial/Industrial/Transportation (Site at airport) | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Commercial/Industrial/Transportation (Not at airport) | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| 31 | Bare Rock/Sand/Clay (Arid Region) | 0.05 | 0.05 | 0.05 | NA | 0.05 |
| | Bare Rock/Sand/Clay (Non-arid Region) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| 32 | Quarries/Strip Mines/Gravel Pits | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| 33 | Transitional | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| 41 | Deciduous Forest | 1.3 | 1.3 | 0.6 | 0.5 | 1 |
| 42 | Evergreen Forest | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| 43 | Mixed Forest | 1.3 | 1.3 | 0.95 | 0.9 | 1.15 |
| 51 | Shrubland (Arid Region) | 0.15 | 0.15 | 0.15 | NA | 0.15 |
| | Shrubland (Non-arid Region) | 0.3 | 0.3 | 0.3 | 0.15 | 0.3 |
| 61 | Orchards/Vineyards/Other | 0.3 | 0.3 | 0.1 | 0.5 | 0.2 |
| 71 | Grasslands/Herbaceous | 0.1 | 0.1 | 0.01 | 0.005 | 0.05 |
| 81 | Pasture/Hay | 0.15 | 0.15 | 0.02 | 0.01 | 0.03 |
| 82 | Row Crops | 0.2 | 0.2 | 0.02 | 0.01 | 0.03 |
| 83 | Small Grains | 0.15 | 0.15 | 0.02 | 0.01 | 0.03 |
| 84 | Fallow | 0.05 | 0.05 | 0.02 | 0.01 | 0.02 |
| 85 | Urban/Recreational Grasses | 0.02 | 0.015 | 0.01 | 0.005 | 0.015 |
| 91 | Woody Wetlands | 0.7 | 0.7 | 0.6 | 0.5 | 0.7 |
| 92 | Emergent Herbaceous Wetlands | 0.2 | 0.2 | 0.2 | 0.1 | 0.2 |

- 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 3.4 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, for a land use types and season combination, 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.

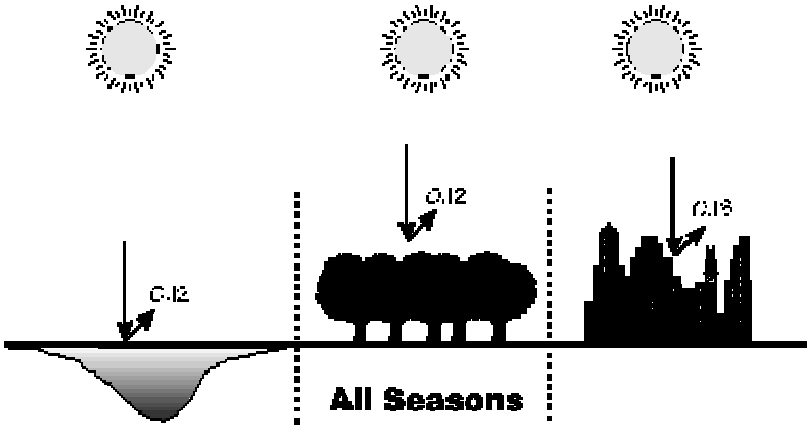



**Table 3.4 AERSURFACE Seasonal Values of Albedo for the NLCD92 21-Land Cover Classification System**

| Class Number | Class Name | Seasonal Albedo Values | | | | |
|---|---|---|---|---|---|---|
| | | *1* | *2* | *3* | *4* | *5* |
| 11 | Open Water | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 12 | Perennial Ice/Snow | 0.6 | 0.6 | 0.7 | 0.7 | 0.6 |
| 21 | Low Intensity Residential | 0.16 | 0.16 | 0.18 | 0.45 | 0.16 |
| 22 | High Intensity Residential | 0.18 | 0.18 | 0.18 | 0.35 | 0.18 |
| 23 | Commercial/Industrial/Transportation (Site at airport) | 0.18 | 0.18 | 0.18 | 0.35 | 0.18 |
| | Commercial/Industrial/Transportation (Not at airport) | 0.18 | 0.18 | 0.18 | 0.35 | 0.18 |
| 31 | Bare Rock/Sand/Clay (Arid Region) | 0.2 | 0.2 | 0.2 | NA | 0.2 |
| | Bare Rock/Sand/Clay (Non-arid Region) | 0.2 | 0.2 | 0.2 | 0.6 | 0.2 |
| 32 | Quarries/Strip Mines/Gravel Pits | 0.2 | 0.2 | 0.2 | 0.6 | 0.2 |
| 33 | Transitional | 0.18 | 0.18 | 0.18 | 0.45 | 0.18 |
| 41 | Deciduous Forest | 0.16 | 0.16 | 0.17 | 0.5 | 0.16 |
| 42 | Evergreen Forest | 0.12 | 0.12 | 0.12 | 0.35 | 0.12 |
| 43 | Mixed Forest | 0.14 | 0.14 | 0.14 | 0.42 | 0.14 |
| 51 | Shrubland (Arid Region) | 0.25 | 0.25 | 0.25 | NA | 0.25 |
| | Shrubland (Non-arid Region) | 0.18 | 0.18 | 0.18 | 0.5 | 0.18 |
| 61 | Orchards/Vineyards/Other | 0.18 | 0.18 | 0.18 | 0.5 | 0.14 |
| 71 | Grasslands/Herbaceous | 0.18 | 0.18 | 0.2 | 0.6 | 0.18 |
| 81 | Pasture/Hay | 0.2 | 0.2 | 0.18 | 0.6 | 0.14 |
| 82 | Row Crops | 0.2 | 0.2 | 0.18 | 0.6 | 0.14 |
| 83 | Small Grains | 0.2 | 0.2 | 0.18 | 0.6 | 0.14 |
| 84 | Fallow | 0.18 | 0.18 | 0.18 | 0.6 | 0.18 |
| 85 | Urban/Recreational Grasses | 0.15 | 0.15 | 0.18 | 0.6 | 0.15 |
| 91 | Woody Wetlands | 0.14 | 0.14 | 0.14 | 0.3 | 0.14 |
| 92 | Emergent Herbaceous Wetlands | 0.14 | 0.14 | 0.14 | 0.3 | 0.14 |

- 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 3.5 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 3.5 AERSURFACE Seasonal Values of Bowen Ratio for the NLCD92 21-Land Cover Classification System - Average moisture conditions**

| Class Number | Class Name | Seasonal Bowen Ratio Values-Average | | | | |
|---|---|---|---|---|---|---|
| | | *1* | *2* | *3* | *4* | *5* |
| 11 | Open Water | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 12 | Perennial Ice/Snow | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| 21 | Low Intensity Residential | 0.8 | 1 | 1 | 0.5 | 0.8 |
| 22 | High Intensity Residential | 1.5 | 1.5 | 1.5 | 0.5 | 1.5 |
| 23 | Commercial/Industrial/Transportation (Site at airport) | 1.5 | 1.5 | 1.5 | 0.5 | 1.5 |
| | Commercial/Industrial/Transportation (Not at airport) | 1.5 | 1.5 | 1.5 | 0.5 | 1.5 |
| 31 | Bare Rock/Sand/Clay (Arid Region) | 4 | 6 | 6 | NA | 3 |
| | Bare Rock/Sand/Clay (Non-arid Region) | 1.5 | 1.5 | 1.5 | 0.5 | 1.5 |
| 32 | Quarries/Strip Mines/Gravel Pits | 1.5 | 1.5 | 1.5 | 0.5 | 1.5 |
| 33 | Transitional | 1 | 1 | 1 | 0.5 | 1 |
| 41 | Deciduous Forest | 0.3 | 1 | 1 | 0.5 | 0.7 |
| 42 | Evergreen Forest | 0.3 | 0.8 | 0.8 | 0.5 | 0.7 |
| 43 | Mixed Forest | 0.3 | 0.9 | 0.9 | 0.5 | 0.7 |
| 51 | Shrubland (Arid Region) | 4 | 6 | 6 | NA | 3 |
| | Shrubland (Non-arid Region) | 1 | 1.5 | 1.5 | 0.5 | 1 |
| 61 | Orchards/Vineyards/Other | 0.5 | 0.7 | 0.7 | 0.5 | 0.3 |
| 71 | Grasslands/Herbaceous | 0.8 | 1 | 1 | 0.5 | 0.4 |
| 81 | Pasture/Hay | 0.5 | 0.7 | 0.7 | 0.5 | 0.3 |
| 82 | Row Crops | 0.5 | 0.7 | 0.7 | 0.5 | 0.3 |
| 83 | Small Grains | 0.5 | 0.7 | 0.7 | 0.5 | 0.3 |
| 84 | Fallow | 0.5 | 0.7 | 0.7 | 0.5 | 0.3 |
| 85 | Urban/Recreational Grasses | 0.5 | 0.7 | 0.7 | 0.5 | 0.3 |
| 91 | Woody Wetlands | 0.2 | 0.2 | 0.3 | 0.5 | 0.2 |
| 92 | Emergent Herbaceous Wetlands | 0.1 | 0.1 | 0.1 | 0.5 | 0.1 |

## Table 3.6 AERSURFACE Seasonal Values of Bowen Ratio for the NLCD92 21-Land Cover Classification System - Wet moisture conditions

| Class Number | Class Name | Seasonal Bowen Ratio Values-Wet | | | | |
|---|---|---|---|---|---|---|
| | | *1* | *2* | *3* | *4* | *5* |
| 11 | Open Water | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 12 | Perennial Ice/Snow | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| 21 | Low Intensity Residential | 0.6 | 0.6 | 0.6 | 0.5 | 0.6 |
| 22 | High Intensity Residential | 1 | 1 | 1 | 0.5 | 1 |
| 23 | Commercial/Industrial/Transportation (Site at airport) | 1 | 1 | 1 | 0.5 | 1 |
| | Commercial/Industrial/Transportation (Not at airport) | 1 | 1 | 1 | 0.5 | 1 |
| 31 | Bare Rock/Sand/Clay (Arid Region) | 1.5 | 2 | 2 | NA | 1 |
| | Bare Rock/Sand/Clay (Non-arid Region) | 1 | 1 | 1 | 0.5 | 1 |
| 32 | Quarries/Strip Mines/Gravel Pits | 1 | 1 | 1 | 0.5 | 1 |
| 33 | Transitional | 0.7 | 0.7 | 0.7 | 0.5 | 0.7 |
| 41 | Deciduous Forest | 0.2 | 0.4 | 0.4 | 0.5 | 0.3 |
| 42 | Evergreen Forest | 0.2 | 0.3 | 0.3 | 0.5 | 0.3 |
| 43 | Mixed Forest | 0.2 | 0.35 | 0.35 | 0.5 | 0.3 |
| 51 | Shrubland (Arid Region) | 1.5 | 2 | 2 | NA | 1 |
| | Shrubland (Non-arid Region) | 0.8 | 1 | 1 | 0.5 | 0.8 |
| 61 | Orchards/Vineyards/Other | 0.3 | 0.4 | 0.4 | 0.5 | 0.2 |
| 71 | Grasslands/Herbaceous | 0.4 | 0.5 | 0.5 | 0.5 | 0.3 |
| 81 | Pasture/Hay | 0.3 | 0.4 | 0.4 | 0.5 | 0.2 |
| 82 | Row Crops | 0.3 | 0.4 | 0.4 | 0.5 | 0.2 |
| 83 | Small Grains | 0.3 | 0.4 | 0.4 | 0.5 | 0.2 |
| 84 | Fallow | 0.3 | 0.4 | 0.4 | 0.5 | 0.2 |
| 85 | Urban/Recreational Grasses | 0.3 | 0.4 | 0.4 | 0.5 | 0.2 |
| 91 | Woody Wetlands | 0.1 | 0.1 | 0.1 | 0.5 | 0.1 |
| 92 | Emergent Herbaceous Wetlands | 0.1 | 0.1 | 0.1 | 0.5 | 0.1 |

**Table 3.7 AERSURFACE Seasonal Values of Bowen Ratio for the NLCD92 21-Land Cover Classification System - Dry moisture conditions**

| Class Number | Class Name | Seasonal Bowen Ratio Values-Dry | | | | |
|---|---|---|---|---|---|---|
| | | *1* | *2* | *3* | *4* | *5* |
| 11 | Open Water | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 12 | Perennial Ice/Snow | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| 21 | Low Intensity Residential | 2 | 2.5 | 2.5 | 0.5 | 2 |
| 22 | High Intensity Residential | 3 | 3 | 3 | 0.5 | 3 |
| 23 | Commercial/Industrial/Transportation (Site at airport) | 3 | 3 | 3 | 0.5 | 3 |
| | Commercial/Industrial/Transportation (Not at airport) | 3 | 3 | 3 | 0.5 | 3 |
| 31 | Bare Rock/Sand/Clay (Arid Region) | 6 | 10 | 10 | NA | 5 |
| | Bare Rock/Sand/Clay (Non-arid Region) | 3 | 3 | 3 | 0.5 | 3 |
| 32 | Quarries/Strip Mines/Gravel Pits | 3 | 3 | 3 | 0.5 | 3 |
| 33 | Transitional | 2 | 2 | 2 | 0.5 | 2 |
| 41 | Deciduous Forest | 0.6 | 2 | 2 | 0.5 | 1.5 |
| 42 | Evergreen Forest | 0.6 | 1.5 | 1.5 | 0.5 | 1.5 |
| 43 | Mixed Forest | 0.6 | 1.75 | 1.75 | 0.5 | 1.5 |
| 51 | Shrubland (Arid Region) | 6 | 10 | 10 | NA | 5 |
| | Shrubland (Non-arid Region) | 2.5 | 3 | 3 | 0.5 | 2.5 |
| 61 | Orchards/Vineyards/Other | 1.5 | 2 | 2 | 0.5 | 1 |
| 71 | Grasslands/Herbaceous | 2 | 2 | 2 | 0.5 | 1 |
| 81 | Pasture/Hay | 1.5 | 2 | 2 | 0.5 | 1 |
| 82 | Row Crops | 1.5 | 2 | 2 | 0.5 | 1 |
| 83 | Small Grains | 1.5 | 2 | 2 | 0.5 | 1 |
| 84 | Fallow | 1.5 | 2 | 2 | 0.5 | 1 |
| 85 | Urban/Recreational Grasses | 1.5 | 2 | 2 | 0.5 | 1 |
| 91 | Woody Wetlands | 0.2 | 0.2 | 0.2 | 0.5 | 0.2 |
| 92 | Emergent Herbaceous Wetlands | 0.2 | 0.2 | 0.2 | 0.5 | 0.2 |

## 3.1 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.

## 3.2 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 surface characteristics need to be assessed in a circle with a radius of one to three kilometers from the source. Contact the District to determine the appropriate parameters for meteorological data in accordance with EPA guidance. Data should be chosen for a meteorological data site with surface characteristics similar to those of the area around the source. To prepare the surface data, use the AERSURFACE module of AERMOD or perform a site survey using the standard land uses defined in the AERSURFACE documentation and the default surface roughness length for those land uses.

The surface characteristics are determined by assessing the land use across the monitoring site 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.

**For example**: If the area under review is 15% cultivated land, 5% desert shrub land, and 80% Urban, the same weighted percentages would be used to derive a weighted average albedo, Bowen ratio, and surface roughness parameters.

## 3.3 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.

## 3.4 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.

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# Modeling and Exposure Assessment Input and Output Data

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The following information must be submitted with a risk assessment. It provides the essential requirements for a general assessment. Site-specific scenarios 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. *Consultation with your local air district is strongly recommended.*

## 1.0 General Information

**1.0.1** Submittal Date
**1.0.2** Facility/Project Name
**1.0.3** Facility/Project Location
**1.0.4** Risk Assessor Name

## 1.1 Hazard Identification

**1.1.1** Table of all toxic air contaminants (TAC) emitted by the Facility/Project including:
- CAS number,
- Chemical name(s) – include appropriate common names,
- Physical state as emitted.

**1.1.2** Table of carcinogens,
**1.1.3** Table of acutely toxic TACs, and
**1.1.4** Table of chronically toxic non-carcinogenic TACs.
**1.1.5** Table showing the processes and the TACs emitted from each process.

## 1.2 Exposure Assessment

### 1.2.1 Air Dispersion Model Options

1.2.1.1 Model Used
- AERMOD - version number,
- ISCST - version number,
- Other Model - Specify name, version number, and reason for use.

1.2.1.2 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.

1.2.1.3 Dispersion Coefficients Used, and How they were Determined
- Urban
- Rural

(Urban or Rural conditions can be determined through the use of an Auer Land Use or Population Density analysis.)

1.2.1.4 Coordinate System Used
- UTM Coordinates
- Local Coordinates
- Other

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

### 1.2.2 Source Information

1.2.2.1 Source Summaries

Create tables which show the following point, area, volume, line, or flare modeling parameters. Following the tables must be a description of the reasoning for each modeling parameter chosen.

Point Sources Summary

- Source name
- Source location coordinates
  - X (m)
  - Y (m)
- Table showing the names of each TAC modeled and max hourly and annual emission rate in grams per second.
- Stack heights in meters
- Stack Diameter in meters
- Stack Exit Temperature in degrees K
- Stack Exit Velocity in meters per second
- Stack direction
  - Vertical exhaust direction
  - Horizontal exhaust direction
- Rain Cap Present
  If the stack is either horizontal in orientation or has a rain cap, stack parameters must be adjusted as per guidance.
- Operating Schedule.
  Create tables showing how the normal emission rates vary by source.

Area Sources Summary

- Source name
- Source location coordinates (Southwest Vertex):
  - X (m)
  - Y (m)
- Table showing the names of each TAC modeled and emission rate in grams per second-meter$^2$.
- Exhaust height in meters
- Easterly Dimension in meters
- Northerly Dimension in meters
- Initial Vertical Dimension in meters
- Angle from North in degrees.
- Operating Schedule.
  Create tables showing how the normal emission rates vary by source.

Volume Sources Summary

- Source name
- Source location coordinates (Center of Source):
  - X (m)
  - Y (m)
- Table showing the names of each TAC modeled and emission rate in grams per second.
- Source height in meters
- Initial Horizontal Dimension in meters
- Initial Vertical Dimension in meters

- Operating Schedule.
  Create tables showing how the normal emission rates vary by source.

Line Sources Summary (CAL3QHCR specific; for step by step guidance according to SMAQMD recommendations, see CAPCOA's CEQA Risk Assessment Guidelines)

- Source name (highway, freeway, or major roadway)
- Roadway compass orientation (in terms of x,y; arbitrary origin of 0,0)
- Location of nearest receptor to source and other receptors as required by local air district
- Calculation averaging time (such as 60 min)
- Surface roughness (cm, from 3 to 400)
- Settling velocity (cm/s)
- Deposition velocity (cm/s)
- Site setting, rural or urban
- Form of traffic volume (recommended: 1 for one hour's data)
- Pollutant (P for PM10)
- Hourly ambient background (0 or as recommended by air district)
- Roadway height indicator (AG for at grade; FL for elevated and filled; BR for bridge; DP for depressed)
- Roadway height (AG is 0)

Other input parameters are required for CAL3QHCR. See CAPCOA's CEQA Risk Assessment Guidelines or contact your local air district.

1.2.2.2 Emissions Profile during Abnormal Operations Start-Up or Shutdown

Create table showing how abnormal emission rates vary by source. Abnormal emission rates include start-up or shutdown.

1.2.2.3 Building Downwash

- Describe whether the stack(s) are 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).
- If it is, then prepare 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.

1.2.2.4 Scaled Plot Plan

Provide a scaled plot plan, preferably in electronic format, displaying:

- Emission release locations,
- Buildings (On site and neighboring),
- Tanks (On site and neighboring),
- Property boundaries,
- Model receptor locations,
- Sensitive receptors locations,
- Fenceline receptors locations.

1.2.2.5 Sensitive Receptors locations

Describe the location and nature of all nearby sensitive receptors (e.g. residences, schools, hospitals, etc...)

1.2.2.6 Points of Maximum Impact

Demonstrate that the actual point of maximum impact, residential point of maximum impact, and the offsite worker point of maximum impact have been reached.

### 1.2.3 Terrain Conditions

1.2.3.1 Elevated or complex terrain

Describe whether the modeled area contains elevated or complex terrain, and provide a discussion on the approach used to determine terrain characteristics of the assessment area.

1.2.3.2 Digital Terrain Data

Describe whether the data for digital terrain is:

- CDED 1-degree,
- CDED 15-minute,
- USGS 7.5-minute Ontario dataset, or
- Other, and describe other.

1.2.3.3 Elevation data import

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

### 1.2.4 Meteorological Data

1.2.4.1 Regional Meteorological data

Specify what Regional Meteorological data set was used and note the period of the record.

1.2.4.2 Was a Regional Meteorological Merge data file used?

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.

1.2.4.3 Meteorological data preparation

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.

1.2.4.4 Local Meteorological data

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.

1.2.4.5 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

1.2.4.6 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.

1.2.4.7 Turbulence

The following should be provided and discussed if site specific data is being used:

- Frequency distributions,
- Diurnal and seasonal variations.

### 1.2.5 Dispersion Model Results

1.2.5.1 Modeling 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

1.2.5.2 Meteorological Data

The electronic meteorological data files must be provided.

1.2.5.3 Terrain Data

Digital elevation terrain data files must be provided if included in the analysis.

1.2.5.3 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.

1.2.5.5 Emission Summary

An emission summary table must be provided.

1.2.5.6 Discussion

The results overview should include a discussion of the following items, where applicable:

- The use of alternative models,
- The use of any non-default model options,
- Topographic effects on the predictions,
- All predicted concentrations based on the REL based exposure period.

## 1.3 Toxicity Data

### 1.3.1 Toxicity Values for Each TAC Emitted

A table must be provided that shows the following data for each TAC emitted:

- The cancer potency factors,
- The acute and chronic RELs,
- The averaging times for the acute RELs,

- The pathways the TAC enters the body, and
- The date these factors were updated.

### 1.3.2 Target Organ Systems for Each Acute and Non-Carcinogenic Chronic Substance

A table must be provided that shows the target organs and body systems each acute and non-carcinogenic chronic impact.

## 1.4 Risk Characterization

### 1.4.1 Points of Maximum Impact

The following points of maximum impact need to be identified:

- The Points of Maximum Impact (PMI),
- The Maximum Exposed Individual - Residential (MEIR), and
- The Maximum Exposed Individual – Worker (MEIW).

At these locations the following data must be provided:

- Locations (UTM coordinates, or Latitude/Longitude coordinates, or other coordinates),
- Cancer risk, acute and chronic hazard indices,
- Sources and pollutants that contribute to risks which exceed the district's cancer risk, or acute, or chronic hazard index significance levels.

### 1.4.2 Exposure Pathways

Identify each pathways used to determine the cancer risk and chronic hazard indices. Provide all assumptions used for pathways (e.g., the percentage of home-grown vegetables consumed locally, etc…).

### 1.4.3 Graphical Presentations

Maps must be provided which show the following:

- Locations of sensitive receptors,
- Location of PMI, MEIR, and MEIW for cancer, acute, and non-cancer chronic risks,
- Isopleth lines showing cancer risk, acute, and chronic hazard indices in magnitudes specified by the Air District (e.g., cancer risk starting at 10 per million and increasing by tens per million.)

### 1.4.4 Guidelines and Software

Specify:

- Describe whether these CAPCOA Guidelines have been applied or other Guidelines were applied,
- The risk assessment software utilized (e.g., Hot Spots Analysis and Reporting Program or HARP),
- If risk assessment software other than HARP is used, then and provide a demonstration that the results will show the same results as HARP,
- Discuss any software used to import model results into HARP.

## 2.0 Modeling Files

The following files from the air quality dispersion model and risk assessment software should be provided:

Air quality dispersion model (if HARP is not used)

- Input file (*.inp, *.ADI, *.dat)
- Output file (*.out, *.ADO, *.lst)
- Meteorological files

- Plotfiles

Building Downwash Analysis (BPIP) (if HARP is not used)

- Input file
- Output file

Risk assessment software (i.e., HARP):

- Transaction files for the facilities, buildings, and property boundaries (*.tra)
- Transaction files for the source receptors (*.rec)
- Facility database for included facilities building, and property boundaries (*.mdb) as an alternative to the transaction files
- Health factor database (Health.mdb)
- ISC Workbook file with all ISC parameters (*.isc)
- ISC input file generated by HARP when ISC is run (*.inp)
- ISC output file generated by HARP when ISC is run (*.out)
- List of error messages generated by ISC (*.err)
- Plot file generated by ISC (*.plt)
- Representative meteorological data used for the facility air dispersion modeling (*.met)
- Any digital elevation model files (if applicable) (*.dem)
- Average and maximum $\chi/Q$ for each source-receptor combination; generated by ISC (*.xoq)
- ISC binary output file (FOR REFINED ACUTE ANALYSIS ONLY); holds $\chi/Q$ data for each hour (*.bin)
- Source/receptor file; contains list of sources and receptors for the ISC run; generated by HARP when you set up ISC (*.src)
- Emission Rate files (if changes were made to database) (*.ems)
- Site-specific parameters used for all receptor risk modeling (*.sit)
- (Screening) Adjustment factor files (IF SCREEN MET IS USED) (*.adj)
- Point estimate risk reports generated by HARP; this file is updated automatically each time you perform one of the point estimate risk analysis functions ((e.g., acute, chronic, cancer, derived (adjusted). Etc.)) (*.rsk)
- Database for Census (population) file (census.mdb)
- Map file used to overlay facility and receptors (*.map)
- HARP Exception Report (ExceptionReport.txt)
- Risk result text files for key receptors (STANDARD REPORT SET) (*.txt)
- STOCHASTIC Raw sample file (*.csv)
- STOCHASTIC Sample file (*.spl)
- STOCHASTIC Summary report (*.txt)
- Equivalent files for software other than HARP

# Downtown Developments

**developsanpedro.com**/map/downtown-developments/

## 2. San Pedro Courthouse Revitalization

*The proposed mixed-use project includes market-rate and affordable housing, joint use open-space, and street-level retail space, including space intended for a grocery store.*

Read Article

## 3. Mixed Use Project by South Bay Developers, LLC

Development Site: 336-348 W 7th Street, San Pedro

Mixed Use Development key metrics are:
Lot size: 14,000 sf
Building size: 40,000 sf
Residential units: 32
Commercial units: 2Developer is looking for a restaurant to lease the ground floor space. Ideal restaurant would have a recognizable brand name restaurant, or a restaurant like Pappy's Seafood with a history of the ownership's success in other locations. Developer would ideally like to work with someone early on so that the design can be tailored to their liking.

Inquiries:

Nate Hobba
Managing Principal
South Bay Developers, LLC
C: 213-300-4699
E: [email protected]
www.southbaydevelopers.net
Schedule Call/Meeting: https://meetme.so/NateHobba

## 4. Palos Verde Apartments

550 Palos Verdes project is under construction with Occupancy scheduled for early 2020.

The seven story midrise building provides 375 for-rent market rate units in a mix of studios, one-, two-, three- and four-bedroom dwellings as well as 647 parking stalls and approximately 5,000 SF of commercial space fronting 6$^{th}$ street.

The luxury apartments include high end finishes such as stone counters, vinyl plank floors, stainless steel appliances, NEST thermostats and most units have their own private balcony. Additionally, amenity spaces in the building include a pool and spa deck, three podium courtyards overlooking the water, a dog run, two story fitness center and personal training space, a golf simulator room, and a rooftop clubroom and adjoining sky-lounge.

https://www.hollandpartnergroup.com/

## 5. Port Town Brewery

Opening in 2020, Port Town Brewing Company will operate a production brewery and tap room, as well as offering brewery tours, beer to go and occasional special events. The group behind the project are owners of San Pedro Brewing Company, the oldest operating brewery in the City of Los Angeles.

Port Town will be located in the 10,000 square foot historic Liberty Auditorium, built in 1921 as a dance hall and social gathering place. Years later, the building was called 7th Street Garage. It has been empty since the late 1990's and the new brewery opening will bring new vibrancy and foot traffic to 7th Street in downtown San Pedro.

## 6. La Terra Apartments

LaTerra Development plans to reposition the project by re-entitling the site for 24 fee-simple homes under the popular City of Los Angeles Small Lot Ordinance. The homes are planned to have direct access garages, and rooftop decks providing valuable private outdoor open space, taking advantage of views of the harbor and the magnificent Vincent Thomas San Pedro Bridge.

**Use:** Residential, Fee Simple Town-homes
**Size:** 24 Fee Simple homes
Website

## 7. Mesa Street Properties

Mesa Properties is planning a 22-unit small lot complex. Located at 1803 South Mesa Street, the plot of empty industrial land measures 26,706 square feet, according to property records.

Website

er Grand Theatre can be seen on the right. | Via joint Northwest, Central, and Coastal San Pedr

## 8. 80-room hotel with a rooftop deck and bar

San Pedro's historic movie palace, the Warner Grand Theatre, could be getting a fancy neighbor. Plans presented at an October 17 joint meeting of the Northwest, Central, and Coastal San Pedro neighborhood councils show the seven-story boutique hotel that would rise on a now-vacant lot at the corner of Sixth Street and Pacific Avenue.

Read Article

## 9. Affordable Housing Development to Replace San Pedro Parking Lot

The project, which was unveiled last month in a presentation to multiple neighborhood councils, would replace a mid-block surface parking lot at 456 W. 9th Street. Plans call for a six-story building, which would contain 91 residential units above 4,900 square feet of commercial space, a 4,000-square-foot community room, and a 60-car parking garage at ground level.

Read Article

- 505 S Centre St, San Pedro, CA 90731

### 2. San Pedro Courthouse Revitalization

*The proposed mixed-use project includes market-rate and affordable housing, joint use open-space, and street-level retail space, including space intended for a grocery store.*

Read Article

- 550 S. Palos Verdes St., San Pedro, CA 90731

### 4. Palos Verde Apartments

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The seven story midrise building provides 375 for-rent market rate units in a mix of studios, one-, two-, three- and four-bedroom dwellings as well as 647 parking stalls and approximately 5,000 SF of commercial space fronting 6th street.

The luxury apartments include high end finishes such as stone counters, vinyl plank floors, stainless steel appliances, NEST thermostats and most units have their own private balcony. Additionally, amenity spaces in the building include a pool and spa deck, three podium courtyards overlooking the water, a dog run, two story fitness center and personal training space, a golf simulator room, and a rooftop clubroom and adjoining sky-lounge.

https://www.hollandpartnergroup.com/

- 336 West 7th Street. San Pedro CA 90731

### 3. Mixed Use Project by South Bay Developers, LLC

Development Site: 336-348 W 7th Street, San Pedro

Mixed Use Development key metrics are:
Lot size: 14,000 sf
Building size: 40,000 sf
Residential units: 32
Commercial units: 2Developer is looking for a restaurant to lease the ground floor space.  Ideal restaurant would have a recognizable brand name restaurant, or a restaurant like Pappy's Seafood with a history of the ownership's success in other locations.  Developer would ideally like to work with someone early on so that the design can be tailored to their liking.

- 286 W 8th St San Pedro, California 90731

### 6. La Terra Apartments

LaTerra Development plans to reposition the project by re-entitling the site for 24 fee-simple homes under the popular City of Los Angeles Small Lot Ordinance. The homes are planned to have direct access garages, and rooftop decks providing valuable private outdoor open space, taking advantage of views of the harbor and the magnificent Vincent Thomas San Pedro Bridge.

**Use:** Residential, Fee Simple Town-homes
**Size:** 24 Fee Simple homes
Website

- 285 W. 7th St., San Pedro, CA 90731

### 5. Port Town Brewing Company

Opening in Fall 2017, Port Town Brewing Company will operate a production brewery and tap room, as well as offering brewery tours, beer to go and occasional special events. The group behind the project are owners of San Pedro Brewing Company, the oldest operating brewery in the City of Los Angeles.

Port Town will be located in the 10,000 square foot historic Liberty Auditorium, built in 1921 as a dance hall and social gathering place. Years later, the building was called 7th Street Garage. It has been empty since the late 1990's and the new brewery opening will bring new vibrancy and foot traffic to 7th Street in downtown San Pedro.

- 1803 S. Mesa St., San Pedro, CA 90731

### 7. Mesa Street Properties

Mesa Properties is planning a 22-unit small lot complex. Located at 1803 South Mesa Street, the plot of empty industrial land measures 26,706 square feet, according to property records.

Website

- 478 W. Sixth St, San Pedro, CA 90731

### 8. 80-room hotel with a rooftop deck and bar

San Pedro’s historic movie palace, the Warner Grand Theatre, could be getting a fancy neighbor. Plans presented at an October 17 joint meeting of the Northwest, Central, and Coastal San Pedro neighborhood councils show the seven-story boutique hotel that would rise on a now-vacant lot at the corner of Sixth Street and Pacific Avenue.

Read Article

- 456 W. Ninth St, San Pedro, CA 90731

### 9. Affordable Housing Development to Replace San Pedro Parking Lot

The project, which was unveiled last month in a presentation to multiple neighborhood councils, would replace a mid-block surface parking lot at 456 W. 9th Street.  Plans call for a six-story building, which would contain 91 residential units above 4,900 square feet of commercial space, a 4,000-square-foot community room, and a 60-car parking garage at ground level.

Read Article

**ATTACHMENT E**

# SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

## Draft Guidance Document – Interim CEQA Greenhouse Gas (GHG) Significance Threshold

October 2008


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**APPENDIX A** - Working Group Members and Contributors

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# P R E F A C E

This Draft *Guidance Document – Interim CEQA Greenhouse Gas (GHG) Significance Threshold* document contains the proposed interim GHG significance threshold, rationale for developing the threshold, and details of the working group meetings and represents a work-in-progress of staff's efforts to date. This document will be updated as more information becomes available. For the staff recommendation to the Governing Board at the December 5, 2008 public hearing, please refer to Attachment A of Agenda Item Number 31.

Finally, to facilitate identifying changes to this Guidance Document since its release in October 2008, added text is underlined and deleted text is denoted with ~~strikethrough~~ text.

# LIST OF ACRONYMS AND ABBREVIATIONS

# List of Acronyms and Abbreviations

| Acronym/ Abbreviation | Definition |
|---|---|
| AB 32 | Assembly Bill 32 Global Warming Solutions Act of 2006 |
| AER | Annual Emission Reporting |
| AG | Attorney General |
| ARB | Air Resources Board |
| BACT | Best Available Control Technology |
| BARCT | Best Available Retrofit Control Technology |
| BAU | Business as Usual |
| CAPCOA | California Air Pollution Control Officers Association |
| CARB | California Air Resource Board |
| CAT | Climate Action Team |
| CCAR | California Climate Action Registry |
| CEC | California Energy Commission |
| CEQA | California Environmental Quality Act |
| $CH_4$ | Methane |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| CPUC | California Public Utilities Commission |
| EIR | Environmental Impact Report |
| EPA | U.S. Environmental Protection Agency |
| FY | Fiscal Year |
| GHG | Greenhouse Gas |
| GGRP | Greenhouse Gas Reduction Plan |
| GP | General Plan |
| GWP | Global Warming Potential |
| IGR | Intergovernmental Review |
| IPCC | International Panel on Climate Change |
| ITE | Institute of Transportation Engineers |
| km | Kilometer |
| LNG | Liquefied Natural Gas |
| MMBTU | Million British Thermal Units |
| MND | Mitigated Negative Declaration |
| MMT $CO_2e$ | Million Metric Tons Carbon Dioxide Equivalent |
| MW | Megawatts |
| $N_2O$ | Nitrous Oxide |
| ND | Negative Declaration |
| $NO_X$ | Oxides of Nitrogen |
| OPR | State Office of Planning and Research |
| PFC | Perfluorocarbon |

## List of Acronyms and Abbreviations (Concluded)

| Acronym/ Abbreviation | Definition |
|---|---|
| PM | Particulate Mater |
| ROG | Reactive Organic Gas |
| RPS | Renewable Portfolio Standards |
| S-3-05 | Executive Order S-3-05 |
| SB | Senate Bill |
| SCAQMD | South Coast Air Quality Management District |
| SIP | State Implementation Plan |
| SOx | Sulfur Oxides |
| TAC | Toxic Air Contaminants |
| URBEMIS | Urban Emissions Model |
| VMT | Vehicle Miles Traveled |

# CHAPTER 1

# INTRODUCTION AND EXECUTIVE SUMMARY

**Introduction**
**Purpose of This Guidance Document**
**California Environmental Quality Act and GHGs**
**Legal Authority**
**Contents of This Guidance Document**

# INTRODUCTION

The California Environmental Quality Act (CEQA) requires public agencies in California to analyze potential adverse impacts for proposed projects undertaken by a public agency, funded by a public agency, and requiring discretionary approval by a public agency. The fundamental purposes of CEQA are to inform governmental decision-makers and the public about the significant environmental effects of proposed activities, identify ways to avoid or significantly reduce environmental damage, use feasible alternatives or mitigation measures to avoid significant damage, and disclose to the public why a governmental agency approved a project if significant effects are involved (CEQA Guidelines §15002[a]). To disclose potential adverse impacts from a proposed project, pursuant to CEQA lead agencies typically prepare multidisciplinary environmental impact analysis and make decisions based on the analysis regarding the environmental effects of the proposed project (CEQA Guidelines §15002[a]).

In the past, air quality analyses tended to focus on potential adverse impacts from criteria pollutants and toxic air contaminants. Subsequent to the adoption of Assembly Bill (AB) 32 – The California Global Warming Solutions Act of 2006, lead agencies have increasingly faced legal challenges to their CEQA documents for failure to analyze greenhouse gases (GHGs) or making a determination of significance regarding GHG emission impacts.

Greenhouse gases are those gases that have the ability to trap heat in the atmosphere, a process that is analogous to the way a greenhouse traps heat. GHGs may be emitted as a result of human activities as well as through natural processes. As a result of human activities, such as electricity production, vehicle use, etc., GHGs have been accumulating in the earth's atmosphere at a faster rate than has occurred historically, i.e., prior to the Industrial Age starting approximately 150 years ago. Increasing GHG concentrations in the atmosphere are leading to global climate change.

The Intergovernmental Panel on Climate Change (IPCC) provided the first unequivocal evidence that global climate temperatures are increasing (2007a). Further, the primary driver of global climate change is increased emissions of GHGs due to human activities. According to the IPCC, there is very high confidence, based on more evidence from a wider range of species, that recent warming is strongly affecting terrestrial, marine, freshwater biological systems.

Carbon dioxide (CO2) is the most important anthropogenic GHG because it comprises the majority of total GHG emissions emitted per year and it is very long-lived in the atmosphere. Annual emissions of CO2 have increased approximately 80 percent between 1970 and 2004. In addition to CO2, other GHG pollutants emitted directly as a result of human activities include methane (CH4), nitrous oxide (N2O) and halocarbons (a group of gases containing fluorine, chlorine or bromine). Without changes in current climate change mitigation policies and related sustainable

development practices, GHG emissions and global climate temperatures will continue to increase.

To prevent or minimize further increases in global temperatures resulting from increases in GHG emissions due to human activities, it is necessary to stabilize the concentration of GHGs in the atmosphere. Stabilizing GHGs in the atmosphere can only occur through reducing GHG emissions. Without further reductions in GHGs, increased global temperatures will surpass humans' and ecosystems' ability to adapt to these changing conditions (IPCC, 2007b).

In response to the increasing body of evidence that GHGs will continue to affect global climate, Governor Schwarzenegger issued executive order (EO S-3-05), which established the following greenhouse gas emission reduction targets for California: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; by 2050, reduce GHG emissions to 80 percent below 1990 levels.

Subsequent to the Governor's issuance of EO S-3-05, the California State Legislature adopted Assembly Bill (AB) 32 – The California Global Warming Solutions Act of 2006. With the adoption of AB 32, the California State Legislature recognized the growing concern regarding changes to global climate resulting from increasing emissions of greenhouse gases (GHGs). AB 32 establishes a cap on statewide greenhouse gas emissions and sets forth the regulatory framework to achieve the corresponding reduction in statewide emissions levels. Specifically, (AB 32) recognizes the serious threat to the "economic wellbeing, public health, natural resources, and the environment of California" that results from global warming. Consequently, AB 32 mandates a significant reduction in GHGs in order to contribute to efforts to stabilize atmospheric concentrations of GHGs. Under AB 32, greenhouse gases are defined as: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

In general, there is currently an absence of regulatory guidance with regard to analyzing GHG emission impacts in CEQA documents. Similarly, no public agency in California has formally adopted GHG significance thresholds. Recognizing the absence of guidance regarding analyzing and determining the significance of GHGs, the California Air Pollution Control Officers Association (CAPCOA) prepared a White Paper reviewing policy choices, analytical tools, and mitigation strategies for GHGs. In particular, the White Paper identifies a number of options for establishing GHG significance thresholds, but makes no formal recommendation of one approach over another.

Air districts typically act in an advisory capacity to local governments in establishing the framework for environmental review of air pollution impacts under CEQA. This may include recommendations regarding significance thresholds, analytical tools to estimate emissions and assess impacts, and mitigations for potentially significant impacts. Although districts will also address some of these issues on a project-specific basis as responsible agencies, they may provide general guidance to local governments on these issues.

Because of its expertise in establishing air quality analysis methodologies and comprehensive efforts to establish regional and localized significance thresholds for criteria pollutants, local public agencies have asked South Coast Air Quality Management District (SCAQMD) for guidance in quantifying GHG impacts and recommending GHG significance thresholds to assist them with determining whether or not GHG impacts in their CEQA documents are significant. As a result, SCAQMD staff has received requests from a number of public agencies and other stakeholders to provide guidance on analyzing GHG impacts and establishing a GHG significance threshold. In response to these requests from the various stakeholders, SCAQMD established a stakeholder working group to receive input on establishing a GHG significance threshold. In the meantime, SCAQMD staff has joined many other stakeholders urging CARB to establish a statewide threshold for GHGs. In the absence of a statewide threshold, SCAQMD staff will recommend its interim approach to the Governing Board for consideration and it will also become the SCAQMD's input to the statewide process.

## PURPOSE OF THIS GUIDANCE DOCUMENT

The purpose of this Guidance Document, therefore, is to provide information on GHG legislation relative to CEQA, a brief summary of the Working Group process, development of the resulting staff-recommended interim GHG significance threshold proposal, and how to use it. This Guidance Document also provides information on the SCAQMD's authority to establish a GHG significance threshold pursuant to CEQA and some background information on GHGs and global climate change. This Guidance Document also discusses future efforts to further refine the interim GHG significance threshold as necessary, includes recommendations for analyzing GHG impacts using current modeling tools, and describes measures to mitigate GHG emission impacts.

## CALIFORNIA ENVIRONMENTAL QUALITY ACT AND GHGS

### - California Attorney General's Office

Subsequent to adopting AB 32, the California Attorney General's Office determined that GHG emissions contributing to global climate change also contribute to potential adverse environmental impacts that should be evaluated pursuant to the California Environmental Quality Act (CEQA). The Attorney General's Office has submitted numerous comment letters to lead agencies on their CEQA documents for failure to analyze GHG emissions, failure to make a significance determination, and failure to implement feasible mitigation measures to reduce GHG emissions to the maximum extent feasible.

For example, the California Attorney General, on behalf of the people of California, filed a legal challenge against the County of San Bernardino for failure to analyze "reasonably foreseeable" GHG emissions in the CEQA document prepared for its

General Plan update. The County reached a settlement with the Attorney General by committing to developing a GHG inventory and a plan for reducing GHGs.

Similarly, the California Attorney General submitted comments on the CEQA document for a refinery in northern California. Although GHG emissions were quantified, the Attorney General cited the failure of the lead agency to make a determination of significance relative to GHG emissions stating, "[E]ven if there is no established threshold in law or regulation, lead agencies are obligated by CEQA to determine significance. Neither CEQA, nor the regulations, authorize reliance on the lack of an agency-adopted standard as the basis for determining that a project's potential cumulative impact is not significant." In other words, the absence of a threshold does not in any way relieve lead agencies of their obligations to address GHG emissions from projects under CEQA. By not concluding whether or not a project is significant, the lead agency may be avoiding its responsibility to implement GHG mitigation measures.

### - Senate Bill (SB) 97 – CEQA: Greenhouse Gas Emissions

In August 2007, Governor Schwarzenegger signed into law Senate Bill (SB) 97 – CEQA: Greenhouse Gas Emissions stating, "This bill advances a coordinated policy for reducing greenhouse gas emissions by directing the Office of Planning and Research (OPR) and the Resources Agency to develop CEQA guidelines on how state and local agencies should analyze, and when necessary, mitigate greenhouse gas emissions." Specifically, SB 97 requires OPR, by July 1, 2009, to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions, as required by CEQA, including, but not limited to, effects associated with transportation or energy consumption. The Resources Agency would be required to certify and adopt those guidelines by January 1, 2010. OPR would be required to periodically update the guidelines to incorporate new information or criteria established by the State Air Resources Board pursuant to the California Global Warming Solutions Act of 2006. SB 97 also identifies a limited number of types of projects that would be exempt under CEQA from analyzing GHG emissions. Finally, the legislation will be repealed on January 1, 2010.

### - Office of Planning and Research Technical Advisory

Consistent with SB 97, on June 19, 2008, OPR released its *Technical Advisory on CEQA and Climate Change*, which was developed in cooperation with the Resources Agency, the California Environmental Protection Agency (Cal/EPA), and the California Air Resources Board (CARB). According to OPR, the *Technical Advisory* offers the informal interim guidance regarding the steps lead agencies should take to address climate change in their CEQA documents, until CEQA guidelines are developed pursuant to SB 97 on how state and local agencies should analyze, and when necessary, mitigate greenhouse gas emissions.

According to OPR, lead agencies should determine whether greenhouse gases may be generated by a proposed project, and if so, quantify or estimate the GHG emissions by

type and source. Second, the lead agency must assess whether those emissions are individually or cumulatively significant. When assessing whether a project's effects on climate change are "cumulatively considerable" even though its GHG contribution may be individually limited, the lead agency must consider the impact of the project when viewed in connection with the effects of past, current, and probable future projects. Finally, if the lead agency determines that the GHG emissions from the project as proposed are potentially significant, it must investigate and implement ways to avoid, reduce, or otherwise mitigate the impacts of those emissions.

**- SB 375 (Steinberg) Transportation, Land Use, and the California Environmental Quality Act (CEQA)**

On September 30, 2008, Governor Schwarzenegger signed into law SB 375 (Steinberg). SB 375 focuses on housing and transportation planning decisions to reduce fossil fuel consumption and conserve farmlands and habitat. This legislation is important to achieving AB 32 goals because greenhouse gas emissions associated with land use, which includes transportation, are the single largest sector of emissions in California. Further, SB 375 provides a path for better planning by providing incentives to locate housing developments closer to where people work and go to school, allowing them to reduce vehicle miles traveled (VMT) every year. The following bullet points summarize some of the main provisions of the bill.

- Require the regional governing bodies in each of the state's major metropolitan areas to adopt, as part of their regional transportation plan, a "sustainable community strategy" that will meet the region's target for reducing GHG emissions. These strategies would get people out of their cars by promoting smart growth principles such as: development near public transit; projects that include a mix of residential and commercial use; and projects that include affordable housing to help reduce new housing developments in outlying areas with cheaper land and reduce vehicle miles traveled (VMT).

- Create incentives for implementing the sustainable community strategies by allocating federal transportation funds only to projects that are consistent with the emissions reductions.

- Provide various forms of CEQA relief by allowing projects that are shown to conform to the preferred sustainable community strategy through the local general plans (and therefore contribute to GHG reduction) to have a more streamlined environmental review process. Specifically, SB 375 will change CEQA in two ways:

  - If a development is consistent with the sustainable community's strategy and incorporates any mitigation measures required by a prior EIR, then the environmental review does not have to consider: a) growth-inducing impacts, or b) project-specific or cumulative impacts from cars on global warming or the regional transportation network.

- A narrowly-defined group of "transit priority projects" will be exempt from CEQA review.

## LEGAL AUTHORITY

CEQA Guidelines §15022(a) states that a public agency shall adopt objectives, criteria, and specific procedures consistent with CEQA and these [State] Guidelines for administering its responsibilities under CEQA. CEQA Guidelines §15022(d) states further, "In adopting procedures to implement CEQA, a public agency may adopt the State CEQA Guidelines through incorporation by reference. The agency may then adopt only those specific procedures or provisions described in subsection [15022] (a) which are necessary to tailor the general provisions of the guidelines to the specific operations of the agency." At the December 11, 1998 Public Hearing the SCAQMD's Governing Board formally incorporated by reference the State CEQA Guidelines as the implementing guidelines for the SCAQMD's CEQA program. Adopting GHG significance thresholds would be consistent with CEQA Guidelines §15022 provision to tailor a public agency's implementing guidelines by adopting criteria relative to the specific operations of the SCAQMD.

Specifically with regard to thresholds of significance, CEQA Guidelines §15064.7(a) states, "Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects." Subsection (b) of the same section states further, "Thresholds of significance to be adopted for general use as part of the lead agency's environmental review process must be adopted by ordinance, resolution, rule or regulation, and developed through a public review process and be supported by substantial evidence." Staff's recommended GHG significance threshold has undergone a public review process as part of stakeholder working group meetings that are open to the public. This Guidance Document provides the substantial evidence relative to the methodology for developing the interim GHG significance threshold. After completion of the public process, the proposed interim GHG significance threshold will be brought to the SCAQMD's Governing Board at a public meeting, where it will be considered for adoption by resolution, consistent with CEQA Guidelines §15064.7(b). Staff's proposed interim GHG significance threshold is a recommendation only for lead agencies and not a mandatory requirement. The GHG significance threshold may be used at the discretion of the local lead agency. However, if adopted the SCAQMD will use the interim GHG significance threshold for projects where it is the lead agency.

### - Considerations When Establishing Significance Thresholds

No significance thresholds for GHG emissions have been developed, adopted, or endorsed statewide or at the local level[1]. Air districts have primary authority under

[1] In response to comments submitted by the Attorney General's Office on a dairy project, the San Joaquin Valley Air Pollution Control District (SJVAPCD) identified a significance threshold of 38,477 metric tons of

state law for "control of air pollution from all sources, other than emissions from motor vehicles" (H&SC §40000). The term air contaminant or "air pollutant" is defined extremely broadly, to mean "any discharge, release, or other propagation into the atmosphere" and includes, but is not limited to, soot, carbon, fumes, gases, particulate matter, etc. Greenhouse gases and other global warming pollutants such as black carbon would certainly be included in this definition. The U.S. Supreme Court held in Massachusetts v. EPA 549 U.S. 497 (2009) that greenhouse gases were clearly within the Federal Clean Air Act's broad definition of air pollutants. Therefore, air districts have the authority to regulate global warming pollutants primarily from non-vehicular sources, while pursuant to AB 32 CARB has authority over a wide range of sources, including vehicular sources.

Appendix G of the CEQA Guidelines provides a checklist of suggested environmental topics that should be addressed in a CEQA document. Questions under each environmental topic area are designed to elicit information on whether a project has the potential to generate significant adverse environmental impacts to that environmental topic area. However, neither the CEQA statutes nor the implementing Guidelines discuss or identify thresholds of significance or particular methodologies for performing an impact analysis. These tasks are left to a lead agency's judgment and discretion, based upon factual data and guidance from regulatory agencies and other sources where available and applicable.

The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting. For example, an activity which may not be significant in an urban area may be significant in a rural area (CEQA Guidelines §15064(b)). Further, in evaluating the significance of the environmental effect of a project, the Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project (§15064(d)). Significance conclusions must be based on substantial evidence, which includes facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts (CEQA Guidelines §15064(f)(5)).

Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is essentially a regulatory standard or set of criteria that represent the level at which a lead agency finds a particular environmental effect of a project to be significant. Specifically, a threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant

carbon dioxide equivalent per year (MT CO2eq./yr). According to SJVAPCD staff, the agency currently has no plans to formally adopt this significance threshold through a public process.

by the agency and compliance with which means the effect normally will be determined to be less than significant (§15064.7(a)).

Even in the absence of clearly defined significance thresholds for GHG emissions, the California Attorney General has advised that such emissions from CEQA projects must be disclosed and mitigated to the extent feasible whenever the lead agency determines that the project contributes to a significant, cumulative climate change impact.

## CONTENTS OF THIS GUIDANCE DOCUMENT

The following subsections provide brief summaries of the chapters contained in this guidance document.

- **Summaries of Chapter 1**

Chapter 1 is the introductory chapter of this document that contains general background information on GHGs and the determination that GHGs must be analyzed in CEQA documents. There is also information on CEQA legislation related to GHGs and global climate change. Finally, the chapter contains information on the legal authority that allows the SCAQMD to adopt significance thresholds for the purpose of determining the severity of impacts analyzed in CEQA documents

- **Summaries of Chapter 2**

Chapter 2 contains more detailed background information on GHG emissions relative to global climate change, both internationally and nationally. This chapter also provides more detailed information on legislation to reduce GHG house gas emissions, e.g., Assembly Bill 32 – the Global Warming Solutions Act of 2006, etc. Finally, Chapter 2 contains information on early guidance on evaluating GHG emissions in CEQA documents.

- **Summaries of Chapter 3**

Chapter 3 contains information on the working group established by the SCAQMD to provide feedback to staff on the development of an interim GHG significance threshold. The chapter also includes discussions on considerations in establishing an interim GHG significance threshold and describes the current staff proposal for an interim GHG significance threshold.

- **Summaries of Chapter 4**

Chapter 4 contains general recommendations for analyzing GHG emissions in CEQA documents.

**- Summaries of Chapter 5**

In Chapter 5 it is assumed that the SCAQMD Governing Board will adopt staff's proposed interim GHG significance threshold. Therefore, this chapter discusses future action items, including outreach to interested stakeholders, compiling lists of applicable GHG design features and mitigation measures, and periodic review and update, as necessary of the interim GHG significance threshold.

# CHAPTER 2

# BACKGROUND INFORMATION ON GHGS

**General Background Information**

**Legislative Background – California**

**Initial Guidance on Evaluating GHGs Pursuant to CEQA**

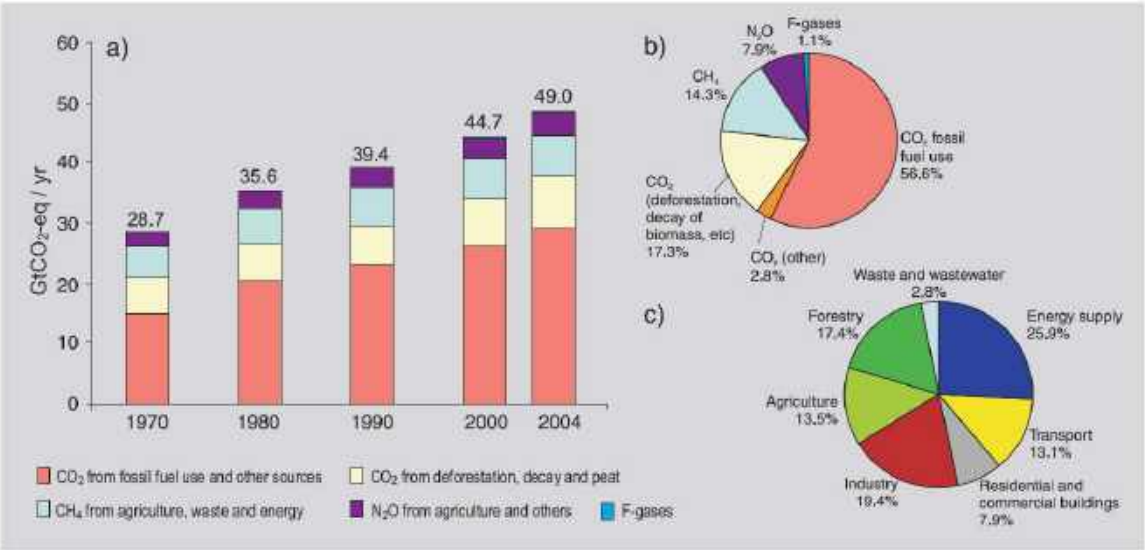
# GENERAL BACKGROUND INFORMATION ON GHGS

## - Intergovernmental Panel on Climate Change

In the last few years information and data have been compiled that demonstrate unequivocally that increases in average global air and ocean temperatures are occurring (IPCC, 2007a). For example, 11 of the last 12 years (1995-2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850). The temperature increase is widespread over the globe and is greater at higher northern latitudes. Further, increases in sea level are consistent with global warming. For example, global average sea level rose at an average rate of 1.8 [1.3 to 2.3]mm per year over 1961 to 2003 and at an average rate of about 3.1 [2.4 to 3.8]mm per year from 1993 to 2003. According to the IPCC (2007b), there is very high confidence, based on more evidence from a wider range of species, that recent warming is strongly affecting terrestrial, marine, and freshwater biological systems.

One of the major drivers in global climate change has been directly linked to the increase in greenhouse gas (GHG) emissions due to human activities worldwide (Figure 2-1). Carbon dioxide (CO2) is the most important anthropogenic GHG. Annual CO2 emissions have increased approximately 80 percent between 1970 and 2004 (IPCC, 2007b)

**Figure 2-1**
Global Anthropogenic GHG Emissions




**Source – IPCC, 2007b:** (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004.5 (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of CO2-eq. (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO2-eq. (Forestry includes deforestation.) {WGIII Figures TS.1a, TS.1b, TS.2b}

Human activities have been responsible for substantial increases in four long-lived GHGs, including: CO2, methane (CH4), nitrous oxide (N2O) and halocarbons (a group of gases

containing fluorine, chlorine or bromine). Global increases in CO2 concentrations are due primarily to fossil fuel use, with land-use change providing another significant but smaller contribution. It is very likely that the observed increase in CH4 concentration is predominantly due to agriculture and fossil fuel use. The increase in N2O concentration is primarily due to agriculture (IPCC, 2007).

According to the IPCC (2007), for the next couple of decades global temperatures are expected to rise approximately $0.2^{o}$ C per decade under a variety of scenarios. Further, global temperatures are expected to continue for centuries as a result of human activities due to the time scales associated with climate processes and feedbacks, even if GHG concentrations are stabilized. As a result, based on the current understanding of climate-carbon feedback, model studies show that substantial GHG emission reductions are necessary to avoid substantial increases in global air and ocean temperatures.

# LEGISLATIVE BACKGROUND – CALIFORNIA

California has taken a leadership role in not only recognizing the future impacts to global climate change from anthropogenic sources of GHG emissions, but in establishing policies and adopting laws to substantially reduce GHG emissions by 2050. In addition to the GHG legislation related to CEQA described in Chapter 1, California has adopted the following policies and laws that specifically address reducing GHG emissions.

### - Governor Schwarzenegger's Executive Order (June 2005)

In June 2005, Governor Arnold Schwarzenegger signed Executive Order (EO) S-3-05, which establishes greenhouse gas emission reduction targets in response to projected increases in global air and ocean temperatures. Specifically, EO S-3-05 establishes the following three GHG emission reduction targets:

- Reduce GHG emissions to 2000 emission levels by 2010;
- Reduce GHG emissions to 1990 emission levels by 2020; and
- Reduce GHG emissions to 80 percent below 1990 levels by 2050.

Further, EO S-3-05 charges the California Environmental Protection Agency (CalEPA) secretary to coordinate with the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the CARB, Chairperson of the Energy Commission and President of the Public Utilities Commission to develop a Climate Action Plan. EO S-3-05 also charges the Secretary of CalEPA with the oversight of efforts to meet the above GHG emission reduction targets and the responsibility to prepare biannual reports on progress in meeting the GHG emission reduction targets.

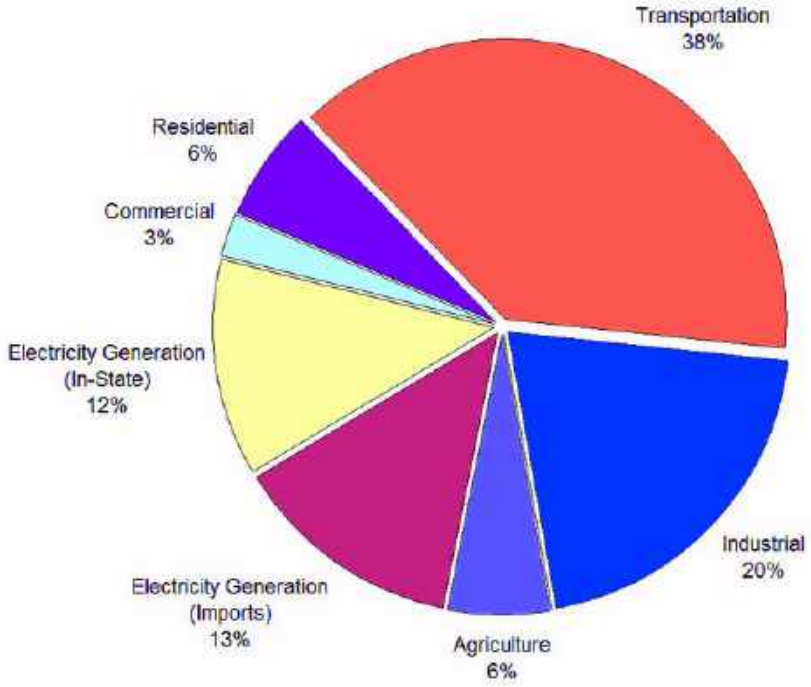
- **Global Warming Solutions Act of 2006 (Assembly Bill (AB) 32)**

The Global Warming Solutions Act of 2006 (AB 32) was adopted by the California State Legislature in 2006. AB 32 assigns CARB the responsibilities of monitoring and reducing GHG emissions. Specifically, AB 32 requires CARB to:

- Establish a statewide greenhouse gas emissions cap for 2020, based on 1990 emissions, by January 1, 2008;
- Adopt mandatory reporting rules for significant sources of greenhouse gases by January 1, 2009;
- Adopt a plan by January 1, 2009, indicating how emission reductions will be achieved from significant greenhouse gas sources via regulations, market mechanisms and other actions;
- Adopt regulations by January 1, 2011, to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas, including provisions for using both market mechanisms and alternative compliance mechanisms;
- Convene an Environmental Justice Advisory Committee and an Economic and Technology Advancement Advisory Committee to advise CARB;
- Ensure public notice and opportunity for comment for all CARB actions;
- To adopt rules for "sources" including non-vehicular; and
- Prior to imposing any mandates or authorizing market mechanisms, CARB must evaluate several factors, including but not limited to impacts on California's economy, the environment and public health; equity between regulated entities; electricity reliability; conformance with other environmental laws, and must ensure that the rules do not disproportionately impact low-income communities.

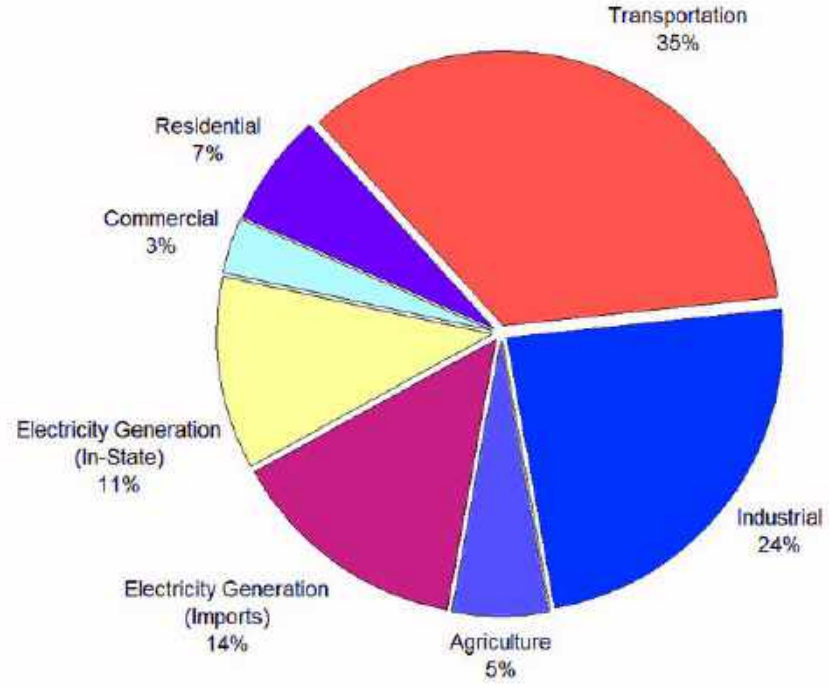
According to the schedule of milestones laid out in AB 32, CARB has made progress in the following areas. Consistent with AB 32's requirement to establish a GHG emission inventory, in December 2007 CARB adopted the California Greenhouse Gas Emission Inventory. The Inventory accounts for all GHG emissions within the state of California and supports the AB 32 Climate Change Program. Figure 2-2 shows CARB's inventory for the year 2004. The Inventory also serves as the basis for developing future year GHG emission forecasts necessary to support measure development and Scoping Plan recommendations. ARB staff has developed a year 2020 "business-as-usual" (BAU) forecast of GHG emissions for use in developing the Draft Scoping Plan. Figure 2-3 shows CARB's inventory for the year 2020, which is AB 32's target inventory.

**Figure 2-2**
2004 GHG Emissions by Sector (Gross Emissions: 484.4 MMT CO2eq.)




Source: CARB, 2007

**Figure 2-3**
1990 GHG Emissions by Sector (Gross Emissions: 433.3 MMT CO2eq.)




Source: CARB, 2007

On December 6, 2007, the Air Resources Board (ARB) approved a regulation for the mandatory reporting of greenhouse gas emissions from major sources, pursuant to AB 32. The mandatory reporting regulation specifies the types of facilities that must report their GHG emissions, requirements for reporting and estimating the GHG emissions, and requirements for emissions verification. Upon adoption, the CARB Board directed staff to make other conforming modifications, as may be appropriate, based on comments received. Subsequent to adoption, the mandatory reporting regulation has undergone two sets of modifications.

Consistent with the requirement to develop a scoping plan indicating how GHG emission reductions will be achieved through regulations, market mechanisms, and other actions, the Draft Scoping Plan was released for public review and comment on June 26, 2008, followed by workshops in July and August, 2008.

The Draft Scoping Plan calls for achievable GHG emission reduction in California's carbon footprint to 1990 levels. Reducing greenhouse gas emissions to 1990 levels means cutting approximately 30 percent from BAU emission levels projected for 2020, or about 10 percent from today's levels. Key elements of CARB's preliminary recommendation for reducing California's greenhouse gas emissions to 1990 levels by 2020 contained in the Draft Scoping Plan include the following:

- Expansion and strengthening of existing energy efficiency programs and building and appliance standards;
- Expansion of the Renewables Portfolio Standard for electricity generation to 33 percent;
- Development of a California cap-and-trade program that links with other WCI Partner programs to create a regional market system;
- Implementation of existing State laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard; and
- Targeted fees to fund the State's long-term commitment to AB 32 administration.

The Scoping Plan is expected go to the CARB Board for adoption in November, 2008.

## INITIAL GUIDANCE ON EVALUATING GHGS PURSUANT TO CEQA

As noted in Chapter 1, both the California Attorney General's Office and the OPR determined that GHG emissions contributing to global climate change have the potential to generate adverse environmental impacts that should be evaluated pursuant to CEQA. Until recently, however, there has been little or no guidance relative to analyzing GHG emissions in CEQA documents or determining significance. The first explicit guidance was provided by the Association of Environmental Professionals (AEP) in its White Paper on Global Climate Change (AEP, 2007) and the White Paper on CEQA and Climate Change prepared by the California Air Pollution Control Officers Association (CAPCOA, 2008). The content of each of these White Papers is summarized in the following subsections.

**- Association of Environmental Professionals – White Paper on Global Climate Change**

AEP's White Paper (AEP) was one of the first attempts to discuss GHGs in the context of CEQA. The intent of the White Paper was to provide practical, interim information to CEQA practitioners and to help Lead Agencies determine how to address GHGs and global climate change in CEQA documents prior to the development and adoption of guidance by appropriate government agencies. Further, AEP's White Paper provided a summary of the current regulatory environment surrounding GHG emissions, and the various approaches that a Lead Agency may select in a CEQA document to address the potential impacts of global climate change and a project's cumulative contribution to GHG. The White Paper described several approaches for addressing GHGs and global Climate Change in CEQA documents, but did not recommend a single approach or methodology, leaving that decision to local Lead Agencies. The AEP White Paper identified eight approaches for analyzing GHGs and global climate change, which are summarized in the following bullet points.

- **Approach 1 – No Analysis:** under this approach the Lead Agency would not mention or discuss GHGs or global climate change.
- **Approach 2 – Screening Analysis:** under this approach the Lead Agency would establish a process to screen projects and determine that they would not make significant contributions to GHG emissions or GCC and, therefore, would not need to mitigate accordingly.
- **Approach 3 – Qualitative Analysis without Significance Determination:** this approach involves a qualitative discussion of GHGs and global climate change and potential ways the project will contribute to the generation of GHG emissions, but does not provide any significance conclusions.
- **Approach 4 – Qualitative Analysis with Significance Determination:** under this approach the Lead Agency would qualitatively discuss GHGs and climate change impacts and conclude that the project impacts are significant.
- **Approach 5 – Quantitative Analysis without Significance Determination:** under this approach the Lead Agency would quantify GHG emissions from the proposed project, but the results are not compared to a quantitative significance threshold.
- **Approach 6 – Quantitative Analysis with Net Zero Threshold:** this approach involves quantifying GHG emissions and using zero net carbon dioxide equivalent increase as the threshold.
- **Approach 7 – Quantitative Analysis Relative to California GHG Emission Reduction Strategies:** this approach employs both quantitative and qualitative components. The quantitative analysis contains an inventory of project GHG emissions. The qualitative component involves project compliance with the emission reduction strategies contained in the California Climate Action Team's (CAT) Report to the Governor, which contains recommendations and strategies to help ensure the targets in Executive Order S-3-05 are met.
- **Approach 8 – Use of Partial Exemption, "Within the Scope" of a Program EIR, or Tiering:** this option relies on the preparation of a broad EIR on a plan, program, or zoning action that is certified and contains a cumulative GHG and global climate change

impact analysis and mitigation. A later project that is consistent with the actions, goals, and/or policies in that plan, program, or zoning action need not again evaluate the cumulative impact regarding the project's GHG contribution to global climate change. In this situation, the later project may use the "partial exemption" provision of Public Resources Code §21083.3 and CEQA Guidelines §15183.

Since the date that the AEP White Paper was finalized (June, 2007), it has become clear that any of the above eight options that do not include quantification of GHG emissions and a determination of significance would be vulnerable to legal challenge. In addition, with the exception of the net zero approach in option 6, none of the options evaluated identify potential GHG significance thresholds. Approaches to developing GHG significance thresholds were specifically addressed in CAPCOA's White Paper (CAPCOA, 2008).

**- California Air Pollution Control Officers Association – White Paper: CEQA and Climate Change**

The intent of CAPCOA's White Paper is to serve as a resource for public agencies as they establish procedures for reviewing GHG emissions from projects under CEQA. It considers the application of thresholds and offers three alternative programmatic approaches toward determining whether GHG emissions are significant. Although the White Paper considers an option of not establishing a GHG significance threshold, as already noted this option is not considered to be a viable approach and will not be considered further. Ultimately, the White Paper is intended to provide consistent approaches for public agencies to ensure that GHG emissions are appropriately considered and addressed under CEQA.

The CAPCOA White Paper identifies three programmatic approaches to establishing GHG significance thresholds and also discusses the benefits and problems associated with each approach. Each approach has inherent advantages and disadvantages. The three basic approaches are:

- No significance threshold for GHG emissions (not discussed further);
- GHG emissions threshold set at zero; or
- GHG threshold set at a non-zero level, two approaches.

The following subsections briefly summarize two of the three major programmatic approaches developed by CAPCOA.

*- Zero Threshold*

An air district or lead agency may determine that any degree of project-related increase in GHG emissions would contribute considerably to climate change which, therefore, would be considered a significant impact. As a result, the air district or lead agency could adopt a zero-emission GHG threshold. If the zero threshold option is chosen, the lead agency would be required to quantify and mitigate GHG emissions for all projects subject to CEQA, regardless of the size of the project or the availability of GHG reduction measures available to reduce the project's emissions. Projects that could not meet the zero-emission threshold would be required to undergo an environmental impact report (EIR) CEQA process to disclose the unmitigable significant impact, and develop the justification for a statement of overriding consideration to be adopted by the lead agency.

CAPCOA notes in the White Paper that if an air district or lead agency elects to adopt a zero threshold approach, it should consider the administrative costs and the environmental review system capacity. Some projects that previously would have qualified for an exemption could require further substantial analysis, including preparation of a Negative Declaration (ND), a Mitigated Negative Declaration (MND) or an EIR. Moreover, the trade-offs between the volume of projects requiring review and the quality of consideration given to reviews should be considered. It may also be useful to consider whether meaningful mitigation can be achieved from smaller projects.

- *Approach 1: Non-Zero Threshold – Statute and Executive Order Approach*

According to CAPCOA, a non-zero GHG significance threshold could minimize the resources spent reviewing environmental analyses that do not result in real GHG reductions or to prevent the environmental review system from being overwhelmed. The practical advantages of considering non-zero thresholds for GHG significance determinations can fit into the concept regarding whether the project's GHG emissions represent a "considerable contribution to the cumulative impact" and therefore warrant analysis.

The first non-zero GHG significance threshold approach is based on achieving the objectives of AB 32 or executive order EO S-3-05 and explores four possible options under this scenario. A project would be required to meet the target objectives, or reduce GHG emissions to the target objectives, to be considered less than significant. The options under this approach are variations of ways to achieve the 2020 goals of AB 32 from new development, which is estimated to be about a 30 percent reduction from business-as-usual. Table 2-1 summarizes the four statute and executive order approaches identified by CAPCOA. SCAQMD staff has identified and included in Table 2-1 potential pros and cons identified for each option.

- *Approach 2: Non-Zero Threshold – Tiered Threshold Options*

The second non-zero GHG significance threshold approach is comprised of a number of tiered GHG significance threshold options. Within this option, the CAPCOA White Paper discusses seven variations. The tiered threshold options offer both quantitative and qualitative approaches to setting a threshold, as well as different metrics for establishing the various tiers. Variations range from setting the first tier at zero to second tiers set at defined emission levels or based on the size of a project. This approach would then prescribe a set of GHG mitigation strategies that would have to be incorporated into the project in order for the project to be considered less than significant. CAPCOA notes that some applications of the tiered threshold approach may require inclusion in a General Plan or adoption of enabling regulations or ordinances to render them fully effective and enforceable. The various tiered threshold options are summarized in Table 2-2. SCAQMD staff has identified and included in Table 2-2 potential pros and cons identified for each option.

**Table 2 – 1**
Statute and Executive Order Approach

| Threshold Number | Description of Threshold | Pros* | Cons* |
|---|---|---|---|
| 1.1 | Project must reduce emissions compared to business as usual to be less than significant, two approaches:<br>a. Project must reduce GHG emissions 33 percent compared to business-as-usual (BAU) (2020 target), or<br>b. Project must reduce GHG emissions 80 percent compared to business-as-usual (2050 target). | • Could reduce resource impacts compared to zero threshold, as not every project would require an EIR<br>• Would achieve GHG reductions consistent with AB 32<br>• A single threshold is easier to apply and understand | • Could be viewed as setting a de minimis level<br>• Fewer projects would trigger significance, thus, less mitigation<br>• BAU should be defined by CARB<br>• BAU may be difficult to define for all projects |
| 1.2 | All new projects must reduce GHG emissions compared to BAU by a uniform percentage to be considered less than significant, e.g., 50 percent. | • Same as 1.1<br>• May produce greater percent reduction of GHGs<br>• Single threshold easier to apply & understand | • Could produce substantially greater GHG reductions than 1.1, but may be difficult to achieve<br>• BAU should be defined by CARB<br>• BAU may be difficult to define for all projects |

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

**Table 2 – 1 (Concluded)**
Statute and Executive Order Approach

| Threshold Number | Description of Threshold | Pros* | Cons* |
|---|---|---|---|
| 1.3 | Projects must reduce GHG emissions compared to business-as-usual by a uniform percentage based on economic sector to be less than significant, i.e., different reductions required for different market sectors. | • Sector-specific approach may be more appropriate approach<br>• Would take into account costs & available control technologies<br>• Avoids over- or under-regulation of GHGs per sector | • Requires extensive information on emission inventories<br>• Requires extensive information on control technologies<br>• Difficult to determine percent reduction by sector<br>• Because of information requirements, may be more viable in the long term |
| 1.4 | Uniform GHG emission reduction by region. Regional GHG reduction plan developed consistent with AB32 emission reductions, e.g., reduce GHG emissions 33% or 80% compared to BAU. A project is not significant if its GHG emissions are consistent with plan. | • Could tailor GHG reductions to specific regional needs<br>• GHG reduction strategies could be integrated into regional plans | • Would need to establish GHG regions<br>• Requires extensive information on regional emission inventories<br>• Because of the need to develop a regional plan, may be a more viable interim approach |

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

**Table 2 – 2**
Tiered Threshold Options

| Threshold Number | Description of Threshold | Pros* | Cons* |
|---|---|---|---|
| 2.1 | This threshold employs a decision tree approach. Tier 1, no increase in GHG emissions, not significant (zero threshold). If GHG emissions greater than zero, tier two, use one of the following threshold options. | • Tiered approach allows flexibility by establishing multiple thresholds to cover a wide range of projects<br>• Tier 2 may minimize administrative burden & costs<br>• Tiers could be set at different levels depending on GHGs, size & other project characteristics<br>• Projects exceeding tier 2 must implement mitigation | • Tier 1 may increase administrative burdens & costs<br>• There may not be meaningful mitigation for small projects<br>• Available mitigation may consist of purchasing offsets<br>• EJ concerns of purchasing offsets because of associated criteria pollutant emissions<br>• Offset markets not well established |
| 2.2 | Establish a quantitative threshold based on capturing a percentage, e.g., 90%, of future discretionary projects, CAPCOA's threshold is 900 metric tons CO2eq per year (equivalent to 50 houses or 30,000 square feet of commercial space, i.e., CAPCOA assumes 90% of all projects are this size or greater). Projects less than this would not be significant. | • Would capture a larger percentage of projects in the district than is currently the case<br>• Would exclude small projects from further GHG analysis<br>• Single threshold easier to apply & understand | • Would increase administrative & cost burden, especially in developing & moderate growth areas<br>• May not be amenable to industrial projects because of the diversity of these projects<br>• There may not be meaningful mitigation for small projects |

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

**Table 2 – 2 (Continued)**
Tiered Threshold Options

| Threshold Number | Description of Threshold | Pros* | Cons* |
|---|---|---|---|
| 2.3 | This threshold is based on CARB's proposed mandatory reporting threshold of 25,000 metric tons of CO2eq per year. Alternatively, use the Market Advisory Committee of 10,000 metric tons of CO2eq per year. Projects less than either would not be significant. | • CARB estimates this threshold would capture 90 % of all industrial projects<br>• Single threshold easier to apply & understand | • May not be amenable to industrial projects because of the diversity of these projects<br>• There may not be meaningful mitigation for small projects |
| 2.4 | This approach establishes a GHG threshold based on and analogous to a NOx/VOC criteria pollutant CEQA significance threshold and is established using the following four steps:<br>a. Define NOx/VOC CEQA thresholds in tons per year (e.g., 10 t/yr)<br>b. Define the regional NOx/VOC inventory in tons per year (e.g., annual NOx inventory for 2005 from 2007AQMP ~ 375,585 t/yr)<br>c. Calculate percentage of NOx/VOC inventory the significance threshold represents (10 / 375,585 = 0.00003) to obtain "minimum percentage of regulated inventory" for NOx/VOC. | • Single threshold easier to apply & understand | • Threshold cumbersome to derive<br>• Threshold would change periodically as inventory goes up or down<br>• Could have widely divergent thresholds by air basin because of varying inventories |

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

**Table 2 – 2 (Continued)**
Tiered Threshold Options

| Threshold Number | Description of Threshold | Pros* | Cons* |
|---|---|---|---|
| 2.4 (Cont.) | d. Define California GHG emission inventory for 2004 in tons CO2eq per year (499 MMT CO2eq). Apply minimum percentage of regulated inventory to California GHG inventory for 2004 to develop a GHG threshold analogous to the CEQA Threshold (e.g., 0.00003 x 499 MMT = 14,970 metric tons CO2eq per year = significance threshold). | • | • |
| 2.5 | Establish quantitative unit-based thresholds based on capturing a percentage, e.g., 90%, of future discretionary projects in specific market sectors (similar to 2.2 above). CAPCOA examples include:<br>• 30,000 square-foot (SF) office =800 metric tons CO2eq per year;<br>• 30,000 SF retail = 2,500 metric tons CO2eq per year;<br>• 30,000 SF supermarket = 43,000 metric tons CO2eq per year. | • Would capture a larger percentage of projects in the district than is currently the case<br>• Would exclude small projects from further GHG analysis<br>• Single threshold easier to apply & understand | • Would increase administrative & cost burden, especially in developing & moderate growth areas<br>• May not be amenable to industrial projects because of the diversity of these projects<br>• There may not be meaningful mitigation for small projects |

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

**Table 2 – 2 (Concluded)**
Tiered Threshold Options

| Threshold Number | Description of Threshold | Pros* | Cons* |
|---|---|---|---|
| 2.6 | This threshold would include tiered CEQA thresholds based on CEQA's definition of "projects with statewide, regional or areawide significance (§15206(b)), which include:<br>• Residential development > 500 dwellings<br>• Shopping center or business establishment employing > 1,000 persons or > 500,000 SF<br>• Commercial office building employing >1,000 persons or > 250,000 SF<br>• Hotel/motel > 500 rooms<br>• Industrial, manufacturing or processing plant or industrial park employing > 1,000 persons or > 600,000 SF | • Could capture up to 50% of all future commercial development | • May capture substantially less than 50% if future development, resulting less GHG mitigation<br>• Percentage capture of industrial/manufacturing projects currently unknown |
| 2.7 | Efficiency-based thresholds would be based on measurements of efficiency compared to intensity. Must be based on reasonable GHG emissions compared to business-as-usual. | • Would benchmark GHG intensity against target levels of efficiency<br>• Thresholds established to provide future foreseeable GHG reductions compared to BAU<br>• Would support AB 32 target objectives | • Would require substantial data & possibly modeling<br>• May be more appropriate as a threshold in the long term |

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

# CHAPTER 3

# INTERIM GHG SIGNIFICANCE THRESHOLD STAFF PROPOSAL

**Introduction**

**GHG Analysis Considerations**

**Current Staff Interim GHG Significance Threshold Proposals**

# INTRODUCTION

Because GHG emissions affect global climate, some have argued that it may be more appropriate for national or state agencies to establish significance thresholds or GHG emission reduction target objectives. However, no agency has established GHG significance thresholds that could assist Lead Agencies with determining the significance of GHG emissions in CEQA documents. In the absence of statewide guidance on this issue and in response to requests from a variety of stakeholders, the SCAQMD established a GHG Significance Threshold Stakeholder Working Group (Working Group) to establish an interim GHG significance threshold until such time as the state establishes a GHG significance threshold or provides recommended guidance on establishing a GHG significance threshold. Staff's goal is to reach consensus regarding an interim GHG significance threshold to the extent possible and take the staff proposal to the SCAQMD Governing for consideration and approval.

The Working Group was formed to assist staff's efforts to develop an interim GHG significance threshold an is comprised of a wide variety of stakeholders including: state agencies, OPR, CARB, and the Attorney General's Office; local agencies, city and county planning departments, utilities such as sanitation and power, etc.; regulated stakeholders, industry and industry groups; and organizations, both environmental and professional. Stakeholders were chosen based on their participation in other related stakeholder working groups and their expressed interest in participating in the developing a GHG significance threshold. Working group meetings are open to the public and have been well attended. The members of the Working Group and other interested parties who have requested to be notified of the meetings are listed in Appendix A. Information on the progress of the Working Group, including agendas, overhead presentations, and letters received from the various stakeholders can be found at the following website:
https://www.aqmd.gov/ceqa/handbook/GHG/GHG.html.

Part of the purpose of the Working Group is to provide a forum to solicit comments and suggestions from the various stakeholders to assist SCAQMD staff with developing an interim GHG significance threshold that is consistent with CEQA requirements for developing significance thresholds, is supported by substantial evidence, and provides guidance to CEQA practitioners with regard to determining whether GHG emissions from a proposed project are significant.

SCAQMD staff held the first Working Group meeting in April 2008. Except for September, Working Group meetings have been held on a monthly basis since April. Brief summaries of each Working Group meeting and the topics and staff GHG significance threshold proposals discussed to date are provided in Appendix B. Staff's initial proposed has been modified over time based on comments and concerns raised at Working Group meetings or in written comments. The following sections summarize staff's latest recommended interim GHG significance threshold proposal and some of the concepts necessary to understanding the various components of staff's

proposal. The latest staff proposal is considered to be a work-in-progress as staff is continuing to solicit further public input and suggestions.

The following subsections briefly summarize the GHG significance threshold design criteria concepts included as part of staff's proposed interim GHG significance threshold proposal. Following the discussion of design concepts, SCAQMD staff's current interim proposal is described.

## GHG ANALYSIS CONSIDERATIONS

Before discussing quantification methodologies, it is necessary to consider design criteria that establish the parameters upon which the actual GHG analysis is based. The following subsections include discussions from the Working Group of some of the most important design criteria to be considered when quantifying GHG emissions. The following topics include some of the most important parameters that should be considered when quantifying GHG emissions and, therefore, should not be considered an exhaustive list of considerations as individual projects may include characteristics that may require additional considerations.

### Policy Objective

The overarching policy objective with regard to establishing a GHG significance threshold for the purposes of analyzing GHG impacts pursuant to CEQA is to establish a performance standard or target GHG reduction objective that will ultimate contribute to reducing GHG emissions to stabilize climate change. Full implementation of the Governor's Executive Order S-3-05 would reduce GHG emissions 80 percent below 1990 levels or 90 percent below current levels by 2050. It is anticipated that achieving the Executive Order's objective would contribute to worldwide efforts to cap GHG concentrations at 450 ppm, thus, stabilizing global climate.

As described below, staff's recommended interim GHG significance threshold proposal uses a tiered approach to determining significance. Tier 3, which is expected to be the primary tier by which the AQMD will determine significance for projects where it is the lead agency, uses the Executive Order S-3-05 goal as the basis for deriving the screening level. Specifically, the Tier 3 screening level for stationary sources is base on an emission capture rate of 90 percent for all new or modified projects. A 90 percent emission capture rate means that 90 percent of total emissions from all new or modified stationary source projects would be subject to some type of CEQA analysis, including a negative declaration, a mitigated negative declaration, or an environmental impact.

Therefore, the policy objective of staff's recommended interim GHG significance threshold proposal is to achieve an emission capture rate of 90 percent of all new or modified stationary source projects. A GHG significance threshold based on a 90 percent emission capture rate may be more appropriate to address the long-term adverse impacts associated with global climate change. Further, a 90 percent emission

capture rate sets the emission threshold low enough to capture a substantial fraction of future stationary source projects that will be constructed to accommodate future statewide population and economic growth, while setting the emission threshold high enough to exclude small projects that will in aggregate contribute a relatively small fraction of the cumulative statewide GHG emissions. This assertion is based on the fact that staff estimates that these GHG emissions would account for less than one percent of future 2050 statewide GHG emissions target (85 MMTCO2eq/yr). In addition, these small projects would be subject to future applicable GHG control regulations that would further reduce their overall future contribution to the statewide GHG inventory

- **GHG Pollutants**

Gases that trap heat in the atmosphere are often called greenhouse gases. The Kyoto Protocol, adopted in December 1997, is an agreement under which industrialized countries will reduce their collective emissions of greenhouse gases by specified percentages, depending on the country, compared to 1990 levels. The goal is to lower overall emissions of six greenhouse gases - carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons, averaged over the period of 2008-2012.

Similarly, AB 32 defines GHGs as including the following: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (Health and Safety Code, section 38505(g)). The most common GHG that results from human activity is carbon dioxide, followed by methane and nitrous oxide.

Some greenhouse gases such as carbon dioxide occur naturally and are emitted to the atmosphere through natural processes and human activities. Other greenhouse gases (e.g., fluorinated gases) are created and emitted solely through human activities. The principal greenhouse gases that enter the atmosphere because of human activities are:

- **Carbon Dioxide (CO2):** Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement). Carbon dioxide is also removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.

- **Methane (CH4):** Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.

- **Nitrous Oxide (N2O):** Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

- **Fluorinated Gases:** Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances (i.e., CFCs, HCFCs, and halons). Fluorinated gases are typically emitted in smaller quantities, but because they are potent greenhouse gases, they are sometimes referred to as high global warming potential gases (high GWP gases).

    - Hydrofluorocarbons are manmade chemicals that have historically replaced Chlorofluorocarbons used in refrigeration and semiconductor manufacturing.

    - Perfluorocarbons are manmade chemicals that are by-products of aluminum smelting and uranium enrichment.

    - Sulfur hexafluoride is a manmade chemical that is largely used in heavy industry to insulate high voltage equipment and to assist in the manufacturing of cable cooling systems.

GWP is a measure of how much a given mass of greenhouse gas is estimated to contribute to global warming. It is a relative scale that compares the gas in question to the same mass of carbon dioxide (whose GWP is by definition 1). A GWP is calculated over a specific time interval and the value of this must be stated whenever a GWP is quoted or else the value is meaningless. A substance's GWP depends on the time span over which the potential is calculated. A gas which is quickly removed from the atmosphere may initially have a large effect but for longer time periods as it has been removed becomes less important. For the purposes of a CEQA analysis, especially an analysis of operation emissions, the maximum GWP is typically used, regardless of the actual atmospheric lifetime. This approach simplifies the analysis and provides a very conservative analysis, especially for the fluorinated gases. The GWP of the six Kyoto GHGs is shown in Table 3-1.

The SCAQMD staff recommends that a GHG analysis include the six Kyoto GHGs, to the extent emission factors are available primarily because there is more information on these GHGs than other potential GHGs. Other GHGs would be added to the list as scientific information becomes available and agreed to by national or international protocols and agreements.

**Table 3-1**
Global Warming Potential of Kyoto GHGs

| Gas | Atmospheric Lifetime | GWP |
|---|---|---|
| Carbon dioxide (CO2) | 50 – 200 | 1 |
| Methane (CH4) | 12 $\pm$ 3 | 21 |
| Nitrous oxide (N2O) | 120 | 310 |
| HFC-23 (Hydrofluorocarbons) | 264 | 11,700 |
| HFC-32 | 5.6 | 650 |

**Table 3-1 (Concluded)**
Global Warming Potential of Kyoto GHGs

| Gas | Atmospheric Lifetime | GWP |
|---|---|---|
| HFC-125 | 32.6 | 2,800 |
| HFC-134a | 14.6 | 1,300 |
| HFC-143a | 48.3 | 3,800 |
| HFC-152a | 1.5 | 140 |
| HFC-227ea | 36.5 | 2,900 |
| HFC-236fa | 209 | 6,300 |
| HFC-4310mee | 17.1 | 1,300 |
| CF4 (Perfluorocarbons) | 50,000 | 6,500 |
| C2F6 | 10,000 | 9,200 |
| C4F10 | 2,600 | 7,000 |
| C6F14 | 3,200 | 7,400 |
| Sulfer hexafluoride (SF6) | 3,200 | 23,900 |

Source: U.S. EPA (http://www.epa.gov/)

Carbon black, a form of particulate air pollution most often produced from biomass burning, cooking with solid fuels and diesel exhaust, may also have a warming effect in the atmosphere. It is estimated that carbon black's contribution to climate change is second only to carbon dioxide. Carbon black contributes to global warming by absorbing heat while airborne in the atmosphere. Carbon black is of particular concern in the arctic because it settles on ice and snow, reducing its reflectivity and increasing the rate of melting.

Based on a survey of available information, there are little data available for calculating carbon black effects on global warming. As a result, SCAQMD staff is not recommending analyzing carbon black effects on global warming. As information becomes available, staff will reconsider adding carbon black to the list of GHGs to be analyzed in CEQA documents.

**Business-As-Usual (BAU)**

In CARB's Scoping Plan (CARB, 2008) CARB states that the BAU case is a representation of what the state of the California economy will be in the year 2020 assuming that none of the measures recommended in the Scoping Plan are implemented. CARB's projected BAU GHG emissions in 2020 are shown in Table 3-2.

**Table 3-2**
2002-2004 Average Emissions and 2020 Projected Emissions (Business-as-Usual)
(MMTCO2E)

| Sector | 2002-2004 Average Emissions | Projected 2020 Emissions [BAU] |
|---|---|---|
| Transportation | 179.3 | 225.4 |
| Electricity | 109.0 | 139.2 |
| Commercial and Residential | 41.0 | 46.7 |
| Industry | 95.9 | 100.5 |
| Recycling and Waste | 5.6 | 7.7 |
| High GWP | 14.8 | 46.9 |
| Agriculture | 27.7 | 29.8 |
| Forest Net Emissions - | 4.7 | 0.0 |
| **Emissions Total** | **469** | **596** |

Source: CARB, 2008 – Scoping Plan, Table 1

CARB's Scoping Plan states further that continuing increases in global greenhouse gas emissions at BAU rates would result, by late in the century, in California losing 90 percent of the Sierra snow pack, sea level rising by more than 20 inches, and a three to four times increase in heat wave days, flood damage, etc. To avoid future foreseeable environmental impacts to California, the Scoping plan calls for an ambitious but achievable reduction in California's carbon footprint. Reducing greenhouse gas emissions to 1990 levels means reducing approximately 30 percent from BAU emission levels projected for 2020, or about 15 percent from today's levels. On a per-capita basis, that means reducing our annual emissions of 14 tons of carbon dioxide equivalent for every man, woman and child in California down to about 10 tons per person by 2020.

Although CARB's Scoping Plan calls for reducing GHG emissions 30 percent from BAU levels, it does not explicitly define BAU. There is, however, a brief definition of BAU in CARB's GHG inventory document (CARB, 2007). In that document CARB describes BAU as:

- BAU is based on GHG emissions estimates in the absence of policies and reduction measures, and
- BAU is based on forecasted demographic and economic growth.

In its White Paper, CAPCOA provides a more detailed definition of BAU compared to the above definition in CARB's inventory document. In the White Paper BAU is defined as follows:

- The projection of GHGs into the future based on current technologies and regulations;

- The adoption of new GHG reduction regulations, e.g., CARB's Scoping Plan measures, in the future establishes new BAU, i.e., the definition of BAU evolves over time; and
- BAU will normally define the CEQA no project alternative, but does not necessarily form the project baseline.

Based on the above definitions and discussions from the Working Group, SCAQMD staff defines BAU as the following

- Is used to project project's future emissions (consistent with CAPCOA and CARB definitions), i.e., level from which GHG reductions must occur;
- Is based first and foremost on current regulatory requirements (consistent with CAPCOA and CARB definitions);
- Regulatory requirements may determine current technology, e.g., advanced technology may be available, but not required, such as combined cycle gas turbine;
- Will normally define the no project alternative (consistent with CAPCOA and CARB definitions); and
- May be used to establish a project's CEQA baseline, only if consistent with CEQA Guidelines §15125.

The importance of BAU lies not only in the fact that it is a methodology for calculating a project's future emissions, is also forms the emission level from which GHG emission reductions must occur. SCAQMD staff's current GHG significance threshold proposal includes the Tier 4 compliance option 1 that establishes a performance standard of reducing GHG emissions 30 percent below the project's projected BAU emissions through design features and/or mitigation measures. A 30 percent reduction from BAU is consistent with the target objectives of AB 32 and CARB's Scoping Plan. The intent of the Tier 4 compliance option 1 is to provide a feasible target objective, that will not only contribute to achieving the AB 32 target objective, but will also contribute to achieving the 2050 target of the Governor's Executive Order S-3-05, which establishes of target objective of reducing GHG emissions 80 percent below 1990 levels or a 90 percent reduction from current BAU estimates.

As recognized by CAPCOA and SCAQMD, BAU will evolve over time as the current regulatory framework changes to implement GHG reduction strategies, either statewide strategies, e.g., CARB's Scoping Plan, or any future federal strategies. Evolving BAU creates two issues for the CEQA practitioner. First, staff's proposed Tier 4 compliance option 1 target objective is unchanged from 30 percent, then over time as BAU changes to incorporate GHG reduction strategies, achieving the target objective will become more difficult. Second, any GHG significance thresholds that rely on BAU will have higher uncertainties because they rely on a constantly changing BAU, which may be difficult to define.

To resolve some of these issues of an evolving definition of BAU, SCAQMD staff recommends that a statewide definition be developed by CARB that is updated periodically. Until such time as a statewide definition of BAU is developed, the SCAQMD staff will rely on the above definition. Because the SCAQMD's staff's GHG significance proposal is considered to be an interim proposal, future updates or revisions to staff's proposal would also include updates to BAU or the target objective as BAU levels decline over time. It may be that a target objective percent reduction from BAU levels is a short-term GHG threshold proposal and may become less important in the future as other concepts are evaluated and more fully developed.

## - GHG Source Categories to Analyze

### Life Cycle Analysis

CEQA requires that the lead agency analyze direct and indirect impacts from a proposed project, giving due consideration to short-term and long-term effects (CEQA Guidelines 15126.2(a)). In the case of GHG pollutants a systems approach to evaluating the consequences of a particular product, process or activity may be more appropriate because of the long atmospheric lifetimes of the various GHGs (see Table 3-1). One of the most effective ways of evaluating GHGs using a systems approach is through the preparation of a life cycle analysis (LCA).

The goal of a life cycle analysis is to compare the full range of environmental damages assignable to products and services, to be able to choose the least burdensome one. The term 'life cycle' refers to the concept that a fair, holistic assessment requires the assessment of raw material production, manufacture, distribution, use and disposal including all intervening transportation steps necessary or caused by the product's existence. The sum of all those steps - or phases - is the life cycle of the product.

Performing a life cycle analysis may be difficult for a number of projects or processes because life cycle emission factors may not be well established for many activities or projects and the life cycle process itself may not be known or well-defined. SCAQMD staff, however, recommends that life cycle analyses be prepared for all projects undergoing a CEQA analysis, as this will produce a more defensible approach. If, however, any component of the life cycle analysis is unavailable, unknown, or not supported by scientific evidence, the lead agency should note such an analysis would be speculative pursuant to CEQA Guidelines §15145 and terminate discussion of that impact.

### Direct/Indirect Impacts

Consistent with CEQA, indirect and direct impacts of the project, typically within California, are required to be analyzed in the CEQA document for a proposed project. The analysis of direct GHG impacts is relatively straightforward as onsite GHG sources or directly related offsite GHG sources, such as worker commute trips, are generally readily identifiable. Indirect GHG emission sources are less obvious, but may include some of the sources identified in the following paragraphs. In general,

for most projects information on direct and indirect emissions may be available, rather than a full life-cycle analysis of emissions. The lead agency has typically been expected to address emissions that are closely related and within the capacity of the project proponent to control and/or influence.

**Direct Impacts -** are primary effects that are caused by a project and occur at the same time and place, such as emissions from boilers, heaters, or other onsite emissions sources. Direct impacts generated by a project may include offsite sources directly related to the project such as emissions from worker commute trips, haul truck trips to import raw materials and/or export finished products or other goods.

Direct GHG emission impacts will include both construction and operation activities. Because impacts from construction activities occur over a relatively short-term period of time, they contribute a relatively small portion of the overall lifetime project GHG emissions. In addition, GHG emission reduction measures for construction equipment are relatively limited. Therefore, SCAQMD staff is recommending that construction emissions be amortized over a 30-year project lifetime, so that GHG reduction measures will address construction GHG emissions as part of the operational GHG reduction strategies.

**Indirect Impacts -** The CEQA Guidelines define indirect impacts as the following: an indirect physical change in the environment…which is not immediately related to the project, but which is caused indirectly by the project. If a direct physical change in the environment in turn causes another change in the environment, then the other change is an indirect change in the environment (CEQA Guidelines §15064 (d)(2)). Indirect or secondary effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems (CEQA Guidelines §15358)(a)(2)).

## DRAFT STAFF INTERIM GHG SIGNIFICANCE THRESHOLD PROPOSAL

As indicated by the evolution of the staff proposal over time, SCAQMD has generally recommended a tiered decision tree approach to establishing a GHG significance threshold. In CAPCOA's White Paper, eight of the 12 significance threshold options are based on a tiered threshold approach (see also Table 2-2 in Chapter 2). A tiered GHG significance threshold approach is an appealing approach because it provides flexibility in determining whether or not GHG emissions from a project are significant typically using a single methodology to establish various tiers that can be based on the physical size of the project, land use type, or other characteristics. The tiered approach envisioned by SCAQMD staff would require quantification of GHG emissions for all projects that are subject to CEQA and quantification of the GHG reduction effectiveness of design parameters incorporated into the project and any mitigation measures imposed by the lead agency. It may even be necessary to

quantify GHG emissions, if any, for projects that would otherwise qualify for a categorical exemption to document that no "cumulative impact of successive projects of the same type in the same place, over time is significant" (CEQA Guidelines §15300.2(b), or that there is no "reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances." (CEQA Guidelines §15300.2(c)).

The CAPCOA White Paper also includes a discussion of a decision tree approach to tiering. Instead of using a single methodology to establish tiers, a decision tree approach would use multiple methodologies to demonstrate significance for a broad range of projects/plans that may be difficult to address using a single GHG significance threshold methodology. Using a decision tree approach promotes even greater flexibility in determining significance for a variety of project types.

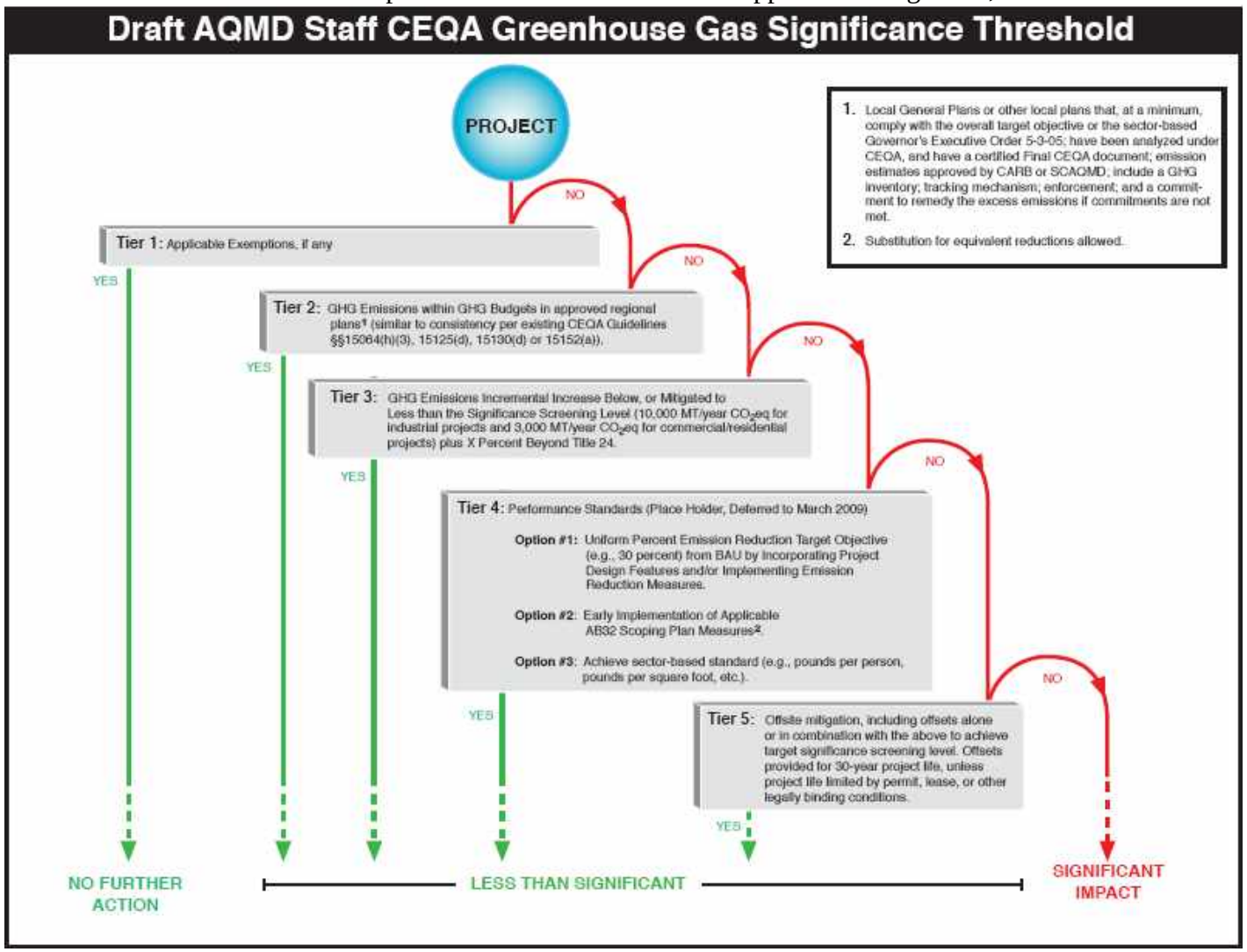
At the August 27, 2008 Working Group meeting #5, staff presented the revised interim GHG significance proposal #3, which included a tiered decision tree approach. Unlike the decision tree approach discussed in CAPCOA's White Paper, some tiers include multiple approaches for determining whether a project's GHG emissions are significant, rather than using a single different methodology for each tier.

For the purposes of determining whether or not GHG emissions from affected projects are significant, project emissions will include direct, indirect, and, to the extent information is available, life cycle emissions during construction and operation. Construction emissions will be amortized over the life of the project, defined as 30 years, added to the operational emissions, and compared to the applicable interim GHG significance threshold tier. The following bullet points describe the basic structure of staff's tiered GHG significance threshold proposal for stationary sources. The components of revised staff proposal #3 are described in the following paragraphs and shown graphically in Figure 3-1.

- **Tier 1 –** consists of evaluating whether or not the project qualifies for any applicable exemption under CEQA. For example, SB 97 specifically exempts a limited number of projects until it expires in 2010. If the project qualifies for an exemption, no further action is required. If the project does not qualify for an exemption, then it would move to the next tier.

- **Tier 2 –** consists of determining whether or not the project is consistent with a GHG reduction plan that may be part of a local general plan, for example. The concept embodied in this tier is equivalent to the existing concept of consistency in CEQA Guidelines §§15064(h)(3), 15125(d), or 15152(a). The GHG reduction plan must, at a minimum, comply with AB 32 GHG reduction goals; include emissions estimates agreed upon by either CARB or the SCAQMD, have been analyzed under CEQA, and have a certified Final CEQA document. Further, the GHG reduction plan must include a GHG emissions inventory tracking mechanism; process to monitor progress in achieving GHG emission reduction targets, and a commitment to remedy the excess emissions if AB 32 goals are not met (enforcement).

**Figure 3-1**
Revised Staff Proposal #3 Tiered Decision Tree Approach – August 27, 2008



If the proposed project is consistent with the local GHG reduction plan, it is not significant for GHG emissions. If the project is not consistent with a local GHG reduction plan or there is no approved plan, the GHG reduction does not include all of the components described above, or there is no adopted GHG reduction plan, the project would move to tier 3.

- **Tier 3 –** attempts to identify small projects that would not likely contribute to significant cumulative GHG impacts. However, because of the magnitude of increasing global temperatures from current and future GHG emissions, staff is recommending that all projects must implement some measure or measures to contribute to reducing GHG emissions. Therefore, Tier 3 includes a requirement that ~~all~~ residential/commercial projects with GHG emissions less than the screening level must include efficiency components that ~~reduce a certain~~go X percent~~age~~ beyond the requirements of Title 24 (Part 6, California Code of Regulations), California's energy efficiency standards for residential and nonresidential buildings. Project proponents would also have to reduce by a specified percentage electricity demand from water use, primarily electricity used for water conveyance.

  ~~The most recently~~A past recommended screening level proposed by staff was 6,500 MTCO2eq./year. This screening level was derived using the SCAQMD's existing NOx operational threshold as a basis. The daily NOx operational significance threshold, 55 pounds per day was annualized, which results in 10 tons of NOx per year.

  Staff initially considered and then rejected a bifurcated screening level, that is one screening level for residential and commercial projects and a different screening level for industrial projects based on the URBEMIS modeling runs used to derive the 6,500 MTCO3eq/yr screening level because GHG emissions from industrial were of the same magnitude as the GHG emissions from residential and commercial projects. Staff has reconsidered the bifurcated screening level approach as there is a more scientific basis for deriving the different screening levels.

  SCAQMD staff is now recommending a bifurcated screening level approach to address two greatly differing project types: industrial projects as opposed to residential and commercial projects (which are largely indirect sources). The former category typically contains stationary source equipment whose emissions are largely permitted or regulated by the SCAQMD; whereas the latter category is mostly residential, commercial (may also include industrial) building structures that attract or generate mobile source emissions. In light of the GHG reductions needed to stabilize the climate while considering implementation resource requirements, the policy objective used to establish the screening thresholds is to capture projects that represent approximately 90 percent of GHG emissions from new sources. The following paragraphs describe the steps taken to derive the screening threshold values.

**Industrial Projects:** Since the majority of GHG emissions in the district are comprised of CO2 emissions from burning natural gas rather than other types of fossil fuel, staff compiled reported annual natural gas consumption for 1,297~~115~~ permitted facilities for 2006-2007 and rank-ordered the facilities to estimate the 90$^{th}$ percentile of the cumulative natural gas usage for all permitted facilities. Operators of these facilities are required to report their emissions and associated throughput under the SCAQMD's Annual Emission Reporting (AER) Program if any of their criteria pollutant emissions exceed four tons per year (100 tons per year for CO) or if the facility has any reportable air toxics emission. Figure 3-2 shows that approximately 10 percent of facilities evaluated comprise more than 90 percent of the total natural gas consumption, which corresponds to 10,000 metric tons per year (tpy) of CO2 emissions. This value represents a boiler with a rating of approximately 27 million British thermal units per hour (mmbtu/hour) of heat input, operating at ~~a~~n ~~25~~ 80 percent capacity factor. If the screening threshold of 10,000 MTCO2eq./yr is implemented, based on the permitting activities for 2006-2007 it will result in at least 31 additional MNDs or EIRs being prepared by the SCAQMD as the lead agency unless another tier option is selected to demonstrate no significant impacts for GHG emissions. It should be noted that this analysis did not include other possible GHG pollutants such as methane, N2O; a life-cycle analysis; mobile sources; or indirect electricity consumption. Therefore, under a 10,000 MTCO2eq./yr screening level more projects would be required to go through an MND or EIR environmental analysis than is currently the case. Furthermore, when the SCAQMD acts as a lead agency, the stationary source equipment employed as part of the proposed project typically must comply with BACT or other SCAQMD rules, regulations, programs that require reducing criteria pollutants or air toxics. Therefore, staff is proposing to replace the 6,500 MTCO2/yr screening level with the 10,000 MTCO2eq/yr as the screening level in tier III for industrial projects when the SCAQMD is the lead agency for the project.

**Residential and Commercial Projects:** To achieve the same 90 percent GHG emission capture rate for this segment of projects GHG emissions from residential and commercial sectors were compared to the GHG emissions from the industrial sector including the in-state power plants. The draft AB32 scoping plan indicates that based on statewide 2002-2004 average GHG emissions, the residential and commercial sectors account for approximately nine percent of the total statewide GHG inventory, while the industrial sector (including instate power plants) accounts for approximately 30 percent of the statewide GHG emission inventory. The inventory methodology for both sectors includes only on-site energy use, consistent with the staff approach taken in deriving the 10,000 tpy threshold. Assuming similar emission characteristics also exist for the residential and commercial sector (i.e., large residential or commercial projects, although fewer in numbers, contribute substantially more to the total emissions), it is estimated that at a threshold of approximately 3,000 MTCO2eq/yr emissions (10,000 x (9 percent / 30 percent)) would capture 90 percent of the GHG emissions from new residential or commercial projects. A series of sensitivity analyses was performed by the staff using URBEMIS to assess the likely project size for 3,000 MTCO2eq/yr emissions. Table 3-3 illustrates various projects by size and shape.

**Figure 3-2**

Total Number of AER Facilities and Their Accumulative Reported NG Usage
FY 06-07

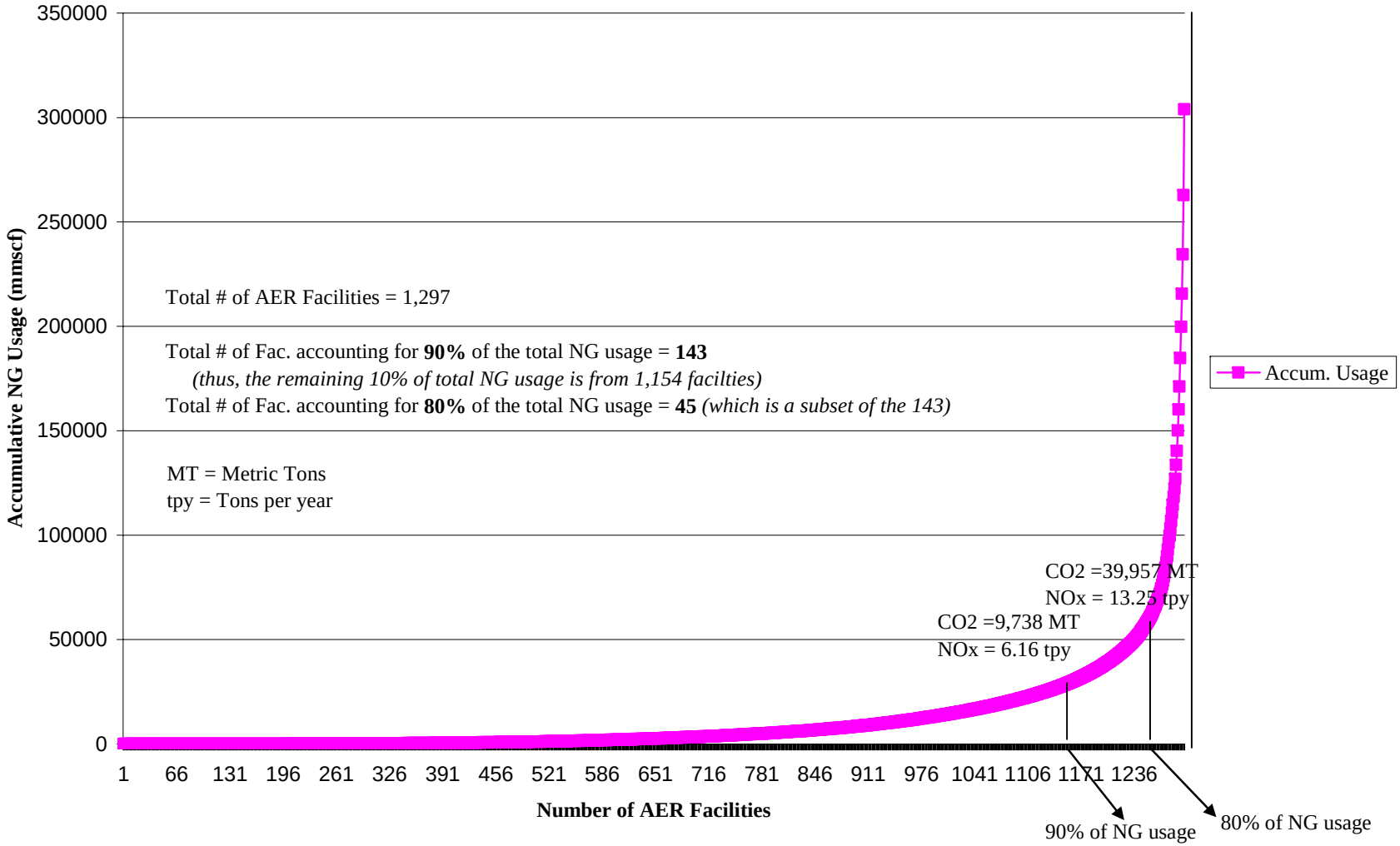


**Table 3-3**

URBEMIS Run Results for Residential/Commercial Projects Emitting Approximately 3,000 MTCO2 per Year*

| | | | *Area Source Emissions* | | *Operational Emissions* | | **TOTAL** |
|---|---|---|---|---|---|---|---|
| | **Weighted Avg Trip Rate** | **Size** | **CO2 (tons/year)** | **CO2 (MT/year)** | **CO2 (tons/year)** | **CO2 (MT/year)** | **CO2 (MT/year)** |
| Res - Single Unit | 19.54 | 80 units | 326.86 | 297.15 | 3003.56 | 2730.51 | 3027.65 |
| Res - Apt | 9.17 | 175 units | 422.70 | 384.27 | 2971.95 | 2701.77 | 3086.05 |
| Comm - Office | 6.02 | 265,000 $ft^2$ | 387.41 | 352.19 | 2961.75 | 2692.50 | 3044.69 |
| Comm - Bank | 206.22 | 9,500 $ft^2$ | 14.38 | 13.07 | 3192.90 | 2902.64 | 2915.71 |
| Single/Apt | 19.54 | 35 units | 379.59 | 345.08 | 2964.82 | 2695.29 | 3040.37 |
| | 9.17 | 100 units | | | | | |
| Office/Bank | 6.02 | 170,000 $ft^2$ | 254.19 | 231.08 | 3042.71 | 2766.10 | 2997.18 |
| | 206.22 | 3,400 $ft^2$ | | | | | |
| Office/Single | 6.02 | 135,000 $ft^2$ | 355.13 | 322.85 | 2956.32 | 2687.56 | 3010.41 |
| | 19.54 | 40 units | | | | | |
| Office/Apt | 6.02 | 135,000 $ft^2$ | 403.19 | 366.54 | 2952.34 | 2683.95 | 3050.48 |
| | 9.17 | 85 units | | | | | |
| Bank/Single | 206.22 | 3,700 $ft^2$ | 202.81 | 184.37 | 3052.93 | 2775.39 | 2959.76 |
| | 19.54 | 50 units | | | | | |
| Bank/Apt | 206.22 | 4,000 $ft^2$ | 248.12 | 225.56 | 3042.64 | 2766.04 | 2991.60 |
| | 9.17 | 100 units | | | | | |
| Single/Apt/Office | 19.54 | 20 units | 382.60 | 347.82 | 2945.26 | 2677.51 | 3025.33 |
| | 9.17 | 65 units | | | | | |
| | 6.02 | 100,000 $ft^2$ | | | | | |
| Single/Apt/Bank | 19.54 | 20 units | 241.78 | 219.80 | 3020.76 | 2746.15 | 2965.95 |
| | 9.17 | 65 units | | | | | |
| | 206.22 | 3,550 $ft^2$ | | | | | |
| | | | | | | Avg CO2 (MT/year): | **3009.60** |

*****Offsite electricity use, water use, or other potential life cycle emissions not included.

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As shown in Table 3-3, this threshold would represent a residential development of about 70 single-family dwelling units. It should be noted that the sensitivity analysis did not include GHG emissions from electricity use and water use. As a result, similar to the earlier discussion of industrial projects, this screening level of 3,000 MTCO2eq/yr could capture development projects less than 70 single-family dwelling units.

In CAPCOA's White Paper, it is suggested that a thresholds of 900 MTCO2eq/yr would capture 90 percent of all development projects, which should translate into at least 90 percent of GHG emissions from the residential and commercial sectors[2]. According to CAPCOA 900 MTCO2eq/yr equates to approximately 50 single-family dwelling units. This information appears to corroborate the SCAQMD staff's finding that the policy objective of capturing 90 percent of all GHG emissions for this region can be achieved with a screening level of 3000 MTCO2eq/yr. Therefore, staff is recommending that this value be used by lead agencies for residential and commercial developments, including industrial parks, warehouses, etc.

- **Tier 4 – Decision Tree Options:** consists of three decision tree options to demonstrate that a project is not significant for GHG emissions. The three compliance options are as follows.

  **Compliance Option 1 –** the lead agency would calculate GHG emissions for a project using a BAU methodology. Once GHG emissions are calculated, the project proponent would need to incorporate design features into the project and/or implement GHG mitigation measures to demonstrate a 30 percent reduction from BAU. Although a 30 percent reduction below BAU is consistent with the target objectives of AB 32, it will continue to reduce GHG emissions beyond 2020, thus, contributing to GHG reductions pursuant to the Governor's Executive Order S-3-05 (a 90 percent reduction compared to current GHG emissions). A 30 percent reduction is also considered to be an achievable GHG reduction target based on current technologies.

  **Compliance Option 2 –** this option consists of early compliance with AB 32 through early implementation of CARB's Scoping Plan Measures. The intent of this compliance option is to accelerate GHG emission reductions from the various

[2] Although the CAPCOA White Paper implies that 900 metric tons per year equates to a 90 percent capture rate, there is no explicit information provided in the White Paper that demonstrates this correlation. Indeed, the CAPCOA authors state that 900 metric tons, which represents approximately 50 residential units, corresponds to widely divergent capture rate percentile rankings depending on the project location (see discussion on page 43 of the White Paper). Percentile rankings were based on a survey of four cities in California. A project of 900 metric tons per year representing a 90 percent capture rate appears to be a working assumption for which there appears to be no factual basis. Further, although not explicitly stated, it is assumed that the 900 metric tons were derived using the URBEMIS2007 model. It should be noted that that the URBEMIS2007 model only quantifies CO2 emissions and direct emissions primarily from on-road mobile sources. It does not capture other GHG pollutants or indirect GHG emissions such as emissions from energy generation, water conveyance, etc. Therefore, it is likely that a 50-unit residential project would actually generate higher GHG emissions than 900 metric tons per year.

sectors subject to CARB's Scoping Plan to eliminate GHG emission, especially for those GHGs that have a long atmospheric lifetime such as CO2, sulfur hexafluoride, etc., to minimize future projected impacts to California from global climate change.

**Compliance Option 3 –** this compliance option consists of establishing sector-based performance standards. For example, it may be possible to use the 1990 inventory required under AB 32 to establish an efficiency standard such as pounds per person, pounds per worker, pounds per square feet, pounds per item manufactured, etc. When calculating GHG emissions from a project, if they are less than the established efficiency standard the project would not be significant relative to GHG emissions, while projects exceeding the efficiency standard would be significant.

If the lead agency or project proponent cannot achieve the performance standards on any of the compliance options in Tier 4, GHG emissions would be considered significant.

- **Tier 5** – under this tier, the lead agency would quantify GHG emissions from the project and the project proponent would implement offsite mitigation (GHG reduction projects) or purchase offsets to reduce GHG emission impacts to less than the proposed screening level. In addition, the project proponent would be required to provide offsets for the life of the project, which is defined as 30 years. If the project proponent is unable to obtain sufficient offsets, incorporate design features, or implement GHG reduction mitigation measures to reduce GHG emission impacts to less than the screening level, then GHG emissions from the project would be considered significant. Since it is currently uncertain how offsite mitigation measures, including purchased offsets, interact with future AB 32 Scoping Plan measures, the AQMD would allow substitution of mitigation measures that include an enforceable commitment to provide mitigation prior to occurrence of emissions and to prevent mitigating the same emissions twice.

  Mitigation Preference – If a project generates significant adverse impacts, CEQA Guidelines §15126.4 requires identification of mitigation measures to minimize potentially significant impacts. Because GHG emissions contribute to global change, mitigation measures could be implemented locally, nationally, or internationally and still provide global climate change benefits. Because reducing GHG emissions may provide co-benefits through concurrent reductions in criteria pollutants, when considering mitigation measures when the AQMD is the lead agency under CEQA, staff will implement mitigation measures that are real, quantifiable, verifiable, and surplus in the following order of preference.

  - Incorporate GHG reduction features into the project design, e.g., increase a building's energy efficiency, use materials with a lower global warming potential than conventional materials, purchase building materials locally, etc.

  - Implement onsite measures that provide direct GHG emission reductions onsite, e.g., replace onsite combustion equipment (boilers, heaters, steam

generators, etc.) with more efficient combustion equipment, replace existing high global warming potential refrigerants with low global warming refrigerants, eliminate or minimize fugitive emissions, etc.

- Implement neighborhood mitigation measure projects that could include incentives for installing solar power, increasing energy efficiency by exceeding Title 24 building standards through replacing low efficiency water heaters with high efficiency water heaters, increasing building insulation, using fluorescent bulbs, replacing old inefficient refrigerators with efficient refrigerators using low global warming potential refrigerants, etc.

- Implement in-district mitigation measures such as any of the above identified GHG reduction measures; reducing vehicle miles traveled (VMT) through greater rideshare incentives, transit improvements, etc.

- Implement in-state mitigation measures, which could include any of the above measures.

- Implement out of state mitigation measure projects, which may include purchasing offsets if no other options are available.

## CARB's Interim GHG Significance Threshold Proposal

In October 2008 CARB released its interim GHG significance threshold proposal and held a public workshop on October 27, 2008. CARB's threshold is considered to be an interim threshold because CARB staff intends to periodically review and change its threshold proposal as necessary. CARB's Preliminary Draft Staff Proposal (Proposal) states that non-zero GHG significance thresholds can be supported by substantial evidence. Futher, different GHG significance thresholds may be established for different sectors. Therefore, as part of its initial interim GHG significance threshold proposal CARB is proposing two separate GHG significance thresholds, one for new industrial projects and another for residential/commercial projects subject to CEQA. CARB's proposal uses a tiered approach (see Table 3-4).

Table 3-4
Comparison of CARB's and AQMD's Interim GHG Significance Thresholds Approaches

| | Stationary/Industrial Sector Projects | | Residential/Commercial Sector Projects | |
|---|---|---|---|---|
| | CARB | AQMD | CARB | AQMD (Not Recommended at this Time) |
| Policy Objective | Capture 90% of statewide stationary project emissions | Capture 90% of district wide GHG emissions (industrial) | Capture X% of statewide residential/commercial project emissions | Capture 90% of district wide residential/commercial project GHG emissions |
| Exemption | Apply applicable exemption | Apply applicable exemption | Apply Applicable Exemption | Apply Applicable Exemption |
| Regional GHG Reduction Plan | N.A. | Project Consistent with Applicable GHG Reduction Plan with GHG inventorying, monitoring, enforcement, etc. | Project Consistent with Applicable GHG Reduction Plan with GHG inventorying, monitoring, enforcement, etc. | Project Consistent with Applicable GHG Reduction Plan with GHG inventorying, monitoring, enforcement, etc. |
| Thresholds | Project < 7,000 MTCO2eq/yr & meets construction & transportation performance standards | GHG emissions from industrial project is < 10,000 MTCO2eq/yr, includes construction emissions amortized over 30 years & added to operational GHG emissions | Project meets construction & operation performance tandards, e.g., energy, water use, waste & ransportation & < X MTCO2eq/yr | Project is < 3,000 MTCO2eq/yr & exceeds Title 24 Energy Efficiency Standards by X%, if applicable – construction emissions amortized over 30 years & added to operational GHG emissions |
| Performance Standards | See above | NA | See above | 3 Compliance Options: 1) Reduce GHG emissions 30% below BAU; 2) Early Implement AB 32 Measure; 3) Comply with Performance Standard |
| Offsets | Offsite substitution allowed | Implement offsite mitigation for life of project, i.e., 30 years, with mitigation preference | Offsite substitution allowed | Implement offsite mitigation for life of project, i.e., 30 years with mitigation preference |
| Determination | GHG emissions significant, EIR is prepared, if meeting none of the above | GHG emissions significant, EIR is prepared, if meeting none of the above | GHG emissions significant, EIR is prepared, if meeting none of the above | GHG emissions significant, EIR is prepared, if meeting none of the above |

CARB's interim GHG significance threshold for industrial sources was developed to capture "the vast majority (~90% statewide) of the GHG emissions from new industrial projects being subject to CEQA's requirement to impose feasible mitigation." According to CARB's Proposal, CARB staff used data from a survey of industrial boilers performed by the Oak Ridge National Laboratory in which it was concluded that small boilers with an input capacity of 10 MMBtu/hr corresponded to 93 percent of total industrial boiler input capacity, or 4,660 MTCO2e/yr. Using this result and accounting for process losses, purchased electricity, and water usage and wastewater discharge, CARB staff is recommending 7,000 MTCO2eq/yr as a GHG significance threshold for industrial projects. The following bullet points summarize CARB's proposed interim GHG significance threshold for industrial sources.

- Box 1 – Apply any applicable categorical or statutory exemptions. If the project does not qualify for an exemption, move to Box 2.

- Box 2 – The industrial project must meet both of the following performance standards or equivalent mitigation measures to be deemed insignificant for GHGs:

  - Construction – Project must meet an interim performance standard for construction- related emissions (performance standard not yet defined).

  - Transportation – Project must meet an interim performance standard for transportation (performance standard not yet defined).

  AND

  - Project with mitigation will emit no more than 7,000 MTCO2eq/yr. If the project does not qualify for either of the performance standards or exceeds 7,000 MTCO2eq/yr, move to Box 3.

- Box 3 – Project is deemed significant and an EIR must be prepared.

- CARB's Preliminary Draft Proposal for Residential and Commercial projects is summarized in the following bullet points.

- Box 1 – Apply any applicable categorical or statutory exemptions. If the project does not qualify for an exemption, move to Box 2.

- Box 2 – Project complies with a previously approved plan that addresses GHG emissions and must: include a GHG reduction target consistent with AB 32; be consistent with transportation-related target adopted by CARB pursuant to SB 375; include a GHG inventory and mechanism for monitoring GHG emissions; include enforceable GHG requirements; include a mechanism for periodic updates to plan; and have a certified CEQA document. If the project is

consistent with a GHG plan that includes all of these elements, it is presumed to be insignificant for GHGs. If the project is not consistent with a GHG plan or there is no adopted GHG plan that includes all of the above elements, move to Box 3.

- Box 3 – The residential/commercial project must meet all of the following performance standards or equivalent mitigation measures to be deemed insignificant for GHGs:

  - Construction – Project must meet an interim performance standard for construction- related emissions (performance standard not yet defined).

  - Operations – Project must meet the following performance standards: energy use performance standard defined in CEC's Tier II Energy Efficiency goal; an interim performance standard for water use (performance standard not yet defined); an interim performance standard for waste (performance standard not yet defined); and an interim performance standard for transportation (performance standard not yet defined).

AND

The project with performance standards or equivalent mitigation will emit no more than X MTCO2eq/yr (criterion to be developed). If the project does not qualify for any one of the performance standards or exceeds X MTCO2eq/yr, move to Box 4.

- Box 4 – Project is deemed significant and an EIR must be prepared.

For a detailed description of CARB's interim GHG significance threshold proposal, refer to the following URL: http://www.arb.ca.gov/cc/localgov/ceqa/meetings/102708/prelimdraftproposal102408.pdf.

CARB is currently accepting comments on its Draft Proposal and has scheduled a second public workshop on December 9, 2008. CARB staff currently anticipates taking their proposal to their Board in February 2009.

# CHAPTER 4

# CONSIDERATIONS WHEN ANALYZING GHG EMISSIONS

**Introduction**

**GHG Analysis Recommendations**

# INTRODUCTION

As noted in Chapter 1, on June 19, 2008, OPR, in collaboration with the California Resources Agency, the California Environmental Protection Agency and the California Air Resources Board, released a *Technical Advisory* containing informal guidance for public agencies as they address the issue of climate change in their CEQA documents. With regard to analyzing GHG emission impacts OPR states,

"Each public agency that is a lead agency for complying with CEQA needs to develop its own approach to performing a climate change analysis for projects that generate GHG emissions. A consistent approach should be applied for the analysis of all such projects, and the analysis must be based on best available information… Lead agencies should determine whether greenhouse gases may be generated by a proposed project, and if so, quantify or estimate the GHG emissions by type and source."

Other than this general advice, the *Technical Advisory* does not provide explicit details for quantifying GHG emissions.

CAPCOA's White Paper provides a comprehensive discussion of modeling tools that are currently available for analyzing GHG emissions[3]. As indicated in the White Paper, no one model is currently available that is capable of estimating all of a project's direct and indirect GHG emissions. It is likely, however, that the Urban Emissions (URBEMIS) Model will be the most commonly used model for calculating GHG emissions because it currently calculates CO2 emissions (in addition to criteria pollutant emissions) during both construction and operation of proposed projects, it is publicly available, and already widely used in California. Statewide use of the URBEMIS model would provide consistency throughout California with regard to quantifying GHG emissions. For a list of currently available models that calculate GHG emissions and summaries of the capabilities, advantages, and disadvantages of each model refer to Table 10 on pages 75 through 78 in the CAPCOA White Paper.

The purpose of this chapter is to provide more explicit guidance to CEQA practitioners with regard to quantifying GHG emissions than OPR's *Technical Advisory*, while building on the information provided CAPCOA's White Paper.

# GHG ANALYSIS RECOMMENDATIONS

### Direct/Indirect Impacts

As noted in Chapter 3 of this Guidance Document, consistent with CEQA, indirect and direct impacts of the project, typically within California, are required to be analyzed in the CEQA document for a proposed project. The analysis of direct GHG impacts is

[3] For maximum transparency with regard to quantifying GHG emissions and disclosure to the public, SCAQMD staff recommends using only publicly available models.

relatively straightforward as onsite GHG sources or directly related offsite GHG sources, such as worker commute trips, are generally readily identifiable. Indirect GHG emission sources are less obvious, but may include some of the sources identified in the following paragraphs. In general, for most projects information on direct and indirect emissions may be available, rather than a full life-cycle analysis of emissions. The lead agency has typically been expected to address emissions that are closely related and within the capacity of the project proponent to control and/or influence.

**Direct Impacts -** are primary effects that are caused by a project and occur at the same time and place, such as emissions from boilers, heaters, or other onsite emissions sources. Direct impacts generated by a project may include offsite sources directly related to the project such as emissions from worker commute trips, haul truck trips to import raw materials and/or export finished products or other goods. The following paragraphs provide general guidance on quantifying direct GHG emissions.

CAPCOA's White Paper provides a comprehensive discussion of modeling tools that are currently available for analyzing GHG emissions. Further, no one model is currently available that is capable of estimating all of a project's direct and indirect GHG emissions. Although there are a number of modeling tools available to calculate GHG emissions the following discussion focuses on a combination of approaches using the URBEMIS model as the basis for analyzing GHG emission impacts. Other approaches for calculating GHG emissions can be used, as long as they are supported by scientific evidence and include publicly available information.

The URBEMIS model is a publicly available model that is currently used statewide to calculate criteria pollutant emissions from construction and operation activities for a wide variety of land use projects. The model is regularly updated through a collaboration of air pollution control agencies, including the SCAQMD, to reflect the most current data, methodologies, and emission factors for quantifying criteria pollutant emissions. The most current update to the model is URBEMIS2007 version 9.2.4, which quantifies CO2 emissions in addition to criteria pollutant emissions.

Currently, there are several disadvantages to using the URBEMIS model to calculate GHG emissions from a proposed project and, as a result, it should not be the only tool used to calculate GHG emissions. For example, currently the URBEMIS model only quantifies CO2 emissions and not other GHG pollutants, with the exception of methane from mobile sources, which is converted to CO2eq. emissions. Since CO2 emissions comprise the bulk of GHG emissions from most projects, URBEMIS GHG results are fairly representative of GHG emissions from a project.

To quantify mobile source emissions from on-road mobile sources, the URBEMIS model uses trip rate information from the Institute of Transportation Engineers Trip Generation Handbook (ITE, 2001) as the trip rate default factor for all land uses. ITE trip rate information is widely used and is considered legally defensible as they rely on substantial reports and surveys of trip rates in cities with little or no transit. As a result, the ITE trip rates are also considered to provide a conservative estimate of trip

rates and associated emissions. The model, however, treats each trip as a separate trip and doesn't consider that a single trip may be used for more than one purpose, referred to as "internalization." The model also does not fully account for interaction between land uses in its estimation of mobile source operational emissions. URBEMIS does allow the user to overwrite the default trip rates and characteristics with more project-specific data from a traffic study prepared for a project.

In spite of the disadvantages of the URBEMIS model described above, it can be used as the first step in quantifying GHG emissions for typical land use projects because it establishes default parameters for the most common emission sources from a project including construction equipment types and activity profiles, area of site disturbed during construction, building size, number vehicle trips, etc., if the level of information about the project is low. If more information about the project is available such as a precise profile of construction equipment and activity levels, number of vehicle trips based on a traffic study prepared for the project, etc., this information can be incorporated into the model. The model can then quantify CO2 emissions from both construction and operation.

The URBEMIS construction analysis quantifies criteria pollutant and CO2 emissions from both off-road sources (primarily construction equipment) and on-road sources (worker commute trips, haul truck trips, etc.). To further flesh out the construction analysis, the lead agency would have to identify emission factors for other GHG pollutants likely to be emitted during construction, i.e., methane and nitrous oxide[4], for both off-road and on-road emissions sources and then quantify the GHG emission results using spreadsheets or other available tools.

The off-road CO2 emission factors in the URBEMIS model are generated from CARB's off- road model (http://www.arb.ca.gov/msei/offroad/offroad.htm). Methane emission factors for off-road equipment can also be obtained from CARB's OFFROAD2007 model. CO2 and methane emission factors for off-road equipment that are based on CARB's OFFROAD2007 model can also be found on the SCAQMD's CEQA webpages at the following URL: http://www.aqmd.gov/ceqa/handbook/offroad/offroad.html. Other sources of off-road GHG emissions factors for equipment used in California may be used, as long as they are supported by scientific evidence and are publicly available.

The URBEMIS model is able to quantify mobile source CO2 emissions during construction from on-road mobile sources such as construction worker commute trips, heavy-duty truck trips to haul away demolition debris, soil hauling to and from the site etc., and during operation, primarily vehicle trips using ITE's Trip Generation Manual (ITE, 2001). The on-road CO2 emission factors in the URBEMIS model for both construction and operation are generated from CARB's on- road mobile source emissions model, EMFAC2007 (http://www.arb.ca.gov/msei/onroad/onroad.htm). Methane emission factors for on-road mobile sources can also be obtained from

[4] Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are not combustion emissions, so would not normally be emitted during construction.

CARB's EMFAC2007 model. CO2 and methane emission factors for on-road mobile sources that are based on CARB's EMFAC2007 model can also be found on the SCAQMD's CEQA webpages at the following URL: http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html.

The analysis of operation emissions from all types of land uses in the URBEMIS model focuses primarily on mobile source emissions and some area sources. The model does not quantify emissions from stationary sources. For stationary sources that require a permit from the SCAQMD, emission calculation procedures and methodologies are available in the SCAQMD's Best Available Control Technology Guidelines (http://www.aqmd.gov/bact/partd7-9-2004update.pdf). Examples of facilities that use stationary sources requiring a permit from the SCAQMD include: fossil fuel power plants[5], cement plants, landfills, wastewater treatment plants, gas stations, dry cleaners and industrial boilers. The SCAQMD has procedures and methodologies for projects subject to SCAQMD permits to calculate criteria pollutants and air toxics. It is anticipated that these same procedures and methodologies could be extended to estimate a permitted facility's GHG calculations. For are any stationary and area sources that do not require SCAQMD permits, the same methodologies used for permitted sources could be used. It will be necessary to contact the SCAQMD to obtain information on GHG emission calculation methodologies applicable to stationary source equipment.

**Indirect Impacts -** Indirect or secondary effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems (CEQA Guidelines §15358)(a)(2)). The examples of facilities that use stationary sources requiring a permit from the SCAQMD that may contribute to direct environmental impact (fossil fuel power plants, cement plants, landfills, wastewater treatment plants, gas stations, dry cleaners and industrial boilers) may also contribute to indirect impacts and, therefore, should be included, as necessary in the CEQA analysis of GHGs.

### Quantification Methodologies and GHG Emission Factors

Methodologies for calculating GHG emissions and GHG emission factors are currently not readily available. Until such time as GHG calculation methodologies and emission factors become well established and more readily available, lead agencies may want to consult the following references to identify acceptable methodologies and emission factors.

1. The first useful reference for GHG emission factors for stationary sources is EPA's Air Pollutant (AP)-42, which is a compilation of air pollutant emission

[5] According to CEQA Guidelines §15227, CEQA does not apply to projects outside of California. The California Attorney General's Office has rendered an opinion stating that the definition of the environment in CEQA does not stop at the borders of California. Further, California public agencies that take an action outside of California is still bound by the requirements of CEQA to prepare an EIR if the action may cause a significant effect on the environment.

factors for stationary point and area sources. Each of the first 13 chapters of AP-42 is dedicated to a specific source activity such as solid waste disposal, petroleum industry, and metallurgical industry. Since the publication of the fifth edition (and supplementals) in 2001, there have been a number of updates to the various specific stationary sources such as hot asphalt plants, organic liquid storage tanks, and coke production. In addition to the criteria pollutant emissions, some of the updated AP-42 chapters provide GHG emission factors for a variety of sources. For example, Chapter 15 of AP-42 focuses on GHG emissions from biogenic sources such as soils, termites, lightning, and enteric fermentation (animal digestive fermentation).

2. Second, the California Climate Action Registry (C-CAR) has prepared a General Reporting Protocol (GRP), which is a relatively easy-to-follow user's manual that outlines the principles, concepts, calculation methodologies and procedures required for effective participation in the California Registry. The appendices of the GRP provide GHG emissions factors, specifically CO2, CH4 and N2O, for electricity use, mobile combustion and stationary combustion based on fuel usage type.

3. Third, a thorough internet search should be conducted to find reliable sources of emissions factors that would assist in accurately determining GHG emissions from a specific source being evaluated. Again, all potential GHGs, such as CO2, CH4 and N2O, should be evaluated to the best of one's ability to locate dependable information.

4. Finally, a material balance approach also may provide reliable average emission estimates for specific sources. A material balance is when one accounts for (or "balances") all the materials going into and coming out of the process in order to make a credible emissions estimation. For some sources, a material balance may provide a better estimate of emissions especially in situations where a high percentage of material is lost to the atmosphere (e. g., sulfur in fuel, or solvent loss in an uncontrolled coating process.) In other cases, material balances may be inappropriate where material is consumed or chemically combined in the process, or where losses to the atmosphere are a small portion of the total process throughput.

**Reporting GHG Emissions – Daily vs. Annual Emissions**

The analysis of GHGs is a much different analysis than the analysis of criteria pollutants for the following reasons. For criteria pollutants, significance thresholds are based on daily emissions because attainment or non-attainment is based on daily exceedances of applicable ambient air quality standards. Further, several ambient air quality standards are based on relatively short term exposure effects on human health, e.g., one-hour and eight-hour. Since the half-life of CO2 is approximately 100 years, the effects of GHGs are longer-term, affecting global climate over a relatively long time frame (see also Table 3-1).

Typical GHG emission inventories (EPA5, ARB6, etc.) represent directly emitted GHGs during a given year. As a result, the current convention is to present GHG emissions as annual emissions. The URBEMIS model can be set to calculate annual emissions for a project. When using the URBEMIS model to calculate annual GHG emissions, it may be useful to modify the trip rate for each land use using a weighted trip rate average to more accurately reflect annualized trip rates. A weighted trip rate average reflects the trip rates during the week, as well as trip rates during Saturdays and Sundays. Trip rate information for weekdays and weekend days can be found in the ITE Trip Rate Handbook.

# CHAPTER 5

# CONCLUSION

**Introduction**

**Future Action Items**

# INTRODUCTION

CEQA Guidelines §15064.7(a) encourages lead agencies to establish thresholds of significance to determine the significance of an environmental impact. Further, thresholds of significance to be adopted for general use as part of the lead agency's environmental review process must be adopted by ordinance, resolution, rule, or regulation, and developed through a public review process and be supported by substantial evidence (CEQA Guidelines §15064.7(b)). Staff's proposed interim GHG significance threshold proposal has been developed through a public process consisting of a series of Stakeholder Working Group meetings. Staff proposals have been modified over time based on written and oral feedback from the Working Group. Staff's intent was to reach consensus to the extent feasible, but for some items staff could not find common ground with some of the stakeholders.

The next immediate step for SCAQMD staff is to present a final interim GHG significance threshold proposal to the SCAQMD Governing Board for consideration. If the Governing Board approves staff's final interim GHG significance threshold proposal, then staff will embark on a number of short-term and intermediate term activities to provide outreach to public agencies that might use staff's interim GHG significance threshold to determine whether or not their projects' GHG emissions are significant, periodically revisit and revise as necessary the interim proposal, and accommodate stakeholders' requests for more information on GHG calculation methodologies and mitigation measures. The following sections provide discussions on future anticipated action items

# FUTURE ACTION ITEMS

### Interim GHG Significance Threshold Outreach Program

It is currently anticipated that staff's interim GHG significance threshold proposal will be presented to, and considered by the Board at the November 7, 2008 public hearing. Consistent with other significance threshold proposals adopted by the Governing Board, if the draft GHG significance threshold proposal is adopted, staff will meet with local cities, councils of governments, and leagues of cities to discuss the staff proposal and address any questions or concerns.

Once the interim GHG significance threshold is adopted, this Guidance Document will be posted on the SCAQMD's CEQA web pages. Staff will also send notice of the adoption of the staff proposal to all agencies, organizations, and individuals on the SCAQMD's CEQA "Interested Parties" mailing list. In addition, it is expected that staff will prepare and make available an informational brochure that summarizes information about the interim GHG significance proposal in addition to this Guidance Document.

Starting in January 2009, as part of its intergovernmental review (IGR) responsibilities under CEQA, where the SCAQMD reviews and CEQA documents prepared by other public agencies, SCAQMD will begin more thorough evaluations of CEQA documents with regard to their GHG analyses and the basis by which they make a determination of significance. Staff will begin recommending use of the staff's interim GHG significance threshold proposal or other available GHG significance thresholds based on substantial evidence in comment letters on notices of preparation of an EIR. As of March 1, 2009, staff will formally recommend use of staff's interim GHG significance threshold proposal or other available GHG significance thresholds based on substantial evidence in comment letters on NDs and MNDs. As of July 1, 2009, staff will formally recommend use of staff's interim GHG significance threshold proposal or other available GHG significance thresholds based on substantial evidence in comment letters on EIRs.

**Compile Lists of GHG Design Features and Mitigation Measures**

CEQA Guidelines §15126.4 requires an EIR to "describe feasible measures which could minimize significant adverse impacts, including where relevant, inefficient and unnecessary consumption of energy." Ideally, it is desirable to avoid impacts altogether through incorporating design features into the proposed project. Because staff's recommended interim GHG significance threshold includes performance standards (see tier 4 compliance options 1 and 3) or a project proponent may try to reduce GHG emissions to less than the applicable screening levels, mitigation measures or design features are important components of the overall GHG significance threshold strategy. As a result, a number of GHG Working Group stakeholders has requested that SCAQMD compile lists of design features or mitigation measures to assist with reducing GHG emissions for all land use types.

In response to the request from GHG Working Group stakeholders to develop GHG design features and mitigation measures, over the next year SCAQMD staff will compile lists of GHG reduction strategies, including control efficiencies, by sector and make the lists available online with other recommended mitigation measures. There is already a robust body of mitigation measures available (see in particular the CAPCOA bullet point discussion below), but in most cases, they do not include control efficiencies. SCAQMD staff will use the following mitigation sources as a basis from which to compile mitigation strategies.

- **CEQA Guidelines, Appendix F –** this appendix includes a list of general energy conservation measures that may be used as a basis to identify GHG reduction strategies. The measures do not contain GHG control efficiencies, so they would need further review to determine if control efficiencies are available.

- **CAPCOA White Paper –** this document provides a comprehensive discussion of GHG reduction strategies and specific mitigation measures are listed in Table 16 in Appendix B. The mitigation measures are grouped by emissions source type, such as transportation measures, parking measures, commercial and residential design features, etc. Table 16 also provides other useful information about each

mitigation measure including source of each measure, comments and descriptions about each control measure, etc. Most importantly, for many of the mitigation measures CAPCOA has included an emission reduction score. In most cases, the emission reduction score is given as a range. As a result, further evaluation would be necessary to provide a single more precise emission reduction score or a defensible average. Otherwise, it is likely that the high end of the emission reduction score would be used.

- **CARB -** is actively working to develop and adopt GHG protocols to support the Climate Change Program. CARB is working in collaboration with other agencies and organizations, including the California Climate Action Registry, to adopt consistent and standardized methods to accurately report GHG emissions. There are two kinds of GHG protocols, a reporting protocol and a project protocol. The project protocol may be useful as it sets standards and provides specific guidance to define GHG reduction projects and quantify and report GHG reductions from project activities. Some example protocols include manure management and urban forestry. It is expected that additional protocols will be developed and adopted by CARB. It is also expected that CARB's Scoping Plan may provide guidance on regulatory guidance that could be used to develop GHG emission reduction measures. GHG reduction strategies that may also serve as GHG mitigation measures to be developed by CARB over the next two years are shown in Table 5-1.

**Table 5-1**
California Air Resources Board GHG Emission Reduction Strategies

| Strategy | Description of Strategy |
|---|---|
| Other Light Duty Vehicle Technology | New standards would be adopted to phase in beginning in the 2017 model year |
| Hydrofluorocarbon Reduction | 1) Ban retail sale of HFC in small cans; 2) Require that only low global warming potential (GWP) refrigerants be used in new vehicular systems; 3) Adopt specifications for new commercial refrigeration; 4) Add refrigerant leak-tightness to the pass criteria for vehicular Inspection and Maintenance programs; 5) Enforce federal ban on releasing HFCs. |
| Transportation Refrigeration Units, Off-Road Electrification, Port Electrification | Strategies to reduce emissions from TRUs, increase off-road electrification, and increase use of shore-side/port electrification. |
| Manure Management | San Joaquin Valley Rule 4570 (adopted 6/15/06) reduces volatile organic compounds from confined animal facilities through implementation of control options. |
| Alternative Fuels: Biodiesel Blends | CARB would develop regulations to require the use of 1 to 4 percent biodiesel displacement of California diesel fuel. |

**Table 5-1 (Concluded)**
California Air Resources Board GHG Emission Reduction Strategies

| Strategy | Description of Strategy |
|---|---|
| Alternative Fuels: Ethanol | Increased use of ethanol fuel. |
| Heavy-Duty Vehicle Emission Reduction Measures | Increased efficiency in the design of heavy duty vehicles and an education program for the heavy duty vehicle sector. |
| Reduced Venting and Leaks in Oil and Gas Systems | Rule considered for adoption by the Air Pollution Control Districts for improved management practices. |
| Hydrogen Highway | The California Hydrogen Highway Network (CA H2 Net) is a State initiative to promote the use of hydrogen as a means of diversifying the sources of transportation energy. |
| Achieve 50% Statewide Recycling Goal | Achieving the State's 50 percent waste diversion mandate as established by the Integrated Waste Management Act of 1989, (AB 939, Sher, Chapter 1095, Statutes of 1989), will reduce climate change emissions associated with energy intensive material extraction and production as well as methane emission from landfills. According to the California Integrated Waste Management Board, in 2005 the statewide waste diversion rate was 52 percent.[6] |
| Landfill Methane Capture | Install direct gas use or electricity projects at landfills to capture and use emitted methane. |
| Zero Waste - High Recycling | Additional recycling beyond the State's 50% recycling goal. |

- CEC and CPUC – These agencies are actively developing GHG emission reduction strategies that may also be used to develop GHG mitigation measures for specific energy production sources. Examples of CEC and CPUC GHG emission reduction strategies are shown in Table 5-2.

Other sources of potential GHG emission reduction measures will be evaluated and incorporated, as applicable into any GHG mitigation measure lists developed by the SCAQMD.

[6] CIWMB, 2007; http://www.ciwmb.ca.gov/LGCentral/Rates/Diversion/2005/Default.htm

**Table 5-2**
GHG Emission Reduction Strategies Implemented by CEC and CPUC

| Strategy | Description of Strategy |
|---|---|
| **ENERGY COMMISSION (CEC)** | |
| Building Energy Efficiency Standards in Place and in Progress | Public Resources Code 25402 authorizes the CEC to adopt and periodically update its building energy efficiency standards (that apply to newly constructed buildings and additions to and alterations to existing buildings). |
| Appliance Energy Efficiency Standards in Place and in Progress | Public Resources Code 25402 authorizes the Energy Commission to adopt and periodically update its appliance energy efficiency standards (that apply to devices and equipment using energy that are sold or offered for sale in California). |
| Cement Manufacturing | Cost-effective reductions to reduce energy consumption and to lower carbon dioxide emissions in the cement industry. |
| Municipal Utility Strategies | Includes energy efficiency programs, renewable portfolio standard, combined heat and power, and transitioning away from carbon intensive generation. |
| Alternative Fuels: non-Petroleum Fuels | Increasing the use of non-petroleum fuels in California's transportation sector, as recommended in the CEC's 2003 and 2005 Integrated Energy Policy Reports. |
| **PUBLIC UTILITIES COMMISSION (PUC)** | |
| Accelerated Renewable Portfolio Standard (33 percent by 2020) | The Governor has set a goal of achieving 33 percent renewables in the State's resource mix by 2020. The joint PUC/Energy Commission September 2005 Energy Action Plan II (EAP II) adopts the 33 percent goal. |
| California Solar Initiative | The solar initiative includes installation of 1 million solar roofs or an equivalent 3,000 MW by 2017 on homes and businesses, increased use of solar thermal systems to offset the increasing demand for natural gas, use of advanced metering in solar applications, and creation of a funding source that can provide rebates over 10 years through a declining incentive schedule. |
| Investor-Owned Utility | This strategy includes energy efficiency programs, combined heat and power initiative, and electricity sector carbon policy for investor owned utility. |

## Periodically Review the Interim GHG Significance Threshold

SCAQMD staff will periodically review and revise staff's GHG proposal to incorporate applicable updated information on GHGs and GHG reduction strategies resulting from regulatory requirements or advances in technology. Some areas of the current proposal that may be reevaluated include the tier 3 screening levels, and the tier 4 compliance option 1 GHG reduction target objective. Further, staff will evaluate whether or not sector based performance standards can be developed for tier 4 compliance option 3.

If a statewide GHG significance threshold is developed by CARB, staff will review that threshold and report to the Governing Board by March 2009 considering such a

threshold for adoption.~~regarding any implementation issues and ways to transition into the recommended GHG significance threshold within six months of formal approval by the CARB Board~~.

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# APPENDIX A

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## WORKING GROUP MEMBERS AND CONTRIBUTORS

## WORKING GROUP MEMBERS AND AFFILIATION:

| | |
|---|---|
| Greg M Adams | Los Angeles County Sanitation District |
| James Arnone | Latham and Watkins |
| Jonathan Evans | Center for Biological Diversity |
| Doug T. Feremenga | San Bernardino County Land Use Planning Department |
| Mark Grey | Building Industry Association (BIA) of Southern California |
| Gretchen Hardison | City of Los Angeles, Environmental Affairs |
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| Bill La Marr | California Small Business Alliance |
| Julia Lester | Dairies/California Farmers Bureau |
| Shari Libicki | Green Developers Coalition |
| Lena Maun-DeSantis | Port of Los Angeles |
| Daniel Mc Givney | Southern California Alliance of Public Owned Treatment Works |
| Clayton Miller | Construction Industry Air Quality Coalition (CIAQC) |
| Jonathan Nadler | Southern California Association of Governments |
| Peter Okurowski | California Environmental Associates |
| Bill Piazza | Los Angeles Unified School District |
| Bill Quinn | California Council for Environmental and Economic Balance (CCEEB) |
| Cathy Reheis-Boyd | Western States Petroleum Association |
| Janill L Richards | California Department of Justice, Public Rights Division, Environment Section |
| Jamesine Rogers | California Air Resources Board (CARB) |
| Terry Roberts | Office of Planning and Research (OPR) |
| David Somers | City of Los Angeles - Planning |
| Debbie Stevens | Refineries |
| Jocelyn Thompson | Weston, Benshoof, Rochefort, Rubalcava, MacCuish Attorneys at Law |
| Carla Walecka | Realtors Committee on Air Quality (RCAQ) |
| Lee Wallace | The Gas Company |

## INVITED AS MEMBERS BUT HAVE NOT ATTENDED:

| | |
|---|---|
| Rick Bishop | Western Riverside Council of Governments |
| Adrene K Briones | City of Los Angeles, LADWP |
| Rick Cameron | Port of Long Beach |
| Bahram Fazeli | Communities for a Better Environment (CBE) |
| Daniel Fierros | Los Angeles County Regional Planning, Impacts Analysis Section |
| Timothy Grabiel | Natural Resources Defense Council (NRDC) |
| Andrea M Hricko | USC Keck School of Medicine, Environmental Health Sciences Center |
| Angela Johnson Meszaras | California Environmental Rights Alliance |
| Janea Scott | Environmental Defense Fund |
| Martin Shlageter | Coalition for Clean Air (CCA) |
| Bryan Speegle | Orange County Planning Department |

## ALTERNATES AND AFFILIATION:

| | |
|---|---|
| Jeannie Blakeslee | CARB |
| Frank Caponi | Los Angeles County Sanitation District |
| Andrew Cheung | Los Angeles Unified School District |
| Mark Elliott | CCEEB |
| Jay Golida | Los Angeles Unified School District |
| Andy Henderson | BIA of Southern California |
| Carrie Hyke | San Bernardino County Land Use Planning Department |
| Michael Lewis | CIAQC |
| John Pastore | Southern California Alliance of Public Owned Treatment Works |
| Sharon Rubalcava | Weston, Benshoof, Rochefort, Rubalcava, MacCuish Attorneys at Law |
| Andrew Skanchy | Latham and Watkins |
| Justis Stewart | SCAG |
| Allyson Teramoto | Port of Long Beach |
| Cindy Thielman-Braun | Riverside County Planning Department |
| Matt Vespa | Center for Biological Diversity |
| Michael Wang | WSPA |

## INTERESTED PARTIES:

| | |
|---|---|
| Lysa Aposhian | Sanitation Districts of Los Angeles |
| Gregory K Arifian | MWH Americas Inc |
| Leila Barker | LADWP |
| Jack Bean | Tesoro |
| Joe Becca | Universal Studios |
| Aaron Dean Burdick | ICF International |
| Curtis L. Coleman | Law Offices of Curtis L. Coleman |
| Keith Cooper | ICF Jones & Stokes |
| Kris Flaig | LA Bureau of Sanitation, Department of Public Works, Regulatory Affairs |
| Howard D Gollay | Southern California Edison |
| Bill Gorham | ENSR Consulting and Engineering |
| Jay Grady | California Portland Cement Co. |
| Patrick Griffith | Los Angeles Unified School District |
| Tony Held | ICF, Jones & Stokes |
| Miles T. Heller | BP |
| Jonathan A. Hershey | City of Los Angeles |
| Vijaya Jammalamadaka | Santa Barbara County APCD |
| Stephen L Jenkins | Michael Brandman Associates |
| Robert Jenne | CARB |
| Diana Kitching | LA City Department of Planning |
| Chandra Knott | City of Irvine |
| Vladimir Kogan | Orange County Sanitation District, Air Quality & Special Projects Div. |
| Leslie Krinsk | CARB |
| Martin Ledwitz | Southern California Edison |
| Rina Leung | City of Rancho Cucamonga |
| Serena Lin | Environmental Defense Fund |
| Allen Lind | CCEEB |
| Sung Key Ma | Riverside County Waste Management Department |
| Josh Margolis | Cantor Cole |

| | |
|---|---|
| Marty Meisler | Metropolitan Water District |
| Denise Michelson | BP |
| Vince Mirabella | Michael Brandman Associates |
| Danielle K Morone | Gatzke Dillon & Ballance LLP |
| Pang Mueller | Tesoro Refining & Marketing Co - Los Angeles Refinery |
| Krishna Nand | City of Vernon |
| Jan Nguyen | Exxon Mobil |
| Maurice Oillataguerre | City of Glendale Public Works Dept. |
| Lynn Perkinton | URS Corp. |
| Haseeb Qureshi | Urban Crossroads |
| Ron Ricks | BP |
| Leonard Scandura | San Joaquin Valley APCD |
| Darren W Stroud | Valero Energy Corporation |
| Ryan Taylor | Brian F. Associates |
| Greg Tholen | Bay Area Air Quality Management District (BAAQMD) |
| Dave Vintze | BAAQMD |
| Sarah Weldon | California Environmental Associates |
| Darcy Wheeles | California Environmental Associates |
| Janet Whittich | CCEEB |
| A.L. Wilson | Southern California Edison |
| Cori Wilson | Michael Brandman Associates |
| Lisa Wunder | The Port of Los Angeles |
| Robert A Wyman Jr. | Latham & Watkins |
| Rick Zbur | Latham & Watkins |
| Michael H Zischke | Cox Castle & Nicholson LLP |

# APPENDIX B

## SUMMARIES OF WORKING GROUP MEETINGS

## WORKING GROUP MEETING #1 (APRIL 30, 2008)

At the first Working Group meeting SCAQMD staff presented the Working Group with a number of policy objectives and design criteria for consideration to establish the framework for developing a GHG significance threshold. Policy objectives include the following concepts. First, the GHG significance threshold should minimize environmental degradation, that is, it should not make impacts worse. To this end, it may be useful to develop a GHG significance threshold that achieves GHG emissions reductions that are consistent with the goals of AB 32 estimated to be approximately 30 percent reduction of GHG emissions from business-as-usual. Although CEQA or a GHG significance threshold established pursuant to CEQA may be useful tools in reducing GHG emissions, they would act in parallel with regulatory requirements, e.g., AB 32, but they do not replace them. As a result, there is no requirement that a GHG significance threshold must reduce GHG emissions consistent with AB 32 or EO S-3-05.

In addition to policy considerations, a number of GHG significance threshold design criteria were also considered. An important consideration in developing a GHG significance threshold is the potential administrative burden it may create on lead agencies through increased resource impacts such as increased costs and staff if the significance threshold is established too low. For example, a zero threshold might result in eliminating or substantially reducing the number of projects that qualify for a categorical exemption, a negative declaration, or a mitigated negative declaration. Other design considerations discussed included establishing a single GHG threshold, such as a "bright line" numerical threshold or multiple thresholds, such as the tiered approaches identified by CAPCOA, etc.

## WORKING GROUP MEETING #2 (MAY 28, 2008)

At the second Working Group meeting, staff presented design criteria recommendations based on the discussion at the first Working Group meeting and correspondence received subsequent to the first Working Group meeting. With regard to analyzing life cycle GHG emissions, staff's initial recommendation was to exclude an analysis of life cycle emissions because life cycle process are not well established. Instead, the GHG emissions analysis should focus on direct and indirect impacts, consistent with current CEQA requirements (CEQA Guidelines §15064(d)). Feedback from the Working Group suggested that a CEQA analysis may be considered deficient without making an effort to conduct a life cycle analysis. Further, if life cycle emissions data are not available, the lead agency should note this consider further analysis speculative and terminate the discussion (CEQA Guidelines §15145).

Another design criteria recommendation made by staff was to take into consideration the administrative burden and resources impacts when establishing a GHG significance threshold. Staff recommended that the GHG significance threshold

should not be set too low, which could result in all projects going through the EIR process. It was pointed out that requiring an EIR for all projects does not necessarily result in more mitigation, no meaningful mitigation may be available for small projects, and it may provide a disincentive for implementing mitigation if the measures are unable to reduce GHG impacts to less than significant.

Other design criteria recommended by staff included analyzing the six Kyoto GHGs, any GHG significance threshold established would be considered interim and would be periodically evaluated and updated as necessary, etc. Staff also introduced the concept of preferred GHG mitigation strategies using a hierarchy from the most to least preferred strategies as shown below.

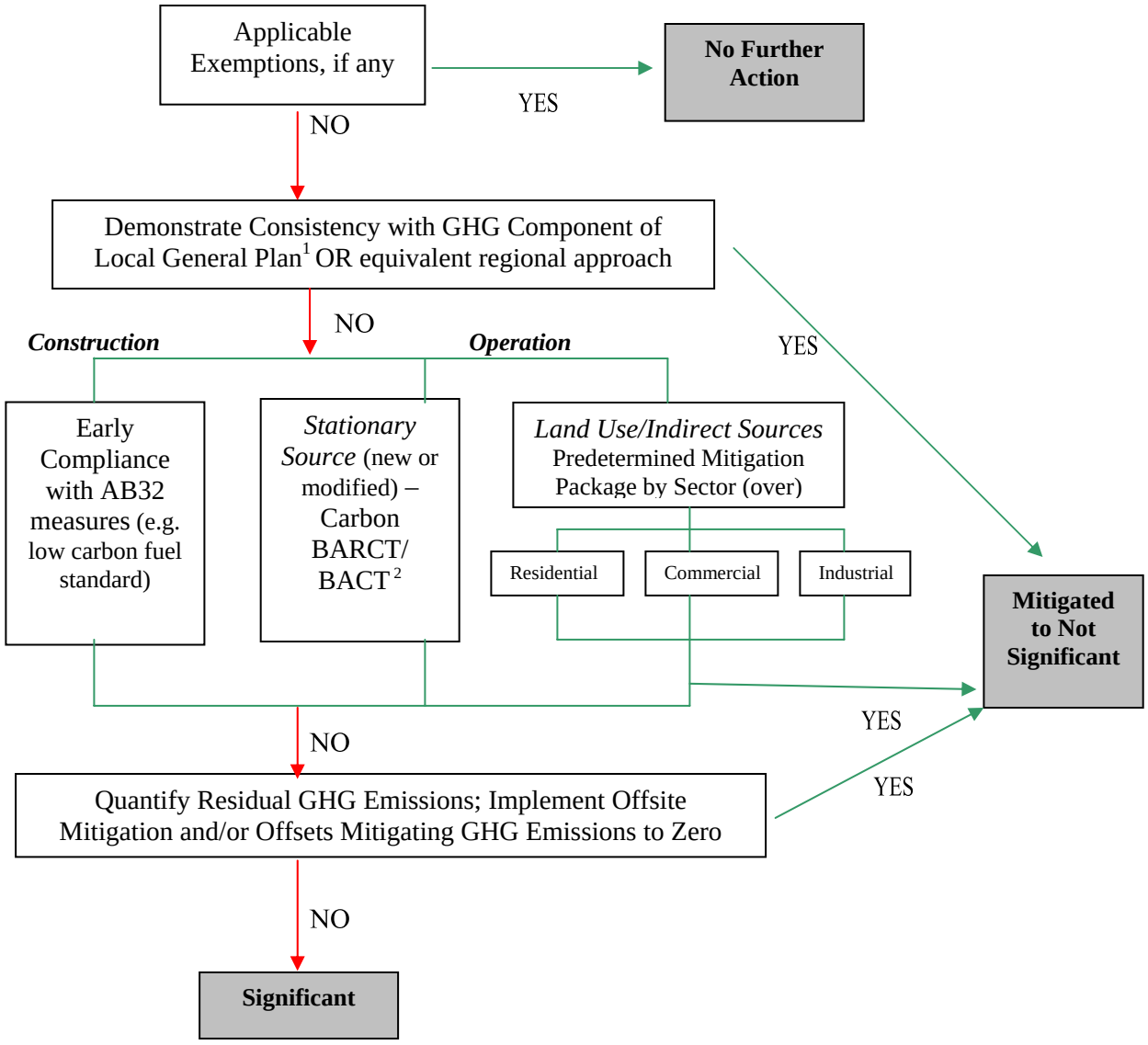
1. Incorporate GHG reduction strategies into project design
2. Mitigate GHGs from other onsite sources for modification projects
3. Mitigate offsite GHG emission reduction projects
4. Mitigate both construction & operational GHG impacts
5. Consider feasible mitigation based on economic factors (cost) pursuant to CEQA Guidelines §15364
6. Purchase acceptable GHG offsets with preference toward GHG reduction projects occurring in-basin or in-state (offset cost a consideration). The following points should be considered:
    a. Offset market still developing, so it is necessary to ensure offsets are obtained from a credible source
    b. Offsets should be provided for at least 10 years of project operation (see SJVAPCD indirect source Rule 9510 §6.2 mitigation requirements)

Finally, SCAQMD staff introduced the initial staff proposal. The initial staff proposal consisted of a tiered approach, similar to CAPCOA's Approach 2 with mandatory GHG mitigation measures. Each tier of this proposal is briefly described in the following bullet points and shown graphically in Figure B-1.

- The first tier consists of evaluating whether or not the project qualifies for any applicable exemption under CEQA. For example, SB 97 specifically exempts a limited number of projects until it expires in 2010. If the project qualifies for an exemption, no further action is required. If the project does not qualify for an exemption, then move to the next tier.

**Figure B-1**
Initial Staff Proposal – Proposed Tiered Approach – May 28, 2008

*Significance determination of Cumulative Impacts from GHG emissions:*




1. Local General Plans, at a minimum, must comply with AB32 reduction goals; have been analyzed under CEQA, and have a certified Final CEQA document; emission estimates approved by CARB or SCAQMD; include a GHG inventory tracking mechanism; and a commitment to remedy the excess emissions if AB32 goals are not met.

2. SCAQMD will work with CAPCOA to develop a list of mitigation measures.

- The second tier consists of determining whether or not the project is consistent with a GHG reduction plan that is part of a local general plan for example. The GHG reduction plan must, at a minimum, comply with AB 32 reduction goals; include emission estimates approved by CARB or SCAQMD, have been analyzed under CEQA, and have a certified Final CEQA document. Further, the GHG reduction plan must include a GHG inventory tracking mechanism; process to monitor progress in achieving GHG emission reduction targets, and a commitment to remedy the excess emissions if AB 32 goals are not met (enforcement). If the proposed project is consistent with the local GHG reduction plan, it is not significant for GHG emissions.

  The concept of consistency with a GHG reduction plan, is similar to the concept of consistency in CEQA Guidelines §15125(d). If the proposed project does not comply with the local GHG reduction plan or no GHG reduction plan has been adopted, then move to the third tier.

- Under the third tier there are three options that can be used to demonstrate that a project would not have significant emissions. The first significance option is early compliance with AB 32 Scoping Plan measures. The second significance option, primarily for stationary source equipment, would be to install carbon best available retrofit control technology (BARCT) or best available control technology (BACT). Carbon BARCT/BACT would be established by the SCAQMD. The third significance option for industrial, commercial, and residential land use projects would be to implement a menu of prescribed mitigation measures. Mitigation measures would be developed for each land use sector by SCAQMD staff. Implementing one of these three options would result in a determination that GHG emission impacts from the proposed project are not significant. If the proposed project is unable to implement any one of these three options or cannot fully implement any option, then it would move to the fourth tier.

- Under the fourth tier, the lead agency would quantify GHG emissions from the project and implement offsite mitigation (GHG reduction projects) or purchase offsets. Under this tier, GHG emission impacts the lead agency would be required to mitigate or offset GHG emissions to zero. If GHG emissions can be offset to zero, GHG emissions from the project are concluded to be insignificant. If GHG impacts cannot be reduced to zero, the project is concluded to be significant for GHGs.

## WORKING GROUP MEETING #3 (JUNE 19, 2008)

Subsequent to Working Group meeting #2, SCAQMD staff received feedback on the initial staff proposal. Issues and concerns raised by the stakeholders on the initial staff proposal were addressed at the third Working Group meeting and are summarized in the following bullet points.

- The staff proposal does not explicitly state any quantitative or qualitative target objectives. If there are no explicit target objectives, how is it possible to determine whether or not a project is insignificant for GHG emissions?

- Concerns were raised regarding the lack of detail relative to the sector-specific mitigation measures and the potentially lengthy lag time between implementing the GHG significance threshold and developing the mitigation measures.

- For most projects, GHG emissions would not need to be calculated as long as the prescribed menu of sector-specific mitigation measures is implemented. Without quantifying GHG emissions and the control efficiencies of the mitigation measures, a project would be vulnerable to a "Fair Argument" that GHG emissions are still significant even after implementing prescribed mitigation measures.

- A CEQA document may be vulnerable in court if control efficiencies of mitigation measures are not identified.

- Is the staff proposal really a zero GHG significance?

  Based on Working Group feedback, staff presented revised staff proposal #1, which consisted of a tiered decision tree approach. The components of revised staff proposal #1 are described in the following bullet points and shown graphically in Figure B-2. As shown in Figure B-2, some of the tier components of the revised staff proposal are similar to those in the initial staff proposal.

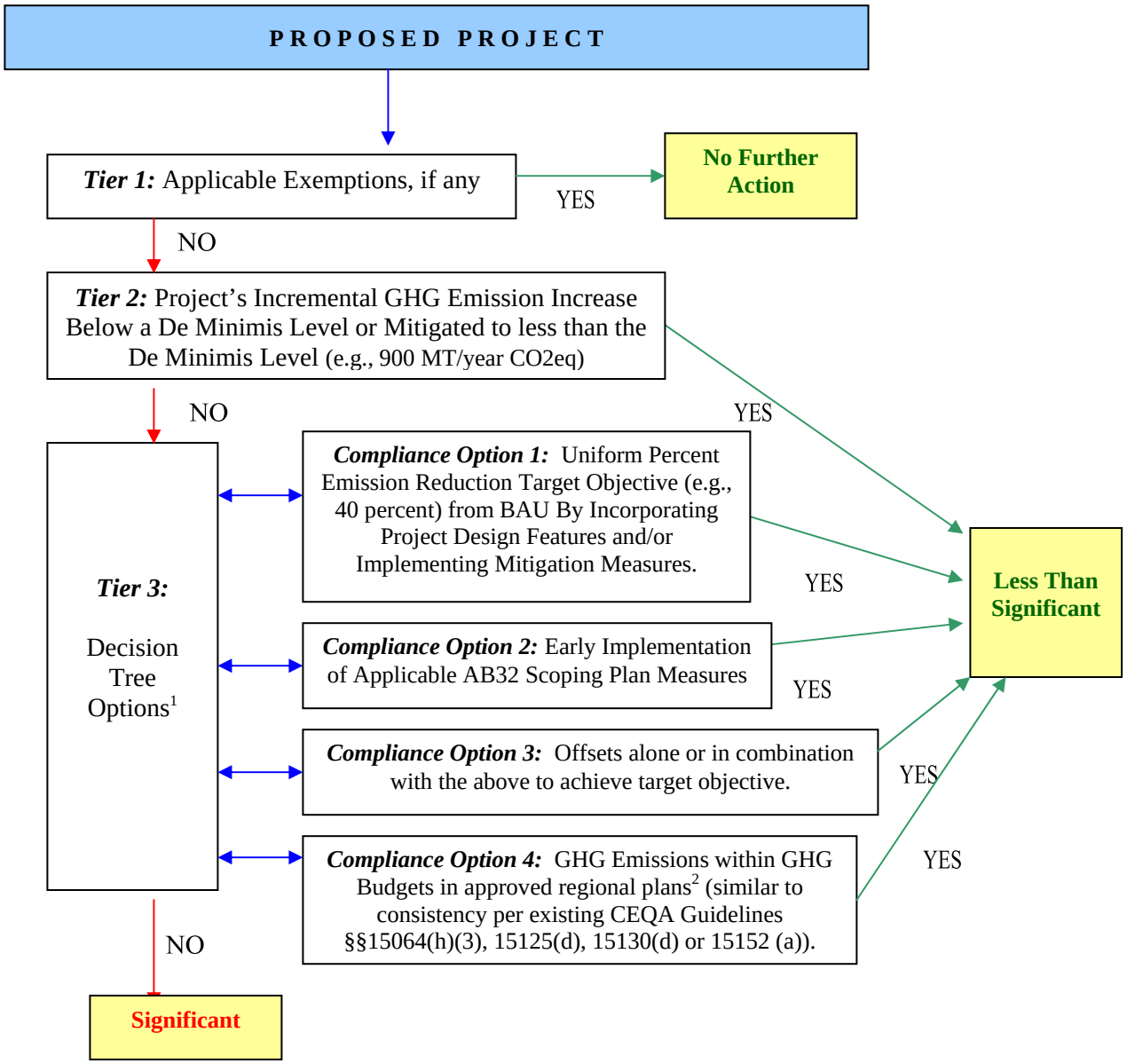
- **Tier 1 –** no change from the initial proposal.

- **Tier 2 –** is a new component of the revised staff proposal. Tier 2 attempts to identify small projects that would not likely contribute to significant cumulative GHG impacts. The de minimis or screening level of 900 metric tons per year is the level that is estimated by CAPCOA to capture 90 percent of the residential units or office space in pending application lists7. CAPCOA infers that projects that emit less than 900 metric ton per year would not likely be considered cumulatively considerable. Further, the 900 metric ton per year level would capture 90 percent

[7] Although the CAPCOA White Paper implies that 900 metric tons per year equates to a 90 percent capture rate, there is no explicit information provided in the White Paper that demonstrates this correlation. Indeed, the CAPCOA authors state that 900 metric tons, which represents approximately 50 residential units, corresponds to widely divergent capture rate percentile rankings depending on the project location (see discussion on page 43 of the White Paper). Percentile rankings were based on a survey of four cities in California. A project of 900 metric tons per year representing a 90 percent capture rate appears to be a working assumption for which there appears to be no factual basis. Further, although not explicitly stated, it is assumed that the 900 metric tons were derived using the URBEMIS2007 model. It should be noted that that the URBEMIS2007 model only quantifies CO2 emissions and direct emissions primarily from on-road mobile sources. It does not capture other GHG pollutants or indirect GHG emissions such as emissions from energy generation, water conveyance, etc. Therefore, it is likely that a 50-unit residential project would actually generate higher GHG emissions than 900 metric tons per year.

**Figure B-2**
Revised Staff Proposal #1 Tiered Decision Tree Approach – June 19, 2008

***Significance Determination of Cumulative Impacts from GHG Emissions:***




1. Substitution for equivalent reductions allowed.
2. Local General Plans or other local plans local plans that, at a minimum, comply with the overall target objective or the sector-based CARB Scoping Plan; have been analyzed under CEQA, and have a certified Final CEQA document; emission estimates approved by CARB or SCAQMD; include a GHG inventory; tracking mechanism; enforcement; and a commitment to remedy the excess emissions if commitments are not met.

of all pending projects, which means that 90 percent of all projects would have to implement GHG reduction measures.

If a project is less than 900 MT/year CO2eq or can mitigate to less than 900 MT/year CO2eq, it would be considered insignificant for GHGs. Projects larger than 900 MT/year CO2eq would move to tier 3.

- Tier 3 Decision Tree Options – consists of four decision tree options to demonstrate that a project is not significant for GHG emissions. The four compliance options are as follows.

  **Compliance Option 1 –** the lead agency would calculate GHG emissions for a project using a business-as-usual (BAU) methodology. Once GHG emissions are calculated, the project proponent would have to incorporate design features into the project and/or implement GHG mitigation measures to demonstrate a 40 percent reduction from BAU. A 40 percent reduction below BAU was selected for the following reason. To comply with the AB 32 requirement of reducing GHG emissions to 1990 levels, an approximately 30 percent reduction from current BAU is necessary.

  Since CEQA is not applicable to all GHG emission sources, i.e., existing projects that are not undergoing expansion or modifications, staff chose a 40 percent reduction below BAU requirement, which goes beyond the target GHG reduction objective of AB 32, but is still a potentially feasible GHG reduction for a variety of different projects.

  **Compliance Option 2 –** this option is the same as the early compliance with AB 32 option in the third tier of the initial staff proposal.

  **Compliance Option 3 –** this option is similar to the fourth tier of the initial staff proposal where GHG emissions would be reduced through offsite GHG reduction projects and/or use of offsets. This compliance option, however, would require offsetting GHG emissions by the same target objective as compliance option 1, that is, 40 percent below BAU instead of reducing GHG emissions to less than the de minimis or screening level.

  **Compliance Option 4 –** this option is the same as the consistency with the greenhouse gas reduction plan component in the second tier of the initial staff proposal.

  If the lead agency or project proponent cannot implement any of the compliance options in Tier 3, GHG emissions would be considered significant.

## WORKING GROUP MEETING #4 (JULY 30, 2008)

Subsequent to Working Group meeting #3, SCAQMD staff received feedback on the revised staff proposal #1. Issues and concerns raised by the stakeholders on the initial

staff proposal were addressed at the third Working Group meeting and are summarized in the following bullet points.

- Compliance with a GHG reduction plan should not be a compliance option in Tier 3, but should be its own tier, earlier in the tiering process.

- There is a large disconnect between screening level and remaining emissions under the Tier 4 compliance options. For example, large projects that can reduce GHG emissions by the target objective of 40 percent would do so, which means GHG emissions would not be significant, could have substantially higher emissions than projects with GHG emissions less than the screening level.

- Compliance with a target objective should not be through offsets alone. Because of the uncertainties regarding the validity of offsets, preferred mitigation should consist of actual GHG emission reductions.

- The Tier 3 compliance option 1, GHG emissions reductions from BAU, is not the proper metric for determining significance. How can a lead agency be sure that the projected BAU emissions for a project are not artificially inflated to make it easier to achieve the required target objective?

- The Tier 3 compliance option 1, reducing GHG emission reductions from BAU, could penalize projects in environmentally progressive areas where BAU may be much lower than in other areas, thus, making it more difficult to achieve the target objectives.

Based on Working Group feedback and internal discussions, staff presented revised staff proposal #2, which further refined the previous tiered decision tree approach. The components of revised staff proposal #2 are described in the following bullet points and shown graphically in Figure B-3. As shown in Figure B-3, some of the tier components of the revised staff proposal are similar to those in the initial staff proposal.

- **Tier 1 –** no change from the initial proposal.

- **Tier 2 –** compliance option 4 in Tier 3 has been moved back a stand-alone tier.

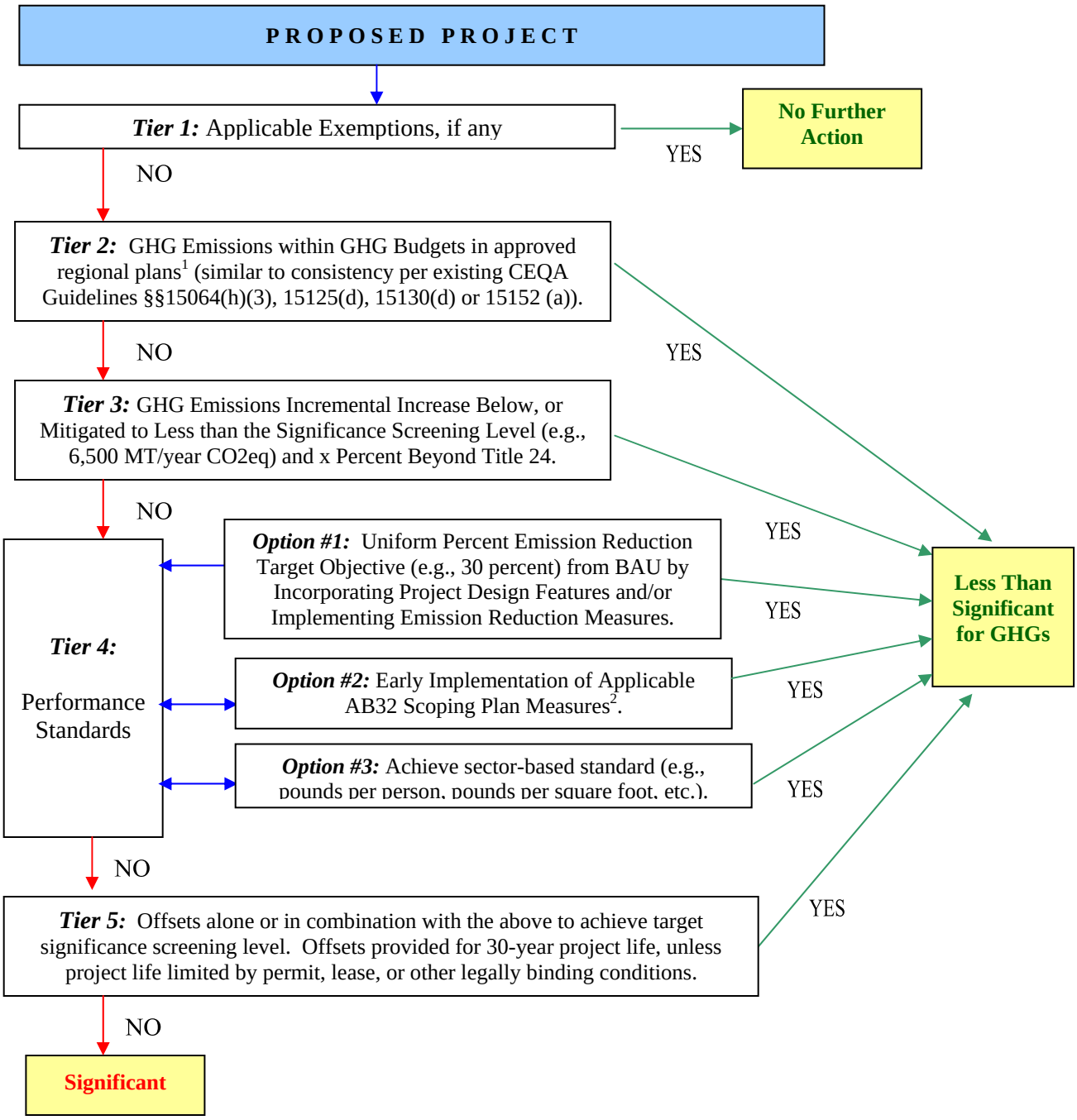
- **Tier 3 –** the screening level that was previously Tier 2 has been moved to Tier 3. In response to feedback from the Working Group, the screening level has been increased to 6,500 MT/year CO2eq. The new screening level was derived using the SCAQMD's existing NOx operational threshold as a basis. The daily NOx operational significance threshold, 55 pounds per day was annualized, which results in 10 tons of NOx per year. Using the URBEMIS2007 model, staff initially modeled a mixed-use project that emits just under 10 tons per year to determine what the equivalent CO2 emissions would be. Resulting CO2 emissions from the mixed use project were approximately 6,500 MT/year CO2. To further corroborate the 6,500 MT/year CO2 staff performed 19 modeling runs on a variety of projects including residential, commercial, industrial, and various combinations of land uses. In addition, since the analysis was an annual

analysis, a weighted trip rate was derived for each land use category to obtain a more accurate estimate of trip rates throughout the week. Although the results from the 19 modeling runs were approximately 16 percent higher than staff's original estimate of 6,500 MT/year CO2, 7,304 to 7,723 MT/year CO2, staff continued to recommend the 6,500 MT/year CO2 provides a margin of safety when deriving CO2 emissions based on the annualized NOx level of 10 tons per year and when evaluating different types of land use projects.

Projects with GHG emissions less than the screening level are considered to be small projects, that is, they would not likely be considered cumulatively considerable. However, because of the magnitude of increasing global temperatures from current and future GHG emissions, staff recommended that all projects must implement some measure or measures to contribute to reducing GHG emissions. Therefore, Tier 3 includes a requirement that all projects with GHG emissions less than the screening level must include efficiency components that reduce to a certain percentage beyond the requirements of Title 24 (Part 6, California Code of Regulations), California's energy efficiency standards for residential and nonresidential buildings.

- Tier 4 Performance Standards – Tier 3 from the revised staff proposal #1 has been moved to Tier 4 and renamed.

**Figure B-3**
Proposed Tiered Decision Tree Approach – July 30, 2008
***Significance Determination of Cumulative Impacts from GHG Emissions:***




1. Local General Plans or other local plans local plans that, at a minimum, comply with the overall target objective or the sector-based CARB Scoping Plan; have been analyzed under CEQA, and have a certified Final CEQA document; emission estimates approved by CARB or SCAQMD; include a GHG inventory; tracking mechanism; enforcement; and a commitment to remedy the excess emissions if commitments are not met.
2. Substitution for equivalent reductions allowed.

**Compliance Option 1 –** is essentially the same as the previously recommended, except that the target objective has been changed from reducing GHG emissions 40 percent below BAU to 30 percent below BAU to be more consistent with AB 32 target objectives.

**Compliance Option 2 - –** no change from the previous proposal.

**Compliance Option 3 –** this is a new compliance option and consists of establishing sector-based performance standards. For example, it may be possible to use the 1990 inventory required under AB32 to establish an efficiency standard such as pounds per person, pounds per worker, pounds per square feet, pounds per item manufactured, etc. When calculating GHGs from a project, if they are less than the established efficiency standard the project would not be significant relative to GHG emissions, while projects exceeding the efficiency standard would be significant.

Projects that cannot comply with any of the compliance options in Tier 4 would then move on to Tier 5.

- **Tier 5 –** consists generally of the Tier 3 compliance option 3 from the previous staff proposal. The only difference is that the project proponent would be required to provide offsets for the life of the project, which is defined as 30 years. If the project proponent is unable to obtain sufficient offsets, incorporate design features, or implement GHG reduction mitigation measures, then GHG emissions from the project would be considered significant.

## WORKING GROUP MEETING #5 (AUGUST 27, 2008)

Subsequent to Working Group meeting #3, SCAQMD staff received feedback on the revised staff proposal #2. Issues and concerns raised by the stakeholders on the initial staff proposal were addressed at the third Working Group meeting and are summarized in the following bullet points.

- A recommendation was made to modify the target objective of Tier 5 to be consistent with the target objective of Tier 4 compliance option 1, that is require emissions to be offset 30 percent from BAU rather than offset down to the screening level.

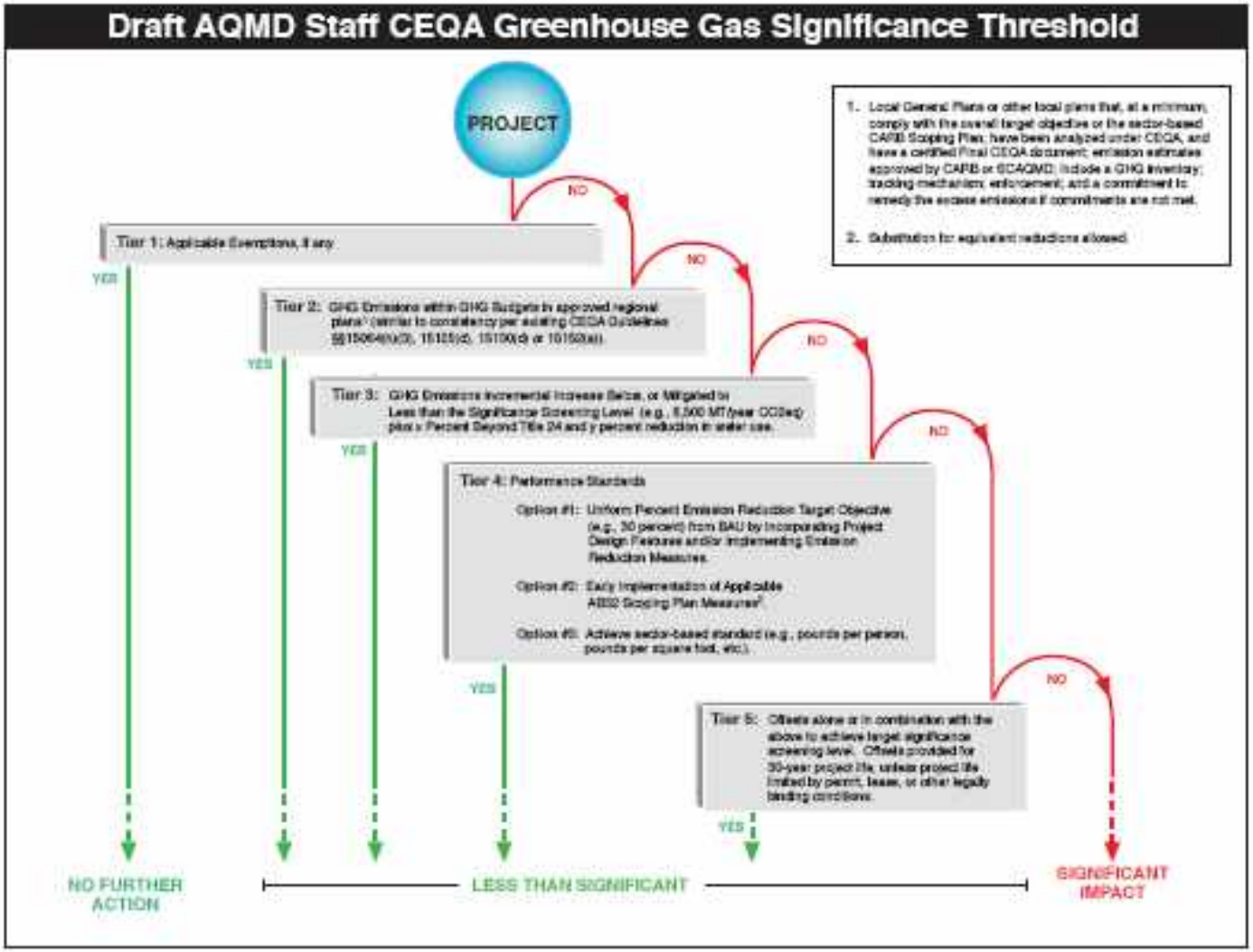
- A Working Group member asked for clarification on the early implementation of applicable AB 32 Scoping Plan measures in Tier 4-Option 2. In addition, a question was asked regarding whether or not this compliance option was applicable after the requirements of AB 32 have become effective.

At Working Group meeting #5, staff presented revised staff proposal #3, which consisted primarily of minor refinements to the previous tiered decision tree approach

in revised staff proposal #2. The components of revised staff proposal #3 are shown graphically in Figure B-4.

Aside from changing the graphic layout of the staff proposal to make it easier to understand, revised staff proposal #3 has only one minor modification. A second energy efficiency requirement has been added to the screening level in Tier 3. In addition to requiring projects to go a certain percentage beyond Title 24, projects would also have to reduce by a specified percentage electricity demand from water use, primarily electricity used for water conveyance.

**Figure B-4**
Revised Staff Proposal #3 Tiered Decision Tree Approach – August 27, 2008



BOARD MEETING DATE: December 5, 2008 AGENDA NO. 31

PROPOSAL: Interim CEQA GHG Significance Threshold for Stationary Sources, Rules and Plans

SYNOPSIS: This action is to adopt a resolution approving the Interim CEQA GHG Significance Threshold for Stationary Sources, Rules, and Plans where AQMD is the lead agency. This interim threshold will be used for determining significant impacts for proposed projects. Once CARB adopts the statewide significance thresholds, staff will report back to the Board regarding any recommended changes or additions to the AQMD's interim threshold.

COMMITTEE: Climate Change, September 19, 2008 and October 29 2008

RECOMMENDED ACTION:
Adopt the attached resolution approving the Interim CEQA GHG Significance Threshold for Stationary Sources, Rules, and Plans for use by the AQMD.

Barry R. Wallerstein, D.Env.
Executive Officer

EC:LT:SN:SS

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**Background**
The California Environmental Quality Act (CEQA) requires public agencies in California to analyze potential adverse impacts from proposed projects undertaken by a public agency, funded by a public agency, or requiring discretionary approval by a public agency. To disclose potential adverse impacts from a proposed project, pursuant to CEQA, lead agencies typically prepare a multidisciplinary environmental impact analysis and make decisions based on the analysis regarding the environmental effects of the proposed project (CEQA Guidelines §15002[a]).

In the past, air quality analyses tended to focus on potential adverse impacts from criteria pollutants and toxic air contaminants. Subsequent to the adoption of Assembly

Bill (AB) 32 – The California Global Warming Solutions Act of 2006, lead agencies have increasingly faced legal challenges to their CEQA documents for failure to analyze greenhouse gases (GHGs) or failure to make a determination of significance regarding GHG emission impacts.

Subsequent to the adoption of AB 32, there had been little regulatory guidance with regard to analyzing GHG emission impacts in CEQA documents until the Governor's Office of Planning and Research (OPR) released its Technical Advisory on CEQA and Climate Change (June 19, 2008). Consistent with Senate Bill (SB) 97, OPR's Technical Advisory was developed in cooperation with the Resources Agency, the California Environmental Protection Agency (Cal/EPA), and the California Air Resources Board (CARB). According to OPR, the Technical Advisory offers informal interim guidance regarding the steps lead agencies should take to address climate change in their CEQA documents, until CEQA guidelines are developed pursuant to SB 97 on how state and local agencies should analyze, and when necessary, mitigate greenhouse gas emissions.

Because of its expertise in establishing air quality analysis methodologies and comprehensive efforts to establish regional and localized significance thresholds for criteria pollutants, local public agencies have asked the AQMD for guidance in quantifying GHG impacts and recommending GHG significance thresholds to assist them with determining whether or not GHG impacts in their CEQA documents are significant. In response to these requests from the various stakeholders, AQMD established a stakeholder working group to receive input on establishing a GHG significance threshold. In the meantime, AQMD staff has joined many other stakeholders urging CARB to establish a statewide threshold for GHGs. AQMD has been making GHG significance determinations for its CEQA documents on a case-by-case basis. Staff believes it is more prudent to make GHG significance determinations using a GHG significance threshold that has gone through a public process and has been adopted by resolution by the Board than making GHG significance determinations on a case-by-case basis. In the absence of a statewide threshold, AQMD staff recommends its interim approach to the Board for consideration and it will also become part of the AQMD's input to the statewide process. The interim GHG significance threshold proposal recommended by staff to the Board that applies only to industrial (stationary source) projects where the AQMD is the lead agency is a narrower recommendation than the version presented at the October 29, 2008 Climate Change Committee meeting.

**GHG Working Group –** The GHG significance threshold Working Group was formed to assist staff's efforts to develop an interim GHG significance threshold and is comprised of a wide variety of stakeholders including: state agencies, OPR, CARB, and the Attorney General's Office; local agencies, city and county planning departments, utilities such as sanitation and power, etc.; regulated stakeholders, industry and industry groups; and organizations, both environmental and professional. Working group meetings are also open to the public. Part of the purpose of the Working Group is to

provide a forum to solicit comments and suggestions from the various stakeholders to assist AQMD staff with developing an interim GHG significance threshold that is consistent with CEQA requirements for developing significance thresholds, is supported by substantial evidence, and provides guidance to CEQA practitioners with regard to determining whether GHG emissions from a proposed project are significant. Since April 2008, seven Working Group meetings have been held. Detailed information on the GHG Working Group process is contained in Attachment E to this Board letter – *Draft Guidance Document – Interim Greenhouse Gas (GHG) Significance Threshold*. The staff-proposed interim GHG significance threshold resulting from the Working Group process is described later in this Board letter.

**Legal Authority**

CEQA Guidelines §15022(a) states that a public agency shall adopt objectives, criteria, and specific procedures consistent with CEQA and these [State] Guidelines for administering its responsibilities under CEQA. CEQA Guidelines §15022(d) states further, "In adopting procedures to implement CEQA, a public agency may adopt the State CEQA Guidelines through incorporation by reference. The agency may then adopt only those specific procedures or provisions described in subsection [15022] (a) which are necessary to tailor the general provisions of the guidelines to the specific operations of the agency." AQMD previously adopted the state guidelines and has since adopted specific provisions such as regional and localized are quality significance thresholds. Adopting GHG significance thresholds would be consistent with the CEQA Guidelines §15022 provision to tailor a public agency's implementing guidelines by adopting criteria relative to the specific operations of the AQMD.

Specifically with regard to thresholds of significance, CEQA Guidelines §15064.7(a) states, "Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects." Subsection (b) of the same section states further, "Thresholds of significance to be adopted for general use as part of the lead agency's environmental review process must be adopted by ordinance, resolution, rule or regulation, and developed through a public review process and be supported by substantial evidence." Staff's recommended GHG significance threshold has undergone a public review process as part of stakeholder working group meetings that are open to the public. The currently proposed interim GHG significance threshold will be for projects where the AQMD is the lead agency.

**Proposal**

**Policy Objective –** The overarching policy objective with regard to establishing a GHG significance threshold for the purposes of analyzing GHG impacts pursuant to CEQA is to establish a performance standard or target GHG reduction objective that will ultimately contribute to reducing GHG emissions to stabilize climate change. Full implementation of the Governor's Executive Order S-3-05 would reduce GHG

emissions 80 percent below 1990 levels or 90 percent below current levels by 2050. It is anticipated that achieving the Executive Order's objective would contribute to worldwide efforts to cap GHG concentrations at 450 ppm, thus, stabilizing global climate.

As described below, staff's recommended interim GHG significance threshold proposal uses a tiered approach to determining significance. Tier 3, which is expected to be the primary tier by which the AQMD will determine significance for projects where it is the lead agency, uses the Executive Order S-3-05 goal as the basis for deriving the screening level. To avoid hindering attaining this goal, new or modified projects will need to be analyzed under CEQA and mitigated to the maximum extent feasible. Specifically, the Tier 3 screening level for stationary sources is based on an emission capture rate of 90 percent for all new or modified projects. A 90 percent emission capture rate means that 90 percent of total emissions from all new or modified stationary source projects would be subject to a CEQA analysis, including a negative declaration, a mitigated negative declaration, or an environmental impact report, which includes analyzing feasible alternatives and imposing feasible mitigation measures.

Therefore, the policy objective of staff's recommended interim GHG significance threshold proposal is to achieve an emission capture rate of 90 percent of all new or modified stationary source projects. A GHG significance threshold based on a 90 percent emission capture rate may be more appropriate to address the long-term adverse impacts associated with global climate change because most projects will be required to implement GHG reduction measures. Further, a 90 percent emission capture rate sets the emission threshold low enough to capture a substantial fraction of future stationary source projects that will be constructed to accommodate future statewide population and economic growth, while setting the emission threshold high enough to exclude small projects that will in aggregate contribute a relatively small fraction of the cumulative statewide GHG emissions. This assertion is based on the fact that staff estimates that these GHG emissions would account for slightly less than one percent of future 2050 statewide GHG emissions target (85 MMTCO2eq/yr). In addition, these small projects may be subject to future applicable GHG control regulations that would further reduce their overall future contribution to the statewide GHG inventory. Finally, these small sources are already subject to BACT for criteria pollutants and are more likely to be single-permit facilities, so they are more likely to have few opportunities readily available to reduce GHG emissions from other parts of their facility.

Staff does not believe a zero threshold, as recommended by some working group members would be feasible to implement. A 90 percent emissions capture rate will assure that all feasible GHG reduction measures will be implemented for a large majority of emissions from new or modified GHG stationary sources, while avoiding overwhelming the AQMD's capabilities to process environmental documents. Implementing the interim GHG significance threshold is expected to at least double or

triple the number of CEQA documents for permit application projects that are prepared by the AQMD each year (from approximately 10 to 15 to more than 45). Based on the number of permit applications received per year, it is likely that a zero GHG significance threshold would require preparing hundreds of additional CEQA documents per year with minimal additional environmental benefits.

**Applicability –** At this time, staff is recommending consideration of an interim GHG significance threshold that would apply to stationary source/industrial projects where the AQMD is the lead agency under CEQA. The types of projects that the staff proposal would apply to include: AQMD rules, rule amendments, and plans, e.g., Air Quality Management Plans. In addition, the AQMD may be the lead agency under CEQA for projects that require discretion approval, i.e., projects that require discretionary air quality permits from the AQMD. It should be noted that stationary source equipment associated with these projects are either at BACT or must comply with source-specific rules that reduce criteria pollutants and/or air toxics.

**Emission Calculations and Significance Threshold Proposal –** For the purposes of determining whether or not GHG emissions from affected projects are significant, project emissions will include direct, indirect, and, to the extent information is available, life cycle emissions during construction and operation. Construction emissions will be amortized over the life of the project, defined as 30 years, added to the operational emissions, and compared to the applicable interim GHG significance threshold tier. The following bullet points describe the basic structure of staff's tiered GHG significance threshold proposal for stationary sources.

- **Tier 1 –** consists of evaluating whether or not the project qualifies for any applicable exemption under CEQA. For example, SB 97 specifically exempts a limited number of projects until it expires in 2010. If the project qualifies for an exemption, no further action is required. If the project does not qualify for an exemption, then it would move to the next tier.

- **Tier 2 –** consists of determining whether or not the project is consistent with a GHG reduction plan that may be part of a local general plan, for example. The concept embodied in this tier is equivalent to the existing concept of consistency in CEQA Guidelines §§15064(h)(3), 15125(d), or 15152(a). The GHG reduction plan must, at a minimum, comply with AB 32 GHG reduction goals; include emissions estimates agreed upon by either CARB or the AQMD, have been analyzed under CEQA, and have a certified Final CEQA document. Further, the GHG reduction plan must include a GHG emissions inventory tracking mechanism; process to monitor progress in achieving GHG emission reduction targets, and a commitment to remedy the excess emissions if GHG reduction goals are not met (enforcement).

  If the proposed project is consistent with the qualifying local GHG reduction plan, it is not significant for GHG emissions. If the project is not consistent with a local

GHG reduction plan, there is no approved plan, or the GHG reduction plan does not include all of the components described above, the project would move to Tier 3.

- **Tier 3 –** establishes a screening significance threshold level to determine significance using a 90 percent emission capture rate approach as described above.

  The 90 percent capture rate GHG significance screening level in Tier 3 for stationary sources was derived using the following methodology. Using AQMD's Annual Emission Reporting (AER) Program staff compiled reported annual natural gas consumption for 1,297 permitted facilities for 2006 through 2007 and rank-ordered the facilities to estimate the 90th percentile of the cumulative natural gas usage for all permitted facilities. Approximately 10 percent of facilities evaluated comprise more than 90 percent of the total natural gas consumption, which corresponds to 10,000 metric tons of CO2 equivalent emissions per year (MTCO2eq/yr) (the majority of combustions emissions is comprised of CO2). This value represents a boiler with a rating of approximately 27 million British thermal units per hour (mmBtu/hour) of heat input, operating at a 80 percent capacity factor. It should be noted that this analysis did not include other possible GHG pollutants such as methane, N2O; a life-cycle analysis; mobile sources; or indirect electricity consumption. Therefore, when implemented, staff's recommended interim proposal is expected to capture more than 90 percent of GHG emissions from stationary source projects.

  If the project exceeds the GHG screening significance threshold level and GHG emissions cannot be mitigated to less than the screening level, the project would move to Tier 4.

- **Tier 4 –** consists of a decision tree approach that allows the lead agency to choose one of three compliance options based on performance standards. *(For the purposes of Board consideration, Tier 4 is not recommended for approval at this time.).*

  The purpose of Tier 4 is to provide a means of determining significance relative to GHG emissions for very large projects that include design features and or other measures to mitigate GHG emissions to the maximum extent feasible, but residual GHG emissions still exceed the interim Tier 3 screening levels. In this situation, since no additional project-related GHG emission reductions are feasible, staff is considering whether it is reasonable to consider that residual emissions are not significant. The intent of the Tier 4 compliance options is to encourage large projects to implement the maximum feasible GHG reduction measures instead of shifting to multiple smaller projects that may forego some design efficiencies that can more easily be incorporated into large projects than small projects. CARB's interim GHG significance threshold proposal incorporates a similar, but modified approach for determining GHG significance along with other suggested approaches that may have merit to consider and incorporate into AQMD staff's recommended

interim proposal. There are also policy and legal questions that need to be further resolved before adopting such an approach.

- **Tier 5 –** under this tier, the project proponent would implement offsite mitigation (GHG reduction projects) to reduce GHG emission impacts to less than the proposed screening level. Any offsite mitigation measures that include purchase of offsets would require the project proponent provide offsets for the life of the project, which is defined as 30 years. If the project proponent is unable to implement offsite GHG reduction mitigation measures to reduce GHG emission impacts to less than the screening level, then GHG emissions from the project would be considered significant. Since it is currently uncertain how offsite mitigation measures, including purchased offsets, interact with future AB 32 Scoping Plan measures, the AQMD would allow substitution of mitigation measures that include an enforceable commitment to provide mitigation prior to the occurrence of emissions. The intent of this provision is to prevent mitigating the same emissions twice.

**Mitigation Preference –** If a project generates significant adverse impacts, CEQA Guidelines §15126.4 requires identification of mitigation measures to minimize potentially significant impacts. Because GHG emissions contribute to global change, mitigation measures could be implemented locally, nationally, or internationally and still provide global climate change benefits. Because reducing GHG emissions may provide co-benefits through concurrent reductions in criteria pollutants, when considering mitigation measures when the AQMD is the lead agency under CEQA, staff recommends that mitigation measures that are real, quantifiable, verifiable, and surplus be selected in the following order of preference.

- Incorporate GHG reduction features into the project design, e.g., increase a boiler's energy efficiency, use materials with a lower global warming potential than conventional materials, etc.

- Implement onsite measures that provide direct GHG emission reductions onsite, e.g., replace onsite combustion equipment (boilers, heaters, steam generators, etc.) with more efficient combustion equipment, install solar panels on the roof, eliminate or minimize fugitive emissions, etc.

- Implement neighborhood mitigation measure projects that could include installing solar power, increasing energy efficiency through replacing low efficiency water heaters with high efficiency water heaters, increasing building insulation, using fluorescent bulbs, replacing old inefficient refrigerators with efficient refrigerators using low global warming potential refrigerants, etc.

- Implement in-district mitigation measures such as any of the above identified GHG reduction measures; reducing vehicle miles traveled (VMT) through greater rideshare incentives, transit improvements, etc.

- Implement in-state mitigation measures, which could include any of the above measures.

- Implement out of state mitigation measure projects, which may include purchasing offsets if other options are not feasible.

**GHG Significance Threshold Components Deferred to the Future**
**Tier 4 Performance Standards –** Based on reasons stated earlier, staff recommends that further evaluation be conducted to address comments raised and to consider other approaches as appropriate. Specifically, CARB staff proposed a hybrid approach in their Draft Proposal that combines the AQMD's Tier 3 and Tier 4 concepts for stationary source projects. If CARB's board does not take final action on their interim GHG significance threshold proposal by February 2009, AQMD staff will report back in the following month regarding the viability of the Tier 4 performance standards and recommended actions, if any.

**Residential/Commercial Sectors GHG Significance Threshold –** To achieve the same policy objective of capturing 90 percent of GHG emissions from new development projects in the residential/commercial sectors and implement a "fair share" approach to reducing emission increases from each sector, staff discussed with the working group a proposal combining performance standards and screening thresholds. The performance standards primarily focus on energy efficiency measures beyond Title 24 and a screening level of 3,000 MTCO2eq/yr based on the relative GHG emissions contribution between residential/commercial sectors and stationary source (industrial) sectors. Additional analysis is needed to further define the performance standards and to coordinate with CARB staff's interim GHG proposal. Staff, therefore, recommends bringing this item back to the Board for discussion and possible action in March 2009 if the CARB board does not take its final action by February 2009.

A comparison between CARB staff's initial concepts and AQMD staff's recommended interim GHG significance threshold proposal for stationary projects and approaches for residential/commercial sectors is summarized in Table 1 for reference. A more detailed discussion is contained in the Draft Guidance Document in Attachment E.

Table 1
Comparison of CARB's and AQMD Staff's Interim GHG Significance Threshold Approaches

| | Stationary/Industrial Sector Projects | |
|---|---|---|
| | CARB | AQMD |
| Policy Objective | Capture 90% of statewide stationary project emissions | Capture 90% of district wide GHG emissions (industrial) |
| Exemption | Apply applicable exemption | Apply applicable exemption |
| Regional GHG Reduction Plan | N.A. | Project Consistent with Applicable GHG Reduction Plan with GHG inventorying, monitoring, enforcement, etc. |
| Thresholds | Project < 7,000 MTCO2eq/yr & meets construction & transportation performance standards | GHG emissions from industrial project is < 10,000 MTCO2eq/yr, includes construction emissions amortized over 30 years & added to operational GHG emissions |
| Performance Standards | See above | N.A. |
| Offsets | Offsite substitution allowed | Implement offsite mitigation for life of project, i.e., 30 years, with mitigation preference |
| Determination | GHG emissions significant, EIR is prepared, if meeting none of the above | GHG emissions significant, EIR is prepared, if meeting none of the above |

-

Since not recommending specific GHG significance thresholds for residential/commercial sectors at this time, staff will perform its intergovernmental review (IGR) commenting function as a commenting and responsible agency by providing technical assistance in quantifying GHG emissions and making reference materials available to lead agencies. Reference materials from organizations other than AQMD may include the following:

- CAPCOA's *CEQA and Climate Change* white paper (http://www.capcoa.org/ceqa/CAPCOA%20White%20Paper%20-%20CEQA%20and%20Climate%20Change.pdf),

- CARB's Interim GHG significance threshold proposal (http://www.arb.ca.gov/cc/localgov/ceqa/meetings/102708/wkspslides102708.pdf), and

**Future Activities –** To assist other public agencies and CEQA practitioners with preparing a scientifically sound GHG analysis as part of preparing a CEQA document, staff will perform surveys of available data bases to compile GHG emission factors for as many GHG emission sources as possible. Staff has already compiled CO2 and methane emission factors for on-road and off-road mobile sources. Other GHG emission factors would be compiled and listed on the AQMD's CEQA webpages.

In addition to compiling GHG emission factors, staff will compile GHG mitigation measures to the extent specific measures with GHG control efficiencies are available. Mitigation measures will be compiled by source category and uploaded to the AQMD's CEQA webpages. Staff will continue the stakeholder working group process to seek input from working group members.

Finally, to further evaluate and refine the interim GHG significance threshold for residential/commercial projects and evaluate the compliance options in Tier 4, staff will participate in the statewide efforts and continue to work with stakeholders.

**Resource Impacts**

The AQMD periodically carries out the role of lead agency for permit application projects that have the potential to generate significant adverse impacts. On average, AQMD staff prepares 10 – 15 CEQA documents per year for permit application projects. In addition, all new and amended AQMD rules and regulations and Plans, e.g., Air Quality Management Plan, are evaluated for CEQA applicability and CEQA documents are prepared as necessary. If AQMD staff's proposed interim screening threshold of 10,000 MTCO2eq./yr is implemented, based on the permitting activities for 2006-2007 it will result in at least 31 additional CEQA documents per year, either MNDs or EIRs, being prepared by the AQMD as the lead agency unless another tier option is selected to demonstrate that the project is exempt or is consistent with a GHG reduction plan.

-

**Attachments**

A. Flow Chart of Staff's Recommended Interim GHG Significance Threshold Proposal
B. Development of Interim GHG Significance Thresholds
C. Resolution
D. GHG Significance Thresholds – Key Issues/Comments
E. Draft Guidance Document – Interim CEQA Greenhouse (GHG) Significance Threshold Document

# South Coast Air Quality Management District

# RISK ASSESSMENT PROCEDURES for Rules 1401, 1401.1 and 212

**Draft Version 8.1**

**~~July 26~~August 8, 2017**

# Preface

This document describes the procedures for preparing risk assessments under Rule 1401 - New Source Review of Toxic Air Contaminants, Rule 1401.1 - Requirements for New and Relocated Facilities Near Schools, and Rule 212 – Standards for Approving Permits and Issuing Public Notice. This version of the Risk Assessment Procedures for Rules 1401, 1401.1 and 212 updates the previous Version 8.0 which was updated in 2015 to incorporate the California Office of Environmental Health Hazard Assessment "Air Toxics Hot Spots Program Risk Assessment Guidelines Guidance Manual for Preparation of Health Risk Assessments" (2015 OEHHA Guidelines). This is intended to be a "living" document, which staff will update periodically with updated meteorological data and dispersion model versions. This preface and the summary table provide an easy reference to identify the changes between versions of the SCAQMD's Risk Assessment Procedures and Attachments containing the screening tables. The major revisions to this document (Version 8.1) from the previous version (Version 8.0) include:

- Revising the emission factors and speciation profiles for gasoline dispensing facilities (refer to Appendix X);
- Adding screening tables for spray booth sources (refer to Appendix XI and Attachment N, Tables 13.1 – 13.3);
- Updating the meteorological data for all screening tables (refer to Appendix VI); and
- Updating the list of TACs approved by OEHHA subject to Rule 1401 (refer to Attachment N);
- Reorganization of tables in Attachment N for ease of use.

On July 26, 2017, SCAQMD staff released a draft of this document (Version 8.1), which utilized a refueling emission rate of 0.396 lbs per 1,000 gallons for gasoline dispensing facilities. SCAQMD staff has been in communication with CARB staff regarding the refueling emissions factor. Both agencies agree that additional time is needed to better understand emission reductions from Phase II EVR for ORVR vehicles. SCAQMD staff is recommending not to incorporate CARB's 2013 revised emission factor for Phase II refueling of ORVR vehicles, but to continue the use of SCAQMD's current refueling emission factor of 0.32 lbs per 1,000 gallons. Staff is recommending the use of CARB's 2013 emission factors for all other categories (loading, breathing, spillage, and hose permeation). The SCAQMD staff is committed to continue working with CARB staff to refine the refueling emission factor for Phase II controls with ORVR vehicles and will return to the Board with future revisions to refueling emission factors.

To facilitate identification, modifications to the document are included as underlined text and text removed from the document is indicated by ~~strikethrough~~. Figures and tables which have been replaced can be identified by a Figure or Table title which is in underlined text.

# Summary of Changes

| **SCAQMD Risk Assessment Procedures** | **Version 8.1** | **Version 8.0** | **Version 7.0** |
|---|---|---|---|
| Date of Rule 1401 Adoption | September 1, 2017 (proposed) | June 5, 2015 | March 4, 2005 |
| Applies to Permit Applications Deemed Complete On Or After | October 1, 2017 (proposed) | July 5, 2015 | July 1, 2005 |
| OEHHA Reference Document | Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments, adopted on March 6, 2015 | Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments, adopted on March 6, 2015 | Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments, finalized in August 2003 |
| SCAQMD Permit Application Package | Attachment N | Attachment M (does not apply to spray booths or gasoline dispensing facilities) | Attachment L |
| Dispersion Model | AERMOD (Version 16216r) | AERMOD (Version 14134) | ISC-ST3 (Version 99155) |
| Meteorological Data Model | AERMET (Version 16216) | AERMET (Version 14134) | N/A |
| Meteorological Data Years | 2010-2016 | 2006-2012 | 1981 |

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**ATTACHMENT:**
**PERMIT APPLICATION PACKAGE "N"**
**(Also referred to as Attachment N)**
For use in conjunction with Risk Assessment Procedures (Version 8.1)

# INTRODUCTION

Risk assessment procedures, including procedures for a simple risk screening, were originally developed by South Coast Air Quality Management District (SCAQMD) staff for the adoption of Rule 1401 - New Source Review of Toxic Air Contaminants, in June 1990. Since that time, this document has been revised several times to reflect updated risk assessment methodologies.

The purpose of this document is to:

- Assist applicants and engineers to evaluate Rule 1401 and 1401.1 compliance;
- Provide explanations and sample risk calculations; and
- Provide industry worksheets.

This document describes the procedures for preparing risk assessments under Rule 1401 and Rule 212 – Standards for Approving Permits and Issuing Public Notice. It also applies to Rule 1401.1 – Requirements for New and Relocated Facilities Near Schools for sources located near schools. It is intended to be a "living" document. That is, as new Toxic Air Contaminants (TACs) are added, risk values changed, or procedures revised, the document will be updated. This version of "Risk Assessment Procedures for Rules 1401, 1401.1 and 212" is based on the "Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments" (2015 OEHHA Guidelines) prepared by the Office of Environmental Health Hazard Assessment (OEHHA) and approved on March 6, 2015. The 2015 OEHHA Guidelines, which may be found at: https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0, supersedes OEHHA'S 2003 version of risk assessment guidelines. The 2015 OEHHA Guidelines incorporates age sensitivity factors which will increase cancer risk estimates to residential and sensitive receptors by approximately three times, and more than three times in some cases depending on whether the TAC has multiple pathways of exposure in addition to inhalation. Under the 2015 OEHHA Guidelines, even though the toxic emissions from a facility have not increased, the estimated cancer risk to a residential receptor will increase. Cancer risks for off-site worker receptors are similar between the existing and revised methodology because the methodology for adulthood exposures remains relatively unchanged.

SCAQMD's Risk Assessment Procedures (Version 8.0) was updated June 2015 to incorporate the 2015 OEHHA Guidelines. Spray booths and gasoline dispensing facilities were exempted under Rule 1401 from using Version 8.0 to allow SCAQMD staff more time to assess the permitting impacts with this change. Version 8.1 (this current document) uses the same risk assessment procedures as Version 8.0, but now includes spray booths and gasoline dispensing facilities to reflect amendments to Rule 1401 in 2017.

## Background

There are four steps involved in the risk assessment process; 1) hazard identification, 2) exposure assessment, 3) dose-response assessment, and 4) risk characterization. Each step is briefly discussed below.

### *Hazard Identification*

For air toxics sources, hazard identification involves determining the type of adverse health effect associated with exposure of the pollutant of concern emitted by a facility, including whether a pollutant is considered a human carcinogen or a potential human carcinogen.

### *Exposure Assessment*

The purpose of exposure assessment is to estimate the extent of public exposure to emitted substances for potential cancer, non-cancer health hazards for chronic and acute, and repeated 8-hour exposures. This involves estimation of long-term (annual), short-term (1-hour maximum), and 8-hour average exposure levels.

### *Dose-Response Assessment*

Dose-response assessment is the process of characterizing the relationship between exposure to a chemical by its modeled concentration. Dose can be calculated as follows:

Dose = Concentration x Exposure

### *Risk Characterization*

This is the final step of the risk assessment in which the information from exposure assessment and dose-response assessment are combined to assess total risk to the surrounding community.

## SCAQMD Rule 1401 History

Rule 1401, adopted June 1, 1990 and amended December 7, 1990, specified limits for Maximum Individual Cancer Risk (MICR) and excess cancer cases for new, relocated, or modified equipment which emits carcinogenic air contaminants. The rule was amended July 10, 1998 to include non-carcinogenic compounds. The rule was amended on March 17, 2000 to remove the requirement to assess cumulative risk from emissions from units permitted after 1990 that are located within 100 meters of the new equipment under evaluation for permit. And, the rule has been amended several times to change the list of regulated compounds (both additions and deletions) and their corresponding risk values (cancer potency factors and reference exposure levels). Most recently, Rule 1401 was amended on June 5, 2015 to incorporate the 2015 OEHHA Guidelines for calculating health risks.

## Requirements

This document describes the procedures for determining cancer and non-cancer health effects for equipment subject to Rules 1401, 1401.1, and 212.

In general, these rules apply only if there is an increase in TAC emissions from new, relocated, or modified equipment. Details regarding applicability of these rules to facilities or equipment can be found within the rules themselves at: http://www.aqmd.gov/home/regulations/rules/scaqmd-rule-book.

Under Rule 1401, the following requirements must be met before a permit is granted for affected equipment.

- The cumulative increase from all TACs emitted from a single piece of equipment in MICR shall not exceed:
  - one in one million ($1.0 \times 10^{-6}$ or 1E-06) if Best Available Control Technology for Toxics (T-BACT) is not used; or,
  - ten in one million ($10 \times 10^{-6}$ or 10E-06) if T-BACT is used;

- The cumulative cancer burden from all TACs emitted from a single piece of equipment (increase in cancer cases in the population) shall not exceed 0.5; and,

- Neither the Chronic Hazard Index (HIC), the 8-hour Chronic Hazard Index (HIC8), nor the total Acute Hazard Index (HIA) from all TACs emitted from a single piece of equipment shall exceed 1.0 for any target organ system, or an alternate hazard index level deemed to be safe.

Rule 1401.1 is designed to be more health protective for school children than Rule 1401 by establishing more stringent risk requirements related to facility-wide cancer risk and non-cancer HIA and HIC for new and relocated facilities emitting TACs near schools, thereby reducing the exposure of toxic emissions to school children. For new facilities, the rule requires the facility-wide cancer risk to be less than one in one million at any school or school under construction within 500 feet of the facility. If there are no schools within 500 feet, the same risk levels must be met at any school or school under construction within 500 to 1,000 feet unless there is a residential or sensitive receptor within 150 feet of the facility. For relocating facilities, the facility must demonstrate, for each school or school under construction within 500 feet of the facility, that either: 1) the risk at the school from the facility in its new location is no greater than the risk at that same school when the facility was at its previous location, or 2) the facility-wide cancer risk at the school does not exceed one in one million. Unlike other SCAQMD risk-based rules, the required risk thresholds of Rule 1401.1 do not change based on whether or not the source is equipped with T-BACT.

Rule 212 also applies to Rule 1401 exempt sources. Rule 212 (c)(3) requires public notification if the MICR, based on Rule 1401 risk assessment procedures, exceeds one in one million, due to a project's proposed construction, modification, or relocation for facilities with more than one permitted equipment unless the applicant can show the total facility-wide MICR is below ten in a million. For facilities with a single permitted piece of equipment, the MICR level must not exceed ten in a million. The circulation and distribution of the notifications must meet the criteria in Rule 212.

## OVERVIEW

This document provides several tiers for preparing a risk assessment, from a quick look-up table to a detailed risk assessment involving air quality dispersion modeling analysis. Permit applicants may use any of these tiers to demonstrate compliance with the risk limits of Rule 1401. The applicant should include a copy of the risk assessment, including all electronic modeling files, with the permit application.

The tiers are designed to be used in order of increasing complexity with each higher tier providing a more refined estimate of risk than the lower tier. If compliance cannot be demonstrated using one tier, the permit applicant may proceed to the next tier. A permit applicant who can show compliance by using a lower tier does not need to perform an analysis for the higher tiers. In general, for most permits a detailed analysis is not required. The tiers are:

- Tier 1: Screening Emission Levels
- Tier 2: Screening Risk Assessment
- Tier 3: Screening Dispersion Modeling
- Tier 4: Detailed Risk Assessment

Please note that the 2015 OEHHA Guidelines "Tier" approach differs from these SCAQMD Risk Procedures "Tier" compliance. The OEHHA Tiers refer to the incorporation of stochastic modeling for the facility and population specific exposure parameters. In contrast, the SCAQMD Tiers refer to increasing complexity for deriving pollutant concentrations based on facility emissions. Regulatory compliance may be demonstrated with any SCAQMD Tier.

In addition, this document briefly discusses the T-BACT identification process for Rule 1401.

## PRELIMINARY TASKS

Before conducting any of these risk assessment tiers, three preliminary tasks must be performed:

1. **Determine if the permitting action or equipment is exempt from the provisions of Rule 1401.** Exemptions are granted for:
   - Permit renewal or change of ownership;
   - Modifications with no increase in risk;
   - Functionally identical equipment replacement;
   - Equipment previously exempt under Rule 219 - Equipment not Requiring a Written Permit Pursuant to Regulation II and filing for a permit to operate within one year of removing the Rule 219 exemption;
   - Modifications to terminate research projects; and
   - Emergency internal combustion engines (ICEs) exempt under Rule 1304 - Exemptions.

   An additional exemption is granted for demonstrations of contemporaneous emission reductions such that no receptor experiences a total increase in MICR of greater than one in one million and the contemporaneous reduction occurs within 100 meters of the equipment. If the equipment falls under one of these exemptions, no further risk assessment is required.

2. **Identify the TACs emitted by the permit unit**. The risk assessment must include those TACs emitted by the permit unit which were listed in the rule when the permit application was deemed complete by SCAQMD staff (refer to Table I of Rule 1401). The first table in the Attachment lists the TACs subject to Rules 1401, 1401.1 and Rule 212. Determine the date on which the application was deemed complete and refer to the appropriate Attachments.

   Default toxic emission factors for TACs associated with combustion equipment have been developed for use in the AB2588 Program[1]. If better source specific data is available, such as

[1]SCAQMD's Supplemental Instructions are available on the SCAQMD website at: http://www.aqmd.gov/docs/default-source/planning/annual-emission-reporting/supplemental-instructions-for-ab2588-facilities.pdf

SCAQMD approved source tests, manufacturer's data, or fuel analysis, it should be used rather than the default emission factors.

If no TACs listed in the applicable version of Rule 1401 are emitted by the equipment, no further risk assessment is required.

3. **Estimate the quantity of emissions from the permit unit.** The appropriate emission estimation technique depends on the type of source. Techniques include emission testing, a mass balance or other engineering calculation, or emission factors for specific types of processes. The emissions used for the risk calculation should be post-control emissions (that is, reductions in emissions due to enforceable controls and permit conditions should be taken into account). SCAQMD Engineering and Permitting staff should be consulted regarding approved techniques for identifying toxic air contaminants and estimating emissions for specific sources.

   The SCAQMD also has a broader mandate to ensure that permits are not granted to facilities which may endanger public health (California Health and Safety Code Section 41700). In addition, under Rule 212, the applicant may be required to evaluate other compounds that are determined to be potentially toxic. Therefore, an applicant may be required to evaluate risks from compounds not listed in the Attachment as part of the permitting process if they are a concern for a specific source. These may include substances with irritant effects or other adverse health effects.

## DEFINITIONS

Before proceeding, it is important to understand some of the terms used when performing a health risk assessment. These terms are commonly used throughout this document.

**Dispersion Factor ($\chi$/Q)**
The concentration of a contaminant decreases as it travels away from the site of release and spreads out or "disperses." $\chi$/Q are numerical estimates of the amount of dispersion that occurs under specific conditions. The amount of dispersion depends on the distance traveled, the height of release, and meteorological conditions such as wind speed and atmospheric stability. The dispersion factors for the screening risk assessment procedure give the estimated annual average ground-level concentration ($\mu g/m^3$) resulting from a source emitting one ton/year of a contaminant. For a more detailed explanation of derivation of $\chi$/Q for each meteorological station, please refer to Appendix VI.

**Molecular Weight Adjustment Factor (MWAF)**
MWAFs should be used when calculating the cancer risk. For most of the toxic metals, the OEHHA cancer potency factor applies to the weight of the toxic metal atom contained in the overall compound. This ensures that the cancer potency factor is applied only to the fraction of the overall weight of the emissions that are associated with health effects of the metal.

For most of the Hot Spots toxic metals, the OEHHA cancer potency factors, acute and chronic Reference Exposure Levels (RELs) apply to the weight of the toxic metal atom contained in the overall compound. Some of the Hot Spots compounds contain various elements along with the toxic metal

atom (e.g., "Nickel hydroxide," CAS number 12054-48-7, has a formula of H2NiO2). Therefore, an adjustment to the reported pounds of the overall compound is needed before applying the OEHHA cancer potency factor for "Nickel and compounds" to such a compound. This ensures that the cancer potency factor, acute or chronic REL is applied only to the fraction of the overall weight of the emissions that are associated with health effects of the metal. In other cases, the Hot Spots metals are already reported as the metal atom equivalent (e.g., CAS 7440-02-0, "Nickel"), and these cases do not use any further molecular weight adjustment. The appropriate MWAF to be used along with the OEHHA cancer potency factors, acute and chronic RELs for Hot Spots metals can be found in the MWAF column of the table containing OEHHA and California Air Resources Board's (CARB) Approved Health Values for use in Hot Spots Facility Risk Assessments (Consolidated Health Values Table), which is available at: https://www.arb.ca.gov/toxics/healthval/contable.pdf.

**Cancer Potency (CP) Factor**

The CP factor is a measure of the cancer potency of a carcinogen. Cancer potency describes the potential risk of developing cancer per unit of average daily dose over a 70-year lifetime. The CP factors in these procedures were approved by the state Scientific Review Panel and prepared by OEHHA. The CP can be found in the Consolidated Health Values Table, which is available at: https://www.arb.ca.gov/toxics/healthval/contable.pdf.

**Reference Exposure Level (REL)**

The concentration level at or below which no adverse non-cancer health effects are anticipated for a specified exposure duration is termed the REL. RELs are based on the most sensitive, relevant, adverse health effect reported in the medical and toxicological literature. RELs are designed to protect the most sensitive individuals in the population by the inclusion of margins of safety. Since margins of safety are incorporated to address data gaps and uncertainties, exceeding the REL does not automatically indicate an adverse health impact. The REL can be found in the Consolidated Health Values Table, which is available at: https://www.arb.ca.gov/toxics/healthval/contable.pdf.

**Multi-Pathway (MP) Adjustment Factor**

The MP adjustment factor is used for substances that may contribute to risk from exposure pathways other than inhalation. These substances deposit on the ground in particulate form and contribute to risk through ingestion of soil or backyard garden vegetables or through other routes. The MP adjustment factor estimates the total risk in comparison to a given inhalation risk. MP adjustment factors are provided in Attachment N, Tables 3.1 and 3.2. These factors allow permit units that emit multi-pathway pollutants to use the risk screening procedure rather than proceeding directly to preparing a detailed risk assessment.

**Daily Breathing Rate (DBR)**

Exposure to airborne chemicals occurs through inhalation and subsequent absorption into the body, potentially resulting in adverse health effects depending on toxicological properties of the chemical and other exposure parameters. For residential exposures, the breathing rates are determined for specific age groups (i.e., third trimester, 0-2, 2-16, and 16-30 years). CARB is developing an updated Risk Management Policy (RMP) that includes recommendations for inhalation exposures. Information regarding CARB's RMP can be located at: http://www.arb.ca.gov/toxics/toxics.htm. For residential exposures, CARB's RMP recommends using the high end DBR (e.g., 95$^{th}$ percentile) for children from the third trimester through age 2, and 80$^{th}$ percentile DBR for all other ages. This is reflected in Attachment N, Tables 4.1A – 4.2D. For worker exposures, it is assumed that the working

age begins at 16 years, and that exposures to facility emissions occur during the work shift which is typically up to eight hours per day during work days.

**Age Sensitivity Factor (ASF)**
Scientific data have shown that young animals are more sensitive than adult animals to exposure to many carcinogens. Therefore, OEHHA developed ASFs to take into account the increased sensitivity to carcinogens during early-in-life exposure. OEHHA recommends an ASF of 10 for exposures that occur from the third trimester of pregnancy to 2 years, and an ASF of 3 for exposures that occur from 2 years through 15 years of age.

**Exposure Duration (ED)**
A 30-year ED (residency time) should be used for residential and sensitive receptor locations. A 25-year ED should be used for off-site workers (i.e., receptor locations in commercial or industrial areas).

**Fraction of Time Spent at Home (FAH)**
OEHHA and CARB have evaluated information from activity patterns databases to estimate the percentage of the day that people are at home. This information is used to adjust cancer risk from a facility's emissions, assuming that exposure to the facility's emissions are not occurring away from home. The FAH factor does not apply for workers since the worker is assumed to be present at the work site 100 percent of the work day. For Tiers 1, 2, and 3 screening purposes, the FAH is assumed to be 1 for ages third trimester to 16. As a default, children are assumed to attend a daycare or school in close proximity to their home and no discount should be taken for time spent outside of the area affected by the facility's emissions. People older than age 16 are assumed to spend only 73 percent of their time at home.

**Exposure Frequency (EF)**
EF is the number of days per year of exposure for the given scenario (i.e. residential, worker). OEHHA recommends the use of 350 days/year for residential exposure (applicable to 30-year risk assessments), and 250 days/year for worker exposure. This equates to EF = 0.96 for residential exposure and EF = 0.68 for worker exposure.

**Averaging Time (AT)**
AT is the lifetime exposure period OEHHA used to develop the cancer potency values. CP factors are developed as estimates of cancer risk from exposure to a lifetime dose (i.e. 70 years) of a carcinogen. Since cancer risks are calculated on a yearly basis to account for age-specific factors (e.g., ASF, DBR, etc.) the CP factor must be divided by its original 70-year AT in the risk equation to generate an annual CP factor to be used in the cancer risk calculations. For AT, OEHHA recommends the use of 70 years.

**Worker Adjustment Factor (WAF)**
In risk assessments, long-term averages are typically used for cancer risk calculations for residents and workers. Therefore, for an off-site worker, the long-term average should represent what the worker breathes during their work shift. However, the long-term averages calculated from AERMOD typically represent exposures for receptors that were present 24 hours a day and seven days a week which is the schedule of a residential receptor. When modeling a non-continuously emitting source (e.g., operating for eight hours per day and five days per week), the long-term concentration has to be adjusted so that it is only based on the hours when the worker is present. WAF is the ratio between

residential exposure and facility schedule. For screening purposes, the off-site worker schedule is assumed to always overlap with the facility's operating schedule.

# Tier 1: Screening Emission Levels

## OVERVIEW OF TIER 1

Tier 1 involves a simple look-up table (Attachment N, Table 1.0) in which the equipment's emissions are compared to screening levels. The screening levels are pollutant emission thresholds which are not expected to produce a MICR greater than one in one million nor a hazard index greater than one.

Tier 1 can be used by applicants to determine whether or not a detailed risk analysis will be required when filing for a permit. It can also be used by applicants and SCAQMD staff to determine whether a permit is required based on paragraph (s)(2) in Rule 219.

Tier 1 may be used only for a single emission source and a single TAC. However, it can be used for multiple pollutants if the Multiple Pollutant Screening Level Procedure (described below) is followed.

## INSTRUCTIONS FOR TIER 1

The Tier 1 analysis is performed as follows:

1. Determine the maximum annual emissions (for cancer and non-cancer 8-hour and chronic TACs) and determine the maximum hourly emissions (for non-cancer acute TACs).
2. Compare the emissions to the screening levels for that contaminant in Attachment N, Table 1.0. Columns are labeled with the distance to the nearest receptor.
3. If the maximum annual emissions or the maximum hourly emissions do not exceed the screening levels, the equipment will comply with Rule 1401 and does not require notice under Rule 212 for toxics.
4. If the maximum annual emissions or the maximum hourly emissions exceed the screening levels, proceed to Tier 2.

The screening levels in Attachment N, Table 1.0 were determined by back calculation, using the highest $\chi/Q$ established in Attachment N, Tables 6.1 A through 7.6 B that would not exceed a cancer risk of one in one million or an HIC, HIC8 or HIA of one.

## MULTIPLE POLLUTANT SCREENING LEVEL PROCEDURE

1. Calculate the Pollutant Screening Index for each TAC ($PSI_{TAC}$). For each carcinogenic and/or 8-hour or chronic compound, divide the maximum annual emissions (in pounds per year) of each TAC ($Q_{lbpy}$) by the Annual Pollutant Screening Level ($PSL_{TAC,\ Annual}$) in pounds per year, as contained in Attachment N, Table 1.0. For each acute compound, divide the maximum hourly emission (in pounds per hour, $Q_{lbph}$) of each TAC by the Hourly Pollutant Screening Level ($PSL_{TAC,\ Hourly}$) as contained in Attachment N, Table 1.0.

$$PSI_{TAC,\ Cancer,\ 8\text{-}hr,\ or\ Chronic} = Q_{lbpy,TAC} / PSL_{TAC,\ Annual}$$

$$PSI_{TAC,\ Acute} = Q_{lbph,TAC} / PSL_{TAC,\ Hourly}$$

2. Calculate the Application Screening Index (ASI). Sum up the individual Pollutant Screening Indices for all chronic, 8-hour and carcinogenic pollutants ($PSI_P$) and, separately, for all acute TACs.

   $$ASI_{cancer,8\text{-}hr,chronic} = PSI_{TAC1,cancer,8\text{-}hr,chronic} + PSI_{TAC2,cancer,8\text{-}hr,chronic} + PSI_{TAC3,cancer,8\text{-}hr,chronic} + \ldots$$

   $$ASI_{acute} = PSI_{TAC1,acute} + PSI_{TAC2,acute} + PSI_{TAC3,acute} + \ldots$$

3. Neither the $ASI_{cancer,8\text{-}hr,chronic}$ , nor the $ASI_{acute}$ can exceed one.

Refer to Example 2 (starting on page 33) for multiple pollutant screening.

If step 3 cannot be met, proceed to Tier 2.

# Tier 2: Screening Risk Assessment

## OVERVIEW OF TIER 2

Tier 2 is a screening risk assessment, which includes procedures for determining the level of risk from a source for cancer risk, cancer burden, HIA, HIC8, and HIC. If the estimated risk from Tier 2 screening is below Rule 1401 limits, then a more detailed evaluation is not necessary. Examples of calculations are provided at the end of the description of Tier 4 risk assessment. (See page 27)

**If the screening risk assessment results in a risk estimate that exceeds the risk limits or the permit applicant feels that a more detailed evaluation would result in a lower risk estimate, the applicant has the option of conducting a more detailed analysis using Tier 3 or 4.**

To perform a Tier 2 screening risk assessment, the following information is needed:

- **Maximum annual emissions** of each carcinogen and non-cancer 8-hour and chronic TAC, and the **maximum hourly emissions** of each non-cancer acute TAC;
- The **distance** from the permit unit to the nearest off-site residential and worker receptor(s);
- Certain source characteristics, such as **stack height** and/or **building dimensions**;
- **Operating schedule**: whether the permit unit will operate more or less than 12 hour/day; and
- **Geographic location** of the permit unit (e.g., city).

In order to perform a Tier 2 screening risk assessment, it is necessary to identify the nearest receptor location. For the purpose of calculating the MICR, HIC8 and HIC, a receptor is any location outside the boundaries of the facility at which a person could experience repeated, continuous exposure. For the purpose of calculating the HIA, a receptor is any location outside the boundaries of the facility at which a person could experience exposure over a short timeframe. Receptor locations include residential, commercial and industrial areas, and other locations where sensitive receptors may be located. Residential receptor locations include current residential land uses and areas which may be developed for residential uses in the future, given existing or planned zoning. Commercial/industrial receptor locations include areas zoned for manufacturing, light or heavy industry, office or retail activity. Sensitive receptor locations include any residence including private homes, condominiums, apartments, and living quarters; schools, including preschools and daycare centers; health facilities such as hospitals, retirement and nursing homes, long term care hospitals, hospices; in addition to prisons, dormitories or similar live-in housing, where children, chronically ill individuals or other sensitive persons could be exposed to TACs.

When identifying receptor locations in order to calculate cancer risk, HIC8 or HIC, the potential for chronic (long-term) exposure should be considered. Land uses at which it is not possible for individuals to be exposed on a long-term basis such as roadways or highways should not be used. When identifying receptor locations to calculate HIA, all off-site locations where there is the potential for acute exposure should be considered (i.e. fenceline receptor). Refer to Rule 1401 for more information regarding receptor locations to be considered.

For assessment of residential cancer risk, the risk is calculated in individual age bins (e.g., third trimester, 0-2 years, etc.) rather than a single lifetime calculation, whereas, for off-site worker, the default assumption is that working age begins at 16 years.

## INSTRUCTIONS FOR CALCULATING MAXIMUM INDIVIDUAL CANCER RISK (MICR)

The MICR Calculation Worksheet in Appendix I can be used to help with the calculation. This worksheet can be included in the permit application as documentation of the MICR calculation.

MICR is calculated as follows:

$$\mathbf{MICR = Cancer\ Potency\ (CP) \times Dose\ (D) \times 10^{-6}}$$

Where:

$$\mathbf{Dose = Concentration \times Exposure}$$

$$\mathbf{Concentration = GLC = (Q_{tpy} \times \chi/Q) \times MWAF}$$

$$\mathbf{CEF_R = (Exposure_{0.25\text{-}0} + Exposure_{0\text{-}2} + Exposure_{2\text{-}16} + Exposure_{16\text{-}30}) \times EF_R / AT}$$

$$\mathbf{Exposure_{AgeBin} = DBR_{AgeBin} \times ED_{AgeBin} \times ASF_{AgeBin} \times FAH_{AgeBin}}$$

$$\mathbf{Exposure_R = CEF_R \times MP_R}$$

$$\mathbf{CEF_W = DBR_W \times ED_W \times EF_W / AT}$$

$$\mathbf{Exposure_W = CEF_W \times MP_W \times WAF}$$

You may also use the following equation using **default combined exposure factor**, found in Tables 4.1D and 4.2D of Attachment N**:**

$$\mathbf{MICR_R = CP \times Q_{tpy} \times \chi/Q \times MWAF \times CEF_R \times MP_R \times 10^{-6}}$$

$$\mathbf{MICR_W = CP \times Q_{tpy} \times \chi/Q \times MWAF \times CEF_W \times MP_W \times WAF \times 10^{-6}}$$

For Tier 2 screening risk assessment procedures for short-term projects, refer to Appendix XII.

## Terminology Reference Guide

| Term | Description | Where to Find |
|---|---|---|
| GLC | Ground Level Concentration = $Q_{tpy}$ x $\chi/Q$ | |
| $Q_{tpy}$ | Maximum emission rate (tons/year) | Emission estimate specific to permit unit |
| $\chi/Q$ | Concentration at a receptor distance / Emission Rate [($\mu g/m^3$)/(tons/year)] | Attachment N, applicable Table by source type |
| MWAF | Molecular Weight Adjustment Factor | Consolidated Health Values Table[2] |
| CP | Cancer Potency $(mg/kg\text{-}day)^{-1}$ | |
| REL | Reference Exposure Level ($\mu g/m^3$) | |
| MP | Multi-Pathway Adjustment Factor (if applicable) | Attachment N, Table 3.1 and 3.2 |
| CEF | Combined Exposure Factor | Attachment N, Tables 4.1 A – 4.2 D |
| DBR | Daily breathing rate (L/kg body weight-day) | Attachment N, Tables 4.1 A – 4.2 D |
| ASF | Age Specific factor (unitless) | Attachment N, Tables 4.1 A – 4.2 D |
| $ED_R$ | Exposure Duration (30 years) – Residential | Attachment N, Tables 4.1 A – 4.1 E |
| $ED_W$ | Exposure Duration (25 years) – Worker | Attachment N, Tables 4.2 A – 4.2 D |
| FAH | Fraction of Time Spent at Home (unitless) | Attachment N, Tables 4.1 A – 4.1 E |
| $EF_R$ | Exposure Frequency, Residential = 0.96 (350 days / 365 days), unitless | Attachment N, Tables 4.1 A – 4.1 E |
| $EF_W$ | Exposure Frequency, Worker = 0.68 (250 days / 365 days), unitless | Attachment N, Tables 4.2 A – 4.2 D |
| AT | Averaging Time (lifetime exposure = 70 years) | |
| WAF | Worker Adjustment Factor | Attachment N, Tables 5.1 and 5.2 |
| $10^{-6}$ | Micrograms to milligrams conversion, liters to cubic meters conversion | Not applicable |

### Step 1: Estimate Emission Rate ($Q_{tpy}$)

The maximum annual emissions of the TAC in tons/year ($Q_{tpy}$) must be estimated. The emission rate must be expressed in tons/year because the $\chi/Q$ are expressed in tons/year.

[2] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

**Step 2: Determine Release Type**

Determine whether the permit unit is best characterized as a point source or a volume source:

- A **point source** is one that releases its emissions through a stack (designed with acceptable stack height). If the point source has a raincap or a horizontal release, a Tier 3 or 4 assessment is required.
- A **volume source** includes emissions that are unrestricted by any physical means (e.g. pipes or vents and/or vacuum or fan), including releases inside of a building or as fugitive emissions.

For permit units that have both point and volume releases, use the table that will result in the highest $\chi/Q$ value, or apportion the emissions between the point and volume sources.

**Step 3: Determine Release Height**

For a **point source**, determine the **stack height**, which is the distance from ground level to the top of the stack.

**Acceptable Stack Height**. Although a taller stack provides better dispersion, there are limits to the degree to which this factor can be incorporated into the risk assessment. Rule 1401 specifies that the stack height used to determine risk shall not exceed the "Acceptable Stack Height" for the permit unit. Acceptable stack height is defined as 2.5 times the height of the equipment or 2.5 times the height of the building housing the equipment, and may not exceed 65 meters (213 feet), unless the applicant demonstrates to the satisfaction of SCAQMD staff that a greater height is necessary. For example, for a building that is 14 feet high, the acceptable stack height is 35 feet, measured from ground level.

For a **volume source**, determine the **building height**, which is the distance from ground level to the top of the building in which the permit unit is located, and the **floor area**, which is the dimensions (length x width) of the building in which the permit unit is located.

An **area source** is similar to a volume source in that the emissions take place over an area (as opposed to a point such as from a stack). However, in an area source, the pollutants are released at a uniform height. Examples of area sources are storage piles, slag dumps, lagoons or ponds, and liquid spills. Toxic hydrocarbon emissions from open top and floating roof storage tanks are also often treated as elevated area sources. Use Tier 3 or 4 for area sources.

**Step 4: Determine Operating Schedule**

Determine whether the equipment will operate:

- 12 hours/day or less; or
- More than 12 hours/day

### Step 5: Identify the Appropriate Meteorological Station

Appendix VI provides the locations of meteorological stations in the South Coast Air Basin (Basin) used for these calculations. Using Appendix VI, Figure VI-1, or the links below, determine the Source/Receptor Area (SRA) for the permit unit. Use Appendix VI, Table VI-1 to determine the meteorological site most appropriate to use for the permit unit's SRA. Additional information on how to select the appropriate SRA can be found on SCAQMD's website at http://www3.aqmd.gov/webappl/gisaqi2/VEMap3D.aspx; and http://www.aqmd.gov/docs/default-source/default-document-library/map-of-monitoring-areas.pdf.

### Step 6: Identify Type of Receptor and Distance from Receptor

Identify the nearest receptor locations. Receptor locations are off-site locations where persons may be exposed to emissions of a TAC from the equipment. Receptor locations include residential, commercial, and industrial land use areas, and other locations where sensitive populations may be located. For all receptor locations, the distance should be measured from the source to the edge of the property line of the nearest receptor.

**Residential receptor locations** include current residential land uses and areas that may be developed for residential uses in the future, based on existing and planned zoning.

**Worker receptor locations** include areas zoned for manufacturing, light or heavy industry, retail activity, or other locations that are regular work sites.

**Sensitive receptor locations** include any residence including private homes, condominiums, apartments, and living quarters, schools, preschools, daycare centers and health facilities such as hospitals, retirement and nursing homes, long term care hospitals, hospices in addition to prisons, dormitories, or similar live-in housing.

When identifying receptor locations to calculate MICR, the potential for chronic (long-term) exposure should be considered. Land uses at which it is not possible for individuals to be exposed on a long-term basis, either presently or in the future, should not be considered receptor locations for purposes of calculating MICR. Examples of such locations include flood channels, or roadways.

**For a point source, the receptor distance is the distance from the center of the stack to the nearest receptor location.**

**For a volume source, the receptor distance is the distance from the edge of the building to the nearest receptor location.**

Experience shows that in most cases, the receptor distance will be 50 meters or more. However, the table also provides $\chi/Q$ values for a 25-meter distance. The 25-meter distance should be used for circumstances in which there is a receptor located very close to the permit unit, for example, a residence located with a business, another business adjacent to the facility, or a sensitive receptor located less than 50 meters from the permit unit.

**If the closest receptor location is a worker receptor, then the MICR must also be calculated for the closest residential or sensitive receptor. The greater of the two MICR values is used to determine compliance with the risk limits in the rule.**

*Care should be taken when estimating these distances since concentrations decrease rapidly with increasing distance. It is acceptable to linearly interpolate to estimate dispersion factors between the downwind distances given in the tables. If the receptor lies over 1,000 meters from the permit unit, use the concentration for 1,000 meters.*

### Step 7: Select $\chi$/Q Value

Several tables are provided for $\chi$/Q, based on the source parameters and the meteorological station. Select the appropriate $\chi$/Q value from the table based on the **meteorological station, source characteristics** (i.e., stack height for point sources and building height and building area for volume sources) and the **receptor distance.** All screening tables are available in the Attachment – Permit Application Package "N" (also referred to as Attachment N), which is to be used in conjunction with these procedures. The Attachment contains $\chi$/Q values for non-combustion sources; combustion sources such as diesel reciprocating internal combustion engines, natural gas reciprocating internal combustion engines, and natural gas boilers; crematoriums; short-term projects; and spray booths, as well as MICR values for gasoline dispensing facilities. Information regarding the methodology used to develop these screening tables can be found in Appendix VI through XIII.

### Step 8: Identify MWAF

Using the Consolidated Health Values Table[3], identify the MWAF for the TAC.

### Step 9: Identify CP Factor and REL

Using the Consolidated Health Values Table[3], identify the CP and REL for the TAC.

### Step 10: Identify MP Adjustment Factor

Using Attachment N, Tables 3.1 and 3.2, identify the MP adjustment factor for the TAC, if applicable.

The MP adjustment factors are to be used only in urban residential or worker exposure situations. Note that there are separate MP adjustment factors for worker ($MP_W$), resident ($MP_R$) and short-term ($MP_{R,ST}$ and $MP_{W,ST}$) exposure (see Attachment N, Tables 3.1 and 3.2) since their potential routes and duration of exposure varies. If the facility is in the vicinity of other potential routes of population exposure such as agricultural areas, drinking water reservoirs, lakes or ponds used for fish that are consumed regularly, or areas used for livestock grazing, then these MP screening assumptions are not appropriate and a more detailed multi-pathway assessment (Tier 4) must be performed.

[3] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

For a more detailed description of the derivation of the MP adjustment factors, please see Appendix II.

**Step 11: Select CEF**

Using Attachment N, Tables 4.1 A – 4.2 D, select the appropriate CEF. The CEF for each exposure type (residential, worker, or short-term) combines default exposure parameters for DBR, ASF, ED, FAH, EF, and AT into a single value.

**Step 12: Calculate WAF**

For sources operating and emitting continuously (24 hours per day and 7 days per week), the worker is assumed to breathe the long-term annual concentration during their work shift and no adjustments are necessary when estimating the cancer risk. In these cases, the WAF is equal to one. For non-continuous sources operating, the appropriate WAF can be calculated using the following equation:

$$WAF = (H_{residential} / H_{source}) \times (D_{residential} / D_{source})$$

Where;
WAF = Worker adjustment factor
$H_{residential}$ = The number of hour per day the long-term concentration is based on (always 24 hours)
$H_{source}$ = The number of hours the source operates per day
$D_{residential}$ = The number of days the per week the long-term residential concentration is based on (always 7 days)
$D_{source}$ = The number of days the source operates per week

Although the 2015 OEHHA Guidelines allow the use of a discount factor (DF) when assessing inhalation cancer health impacts, if the off-site worker's schedule partially overlaps with the source's emission schedule, the DF should only be used when there are limits on the hours of operation specified in the facility's operating permits. Since SCAQMD permits do not typically include limits on the hours of operation, it is not appropriate to apply the DF when calculating the health impacts.

**MICRs for Multiple TACs**

If the equipment emits more than one TAC, the total MICR must be calculated. The total MICR is the sum of the MICRs for each of the TACs emitted by the equipment.

## INSTRUCTIONS FOR CALCULATING CANCER BURDEN

The cancer burden is the estimated increase in the occurrence of cancer cases in a population as a result of exposures to TAC emissions from the equipment over a 70-year exposure duration. The cancer burden for a population unit (city, census tract, sub-area or grid) is the product of the number of persons in the population and the estimated individual risk from TACs. The cancer burden only needs to be calculated if the resulting MICR from a 30-year exposure duration is greater than one in one million.

The following procedure may be used to perform an acceptable screening analysis for cancer burden due to a single source of TAC:

- Re-calculate total MICR from all TACs from a single permit unit using a 70-year exposure duration, as is required in the 2015 OEHHA Guidelines[4]. The CEF for the 70-year exposure duration can be found in Attachment N, Table 4.1 E.

- Estimate the distance at which the MICR from a 70-year exposure duration falls below one in one million. This distance can be estimated by back-calculating the distance that would result in a MICR of one in one million, using the $\chi$/Q values in Attachment N source specific tables.

- Define a zone of impact in the shape of a circle. The radius (r) of this circle is the distance between the equipment and the point at which the risk falls below one in one million. The area of this circle is calculated using the equation for the area of a circle, which is $3.14 \times r^2$.

- Estimate the residential population within this zone of impact based on census data or a worst-case estimate. Generally, the residential population in the Basin is less than 4,000 persons/km$^2$, but some areas are as high as 7,000 persons/km$^2$.

  For areas where census data is available, it should be used. Where there is no census data, 7,000 persons/km$^2$ should be used for the areas with high population densities and 4,000 persons/km$^2$ should be used for areas with low population densities (such as locations along the Pacific Ocean). Where the population densities are unknown, use 7,000 persons/km$^2$.

- Calculate the screening level cancer burden by multiplying the total residential population in the zone of impact by the maximum individual cancer risk.

If the $\chi$/Q in the Attachment N source specific tables are not sufficient to estimate the distance at which MICR falls below one in one million, then a more refined risk assessment is warranted.

[4] OEHHA, 2015. Section 8, "Risk Characterization for Carcinogens and Noncarcinogens and the Requirements for Hot Spots Risk Assessments." Available at: https://oehha.ca.gov/media/downloads/crnr/2015guidancemanual.pdf.

## INSTRUCTIONS FOR CALCULATING HIC, HIC8, AND HIA

Some TACs have the potential to cause non-cancer health risk due to short term (acute) or long term (chronic) exposures. The screening risk assessment for those TACs must estimate HIA, HIC8, and/or HIC as applicable. Like the calculation procedure for MICR, one must first identify when the application was deemed complete and select the appropriate set of risk tables found in the attachments (e.g. Attachment M, Attachment L, etc).

The REL is used as an indicator of potential adverse non-cancer health effects. An inhalation REL is a concentration level ($\mu g/m^3$) at which no adverse health effects are anticipated. Inhalation RELs are provided in the Consolidated Health Values Table[5].

When a health impact calculation is performed for a single substance, it is called the **Hazard Quotient (HQ)**. When several TACs affect the same organ system in the body (e.g., respiratory system, nervous system, reproductive system), there can be a cumulative effect on the target organ. In these cases, the sum of the HQs of all chemicals emitted that impact the same target organ, called total **Hazard Index (HI)**, is evaluated. The Target Organs Tables for each TAC are available on CARB's website[6].

Detailed procedures for calculating the total HI are provided in the 2015 OEHHA Guidelines. The equations used to calculate the HIC, HIC8, and HIA per target organ are as follows:

$$\text{Total HIC}_{\text{target organ}} = \{[Q_{\text{tpy,TAC1}} \times (\chi/Q) \times MP_{\text{TAC1}} \times \text{MWAF}]/\text{Chronic REL}_{\text{TAC1}}\}_{\text{target organ}} + \{[Q_{\text{tpy,TAC2}} \times (\chi/Q) \times MP_{\text{TAC2}} \times \text{MWAF}]/\text{Chronic REL}_{\text{TAC2}}\}_{\text{target organ}} + \ldots.$$

$$\text{Total HIC8}_{\text{target organ}} = \{[Q_{\text{tpy,TAC1}} \times (\chi/Q) \times \text{WAF} \times \text{MWAF}]/\text{8-Hour REL}_{\text{TAC1}}\}_{\text{target organ}} + \{[Q_{\text{tpy,TAC1}} \times (\chi/Q) \times \text{WAF} \times \text{MWAF}]/\text{8-Hour REL}_{\text{TAC2}}\}_{\text{target organ}} + \ldots..$$

$$\text{Total HIA}_{\text{target organ}} = \{[Q_{\text{lbph,TAC1}} \times (\chi/Q)_{\text{hr}} \times \text{MWAF}]/\text{Acute REL}_{\text{TAC1}}\}_{\text{target organ}} + \{[Q_{\text{lbph,TAC2}} \times (\chi/Q)_{\text{hr}} \times \text{MWAF}]/\text{Acute REL}_{\text{TAC2}}\}_{\text{target organ}} + \ldots..$$

Note that the HIC is based upon an annual average emission per year whereas the HIA is based upon a maximum 1-hour emission level and the HIA does not use an MP. In addition, the 8-hour RELs were developed only for repeated, chronic daily 8-hour exposures (e.g. a typical worker or resident exposed to a facility that operates equal to or more than 8 hours per day and 5 days per week). The HIC8 is based upon the daily average 8-hour exposure only for those chemicals with 8-hour RELs. There are currently only a limited number of substances with an 8-hour inhalation REL.

[5] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf.
[6] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.

## PROCEDURE FOR ALTERNATE HI LEVEL EXEMPTION

Rule 1401 provides an exemption from the HI limit of one in cases in which a higher exposure level is deemed to be safe. This exemption has never been used. Under this exemption, the HIC and/or HIA limit of one does not apply if the applicant substantiates to the satisfaction of SCAQMD staff that at all receptor locations and for every target organ system, the total HIC and HIA levels resulting from emissions from the equipment will not exceed alternate HI levels determined by OEHHA to be protective against adverse health effects. This applies only to TACs listed in Rule 1401 at the time the application was deemed complete. Refer to the attachments for the appropriate list of TACs.

Applicants should indicate in their permit application that they wish to apply for an exemption under the alternative HI provisions of the rule. The permit application should include both a risk assessment estimating the HIA and HIC levels and relevant information supporting the exemption. Depending on the particular health risks in question, additional information such as characterization of the surrounding population, the location of sensitive receptors, or other data may be required.

SCAQMD staff will consult with OEHHA staff regarding the request for the alternative HI level. If OEHHA staff finds that the levels of exposure to the public will not exceed levels that are protective against adverse health effects, the application will be eligible for the exemption.

In some cases, OEHHA staff may establish a general policy recommending different acceptable exposure levels for different exposed populations. For example, if exposure to a certain compound is particularly harmful to children but less of a concern for adults, OEHHA staff may determine as a general policy that higher exposure levels are acceptable in locations where children would not be exposed. OEHHA policy in these cases would be a basis for eligibility for the alternate HI exemption.

# Tier 3: Screening Dispersion Modeling

Tier 3 uses a screening dispersion model to estimate risk. This tier requires more expertise than Tiers 1 and 2. For guidance on performing a Tier 3 analysis, refer to the SCAQMD website at: http://www.aqmd.gov/home/permits/risk-assessment.

Tier 3 screening dispersion modeling should only be used for equipment with a single emission or release point. If there are multiple emission or release points, Tier 4 must be used. In addition, Tier 3 would only be beneficial for applications involving source parameters that differ substantially from those used to derive $\chi/Q$ values in Attachment N source specific tables and Appendices VII through XII.

To perform a Tier 3 analysis, the following is needed:

- Air dispersion modeling expertise;
- The most recently approved version of U.S. EPA's screening dispersion model AERSCREEN, which can be downloaded from www.epa.gov/scram; and
- Additional equipment information such as stack gas temperature, stack gas exit velocity or flow rate, stack inside diameter, and surface characteristics (albedo, Bowen ratio, and surface roughness) of the appropriate meteorological station (see Appendix VI, Table VI-1).

It should be noted that AERSCREEN estimates peak 1-hour concentrations for HIA calculations. For the MICR and HIC calculations, use the annual average concentration estimated in the AERSCREEN output. Note that when modeling an area source in AERSCREEN, only the 1-hour concentration is estimated. The U.S. EPA's user's guide for screening models states the following for area sources: "Do not use the multiplying factors to correct for averaging times greater than 1 hour. Concentrations close to an area source will not vary as much as those for point sources in response to varying wind directions, and the meteorological conditions which are likely to give maximum 1-hour concentrations can persist for several hours. Therefore it is recommended that the maximum 1-hour concentration be conservatively assumed to apply for averaging periods out to 24 hours.[7]"

In a Tier 3 approach, the Tier 2 equations for MICR, HIC, and HIA continue to be used except that a screening dispersion model is used to estimate each pollutant concentration. Thus, the Tier 3 equations to be used are as follows:

$$\mathbf{MICR_R = CP \times PeakConc \times CEF_R \times MP_R \times 10^{-6} \times MWAF}$$

$$\mathbf{MICR_W = CP \times PeakConc \times CEF_W \times MP_W \times WAF \times 10^{-6} \times MWAF}$$

$$\mathbf{Total\ HIC_{target\ organ} = \Sigma\ \{[AveConc_{TAC} \times MP \times MWAF]/Chronic\ REL_{TAC}\}_{target\ organ}}$$

$$\mathbf{Total\ HIC8_{target\ organ} = \Sigma\ \{[AveConc_{TAC} \times WAF \times MWAF]/8\text{-}Hour\ REL_{TAC}\}_{target\ organ}}$$

$$\mathbf{Total\ HIA_{target\ organ} = \Sigma\ \{[PeakConc_{TAC} \times MWAF]/Acute\ REL_{TAC}\}_{target\ organ}}$$

[7] U.S. EPA, October 1992. Section 4.5.4, "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources Revised", EPA 454/R-92-019. Available at: https://www3.epa.gov/scram001/guidance/guide/EPA-454R-92-019_OCR.pdf.

PeakConc is the peak 1-hour pollutant concentration estimated by AERSCREEN and AveConc is the annual average concentration in the AERSCREEN output file. Refer to the section on Tier 2, Screening Risk Assessment for explanation of the other variables in the equations.

If the MICR, HIC, HIC8, and HIA do not exceed the rule limits, then the equipment complies with Rule 1401 and no further analysis is required. If any risk value exceeds the rule limits, then proceed to Tier 4.

# Tier 4: Detailed Risk Assessment

Tier 4 is a detailed risk assessment using the Hotspots Analysis and Reporting Program Version 2 (HARP 2) software developed by CARB which replaces the prior version of HARP and incorporates the information contained in the 2015 OEHHA Guidelines. The HARP 2 software and documentation can be obtained at http://www.arb.ca.gov/toxics/harp/harp.htm. The U.S. EPA's air quality dispersion model AERMOD is used by HARP 2 to estimate the concentration of pollutants in place of the previously used Industrial Source Complex - Short Term Version 3 (ISCST3) model. ISCST3 dispersion modeling will no longer be allowed for determining TAC concentrations. CARB recommends AERMOD for Hot Spots risk assessments. AERMOD documentation is available at: https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod. Meteorological data for use in HARP 2 and AERMOD can be downloaded from http://www.aqmd.gov/home/library/air-quality-data-studies/meteorological-data/data-for-aermod.

Tier 4 is an option if neither Tier 2 nor Tier 3 can demonstrate compliance, or if the applicant wishes to obtain a more refined estimate of the cancer and non-cancer risks. Since Tier 4 involves detailed dispersion modeling using actual meteorological data from the station that is most representative of the facility's meteorological conditions, it will often result in a less conservative estimate of the risk than either Tiers 2 or 3. Tier 4 modeling will be most useful for analyses that have source parameters that differ substantially from defaults used to develop the source specific tables in Attachment N, Tables 6.1 A – 13.3 and Appendices VII through XII, and/or analyses whose closest receptors do not lie immediately downwind of the emission sources.

A detailed risk assessment should be performed by individuals with experience and training in air quality dispersion modeling and risk assessment. In addition, SCAQMD modeling staff should be consulted and a modeling protocol be approved before performing a detailed risk assessment which deviates from SCAQMD's methodology. For guidance on performing a detailed risk assessment, refer to SCAQMD website at: http://www.aqmd.gov/home/permits/risk-assessment. AERMOD should be run using the averaging times PERIOD and 1-hour.

Written guidance on preparing a detailed risk assessment is contained in the 2015 OEHHA Guidelines which may be obtained at: http://www.oehha.ca.gov/air/hot_spots/hotspots2015.html.

SCAQMD modeling staff has prepared supplemental risk assessment guidance which must be followed by all applicants submitting Tier 4 assessments. SCAQMD's supplemental guidance is available at: http://www.aqmd.gov/home/regulations/compliance/toxic-hot-spots-ab-2588/health-risk-assessment. HARP 2 settings should follow the options described in Appendix II. Lastly, SCAQMD guidance on using AERMOD can be found at: http://www.aqmd.gov/home/library/air-quality-data-studies/meteorological-data/modeling-guidance.

## EXAMPLE 1: MICR, CANCER BURDEN, and HIC CALCULATION

The facility does not have operating schedule restrictions and is located in an industrial and residential area. Chromium 6+ (Hexavalent chromium) is emitted from the manufacturing process from one piece of equipment, which is fitted with control equipment considered as T-BACT. Chromium 6+ is a carcinogen and has chronic non-carcinogenic risks.

The application was deemed complete on October 1, 2017.
The nearest receptor distances:
Worker (Industrial) = 328 feet (100 meters)
Residential = 492 feet (150 meters)
Operating Schedule: 24 hours/day, 7 days/week since no schedule restrictions are included in the permit conditions.
Stack height = 28 feet
Facility location: Ontario, CA
TACs: Chromium 6+

Emission rates for the TACs are listed in Table A below.
*Note: The maximum hourly emissions should be estimated based on the maximum operating parameters in any hour.*

**Table A**

| TAC | Emission Rate | | |
|---|---|---|---|
| | **$Q_{lbph}$ (lbs/hr)** | **$Q_{lbpy}$ (lbs/yr)** | **$Q_{tpy}$ (tons/yr)** |
| Chromium 6+ | 2.63E-07 | 2.30E-03 | 1.15E-06 |

**(The list of TACs and their corresponding emission rates are for illustration purposes only. They may not reflect actual conditions.)**

**First,** identify the appropriate risk assessment tables based upon when the application was deemed complete. In this case, the tables for applications deemed complete on or after October 1, 2017 (i.e., Permit Application Package "N") are used.

**Second**, calculate MICR for those TACs that have Inhalation CP Values from the Consolidated Health Values Table[8]. Note that the MICR calculated here is for a 30-year exposure duration. Table B below identifies the TACs and their corresponding Inhalation CP Values for MICR calculations.

[8] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

**Table B**

| TAC | Inhalation (CP) (mg/kg-day)$^{-1}$ |
|---|---|
| Chromium 6+ | 5.10E+02 |

Based on the above table, MICR will be evaluated for residential and worker receptors for Chromium 6+.

From the Consolidated Health Values Table[9], determine if the emitted pollutant has carcinogenic, HIC, HIC8, and/or HIA health values. The results are as follows:

**Table C**

| TAC | MICR (cancer) | HIC (chronic) | HIC8 (chronic) | HIA (Acute) |
|---|---|---|---|---|
| Chromium 6+ | √ (MP) | √ (MP) | | |

**MP** indicates that the adjustment factor will be different than 1.0. MP adjustment factors can be found in Attachment N, Tables 3.1 and 3.2.

Tier 1: Screening Emission Levels

The nearest receptor location, in this case the worker location of 100 meters, should be used.
*Please note that this step is used to approximate the equipment's potential risk.*

For Tier 1, the equipment's TACs emissions (annual and/or maximum hourly) should be compared with the screening levels for the Chromium 6+ in Attachment N, Table 1.0 as appropriate. The annual emission rate for Chromium 6+ in Table 1.0 is 4.31E-04 pounds per year at a distance of 100 meters. No maximum hourly emissions are presented in Table 1.0 because no acute value has been adopted in Rule 1401 for Chromium 6+.

Please note that the cumulative cancer/chronic risk cannot exceed the emissions presented in Table 1.0. In this example, this facility did not pass Tier 1 since the annual emissions (2.30E-03 lb/yr) are greater than those presented in Table 1.0 (4.31E-04 lb/yr) and would have to proceed to Tier 2 to demonstrate compliance with Rule 1401.

Tier 2: Screening Risk Assessment

**Step 1: Estimate $Q_{tpy}$**

According to Table A of the example, **$Q_{tpy}$ = 1.15E-06**.

**Step 2: Determine Release Type**

[9] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

The TAC is released from one piece of equipment fitted with control equipment and vented through a stack. This would be treated as a **point source**.

**Step 3: Determine Release Height**

The piece of equipment has a stack height of **28 feet**.

**Step 4: Determine Operating Schedule**

The equipment can operate 24 hours/day and 7 days/week as there are no restrictions on hours of use in the permit. Therefore, the operating schedule is **more than 12 hours/day**.

**Step 5: Identify the Appropriate Meteorological Station**

The facility is located in Ontario and according to Appendix VI, Figure VI-1, the closest monitoring station is **Ontario International Airport (KONT)**.

**Step 6: Identify Type of Receptor and Distance from Receptor**

There are two identified receptor types – **a worker receptor located 100 meters** away and a **residential receptor located 150 meters** away.

**Step 7: Select $\chi$/Q Value**

Since the point source operates more than 12 hours/day and is 28 feet high, the $\chi$/Q values from Attachment N, Table 6.2 B for Ontario at a distance of 100 meters (**4.02**) and 150 meters (**2.78**) were used. The $\chi$/Q value at 150 meters was interpolated between 100 meters and 200 meters.

**Step 8: Identify MWAF**

The MWAF value for Chromium 6+ (**1**) was found in the Consolidated Health Values Table[10].

**Step 9: Identify CP and REL**

The CP value (**5.10E+02**) and chronic REL value (**2.00E-01**) for Chromium 6+ was found in the Consolidated Health Values Table[11]. Note that there is no acute REL value for Chromium 6+.

**Step 10: Identify MP**

The MP values (**Cancer $MP_R$ = 1.60, Cancer $MP_W$ = 1.02, Chronic $MP_R$ = 2.44, Chronic $MP_W$ = 1.00**) for Chromium 6+ was found in Attachment N, Tables 3.1 and 3.2.

[10] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

**Step 11: Select CEF**

The CEF values (**$CEF_R$ = 677.40, $CEF_W$ = 55.86**) for residential and worker exposures were found in Attachment N, Tables 4.1 D and 4.2 D.

**Step 12: Calculate WAF**

Since the point source operates 24 hours/day and 7 days/week, the WAF value (**1.0**) was found in Attachment N, Table 5.2.

**MICR Calculation**

(1) Worker: $\mathbf{MICR_W = CP \times Q_{tpy} \times \chi/Q \times CEF_W \times MP_W \times WAF \times 10^{-6} \times MWAF}$

| TAC | CP | $Q_{tpy}$ | $\chi/Q$ | $CEF_W$ | $MP_W$ | WAF | MWAF | MICR |
|---|---|---|---|---|---|---|---|---|
| Chromium 6+ | 5.10E+02 | 1.15E-06 | 4.02 | 55.86 | 1.02 | 1 | 1 | 1.34E-07 |

(2) Resident: $\mathbf{MICR_R = CP \times Q_{tpy} \times \chi/Q \times CEF_R \times MP_R \times 10^{-6} \times MWAF}$

| TAC | CP | $Q_{tpy}$ | $\chi/Q$ | $CEF_R$ | $MP_R$ | MWAF | MICR |
|---|---|---|---|---|---|---|---|
| Chromium 6+ | 5.10E+02 | 1.15E-06 | 2.78 | 677.40 | 1.60 | 1 | 1.77E-06 |

Please note that the higher of the worker and residential cancer risks needs to be selected. In this example, the maximum cancer risk is at the residential receptor.

**Cancer Burden Calculation**

Cancer burden should always be calculated if the MICR exceeds one in a million, regardless of the type of receptor. Since the cancer risk at the residential receptor was calculated to be **$1.77 \times 10^{-6}$**, the cancer burden needs to be calculated.

Re-calculate the MICR using a 70-year exposure duration
Since cancer burden is based on a 70-year exposure period, and our previous MICR calculation was based on a 30-year exposure period, the MICR needs to be re-calculated. Using $CEF_R$ = 766.78 (Attachment N, Table 4.1 E), the new MICR ($MICR_{70}$) at the residential receptor is calculated to be $2.00 \times 10^{-6}$.

Estimate of distance at which $MICR_{70}$ falls below one in one million.
The distance at which the $MICR_{70}$ falls below one in one million requires you to take the reciprocal of the calculated $MICR_{70}$ multiplied by $1.0 \times 10^{-6}$. This factor (F) will be the multiplier to the $\chi/Q$ value used in determining the MICR.

$$F = (1 / MICR) \times 1.0 \times 10^{-6}$$

$F = (1 / 2.00 \times 10^{-6}) \times 1.0 \times 10^{-6}$

$F = 0.500$

Determination of the new downwind distance will be based upon a new $\chi/Q$ value calculated by multiplying the originally used $\chi/Q$ value by F.
Therefore,

New $\chi/Q = 2.78 \times 0.500$

New $\chi/Q = 1.39$

Using Attachment N, Table 6.2 B, the new $\chi/Q$ lies between downwind distances of 200 to 300 meters. Interpolating for the new downwind distance gives is 219 meters.

This new downwind distance is where the MICR will fall below one in one million.

Define Zone of Impact
The Zone of Impact is calculated using the new downwind distance as the radius of a circle and calculating the area of that circle.

Therefore,

Zone of Impact = $3.14\ r^2$

Zone of Impact = $3.14\ (0.219\ km)^2$

Zone of Impact = $0.151\ km^2$

Estimate the population within the Zone of Impact
The Zone of Impact should include both worker and residential populations.

For areas where census data is available, it should be used. Where there is no census data, 7,000 persons/$km^2$ should be used for the areas with high population densities and 4,000 persons/$km^2$ should be used for areas with low population densities. Where the population densities are unknown, use 7,000 persons/$km^2$.

In this example we have no information on census data or population density, therefore,

Zone of Impact Population = Zone of Impact x Population Density

Zone of Impact Population = $0.151\ km^2 \times 7{,}000$ person/ $km^2$

Zone of Impact Population = 1,055 persons

Calculate Cancer Burden
For a screening level analysis, the cancer burden is estimated using the zone of impact population multiplied by the calculated $MICR_{70}$.

Therefore,

Cancer Burden = $910 \text{ persons} \times 2.00 \times 10^{-6}$

**Cancer Burden = 0.00211**

**HI Calculations**

*HIC, HIC8 and HIA should be calculated for each target organ.* Since no HIA or HIC8 health values have been adopted for Chromium 6+, only the HIC is estimated.

**HIC:**

$$\mathbf{HIC = \Sigma [(Q_{tpy}) \times (\chi/Q)_{chronic} \times MP \times MWAF]/(Chronic\ REL)}$$

The HIC for the TAC in this example are calculated as follows:

**Chromium 6+:**

Worker: HIC = [1.15E-06 x 4.02 x 1.00 x 1] / (2.00E-01) **= 2.31E-05**

Resident: HIC = [1.15E-06 x 2.78 x 2.44 x 1] / (2.00E-01) **= 3.90E-05**

Since there is only one TAC, the HI does not need to be summed across the target organs.

**Summary of Results**

| | MICR | HIC | HIC8 | HIA |
|---|---|---|---|---|
| Worker | **1.34E-07** | **2.31E-05** | **N/A** | **N/A** |
| Resident | **1.77E-06** | **3.90E-05** | **N/A** | **N/A** |
| Rule 1401 Threshold | **10E-06** | **1.0** | **1.0** | **1.0** |
| Exceeds Threshold? | **No** | **No** | **N/A** | **N/A** |

**RESULT:**

- ***MICRs for residential and commercial receptors do not exceed 10E-06 (ten in one million).***
- ***Cancer burden is less than 0.5.***
- ***HICs for residential and commercial receptors are less than 1.***
- ***There are no health values associated with HIC8 or HIA and those hazard indices have not been calculated.***

***The equipment in this example contains T-BACT; therefore, it would pass the Rule 1401 MICR limit. A Tier 3 or 4 analysis is not necessary.***

## EXAMPLE 2: MICR, CANCER BURDEN, HIC, HIC8, and HIA CALCULATIONS

An industrial operation generates arsenic, benzene, and dioxin emissions.

The application was deemed complete on October 1, 2017.
Volume source: Building dimensions 40 feet (W) x 70 feet (L) x 17 feet (H)
The nearest receptor distances are:
Worker (Industrial) = 328 feet (100 meters)
Residential = 1640 feet (500 meters)
Permitted Operating Schedule: 8 hours/day, 5 days/week, 50 weeks/year = 2,000 hours/year
Facility location: Azusa, CA
TACs: Arsenic, Benzene, 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (Dioxin), Nickel hydroxide

Emission rates for the TACs are listed in Table A below.
*Note: The maximum hourly emissions should be estimated based on the maximum operating parameters in any hour.*

**Table A**

| TAC | Emission Rate | | |
|---|---|---|---|
| | **$Q_{lbph}$ (lbs/hr)** | **$Q_{lbpy}$ (lbs/yr)** | **$Q_{tpy}$ (tons/yr)** |
| Arsenic | 8.30E-06 | 1.66E-02 | 8.30E-06 |
| Benzene | 7.50E-03 | 1.50E+01 | 7.50E-03 |
| Dioxin | 6.10E-10 | 1.22E-06 | 6.10E-10 |
| Nickel hydroxide | 2.30E-03 | 4.60E+00 | 2.30E-03 |

**(The list of TACs and their corresponding emission rates are for illustration purposes only. They may not reflect actual conditions.)**

**First,** identify the appropriate risk assessment tables (included in the appendices) based upon when the application was deemed complete. In this case, the tables for applications deemed complete on or after October 1, 2017 (i.e., Permit Application Package "N") are used.

**Second**, calculate MICR for those TACs that have Inhalation Cancer Potency Values from the Consolidated Health Values Table[11]. Table B below identifies the TACs and their corresponding Inhalation Cancer Potency Values for MICR calculations.

[11] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

**Table B**

| TAC | Inhalation Cancer Potency (CP) (mg/kg-day)$^{-1}$ |
|---|---|
| Arsenic | 1.20E+01 |
| Benzene | 1.00E-01 |
| Dioxin | 1.30E+05 |
| Nickel hydroxide | 9.10E-01 |

Based on the above table, MICR will be evaluated for residential and worker receptors for arsenic, benzene, dioxin, and nickel hydroxide.

From the Cosolidated Health Values Table[12], we can also determine if the emitted pollutant is carcinogenic, HIC, HIC8, and/or HIA. The results are as follows:

| TAC | MICR (cancer) | HIC (chronic) | 8-hr HIC (chronic) | HIA (Acute) |
|---|---|---|---|---|
| Arsenic | √ (MP) | √ (MP) | √ | √ |
| Benzene | √ | √ | √ | √ |
| Dioxin | √ (MP) | √ (MP) | | |
| Nickel hydroxide | √ | √ | √ | √ |

**MP** indicates that the adjustment factor will be different than 1.0. Multi-pathway factors can be found in Attachment N, Tables 3.1 and 3.2.

Next, for chronic and acute substances, review the Target Organs Tables[12] to determine the target organs affected by TACs due to chronic and/or acute toxicity. Tables C, D, and E below indicate the target organs affected by the TACs with chronic toxicity, chronic 8-hour toxicity, and acute toxicity, respectively. In the table, check marks (√ ) indicate the affected target organs. Conservatively, it can be assumed that all TACs affect the same target organ, therefore, a breakdown of the affected target organ by TAC is not needed for the analysis.

[12] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.

## Table C (Chronic Toxicity)

| TAC | AL | BN | CV | REP/DEV | END | EYE | HEM | IMM | KID | NS | RESP | SKIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | | | √ | √ | | | | | | √ | √ | √ |
| Benzene | | | | | | | √ | | | | | |
| Dioxin | √ | | | √ | √ | | √ | | | | √ | |
| Nickel hydroxide | | | | √ | | | √ | | | | √ | |

AL: Alimentary system (liver)
BN: Bones and teeth
CV: Cardiovascular system
REP/DEV: Reproductive/Developmental
END: Endocrine system
EYE: Eye
HEM: Hematopoietic system
IMM: Immune system
KID: Kidney
NS: Nervous system
RESP: Respiratory system
SKIN: Skin

## Table D (Chronic 8-hour Toxicity)

| TAC | AL | BN | CV | REP/DEV | END | EYE | HEM | IMM | KID | NS | RESP | SKIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | | | √ | √ | | | | | | √ | √ | √ |
| Benzene | | | | | | | √ | | | | | |
| Dioxin | | | | | | | | | | | | |
| Nickel hydroxide | | | | | | | | √ | | | √ | |

## Table E (Acute Toxicity)

| TAC | AL | CV | REP/DEV | END | EYE | HEM | IMM | KID | NS | RESP | SKIN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | | √ | √ | | | | | | √ | | |
| Benzene | | | √ | | | √ | √ | | | | |
| Dioxin | | | | | | | | | | | |
| Nickel hydroxide | | | | | | | √ | | | | |

Tier 1: Screening Emission Levels

The nearest receptor location, in this case the worker location of 100 meters, should be used.

*For Carcinogenic and/or Chronic Compounds*:

Calculate the Pollutant Screening Index for each pollutant ($PSI_P$).

$$PSI_P = Q_{lbpy,P} / PSL_P$$

The $Q_{lbpy}$ is based upon the annual emissions of each TAC (lbs/yr). The PSLs are found in Attachment N, Table 1.0 and are expressed in lb/yr.

Sum up the individual Pollutant Screening Indices for each pollutant ($\sum PSI_P$).

| TAC | $Q_{lbpy,P}$ | $PSL_P$ | $PSI_P$ |
|---|---|---|---|
| Arsenic | 1.66E-02 | 3.81E-03 | 4.36 |
| Benzene | 1.50E+01 | 4.44E+00 | 3.38 |
| Dioxin | 1.22E-06 | 1.33E-07 | 9.17 |
| Nickel hydroxide | 4.60E+00 | 1.92E-01 | 23.96 |
| | | **$\sum PSI_P$ =** | **40.87** |

Calculate the Application Screening Index (ASI).

$$ASI_{cancer\ and/or\ chronic} = \Sigma\ PSI_P = 40.87$$

*For Acute Compounds*:

Calculate the Pollutant Screening Index for each pollutant ($PSI_P$).

$$PSI_P = Q_{lbph,P} / PSL_P$$

The $Q_{lbph}$ is based upon the maximum hourly emissions (lb/hr). The PSLs for acute compounds are found in Attachment N, Table 1.0 and are expressed in lb/hr.

Sum up the individual pollutant screening indices for each acute pollutant ($\sum PSI_P$).

| TAC | $Q_{lbph,P}$ | $PSL_P$ | $PSI_P$ |
|---|---|---|---|
| Arsenic | 8.30E-06 | 2.76E-04 | 0.03 |
| Benzene | 7.50E-03 | 3.73E-02 | 0.20 |
| Nickel hydroxide | 2.30E-03 | 4.36E-04 | 5.28 |
| | | **$\sum$ PSIp =** | **5.51** |

Calculate the Application Screening Index (ASI).

$$ASI_{acute} = \Sigma \ PSI_P = 5.51$$

Please note that the cumulative cancer/chronic risk and the cumulative acute hazard index exceeded 1. In this example, this facility did not pass Tier 1 as the ASI exceeded 1 for cancer/chronic and acute. Since this Tier 1 screening was calculated to be greater than 1, the applicant would have to proceed with further health risk screening assessment procedures.

Tier 2: Screening Risk Assessment

**Step 1: Estimate Emission Rate ($Q_{tpy}$)**

The emission rates are listed in Table A of the example.

**Step 2: Determine Release Type**

The TAC is released from a building with dimensions of 40 feet x 70 feet (2,800 $ft^2$ area) and height of 17 feet. This would be treated as a **volume source**.

**Step 3: Determine Release Height**

Since the source is a volume source, the release height is not relevant.

**Step 4: Determine Operating Schedule**

The facility operates 8 hours/day and 5 days/week as specified in the permit conditions. Therefore, the operating schedule is **less than 12 hours/day**.

**Step 5: Identify the Appropriate Meteorological Station**

The facility is located in Azusa and according to Appendix VI, Figure VI-1, the closest monitoring station is **Azusa (AZUS)**.

**Step 6: Identify Type of Receptor and Distance from Receptor**

There are two identified receptor types – **a worker receptor located 100 meters** away and a **residential receptor located 500 meters** away.

**Step 7: Select χ/Q Value**

Since the volume source of 2,800 $ft^2$ and height of 17 feet operates less than 12 hours/day, the χ/Q values from Attachment N, Table 7.1 A for Azusa at a distance of 100 meters (**0.84**) and 500 meters (**0.05**) were used.

**Step 8: Identify MWAF**

The MWAF values for all TACs were found in the Consolidated Health Values Table[13].

**Step 9: Identify CP and REL**

The CP values and chronic REL values for all TACs were found in the Consolidated Health Values Table[12].

**Step 10: Identify MP**

The MP values for all TACs were found in Attachment N, Tables 3.1 and 3.2.

**Step 11: Select CEF**

The CEF values (**$CEF_R$ = 677.40, $CEF_W$ = 55.86**) for residential and worker exposures were found in Attachment N, Tables 4.1 D and 4.2 D.

**Step 12: Calculate WAF**

Since the volume source operates 8 hours/day and 5 days/week, the WAF value (**4.2**) was found in Attachment N, Table 5.1.

[13] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

## MICR Calculation

(1) Worker: $\mathbf{MICR_W = CP \times Q_{tpy} \times \chi/Q \times CEF_W \times MP_W \times WAF \times 10^{-6} \times MWAF}$

| TAC | CP | $Q_{tpy}$ | $\chi/Q$ | $CEF_W$ | $MP_W$ | WAF | MWAF | MICR |
|---|---|---|---|---|---|---|---|---|
| Arsenic | 1.20E+01 | 8.30E-06 | 0.84 | 55.86 | 4.52 | 4.2 | 1 | 8.87E-08 |
| Benzene | 1.00E-01 | 7.50E-03 | 0.84 | 55.86 | 1.00 | 4.2 | 1 | 1.48E-07 |
| Dioxin | 1.30E+05 | 6.10E-10 | 0.84 | 55.86 | 7.58 | 4.2 | 1 | 1.18E-07 |
| Nickel hydroxide | 9.10E-01 | 2.30E-03 | 0.84 | 55.86 | 1.00 | 4.2 | 0.6332 | 2.61E-07 |
| | | | | | | | **TOTAL** | **6.16E-07** |

(2) Resident: $\mathbf{MICR_R = CP \times Q_{tpy} \times \chi/Q \times CEF_R \times MP_R \times 10^{-6} \times MWAF}$

| TAC | CP | $Q_{tpy}$ | $\chi/Q$ | $CEF_R$ | $MP_R$ | MWAF | MICR |
|---|---|---|---|---|---|---|---|
| Arsenic | 1.20E+01 | 8.30E-06 | 0.05 | 677.40 | 9.71 | 1 | 3.28E-08 |
| Benzene | 1.00E-01 | 7.50E-03 | 0.05 | 677.40 | 1.00 | 1 | 2.54E-08 |
| Dioxin | 1.30E+05 | 6.10E-10 | 0.05 | 677.40 | 25.72 | 1 | 6.91E-08 |
| Nickel hydroxide | 9.10E-01 | 2.30E-03 | 0.05 | 677.40 | 1.00 | 0.6332 | 4.49E-08 |
| | | | | | | **TOTAL** | **1.72E-07** |

Please note that the higher of the worker and residential cancer risks needs to be selected. In this example, the maximum cancer risk is at the worker receptor.

## Cancer Burden Calculation

Cancer burden should always be calculated if the MICR exceeds one in a million, regardless of the type of receptor. For this example, cancer burden was not calculated because neither worker nor residential risk exceeded one in a million.

## HI Calculations

*HIC, HIC8, and HIA should be calculated for each target organ. Conservatively, it can be assumed that all TACs affect the same target organ to calculate the worst-case HI.*

**HIC:**

**Worker:** $HIC_W = \Sigma [(Q_{tpy}) \times (\chi/Q)_{chronic} \times MP_W \times MWAF]/(Chronic\ REL)$
**Resident:** $HIC_R = \Sigma [(Q_{tpy}) \times (\chi/Q)_{chronic} \times MP_R \times MWAF]/(Chronic\ REL)$

Based on the Target Organs Tables[14], the target organs for the TACs for chronic toxicity have been listed in Table C. The Chronic Hazard Index for the TACs in this example are calculated as follows:

**Arsenic:** $HIC_W$ = [8.30E-06 x 0.84 x 28.37 x 1] / (1.50E-02) = **1.32E-02**
$HIC_R$ = [8.30E-06 x 0.05 x 88.03 x 1] / (1.50E-02) = **2.44E-03**

**Benzene:** $HIC_W$ = [7.50E-03 x 0.84 x 1.00 x 1] / (3.00E+00) = **2.10E-03**
$HIC_R$ = [7.50E-03 x 0.05 x 1.00 x 1] / (3.00E+00) = **1.25E-04**

**Dioxin:** $HIC_W$ = [6.10E-10 x 0.84 x 307.60 x 1] / (4.00E-05) = **8.62E-05**
$HIC_R$ = [6.10E-10 x 0.05 x 6.73 x 1] / (4.00E-05) = **2.35E-04**

**Nickel hydroxide:** $HIC_W$ = [2.30E-03 x 0.84 x 1.00 x 0.6332] / (1.40E-02) = **8.74E-02**
$HIC_R$ = [2.30E-03 x 0.05 x 1.00 x 0.6332] / (1.40E-02) = **5.20E-03**

**8.** Worker: $HIC_W$ (summed across each target organ)

| TAC | AL | BN | CV | REP/ DEV | END | EYE | HEM | IMM | KID | NS | RESP | SKIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | | | 1.32E-02 | 1.32E-02 | | | | | | 1.32E-02 | 1.32E-02 | 1.32E-02 |
| Benzene | | | | | | | 2.10E-03 | | | | | |
| Dioxin | 8.62E-05 | | | 8.62E-05 | 8.62E-05 | | 8.62E-05 | | | | 8.62E-05 | |
| Nickel hydroxide | | | | 8.74E-02 | | | 8.74E-02 | | | | 8.74E-02 | |
| **TOTAL** | 8.62E-05 | | 1.32E-02 | **1.01E-01** | 8.62E-05 | | 8.96E-02 | | | 1.32E-02 | **1.01E-01** | 1.32E-02 |

(2) Resident: $HIC_R$ (summed across each target organ)

| TAC | AL | BN | CV | REP/ DEV | END | EYE | HEM | IMM | KID | NS | RESP | SKIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | | | 2.44E-03 | 2.44E-03 | | | | | | 2.44E-03 | 2.44E-03 | 2.44E-03 |
| Benzene | | | | | | | 1.25E-04 | | | | | |
| Dioxin | 2.35E-04 | | | 2.35E-04 | 2.35E-04 | | 2.35E-04 | | | | 2.35E-04 | |
| Nickel hydroxide | | | | 5.20E-03 | | | 5.20E-03 | | | | 5.20E-03 | |
| **TOTAL** | 2.35E-04 | | 2.44E-03 | **7.87E-03** | 2.35E-04 | | 5.56E-03 | | | 2.44E-03 | **7.87E-03** | 2.44E-03 |

[14] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.

**HIC8:**

**Worker:** $HIC8_W = \Sigma [(Q_{tpy}) \times (\chi/Q)_{chronic} \times WAF \times MWAF]/(8\text{-hour Chronic REL})$
**Resident:** $HIC8_R = \Sigma [(Q_{tpy}) \times (\chi/Q)_{chronic} \times MWAF]/(8\text{-hour Chronic REL})$

Based on the Target Organs Table[15], the target organs for the TACs with HIC8 RELs have been listed in Table D. The HIC8 for the TACs in this example are calculated as follows:

**Arsenic:** $HIC8_W$ = [8.30E-06 x 0.84 x 4.2 x 1] / (1.50E-02) = **1.95E-03**
$HIC8_R$ = [8.30E-06 x 0.05 x 1] / (1.50E-02) **= 2.77E-05**

**Benzene:** $HIC8_W$ = [7.50E-03 x 0.84 x 4.2 x 1] / (3.00E+00) = **8.82E-03**
$HIC8_R$ = [7.50E-03 x 0.05 x 1] / (3.00E+00) **= 1.25E-04**

**Dioxin:** **There are no HIC8 REL values established for dioxin.**

**Nickel hydroxide:** $HIC8_W$ = [2.30E-03 x 0.84 x 4.2 x 0.6332] / (6.00E-02) = **8.56E-02**
$HIC8_R$ = [2.30E-03 x 0.05 x 0.6332] / (6.00E-02) **= 1.21E-03**

**9.** Worker: $HIC8_W$ (summed across each target organ)

| TAC | AL | BN | CV | REP/ DEV | END | EYE | HEM | IMM | KID | NS | RESP | SKIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | | | 1.95E-03 | 1.95E-03 | | | | | | 1.95E-03 | 1.95E-03 | 1.95E-03 |
| Benzene | | | | | | | 8.82E-03 | | | | | |
| Dioxin | | | | | | | | | | | | |
| Nickel hydroxide | | | | | | | | 8.56E-02 | | | 8.56E-02 | |
| **TOTAL** | | | 1.95E-03 | 1.95E-03 | | | 8.82E-03 | 8.56E-02 | | 1.95E-03 | **8.76E-02** | 1.95E-03 |

(2) Resident: $HIC8_R$ (summed across each target organ)

| TAC | AL | BN | CV | REP/ DEV | END | EYE | HEM | IMM | KID | NS | RESP | SKIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | | | 2.77E-05 | 2.77E-05 | | | | | | 2.77E-05 | 2.77E-05 | 2.77E-05 |
| Benzene | | | | | | | 1.25E-04 | | | | | |
| Dioxin | | | | | | | | | | | | |
| Nickel hydroxide | | | | | | | | 1.21E-03 | | | 1.21E-03 | |
| **TOTAL** | | | 2.77E-05 | 2.77E-05 | | | 1.25E-04 | 1.21E-03 | | 2.77E-05 | **1.24E-03** | 2.77E-05 |

[15] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.

**HIA:**

For all acute compounds with RELs developed for a 1-hour averaging period, the HIA are estimated using the equation below:

**Worker & Resident: HIA= [$Q_{lbph}$ x ($\chi$/Q)$_{lbhr}$ x MWAF]/(Acute REL)**

Based on the Target Organs Tables[16], the target organs for the TACs have been listed in Table E. The $\chi$/Q values were taken from Attachment N, Table 7.7.

*Note: The $\chi$/Q values in Table 7.7 are based upon the maximum hourly emission rates.*

**Arsenic:** $HIA_W$ = [8.30E-06 x 107.4 x 1] / (2.00E-01) = **4.5E-03**
$HIA_R$ = [8.30E-06 x 10.44 x 1] / (2.00E-01) **= 4.3E-04**

**Benzene:** $HIA_W$ = [7.50E-03 x 107.4 x 1] / (2.70E+01) = **3.0E-02**
$HIA_R$ = [7.50E-03 x 10.44 x 1] / (2.70E+01) **= 2.9E-03**

**Dioxin:** **There are no HIA REL values established for dioxin.**

**Nickel hydroxide:** $HIA_W$ = [2.30E-03 x 107.4 x 0.6332] / (2.00E-01) = **7.8E-01**
$HIA_R$ = [2.30E-03 x 10.44 x 0.6332] / (2.00E-01) **= 7.6E-02**

(1) Worker: $HIA_W$ (summed across each target organ)

| TAC | AL | CV | REP/ DEV | EYE | HEM | IMM | NS | RESP | SKIN |
|---|---|---|---|---|---|---|---|---|---|
| Arsenic | | 5.61E-03 | 5.61E-03 | | | | 5.61E-03 | | |
| Benzene | | | 3.75E-02 | | 3.75E-02 | 3.75E-02 | | | |
| Dioxin | | | | | | | | | |
| Nickel hydroxide | | | | | | 9.84E-01 | | | |
| **TOTAL** | | 5.61E-03 | 4.31E-02 | | 3.75E-02 | **1.02E+00** | 5.61E-03 | | |

[16] Available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.

(2) Resident: $HIA_R$ (summed across each target organ)

| TAC | AL | CV | REP/ DEV | EYE | HEM | IMM | NS | RESP | SKIN |
|---|---|---|---|---|---|---|---|---|---|
| Arsenic | | 4.15E-04 | 4.15E-04 | | | | 4.15E-04 | | |
| Benzene | | | 2.78E-03 | | 2.78E-03 | 2.78E-03 | | | |
| Dioxin | | | | | | | | | |
| Nickel hydroxide | | | | | | 7.29E-02 | | | |
| **TOTAL** | | 4.15E-04 | 3.20E-03 | | 2.78E-03 | **7.57E-02** | 4.15E-04 | | |

**Summary of Results**

| | MICR | HIC | HIC8 | HIA |
|---|---|---|---|---|
| **Worker** | $6.16 \times 10^{-7}$ | 1.01E-01 | 8.76E-02 | 1.02E+00 |
| **Resident** | $1.72 \times 10^{-7}$ | 7.87E-03 | 1.24E-03 | 7.57E-02 |
| **Rule 1401 Threshold** | $1.0 \times 10^{-6}$ | 1.0 | 1.0 | 1.0 |
| **Exceeds Threshold?** | **No** | **No** | **No** | **Yes** |

***RESULT:***

- ***MICRs for residential and commercial receptors do not exceed $1 \times 10^{-6}$ (one in one million).***
- ***Calculation of cancer burden is not necessary.***
- ***HIC and HIC8 for residential and off-site worker receptors, and HIA for residential receptors are less than 1.0 for all organ systems.***
- ***HIA for off-site worker receptors is greater than 1.0 for all organ systems.***

***The equipment in this example does not contain T-BACT; therefore, it would pass the Rule 1401 limits for all but acute. A Tier 3 or 4 analysis is required for the HIA.***

## EXAMPLE 3: CONTEMPORANEOUS RISK REDUCTION

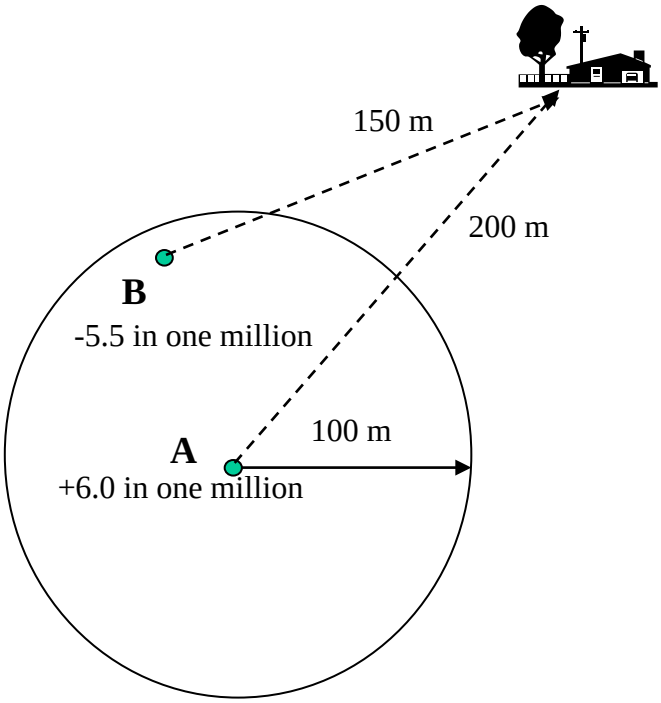
*Rule 1401(g)(2)(A): The requirements of paragraph (d)(1) and (d)(4) shall not apply if the applicant demonstrates that a contemporaneous risk reduction resulting in a decrease in emissions will occur such that both of the following conditions are met:*

*(i) no receptor location will experience a total increase in MICR of greater than one in one million due to the cumulative impact of both the permit unit and the contemporaneous risk reduction, and*

*(ii) the contemporaneous risk reduction occurs within 100 meters of the permit unit.*

*T-BACT shall be used on permit units exempted under this subparagraph if the MICR from the permit unit exceeds one in one million ($1.0 \times 10^{-6}$).*

*Note: All permit applications associated with the increases and decreases in risk for contemporaneous risk reduction must be submitted together and the reduction in risk must occur before the start of operation of the equipment that will have an increase in risk.*




Assumptions:

Units A and B: Only have cancer impacts.

Unit A: New equipment, installed with T-BACT, MICR = 6.0 in one million

Unit B: Existing equipment with decreased MICR of 5.5 in one million due to change in operating conditions or process. Unit B emissions, prior to modification, resulted in an 8 in a million risk for the nearest receptor. After modification, Unit B risk is 2.5 in a million which is a decrease of 5.5 in a million.

Receptor R1: The increased risk for Receptor R1 is the MICR for Unit A less the decrease in risk for Unit B.

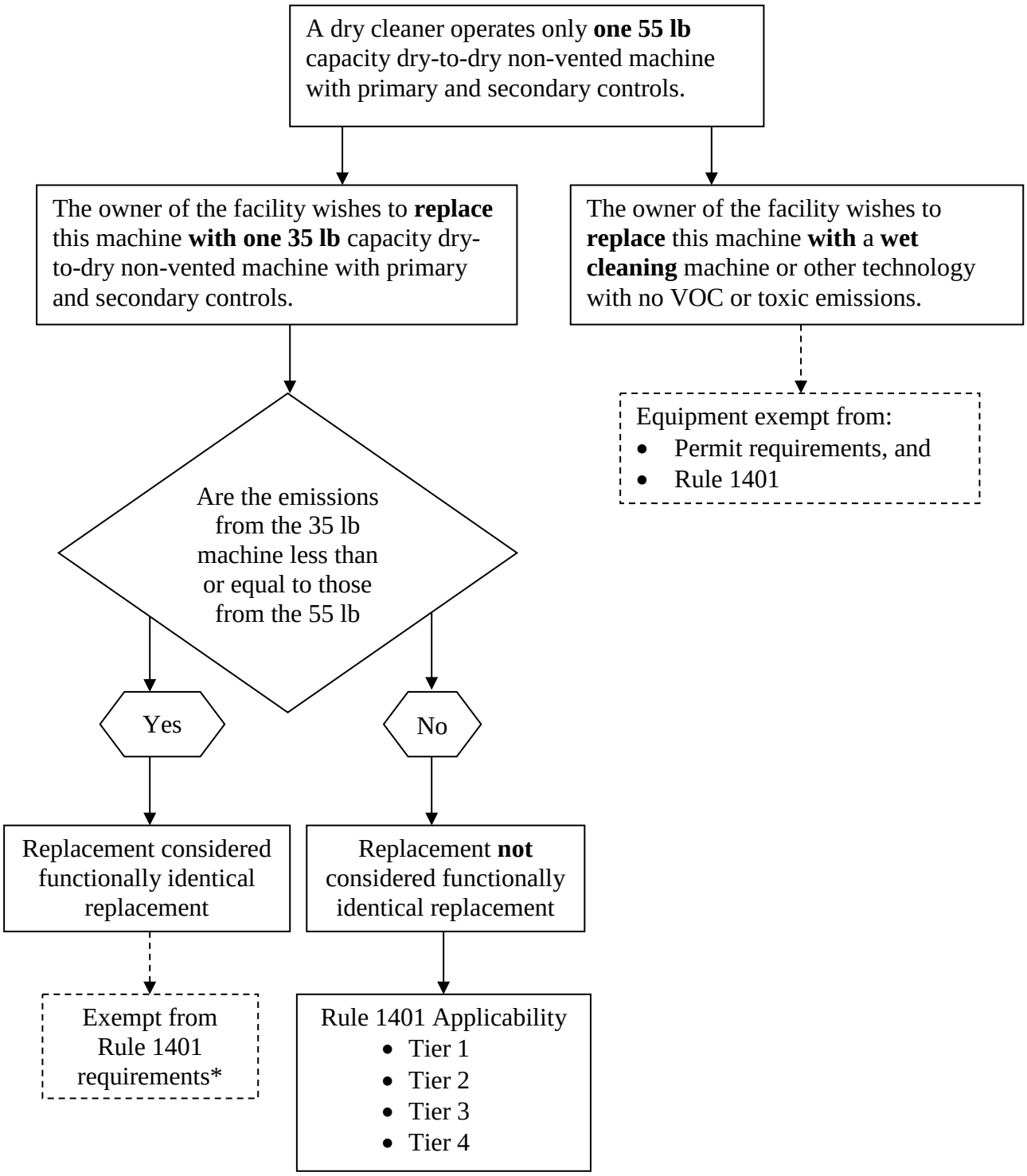
6.0 – 5.5 = **0.5 in one million**.

*Note: This demonstaration is best achieved with a Tier 4 analysis (detailed air dispersion modeling) and must be performed for all possible receptors.*

***RESULT:***

- ***Equipment was installed using T-BACT.***
- ***No receptor experiences an increase in risk greater than one in** one **million.***
- ***The contemporaneous risk reduction occurs within 100 meters of the new equipment.***
- ***If all other rule requirements are met, a permit would be issued.***

## EXAMPLE 4: FUNCTIONALLY IDENTICAL EQUIPMENT REPLACEMENT




• Rule 1421(d)(1)(F) allows for the functionally identical equipment replacement of **only one** machine. Please note that all perchloroethylene machines must comply with Rule 1402 as well. As of December 31, 2020, no new or existing dry cleaning facility may use a perchloroethylene dry cleaning system.

## BEST AVAILABLE CONTROL TECHNOLOGY FOR TOXICS

T-BACT is not required if the MICR is less than or equal to one in one million. If cancer risk is greater than one in a million, T-BACT is required and must reduce risk to less than or equal to ten in one million.

SIC Codes, which describe industry types or classifications, or SCC Codes, which describe emitting processes or equipment, can be used to help identify T-BACT. If no standard is available, SCAQMD staff works with the applicant to identify T-BACT when required.

SCAQMD staff is continually examining and updating control technologies that comply with the definition presented in Rule 1401(c)(2). However, in many situations T-BACT is equivalent to BACT. The applicant is encouraged to contact the SCAQMD permit processing division for current T-BACT information.

## T-BACT EXAMPLES

| | |
|---|---|
| *Type of Industry:* | *Wood Finishing* |
| ***Type of Emitting Process:*** | ***Wood Coatings*** |
| ***Specific TAC Emissions:*** | ***Ethylbenzene,*** |
| | ***Formaldehyde*** |
| *Applicable BACT:* | *Thermal Oxidizer* |
| *T-BACT:* | *Thermal Oxidizer* |

***BACT = T-BACT***

*With T-BACT, risk is ten in one million or less*

***T-BACT is acceptable***

---

| | |
|---|---|
| *Type of Industry:* | *Metal Plating* |
| ***Type of Emitting Process:*** | ***Nickel Plating, Chromium Plating*** |
| ***Specific TAC Emissions:*** | ***Nickel, Hexavalent chromium*** |
| *Applicable BACT:* | *Wet Scrubber* |
| *T-BACT:* | *HEPA* |

*With T-BACT, risk is 10 in one million or less*

***T-BACT is acceptable***

# APPENDIX I

# CALCULATION WORKSHEETS

**MICR Calculation Worksheet**
**HIA Calculation Worksheet**
**HIC Calculation Worksheet**
**HIC8 Calculation Worksheet**

# MICR CALCULATION WORKSHEET

Facility Name: _____

Facility Address: _____

Description of Equipment: _____

Equipment is (circle one): **Point Source** or **Volume Source**

| Toxic Air Contaminants Emitted by Equipment | Maximum Annual Emissions, $Q_{lbpy}$ (lb/yr) | Maximum Annual Emissions, $Q_{tpy}$ (ton/yr ) | CP (Table 8.1) | MICR MP (Att. N, Table ) | |
|---|---|---|---|---|---|
| | | | | Resident | Worker |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

Equipment operates (circle one) ≤ **12 hr/day** or > **12 hr/day**

If equipment is a **point source**, enter **Stack Height:** _____ ft

If equipment is a **volume source**, enter **Building Height:** _____ ft & **Floor Area:** _____ $ft^2$

Distance **to nearest residential or sensitive receptor:**_____ m &

**Off-site worker receptor:** _____ m

Nearest **SCAQMD meteorological station:** _____ (Appendix VI, Figure VI-1 & Table VI-1)

Select **χ/Q** and **WAF Tables** as follows (circle tables selected)

| | Point Source | Volume Source |
|---|---|---|
| ≤ 12 hr/day | Att. N, Tables 6.1 A, 6.2 A, 6.3 A | Att. N, Tables 7.1 A, 7.2 A, 7.3 A, 7.4 A, 7.5 A, 7.6 A |
| > 12 hr/day | Att. N, Tables 6.1 B, 6.2 B, 6.3 B | Att. N, Tables 7.1 B, 7.2 B, 7.3 B, 7.4 B, 7.5 B, 7.6 B |

Select **CP** and **MP** from Attachment N, Table3.1 and the Consolidated Health Values Table found at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

**χ/Q value** for nearest residential/sensitive receptor: _____

for nearest off-site worker receptor: _____

**WAF value** for nearest residential/sensitive receptor: 1.0

for nearest off-site worker receptor: _____

**CEF value** for nearest residential/sensitive receptor: 677.40

for nearest off-site worker receptor: 55.86

## MICR CALCULATION

| TACs | CP | $Q_{tpy}$ | χ/Q | CEF | MP | WAF | $10^{-6}$ | MWAF | MICR |
|---|---|---|---|---|---|---|---|---|---|
| 1. | | x | x | x | x | x | x $10^{-6}$ | x | = |
| 2. | | x | x | x | x | x | x $10^{-6}$ | x | = |
| 3. | | x | x | x | x | x | x $10^{-6}$ | x | = |
| 4. | | x | x | x | x | x | x $10^{-6}$ | x | = |

MICR =_____

## HIC CALCULATION WORKSHEET

Target Organ/System*: (Target Organs Tables are available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.)

Facility Name: _____

Facility Address: _____

Description of Equipment: _____

Equipment operates (circle one) ≤ **12 hr/day** or > **12 hr/day**

Equipment is (circle one): **Point Source** or **Volume Source**

If equipment is a **point source**, enter:

**Stack Height:** _____ ft

If equipment is a **volume source**, enter

**Building Height:** _____ ft & **Floor Area**: _____ $ft^2$

Distance **to nearest residential or sensitive receptor:** _____ meters

Distance to **nearest off-site worker receptor**: _____ meters

Nearest **SCAQMD meteorological station:** _____ (Appendix VI, Figure VI-1 & Table VI-1)

Select **χ/Q** as follows (circle tables selected)

| | Point Source | Volume Source |
|---|---|---|
| ≤ 12 hr/day | Att. N, Tables 6.1 A, 6.2 A, 6.3 A | Att. N, Tables 7.1 A, 7.2 A, 7.3 A, 7.4 A, 7.5 A, 7.6 A |
| > 12 hr/day | Att. N, Tables 6.1 B, 6.2 B, 6.3 B | Att. N, Tables 7.1 B, 7.2 B, 7.3 B, 7.4 B, 7.5 B, 7.6 B |

Select **Chronic REL** and **Chronic MP** from Attachment N, Table 3.2 and the Consolidated Health Values Table, found at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

| Toxic Air Contaminants Emitted by Equipment | Maximum Annual Emissions, $Q_{lbpy}$ (lb/yr) | Maximum Annual Emissions, $Q_{tpy}$ (ton/yr) | Dispersion Factor (χ/Q) | Chronic Reference Exposure Level (REL) | Chronic Multi-pathway Factor (MP) |
|---|---|---|---|---|---|
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

**HIC CALCULATION:**

**Σ [($Q_{tpy}$) x (χ/Q) x MP] / (Chronic REL) for each TAC**

| TACs | $Q_{tpy}$ | | χ/Q | | MP | | REL | | HIC |
|---|---|---|---|---|---|---|---|---|---|
| 1. | | **x** | | **x** | | / | | = | |
| 2. | | **x** | | **x** | | / | | = | |
| 3. | | **x** | | **x** | | / | | = | |

* A worksheet needs to be filled out for each affected target organ/system.

## HIC8 CALCULATION WORKSHEET

Target Organ/System*: (Target Organs Tables are available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.)

Facility Name: _____

Facility Address: _____

Description of Equipment: _____

Equipment operates (circle one) ≤ **12 hr/day** or > **12 hr/day**

Equipment is (circle one): **Point Source** or **Volume Source**

If equipment is a **point source**, enter:

**Stack Height:** _____ ft

If equipment is a **volume source**, enter

**Building Height:** _____ ft & **Floor Area**: _____ $ft^2$

Distance **to nearest residential or sensitive receptor:** _____ meters

Distance to **nearest off-site worker receptor**: _____ meters

Nearest **SCAQMD meteorological station:** _____ (Appendix VI, Figure VI-1 & Table VI-1)

Select **χ/Q** as follows (circle tables selected)

| | Point Source | Volume Source |
|---|---|---|
| ≤ 12 hr/day | Att. N, Tables 6.1 A, 6.2 A, 6.3 A | Att. N, Tables 7.1 A, 7.2 A, 7.3 A, 7.4 A, 7.5 A, 7.6 A |
| > 12 hr/day | Att. N, Tables 6.1 B, 6.2 B, 6.3 B | Att. N, Tables 7.1 B, 7.2 B, 7.3 B, 7.4 B, 7.5 B, 7.6 B |

Select **8-Hour Chronic REL from the Consolidated Health Values Table found at https://www.arb.ca.gov/toxics/healthval/contable.pdf;** and **WAF from Attachment N, Tables 5.1 or 5.2 for off-site worker receptor only**

| Toxic Air Contaminants Emitted by Equipment | Maximum Annual Emissions, $Q_{lbpy}$ (lb/yr) | Maximum Annual Emissions, $Q_{tpy}$ (ton/yr) | Dispersion Factor (χ/Q) | Worker Adjustment Factor (WAF) | Chronic Reference Exposure Level (REL) |
|---|---|---|---|---|---|
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

**HIC8 CALCULATION:**

**Σ [($Q_{tpy}$) x (χ/Q) x WAF] / (8-Hour Chronic REL) for each TAC**

| TAC | $Q_{tpy}$ | | χ/Q | | WAF | | REL | | HIC8 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | | **x** | | **x** | | / | | = | |
| 2. | | **x** | | **x** | | / | | = | |
| 3. | | **x** | | **x** | | / | | = | |

* A worksheet needs to be filled out for each affected target organ/system.

## HIA CALCULATION WORKSHEET

Target Organ/System*: (Target Organs Tables are available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.)

Facility Name: _____

Facility Address: _____

Description of Equipment: _____

Equipment is (circle one): **Point Source** or **Volume Source**

If equipment is a **point source**, enter:

**Stack Height:** _____ ft

If equipment is a **volume source**, enter

**Building Height:** _____ ft & **Floor Area**: _____ $ft^2$

Distance **to nearest residential or sensitive receptor:** _____ meters

Distance to **nearest off-site worker receptor**: _____ meters

Nearest **SCAQMD meteorological station:** _____ (Appendix VI, Figure VI-1 & Table VI-1)

Select **$\chi$/Q:** _____

Select **$\chi$/Q**: from Attachment N, Table 6.4 if Point Source or from Attachment N, Table 7.7 if Volume Source

Select **Acute REL** from the Consolidated Health Values Table found at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

| Toxic Air Contaminants Emitted by Equipment | Maximum Hourly Emissions, $Q_{lbph}$ (lb/hr) | Peak Hourly Dispersion Factor $\chi$/Q | Acute Reference Exposure Level (REL) |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |

**HIA CALCULATION:**

**$[Q_{lbph}$ x ($\chi$/Q)] / (Acute REL)**

| TAC | $Q_{lbph}$ | | $\chi$/Q | | REL | | HIA |
|---|---|---|---|---|---|---|---|
| 1. | | **x** | | / | | = | |
| 2. | | **x** | | / | | = | |
| 3. | | **x** | | / | | = | |

* A worksheet needs to be filled out for each affected target organ/system.

# APPENDIX II

# DERIVATION OF TIER 2 MP ADJUSTMENT FACTORS

## INTRODUCTION

Toxic air contaminants (TACs) enter the body through a number of routes: inhalation; absorption through the skin; and ingestion from contaminated food, water, milk and soil. To account for uptake of toxics through routes of exposure other than inhalation, risk assessments often include a multi-pathway exposure analysis.

To simplify the screening risk assessment, MP adjustment factors were developed. The inhalation risk is multiplied by the MP adjustment factors to account for the additional health risk due to other pathways of exposure.

The MP adjustment factors were developed using the Risk Assessment Standalone Tool (RAST) build 15071, a computer software package that calculates risks based on ground level concentrations (GLC). Assumptions and parameters used to develop the MP adjustment factors are listed below:

Risk assessment options:

- Deposition velocity – 0.02 m/sec
- OEHHA default exposures are assumed for mother's milk, homegrown produce, and soil exposure
- A 'warm' climate, typical for Southern California is assumed for the dermal exposure pathway
- For non-cancer chronic risk estimates, the "OEHHA Derived Method" risk analysis method is used. In this approach, the inhalation pathway is always considered a driving pathway, the next two dominant (driving) exposure pathways use the high-end point-estimates of exposure, while the remaining exposure pathways use mean point estimates.
- For residential cancer risk estimates, the "RMP (Derived) Method" risk analysis method is used. In this method, if inhalation is one of the top two dominant pathways, the method uses the breathing rate at 95$^{th}$ percentile of exposure for $\leq$ 2 years of age, and the breathing rate at the 80$^{th}$ percentile exposure for > 2 years of age. If inhalation is not the top two dominant pathways, it uses mean. For worker cancer risk, the "OEHHA Derived Method" risk analysis method is used.
- Pathways considered for residential exposure include inhalation, soil ingestion, dermal absorption, homegrown produce, and mother's milk.
- Pathways considered for worker exposure include inhalation, soil ingestion, and dermal absorption.
- The cancer risk estimates, including the Derived equations (both OEHHA and Adjusted), are based on 30-year exposures.
- The chronic MP adjustment factors (resident and worker) for the group listing of polychlorinated biphenyls (CAS number 57465-28-8) has been assigned those of its individual subspecies (243.908 and 10.82, respectively). (The group listing of PCBs does not include the Toxicity Equivalency Factors as developed by the World Health Organization 1997 and as adopted by the 2015 OEHHA Guidelines). PCB 126 (',3',',4',5-Pentachlorobiphenyl, CAS number 57465-28-8) was used in the calculation of the screening approach since it has the most stringent REL. In a case that a facility provides

speciated PCB data, or other justification is available, different MP adjustment factors can be used subject to SCAQMD approval.

# APPENDIX III

# PROCEDURES FOR ADDRESSING NON-DETECTED COMPOUNDS AND BLANKS IN RISK ASSESSMENT

## INTRODUCTION

This appendix describes guidelines for estimating emissions of non-detected toxic air contaminants (TACs) and using blanks in emissions estimations for purposes of preparing health risk assessments for Rules 1401, 1402 and the Air Toxics "Hot Spots" Program (AB2588 Program). Procedures are the same for preparing risk assessments for Rules 1401, 1402 and the AB2588 Program, however the lists of compounds are different. Rule 1401 uses only cancer potency factors (CP) and reference exposure levels (RELs) approved by the Scientific Review Panel and prepared by the state Office of Environmental Health Hazard Assessment (OEHHA), whereas Rule 1402 and the AB2588 Program use different sources for CPs and RELs, including draft numbers.

Under previous policy, the SCAQMD required that if a TAC could be present in emissions from a source but not detected during air testing, it must be assumed to be present below the limit of detection (LOD). This approach has been applied to stack testing, to measurements such as laboratory analysis of materials, and other monitoring and measurement methods. The concentration of non-detected TACs were to be reported as one-half (1/2) of the LOD.

Concerns were raised that this policy of carrying undetected TACs through a health risk assessment at half the LOD could inflate risk estimates and might require facilities to install control equipment for emissions that may not be present. In addition, it would not be possible to detect the TAC after its emissions had been controlled and reduced.

Also, in the past, the SCAQMD did not allow any adjustments in the measured values of samples based on the results of reagent blanks. Concerns were raised that in certain cases the concentration of TACs measured in reagent blanks should be deducted from the actual measured samples.

To address these concerns, SCAQMD staff worked closely with affected facilities such as publicly owned treatment works (POTWs) and others during previous rulemaking efforts for Rules 1401 and 1402 to develop guidelines for addressing non-detected TACs and blanks in risk assessment.

## OVERVIEW

The new approach begins with an initial level of screening to determine whether or not a TAC is likely to be present and therefore should be tested for. If the conditions in the screening guidelines are met, no further testing or analysis is required. If a TAC does not pass the screening guidelines, the facility must quantify and report the emissions of the compound through testing or other methods as approved by SCAQMD staff. The reported emission levels are calculated based on the number of test runs or analyses that are below the LOD.

## SCREENING GUIDELINES

For a TAC to be excluded from testing or analysis and hence quantification for health risk assessment, it must meet either condition A, B, or C listed below.

Proof for exclusion of any TAC based on literature studies on physical nature or chemistry of the compounds to substantiate the findings, and any prior analysis or testing shall be deemed complete

for SCAQMD approval. Any prior testing must have been conducted according to SCAQMD's approved test methods or other recognized standards, as approved by SCAQMD staff.

If a list of TACs to be tested for is agreed upon but is subsequently discovered by the facility or the SCAQMD that additional compounds may be present, SCAQMD staff may require that the facility test for the presence of the additional TACs.

The screening criteria to be used for determining the presence of TACs are the following.

**Condition A: No likelihood of the presence of a TAC**

A facility may choose to demonstrate that there is no likelihood of a TAC being present in the raw materials, process streams or materials introduced into the equipment or process. The methodology or documentation to show proof of the non-existence of the TAC must be deemed complete with the source test protocol or test method analysis protocol for SCAQMD approval. If the evidence to substantiate the absence of a TAC is insufficient, or SCAQMD staff has reason to believe that the TAC may be present, it must be tested for and quantified (see Cases 1, 2, and 3).

For example, a facility operator can demonstrate the absence of cadmium in emissions from the melting of lead ingots in a pot furnace by presenting the following documentation:

- Certified analysis of the lead ingots showing that cadmium is not a constituent of the ingot.
- Description of the process substantiating that no other material is added to the furnace that will contribute to cadmium emissions. The operator must also provide analysis for the fuel used in the process to demonstrate that it does not contain cadmium.
- Documentation substantiating that melting lead ingots without cadmium present in the ingot in a pot furnace will not result in the emissions of cadmium when the firebricks or pot liner are heated during the melting operations.

In addition, the facility operator may submit test results based on tests performed within the last two years, or a longer period if the facility can demonstrate that no significant changes have occurred to the SCAQMD-approved test method, process equipment or process materials that indicate cadmium was reported as below LOD.

**Condition B: Absence of a TAC or its precursors in the process**

If there is any evidence that precursors, which could lead to formation of a TAC during a process or reaction, may be present, then a facility may have to test for the TAC. To be excluded from testing and quantification requirements, the facility must provide documentation to demonstrate, based on test results, that none of the essential precursors are present in the material or process. This is similar to the previous criteria and differs only in that precursor compounds that could contribute to the formation of the subject TAC must also be identified as not being present.

An example is emission of dioxins from a waste incinerator. In this case, test data may be available to show that there are no dioxins present in the waste stream being incinerated. However, the

presence of chlorine and hydrocarbons in the combustion process could result in the formation of products of incomplete combustion (PICs) such as dioxins or other toxic compounds. Testing for these compounds would be required unless the facility operator demonstrates that none of the essential precursors are present in the waste stream or the process itself.

**Condition C: Special TAC list for POTWs**

Unlike other industrial sources whose potential toxic air emissions are relatively well defined and which contain limited species, proving the absence of TACs from emissions from POTWs is more difficult. This is because the instantaneous discharge of wastewater from various residential, commercial and industrial system users could potentially result in the presence of different toxic contaminants in the influent sewage. Therefore, it is recommended that a special TAC list be developed for POTWs to select appropriate TACs for testing and determination of health risk associated with air emissions from liquid phase and sludge treatment processes.

The special TAC list for POTWs will be approved by SCAQMD staff with consideration given to information including but not limited to the following:

1. The Pooled Emission Estimating Program (PEEP) identified and selected compounds under the AB2588 Program, as approved by SCAQMD staff.
2. The Joint Emissions Inventory Program (JEIP) identified and selected compounds under SCAQMD Rule 1179 – Publicly Owned Treatment Works Operations inventory requirements, as approved by SCAQMD staff.
3. TACs that have a reasonable likelihood of being present in the air emissions of POTWs, based on other test results or information sources, as approved by SCAQMD staff.

Additionally, based on the specific sources of sewage for certain POTWs, specific TACs in addition to the ones identified through the above steps could be added or deleted from the list on a case-by-case basis.

Based on the special TAC list for POTWs as developed from the above procedure and subject to approval by SCAQMD staff, facilities will be required to quantify the listed compounds through testing or other methods approved by SCAQMD staff for inclusion in the health risk assessment. The facility will not have to test for compounds not included in the special TAC list for POTWs, and the inclusion of non-listed TACs in the health risk assessment is not required. However, if after the industry-specific list is developed and approved, the facility or the SCAQMD later discovers information that additional TACs may be present, SCAQMD staff may revise the industry-specific list and may require the facility to quantify emissions of such TACs that were previously excluded from quantification.

## QUANTIFICATION OF EMISSIONS BASED ON SOURCE TEST RESULTS

The cases listed below explain the process for quantification of emissions based on the source test results.

**Treatment of Test Runs Below LOD**

If some test runs are below LOD, quantification of the TAC depends on the percent of the test runs and analyses that are below LOD. Three possible scenarios are discussed below. In all of these cases, all of the following three conditions must be met:

1. All tests should be performed using SCAQMD-approved test methods, triplicate sample runs and SCAQMD-approved detection limits. When non-detected values are reported, the actual analytical limit of detection for all runs and the number of sample runs shall be reported; and
2. The data from the analyses or tests were obtained within a period of two years prior to the time the data is to be used by SCAQMD staff, unless the facility demonstrates to the SCAQMD's satisfaction that earlier test data remain valid due to lack of significant changes in test methods, process equipment or process materials; and
3. For cyclic operations or variations in feedstock, the tests or analyses conducted should be representative of the variations in loads, feed rates and seasons, if applicable. In such cases, an adequate number of test runs should be conducted for all cyclic or seasonal operations.

**Case #1: TAC is not detected in any test runs or analyses**

In situations in which all test runs and analyses consistently indicate levels below the LOD, the compound can be identified as "not detected" and its inclusion in the health risk assessment will not be required, provided all three conditions listed above are met.

**Case #2: TAC is detected in less than 10% of the test runs or analyses**

In situations in which a compound has been detected and the percentage of samples in which it is detected is less than ten percent, and provided that all three conditions listed above are met, the following procedure shall be used to average the results:

1. For those runs or analyses that were below LOD, assign zero.
2. Average the measured values obtained for the runs that were above LOD with zero values for the runs below LOD and report the final average result for use in the risk estimation.

**Case #3: TAC is detected in 10% or more of the test runs or analyses**

In cases in which ten or more percent of the test runs and analyses show measured values of a TAC above the LOD, and provided that all three condition listed above are met, the following procedure shall be used to average the results:

1. For those runs or analysis that were below LOD, assign one half (1/2) of the corresponding LOD for each run.

2. Average the measured values obtained for the runs that were above LOD wi1/2 LOD values for the runs below LOD and report the final average result for use in the risk estimation.

In cases in which there are fewer than ten samples (for example, two triplicate samples have been taken) and a TAC has been detected in one or more samples, the following procedures shall be used.

- If the TAC is detected in one sample, use Case #2.
- If the TAC is detected in two or more samples, use Case #3.

**Use of Reagent Blanks**

Reagent blank values may be subtracted from sample values under the conditions specified below. In order to use these procedures, it will be necessary to obtain from SCAQMD staff, prior to the test or analyses, a determination as to the maximum allowable value for the blank.

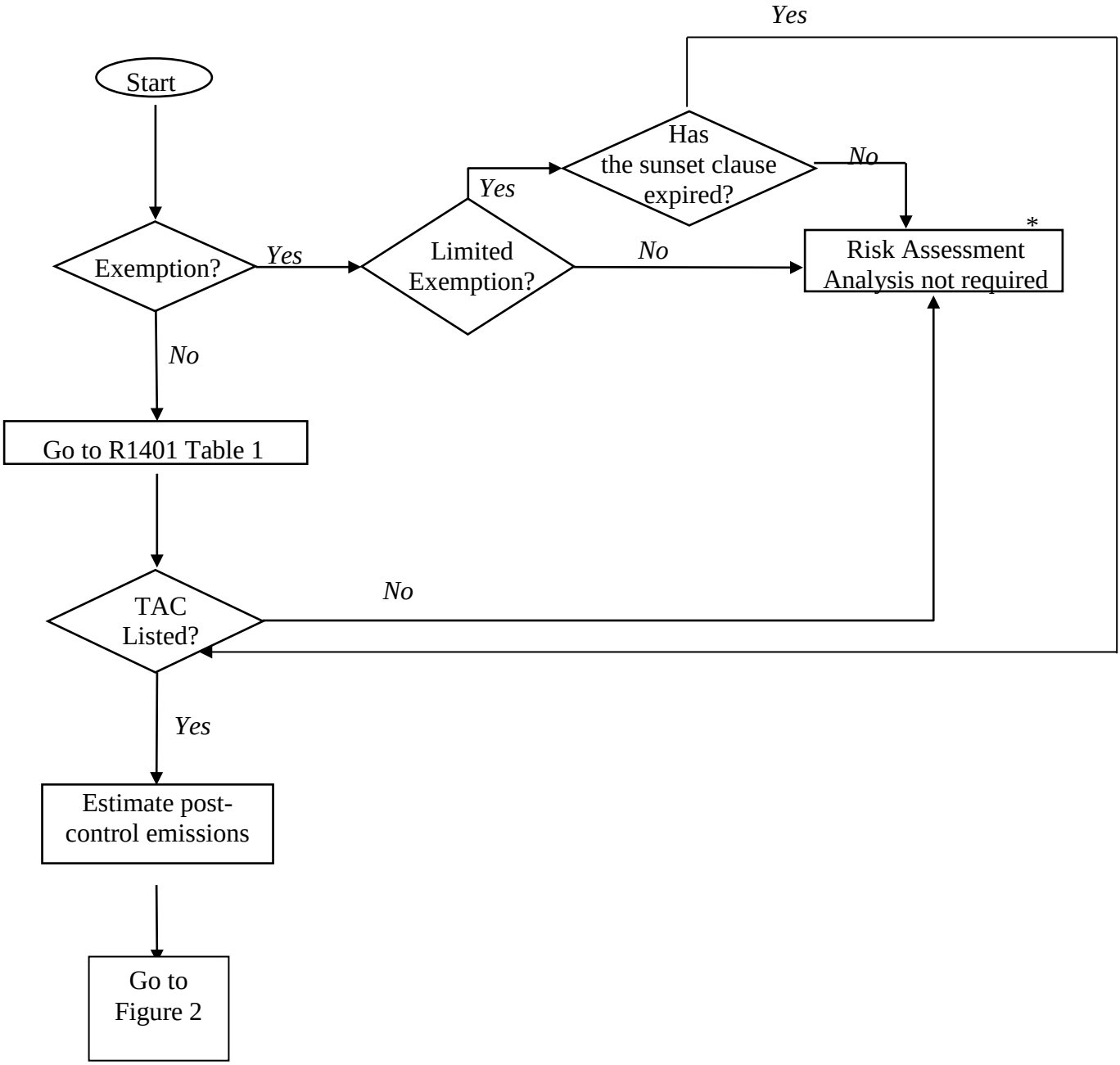
If the level of the TAC in the reagent blank is less than or equal to the maximum allowable blank, the reagent blank may be subtracted. The data must be reported with and without the correction. If the level of the TAC in the reagent blank is greater than the maximum allowable blank and the concentration of the sample is greater than three times the reagent blank value, then the maximum allowable reagent blank value can be subtracted. The data must be reported with and without correction.

# APPENDIX IV

# FLOW CHARTS AND DIAGRAMS

***Note: The reader needs to ascertain the date in which the subject equipment's permit application was deemed complete. This date is used to identify the correct set of permitting tables (see Attachments) to be used for permit processing.***

**Figure 1**
**Preliminary Tasks**




* Consult with SCAQMD staff for other TACs not listed in Attachment N, Table 1.0, which potentially endanger public health or may require a Rule 212 evaluation.

**Figure 2**
**Tier 1 - Screening Levels**

*Tier 1 involves comparing emissions or source specific units from a piece of equipment to Screening Levels*

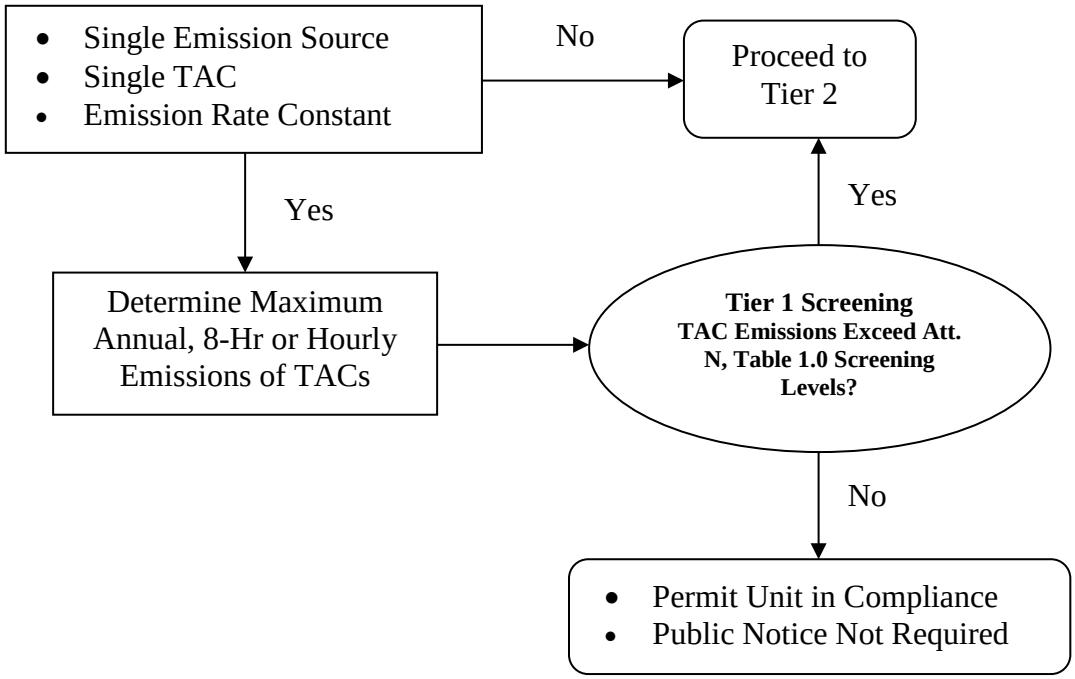
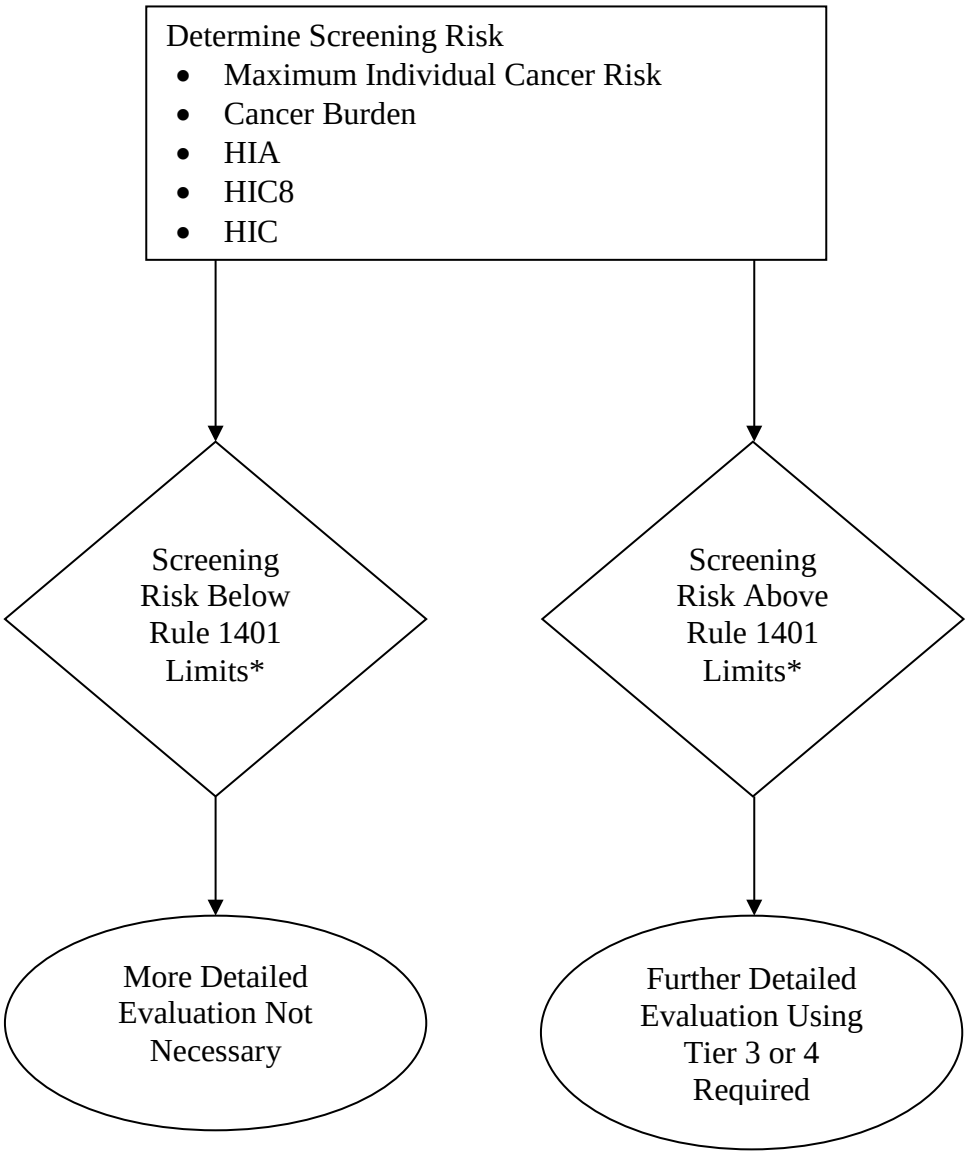


**Figure 3A**
**Tier 2 - Screening Levels**

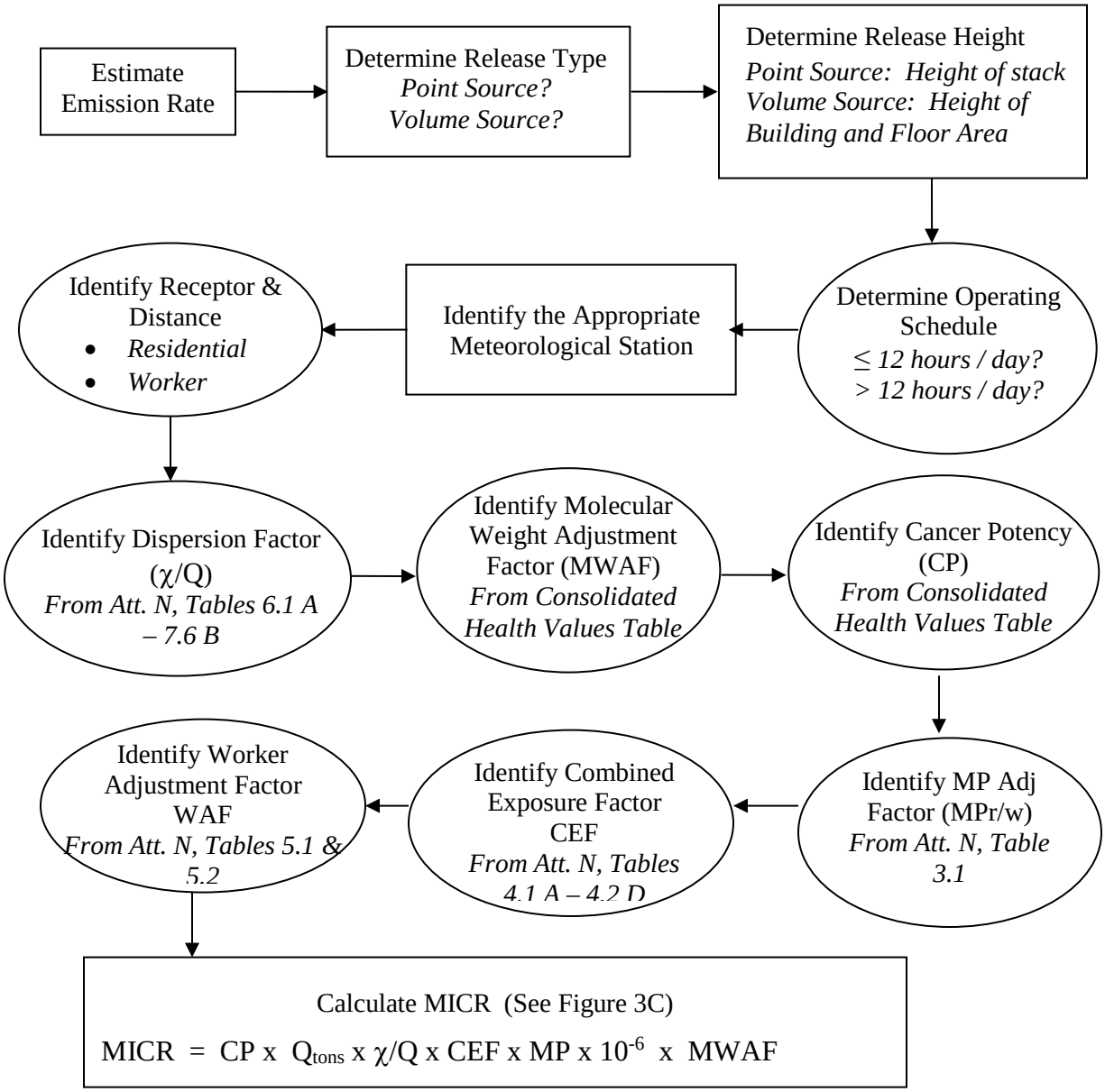
*Tier 2 is a screening risk assessment, which includes procedures for determining level of risk from MICR, Cancer Burden, HIA, HIC8 & HIC*




** Level of Concern:*

- *MICR exceeds one in one million with no T-BACT*
- *MICR exceeds ten in one million with T-BACT*
- *Cancer burden exceeds 0.5*
- *HIA, HIC8 or HIC exceeds 1 for any target organ system*

**Figure 3B**
**Tier 2 - MICR Calculation**




*If MICR exceeds one in one million, cancer burden must also be estimated. (See Figure 4.)*

Note that the Consolidated Health Values Table is available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf.

**Figure 3C**
**Tier 2 - MICR Equation**

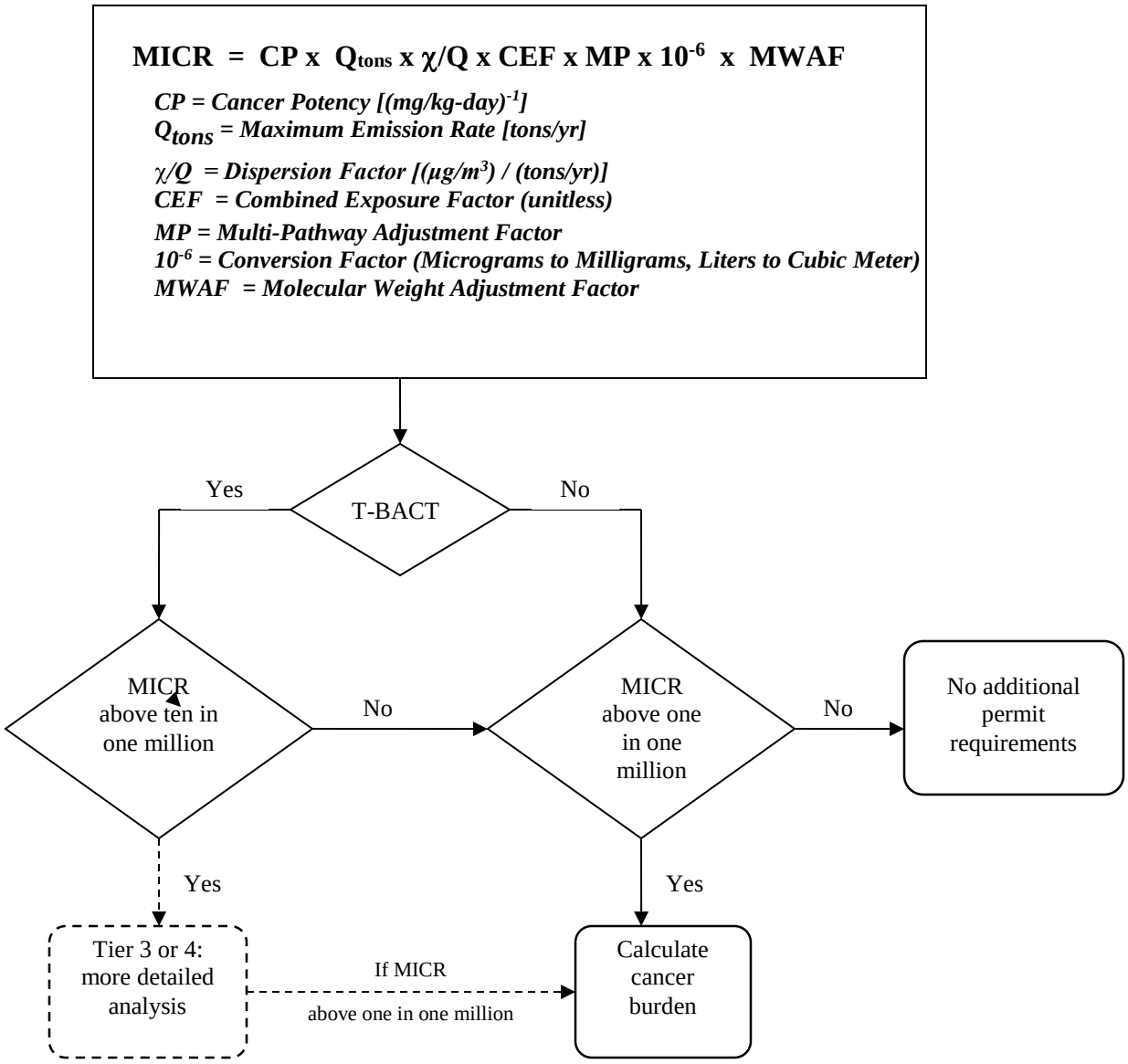


**Figure 3D**
**Tier 2 - χ/Q**

*(χ/Q): Numerical estimates of the amount of decrease in concentration of a contaminant as it travels away from the site of release.*

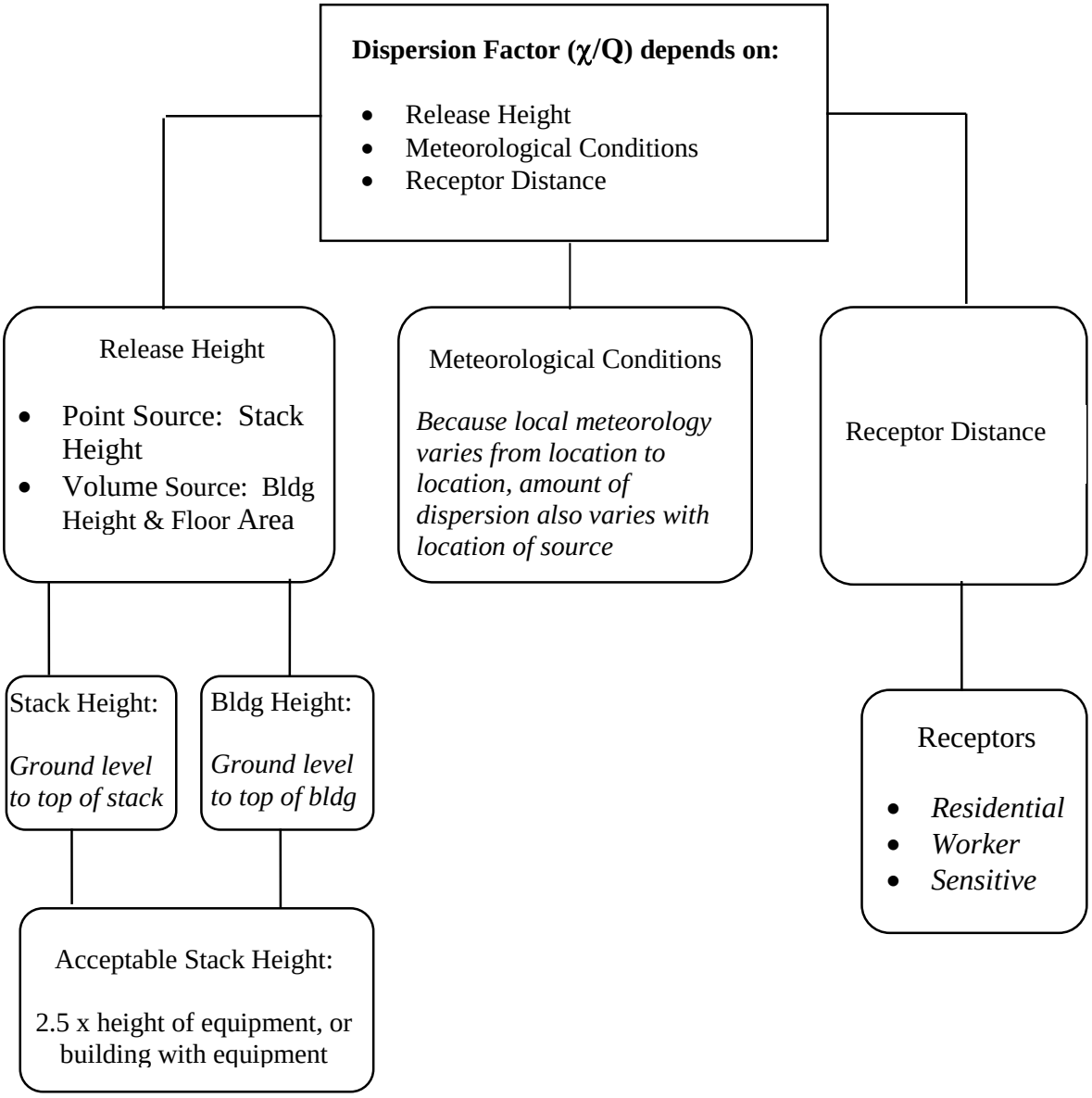


**Figure 3E**
**Tier 2 - MP Adjustment Factor**

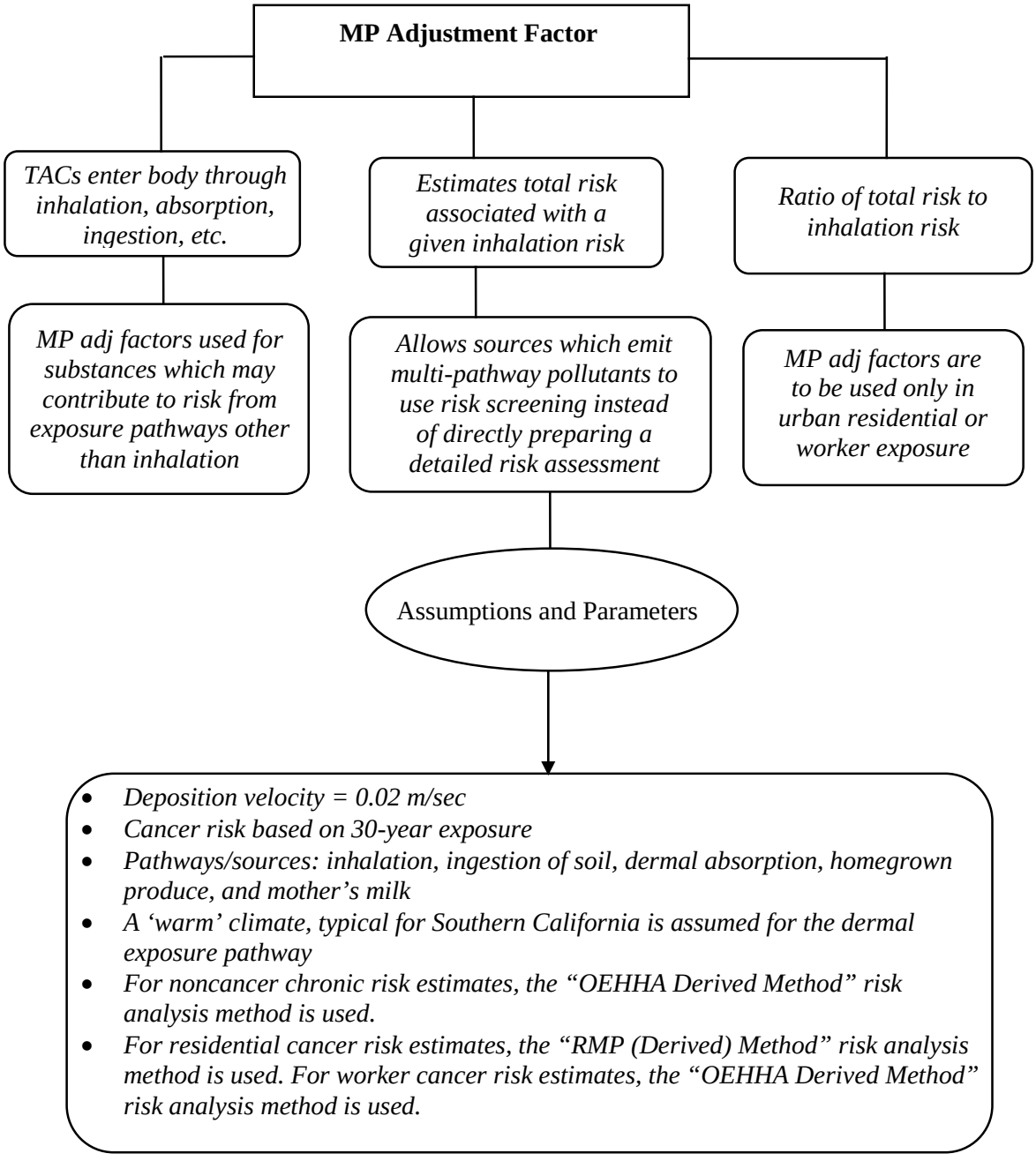


**Figure 3F**
**Tier–2 - CEF**

**CEF**

Combines default exposure parameters for:

- Daily Breathing Rate (DBR)
- Age Sensitivity Factor (ASF)
- Exposure Duration (ED)
- Fraction of Time Spent at Home (FAH)
- Exposure Frequency (EF)
- Average Time (AT)

*From Att. N, Tables 4.1 A – 4.2 D*

**Figure 4**
**Cancer Burden**

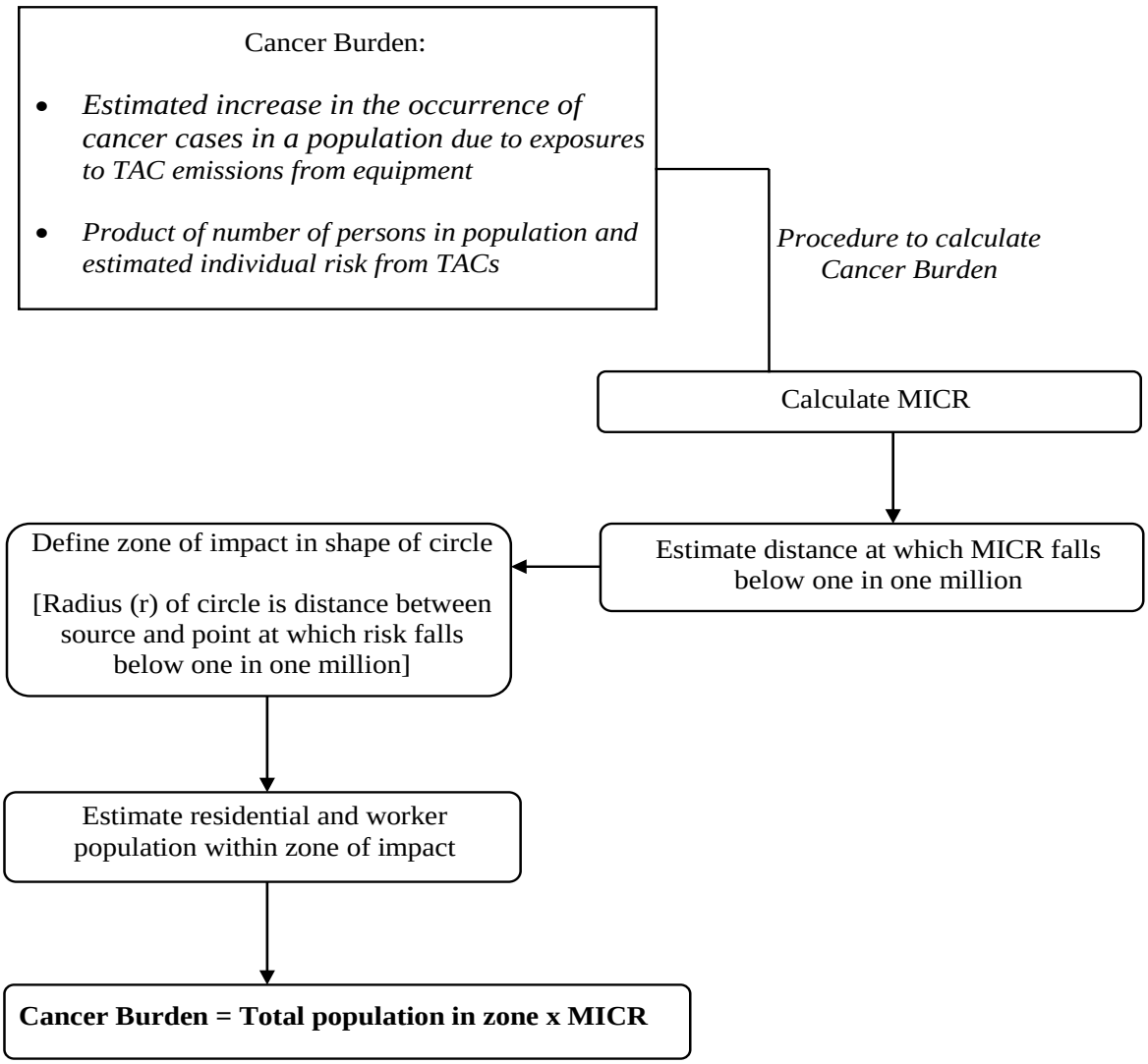
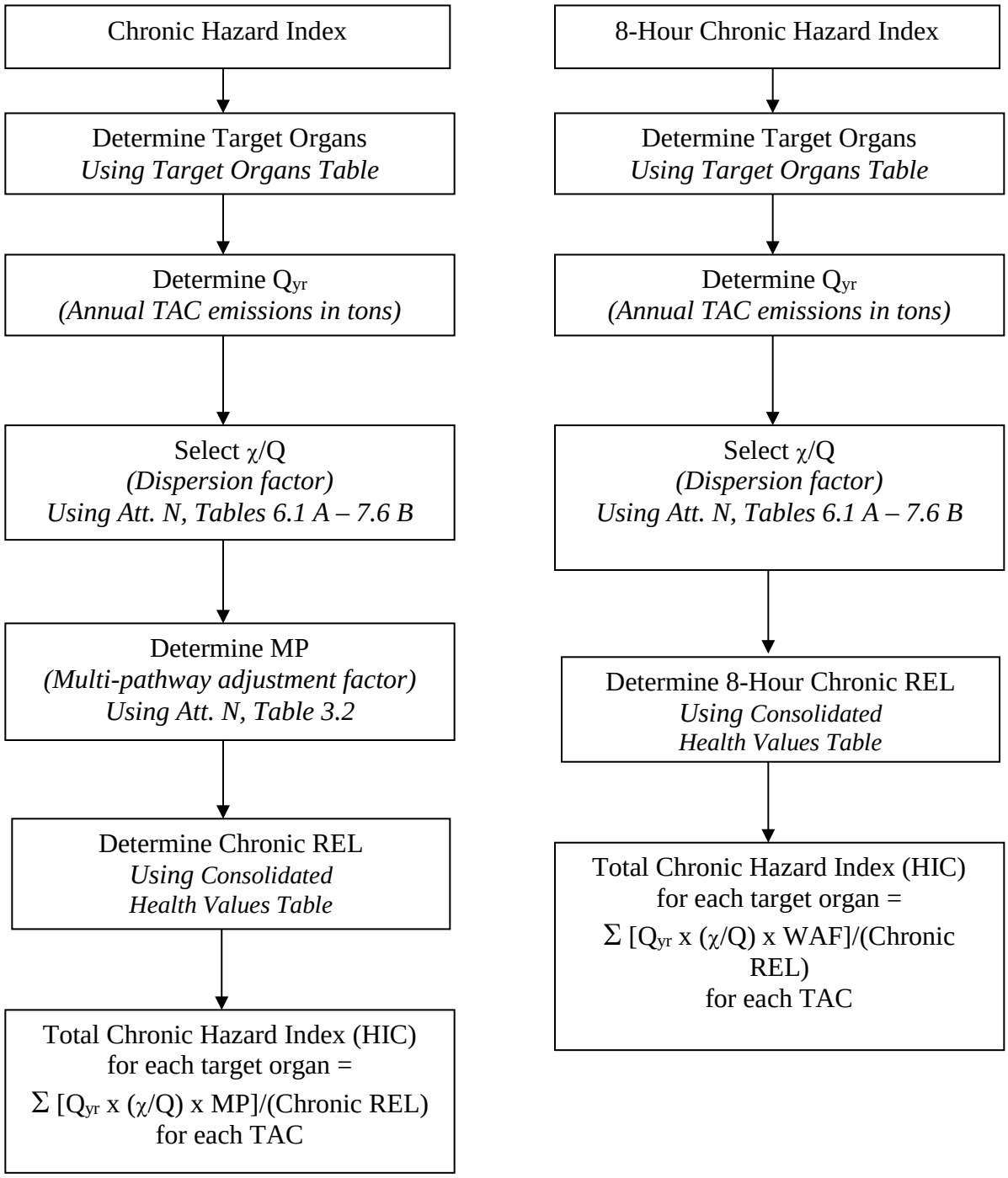
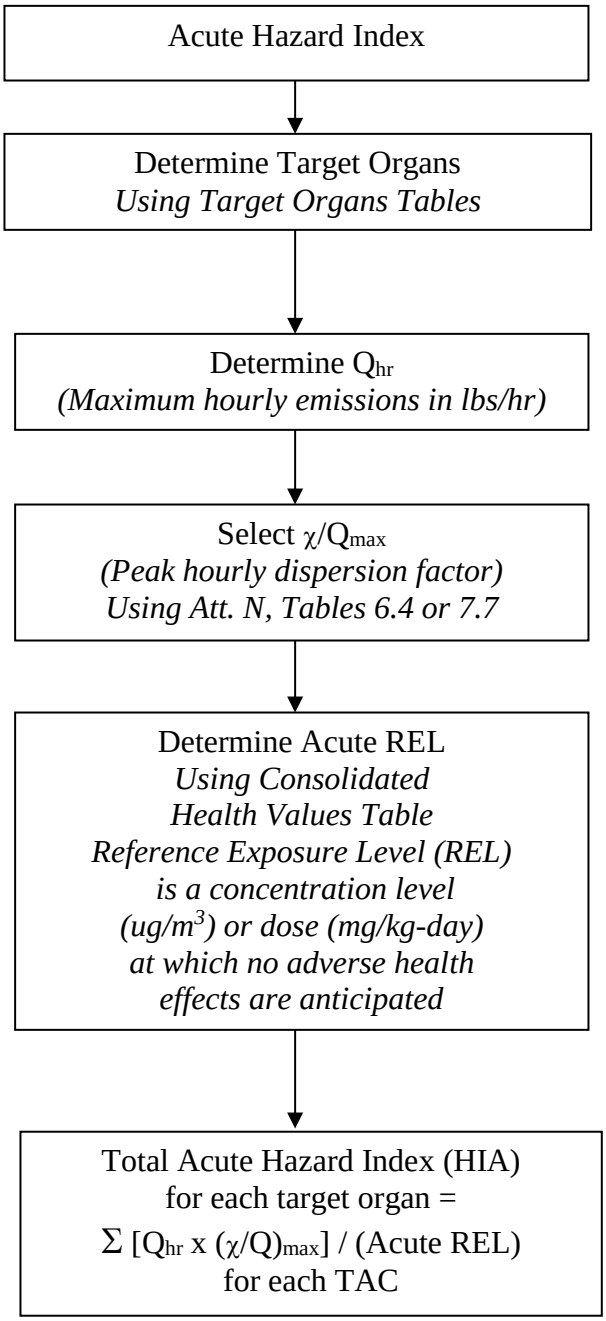


**Figure 5**
**HIC and HIC8**




Note that the Consolidated Health Values Table is available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf and the Target Organs Tables are available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.

**Figure 6**
**HIA**




Note that the Consolidated Health Values Table is available on CARB's website at https://www.arb.ca.gov/toxics/healthval/contable.pdf and the Target Organs Tables are available on CARB's website at https://www.arb.ca.gov/toxics/healthval/totables.pdf.

# APPENDIX V

# RULE 1401 EXEMPTION PROVISIONS

# Exemption Provisions

Rule 1401 (g)(1)(A): Permit Renewal or Change of Ownership

*Any equipment which is in continuous operation, without modification or change in operating conditions, for which a new permit to operate is required solely because of permit renewal or change of ownership.*

Rule 1401 (g)(1)(B): Modification with No Increase in Risk

*A modification of a permit unit that causes a reduction or no increase in the cancer burden, MICR or acute or chronic HI at any receptor location.*

Rule 1401 (g)(1)(C): Functionally Identical Replacement

*A permit unit replacing a functionally identical permit unit, provided there is no increase in maximum rating or increase in emissions of any toxic air contaminants. For replacement of dry cleaning permit units only, provided there is no increase in any toxic air contaminants.*

Rule 1401 (g)(1)(D): Equipment Previously Exempt Under Rule 219

*Equipment which previously did not require a written permit pursuant to Rule 219 that is no longer exempt, provided that the equipment was installed prior to the Rule 219 amendment eliminating the exemption and a complete application for the permit is received within one (1) year after the Rule 219 amendment removing the exemption.*

Rule 1401 (g)(1)(E): Modifications to Terminate Research Projects

*Modifications restoring the previous permit conditions of a permit unit, provided that: the applicant demonstrates that the previous permit conditions were modified solely for the purpose of installing innovative control equipment as part of a demonstration or investigation designed to advance the state of the art with regard to controlling emissions of toxic air contaminants; the emission reductions achieved by the demonstration project are not used for permitting any equipment with emission increases under the contemporaneous emission reduction exemption as specified in paragraph (g)(2); the demonstration project is completed within two (2) years; and a complete application is submitted no later than two (2) years after the date of issuance of the permit which modified the conditions of the previous permit for the purpose of the demonstration or investigation.*

Rule 1401 (g)(1)(F): Emergency Internal Combustion Engines

*Emergency internal combustion engines that are exempted under Rule 1304.*

Rule 1401 (g)(1)(G): Wood Product Stripping (Expired)

*Wood product stripping permit units, provided that the risk increases due to emissions from the permit unit owned or operated by the applicant for which complete applications were submitted on or after July 10, 1998 will not exceed a MICR of 100 in one million ($1.0 \times 10^{-4}$) or a total acute or chronic hazard index of five (5) at any receptor location. This exemption shall not apply to permit applications received after January 10, 2000, or sooner if the Executive Officer makes a determination that T-BACT is available to enable compliance with the requirements of paragraphs (d)(1), (d)(2) and (d)(3).*

Rule 1401 (g)(1)(H): Gasoline Transfer and Dispensing Facilities (Expired)

*For gasoline transfer and dispensing facilities, as defined in Rule 461 – Gasoline Transfer and Dispensing, the Executive Officer shall not, for the purposes of paragraphs (d)(1) through (d)(5), consider the risk contribution of methyl tert-butyl ether for any gasoline transfer and dispensing permit applications deemed complete on or before December 31, 2003. If the state of California extends the phase-out requirement for methyl tert-butyl ether as an oxygenate in gasoline, the limited time exemption shall be extended to that expiration date or December 31, 2004, whichever is sooner.*

Rule 1401 (g)(2): Contemporaneous Risk Reduction

*Simultaneous risk reduction such that an increase in MICR or HI from a equipment will be mitigated by a risk reduction from another equipment within 100 meters and the net impact on any receptor will be less than or equal to an increased MICR of 1 in 1 million or an HI of 1, provided that both applications for the increase and decrease are deemed complete together, the risk reduction occurs first, and the reduction is enforceable.*

# APPENDIX VI

# AIR QUALITY DISPERSION MODELING METHODOLOGY AND METEOROLOGICAL STATIONS/DATA

## Introduction

This appendix discusses the general modeling methodologies used in the development of the screening tables contained in SCAQMD's Risk Assessment Procedures for Rule 1401 and 212 (Version 8.1) and *Attachment N*. Information on the meteorological data used in the analyses and how the data was processed are also included in the discussion below. The meteorological data is available on SCAQMD's website[1] for use in Tier 4 health risk assessments.

## Air Quality Dispersion Modeling Methodology

Air quality modeling was performed using the air quality dispersion model AERMOD. As of December 9, 2006, U.S. EPA promulgated AERMOD as a replacement for ISCST3 as the recommended dispersion model. AERMOD is a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.

Air quality dispersion modeling performed for the development of the screening tables in Attachment N used U.S. EPA's most recent approved version of AERMOD, which is version 16216r. AERMOD was executed using the urban option, which is SCAQMD policy for all permitting in its jurisdiction. The U.S. EPA regulatory non-default option of flat terrain was implemented and the SCAQMD's AERMOD-ready meteorological data was used. The County populations used are based on the 2010 estimates from the U.S. Census Bureau. The Los Angeles County population was 9,818,605; Orange County population was 3,010,232; Riverside County population was 2,189,641; and San Bernardino County population was 2,035,210.

For all modeling performed, a polar receptor grid was utilized with ten degree azimuth increments at the following downwind distances: 25, 50, 75, 100, 200, 300, 500, and 1,000 meters. The peak model-predicted impacts at each downwind distance over the 36 azimuth angles are used to develop the screening risk tables.

For all modeling that included building downwash effects as part of the analysis, the U.S. EPA's Building Profile Input Program for PRIME (BPIP-PRIME) version 04274 was used. BPIP-PRIME calculates downwash values that are used as input for models like AERMOD. The AERMOD modeling system (including all associated processors) is available on the U.S. EPA's website[2].

For more information regarding the modeling parameters and assumptions used to develop the screening tables for each specific category, please refer to the applicable appendix.

[1] SCAQMD's AERMOD-ready meteorological data is available for download here: http://www.aqmd.gov/home/library/air-quality-data-studies/meteorological-data/data-for-aermod

[2] U.S. EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM), AERMOD Modeling System. Available at: https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod

## Meteorological Stations

All modeling was performed using SCAQMD's meteorological data processed for AERMOD, as shown in Figure VI-1 below. The locations for each of the 24 stations are given in Table VI-1. It is SCAQMD's policy to continuously update the AERMOD-ready meteorological data every three years; therefore, applicants are advised to check for the most recent version of meteorological data available for use prior to starting any dispersion modeling projects.

The meteorological data used to produce the screening tables in Attachment N was processed with U.S. EPA's AERMET Version 16216. Raw meteorological data from SCAQMD's monitoring stations and the Automated Surface Observing System (ASOS)[3] stations were collected for the years of 2010 – 2016. Hourly wind and temperature data were collected from both SCAQMD and ASOS stations, while cloud cover and 1-minute wind data was only available from the ASOS stations. The ASOS 1-minute wind data was processed with U.S. EPA's processor AERMINUTE Version 15272 and included in AERMET for ASOS stations with the use of a wind speed threshold of 0.5 m/s, which is consistent with U.S. EPA's guidelines[4]. The ADJ_U* option was used in AERMET for all stations, as this is now a regulatory option in AERMOD. The ADJ_U* option adjusts the surface friction velocity parameter in the surface file to improve model performance for sources that have peak concentrations under low wind, stable atmospheric conditions[5].

Surface characteristics, such as albedo, Bowen ratio, and surface roughness, were determined from U.S. EPA's processor AERSURFACE Version 13016. Each station's Bowen ratio varies by year based on the year's precipitation total compared to the 30-year climatological average precipitation. This comparison resulted in a year being classified as Average, Dry, or Wet. For the period of 2010 – 2016, most years fell into the Dry category, with the exception of 2010 and 2016.

After the meteorological data was processed with AERMET, the data went through QA/QC to determine if it passed the U.S. EPA thresholds of less than ten percent missing data by quarter and less than 15 percent calm hours by quarter. The most recent five years of data meeting the QA/QC criteria were then determined for each station, with some stations being eliminated for use in dispersion modeling applications. A number of SCAQMD stations that had been available in the past were determined to no longer be useable for this update, due to not passing the U.S. EPA's QA/QC criteria, or the station being discontinued, or due to having a co-located ASOS station available. Additionally, the ASOS stations within the Basin were included to provide robust coverage for dispersion modeling purposes.

[3] The ASOS program is a collaboration between the National Weather Service (NWS), the Federal Aviation Administration (FAA), and the Department of Defense (DOD). For more information on the ASOS program, please see http://www.nws.noaa.gov/asos/.

[4] See Section 8.4.6 of the U.S. EPA's Appendix W: Guidelines on Air Quality Models. May 22, 2017. https://www3.epa.gov/ttn/scram/appendix_w-2016.htm

[5] See Section IV.A.2 of the Revisions to the Guideline on Air Quality Models. May 22, 2017. https://www3.epa.gov/ttn/scram/appendix_w-2016.htm

## Choosing a Meteorological Station for Modeling

The meteorological station that best represents the facility's meteorological conditions (such as prevailing winds), terrain, and surrounding land use should be used in all modeling analyses. This means that the closest meteorological station to the facility is not always the most representative meteorologically. The SCAQMD is broken up into 38 source/receptor areas (SRAs) as shown in Figure VI-1. If the prevailing meteorological conditions at the facility are similar to the meteorological station in the facility's SRA, then the SRA station can be used. All technical justification used in choosing the appropriate meteorological station for dispersion modeling and health risk assessment should be included in the report submitted with the analysis and all electronic modeling files. Please contact SCAQMD modeling staff for questions related to choosing the most appropriate meteorological station for your analysis.

**Table VI-1: Locations of SCAQMD's AERMOD-Ready Meteorological Data and Corresponding Applicable SRA**

| Station Abbr. | Meteorological Station | Lat./Long. Coordinates | | Elevation (m) | Source/Receptor Area (SRA) |
|---|---|---|---|---|---|
| | | Latitude | Longitude | | |
| AZUS | Azusa | 34.1365 | -117.9239 | 182 | 8, 9, 10 |
| BNAP | Banning | 33.9208 | -116.8584 | 660 | 28, 29 |
| CELA | Central L.A. | 34.0664 | -118.2267 | 87 | 1 |
| ELSI | Lake Elsinore | 33.6765 | -117.3310 | 406 | 25, 26, 27 |
| FONT | Fontana | 34.1001 | -117.4920 | 367 | 34 |
| MSVJ | Mission Viejo | 33.6300 | -117.6756 | 170 | 19, 20, 21 |
| PERI | Perris | 33.7889 | -117.2278 | 442 | 24, 27, 28 |
| PICO | Pico Rivera | 34.0103 | -118.0686 | 58 | 5, 10, 11 |
| RDLD | Redlands | 34.0597 | -117.1472 | 481 | 35, 38 |
| UPLA | Upland | 34.1036 | -117.6292 | 379 | 32, 36 |
| KBUR | Burbank Airport | 34.1997 | -118.3654 | 236 | 7, 8, 15 |
| KCNO | Chino Airport. | 33.9756 | -117.6249 | 198 | 22, 33 |
| KCQT | USC/Downtown L.A. | 34.0236 | -118.2912 | 55 | 1, 12 |
| KFUL | Fullerton Airport | 33.8715 | -117.9856 | 29 | 16, 17 |
| KHHR | Hawthorne Airport | 33.9235 | -118.3329 | 19 | 3, 12 |
| KLAX | Los Angeles Int'l Airport | 33.9382 | -118.3866 | 30 | 3 |
| KLGB | Long Beach Airport | 33.8118 | -118.1472 | 10 | 4, 18 |
| KONT | Ontario Airport | 34.0531 | -117.5769 | 289 | 33 |
| KPSP | Palm Springs Airport | 33.8222 | -116.5043 | 125 | 30, 31 |
| KRAL | Riverside Airport | 33.9528 | -117.4352 | 245 | 22, 23 |
| KSMO | Santa Monica Airport | 34.0210 | -118.4471 | 53 | 2 |
| KSNA | John Wayne Int'l Airport | 33.6798 | -117.8675 | 17 | 17, 18, 20 |
| KTRM | Desert Hot Springs Airport | 33.6317 | -116.1641 | -36 | 27, 30, 31 |
| KVNY | Van Nuys Airport | 34.2123 | -118.4915 | 235 | 6, 13, 15 |

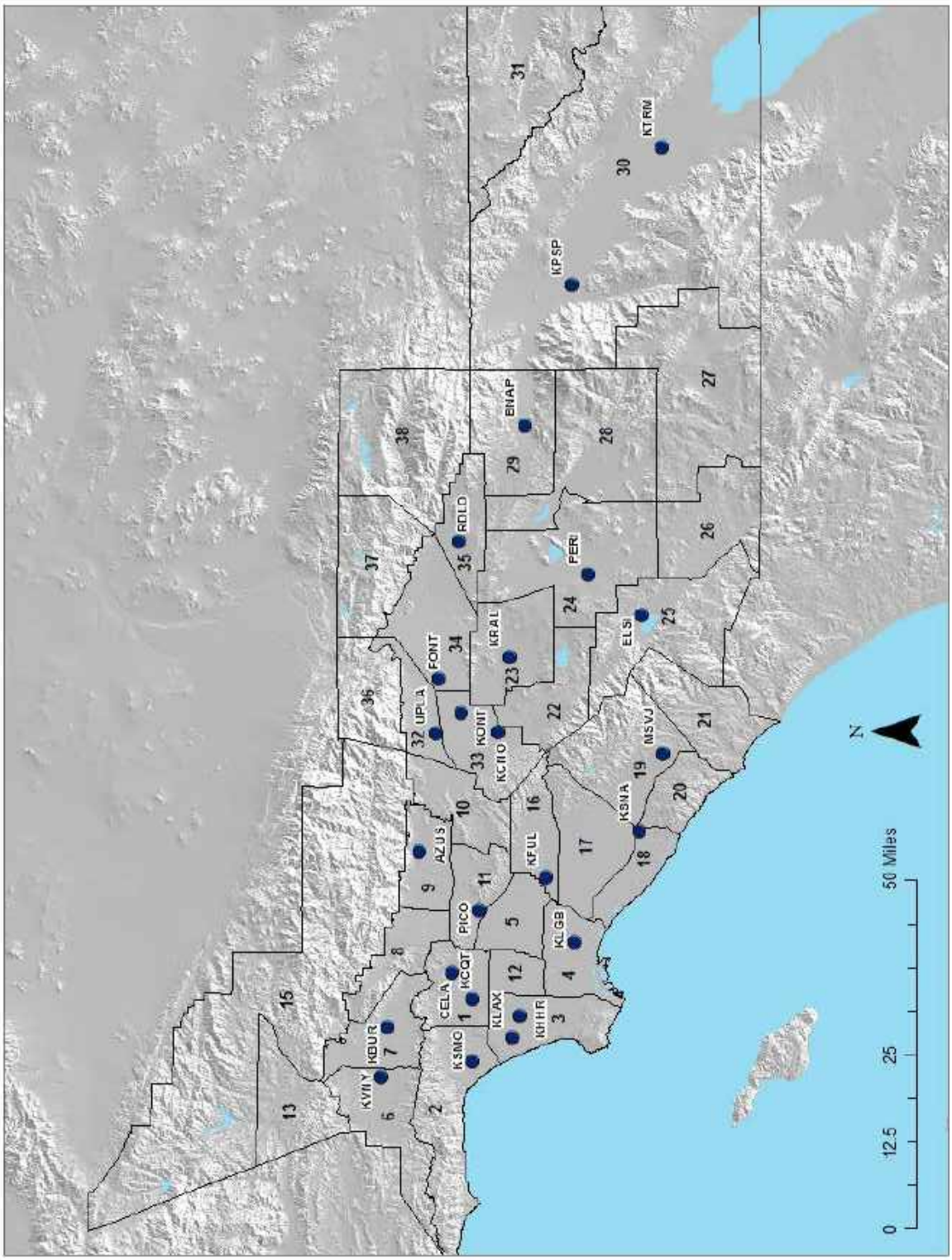



**Figure VI-1: Meteorological Monitoring Stations and SRAs in the South Coast Air Basin**

# APPENDIX VII

# METHODOLOGY USED TO DEVELOP TIER 2 SCREENING TABLES FOR NON-COMBUSTION SOURCES

## Introduction

The purpose of this appendix is to document the methods used by SCAQMD staff to estimate cancer risks from non-combustion sources. The methods are consistent with SCAQMD's risk assessment procedures for Rule 1401 and were used to update the Rule 1401 Tier 2 screening tables using AERMOD.

## Emission Inventory Methods

In order to determine the appropriate emission rates to use, please contact the appropriate SCAQMD Engineering and Permitting staff (http://www.aqmd.gov/contact/permitting-staff) for more information.

## Modeling Parameters

For the general dispersion modeling methodology and meteorological stations used in the development of the screening tables, please see Appendix VI.

The non-combustion sources were modeled as either a point source or volume source. The point source was modeled as a stack using a constant ambient temperature at the release point (0 K in AERMOD), a 0.3 meter stack diameter and 10 m/s exit velocity with varying release heights. Consistent with the modeling prepared for SCAQMD's Risk Assessment Procedures (Version 8.0), building downwash effects were analyzed for point sources with a 20 meter by 30 meter building, 4 meters high. Table VII-1 shows the parameters used to model the point sources while Table VII-2 shows the parameters used for the volume sources. The source IDs are used to differentiate between the different parameters for each source configuration.

**Table VII-1: Model Parameters for Point Sources**

| Source ID | Stack Height | | Stack Diameter | | Stack Temperature | | Stack Velocity | | Flowrate |
|---|---|---|---|---|---|---|---|---|---|
| | (ft) | (m) | (in) | (m) | ($^0$F) | (K) | (ft/s) | (m/s) | ($ft^3$/min) |
| P1 | 14 | 4.27 | 12 | 0.30 | Ambient | 0* | 32.81 | 10 | 1,546.1 |
| P2 | 25 | 7.62 | 12 | 0.30 | Ambient | 0* | 32.81 | 10 | 1,546.1 |
| P3 | 50 | 15.24 | 12 | 0.30 | Ambient | 0* | 32.81 | 10 | 1,546.1 |

Note: * The temperature used in AERMOD was set to 0 K, which indicates that the ambient temperature was used in the model run.

**Table VII-2: Model Parameters for Volume Sources**

| Source ID | Release Height | | Lateral Dimension | | Vertical Dimension | | $\sigma_y$ | $\sigma_z$ |
|---|---|---|---|---|---|---|---|---|
| | (ft) | (m) | (ft) | (m) | (ft) | (m) | (m) | (m) |
| V1 | 7.50 | 2.29 | 38.73 | 11.80 | 15.00 | 4.57 | 2.75 | 2.13 |
| V2 | 7.50 | 2.29 | 70.71 | 21.55 | 15.00 | 4.57 | 5.01 | 2.13 |
| V3 | 15.00 | 4.57 | 70.71 | 21.55 | 30.00 | 9.14 | 5.01 | 4.25 |
| V4 | 7.50 | 2.29 | 122.47 | 37.33 | 15.00 | 4.57 | 8.68 | 2.13 |
| V5 | 15.00 | 4.57 | 122.47 | 37.33 | 30.00 | 9.14 | 8.68 | 4.25 |
| V6 | 15.00 | 4.57 | 212.13 | 64.66 | 30.00 | 9.14 | 15.04 | 4.25 |

A sample AERMOD model input file is provided in Appendix XIII, Exhibit VII.

# APPENDIX VIII

# METHODOLOGY USED TO DEVELOP TIER 2 SCREENING TABLES FOR COMBUSTION SOURCES (NATURAL GAS BOILERS, NATURAL GAS INTERNAL COMBUSTION ENGINES, DIESEL INTERNAL COMBUSTION ENGINES)

## Introduction

The purpose of this appendix is to document the methods used by SCAQMD staff to estimate cancer risks from natural gas-fueled boilers, natural gas-fueled internal combustion engines (ICEs), and diesel-fueled ICEs. The methods are consistent with SCAQMD's risk assessment procedures for Rule 1401 and were used to update the Rule 1401 Tier 2 screening tables using AERMOD.

## Emission Inventory Methods

In order to determine the appropriate/default emission rates to use for fuel combustion sources, please refer to "Supplemental Instructions, Reporting Procedures for AB2588 Facilities for Reporting their Quadrennial Air Toxics Emissions Inventory, Annual Emissions Reporting Program" (http://www.aqmd.gov/docs/default-source/planning/annual-emission-reporting/supplemental-instructions-for-ab2588-facilities.pdf) for more information.

## Modeling Parameters

For the general dispersion modeling methodology and meteorological stations used in the development of the screening tables, please see Appendix VI.

Combustion source stacks were modeled as a point source with the stack parameters presented in Table VIII-1. These parameters were based on the San Joaquin Valley Unified Air Pollution Control District's modeling parameters for combustion sources[22]. Consistent with the modeling prepared for SCAQMD's Risk Assessment Procedures for Rule 1401, building downwash effects were analyzed with a 20 meter by 30 meter building, 4 meters high.

[22] San Joaquin Valley Unified Air Pollution Control District, Final Draft Staff Report with Appendices for Update to District's Risk Management Policy to Address OEHHA's Revised Risk Assessment Guidance Document, found at https://www.valleyair.org/busind/pto/staff-report-5-28-15.pdf, accessed on June 15, 2017

**Table VIII-1: Model Parameters for Combustion Sources**

| Source ID | Release Height | | Stack Diameter | | Stack Temperature | | Stack Velocity | | Flowrate |
|---|---|---|---|---|---|---|---|---|---|
| | (ft) | (m) | (in) | (m) | ($^0$F) | (K) | (ft/s) | (m/s) | (ft$^3$/min) |
| **B1** | 29.53 | 9 | 1.46 | 0.4 | 332.3 | 440 | 16.40 | 5 | 11.5 |
| **B2** | 29.53 | 9 | 1.83 | 0.5 | 386.3 | 470 | 22.97 | 7 | 25.1 |
| **B3** | 29.53 | 9 | 2.01 | 0.55 | 386.3 | 470 | 29.53 | 9 | 39.1 |
| **B4** | 32.81 | 10 | 2.45 | 0.67 | 386.3 | 470 | 32.81 | 10 | 64.5 |
| **B5** | 32.81 | 10 | 2.63 | 0.72 | 431.3 | 495 | 39.37 | 12 | 89.4 |
| **B6** | 45.93 | 14 | 4.02 | 1.1 | 332.3 | 440 | 32.81 | 10 | 173.8 |
| **B7** | 52.49 | 16 | 5.49 | 1.5 | 314.3 | 430 | 39.37 | 12 | 387.8 |
| **N1** | 13.12 | 4 | 0.26 | 0.07 | 1070.3 | 850 | 131.23 | 40 | 2.8 |
| **N2** | 13.12 | 4 | 0.29 | 0.08 | 1070.3 | 850 | 213.25 | 65 | 6.0 |
| **N3** | 13.12 | 4 | 0.51 | 0.14 | 1142.3 | 890 | 180.45 | 55 | 15.5 |
| **N4** | 16.40 | 5 | 0.69 | 0.19 | 1016.3 | 820 | 196.85 | 60 | 31.1 |
| **N5** | 22.97 | 7 | 1.28 | 0.35 | 890.3 | 750 | 213.25 | 65 | 114.4 |
| **D1** | 9.84 | 3 | 0.33 | 0.09 | 908.3 | 760 | 213.25 | 65 | 7.6 |
| **D2** | 9.84 | 3 | 0.44 | 0.12 | 908.3 | 760 | 180.45 | 55 | 11.4 |
| **D3** | 9.84 | 3 | 0.48 | 0.13 | 908.3 | 760 | 262.47 | 80 | 19.4 |
| **D4** | 9.84 | 3 | 0.55 | 0.15 | 926.3 | 770 | 295.28 | 90 | 29.1 |
| **D5** | 13.12 | 4 | 0.62 | 0.17 | 980.3 | 800 | 524.93 | 160 | 66.4 |

A sample AERMOD model input file is provided in Appendix XIII, Exhibit VIII.

# APPENDIX IX

# METHODOLOGY USED TO DEVELOP TIER 2 SCREENING TABLES FOR CREMATORIUMS

## Introduction

The purpose of this report is to document the methods used by SCAQMD staff to estimate cancer risks from the industry-wide source category of crematoriums. The methods are consistent with SCAQMD's risk assessment procedures for Rule 1401 and were used to update the Rule 1401 Tier 2 screening tables using AERMOD for crematoriums ONLY.

## Emission Inventory Methods

For emission rates associated with crematoriums, please contact the appropriate SCAQMD Engineering and Permitting staff (http://www.aqmd.gov/contact/permitting-staff).

## Modeling Parameters

For the general dispersion modeling methodology and meteorological stations used in the development of the screening tables, please see Appendix VI.

Based on information from SCAQMD Engineering and Permitting staff, the model parameters for a standard crematorium is a 13 foot building with a single stack located six feet above the roof of the building. The stack was modeled as a point source with the following stack parameters – 19 feet stack height, 19.03 ft/s exit velocity, 1300ºF exit temperature. Due to the sensitivity to building downwash effects, there are three different square building sizes analyzed: 5,000, 10,000, and 15,000 $ft^2$.

**Table IX-1: Model Parameters for Crematories**

| Source ID* | Release Height | | Stack Diameter | | Stack Temperature | | Stack Velocity | | Flowrate |
|---|---|---|---|---|---|---|---|---|---|
| | (ft) | (m) | (in) | (m) | ($^0$F) | (K) | (ft/s) | (m/s) | ($ft^3$/min) |
| P1, P2, P3 | 19 | 5.79 | 20 | 0.508 | 1,300 | 977.59 | 19 | 5.8 | 2,490.9 |

*Same point source model parameters with three separate building sizes to account for differing building downwash effects.

A sample AERMOD model input file is provided in Appendix XIII, Exhibit IX.

# APPENDIX X

# METHODOLOGY USED TO DEVELOP TIER 2 SCREENING TABLES FOR GASOLINE TRANSFER AND DISPENSING FACILITIES

## Introduction

The purpose of this appendix is to document the methods used by SCAQMD staff to estimate cancer risks from retail gasoline dispensing facilities. The methods are consistent with SCAQMD's Risk Assessment Procedures (Version 8.1), which incorporates the 2015 OEHHA Guidelines. The methods used to estimate emissions, pollutant concentrations, and cancer risks are discussed here. Screening tables of maximum cancer risks at various locations in the Basin and at various residential and occupational distances are provided in Attachment N. This appendix concludes with an example calculation using the cancer risk tables.

## Emission Inventory Methods

Rule 461 – Gasoline Transfer and Dispensing currently has annual throughput reporting requirements. It is designed to regulate gasoline vapor emissions from gasoline transfer and dispensing processes which contain volatile organic compounds and TACs such as benzene, ethylbenzene, toluene, xylenes, and naphthalene. The rule was initially adopted in 1976 and has been amended a number of times, most recently on March 7, 2008. Therefore, risk from these facilities can be calculated from the available information.

Emissions from gasoline transfer and dispensing mainly occur during loading, breathing, refueling, spillage, and hose permeation as described below:

Loading – Emissions occur when a fuel tanker truck unloads gasoline to the storage tanks. The storage tank vapors, displaced during loading, are emitted through its vent pipe. A pressure/vacuum valve installed on the tank vent pipe significantly reduces these emissions.

Breathing – Emissions occur through the storage tank vent pipe as a result of temperature and pressure changes in the tank vapor space.

Refueling – Emissions occur during motor vehicle refueling when gasoline vapors escape either through the vehicle/nozzle interface or the on-board vapor recovery (ORVR) system.

Spillage – Emissions occur from evaporating gasoline that spills during vehicle refueling.

Hose Permeation – Emissions occur when liquid gasoline or gasoline vapors diffuse through the dispensing hose outer surface to the atmosphere.

All retail service stations under SCAQMD jurisdiction have Phase I and II vapor recovery systems to control gasoline emissions. Phase I vapor recovery refers to the collection of gasoline vapors displaced from storage tanks when cargo tank trucks make gasoline deliveries. Phase II vapor recovery systems control the vapors displaced from the vehicle fuel tanks during refueling. In addition, all gasoline is stored underground with valves installed on the tank vent pipes to further control gasoline emissions. Out of the TACs emitted from the gasoline stations, only benzene, ethylbenzene, and naphthalene have cancer toxicity values.

The emission factors for each of the five processes are summarized in Table X-1. The factors given in the table follow CARB's 2013 Revised Controlled Gasoline Emission Factors ~~recommended emission factors~~ except ~~that 95 percent control is assumed~~ for Phase II Onboard Refueling Vapor Recovery (ORVR)~~, whereas CARB assumes that the 95 percent control for Phase II vapor recovery and ORVR are compounded.~~ . SCAQMD staff has been in communication with CARB staff regarding the refueling emissions factor. Both agencies agree that additional time is needed to better understand emission reductions from Phase II EVR for ORVR vehicles. SCAQMD staff is recommending not to incorporate CARB's 2013 revised emission factor for Phase II refueling of ORVR vehicles, but to continue the use of SCAQMD's current emission factor of 0.32 lbs per 1,000 gallons for refueling. Staff is recommending the use of CARB's 2013 emission factors for all other categories (loading, breathing, spillage, and hose permeation). The SCAQMD staff is committed to continue working with CARB staff to refine the refueling emission estimates for Phase II controls with ORVR vehicles and will return to the Board with future revisions to refueling emission factors. It is important to note that for purposes of modeling, Phase II emissions are broken up into refueling and breathing for dispersion modeling purposes.

| **Table X-1. Gasoline Emission Factors for Retail Service Stations Process** | | **Loading** | **Breathing** | **Refueling** | **Hose Permeation** | **Spillage** |
|---|---|---|---|---|---|---|
| **Controlled Gasoline EF (lbs/1,000 gal)** | | 0.15 | 0.024 | 0.~~396~~32 | 0.009 | 0.24 |
| **Benzene** | **Weight Percent** | 0.455% | 0.455% | 0.455% | 0.455% | 0.707% |
| | **Emission Factor (lbs/1,000 gal)** | 0.000683 | 0.000109 | 0.~~0018~~00146 | 0.000041 | 0.0017 |
| **Ethylbenzene** | **Weight Percent** | 0.107% | 0.107% | 0.107% | 0.107% | 1.29% |
| | **Emission Factor (lbs/1,000 gal)** | 0.000161 | 0.0000283 | 0.~~000467~~000342 | 0.0000106 | 0.0031 |
| **Naphthalene** | **Weight Percent** | 0.0004% | 0.0004% | 0.0004% | 0.0004% | 0.174% |
| | **Emission Factor (lbs/1,000 gal)** | 0.0000006 | 0.000000096 | 0.~~00000158~~00000128 | 0.000000036 | 0.000418 |

Note: Gasoline speciation profile: https://www.arb.ca.gov/ei/speciate/refspec.htm
The weight percentages of the TACs evaluated for cancer risk are listed here.

## Modeling Parameters

For the general dispersion modeling methodology and meteorological stations used in the development of the screening tables, please see Appendix VI.

Emissions from gasoline service stations are non-buoyant and ground-based (or nearly ground-based). In addition, the peak impacts from this type of facility occur in close proximity to the

source. Under these circumstances the local terrain is relatively unimportant; therefore flat terrain is assumed in the dispersion modeling.

The California Air Pollution Control Officers Association (CAPCOA) has developed industry-wide risk assessment guidelines for gasoline service stations[23] (1997 CAPCOA Guidelines) and has started the process to update these guidelines using the 2015 OEHHA Guidelines and SCAQMD staff is participating in that Working Group. The current industry-wide risk assessment guidance was approved in 1997. These risk assessment guidelines were developed to promote consistency throughout the State. However, CAPCOA recognized that many of the districts in the state have developed modeling methods and procedures unique to their situations. To address these differences among districts, CAPCOA allows for a district to deviate from the published guidelines as evidenced by the following statement in the industry-wide risk assessment guidelines for gas stations[23]:

> *This effort was initiated to provide a cost effective and uniform method for calculating gasoline station emission inventories and risk assessment for the thousands of gasoline stations throughout the State. However, districts may use other emission information and modeling procedures appropriate in their district.*

The modeling performed here follows the 1997 CAPCOA Guidelines unless otherwise noted.

Loading and breathing emissions exit the underground storage tank vent pipe and are thus treated as a point source. The height and diameter of the vent are assumed to be 3.66 meters (12 feet) and 0.05 meters (2 inches), respectively.

Refueling, spillage, and hose permeation emissions are modeled as volume sources with horizontal dimensions of 13 meters by 13 meters to correspond to the dimensions of the pump islands and a vertical dimension of 5 meters to correspond to the height of the canopy. For refueling and hose permeation, the release height is assumed to be 1 meter to approximate the height of a vehicle fuel tank inlet, whereas spillage emissions are assumed to be released at ground level since nearly all the gasoline from spillage reaches the ground. These dimensions match the 1997 CAPCOA Guidelines recommendations except for the vertical dimension of the volume source; CAPCOA recommends 4 meters. The SCAQMD has been requiring gas station risk assessments for permitting since early 1990s using a vertical dimension of the volume source corresponding to the pump island canopy top. Assuming a 5-meter vertical dimension continues this modeling practice.

According to the 1997 CAPCOA Guidelines, the effects of building downwash on the calculated cancer risk were determined by using three different scenarios with a 10 meter long by 5 meter wide, by 4 meter high building. The building downwash algorithms only affect point sources and do not affect volume or area sources. Results of the modeling indicated that the placement of the buildings and their subsequent potential to create downwash have very little effect on the resultant risks from the vent pipes. Thus, CAPCOA concluded that it is not necessary to include building downwash when determining the dispersion from the vent pipes when using ISCST3. In order to determine the effects of building downwash using AERMOD, a similar analysis was conducted by

[10] The 1997 CAPCOA AB2588 Gasoline Service Station Industrywide Risk Assessment Guidelines are available on the internet at: https://www.arb.ca.gov/ab2588/rrap-iwra/GasIWRA.pdf

SCAQMD staff with the same building dimensions using the BPIP-PRIME computer program. The modeling results showed that building downwash caused the maximum ground level concentrations to more than double. Therefore, building downwash has a significant effect on the maximum concentrations and subsequent cancer risk and thus, cannot be ignored.

The vent pipe, volume sources, and building are assumed to be located at the center of the service station property. Ideally, the locations of the vent pipes, pump islands, and buildings would be determined on a site by site basis. Unfortunately, that level of detail is not feasible for the development of screening tables due to the large number of facilities.

It is assumed that the gas station described above operates continuously throughout the year. Further, it is assumed that 80 percent of the daily emissions occur equally each hour from 6:00 a.m. to 8:00 p.m. and the remaining 20 percent of the daily emissions occur equally each hour from 8:00 p.m. to 6:00 a.m.

A sample AERMOD model input file for the generic retail service station described above is included in Appendix XIII, Exhibit X.

The peak model-predicted impacts at each downwind distance over the 36 azimuth angles are used to develop the screening cancer risk tables for gasoline service stations (see Attachment N, Tables 12.1A – 12.2B).

## Cancer Risk Screening Tables

Based on a review of the 16 TACs emitted from gasoline, only three (benzene, ethylbenzene, and naphthalene) result in cancer effects and were analyzed for cancer risk. Cancer risk screening tables were developed for a generic retail gasoline service station. The modeled stations are assumed to have Phase I and II vapor recovery with cancer risk calculated for different locations; see Table X-1 for the control efficiencies and emission factors assumed for the modeling.

The following paragraphs describe how the cancer risks from a typical gasoline service station can be estimated from the screening tables as follows: First, determine which of the 24 meteorological site locations in these tables best represents the facility's meteorological conditions and location. The SCAQMD is broken up into 38 source/receptor areas (SRAs) as shown in Appendix VI, Figure VI-1. As shown in Appendix VI, Table VI-1, each of the 24 meteorological sites is assigned to the appropriate SRAs, which can then be used to choose the corresponding meteorological site for each gasoline dispensing facility.

Next, determine the distance from the service station to the nearest residential and off-site worker location. Tables 12.1 A – 12.2 B in Attachment N provide the maximum cancer risks for a gasoline dispensing station with either underground or aboveground storage tanks with a one million gallons per year throughput at various residential and off-site worker distances, respectively. Using the data from these tables and steps described above, determine the applicable cancer risks.

Lastly, multiply the cancer risks by the requested annual gasoline throughput of the service station. An example of a risk calculation is provided for a hypothetical gasoline service station on page X-8.

## Results

Figure X-1 shows the TAC species apportionment in gasoline and Figure X-2 shows the source apportionment of the calculated cancer risks for underground storage tanks. Using the results from the Ontario Airport meteorological station and at a downwind distance of 25 meters, emissions from spillage account for 48.5 percent of the cancer risk, while benzene is the air toxics which drives the cancer risk, accounting for 845 percent. This is consistent with the discussion of the relative toxicity of substances in gasoline found in Appendix I of the 1997 CAPCOA Guidelines, which shows that benzene is the most important TAC driving the cancer risks at gasoline service stations.

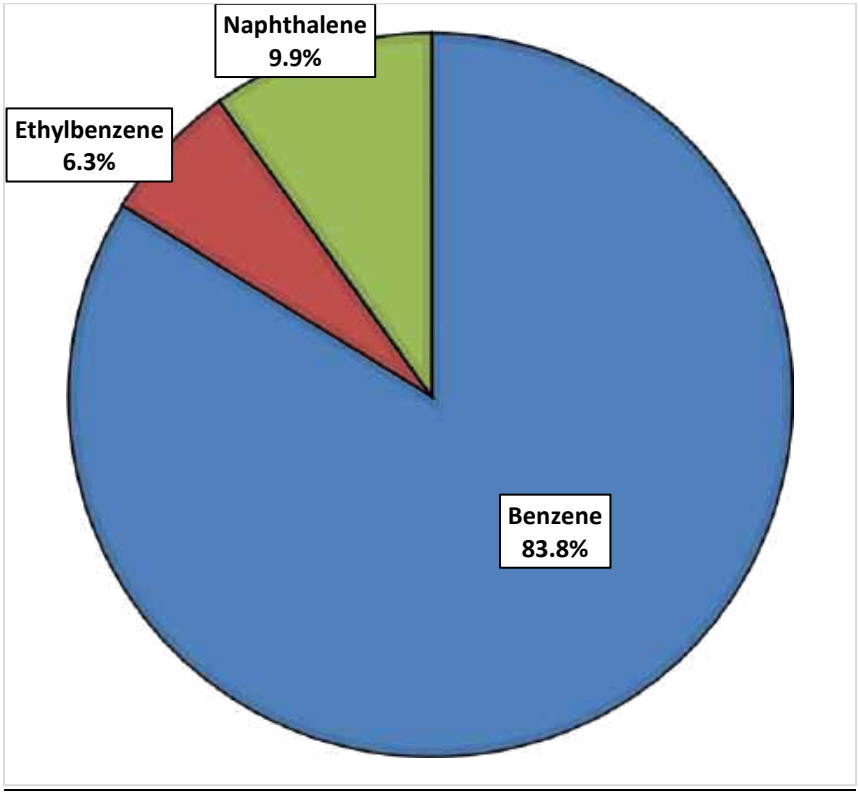



**Figure X-1: Cancer Risk by Toxic Compound**

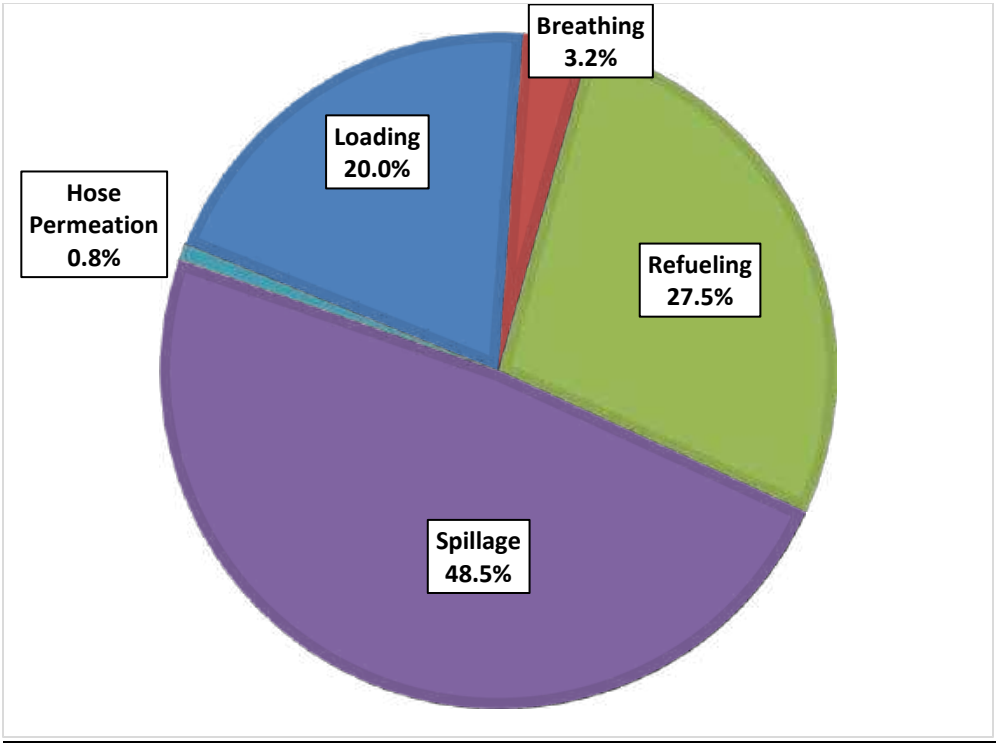



**Figure X-2: Cancer Risk by Source**

## Sensitivity Analysis Regarding Non-Cancer Risks

A sensitivity analysis examining the chronic and acute non-cancer risks was prepared using CARB's speciation profile of 16 TACs in gasoline, the Ontario International Airport meteorological station, a receptor distance of 25 meters, and a throughput of one million gallons per year. The TACs included in CARB's speciation profile are n-butyl alcohol, benzene, isoprene, naphthalene, 2-methyl naphthalene, o-xylene, 1,2,4-trimethylbenzene, cumene, ethylbenzene, p-xylene, m-xylene, toluene, hexane, cyclohexane, propylene, and 2,2,4-trimethylpentane. As seen in Table X-2, the sensitivity analysis calculated the Hazard Index (HI) for each of the 16 TACs, which was then summed, regardless of target organ.

**Table X-2: Sensitivity Analysis Results for Non-Cancer Risks**

| TACs | Chronic HI | Acute HI |
|---|---|---|
| Benzene | 0.01996 | 0.02967 |
| Ethylbenzene | 0.000025909 | 0 |
| Naphthalene | 0.000654 | 0 |
| Toluene | 0.000925 | 0.000102 |
| m-Xylene | 0.0001846 | 0.00008009 |
| o-Xylene | 0.0001013 | 0.00004398 |
| p-Xylene | 0.0000774 | 0.00003357 |
| Hexane | 0.00002951 | 0 |
| Propylene | 0.0000000398 | 0 |
| 1,2,4-trimethylbenzene | 0 | 0 |
| 2,2,4-trimethylpentane | 0 | 0 |
| 2-methyl naphthalene | 0 | 0 |
| Cumene | 0 | 0 |
| Cyclohexane | 0 | 0 |
| Isoprene | 0 | 0 |
| n-Butyl Alcohol | 0 | 0 |
| **Max Chronic HI** | **0.01996** | **0.02967** |
| | | |
| **Million Gallons of Throughput to reach HI = 1.0** | **50.09** | **33.7** |

The results of the sensitivity analysis show that benzene is the driver for both the chronic and acute hazard indices, with risks from benzene being two orders of magnitude higher than the next highest TAC. Using CARB's speciation profile, seven of the 16 TACs did not have RELs associated with them. The maximum chronic HI was 0.02 and the maximum acute HI was 0.03 at a throughput of one million gallons of gasoline per year. The results demonstrate that for the maximum permitted risk of ten in a million, the acute and chronic HI are much lower (< 0.1) than the threshold of 1.0. Therefore, the chronic and acute non-cancer health effects do not need to be calculated, which is consistent with the 1997 CAPCOA Guidelines.

## Example Calculation

The following example demonstrates how SCAQMD staff plans to estimate cancer risk values for retail gasoline dispensing facilities based on information received and using Attachment N, Tables 12.1 A – 12.2 B.

The calculation steps are as follows:

1. **Cancer Risk (CR):** Cancer risk values are estimated for each retail gasoline dispensing facility based on facility location, process information, and receptor proximity.
   a. *Residential CR:* Use the facility location and the distance to the nearest resident to identify the risk. The residential CRs for retail gasoline dispensing are contained in Attachment N, Tables 12.1A and 12.2A.
   b. *Off-Site Worker CR:* Use the facility location and the distance to the nearest worker to identify the risk. The off-site worker CRs for retail gasoline dispensing are contained in Table 12.1B and 12.2B.
   c. *Maximum Individual CR (MICR):* Select the greater CR between the residential and occupational CRs (as identified above).

Please note the following when calculating risk values for gasoline dispensing facilities:

- The gasoline dispensing risk tables (Attachment N, Tables 12.1 A – 12.2 B) are based on a gasoline throughput of one million (MM) gallons per year (gal/yr). The annual facility throughput should be multiplied by the values contained in the gasoline dispensing risk tables to calculate the appropriate facility risk.
- The SCAQMD maintains 24 meteorological stations that are processed for modeling purposes, as shown in Appendix VI, Figure VI-1 and Appendix VI, Table VI-1. The meteorological station that best represents the facility's meteorological conditions (such as prevailing winds), terrain, and surrounding land use should be used. This means that the closest meteorological station to the facility is not always the most representative meteorologically.
- The gasoline dispensing risk tables (Attachment N, Tables 12.1 A – 12.2 B) are based on discrete downwind distances. If the actual downwind distance is not listed in the tables, then linear interpolation between distance cells is acceptable.
- Although gasoline vapors and its TAC constituents (for example, benzene, toluene, and xylene) have non-cancer impacts, **the risks from retail gasoline dispensing facilities are dominated by cancer risk**. Therefore, the hazard index will not be calculated for inclusion in the gasoline dispensing risk tables.

**Example: A retail gasoline dispensing facility with an underground storage tank submits the following information with their application: 15 MM gal/yr gasoline requested throughput, located in Yorba Linda, nearest residential receptor 200 meters away, and nearest off-site worker receptor 25 meters away.**

In this example, the actual downwind distances match the distances found in the tables. However, when the actual downwind distances are not in the tables, then using linear interpolation to calculate between the distance cells is acceptable to obtain cancer risks for the actual downwind distances.

2. **Cancer Risk (CR):**

   a. *Residential CR:* According to Appendix VI, Table VI-1, Yorba Linda is located in SRA 16 and the appropriate meteorological station is in Fullerton (KFUL). Using Attachment N, Table 12.1 A for the Fullerton meteorological station, the residential cancer risk is 0.1041~~2~~ in one million (200 meters) for 1 MM gal/yr. Since the facility's requested gasoline throughput for this example is 15 MM gal/yr, the corresponding residential cancer risk is 1.~~6~~856 in one million.

   **Residential CR** = 0.~~1~~104 in one million x 15 MM gal/yr
   (1 MM gal/yr)

   **Residential CR** = 1.~~6~~856 in one million

   b. *Worker CR:* According to Appendix VI, Table VI-1, Yorba Linda is located in SRA 16 and the appropriate meteorological station is in Fullerton (KFUL). Using Attachment N, Table 12.1 B, the occupational cancer risk is 0.~~2~~225 in one million (25 meters) for 1 MM gal/yr. Since the facility's gasoline throughput for this example is 15 MM gal/yr, the corresponding occupational cancer risk is 3.38~~59~~ in one million.

   **Occupational CR** = 0.~~2~~225 in one million x 15 MM gal/yr
   (1 MM gal/yr)

   **Occupational CR** = 3.~~5~~38 in one million

   c. *MICR:* The MICR for this retail gasoline facility is **3.~~5~~38** in one million (occupational receptor).

# APPENDIX XI

# METHODOLOGY USED TO DEVELOP TIER 2 SCREENING TABLES FOR SPRAY BOOTHS

## Introduction

The purpose of this appendix is to document the methods used by SCAQMD staff to develop the screening tables for spray booths. The methods are consistent with SCAQMD's risk assessment procedures for Rule 1401 and were used to update the Rule 1401 Tier 2 screening tables using AERMOD.

## Emission Inventory Methods

In order to determine the appropriate emission rates to use, please contact the appropriate SCAQMD Engineering and Permitting staff (http://www.aqmd.gov/contact/permitting-staff) for more information.

## Modeling Parameters

For the general dispersion modeling methodology and meteorological stations used in the development of the screening tables, please see Appendix VI.

Based on information from SCAQMD Engineering and Permitting staff, the model parameters were developed for two typical spray booth configurations, each with a single stack vent located 6 feet above the roof of a building. Each spray booth was modeled as a point source using the parameters shown in Table XI-1. Building downwash effects were analyzed, with a building size of 20 meters by 70 meters and a building height of 6 feet below each stack height.

**Table XI-1: Model Parameters for Spray Booths**

| Source ID | Stack Height | | Stack Diameter | | Stack Temperature | | Stack Velocity | | Flowrate |
|---|---|---|---|---|---|---|---|---|---|
| | (ft) | (m) | (ft) | (m) | ($^0$F) | (K) | (ft/s) | (m/s) | ($ft^3$/min) |
| P1 | 16 | 4.88 | 2.83 | 0.864 | Ambient | 0* | 26.43 | 8.05 | 10,000 |
| P2 | 24 | 7.32 | 2.83 | 0.864 | Ambient | 0* | 26.43 | 8.05 | 10,000 |

Note: * The temperature used in AERMOD was set to 0 K, which indicates that the ambient temperature was used in the model run.

A sample AERMOD model input file is provided in Appendix XIII, Exhibit XI.

# APPENDIX XII

# METHODOLOGY USED TO DEVELOP TIER 2 SCREENING TABLES FOR SHORT-TERM PROJECTS

## Introduction

When performing a Tier 2 analysis for short-term projects (such as portable equipment, air pollution control equipment used for soil remediation projects, etc), the combined exposure factor and appropriate multi-pathway factor needs to be determined based on the duration of the project.

When conducting a Tier 2 analysis for short-term projects, you may also use the following equation using a **default exposure value (CEF):**

$$\mathbf{MICR_{(R,ST)} = CP \times Q_{tpy} \times \chi/Q \times CEF_{(R,ST)} \times MP_{(R,ST)} \times 10^{-6} \times MWAF}$$

$$\mathbf{MICR_{(W,ST)} = CP \times Q_{tpy} \times \chi/Q \times CEF_{(W,ST)} \times MP_{(W,ST)} \times WAF \times 10^{-6} \times MWAF}$$

| Term | Description | Where to Find |
|---|---|---|
| $Q_{tpy}$ | Maximum emission rate (tons/yr) | Emission estimate specific to permit unit |
| $\chi/Q$ | Concentration at a receptor distance / Emission Rate [($\mu g/m^3$)/(tons/yr)] | Attachment N, Tables 6.1 A – 7.6 B |
| MWAF | Molecular Weight Adjustment Factor | Consolidated Health Values Table found at https://www.arb.ca.gov/toxics/healthval/contable.pdf |
| CP | Cancer Potency $(mg/kg\text{-}day)^{-1}$ | |
| MP | Multi-Pathway Adjustment Factor (if applicable) | Attachment N, Table 3.1 |
| CEF | Combined Exposure Factor | Attachment N, Tables 4.1 A – 4.2 D |
| WAF | Worker Adjustment Factor | Attachment N, Tables 5.1 and 5.2 |
| $10^{-6}$ | Micrograms to milligrams conversion, liters to cubic meters conversion | not applicable |

Please note that SCAQMD Engineering and Permitting staff (http://www.aqmd.gov/contact/permitting-staff) should be consulted prior to the use of these exposure factors to determine if these factors are appropriate for the air quality permit application. Permit conditions limiting the duration of the use of equipment consistent with the analysis will be imposed, and information regarding the project duration will need to be well documented for the short-term projects.

Since these short-term calculations are only meant for projects with limits on the operating duration, these short-term cancer risk assessments can be thought of as being the equivalent to a 30-year cancer risk estimate and the appropriate thresholds would still apply (i.e. for a 5-year project, the maximum emissions during the 5-year period would be assessed on the more sensitive

population, from the third trimester to age 5, after which the project's emissions would drop to 0 for the remaining 25 years to get the 30-year equivalent cancer risk estimate).

# APPENDIX XIII

# AERMOD INPUT FILES USED TO DEVELOP TIER 2 SCREENING TABLES

# Exhibit VII - Sample AERMOD Input Files for Non-Combustion Sources

**Non-Combustion Point Sources (P1, P2, P3)**

```
CO STARTING
   TITLEONE R1401 Risk Assessment Procedures
   TITLETWO Continuous Operation
   MODELOPT CONC FLAT
   AVERTIME 1   PERIOD
   POLLUTID Any
   RUNORNOT RUN
   URBANOPT 9818605 LA
CO FINISHED
SO STARTING
   LOCATION P1 POINT     0.0    0.0    0.0
   LOCATION P2 POINT     0.0    0.0    0.0
   LOCATION P3 POINT     0.0    0.0    0.0
   SRCPARAM P1   2.88E-02    4.27    0      10.0       0.3
   SRCPARAM P2   2.88E-02    7.62    0      10.0       0.3
   SRCPARAM P3   2.88E-02   15.24    0      10.0       0.3
SO BUILDHGT P1    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P1    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P1    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P1    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P1    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P1    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDWID P1   24.91   29.05   32.32   34.60   35.84   35.98
SO BUILDWID P1   35.03   33.02   30.00   33.02   35.03   35.98
SO BUILDWID P1   35.84   34.60   32.32   29.05   24.91   20.00
SO BUILDWID P1   24.91   29.05   32.32   34.60   35.84   35.98
SO BUILDWID P1   35.03   33.02   30.00   33.02   35.03   35.98
SO BUILDWID P1   35.84   34.60   32.32   29.05   24.91   20.00
SO BUILDLEN P1   33.02   35.03   35.98   35.84   34.60   32.32
SO BUILDLEN P1   29.05   24.91   20.00   24.91   29.05   32.32
SO BUILDLEN P1   34.60   35.84   35.98   35.03   33.02   30.00
SO BUILDLEN P1   33.02   35.03   35.98   35.84   34.60   32.32
SO BUILDLEN P1   29.05   24.91   20.00   24.91   29.05   32.32
SO BUILDLEN P1   34.60   35.84   35.98   35.03   33.02   30.00
SO XBADJ    P1  -16.51  -17.52  -17.99  -17.92  -17.30  -16.16
SO XBADJ    P1  -14.53  -12.45  -10.00  -12.45  -14.53  -16.16
SO XBADJ    P1  -17.30  -17.92  -17.99  -17.52  -16.51  -15.00
SO XBADJ    P1  -16.51  -17.52  -17.99  -17.92  -17.30  -16.16
SO XBADJ    P1  -14.53  -12.45  -10.00  -12.45  -14.53  -16.16
SO XBADJ    P1  -17.30  -17.92  -17.99  -17.52  -16.51  -15.00
SO YBADJ    P1    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P1    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P1    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P1    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P1    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P1    0.00    0.00    0.00    0.00    0.00    0.00
SO BUILDHGT P2    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P2    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P2    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P2    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P2    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P2    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDWID P2   24.91   29.05   32.32   34.60   35.84   35.98
SO BUILDWID P2   35.03   33.02   30.00   33.02   35.03   35.98
SO BUILDWID P2   35.84   34.60   32.32   29.05   24.91   20.00
SO BUILDWID P2   24.91   29.05   32.32   34.60   35.84   35.98
SO BUILDWID P2   35.03   33.02   30.00   33.02   35.03   35.98
SO BUILDWID P2   35.84   34.60   32.32   29.05   24.91   20.00
SO BUILDLEN P2   33.02   35.03   35.98   35.84   34.60   32.32
SO BUILDLEN P2   29.05   24.91   20.00   24.91   29.05   32.32
SO BUILDLEN P2   34.60   35.84   35.98   35.03   33.02   30.00
SO BUILDLEN P2   33.02   35.03   35.98   35.84   34.60   32.32
SO BUILDLEN P2   29.05   24.91   20.00   24.91   29.05   32.32
SO BUILDLEN P2   34.60   35.84   35.98   35.03   33.02   30.00
SO XBADJ    P2  -16.51  -17.52  -17.99  -17.92  -17.30  -16.16
SO XBADJ    P2  -14.53  -12.45  -10.00  -12.45  -14.53  -16.16
SO XBADJ    P2  -17.30  -17.92  -17.99  -17.52  -16.51  -15.00
SO XBADJ    P2  -16.51  -17.52  -17.99  -17.92  -17.30  -16.16
SO XBADJ    P2  -14.53  -12.45  -10.00  -12.45  -14.53  -16.16
SO XBADJ    P2  -17.30  -17.92  -17.99  -17.52  -16.51  -15.00
SO YBADJ    P2    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P2    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P2    0.00    0.00    0.00    0.00    0.00    0.00
```

```
SO YBADJ    P2    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P2    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P2    0.00    0.00    0.00    0.00    0.00    0.00
SO BUILDHGT P3    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P3    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P3    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P3    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P3    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDHGT P3    4.00    4.00    4.00    4.00    4.00    4.00
SO BUILDWID P3   24.91   29.05   32.32   34.60   35.84   35.98
SO BUILDWID P3   35.03   33.02   30.00   33.02   35.03   35.98
SO BUILDWID P3   35.84   34.60   32.32   29.05   24.91   20.00
SO BUILDWID P3   24.91   29.05   32.32   34.60   35.84   35.98
SO BUILDWID P3   35.03   33.02   30.00   33.02   35.03   35.98
SO BUILDWID P3   35.84   34.60   32.32   29.05   24.91   20.00
SO BUILDLEN P3   33.02   35.03   35.98   35.84   34.60   32.32
SO BUILDLEN P3   29.05   24.91   20.00   24.91   29.05   32.32
SO BUILDLEN P3   34.60   35.84   35.98   35.03   33.02   30.00
SO BUILDLEN P3   33.02   35.03   35.98   35.84   34.60   32.32
SO BUILDLEN P3   29.05   24.91   20.00   24.91   29.05   32.32
SO BUILDLEN P3   34.60   35.84   35.98   35.03   33.02   30.00
SO XBADJ    P3  -16.51  -17.52  -17.99  -17.92  -17.30  -16.16
SO XBADJ    P3  -14.53  -12.45  -10.00  -12.45  -14.53  -16.16
SO XBADJ    P3  -17.30  -17.92  -17.99  -17.52  -16.51  -15.00
SO XBADJ    P3  -16.51  -17.52  -17.99  -17.92  -17.30  -16.16
SO XBADJ    P3  -14.53  -12.45  -10.00  -12.45  -14.53  -16.16
SO XBADJ    P3  -17.30  -17.92  -17.99  -17.52  -16.51  -15.00
SO YBADJ    P3    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P3    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P3    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P3    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P3    0.00    0.00    0.00    0.00    0.00    0.00
SO YBADJ    P3    0.00    0.00    0.00    0.00    0.00    0.00
   URBANSRC P1
   URBANSRC P2
   URBANSRC P3
   SRCGROUP  P1  P1
   SRCGROUP  P2  P2
   SRCGROUP  P3  P3
SO SRCGROUP  ALL
SO FINISHED
RE STARTING
   GRIDPOLR POL1 STA
                ORIG     0.0     0.0
                DIST  25 50 75 100 200 300 500 1000
                GDIR     36     10.0     10.0
   GRIDPOLR POL1 END
RE FINISHED
ME STARTING
   SURFFILE AZUS_v9.SFC
   PROFFILE AZUS_v9.PFL
   SURFDATA 0 2010
   UAIRDATA 3190 2010
   PROFBASE 0.0 METERS
ME FINISHED
OU STARTING
   RECTABLE  1       FIRST
   RECTABLE  ALLAVE  FIRST
   PLOTFILE  1       P1  FIRST  BM1T1P1.TXT
   PLOTFILE  PERIOD  P1         BM1T2P1.TXT
   PLOTFILE  1       P2  FIRST  BM1T1P2.TXT
   PLOTFILE  PERIOD  P2         BM1T2P2.TXT
   PLOTFILE  1       P3  FIRST  BM1T1P3.TXT
   PLOTFILE  PERIOD  P3         BM1T2P3.TXT
OU FINISHED
```

**Non-Combustion Volume Source (V1)**

```
CO STARTING
   TITLEONE Modeling for R1401 Risk Assessment Procedures
   TITLETWO 24 hrs/day; 7 days/week; 52 weeks/yr
   MODELOPT CONC FLAT
   AVERTIME 1 PERIOD
   URBANOPT 9818605 LA
   POLLUTID ANY
   RUNORNOT RUN
CO FINISHED
SO STARTING
   LOCATION V1 VOLUME 0.0  0.0  0.0
```

```
   SRCPARAM V1       0.0288      2.29    2.75   2.13
   URBANSRC ALL
   SRCGROUP V1       V1
   SRCGROUP ALL
SO FINISHED
RE STARTING
   GRIDPOLR UPOL1 STA
                  ORIG 0.0 0.0
                  DIST 33  58  83  108  208  308  508  1008
                  GDIR 36 0.0 10.0
   GRIDPOLR UPOL1 END
RE FINISHED
ME STARTING
   SURFFILE AZUS_v9.SFC
   PROFFILE AZUS_v9.PFL
   SURFDATA 0 2010
   UAIRDATA 3190 2010
   SITEDATA 99999 2010
   PROFBASE 0.0 METERS
ME FINISHED
OU STARTING
   RECTABLE ALLAVE 1ST
   RECTABLE 1 1ST
   PLOTFILE 1 V1 1ST  BM1T1V1.TXT
   PLOTFILE PERIOD V1 BM1T2V1.TXT
OU FINISHED
```

**Non-Combustion Volume Source (V2 and V3)**

```
CO STARTING
   TITLEONE Modeling for R1401 Risk Assessment Procedures
   TITLETWO 24 hrs/day; 7 days/week; 52 weeks/yr
   MODELOPT CONC FLAT
   AVERTIME 1 PERIOD
   URBANOPT 9818605 LA
   POLLUTID ANY
   RUNORNOT RUN
CO FINISHED
SO STARTING
   LOCATION V2 VOLUME  0.0 0.0 0.0
   LOCATION V3 VOLUME  0.0 0.0 0.0
   SRCPARAM V2      0.0288     2.29    5.01    2.13
   SRCPARAM V3      0.0288     4.57    5.01    4.25
   URBANSRC ALL
   SRCGROUP V2       V2
   SRCGROUP V3       V3
   SRCGROUP ALL
SO FINISHED
 RE STARTING
   GRIDPOLR UPOL1 STA
                   ORIG 0.0 0.0
                   DIST 40  65  90  115  215  315  515  1015
                   GDIR 36 0.0 10.0
   GRIDPOLR UPOL1 END
RE FINISHED
ME STARTING
   SURFFILE AZUS_v9.SFC
   PROFFILE AZUS_v9.PFL
   SURFDATA 0 2010
   UAIRDATA 3190 2010
   SITEDATA 99999 2010
   PROFBASE 0.0 METERS
ME FINISHED
OU STARTING
   RECTABLE ALLAVE 1ST
   RECTABLE 1 1ST
   PLOTFILE 1 V2 1ST  BM1T1V2.TXT
   PLOTFILE 1 V3 1ST  BM1T1V3.TXT
   PLOTFILE PERIOD V2 BM1T2V2.TXT
   PLOTFILE PERIOD V3 BM1T2V3.TXT
OU FINISHED
```

**Non-Combustion Volume Source (V4 and V5)**

```
CO STARTING
   TITLEONE Modeling for R1401 Risk Assessment Procedures
   TITLETWO 24 hrs/day; 7 days/week; 52 weeks/yr
   MODELOPT CONC FLAT
   AVERTIME 1 PERIOD
```

```
   URBANOPT 9818605 LA
   POLLUTID ANY
   RUNORNOT RUN
CO FINISHED
SO STARTING
   LOCATION V4 VOLUME  0.0 0.0 0.0
   LOCATION V5 VOLUME  0.0 0.0 0.0
   SRCPARAM V4      0.0288     2.20    8.68    2.13
   SRCPARAM V5      0.0288     4.57    8.68    4.25
   URBANSRC ALL
   SRCGROUP V4       V4
   SRCGROUP V5       V5
   SRCGROUP ALL
SO FINISHED
RE STARTING
   GRIDPOLR UPOL1 STA
                    ORIG 0.0 0.0
                    DIST 51  76  101  126  226  326  526  1026
                    GDIR 36 0.0 10.0
   GRIDPOLR UPOL1 END
RE FINISHED
ME STARTING
   SURFFILE AZUS_v9.SFC
   PROFFILE AZUS_v9.PFL
   SURFDATA 0 2010
   UAIRDATA 3190 2010
   SITEDATA 99999 2010
   PROFBASE 0.0 METERS
ME FINISHED
OU STARTING
   RECTABLE ALLAVE 1ST
   RECTABLE 1 1ST
   PLOTFILE 1 V4 1ST  BM1T1V4.TXT
   PLOTFILE 1 V5 1ST  BM1T1V5.TXT
   PLOTFILE PERIOD V4 BM1T2V4.TXT
   PLOTFILE PERIOD V5 BM1T2V5.TXT
OU FINISHED
```

**Non-Combustion Volume Source (V6)**

```
CO STARTING
   TITLEONE Modeling for R1401 Risk Assessment Procedures
   TITLETWO 24 hrs/day; 7 days/week; 52 weeks/yr
   MODELOPT CONC FLAT
   AVERTIME 1 PERIOD
   URBANOPT 9818605 LA
   POLLUTID ANY
   RUNORNOT RUN
CO FINISHED
SO STARTING
   LOCATION V6 VOLUME  0.0 0.0 0.0
   SRCPARAM V6       0.02885   4.57   15.04    4.25
   URBANSRC ALL
   SRCGROUP V6       V6
   SRCGROUP ALL
SO FINISHED
RE STARTING
   GRIDPOLR UPOL1 STA
                    ORIG 0.00 0.00
                    DIST 71  96  121  146  246  346  546  1046
                    GDIR 36 0.00 10.00
   GRIDPOLR UPOL1 END
RE FINISHED
ME STARTING
   SURFFILE AZUS_v9.SFC
   PROFFILE AZUS_v9.PFL
   SURFDATA 0 2010
   UAIRDATA 3190 2010
   SITEDATA 99999 2010
   PROFBASE 0.0 METERS
ME FINISHED
OU STARTING
   RECTABLE ALLAVE 1ST
   RECTABLE 1 1ST
   PLOTFILE 1 V6 1ST  BM1T1V6.TXT
   PLOTFILE PERIOD V6 BM1T2V6.TXT
OU FINISHED
```

# Exhibit VIII - Sample AERMOD Input File for Combustion Sources

```
CO STARTING
   TITLEONE Combustion Screening Table
   TITLETWO Continuous Operation
   MODELOPT CONC FLAT
   AVERTIME 1   PERIOD
   POLLUTID Any
   RUNORNOT RUN
   URBANOPT 9818605 LA
CO FINISHED
SO STARTING
   LOCATION D1 POINT     0.0    0.0    0.0
   LOCATION D2 POINT     0.0    0.0    0.0
   LOCATION D3 POINT     0.0    0.0    0.0
   LOCATION D4 POINT     0.0    0.0    0.0
   LOCATION D5 POINT     0.0    0.0    0.0
   LOCATION N1 POINT     0.0    0.0    0.0
   LOCATION N2 POINT     0.0    0.0    0.0
   LOCATION N3 POINT     0.0    0.0    0.0
   LOCATION N4 POINT     0.0    0.0    0.0
   LOCATION N5 POINT     0.0    0.0    0.0
   LOCATION B1 POINT     0.0    0.0    0.0
   LOCATION B2 POINT     0.0    0.0    0.0
   LOCATION B3 POINT     0.0    0.0    0.0
   LOCATION B4 POINT     0.0    0.0    0.0
   LOCATION B5 POINT     0.0    0.0    0.0
   LOCATION B6 POINT     0.0    0.0    0.0
   LOCATION B7 POINT     0.0    0.0    0.0
   SRCPARAM D1   2.88E-02     3.0     760     65.0      0.09
   SRCPARAM D2   2.88E-02     3.0     760     55.0      0.12
   SRCPARAM D3   2.88E-02     3.0     760     80.0      0.13
   SRCPARAM D4   2.88E-02     3.0     770     90.0      0.15
   SRCPARAM D5   2.88E-02     4.0     800    160.0      0.17
   SRCPARAM N1   2.88E-02     4.0     850     40.0      0.07
   SRCPARAM N2   2.88E-02     4.0     850     65.0      0.08
   SRCPARAM N3   2.88E-02     4.0     890     55.0      0.14
   SRCPARAM N4   2.88E-02     5.0     820     60.0      0.19
   SRCPARAM N5   2.88E-02     7.0     750     65.0      0.35
   SRCPARAM B1   2.88E-02     9.0     440      5.0      0.40
   SRCPARAM B2   2.88E-02     9.0     470      7.0      0.50
   SRCPARAM B3   2.88E-02     9.0     470     9.0      0.55
   SRCPARAM B4   2.88E-02    10.0     470    10.0      0.67
   SRCPARAM B5   2.88E-02    10.0     495    12.0      0.72
   SRCPARAM B6   2.88E-02    14.0     440    10.0      1.10
   SRCPARAM B7   2.88E-02    16.0     430    12.0      1.50
   BUILDHGT D1              4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT D1              4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT D1              4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT D1              4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT D1              4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT D1              4.00     4.00     4.00     4.00     4.00     4.00
   BUILDWID D1             24.91    29.05    32.32    34.60    35.84    35.98
   BUILDWID D1             35.03    33.02    30.00    33.02    35.03    35.98
   BUILDWID D1             35.84    34.60    32.32    29.05    24.91    20.00
   BUILDWID D1             24.91    29.05    32.32    34.60    35.84    35.98
   BUILDWID D1             35.03    33.02    30.00    33.02    35.03    35.98
   BUILDWID D1             35.84    34.60    32.32    29.05    24.91    20.00
   BUILDLEN D1             33.02    35.03    35.98    35.84    34.60    32.32
   BUILDLEN D1             29.05    24.91    20.00    24.91    29.05    32.32
   BUILDLEN D1             34.60    35.84    35.98    35.03    33.02    30.00
   BUILDLEN D1             33.02    35.03    35.98    35.84    34.60    32.32
   BUILDLEN D1             29.05    24.91    20.00    24.91    29.05    32.32
   BUILDLEN D1             34.60    35.84    35.98    35.03    33.02    30.00
   XBADJ    D1            -16.51   -17.52   -17.99   -17.92   -17.30   -16.16
   XBADJ    D1            -14.53   -12.45   -10.00   -12.45   -14.53   -16.16
   XBADJ    D1            -17.30   -17.92   -17.99   -17.52   -16.51   -15.00
   XBADJ    D1            -16.51   -17.52   -17.99   -17.92   -17.30   -16.16
   XBADJ    D1            -14.53   -12.45   -10.00   -12.45   -14.53   -16.16
   XBADJ    D1            -17.30   -17.92   -17.99   -17.52   -16.51   -15.00
   YBADJ    D1              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    D1              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    D1              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    D1              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    D1              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    D1              0.00     0.00     0.00     0.00     0.00     0.00
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BUILDHGT | D2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | D2 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | D2 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | D2 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | D2 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | D2 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | D2 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | D2 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | D2 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | D2 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | D2 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | D2 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | D2 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | D2 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | D2 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | D2 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | D2 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | D2 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | D2 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | D2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | D3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | D3 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | D3 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | D3 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | D3 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | D3 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | D3 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | D3 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | D3 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | D3 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | D3 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | D3 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | D3 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | D3 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | D3 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | D3 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | D3 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | D3 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | D3 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | D3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | D4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | D4 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | D4 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | D4 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | D4 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | D4 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | D4 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | D4 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | D4 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | D4 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | D4 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | D4 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | D4 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | D4 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| XBADJ | D4 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | D4 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | D4 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | D4 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | D4 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | D4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | D5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | D5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | D5 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | D5 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | D5 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | D5 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | D5 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | D5 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | D5 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | D5 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | D5 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | D5 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | D5 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | D5 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | D5 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | D5 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | D5 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | D5 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | D5 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | D5 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | D5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | D5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | N1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | N1 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N1 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | N1 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | N1 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N1 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | N1 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | N1 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N1 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N1 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | N1 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N1 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N1 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | N1 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N1 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N1 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | N1 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N1 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N1 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | N1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | N2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | N2 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N2 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BUILDWID | N2 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | N2 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N2 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | N2 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | N2 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N2 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N2 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | N2 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N2 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N2 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | N2 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N2 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N2 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | N2 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N2 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N2 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | N2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | N3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | N3 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N3 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | N3 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | N3 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N3 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | N3 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | N3 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N3 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N3 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | N3 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N3 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N3 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | N3 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N3 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N3 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | N3 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N3 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N3 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | N3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | N4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | N4 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N4 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | N4 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | N4 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N4 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | N4 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | N4 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N4 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N4 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | N4 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N4 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N4 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | N4 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N4 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N4 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | N4 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N4 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N4 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | N4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| YBADJ | N4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | N5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | N5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | N5 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N5 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | N5 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | N5 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | N5 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | N5 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | N5 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N5 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N5 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | N5 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | N5 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | N5 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | N5 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N5 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N5 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | N5 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | N5 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | N5 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | N5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | N5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | B1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B1 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | B1 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B1 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B1 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | B1 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B1 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B1 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | B1 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B1 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B1 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | B1 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B1 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B1 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | B1 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B1 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B1 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | B1 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B1 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B1 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | B1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | B2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B2 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | B2 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B2 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B2 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | B2 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B2 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B2 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | B2 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B2 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B2 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | B2 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BUILDLEN | B2 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B2 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | B2 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B2 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B2 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | B2 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B2 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B2 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | B2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | B3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B3 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | B3 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B3 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B3 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | B3 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B3 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B3 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | B3 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B3 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B3 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | B3 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B3 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B3 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | B3 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B3 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B3 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | B3 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B3 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B3 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | B3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | B4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | B4 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B4 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B4 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | B4 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B4 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B4 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | B4 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B4 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B4 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | B4 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B4 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B4 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | B4 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B4 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B4 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | B4 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B4 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B4 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | B4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | B5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BUILDHGT | B5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | B5 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B5 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B5 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | B5 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B5 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B5 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | B5 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B5 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B5 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | B5 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B5 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B5 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | B5 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B5 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B5 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | B5 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B5 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B5 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | B5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | B6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | B6 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B6 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B6 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | B6 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B6 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B6 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | B6 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B6 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B6 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | B6 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B6 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B6 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | B6 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B6 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B6 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | B6 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B6 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B6 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| YBADJ | B6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | B6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BUILDHGT | B7 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B7 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B7 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B7 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B7 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | B7 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | B7 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B7 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B7 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDWID | B7 | 24.91 | 29.05 | 32.32 | 34.60 | 35.84 | 35.98 |
| BUILDWID | B7 | 35.03 | 33.02 | 30.00 | 33.02 | 35.03 | 35.98 |
| BUILDWID | B7 | 35.84 | 34.60 | 32.32 | 29.05 | 24.91 | 20.00 |
| BUILDLEN | B7 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B7 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B7 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| BUILDLEN | B7 | 33.02 | 35.03 | 35.98 | 35.84 | 34.60 | 32.32 |
| BUILDLEN | B7 | 29.05 | 24.91 | 20.00 | 24.91 | 29.05 | 32.32 |
| BUILDLEN | B7 | 34.60 | 35.84 | 35.98 | 35.03 | 33.02 | 30.00 |
| XBADJ | B7 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B7 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B7 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |
| XBADJ | B7 | -16.51 | -17.52 | -17.99 | -17.92 | -17.30 | -16.16 |
| XBADJ | B7 | -14.53 | -12.45 | -10.00 | -12.45 | -14.53 | -16.16 |
| XBADJ | B7 | -17.30 | -17.92 | -17.99 | -17.52 | -16.51 | -15.00 |

```
   YBADJ    B7              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    B7              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    B7              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    B7              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    B7              0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    B7              0.00     0.00     0.00     0.00     0.00     0.00
   URBANSRC D1
   URBANSRC D2
   URBANSRC D3
   URBANSRC D4
   URBANSRC D5
   URBANSRC N1
   URBANSRC N2
   URBANSRC N3
   URBANSRC N4
   URBANSRC N5
   URBANSRC B1
   URBANSRC B2
   URBANSRC B3
   URBANSRC B4
   URBANSRC B5
   URBANSRC B6
   URBANSRC B7
   SRCGROUP  D1  D1
   SRCGROUP  D2  D2
   SRCGROUP  D3  D3
   SRCGROUP  D4  D4
   SRCGROUP  D5  D5
   SRCGROUP  N1  N1
   SRCGROUP  N2  N2
   SRCGROUP  N3  N3
   SRCGROUP  N4  N4
   SRCGROUP  N5  N5
   SRCGROUP  B1  B1
   SRCGROUP  B2  B2
   SRCGROUP  B3  B3
   SRCGROUP  B4  B4
   SRCGROUP  B5  B5
   SRCGROUP  B6  B6
   SRCGROUP  B7  B7
SO FINISHED
RE STARTING
   GRIDPOLR POL1 STA
                ORIG     0.0     0.0
                DIST  25 50 75 100 200 300 500 1000
                GDIR     36     10.0     10.0
   GRIDPOLR POL1 END
RE FINISHED
ME STARTING
   SURFFILE AZUS_v9.SFC
   PROFFILE AZUS_v9.PFL
   SURFDATA 0 2010
   UAIRDATA 3190 2010
   PROFBASE 0.0 METERS
ME FINISHED
OU STARTING
   RECTABLE  1       FIRST
   RECTABLE  ALLAVE  FIRST
   PLOTFILE  1       D1  FIRST  BM1T1D1.TXT
   PLOTFILE  PERIOD  D1         BM1T2D1.TXT
   PLOTFILE  1       D2  FIRST  BM1T1D2.TXT
   PLOTFILE  PERIOD  D2         BM1T2D2.TXT
   PLOTFILE  1       D3  FIRST  BM1T1D3.TXT
   PLOTFILE  PERIOD  D3         BM1T2D3.TXT
   PLOTFILE  1       D4  FIRST  BM1T1D4.TXT
   PLOTFILE  PERIOD  D4         BM1T2D4.TXT
   PLOTFILE  1       D5  FIRST  BM1T1D5.TXT
   PLOTFILE  PERIOD  D5         BM1T2D5.TXT
   PLOTFILE  1       N1  FIRST  BM1T1N1.TXT
   PLOTFILE  PERIOD  N1         BM1T2N1.TXT
   PLOTFILE  1       N2  FIRST  BM1T1N2.TXT
   PLOTFILE  PERIOD  N2         BM1T2N2.TXT
   PLOTFILE  1       N3  FIRST  BM1T1N3.TXT
   PLOTFILE  PERIOD  N3         BM1T2N3.TXT
   PLOTFILE  1       N4  FIRST  BM1T1N4.TXT
   PLOTFILE  PERIOD  N4         BM1T2N4.TXT
   PLOTFILE  1       N5  FIRST  BM1T1N5.TXT
   PLOTFILE  PERIOD  N5         BM1T2N5.TXT
   PLOTFILE  1       B1  FIRST  BM1T1B1.TXT
```

```
   PLOTFILE  PERIOD  B1         BM1T2B1.TXT
   PLOTFILE  1       B2  FIRST  BM1T1B2.TXT
   PLOTFILE  PERIOD  B2         BM1T2B2.TXT
   PLOTFILE  1       B3  FIRST  BM1T1B3.TXT
   PLOTFILE  PERIOD  B3         BM1T2B3.TXT
   PLOTFILE  1       B4  FIRST  BM1T1B4.TXT
   PLOTFILE  PERIOD  B4         BM1T2B4.TXT
   PLOTFILE  1       B5  FIRST  BM1T1B5.TXT
   PLOTFILE  PERIOD  B5         BM1T2B5.TXT
   PLOTFILE  1       B6  FIRST  BM1T1B6.TXT
   PLOTFILE  PERIOD  B6         BM1T2B6.TXT
   PLOTFILE  1       B7  FIRST  BM1T1B7.TXT
   PLOTFILE  PERIOD  B7         BM1T2B7.TXT
OU FINISHED
```

# Exhibit IX - Sample AERMOD Input File for Crematories

```
CO STARTING
   TITLEONE Modeling for R1401 Risk Assessment Procedures
   TITLETWO Crematory - Continuous Operation
   MODELOPT CONC FLAT
   AVERTIME 1   PERIOD
   URBANOPT 9818605 LA
   POLLUTID Any
   RUNORNOT RUN
CO FINISHED
SO STARTING
   LOCATION P1 POINT     0.0    0.0    0.0
   LOCATION P2 POINT     0.0    0.0    0.0
   LOCATION P3 POINT     0.0    0.0    0.0
   SRCPARAM P1   2.885E-02   5.791  977.59    5.8      0.508
   SRCPARAM P2   2.885E-02   5.791  977.59    5.8      0.508
   SRCPARAM P3   2.885E-02   5.791  977.59    5.8      0.508
SO BUILDHGT P1    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P1    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P1    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P1    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P1    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P1    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDWID P1   24.97    27.62    29.44    30.36    30.36    29.44
SO BUILDWID P1   27.62    24.97    21.55    24.97    27.62    29.44
SO BUILDWID P1   30.36    30.36    29.44    27.62    24.97    21.55
SO BUILDWID P1   24.97    27.62    29.44    30.36    30.36    29.44
SO BUILDWID P1   27.62    24.97    21.55    24.97    27.62    29.44
SO BUILDWID P1   30.36    30.36    29.44    27.62    24.97    21.55
SO BUILDLEN P1   24.97    27.62    29.44    30.36    30.36    29.44
SO BUILDLEN P1   27.62    24.97    21.55    24.97    27.62    29.44
SO BUILDLEN P1   30.36    30.36    29.44    27.62    24.97    21.55
SO BUILDLEN P1   24.97    27.62    29.44    30.36    30.36    29.44
SO BUILDLEN P1   27.62    24.97    21.55    24.97    27.62    29.44
SO BUILDLEN P1   30.36    30.36    29.44    27.62    24.97    21.55
SO XBADJ    P1  -12.48   -13.81   -14.72   -15.18   -15.18   -14.72
SO XBADJ    P1  -13.81   -12.48   -10.78   -12.48   -13.81   -14.72
SO XBADJ    P1  -15.18   -15.18   -14.72   -13.81   -12.48   -10.78
SO XBADJ    P1  -12.48   -13.81   -14.72   -15.18   -15.18   -14.72
SO XBADJ    P1  -13.81   -12.48   -10.78   -12.48   -13.81   -14.72
SO XBADJ    P1  -15.18   -15.18   -14.72   -13.81   -12.48   -10.78
SO YBADJ    P1    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P1    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P1    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P1    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P1    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P1    0.00     0.00     0.00     0.00     0.00     0.00
SO BUILDHGT P2    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P2    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P2    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P2    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P2    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P2    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDWID P2   35.31    39.07    41.64    42.94    42.94    41.64
SO BUILDWID P2   39.07    35.31    30.48    35.31    39.07    41.64
SO BUILDWID P2   42.94    42.94    41.64    39.07    35.31    30.48
SO BUILDWID P2   35.31    39.07    41.64    42.94    42.94    41.64
SO BUILDWID P2   39.07    35.31    30.48    35.31    39.07    41.64
SO BUILDWID P2   42.94    42.94    41.64    39.07    35.31    30.48
SO BUILDLEN P2   35.31    39.07    41.64    42.94    42.94    41.64
SO BUILDLEN P2   39.07    35.31    30.48    35.31    39.07    41.64
SO BUILDLEN P2   42.94    42.94    41.64    39.07    35.31    30.48
SO BUILDLEN P2   35.31    39.07    41.64    42.94    42.94    41.64
SO BUILDLEN P2   39.07    35.31    30.48    35.31    39.07    41.64
SO BUILDLEN P2   42.94    42.94    41.64    39.07    35.31    30.48
SO XBADJ    P2  -17.65   -19.53   -20.82   -21.47   -21.47   -20.82
SO XBADJ    P2  -19.53   -17.65   -15.24   -17.65   -19.53   -20.82
SO XBADJ    P2  -21.47   -21.47   -20.82   -19.53   -17.65   -15.24
SO XBADJ    P2  -17.65   -19.53   -20.82   -21.47   -21.47   -20.82
SO XBADJ    P2  -19.53   -17.65   -15.24   -17.65   -19.53   -20.82
SO XBADJ    P2  -21.47   -21.47   -20.82   -19.53   -17.65   -15.24
SO YBADJ    P2    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P2    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P2    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P2    0.00     0.00     0.00     0.00     0.00     0.00
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SO YBADJ    P2    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P2    0.00     0.00     0.00     0.00     0.00     0.00
SO BUILDHGT P3    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P3    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P3    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P3    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P3    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDHGT P3    3.96     3.96     3.96     3.96     3.96     3.96
SO BUILDWID P3   43.25    47.85    50.99    52.59    52.59    50.99
SO BUILDWID P3   47.85    43.25    37.33    43.25    47.85    50.99
SO BUILDWID P3   52.59    52.59    50.99    47.85    43.25    37.33
SO BUILDWID P3   43.25    47.85    50.99    52.59    52.59    50.99
SO BUILDWID P3   47.85    43.25    37.33    43.25    47.85    50.99
SO BUILDWID P3   52.59    52.59    50.99    47.85    43.25    37.33
SO BUILDLEN P3   43.25    47.85    50.99    52.59    52.59    50.99
SO BUILDLEN P3   47.85    43.25    37.33    43.25    47.85    50.99
SO BUILDLEN P3   52.59    52.59    50.99    47.85    43.25    37.33
SO BUILDLEN P3   43.25    47.85    50.99    52.59    52.59    50.99
SO BUILDLEN P3   47.85    43.25    37.33    43.25    47.85    50.99
SO BUILDLEN P3   52.59    52.59    50.99    47.85    43.25    37.33
SO XBADJ    P3  -21.62   -23.92   -25.50   -26.30   -26.30   -25.50
SO XBADJ    P3  -23.92   -21.62   -18.67   -21.62   -23.92   -25.50
SO XBADJ    P3  -26.30   -26.30   -25.50   -23.92   -21.62   -18.67
SO XBADJ    P3  -21.62   -23.92   -25.50   -26.30   -26.30   -25.50
SO XBADJ    P3  -23.92   -21.62   -18.67   -21.62   -23.92   -25.50
SO XBADJ    P3  -26.30   -26.30   -25.50   -23.92   -21.62   -18.67
SO YBADJ    P3    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P3    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P3    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P3    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P3    0.00     0.00     0.00     0.00     0.00     0.00
SO YBADJ    P3    0.00     0.00     0.00     0.00     0.00     0.00
   URBANSRC P1
   URBANSRC P2
   URBANSRC P3
   SRCGROUP  P1  P1
   SRCGROUP  P2  P2
   SRCGROUP  P3  P3
SO SRCGROUP  ALL
SO FINISHED
RE STARTING
   GRIDPOLR POL1 STA
                ORIG     0.0     0.0
                DIST  25 50 75 100 200 300 500 1000
                GDIR     36     10.0     10.0
   GRIDPOLR POL1 END
RE FINISHED
ME STARTING
   SURFFILE AZUS_v9.SFC
   PROFFILE AZUS_v9.PFL
   SURFDATA 0    2010
   UAIRDATA 3190 2010
   PROFBASE 0    METERS
ME FINISHED
OU STARTING
   RECTABLE  1       FIRST
   RECTABLE  ALLAVE  FIRST
   PLOTFILE  1       P1  FIRST  BM1T1P1.TXT
   PLOTFILE  PERIOD  P1         BM1T2P1.TXT
   PLOTFILE  1       P2  FIRST  BM1T1P2.TXT
   PLOTFILE  PERIOD  P2         BM1T2P2.TXT
   PLOTFILE  1       P3  FIRST  BM1T1P3.TXT
   PLOTFILE  PERIOD  P3         BM1T2P3.TXT
OU FINISHED
```

# Exhibit X - Sample AERMOD Input Files for Gasoline Transfer and Dispensing Facilities (Underground Storage Tanks and Aboveground Storage Tanks)

~~Aboveground~~ Underground Gasoline Tank

```
CO STARTING
   TITLEONE SCAQMD R461 SCREEN TABLE PREPARATION
   TITLETWO Template - Underground, 10mX5mX4m building in middle
   MODELOPT CONC FLAT
   AVERTIME 1 PERIOD
   URBANOPT 9818605 LA
   POLLUTID ANY
   RUNORNOT RUN
CO FINISHED
SO STARTING
   LOCATION P1      POINT   0.0  0.0  0.0
   LOCATION P3      POINT   0.0  0.0  0.0
   LOCATION P5      POINT   0.0  0.0  0.0
   LOCATION P2      POINT   0.0  0.0  0.0
   LOCATION P4      POINT   0.0  0.0  0.0
   LOCATION P6      POINT   0.0  0.0  0.0
   LOCATION V1      VOLUME  0.0  0.0  0.0
   LOCATION V4      VOLUME  0.0  0.0  0.0
   LOCATION V7      VOLUME  0.0  0.0  0.0
   LOCATION V2      VOLUME  0.0  0.0  0.0
   LOCATION V5      VOLUME  0.0  0.0  0.0
   LOCATION V8      VOLUME  0.0  0.0  0.0
   LOCATION V3      VOLUME  0.0  0.0  0.0
   LOCATION V6      VOLUME  0.0  0.0  0.0
   LOCATION V9      VOLUME  0.0  0.0  0.0
   SRCPARAM P1      9.84E-06    3.66   291.5   0.00063    0.051
   SRCPARAM P2      1.57E-06    3.66   288.7   0.00010    0.051
   SRCPARAM P3      2.30E-06    3.66   291.5   0.00063    0.051
   SRCPARAM P4      3.68E-07    3.66   288.7   0.00010    0.051
   SRCPARAM P5      9.56E-09    3.66   291.5   0.00063    0.051
   SRCPARAM P6      1.53E-09    3.66   288.7   0.00010    0.051
   SRCPARAM V1      2.602.10E-05    1.0     3.02    2.33
   SRCPARAM V2      2.44E-05    0.0     3.02    2.33
   SRCPARAM V3      5.90E-07    1.0     3.02    2.33
   SRCPARAM V4      6.084.91E-06    1.0     3.02    2.33
   SRCPARAM V5      4.44E-05    0.0     3.02    2.33
   SRCPARAM V6      1.38E-07    1.0     3.02    2.33
   SRCPARAM V7      2.522.04E-08    1.0     3.02    2.33
   SRCPARAM V8      6.00E-06    0.0     3.02    2.33
   SRCPARAM V9      5.74E-10    1.0     3.02    2.33
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P4      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P4      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P4      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P4      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P4      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P4      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P5      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P5      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P5      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P5      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P5      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P5      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P6      4.00     4.00     4.00     4.00     4.00     4.00
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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BUILDHGT | P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT | P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID | P1 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P1 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P1 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P1 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P1 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P1 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P2 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P2 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P2 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P2 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P2 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P2 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P3 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P3 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P3 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P3 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P3 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P3 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P4 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P4 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P4 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P4 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P4 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P4 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P5 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P5 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P5 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P5 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P5 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P5 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P6 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P6 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P6 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID | P6 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID | P6 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID | P6 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDLEN | P1 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P1 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P1 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P1 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P1 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P1 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P2 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P2 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P2 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P2 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P2 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P2 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P3 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P3 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P3 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P3 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P3 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P3 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P4 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P4 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P4 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P4 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P4 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P4 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P5 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P5 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P5 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P5 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P5 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P5 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P6 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P6 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P6 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P6 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P6 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P6 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| XBADJ | P1 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P1 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |

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XBADJ    P1     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P1     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P1     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P1     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P2     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P2     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P2     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P2     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P2     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P2     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P3     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P3     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P3     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P3     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P3     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P3     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P4     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P4     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P4     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P4     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P4     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P4     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P5     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P5     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P5     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P5     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P5     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P5     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P6     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P6     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P6     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
XBADJ    P6     -5.36    -5.55    -5.58    -5.44    -5.13    -4.67
XBADJ    P6     -4.06    -3.33    -2.50    -3.33    -4.06    -4.67
XBADJ    P6     -5.13    -5.44    -5.58    -5.55    -5.36    -5.00
YBADJ    P1      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P1      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P1      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P1      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P1      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P1      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P2      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P2      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P2      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P2      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P2      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P2      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P3      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P3      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P3      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P3      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P3      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P3      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P4      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P4      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P4      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P4      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P4      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P4      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P5      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P5      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P5      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P5      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P5      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P5      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P6      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P6      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P6      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P6      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P6      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P6      0.00     0.00     0.00     0.00     0.00     0.00
URBANSRC P1
URBANSRC P2
URBANSRC P3
URBANSRC P4
URBANSRC P5
URBANSRC P6
URBANSRC V1
URBANSRC V2
URBANSRC V3
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   URBANSRC V4
   URBANSRC V5
   URBANSRC V6
   URBANSRC V7
   URBANSRC V8
   URBANSRC V9
   EMISFACT P1     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT P1     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P1     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P1     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT P2     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT P2     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P2     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P2     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT P3     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT P3     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P3     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P3     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT P4     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT P4     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P4     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P4     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT P5     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT P5     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P5     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P5     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT P6     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT P6     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P6     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT P6     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT V1     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT V1     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V1     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V1     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT V2     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT V2     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V2     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V2     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT V3     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT V3     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V3     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V3     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT V4     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT V4     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V4     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V4     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT V5     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT V5     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V5     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V5     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT V6     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT V6     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V6     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V6     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT V7     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT V7     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V7     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V7     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT V8     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT V8     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V8     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V8     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   EMISFACT V9     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
   EMISFACT V9     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V9     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
   EMISFACT V9     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
   SRCGROUP BE     P1  P2  V1  V2  V3
   SRCGROUP EB     P3  P4  V4  V5  V6
   SRCGROUP NA     P5  P6  V7  V8  V9
SO FINISHED
RE STARTING
   GRIDPOLR POL1 STA
                   ORIG 0.0 0.0
                   DIST 34  59  84  109  209  309  509  1009
                   GDIR 36 10.0 10.0
   GRIDPOLR POL1 END
RE FINISHED
ME STARTING
   SURFFILE AZUS_v9.SFC
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   PROFFILE AZUS_v9.PFL
   SURFDATA 0 2010
   UAIRDATA 3190 2010
   SITEDATA 99999 2010
   PROFBASE 0.0 METERS
ME FINISHED
OU STARTING
   RECTABLE ALLAVE 1ST
   RECTABLE 1 1ST
   PLOTFILE 1 BE 1ST  UM1T1BE.TXT
   PLOTFILE 1 EB 1ST  UM1T1EB.TXT
   PLOTFILE 1 NA 1ST  UM1T1NA.TXT
   PLOTFILE PERIOD BE UM1T2BE.TXT
   PLOTFILE PERIOD EB UM1T2EB.TXT
   PLOTFILE PERIOD NA UM1T2NA.TXT
OU FINISHED

Aboveground Gasoline Tank

CO STARTING
   TITLEONE SCAQMD R461 SCREEN TABLE PREPARATION
   TITLETWO Template - Aboveground, 10mX5mX4m building in middle
   MODELOPT CONC FLAT
   AVERTIME 1 PERIOD
   POLLUTID ANY
   RUNORNOT RUN
   URBANOPT 9818605 LA
CO FINISHED
SO STARTING
   LOCATION P1      POINT   0.0  0.0  0.0
   LOCATION P3      POINT   0.0  0.0  0.0
   LOCATION P5      POINT   0.0  0.0  0.0
   LOCATION P2      POINT   0.0  0.0  0.0
   LOCATION P4      POINT   0.0  0.0  0.0
   LOCATION P6      POINT   0.0  0.0  0.0
   LOCATION V1      VOLUME  0.0  0.0  0.0
   LOCATION V4      VOLUME  0.0  0.0  0.0
   LOCATION V7      VOLUME  0.0  0.0  0.0
   LOCATION V2      VOLUME  0.0  0.0  0.0
   LOCATION V5      VOLUME  0.0  0.0  0.0
   LOCATION V8      VOLUME  0.0  0.0  0.0
   LOCATION V3      VOLUME  0.0  0.0  0.0
   LOCATION V6      VOLUME  0.0  0.0  0.0
   LOCATION V9      VOLUME  0.0  0.0  0.0
   SRCPARAM P1   2.75E-05   3.66    291.0   0.0018   0.051
   SRCPARAM P2   3.47E-06   3.66    289.0   0.00022  0.051
   SRCPARAM P3   6.44E-06   3.66    291.0   0.0018   0.051
   SRCPARAM P4   8.13E-07   3.66    289.0   0.00022  0.051
   SRCPARAM P5   2.67E-08   3.66    291.0   0.0018   0.051
   SRCPARAM P6   3.38E-09   3.66    289.0   0.00022  0.051
   SRCPARAM V1   1.36E-05    1.0     3.02    2.33
   SRCPARAM V2   2.44E-05    0.0     3.02    2.33
   SRCPARAM V3   5.90E-07    1.0     3.02    2.33
   SRCPARAM V4   3.19E-06    1.0     3.02    2.33
   SRCPARAM V5   4.44E-05    0.0     3.02    2.33
   SRCPARAM V6   1.38E-07    1.0     3.02    2.33
   SRCPARAM V7   1.32E-08    1.0     3.02    2.33
   SRCPARAM V8   5.99E-06    0.0     3.02    2.33
   SRCPARAM V9   5.73E-10    1.0     3.02    2.33
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P1      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P2      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P3      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P4      4.00     4.00     4.00     4.00     4.00     4.00
   BUILDHGT P4      4.00     4.00     4.00     4.00     4.00     4.00
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| | | | | | | |
|---|---|---|---|---|---|---|
| BUILDHGT P4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P4 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P5 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDHGT P6 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| BUILDWID P1 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P1 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P1 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P1 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P1 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P1 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P2 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P2 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P2 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P2 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P2 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P2 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P3 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P3 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P3 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P3 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P3 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P3 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P4 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P4 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P4 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P4 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P4 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P4 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P5 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P5 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P5 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P5 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P5 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P5 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P6 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P6 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P6 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDWID P6 | 6.66 | 8.12 | 9.33 | 10.26 | 10.87 | 11.16 |
| BUILDWID P6 | 11.11 | 10.72 | 10.00 | 10.72 | 11.11 | 11.16 |
| BUILDWID P6 | 10.87 | 10.26 | 9.33 | 8.12 | 6.66 | 5.00 |
| BUILDLEN P1 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN P1 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN P1 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN P1 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN P1 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN P1 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN P2 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN P2 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN P2 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN P2 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN P2 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN P2 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN P3 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN P3 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN P3 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN P3 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN P3 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN P3 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN P4 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN P4 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN P4 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN P4 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN P4 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN P4 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN P5 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN P5 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN P5 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BUILDLEN | P5 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P5 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P5 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P6 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P6 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P6 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| BUILDLEN | P6 | 10.72 | 11.11 | 11.16 | 10.87 | 10.26 | 9.33 |
| BUILDLEN | P6 | 8.12 | 6.66 | 5.00 | 6.66 | 8.12 | 9.33 |
| BUILDLEN | P6 | 10.26 | 10.87 | 11.16 | 11.11 | 10.72 | 10.00 |
| XBADJ | P1 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P1 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P1 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P1 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P1 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P1 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P2 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P2 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P2 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P2 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P2 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P2 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P3 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P3 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P3 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P3 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P3 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P3 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P4 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P4 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P4 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P4 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P4 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P4 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P5 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P5 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P5 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P5 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P5 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P5 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P6 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P6 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P6 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| XBADJ | P6 | -5.36 | -5.55 | -5.58 | -5.44 | -5.13 | -4.67 |
| XBADJ | P6 | -4.06 | -3.33 | -2.50 | -3.33 | -4.06 | -4.67 |
| XBADJ | P6 | -5.13 | -5.44 | -5.58 | -5.55 | -5.36 | -5.00 |
| YBADJ | P1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| YBADJ | P6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

```
YBADJ    P6      0.00     0.00     0.00     0.00     0.00     0.00
YBADJ    P6      0.00     0.00     0.00     0.00     0.00     0.00
URBANSRC P1
URBANSRC P2
URBANSRC P3
URBANSRC P4
URBANSRC P5
URBANSRC P6
URBANSRC V1
URBANSRC V2
URBANSRC V3
URBANSRC V4
URBANSRC V5
URBANSRC V6
URBANSRC V7
URBANSRC V8
URBANSRC V9
EMISFACT P1     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT P1     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P1     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P1     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT P2     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT P2     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P2     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P2     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT P3     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT P3     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P3     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P3     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT P4     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT P4     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P4     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P4     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT P5     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT P5     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P5     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P5     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT P6     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT P6     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P6     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT P6     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT V1     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT V1     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V1     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V1     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT V2     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT V2     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V2     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V2     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT V3     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT V3     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V3     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V3     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT V4     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT V4     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V4     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V4     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT V5     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT V5     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V5     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V5     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT V6     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT V6     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V6     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V6     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT V7     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT V7     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V7     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V7     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT V8     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT V8     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V8     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V8     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
EMISFACT V9     HROFDY 0.48 0.48 0.48 0.48 0.48 0.48
EMISFACT V9     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V9     HROFDY 1.37  1.37  1.37  1.37  1.37  1.37
EMISFACT V9     HROFDY 1.37  1.37  0.48 0.48 0.48 0.48
SRCGROUP BE     P1  P2  V1  V2  V3
SRCGROUP EB     P3  P4  V4  V5  V6
```

```
   SRCGROUP NA     P5  P6  V7  V8  V9
SO FINISHED
RE STARTING
   GRIDPOLR POL1 STA
                  ORIG 0.0 0.0
                  DIST 34  59  84  109  209  309  509  1009
                  GDIR 36 10.0 10.0
   GRIDPOLR POL1 END
RE FINISHED
ME STARTING
   SURFFILE AZUS_v9.SFC
   PROFFILE AZUS_v9.PFL
   SURFDATA 0 2010
   UAIRDATA 3190 2010
   SITEDATA 99999 2010
   PROFBASE 0.0 METERS
ME FINISHED
OU STARTING
   RECTABLE ALLAVE 1ST
   RECTABLE 1 1ST
   PLOTFILE 1 BE 1ST  AM1T1BE.TXT
   PLOTFILE 1 EB 1ST  AM1T1EB.TXT
   PLOTFILE 1 NA 1ST  AM1T1NA.TXT
   PLOTFILE PERIOD BE AM1T2BE.TXT
   PLOTFILE PERIOD EB AM1T2EB.TXT
   PLOTFILE PERIOD NA AM1T2NA.TXT
OU FINISHED
```

# EXHIBIT XI - Sample AERMOD Input File for Spray Booths

```
CO STARTING
   TITLEONE Spraybooth, 8-hour
   MODELOPT CONC FLAT
   AVERTIME 1 PERIOD
   URBANOPT 9818605 LA
   POLLUTID OTHER
   RUNORNOT RUN
   ERRORFIL Spraybooth.err
CO FINISHED
SO STARTING
   LOCATION P1           POINT           0.000        0.000          0.0
   LOCATION P2           POINT           0.000        0.000          0.0
   SRCPARAM P1              0.0865     4.877     0.000   8.05709     0.864
   SRCPARAM P2              0.0865     7.315     0.000   8.04963     0.864
   BUILDHGT P1               3.05     3.05     3.05     3.05     3.05     3.05
   BUILDHGT P1               3.05     3.05     3.05     3.05     3.05     3.05
   BUILDHGT P1               3.05     3.05     3.05     3.05     3.05     3.05
   BUILDHGT P1               3.05     3.05     3.05     3.05     3.05     3.05
   BUILDHGT P1               3.05     3.05     3.05     3.05     3.05     3.05
   BUILDHGT P1               3.05     3.05     3.05     3.05     3.05     3.05
   BUILDHGT P2               5.49     5.49     5.49     5.49     5.49     5.49
   BUILDHGT P2               5.49     5.49     5.49     5.49     5.49     5.49
   BUILDHGT P2               5.49     5.49     5.49     5.49     5.49     5.49
   BUILDHGT P2               5.49     5.49     5.49     5.49     5.49     5.49
   BUILDHGT P2               5.49     5.49     5.49     5.49     5.49     5.49
   BUILDHGT P2               5.49     5.49     5.49     5.49     5.49     5.49
   BUILDWID P1              31.85    42.74    52.32    60.32    66.48    70.62
   BUILDWID P1              72.62    72.41    70.00    72.41    72.62    70.62
   BUILDWID P1              66.48    60.32    52.32    42.74    31.85    20.00
   BUILDWID P1              31.85    42.74    52.32    60.32    66.48    70.62
   BUILDWID P1              72.62    72.41    70.00    72.41    72.62    70.62
   BUILDWID P1              66.48    60.32    52.32    42.74    31.85    20.00
   BUILDWID P2              31.85    42.74    52.32    60.32    66.48    70.62
   BUILDWID P2              72.62    72.41    70.00    72.41    72.62    70.62
   BUILDWID P2              66.48    60.32    52.32    42.74    31.85    20.00
   BUILDWID P2              31.85    42.74    52.32    60.32    66.48    70.62
   BUILDWID P2              72.62    72.41    70.00    72.41    72.62    70.62
   BUILDWID P2              66.48    60.32    52.32    42.74    31.85    20.00
   BUILDLEN P1              72.41    72.62    70.62    66.48    60.32    52.32
   BUILDLEN P1              42.74    31.85    20.00    31.85    42.74    52.32
   BUILDLEN P1              60.32    66.48    70.62    72.62    72.41    70.00
   BUILDLEN P1              72.41    72.62    70.62    66.48    60.32    52.32
   BUILDLEN P1              42.74    31.85    20.00    31.85    42.74    52.32
   BUILDLEN P1              60.32    66.48    70.62    72.62    72.41    70.00
   BUILDLEN P2              72.41    72.62    70.62    66.48    60.32    52.32
   BUILDLEN P2              42.74    31.85    20.00    31.85    42.74    52.32
   BUILDLEN P2              60.32    66.48    70.62    72.62    72.41    70.00
   BUILDLEN P2              72.41    72.62    70.62    66.48    60.32    52.32
   BUILDLEN P2              42.74    31.85    20.00    31.85    42.74    52.32
   BUILDLEN P2              60.32    66.48    70.62    72.62    72.41    70.00
   XBADJ    P1             -36.20   -36.31   -35.31   -33.24   -30.16   -26.16
   XBADJ    P1             -21.37   -15.93   -10.00   -15.93   -21.37   -26.16
   XBADJ    P1             -30.16   -33.24   -35.31   -36.31   -36.20   -35.00
   XBADJ    P1             -36.20   -36.31   -35.31   -33.24   -30.16   -26.16
   XBADJ    P1             -21.37   -15.93   -10.00   -15.93   -21.37   -26.16
   XBADJ    P1             -30.16   -33.24   -35.31   -36.31   -36.20   -35.00
   XBADJ    P2             -36.20   -36.31   -35.31   -33.24   -30.16   -26.16
   XBADJ    P2             -21.37   -15.93   -10.00   -15.93   -21.37   -26.16
   XBADJ    P2             -30.16   -33.24   -35.31   -36.31   -36.20   -35.00
   XBADJ    P2             -36.20   -36.31   -35.31   -33.24   -30.16   -26.16
   XBADJ    P2             -21.37   -15.93   -10.00   -15.93   -21.37   -26.16
   XBADJ    P2             -30.16   -33.24   -35.31   -36.31   -36.20   -35.00
   YBADJ    P1               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P1               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P1               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P1               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P1               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P1               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P2               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P2               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P2               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P2               0.00     0.00     0.00     0.00     0.00     0.00
   YBADJ    P2               0.00     0.00     0.00     0.00     0.00     0.00
   URBANSRC ALL
   EMISFACT P2           HROFDY 0.0 0.0 0.0 0.0 0.0 0.0
```

```
   EMISFACT P2           HROFDY 0.0 0.0 1.0 1.0 1.0 1.0
   EMISFACT P2           HROFDY 1.0 1.0 1.0 1.0 0.0 0.0
   EMISFACT P2           HROFDY 0.0 0.0 0.0 0.0 0.0 0.0
   EMISFACT P1           HROFDY 0.0 0.0 0.0 0.0 0.0 0.0
   EMISFACT P1           HROFDY 0.0 0.0 1.0 1.0 1.0 1.0
   EMISFACT P1           HROFDY 1.0 1.0 1.0 1.0 0.0 0.0
   EMISFACT P1           HROFDY 0.0 0.0 0.0 0.0 0.0 0.0
   SRCGROUP P1       P1
   SRCGROUP P2       P2
SO FINISHED
RE STARTING
   GRIDPOLR GRID STA
                  ORIG 0.00 0.00
                  DIST 25 50 75 100 200 300 500 1000
                  GDIR 36 0.00 10.00
   GRIDPOLR GRID END
RE FINISHED
ME STARTING
   SURFFILE E:\SCRAM\2017MetUpdate\Outputs\AZUS_v9.SFC
   PROFFILE E:\SCRAM\2017MetUpdate\Outputs\AZUS_v9.PFL
   SURFDATA 3102 2010
   UAIRDATA 3190 2010
   PROFBASE 0.0 METERS
ME FINISHED
OU STARTING
   RECTABLE ALLAVE 1ST
   RECTABLE 1 1ST
   PLOTFILE  1       P1  FIRST  AM1T1P1.TXT
   PLOTFILE  1       P2  FIRST  AM1T1P2.TXT
   PLOTFILE  PERIOD  P1         AM1T2P1.TXT
   PLOTFILE  PERIOD  P2         AM1T2P2.TXT
   SUMMFILE Spraybooth.sum
OU FINISHED
```

South Coast Air Quality Management District

# AB 2588 and Rule 1402 Supplemental Guidelines

# (Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act)

**July 2018**

## Preface

This document (Supplemental Guidelines) is a supplementary guide to the State of California Office of Environmental Health Hazard Assessment (OEHHA) document entitled *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*. The OEHHA guidance document contains several sections that refer users to their local air district for specific or additional requirements and this document describes and clarifies the requirements for the South Coast Air Quality Management District (SCAQMD). This version of the Supplemental Guidelines updates the previous November 2016 version.

The Supplemental Guidelines are intended to be a "living" document, which staff will update periodically as needed. The major revisions to this document from the previous November 2016 version include:

- Adding a description for the Voluntary Risk Reduction Program (refer to Section 3.6 and Table 3);
- Adding an HRA Summary Form (refer to Attachment A to Appendix B);
- Removing tables that are updated frequently and are listed in other SCAQMD rules or guidelines and including a reference to the applicable table(s) in the existing SCAQMD rule or guidelines instead; and
- Updating terms and acronyms (refer to Appendix G).

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# 1. INTRODUCTION

These Supplemental Guidelines are to be used in conjunction with the document prepared by the State of California Office of Environmental Health Hazard Assessment (OEHHA) entitled "Air Toxics Hot Spots Program Guidance Manual for the Preparation of Risk Assessments" (referred to hereafter as the 2015 OEHHA HRA Guidelines).[1] Facilities required to submit health risk assessments to the South Coast Air Quality Management District (SCAQMD) must follow the 2015 OEHHA HRA Guidelines pursuant to Health and Safety Code 44360(b)(2). Since the 2015 OEHHA HRA Guidelines defer to the local air district for specific, localized, or additional requirements, these Supplemental Guidelines address those areas and other issues that have arisen during the implementation of the AB 2588 Program at SCAQMD.

A certification form must be submitted to SCAQMD with all documents and correspondence relating to health risk assessments.[2]

Please visit SCAQMD's AB 2588 Program webpage provided below for additional information, documents, and any questions regarding this document, health risk assessment methodology, and other AB 2588 Program issues.[3] Questions may be emailed to AB2588@aqmd.gov or asked via phone at (909) 396-3610.

[1] https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0

[2] http://www.aqmd.gov/home/rules-compliance/compliance/toxic-hot-spots-ab-2588/forms

[3] http://www.aqmd.gov/home/rules-compliance/compliance/toxic-hot-spots-ab-2588

## 2. OVERVIEW OF THE AB 2588 PROGRAM

In 1987, the California legislature adopted the Air Toxics "Hot Spots" Information and Assessment Act; also known as Assembly Bill 2588 (AB 2588). The goals of the AB 2588 Program are to collect toxic air contaminant emissions data, identify facilities having localized impacts, determine health risks, and notify affected individuals. In 1992, the California legislature added a risk reduction component, the Facility Air Toxic Contaminant Risk Audit and Reduction Plan, or Senate Bill 1731 (SB 1731), which requires facilities to develop and implement measures to reduce impacts if risks are found above thresholds specified by air districts. SCAQMD *Rule 1402 - Control of Toxic Air Contaminants from Existing Sources* implements various aspects of AB 2588 and SB 1731 including public notification and risk reduction requirements for facilities with health risks that are above specified thresholds.

Rule 1402 was amended in October 7, 2016 to include a provision to allow facilities to participate in a Voluntary Risk Reduction Program. This program is an alternative to complying with the traditional AB 2588 Program and Rule 1402 approach that provides qualifying facilities an opportunity to reduce health risks below the Notification Risk Level through a Voluntary Risk Reduction Plan (VRRP) and employ a Modified Public Notification approach as specified in Rule 1402. The Voluntary Risk Reduction Program will achieve risk reductions both sooner and beyond what is required in the traditional AB 2588, SB 1731, and Rule 1402 process.

There are five important components to the AB 2588 program as follows:

- *Emissions Reporting* - Facilities subject to the AB 2588 Program submit an air toxics inventory every four years through SCAQMD's Annual Emissions Reporting (AER) Program. Facilities are allowed to simplify AER reporting by aggregating common sources.
- *Prioritization* - From the simplified reported toxic emissions submitted through AER, SCAQMD staff prioritizes facilities, using a procedure approved by the Governing Board, into three categories: high, intermediate, and low priority. High priority facilities are then asked to prepare an Air Toxics Inventory Report (ATIR). In contrast to the simplified reporting allowed under AER, the ATIR requires greater detail which includes process, device, and stack information for each piece of equipment.
- *Health Risk Assessment* - From the detailed reported toxic emissions submitted through the ATIR, high priority facilities must prepare a Health Risk Assessment (HRA).
- *Public Notice* - If the health risks reported in the HRA exceed specified public notification thresholds, then the facility is required to provide public notice to the affected community.
- *Risk Reduction* - If the health risks reported in the HRA exceed specified action risk levels in Rule 1402, then the facility is required to reduce their health risks below the action risk levels.

Figure 1 below provides an overview of the AB 2588 Program and the different paths a facility may follow under Rule 1402.

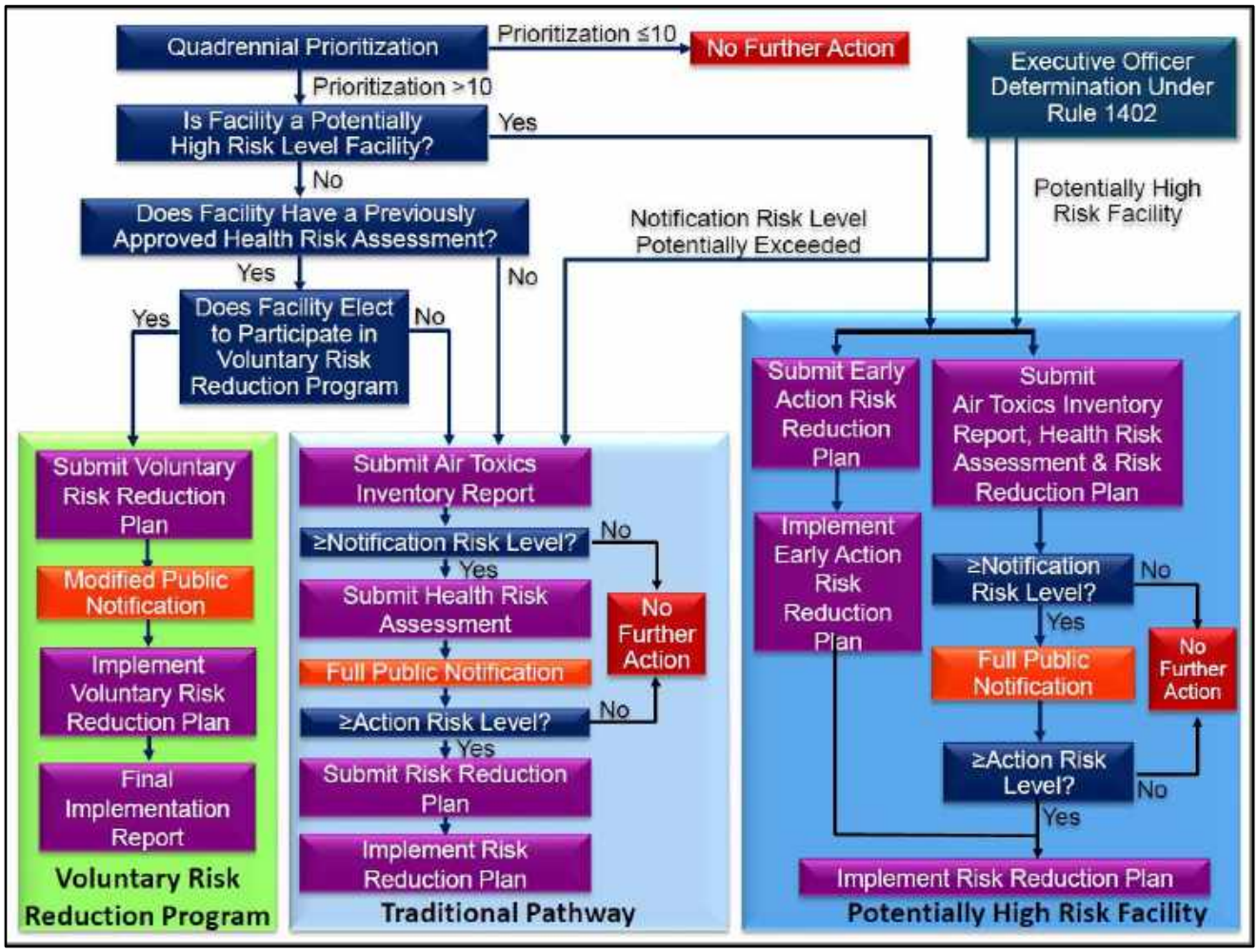


**Figure 1. Overview of the AB 2588 Program and illustration of the paths by which a facility may follow**

# 3. SUPPLEMENTAL GUIDELINES

## 3.1 Air Toxics Emissions Reporting

SCAQMD's AER Program is used for:

- All facilities subject to AER, including AB 2588 facilities who report their annual emissions of criteria pollutants and any one of 24 toxic air contaminants and ozone depleting compounds (ODC) (shown in Table 1 below). The report comprises the annual emissions report for toxic air contaminants.
- AB 2588 facilities which are subject to quadrennial (once in four years) reporting requirements. These facilities report any one of approximately 177 toxic air contaminants and ODCs from a detailed list of substances in Table A-1 of *Reporting Procedures for AB 2588 Facilities for Reporting their Quadrennial Air Toxics Emissions Inventory*.[4] This report comprises the quadrennial emissions report for toxic air contaminants.

Facilities subject to the AER Program calculate and report their emissions based on their throughput data (e.g., fuel usage, material usage, etc.), appropriate emission factors, and control efficiency, if applicable. The method for reporting emissions is described on SCAQMD's website.[5]

**Table 1. Annually Reported Toxic Air Contaminants and ODCs under the AER Program**

| | | |
|---|---|---|
| Ammonia | Chlorinated dioxins and dibenzofurans | Lead |
| Asbestos | Chlorofluorocarbons | Methylene chloride |
| Arsenic (inorganic) | 1,4-Dioxane | Nickel |
| Benzene | Ethylene dibromide | Perchloroethylene |
| Beryllium | Ethylene dichloride | Polynuclear aromatic hydrocarbons (PAH) |
| 1,3-Butadiene | Ethylene oxide | 1,1,1-Trichloroethane |
| Cadmium | Formaldehyde | Trichloroethylene |
| Carbon tetrachloride | Hexavalent chromium | Vinyl chloride |

The data collected in the AER Program in addition to information from other sources (i.e. monitoring data, source specific information, etc...) are used to determine potential candidates for the AB 2588 Program. Facilities that meet one of the following AB 2588 Program qualification conditions are required to prepare and submit a quadrennial air toxics inventory if:

- They emit 10 tons per year or more of VOC, NOx, SOx, or PM;
- They emit 25 tons per year or more of a combination of VOC, NOx, SOx, and PM;
- They emit less than 10 tons per year of VOC, NOx, SOx, or PM, but the facility activity is listed in California Air Resources Board's (CARB) Emission Inventory Criteria and Guidelines for the Air Toxics "Hot Spots" Program[6];
- Their emissions exceed one or more of the reporting thresholds in Table I or II in *Rule*

[4] http://www.aqmd.gov/docs/default-source/planning/risk-assessment/quadrennial_atir_procedure.pdf
[5] http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting
[6] http://www.arb.ca.gov/ab2588/2588guid.htm

*1402 – Control of Toxic Air Contaminants From Existing Sources*;[7] or

- The Executive Officer of SCAQMD determines that emissions levels from the facility have the potential to cause an exceedance of risk reduction thresholds.

Facilities subject to the AB 2588 Program must provide a quadrennial report for toxic air contaminants. These substances are listed in Table A-1 of *Reporting Procedures for AB 2588 Facilities for Reporting their Quadrennial Air Toxics Emissions Inventory*, which provides the substance names and associated Chemical Abstracts Service (CAS) numbers. The degree of accuracy is also provided for each substance. The degree of accuracy is a de minimis emission level for reporting. As a result, facility-wide emissions of the substance which are greater than one-half of their corresponding degree of accuracy must be inventoried and reported.

As part of the quadrennial report for toxic air contaminants, facilities must also provide the distances to the nearest residential and commercial receptors, and the facility operating schedule (e.g., operating hours per day, operating days per week, and operating weeks per year). It is critical that facilities estimate their toxic emissions as precisely and accurately as possible. These reported emissions are used to prioritize the facility as discussed in the next section, 3.2. Prioritization Procedure. A facility's prioritization score determines its fees and if it is necessary to prepare an ATIR or VRRP (if eligible).

An ATIR should be prepared by using the latest approved version of CARB's Hotspots Analysis and Reporting Program (HARP).[8] In contrast to the simplified reporting allowed under AER, an ATIR requires a larger list of compounds (approximately 450 toxic air contaminants) and greater detail including process, device, and stack information for each piece of equipment.

When a facility is notified to prepare an ATIR or VRRP, the quadrennial toxic air contaminants emissions report is used as the 'base year emissions inventory.' This same base year emissions inventory is also used to prepare an HRA, Public Notice, and Risk Reduction Plan (RRP).

## 3.2. Prioritization Procedure

The AB 2588 Program requires SCAQMD staff to designate each facility as either high, intermediate, or low priority based on its individual priority score.

Per the requirements of the AB 2588 Program, SCAQMD's Prioritization Procedure considers the potency, toxicity, and quantity of hazardous materials released from the facility; the proximity of the facility to potential receptors, including, but not limited to, hospitals, schools, daycare centers, worksites, and residences; and any other factors that SCAQMD uses to determine that the facility may pose a significant risk to receptors. SCAQMD's Prioritization Procedure also includes adjustment factors for exposure period, averaging times, and the treatment of multipathway pollutants. The Prioritization Procedure is available at SCAQMD's website.[9]

A facility receives two scores: one for carcinogenic effects and the other for non-carcinogenic effects. The facility is then ranked using the higher of the two scores. Three categories are used in

[7] http://www.aqmd.gov/docs/default-source/rule-book/reg-xiv/rule-1402.pdf
[8] http://www.arb.ca.gov/toxics/harp/harp.htm
[9] http://www.aqmd.gov/home/rules-compliance/compliance/toxic-hot-spots-ab-2588/prioritization

the ranking: high priority, intermediate priority, and low priority. Facilities designated as high priority are notified by SCAQMD staff of their priority score, required to submit a comprehensive inventory of their air toxic emissions via an ATIR, and required to submit a quadrennial emissions report using the AER software. Facilities ranked as intermediate priority are considered to be "District Tracking" facilities, which are required to submit an air toxics inventory once every four years, using the AER software. Facilities ranked as low priority are exempt from quadrennial emissions reporting. Priority scores are re-calculated each time a facility updates its quadrennial air toxic emission inventory. Table 2 summarizes the priority score categories and the actions required by each category.

**Table 2. Priority Score Categories**

| Category | Facility Priority Score (PS) | Actions |
|---|---|---|
| High Priority | PS > 10 | Prepare ATIR; update emissions quadrennially through AER |
| Intermediate Priority | 1 < PS ≤ 10 | Update emissions quadrennially through AER |
| Low Priority | PS ≤ 1 | Exempt from quadrennial emissions reporting |

SCAQMD staff considers requests from High Priority facilities to be re-prioritized after errors or other problems with their quadrennial emissions inventory report. Once the corrections are verified by SCAQMD staff, the facility will be informed, in writing. The following sections discuss the criteria used for evaluating requests to reprioritize a facility.

### 3.2.1. Receptor Distance

One of the factors considered when prioritizing facilities is the receptor distance. All facilities must report the distances to the nearest residential and commercial receptors as part of their AER submittal. If receptor distances are not provided, then default values (conservative receptor distances) are used by SCAQMD staff to prioritize that facility. If a facility operator believes that their facility was incorrectly categorized due to an incorrect or default receptor distance, then the facility must prepare and submit a signed copy of the Receptor Proximity Form which can be downloaded from the SCAQMD's website.[10]

### 3.2.2. Computational Errors

If computational errors or conservative assumptions were made in the quadrennial emissions report for toxic air contaminants inventory that overestimated emissions and resulted in a High Priority classification, the facility may correct the errors and submit the corrected estimates and supporting documentation to AB 2588 Program staff. The facility must include in their submission the nature of the error and calculations showing how the original emission estimate was determined and how the correction changes this value.

Please note that SCAQMD staff must use process rates and emissions from the quadrennial emissions reporting year to prioritize a facility. Changes in emissions estimates due to changes in

[10] http://www.aqmd.gov/home/rules-compliance/compliance/toxic-hot-spots-ab-2588/forms

process rates in years other than the quadrennial emissions reporting year cannot be used to re-categorize a facility. See section 3.3.2 for further details.

### 3.2.3 New Source Test Results

If new source test results are available and have been previously submitted to and approved by SCAQMD, then the approved source test results may be used with the process rates in the quadrennial emissions inventory report to recalculate emissions and the priority score of a facility.

### 3.2.4. Equipment/Process Shutdowns or Process Modifications

If equipment or processes with air toxic emissions have been shut down prior to High Priority classification and the permits have been surrendered, then these emission reductions may be used to recalculate the priority score of High Priority facilities. Evidence for these emission reductions must include copies of letters sent to SCAQMD requesting emission reduction credits and/or the surrender of SCAQMD permits.

If a process has been modified since the quadrennial emissions report and the equipment or process emits a different quantity of a toxic substance, and the facility has applied for and received a permit modification reflecting this change, then the emission reduction for that substance may be used to recalculate the priority score.

All supporting documentation regarding equipment shutdowns and process modifications must be received by AB 2588 Program staff in order to recalculate the priority score.

### 3.2.5. Facility Closures

If the entire facility is closed prior to High Priority classification or if a facility is scheduled for complete closure, this information must be reported to AB 2588 Program staff. Upon review, staff will make a decision whether the facility should submit an ATIR. Factors that must be considered include the status of permits granted to the facility by SCAQMD and the nature of any ongoing activities at the facility. Unless a facility is informed by staff in writing that an ATIR is no longer required, the facility operator must submit an ATIR by the date required.

### 3.2.6. Change of Ownership/Operator

If there has been a change in ownership or operator, the new owner/operator must submit the requested reports unless the facility no longer emits any substances required to be reported under AB 2588. In such case, the new facility owner/operator must provide SCAQMD staff the necessary documentation to be exempt from reporting requirements of the AB 2588 Program.

## 3.3. Emission Estimates Approved for Use in HRAs

Facilities subject to the submittal of HRAs under the AB 2588 Program must estimate and submit their ATIR using the latest approved version of HARP.[11] This ATIR should include, at a minimum, the elements outlined in Appendix A of these Supplemental Guidelines. OEHHA has grouped the substances to be reported into three groups as shown in Appendix A of the 2015 OEHHA HRA Guidelines.[12] There are distinct reporting requirements for the three groups as follows:

Appendix A-I Substances – All emissions of these substances must be quantified in the ATIR and HRA including those calculated in the ATIR as below the degree of accuracy or below detection limits.

Appendix A-II Substances – Emissions of these substances do not need to be quantified in the ATIR and HRA; however, facilities must report whether the substances are used, produced, or otherwise present on-site. These substances can be simply listed in a table in the HRA.

Appendix A-III Substances – These substances only need to be reported in a table in the ATIR and HRA if they are manufactured by the facility.

The intent of the AB 2588 Program is that facilities performing HRAs use the process rates and emissions data submitted in their quadrennial emissions inventory report (see Section 3.1). SCAQMD receives requests from facilities to use process rates and emissions data other than those reported in their quadrennial emissions inventory report. As a general policy, SCAQMD will allow emission changes only if (1) the changes conform to one of the situations discussed in the following sections and (2) any emission increases are also included.

### 3.3.1. Computational Errors

Computational errors in the quadrennial emissions inventory report must be reported to SCAQMD staff as soon as detected. Written requests to correct errors for inclusion in the risk assessment must include documentation of the nature of the error and calculations to show how the original emission value was determined and how correcting the computational error changes this value.

### 3.3.2. Emission Reductions from a Facility's Base Year Emissions Inventory

HRAs in the AB 2588 Program take a 'snapshot' of a base year emissions inventory (or quadrennial emissions inventory report) which is determined by the HRA request letter or notification by the Executive Officer to prepare an ATIR, HRA, or VRRP. This base year is commonly the most recent quadrennial emissions reporting year. Emissions reductions must be verified to be considered as an allowable change. The allowable changes in this section can only be considered as a revision to the quadrennial emissions inventory report that has already been submitted. Modifications after the base year are discussed in Section 3.3.3. Verified emission reductions are those which are permanent and can be substantiated as occurring during the base

[11] http://www.arb.ca.gov/toxics/harp/harp.htm

[12] https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0

year. Verification requirements include specifications in SCAQMD's permit issued to the facility, a surrender of the existing SCAQMD permit, or reductions as required by SCAQMD rule(s). Letters of intent or internal memos mandating new company policy are not considered verifiable emission reductions.

Examples of verifiable emission reductions include:

- Misreporting of throughput information, inaccurate emission factors, and incorrect emission calculation methodology.
- A previously operating permitted source has been shut down and therefore has no emissions. In order for this to be considered as a verified emissions reduction, the facility must have surrendered the permit to SCAQMD. If a facility chooses to retain the permit for possible use of the equipment in the future, that source cannot be considered a permanent verified emissions reduction. Please send a copy of the letter requesting inactivation of the permit and any other supporting documentation to AB 2588 Program staff.
- A listed substance was no longer used and therefore not emitted in a process at the facility. The permit conditions have previously been modified to reflect this change. A copy of the modified permit or, if not yet available, a copy of the 400A application form requesting a change of permit conditions and a copy of the check for filing fee submitted to SCAQMD must be sent to AB 2588 Program staff.
- Pollution control equipment which has been issued a permit-to-construct, has been installed, and was in operation. Provide a copy of the permit-to-construct (and permit-to-operate, if issued), and show calculations for emission reductions. Provide the references for any emission factors used in the calculations. If source testing data was used to calculate the emissions, provide a copy of the source test protocol and all documentation relating to the results.
- Requirements of new SCAQMD rules that have resulted in permanent and enforceable reductions. Provide documentation on how and when reductions were achieved.

If the facility wishes to use verified emission reductions in their HRA, documentation of these verified changes must be provided.

### 3.3.3. Modifications in Risk after the Base Year

HRAs in the AB 2588 Program take a 'snapshot' of a base year emissions inventory which is determined by the HRA request letter. This base year is commonly the most recent quadrennial emissions reporting year. In some cases, more recent emissions are substantially different than the base year emissions of a facility due to modifications. Facilities can include information about the more recent emission changes and how those affect health risks in a supplemental appendix to their HRA. If a facility includes supplemental information showing that emissions and health risks have been reduced since the base year, then this more recent emissions scenario can be used when comparing residual health risks against Rule 1402(c)(2) Risk Reduction thresholds as long as the new emissions scenario is based on emission reductions that are permanent, enforceable, and verifiable. The health risks from the base year will still be used when comparing against Rule 1402(c)(12) Public Notification Thresholds. If public notification is required, then the supplemental information about reductions in health risk since the base year can be included in the notification materials.

The facility should contact AB 2588 Program staff to obtain approval and determine if the changes occurring after the base year can be considered as verifiable, enforceable, and permanent emission reductions. Upon approval, the facility must estimate cancer risk, cancer burden, and hazard indices for both the base year and the estimated emissions after the proposed future reductions are complete. The two risk estimates must be presented separately in the HRA submitted to SCAQMD. The dual estimate provides a backup in case reductions proposed by the facility are not implemented as planned. Note that new emissions or emission increases, due to process changes or new equipment, must also be quantified and included in any HRA which incorporates emission reductions since the quadrennial emissions inventory was prepared.

### 3.3.4. New Source Testing Data

Data from new or yet to be completed source tests will not be approved for use in the preparation of the required HRA if an ATIR has already been approved without the use of those source tests. However, if a facility has already conducted and completed the source test with an SCAQMD-approved source test protocol, and all supporting documentation is provided to AB 2588 Program staff, it may be considered for approval. SCAQMD staff will notify the facility in writing if new source test results are approved for use in the HRA. Please call AB 2588 Program staff if you submit a request and have not been notified regarding approval before submitting the HRA.

If a facility wishes to provide unapproved source test data for informational purposes only, it must be presented in an alternate HRA (i.e., as an appendix to the HRA). The alternate HRA must be presented with separate findings and discussion of cancer risk and hazard indices. Failure to completely separate the alternate HRA from the required analysis is grounds for rejection of the HRA.

### 3.3.5. Diesel Particulate Matter Emissions

Diesel particulate matter emissions were identified as a toxic air contaminant by CARB in 1998, and were added to the list of compounds in SCAQMD *Rule 1401 – New Source Review* on March 7, 2008. Under the current AB 2588 Air Toxics "Hot Spots" Emission Inventory Criteria and Guidelines Regulation, amended on August 27, 2007, facility operators are required to include health risks of any diesel exhaust particulate emissions from stationary emergency and prime compression ignition internal combustion engines, as well as portable diesel engines. Please clearly identify emergency diesel internal combustion engines (DICEs) and their corresponding emissions. This is essential because, on January 5, 2007, the SCAQMD Governing Board adopted separate public notification procedures for emergency DICEs.[13]

## 3.4. Uncertainty Analyses and Alternative HRAs

The 2015 OEHHA HRA Guidelines describe uncertainty analyses (or HRAs with alternate assumptions) that may be provided at the discretion of SCAQMD. SCAQMD staff will allow such analyses to be included as one of the appendices to the facility's HRA. This analysis would be a supplement to the primary HRA that is carried out using the assumptions presented in the 2015

[13] http://www3.aqmd.gov/hb/2007/January/070128a.html

OEHHA HRA Guidelines and the guidelines included. Deviations from the OEHHA Tier-1 point estimate methodology must be described in detail at the beginning of the appendix and the reasons for the alternative assumptions must also be described in detail with supporting documentation.

All analyses and discussion relating to an alternative analysis must appear under a separate title such as "Alternative Analysis" in an appendix to the HRA. If an alternative HRA is mixed together with the Tier-1 analysis and not presented in a separate appendix of the document as required by OEHHA and SCAQMD guidelines, the HRA will be considered unacceptable and returned to the facility owner/operator for revision. An alternative HRA is also held to the same grounds for rejection as the primary HRA in accordance with Rule 1402(e).[14]

### 3.5. HRA Format

The format for the HRA must follow the detailed outline presented in Appendix B of these Supplemental Guidelines. A completed HRA Summary must be included in the Executive Summary of all HRAs submitted to SCAQMD; a sample of the form can be downloaded from SCAQMD's AB 2588 Program website.[15] The detailed HRA outline provided in Appendix B lists the HARP computer files to be included electronically with the HRA. All copies of electronic file(s) should be sent to AB 2588 Program staff. The HRA should also be submitted electronically (i.e., PDF format).

Cancer risk values should be reported to the nearest tenth and should be rounded up from 5 (e.g., 5.05 in a million is rounded up to 5.1 in a million). Non-cancer risk values should be reported to the nearest hundredth and should be rounded up from 5 (e.g., a hazard index (HI) of 0.105 is rounded to 0.11).

### 3.6. Public Notification, Risk Reduction, and Voluntary Risk Reduction Levels

The SCAQMD Governing Board has adopted risk levels for purposes of public notification pursuant to the AB 2588 Program. In addition, SCAQMD Rule 1402 establishes action risk levels that require risk reduction; the levels are summarized in Table 3 below and the elements to include in a RRP are included in Appendix D of these Supplemental Guidelines. Additional information regarding SCAQMD's public notification procedures are available on the website.[16]

Rule 1402 includes a provision to allow facilities to participate in the Voluntary Risk Reduction Program. If facilities choose to participate, they voluntarily reduce their health risk beyond the Action Risk Level to below the Notification Risk Level in lieu of the traditional AB 2588 Program process. Facilities also perform a modified public notification that does not require distribution of individual letters and public meetings as in the traditional AB 2588 Program approach. Additional information regarding qualifications and procedures for SCAQMD's Voluntary Risk Reduction Program are available on SCAQMD's website.[17]

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[14] http://www.aqmd.gov/docs/default-source/rule-book/reg-xiv/rule-1402.pdf?sfvrsn=4
[15] http://www.aqmd.gov/home/rules-compliance/compliance/toxic-hot-spots-ab-2588/forms
[16] http://www.aqmd.gov/nav/about/public-notices/ab-2588-notices
[17] http://www.aqmd.gov/docs/default-source/planning/risk-assessment/vrrp_guidelines.pdf?sfvrsn=4

**Table 3. Public Notification, Risk Reduction, and Voluntary Risk Reduction Levels**

| Risk Variable | Public Notification Levels | Risk Reduction Levels | Voluntary Risk Reduction Levels |
|---|---|---|---|
| Cancer risk | ≥ 10 in a million | ≥ 25 in a million | ≥ 10 in a million |
| Non-cancer risk | HI > 1 | HI ≥ 3 | HI > 1 |
| Cancer burden | -- | ≥ 0.5 excess cancer cases | -- |

### 3.7. Maximum Exposed Individual

To identify the location of the maximum exposed individual, it is necessary to examine current land use and allowable land use in the vicinity of the point of maximum impact (residential, commercial/industrial, or mixed use). Currently, the use of block group or census tract centroids as surrogates for the maximum exposed individual does not provide sufficient spatial resolution and will not be approved.

Cancer risk and non-cancer chronic hazard indices (HI) must be provided for both the most exposed residential and the most exposed commercial/industrial receptors. The non-cancer acute HI must be provided for the offsite point of maximum impact (PMI). Additionally, cancer risk and HI values at each sensitive receptor located within the zone of impact must be presented in a table. The zone of impact is discussed in the next section.

### 3.8. Zone of Impact

In an HRA, it is necessary to define a zone of impact or a method to set boundaries on the analysis. For AB 2588 purposes, SCAQMD requires that the HRA must encompass the area subject to an added lifetime cancer risk (all pathways) of one in one million or greater (i.e. $\geq 1.0 \times 10^{-6}$). For non-cancer risks, the analysis must bound the area subject to an HI greater than or equal to one half ($\geq 0.5$).

### 3.9. Land Use Considerations

Risk estimates are sensitive to land uses (e.g. residential, commercial, vacant) since these factors can affect exposure assumptions. If residential or worker risks are not calculated at the PMI because the land is currently vacant, then the location, zoning and potential future land uses must be discussed. Updated information on current land uses is requested when updated emission estimates are reported to SCAQMD.

### 3.10. Maps

Maps showing the location of the source in relation to the zone of impact must be submitted. Dispersion modeling for sources should be conducted with receptors defined in terms of Universal Transverse Mercator (UTM) coordinates and a World Geodetic System 1984 (WGS84) spatial reference system. For cancer risk, total risk isopleths for facilities should be plotted on the street

map provided using HARP at cancer risk intervals of 1, 10, 25, and 100 in a million. Isopleths for non-cancer HI must include levels corresponding to an HI of 0.5, 1.0, 3.0, and 5.0.

Separate maps should be provided for each of the four risk variables: cancer risks, non-cancer acute risks, non-cancer chronic risks, and non-cancer 8-hour chronic risks. The maps must contain an accurate scale for measuring distances and a legend. The map scale that can accommodate the isopleths and show the greatest level of detail must be used. The names of streets and other locations must be presented and be legible.

The location of schools, hospitals, day-care centers, other sensitive receptors, residential areas and work-sites within the zone of impact must be identified on the map. If the area of the zone of impact is very large, then more detail should be devoted to higher concentration/risk areas versus lower risk areas. The land uses in the vicinity of the PMI must be shown in detail. This may require a separate map. If sensitive receptors are located within the zone of impact, then cancer risk and HI values must also be presented in the form of a table including all the sensitive receptors.

## 3.11. Air Dispersion Modeling

Air dispersion modeling is performed for the exposure assessment of the HRA. A basic understanding of dispersion modeling is presumed. For a more detailed overview of regulatory modeling procedures, refer to the U.S. EPA's "Guideline on Air Quality Models[18]" and/or the 2015 OEHHA HRA Guidelines.

### 3.11.1. Facility Description and Source Information

The HRA should contain a brief description of the facility and its activities as shown in the detailed HRA outline provided in Appendix B. Table 4 lists the information on the facility and its surroundings that must be provided in the modeling analysis. The facility location is used to determine the most representative meteorological data for the analysis. The nearby land use is needed to properly label receptors as residential, commercial, sensitive, etc.

The facility plot plan (including a length scale) is needed to determine all source locations including their elevations above sea level, building dimensions, and the property boundary. The operating schedule, the hourly emission rates, the annual average emission rates, and the source parameters listed in Table 4 are necessary to accurately characterize the source emissions. Please refer to the detailed outline provided in Appendix B for additional information and guidance.

[18] https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models

**Table 4. Required Source Information**

Information on the Facility and Its Surroundings
- Location (i.e., address and UTM coordinates in WGS84)
- Local land use (within 20 km)
- Local topography (within 20 km)
- Facility plot plan
  - Property boundaries
  - Horizontal scale
  - Building heights (for building downwash calculations)
  - Source locations including elevations

Point Source Information (stacks, vents, etc.)
- Maximum and average hourly emission rates
- Annual emissions
- Stack location (in UTM coordinates in WGS84) on plot plan including elevation
- Stack height
- Stack gas exit velocity
- Stack gas exit temperature
- Building dimensions, heights, and location

Fugitive Source Information (area and volume sources)
- Maximum and average hourly emission rates
- Annual emissions
- Source location (in UTM coordinates in WGS84) on plot plan including elevations
- Source height
- Area or volume dimensions

### 3.11.2. Model Selection and Model Options

All HRAs prepared for the AB 2588 Program must use the most recent version of HARP.[19] U.S. EPA's air quality dispersion model, AERMOD, is used by HARP for the exposure assessment. AERMOD is a Gaussian plume model capable of estimating pollutant concentrations from a wide variety of sources that are typically present in an industrial source complex. Emission sources are categorized into four basic types: point, area, volume, and open pit sources. AERMOD estimates hourly concentrations for each source/receptor pair and calculates concentrations for user-specified averaging times, including an average concentration for the complete simulation period. AERMOD includes atmospheric dispersion options for both urban and rural environments and can address flat, gently rolling, and complex terrain situations. AERMOD documentation is available on the U.S. EPA website.[20] Table 5 summarizes the default dispersion modeling assumptions recommended by SCAQMD. AERMOD-ready meteorological data are available on SCAQMD's website.[21]

[19] https://www.arb.ca.gov/toxics/harp/harp.htm
[20] https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models
[21] http://www.aqmd.gov/home/air-quality/air-quality-data-studies/meteorological-data

**Table 5. Summary of SCAQMD Dispersion Modeling Guidance**

| Parameter | Assumption |
|---|---|
| Model Control Options | |
| • Use Regulatory Default? | Yes |
| • Urban or Rural? | Urban |
| Source Options | |
| • Include Building Downwash? | Yes |
| Meteorology Options | |
| • Meteorological Data | AERMOD-ready data available on SCAQMD website. See section 3.11.3. |

AERMOD should be executed using the urban dispersion parameters (i.e., URBAN), which is SCAQMD policy for all air quality impact analyses in its jurisdiction. The U.S. EPA regulatory default options should be used for all projects. If non-default options are used, a justification must be included and SCAQMD staff approval is needed.

### 3.11.3. Meteorological Data

SCAQMD has AERMOD-ready meteorological data for the South Coast Air Basin available on the SCAQMD website including a map showing the locations of meteorological stations with AERMOD-ready data, a table listing the meteorological data for the meteorological stations, and a list of station data including abbreviations, geographical information, and surface characteristics.[22]

The most representative meteorological station should be chosen for modeling which in most cases, is the nearest station; however, an intervening terrain feature may dictate the use of an alternate station. Modelers should contact AB 2588 Program staff regarding the most representative meteorological station, if necessary. The data are available on the following SCAQMD website.[23]

### 3.11.4. Receptor Grid

Air dispersion modeling is required to estimate (a) annual average concentrations to calculate the Maximum Individual Cancer Risk (MICR), the maximum chronic HI, the zones of impact, and excess cancer burden and (b) peak hourly concentrations to calculate the health impact from substances with acute non-cancer health effects. To achieve these goals, the receptor grid should begin at the facility fence line and extend to cover the zone of impact. In addition, the receptor grid should be fine enough to identify the points of maximum impact.

To identify the maximum impacted receptors (i.e., peak cancer risk and peak hazard indices) a grid spacing of 100 meters or less must be used. All receptors should be identified in UTM coordinates. Receptor grid points outside of the facility boundary must be placed so that individual grid points

[22] http://www.aqmd.gov/home/air-quality/air-quality-data-studies/meteorological-data
[23] http://www.aqmd.gov/home/air-quality/air-quality-data-studies/meteorological-data/data-for-aermod

are placed at UTM coordinates ending in "00" (e.g., grid point UTM East 572300 and UTM North 3731000). Receptor grids with less than 100 meter spacing must include grid points at UTM coordinates ending in "00." Elevations must be provided for all receptor grids.

Receptors on the facility boundary must be placed along the boundary following the maximum spacing requirements shown in Table 6. Sensitive receptors must be identified by exact UTM coordinates. Elevations must be provided for all receptors.

**Table 6. Maximum Receptor Spacing Requirements for Fenceline Receptors**

| Area of Facility | Maximum Receptor Spacing |
|---|---|
| Area < 4 acres | 20 meters |
| 4 acres ≤ Area < 10 acres | 30 meters |
| 10 acres ≤ Area < 25 acres | 50 meters |
| 25 acres ≤ Area < 100 acres | 75 meters |
| Area ≥ 100 acres | 100 meters |

### 3.11.5. Stacks with Raincaps and Area Sources

Emission release points with raincaps or which are oriented so that the exhaust is vented downward or horizontally may not use the velocity inside the stack as the vertical velocity of the point source in the model. However, as a point source must be modeled with some vertical velocity, these stacks may be modeled with a positive vertical velocity of no more than 0.01 meters per second. In general, if there is uncertainty on how to represent sources in a model, AB 2588 Program staff should be consulted before proceeding with modeling.

According to U.S. EPA guidance for area sources in AERMOD, the aspect ratio (i.e., length/width) for area sources should be less than 10 to 1. If this is exceeded, then the area should be subdivided to achieve a 10 to 1 or less aspect ratio for all sub-areas.

## 3.12. HRA

SCAQMD requires that all HRAs for the AB 2588 Program be prepared in accordance with OEHHA and CARB guidance[24] and using the latest approved version of HARP. The OEHHA Guidelines requires at least a Tier-1 evaluation, which allows for Derived Risk Calculations. The Derived method uses high end exposure parameters for the top two exposure pathways and mean exposure parameters for the remaining pathways for cancer risk estimates. For chronic non-cancer assessments, the Derived method uses high end exposures for the top three exposure pathways. CARB has developed an updated Risk Management Policy that includes recommendations for inhalation exposures,[25] which recommends using high end breathing rates (95th percentile) for children from the 3rd trimester through age 2, and 80th percentile breathing rates for all other ages

[24] https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0

[25] Information regarding CARB's Risk Management policy can be located at: https://www.arb.ca.gov/toxics/toxics.htm

for residential exposures. In accordance with these guidelines, SCAQMD recommends Derived Risk Calculations using CARB's Risk Management Policy to be prepared and presented in an HRA. CARB prepared HARP to facilitate the preparation and transmittal of a compliant ATIR and HRA. The details are provided below.

### 3.12.1. OEHHA Guidance

OEHHA's guidance for preparing HRAs is contained in the *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*.[26] This guidance manual has undergone public and peer review, was endorsed by the California Scientific Review Panel (SRP), and approved by OEHHA in March 2015.

The 2015 OEHHA HRA Guidelines recognizes four types of evaluations.

Tier-1: point estimate, using standard assumptions

Tier-2: point estimate, using site-specific details

Tier-3: stochastic risk, using standard assumptions

Tier-4: stochastic risk, using site-specific details

The details are described in the 2015 OEHHA HRA Guidelines.

"Tier-1 is a standard point-estimate approach using the recommended point-estimates presented in this document. […] Tier-1 evaluations are required for all HRAs prepared for the Hot Spots Program." (see Section 2.5.3. of 2015 OEHHA HRA Guidelines[26])
"[T]he Tier-1 evaluation is useful in comparing risks among a large number of facilities and must be included in all HRAs." (see Section 8.2.5.C. of 2015 OEHHA HRA Guidelines[26])

As such, SCAQMD requires that all HRAs for the AB 2588 Program contain at least a Tier-1 evaluation. The results of the Tier-1 evaluation are used for comparative and regulatory purposes (i.e., risk status, fee category, public notice, and risk reduction).

The Executive Summary and main body of the HRA shall contain only statements regarding the results of the Tier-1 evaluation. Tier-2, Tier-3, and Tier-4 evaluations should not be in the Executive Summary or main document; they may be prepared and presented as appendices to the main document. Site specific details for either a Tier-2, Tier-3, or Tier-4 evaluation will require review and approval by OEHHA, CARB, and SCAQMD.

### 3.12.3. HARP

HARP is designed to meet the programmatic requirements of the AB 2588 Program and will calculate all four OEHHA Tiers, both the Derived Risk Calculations (as designed by OEHHA), and CARB's "Risk Management Policy Inhalation Rates for Residential Cancer Risk Calculations."

[26] https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0

The outline for an HRA is contained in Appendix B. The list of files that must be submitted with an HRA for the AB 2588 Program are included in Table 7. Any emissions factor development, emission rate calculations, or approved source test protocol and reports must be submitted in electronic format (e.g., in Microsoft Excel). If these items have been attached to the AER report, please refer to it in the cover letter to avoid a redundant submittal.

**Table 7. Files that must be provided with HRA submittals**

| File Type | Notes |
|---|---|
| HRA Input | All files created by CARB's Air Dispersion Modeling and Risk Tool (ADMRT) Module |
| HRA Output | |
| Dispersion Modeling Input | All AERMOD and BPIP files used in the HRA including terrain data. All meteorological data files including any AERMET files if default SCAQMD meteorological data is not used. |
| Dispersion Modeling Output | |
| Emission Inventory Input | All files created by CARB's Emission Inventory Module (EIM) |
| Emission Inventory Output | |
| Emission Calculations | Provided in electronic format (e.g., Excel) and documented references (i.e. sample calculations) |
| Source Tests | Only SCAQMD-approved source tests can be used. SCAQMD approval must be included in submittal. |
| Air Monitoring Data | Any monitoring data used in the HRA should be provided. |

### 3.12.4. SCAQMD's Default Assumptions for HRAs

All HRAs prepared for SCAQMD must include an OEHHA Tier-1 evaluation. All SCAQMD risk management decisions are based on the Tier-1 evaluation. Tier-2, Tier-3, and Tier-4 evaluations may be prepared but must be included in an appendix to the HRA. The results of the Tier-2, Tier-3, and/or Tier-4 evaluations must not be included in the Executive Summary or main body of the HRA. Table 8 summarizes the HRA assumptions required by SCAQMD. Deviations from these defaults must be approved by SCAQMD staff prior to their use.

Residential cancer risks assume a 30-year exposure (cancer burden assumes a 70-year exposure) and must include, at a minimum, the following pathways: home grown produce, dermal absorption, soil ingestion, and mother's milk. A deposition velocity of 0.02 m/s should be assumed for the non-inhalation pathways. The HRA should assume default values in HARP for all pathways with the exception of the dermal pathway which should assume a "warm" climate. The other pathways of fish ingestion, dairy milk ingestion, drinking water consumption, and meat (i.e., beef, pork, chicken, and egg) ingestion should be included only if the facility impacts a local fishable body of water, grazing land, dairy, or water reservoir. The "RMP Using the Derived Method" risk calculation option should be used for estimating cancer risks at residential receptors. To estimate chronic non-cancer risks at residential receptors the "OEHHA Derived Method" risk calculation option should be used. The 8-hour chronic non-cancer risk should also be calculated for residential receptors for any source that operates at least 8 hours per day and 5 days per week.

**Table 8. Summary of SCAQMD Health Risk Assessment Guidance**

| Parameter | Assumptions |
|---|---|
| Multipathway | |
| • Inhalation | Required for residential and worker receptors |
| • Dermal | Required for residential and worker receptors |
| • Soil | Required for residential and worker receptors |
| • Homegrown Produce | Required for residential receptors |
| • Mother's Milk | Required for residential receptors |
| • Beef/Dairy | Site specific |
| • Pigs, Chickens, and/or Eggs | Site specific |
| • Deposition Velocity | 0.02 meters per second |
| • MP Exposure Assumptions | Use HARP defaults except for dermal pathway which uses "warm" climate |
| Residential Cancer Risk Assumptions | |
| • Exposure Duration | 30 years for individual receptors<br>70 years for cancer burden |
| • Analysis Option | RMP Using the Derived Method |
| Worker Cancer Risk Assumptions | |
| • Exposure Duration | 25 years |
| • Analysis Option | OEHHA Derived Method |
| Residential and Worker Non-Cancer Risk Assumptions | |
| • Analysis Option | OEHHA Derived Method |

Worker cancer risks assume a 25-year exposure and must include the pathways of dermal absorption and soil ingestion. A deposition velocity of 0.02 m/s should be assumed for these pathways and the dermal pathway should assume a 'warm' climate. The "OEHHA Derived Method" risk calculation option should be used for estimating cancer and non-cancer chronic risks at worker receptors.

The air concentration that the neighboring workers breathe when present at work is different than the annual average concentration calculated by AERMOD. The annual average estimated by AERMOD is a 24 hours per day, 7 days per week, 365 days per year average, regardless of the actual operating schedule of the emitting facility. It is assumed the off-site worker is impacted by the toxic emissions only during work hours. Thus, the model-predicted concentrations must be adjusted by a multiplying factor to reflect the pollutant concentration that the worker breathes. For example, suppose that the off-site worker and the emitting facility have the same operating schedule, perhaps 8 hours per day, 5 days per week, and 52 weeks per year. The annual average concentrations predicted by AERMOD must be adjusted by a factor of 4.2 (i.e., 7/5 x 24/8). Please refer to the 2015 OEHHA HRA Guidelines for further information.

The adjustment factors for all possible operating schedules are provided in Tables 5.1 and 5.2 of SCAQMD *Permit Application Package "N" For Use in Conjunction with the Risk Assessment*

*Procedures for Rules 1401, 1401.1, and 212*.[27] These factors are entered into HARP by activating the Worker Adjustment Factor (WAF) option in the Inhalation Pathway and entering the appropriate factor from either one of the tables.

The adjustments in Tables 5.1 and 5.2 should only be applied when estimating worker cancer risks for facilities that do not operate continuously. The adjustments are not applicable to residential cancer risks and to residential or worker chronic non-cancer risks.

[27] http://www.aqmd.gov/docs/default-source/permitting/rule-1401-risk-assessment/attachmentn-v8-1.pdf

# Appendix A

## Elements of an Air Toxics Inventory Report

1. Report Summary (hard copy)

- Facility name, Facility ID, and location
- Facility plot plan identifying: emission source location, property line, horizontal scale, and building heights and dimensions
- Facility total emission rate by substance for all emittants including the following information (2015 OEHHA HRA Guidelines Appendix A-I Substances must be quantified in the inventory report):
  - substance name and CAS number
  - annual average emission for each substance (lb/yr and g/s)
  - maximum one-hour emissions for each substance (lbs/hr and g/s)
- Supporting documentation such as source test report and SCAQMD approval letter if emissions are measured

2. Use the EIM portion of HARP to provide facility, device, process, emissions, and stack data in a HARP database, including but not limited to the following information:

- Source identification number used by the facility
- Source name
- SCAQMD permit number if available
- Source location using UTM coordinates (in meters) with a WGS84 projection
- Source base elevation (m)
- Source height (m)
- Source dimensions (e.g., stack diameter, building dimensions, area/volume size, etc.) (m)
- Stack gas exit velocity (m/s) if applicable
- Stack gas volumetric flow rate (ACFM) if applicable
- Stack gas exit temperature (K)
- Number of operating hours per day
- Number of operating days per week
- Number of operating weeks per year
- Report emission control equipment and efficiency by source and by substance.

The description should be brief.

- Report annual average and maximum hourly emission rates for each toxic substance for each source
- Report emission inventory methods indicating whether emissions are measured or estimated

# Appendix B

## Outline for the HRA

## I. Table of Contents

- Section headings with page numbers indicated
- Tables and figures with page numbers indicated
- Definitions and abbreviations. Must include a definition of acute, 8-hour chronic, chronic, and cancer health impacts
- Appendices with page numbers indicated

## II. Executive Summary

- Name of facility and the complete address
- Facility ID number
- Description of facility operations and a list identifying emitted substances, including a table of maximum 1-hour and annual emissions in units of lbs/hr and lbs/yr, respectively
- List the multipathway substances and their pathways
- Text presenting overview of dispersion modeling and exposure assessment
- Text defining dose-response assessment for cancer and non-cancer health impacts and a table showing target organ systems by substance for non-cancer impacts
- Summary of results (See Attachment A to this Appendix). Potential cancer risks for residents must be based on 30-year, Tier-1 analysis and potential cancer risks for workers must be based on 25-year, Tier-1 analysis. Cancer burden results must be based on 70-year, Tier-1 analysis
    - Location (address or UTM coordinates) and description of the off-site PMI, maximum exposed individual resident (MEIR), and maximum exposed individual worker (MEIW). See Attachment A for the required summary form
    - Location (address or UTM coordinates) and description of any sensitive receptors that are above a cancer risk of ten in one million or above a non-cancer health HI of one
    - Text presenting an overview of the total potential multipathway cancer risk at the PMI, MEIR, MEIW, and sensitive receptors (if applicable). Provide a table of cancer risk by substance for the MEIR and MEIW. Include a statement indicating which of the substances appear to contribute to (i.e., drive) the potential health impacts. In addition, identify the exposure pathways evaluated in the HRA
    - Provide a map of the facility and surroundings and identify the location of the MEIR, MEIW, and PMI
    - Provide a map of 30-year lifetime cancer risk zone of impact (i.e., 1 in one million risk contour), if applicable. Also show the 10, 25, and 100 in one million risk contours, if applicable. If the cancer burden is greater than 0.5, then a map showing the 1 in one million risk contour based on a 70-year lifetime should also be presented
    - Text presenting an overview of the acute and chronic non-cancer hazard quotients or the (total) hazard indices for the PMI, MEIR, MEIW, and sensitive receptors.

Include separate statements (for acute, 8-hour chronic, and annual chronic exposures) indicating which of the substances appear to drive the potential health impacts. In addition, clearly identify the primary target organ(s) that are impacted from acute and chronic exposures
- Identify any subpopulations (e.g., subsistence fishers) of concern
- Table and text presenting an overview of estimates of population exposure
- Version of the Risk Assessment Guidelines and computer program(s) used to prepare the risk assessment

## III. Main Body of Report

A. Hazard Identification

- Table and text identifying all substances emitted from the facility. Include the CAS number of substance and the physical form of the substance if possible. The complete list of the substances to be considered is contained in Appendix A of the 2015 OEHHA HRA Guidelines[28]
- Table and text identifying all substances that are evaluated for cancer risk and/or non-cancer acute and chronic health impacts. In addition, identify any substances that present a potential cancer risk or chronic non-cancer hazard via non-inhalation routes of exposure
- Describe the types and amounts of continuous or intermittent predictable emissions from the facility that occurred during the reporting year. As required by statute, releases from a facility include spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping (fugitive), leaching, dumping, or disposing of a substance into ambient air. Include the substance(s) released and a description of the processes that resulted in long-term and continuous releases

B. Exposure Assessment

This section describes the information related to the air dispersion modeling process that should be reported in the risk assessment. In addition, doses calculated by pathway of exposure for each substance should be included in this section. The educated reader should be able to reproduce the risk assessment without the need for clarification. The location of any information that is presented in appendices, on electronic media, or attached documents that supports information presented in this section, must be clearly identified by title and page number in this section's text and in the document's table of contents.

B.1 Facility Description

[28] https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0

Report the following information regarding the facility and its surroundings:

- Facility name
- Facility ID number
- Facility location (i.e., address)
- Local topography
- Facility plot plan identifying: emission source locations, property line, horizontal scale, building heights and dimensions
- Description of the site/route dependent exposure pathways. Provide a summary of the site-specific inputs used for each pathway (e.g., water or grazing intake assumptions). This information may be clearly presented and cross-referenced to the text in an appendix

## B.2 Emissions Inventory

Report the following information regarding the facility's sources and emissions in table format; see Appendix K of 2015 OEHHA HRA Guidelines.[29] Depending on the number of sources and/or pollutants, this information may be placed in the main body of the report or in an appendix

- Source identification number used by the facility
- Source name
- Source location using UTM coordinates (in meters); with a WGS84 projection
- Source base elevation (m)
- Source height (m)
- Source dimensions (e.g., stack diameter, building dimensions, area/volume size, etc.) (m)
- Stack gas exit velocity (m/s) if applicable
- Stack gas volumetric flow rate (ACFM) if applicable
- Stack gas exit temperature (K)
- Number of operating hours per day and per year
- Number of operating days per week
- Number of operating days or weeks per year
- Report emission control equipment and efficiency by source and by substance. The description should be brief.
- Report emission inventory methods indicating whether emissions are measured or estimated.
- Report emission rates for each toxic substance, grouped by source, in table form

[29] https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0

including the following information (see Appendix K of 2015 OEHHA HRA Guidelines). Depending on the number of sources and/or pollutants, this information may be placed in the main body of the report or in an appendix

- Source name
- Source identification number
- Substance name and CAS number
- Annual average emissions for each substance (lbs/yr and g/s). Radionuclides are reported in curies/yr
- Maximum one hour emissions for each substance (lbs/hr and g/s). Radionuclides are reported in millicuries/yr
- Report facility total emission rates by substance for all emittants including the following information (see Appendix K of 2015 OEHHA HRA Guidelines). This information should be in the main body of the report
- Substance name and CAS number
- Annual average emissions for each substance (lbs/yr and g/s). Radionuclides are reported in curies/yr
- Maximum one-hour emissions for each substance (lbs/hr and g/s). Radionuclides are reported in millicuries/yr

## B.3 Air Dispersion Modeling

- The HRA should indicate the source and time period of the meteorological data used. Include the meteorological data electronically with the HRA. SCAQMD has AERMOD-ready meteorological data for available stations in the South Coast Air Basin. This data can be downloaded from SCAQMD's website[30]
- Include proper justification for using the meteorological data. The nearest representative meteorological station should be chosen for modeling. Usually this is simply the nearest station to the facility; however, an intervening terrain feature may dictate the use of an alternate site
- The latest approved version of AERMOD and HARP should be used for all HRAs prepared for the AB 2588 Program
- Table and text that specifies the following information:
  - Selected model options and parameters
  - Receptor grid spacing
- For the PMI, MEIR, MEIW, and any sensitive receptors required by SCAQMD, include tables that summarize the annual average concentrations calculated for all substances
- For the PMI, MEIR, MEIW, and any sensitive receptors required by SCAQMD,

[30] http://www.aqmd.gov/home/air-quality/air-quality-data-studies/meteorological-data

include tables that summarize the maximum one-hour; chronic 8-hour; and 90-day rolling average (lead only) concentrations

C. Risk Characterization

HARP generates the risk characterization data needed for the outline below. Any data needed to support the risk characterization findings should be clearly presented and referenced in the text and appendices. A listing of HARP files that meet these HRA requirements are provided in Section V. All HARP files should be included in the HRA. Ideally, the HRA report and a summary of data used in the HRA should be on paper and all data and model input and output files should be provided electronically.

The potential cancer risk for the PMI, MEIR, and sensitive receptors of interest must be presented in the HRA's text, tables, and maps using a residential 30-year exposure period. MEIW location should use appropriate exposure periods. For the AB 2588 Program, the 30-year exposure duration should be used as the basis for residential public notification and risk reduction audits and plans. All HRAs must include the results of a Tier-1 exposure assessment. If persons preparing the HRA would like to present additional information (i.e., exposure duration adjustments or the inclusions of risk characterizations using Tier-2 through Tier-4 exposure data), then this information should be presented in separate, clearly titled, sections, tables, and text.

The following information should be presented in this section of the HRA. If not fully presented here, then by topic, clearly identify the section(s) and pages within the HRA where this information is presented.

- Description of receptors to be quantified
- Identify the site/route dependent exposure pathways (e.g., water ingestion) for the receptor(s), where appropriate (e.g., MEIR). Provide a summary of the site-specific inputs used for each exposure pathway (e.g., water or grazing intake assumptions). In addition, provide reference to the appendix (section and page number) that contains the modeling (i.e., HARP/dispersion modeling) files that show the same information
- Tables and text providing the following information regarding the potential multipathway cancer risks at the PMI, MEIR, MEIW, and any sensitive receptors of concern:
  - Location in UTM coordinates
  - Contribution by substance
  - Contribution by source
- Tables and text providing the following information regarding the acute non-cancer hazard quotient at the PMI, MEIR, MEIW, and any sensitive receptors of concern:
  - Location in UTM coordinates
  - Target organ(s)
  - Contribution by substance
  - Contribution by source

- Tables and text providing the following information regarding the chronic non-cancer (inhalation and oral) hazard quotient at the PMI, MEIR, MEIW, and any sensitive receptors of concern:
  - Location in UTM coordinates
  - Target organ(s)
  - Contribution by substance
  - Contribution by source
- Table and text presenting estimates of population exposure. Tables should indicate the number of persons exposed to a total cancer risk greater than $10^{-6}$, $10^{-5}$, $10^{-4}$, etc. and total hazard quotient or HI greater than 0.5, 1.0, 3.0, and 5.0. Total excess cancer burden should also be provided
- Provide maps that illustrate the HRA results as noted below. The maps should be an actual street map of the area impacted by the facility with UTM coordinates and facility boundaries clearly labeled. This should be a true map (i.e., one that shows roads, structures, etc.), drawn to scale, and not a schematic drawing. Color aerial photos are usually the most appropriate choice. The following maps are required:
  - Locations of the PMI, MEIR, MEIW, and sensitive receptors for the cancer and non-cancer acute and chronic risks. Also show the facility emission points and property boundary
  - Total cancer risk (including multipathway factors) contours for the following risk levels: 100, 25, 10, and 1 in a million. Maps should be provided for the minimum exposure pathways (i.e., inhalation, soil ingestion, dermal exposure, and mother's milk) and for all applicable exposure pathways (i.e., minimum exposure pathways plus additional site/route specific pathways). Include the facility location on the maps
  - Non-cancer acute and chronic HI contours for the following levels: 5.0, 3.0, 1.0 and 0.5. Include the facility location
- The risk assessor may want to include a discussion of the strengths and weaknesses of the risk analyses and associated uncertainty directly related to the facility HRA
- If appropriate, comment on the possible alternatives for control or remedial measures
- If possible, identify any community concerns that influence public perception of risk

D. References

## IV. Appendices

The appendices should contain all data, sample calculations, assumptions, and all modeling and risk assessment files that are needed to reproduce the HRA results. All data and model input and output files should be provided electronically (e.g., uploaded to SCAQMD's OnBase system or on USB Flash Drive). All appendices and the information they contain should be referenced, clearly titled, and paginated. The following are potential appendix topics unless presented elsewhere in the HRA:

- List of all receptors in the zone of impact and their associated risks
- Emissions by source
- Census data
- Maps and facility plot plan
- All calculations used to determine emissions, concentrations, and potential health impacts at the PMI, MEIR, MEIW, and sensitive receptors
- Presentation of alternate risk assessment methods (e.g., alternate exposure durations, or Tier-2 to Tier-4 evaluations with supporting information)

## V. Computer Files

The list of electronic files that must be submitted for the HRA are found in Table 7 of Chapter 3 of this document. They must be useable (i.e., can be opened and run in AERMOD/HARP if file is an AERMOD/HARP file). Any supplementary files should be submitted in formats that will not lose formatting in transfer (i.e. pdf for text documents).

**Attachment A to Appendix B**

**HRA Summary Form**

This summary form should accompany all HRAs and be presented at the beginning of the Executive Summary.

**South Coast Air Quality Management District**
21865 Copley Drive, Diamond Bar, CA 91765-4182
(909) 396-2000 • www.aqmd.gov

# HEALTH RISK ASSESSMENT SUMMARY FORM

(Required in Executive Summary of HRA)

Facility Name : _____
Facility Address: _____
_____
Type of Business: _____
SCAQMD ID No.: _____

## A. Cancer Risk

*(One in a million means one chance in a million of getting cancer from being constantly exposed to a certain level of a chemical over a period of time)*

1. Inventory Reporting Year : _____
2. Maximum Cancer Risk to Receptors : *(Offsite and residence = 30-year exposure, worker = 25-year exposure)*
   a. Offsite _____ in a million Location: _____
   b. Residence _____ in a million Location: _____
   c. Worker _____ in a million Location: _____
3. Substances Accounting for 90% of Cancer Risk: _____
   Processes Accounting for 90% of Cancer Risk: _____
4. Cancer Burden for a 70-yr exposure: *(Cancer Burden = [cancer risk] x [# of people exposed to specific cancer risk])*
   a. Cancer Burden _____
   b. Number of people exposed to >1 per million cancer risk for a 70-yr exposure _____
   c. Maximum distance to edge of 70-year, 1 x $10^{-6}$ cancer risk isopleth (meters) _____

## B. Hazard Indices

*[Long Term Effects (chronic) and Short Term Effects (acute)]*
*(non-carcinogenic impacts are estimated by comparing calculated concentration to identified Reference Exposure Levels, and expressing this comparison in terms of a "Hazard Index")*

1. Maximum Chronic Hazard Indices:
   a. Residence HI: _____ Location: _____ toxicological endpoint: _____
   b. Worker HI : _____ Location: _____ toxicological endpoint: _____
2. Substances Accounting for 90% of Chronic Hazard Index: _____
3. Maximum 8-hour Chronic Hazard Index:
   8-Hour Chronic HI: _____ Location: _____ toxicological endpoint: _____
4. Substances Accounting for 90% of 8-hour Chronic Hazard Index: _____
5. Maximum Acute Hazard Index:
   PMI: _____ Location: _____ toxicological endpoint: _____
6. Substances Accounting for 90% of Acute Hazard Index: _____

## C. Public Notification and Risk Reduction

1. Public Notification Required? ____ Yes ____ No
   a. If 'Yes', estimated population exposed to risks > 10 in a million for a 30-year exposure, or an HI >1
   _____
2. Risk Reduction Required? ____ Yes ____ No

Revised 4/30/2015

# Appendix C

## HRA Review Check List

The check list contained here is used by SCAQMD staff to standardize the review of HRAs. It is being provided to assist facilities and consultants in their HRA preparation.

| **Facility Name:** | **Facility ID:** |
|---|---|
| **Street Address:** | |
| **City:** | **Zip Code:** |
| **HRA Consultant:** | **Reviewer:** |

**Dispersion Modeling**

1. Control Pathway
   a. "Regulatory Default Option" checked? **Yes No**
      i) If No, explain why:_____
   b. Urban Option
      i) "Apply All Sources" checked? **Yes No**
      ii) "Population" from the latest Census data is added for county? **Yes No**
      iii) "Roughness Length" = 1.0 (default value) **Yes No**
2. Source Pathways
   a. Sources
      i) Check if source list is consistent with following documents:
         - Base Year AER source list? **Yes No**
         - District equipment list (permit list)? **Yes No**
      ii) "Source Type" determined properly? **Yes No**
      iii) "Volume/Area source dimensions" are reasonable? **Yes No**
      iv) "UTMs" are consistent with Plot Plan? **Yes No**
      v) "Elevation" of source(s) are imported from AERMAP output file? **Yes No**
      vi) Adequate "Emission Rates" used? (default 1 g/s) **Yes No**
      vii)"Release Heights" reasonable? **Yes No**
      viii) Stack parameters are consistent with those provided in the report **Yes No**
      ix) Accurate and sufficient details entered for every source? **Yes No**
   b. Variable Emissions
      i) Default emission rate used? (default: 1 g/s, 24 hrs/day, 365 days/yr) **Yes No**
      ii) If not, appropriate emission rate factors are used? (Table 2) **Yes No**
   c. Buildings
      i) All surrounding buildings included? **Yes No**
      ii) Tier Heights and corner points reasonable? **Yes No**

- If No in any, _

3. Receptors
   a. Grid receptors
      i) Included? (should be "Yes") **Yes No**
      ii) Spacing? (should be no greater than 100 meters) **Yes No**
         - Assumed spacing_____meters
      iii) Elevations included? (should be "Yes") **Yes No**
      iv) Is gridded area sufficient to cover acceptable risk levels? **Yes No**
   b. Property boundary receptors
      i) Included? (should be "Yes") **Yes No**
      ii) Spacing? (should follow guidance in Table 3) **Yes No**
         - Assumed spacing_____meters
      iii) Elevations included (should be "Yes") **Yes No**
   c. Sensitive receptors
      i) Included? (should be "Yes" if cancer risks >1 in a million) **Yes No**
      ii) Elevation included? (should be "Yes") **Yes No**
      iii) Verified from review of Google Earth or other source **Yes No**
   d. Census block receptors
      i) Included? (should be "Yes" if cancer risks >1 in a million) **Yes No**
      ii) Elevation included? (should be "Yes") **Yes No**
   e. Pathway receptors included? (should be "No") **Yes No**
4. Meteorology Pathway (The latest met data files shall be used.)
   a. Surface Met Data File: _____.sfc
   b. Profile Met Data File:_____.pfl
   c. Base Elevation of Met Station (PROFBASE):_____meters
   d. Does the Met Station reflect prevailing meteorological conditions (ex., prevailing winds), surrounding land use, and topography that exists at the source? This is not always the closest Met Station (Table 1) **Yes No**
5. Terrain Option
   a. (Step 1) is Anchor location correct? **Yes No**
   b. (Step 2) is appropriate DEM/NED data file linked? **Yes No**

i) DEM/NED file used: _____

ii) Is (Are) the DEM/NED file(s) covering sufficient area? **Yes No**

c. (Step 3) independently ran AERMAP? **Yes No**

6. Building Downwash
7. Independently ran BPIP Prime? **Yes No** Duplication of AERMOD Results
   a. Independently ran AERMOD? **Yes No**
   b. Average $\chi$/Q first high values for each source group reproduced? **Yes No** (not required; useful if diagnosing discrepancies)
   c. Max 1-hour $\chi$/Q first high values for each source group reproduced? **Yes No** (not required; useful if diagnosing discrepancies)
8. All plt files are generated successfully? **Yes No**

Site Visit

- Site visit conducted? **Yes No**
  a. If Yes, **Date** **Time** ,
  b. Facility Contact: _____
  c. SCAQMD Staff: _____

Program Used

1. Facility submittal package is processed by the latest version of HARP? **Yes No**
   a. If NOT, name software used: _____
2. This review is performed using the latest version of HARP? **Yes No**
   a. If NOT, name software used: _____

General Comments

_____

_____

_____

# Appendix D

## Elements of a Risk Reduction Plan

## INTRODUCTION

Facilities with an approved HRA with health risks greater than or equal to the Action Risk Levels as identified in SCAQMD Rule 1402 are required to submit an RRP within the specified timeframes for each specific category as specified in the Rule. Facilities participating in the Voluntary Risk Reduction Program under Rule 1402 should follow the *Guidelines for Participating in the Rule 1402 Voluntary Risk Reduction Program* that are available online.[31] The owner or operator is responsible for preparing a RRP that identifies the risk reduction measures that should be implemented in order to reduce the impact of the total facility emissions below the Action Risk Levels.

## ELEMENTS OF A RISK REDUCTION PLAN

1. The name, address, and SCAQMD facility identification number, and Standard Industrial Code (SIC) and North American Industry Classification System (NAICS) codes of the facility;
2. A facility risk characterization which includes an updated ATIR and HRA, if the risk due to total facility emissions has increased above or decreased below the levels indicated in the previously approved HRA;
3. Identification of each source from which risk needs to be reduced in order to achieve a risk below Rule 1402 Action Risk Levels;
4. For each source identified in subparagraph (3), an evaluation of the risk reduction measures available to the owner or operator, including emission and risk reduction potential, and time necessary for implementation;
    - An updated ATIR and HRA if total facility risks are different than what was approved in the previously approved HRA.
5. Specification of the risk reduction measures that shall be implemented by the owner or operator to comply with the requirements of Rule 1402, subdivision (i) to achieve the Action Risk Level or the lowest achievable level;
6. A schedule for implementing the specified risk reduction measures as quickly as feasible. The schedule shall include the submittal of all necessary applications for permits to construct or modify within 180 days of approval of the RRP, or in accordance with another schedule subject to approval by the Executive Officer, and specify the dates for other increments of progress associated with implementation of the risk reduction measures;
7. If requesting a time extension, the plan must also include the following information:
    - A description of the risk reduction measure(s) for which a time extension is needed;
    - The reason(s) a time extension is needed;
    - Progress in implementing risk reduction measures in the plan;
    - For RRPs, estimated health risks at the time of the extension request and at the end

[31] http://www.aqmd.gov/docs/default-source/planning/risk-assessment/vrrp_guidelines.pdf?sfvrsn=4

of the risk reduction period; and the length of time extension requested.

The Executive Officer will review the request for the time extension and will approve or reject the time extension based on the following criteria:

- The facility-wide health risk is below the Significant Risk Level at the time of submittal of the time extension request;
- The owner or operator provides sufficient details identifying the reason(s) a time extension is needed that demonstrates to the Executive Officer that there are specific circumstances beyond the control of the owner or operator that necessitate additional time to complete implementation of the plan. Such a demonstration may include, but is not limited to, providing detailed schedules, engineering designs, construction plans, permit applications, purchase orders, economic burden, and technical infeasibility; and
- The time extension will not result in an unreasonable risk to public health.

8. An estimation of the residual health risk after implementation of the specified risk reduction measures; and
9. Proof of certification of the RRP as meeting all requirements by an individual who is officially responsible for the processes and operations of the facility. The person who makes this certification must be one of the following:
    - An engineer who is registered as a professional engineer pursuant to Business and Professional Code section 6762.
    - An individual who is responsible for the operations and processes of the facility.
    - An environmental assessor registered pursuant to Health and Safety Code section 25570.3.

# Appendix E

## Elements of a Risk Reduction Progress Report

## INTRODUCTION

Facilities with an approved RRP or VRRP as identified in SCAQMD Rule 1402 are required to submit an **Annual Progress Report** every twelve months as long as their total facility risk meets or exceeds the Rule 1402 Action or Significance Risk Levels.

## ELEMENTS OF A RISK REDUCTION PROGRESS REPORT

1. A description of any increases or decreases in emissions of toxic air contaminants that have occurred at the facility, including a description of any associated permits that were subject to Rule 1401, since approval of the RRP or VRRP;
2. The increments of progress (interim facility risks) achieved in implementing the risk reduction measures specified in the RRP or VRRP. The interim facility risk should represent the previous twelve month period;
3. Submittal dates of all applicable permit application(s), the status of the application(s), the name of the regulatory agency, and the corresponding permit number(s);
4. A schedule indicating dates for future increments of progress; and
5. Identification of any increments of progress that will be achieved later than specified in the plan and the reason for achieving the increments late.

# Appendix F

## Elements of Early Action Reduction Plans for Potentially High Risk Level Facilities

## INTRODUCTION

Facilities designated as a Potentially High Risk Level Facility by the Executive Officer, as identified in SCAQMD Rule 1402, are required to submit an Early Action Reduction Plan within 90 days of notification of such designation. The purpose of the Early Action Reduction Plan is to expedite risk reduction to mitigate the elevated health risk to protect public health.

## ELEMENTS OF AN EARLY ACTION REDUCTION PLANS FOR POTENTIALLY HIGH RISK LEVEL FACILITIES

Within 90 days of the date of notification by the Executive Officer that the facility is a Potentially High Risk Level Facility, an owner or operator shall submit an Early Action Reduction Plan that identifies a list of measures that can be implemented immediately to reduce the facility-wide health risk. The Early Action Reduction Plan shall include:

1. The name, address, and SCAQMD Facility ID number;
2. Identification of device(s) or process(es) that are the key health risk driver(s);
3. Risk reduction measure(s) that can be implemented by the owner or operator that includes but are not limited to procedural changes, process changes, physical modifications, and curtailments; and
4. A schedule for implementing the specified risk reduction measures.

# Appendix G

# List of Acronyms and Abbreviations

## List of Acronyms and Abbreviations

| Acronym | Description |
|---|---|
| AB 2588 | Air Toxics "Hot Spots" Information and Assessment Act |
| AER | Annual Emissions Reporting |
| ATIR | Air Toxics Inventory Report |
| CARB | California Air Resources Board |
| CAS | Chemical Abstracts Service |
| DICE | Diesel Internal Combustion Engine |
| EIM | Emission Inventory Module |
| HARP | Hotspots Analysis and Reporting Program |
| HI | Hazard Index |
| HRA | Health Risk Assessment |
| MEIR | Maximum Exposed Individual Resident |
| MEIW | Maximum Exposed Individual Worker |
| MICR | Maximum Individual Cancer Risk |
| NAICS | North American Industry Classification System |
| ODC | Ozone Depleting Compound |
| OEHHA | Office of Environmental Health Hazard Assessment |
| PMI | Point of Maximum Impact |
| RRP | Risk Reduction Plan |
| SB 1731 | Facility Air Toxic Contaminant Risk Audit and Reduction Plan |
| SIC | Standard Industrial Code |
| SRP | (California) Scientific Review Panel |
| SCAQMD | South Coast Air Quality Management District |
| U.S. EPA | United States Environmental Protection Agency |
| UTM | Universal Transverse Mercator |
| VRRP | Voluntary Risk Reduction Plan |
| WAF | Worker Adjustment Factor |
| WGS84 | World Geodetic System 1984 |

# Minutes for the GHG CEQA Significance Threshold Stakeholder Working Group #15

**Tuesday, September 28, 2010**
**SCAQMD, Room GB, 10:00 AM – 12:00 PM**

## 1. Welcome and Introductions

Dr. Elaine Chang, Deputy Executive Officer of SCAQMD's Planning Rule Development and Area Sources Division, called the meeting to order at 10:10 A.M. and asked for self introductions of the working group members and SCAQMD staff. Dr. Chang then presented an overview of the meeting agenda.

## 2. Review of Significance Threshold Approach

Mr. Mike Krause, Program Supervisor of the CEQA Special Projects section in SCAQMD's Planning Rule Development and Area Sources Division, provided a summary of SCAQMD staff's proposed GHG significance threshold approach, shown in the following bullet points:

- Tier I – Exemptions, e.g., categorical, statutory, etc.
- Tier II – Consistency with a locally adopted GHG reduction plan
- Tier III – Numerical Screening Thresholds

  Mr. Krause reminded the group that on December 5, 2008, the SCAQMD Governing Board adopted a numerical GHG significance threshold of 10,000 MTCO2e/year for industrial projects where the SCAQMD is the lead agency. Staff is now proposing to extend the industrial GHG significance threshold for use by all lead agencies. Similarly, with regard to numerical residential/commercial GHG significance thresholds, at the 11/19/2009 stakeholder working group meeting staff presented two options that lead agencies could choose: option #1 – separate numerical thresholds for residential projects (3,500 MTCO2e/year), commercial projects (1,400 MTCO2e/year), and mixed use projects (3,000 MTCO2e/year) and; option #2 – a single numerical threshold for all non-industrial projects of 3,000 MTCO2e/year. If a lead agency chooses one option, it must consistently use that same option for all projects where it is lead agency. The current staff proposal is to recommend the use of option #2, but allow lead agencies to choose option #1 if they prefer that approach.

- Tier IV – Performance Standards
  - Option 1 – Percent Emission Reduction Target

    SCAQMD staff has no recommendation regarding this approach at this time. Instead, if lead agencies enquire about using this approach, staff would reference the GHG significance approach recommended by San Joaquin Valley APCD and describe some of the challenges of using this approach.
  - Option 2 – Early Implementation of Applicable Measures – this option has been folded into option 3.
  - Option 3 – Sector-based Standard

Dr. Elaine Chang presented information on the currently proposed Tier IV performance standards. Option 3 has been modified to incorporate the Bay Area AQMD's concept of efficiency-based threshold for two target dates: 2020 and 2035. Relative to the 2020 target date, staff agrees with the methodology for establishing the efficiency threshold value of 6.6 MTCO2/yr for plans because this number is based on statewide service population (SP) in 2020. With regard to the project level efficiency threshold SCAQMD staff took a slightly different approach than BAAQMD. To derive the project level efficiency threshold of 4.6, it appears that BAAQMD took the 2020 statewide GHG reduction target for land use only (295,530,000 MTCO2e/yr) and divided it by the total 2020 statewide SP (population plus employment) (44,135,923 + 20,194,661), i.e., (295,530,000 MTCO2e/yr)/(44,135,923 + 20,194,661) = 4.6 MTCO2e/yr. SCAQMD staff believes that instead of using total 2020 statewide employment for all sectors, this approach should have used total 2020 statewide employment for the land use sectors only (17,064,489). If you use total 2020 statewide employment for land use sectors instead of total 2020 statewide employment for all sectors as BAAQMD did, your local project efficiency threshold becomes: (295,530,000 MTCO2e/yr)/( 44,135,923 + 17,064,489) = 4.8 MTCO2e/yr.

Relative to the 2035 target date, this target date was selected to be consistent with the GHG reduction target date of SB375. Overall, GHG reductions by the SB 375 target date of 2035 would be approximately 40 percent. This 40 percent reduction was applied to the 2020 targets, resulting in an efficiency threshold for plans of 4.1 MTCO2e/yr and an efficiency threshold at the project level of 3.0 MTCO2e/yr.

- Tier V – Mitigation: CEQA Offsets – no changes.

A question was asked whether or not a project must be less than or equal to both the 2020 and 2035 efficiency threshold in order to be considered insignificant. Staff responded yes.

Another stakeholder asked if the lead agency could take credit for GHG design features when determining the significance of GHG impacts. Staff responded yes.

Staff was asked whether or not they had looked at any test cases to see if projects could meet the 2035 efficiency threshold. Staff responded that no test cases were evaluated. However, it may be likely that projects can achieve the 2035 efficiency threshold because the SB375 target GHG reductions are expected to be met primarily through cleaner fleets as a result of fleet turnover and reducing VMT. Consequently, fleet turnover plus a small increment of GHG reductions from land use projects could potentially achieve the 2035 efficiency threshold.

A comment was made that by establishing a GHG significance threshold for both 2020 and 2035, a lead agency would have to continuing mitigating GHG emission impacts for 40 years, which is equivalent to establishing a reasonably available control technology (RACT) rule. Dr. Chang responded that by establishing the 2035 efficiency threshold, to reduce potential GHG impacts to less than significant, the lead agency and project proponent may need to "sharpen their pencils" to identify mitigation measures to remain less than significant. The staff proposal is not considered to be equivalent to a RACT rule because a

project could exceed the 2020 and or 2035 efficiency threshold, but still be approved and built.

A comment was made that exceeding the target efficiency threshold is not just a question of going through the CEQA process, which would require preparation of an EIR, feasible mitigation measures, alternatives, etc. The lead agency would have to approve a project with significant impacts, make findings, and prepare a statement of overriding considerations. In this situation there is legal vulnerability to a certain extent.

A question was asked about how to treat projects where GHG impacts from VMT are a small part of the project. Dr. Chang responded that for this type of project, the lead agency and/or project proponent would have to look at other measures or design features to reduce impacts to less than the 2020 and 2035 efficiency threshold. For these types of projects, it may be difficult to achieve the target efficiency threshold.

A comment was made that the SCAQMD's approach to Tier IV option one, that is, no recommendation, but discuss challenges, implies opposition to this approach. This perceived opposition could jeopardize the Tier II approach, which relies on consistency with a GHG reduction plan. GHG reduction plans will likely rely on a percent GHG reduction to achieve some future target, e.g., AB 32 2020 GHG reduction targets. Although there may be some issues with the percent reduction approach, e.g., gaming the system, there may be valid reasons for using this approach, so the SCAQMD should not discourage it. Another participant suggested that perhaps the SCAQMD could simply say that staff has not sufficiently evaluated this approach and will evaluate the appropriateness of this option on a case-by-case basis.

A comment was made that using SB 375 targets may require GHG reductions that go beyond what would be required in sustainable community strategies (SCSs) and alternative planning strategies (APSs). Further, SB 375 is primarily related to reducing GHG emissions from mobile sources, so establishing 2035 efficiency threshold based only on SB 375 ignores the GHG emission effects from AB 32 (CARB's Scoping Plan). SB 375 relies primarily on process or incentives to reduce GHG emissions rather than mandates. SB 375 also relaxes state requirements to update Housing Elements from five to eight years. CARB's Scoping Plan has provisions for updating the GHG reduction targets every four or eight years, which would provide more flexibility in developing future target efficiency threshold. For this reason and the fact that the Scoping Plan addresses GHG emission reductions from various land use sectors, it may be more appropriated to rely on the GHG emission reduction targets identified by CARB in the Scoping Plan for developing future target efficiency threshold.

A question was asked whether or not a lead agency could use GHG emission offsets to achieve the target efficiency threshold. Staff responded that there did not seem to be a downside to using offsets to get below the target efficiency threshold.

A request was made for SCAQMD staff to eliminate the maximum GHG limit proposal that was discussed at the November 19, 2009 stakeholder working group meeting. Any projects that exceed the maximum GHG limit would be considered significant, even though they

achieved or are less than the target efficiency threshold. Staff stated that they were no longer including the maximum limit in the staff proposal.

A suggestion was made that the SCAQMD should not move forward with the efficiency threshold approach because lead agencies in the Bay Area are encountering a number of serious issues using this approach. In addition, because of the way the efficiency threshold is derived, it may inhibit proposals for mixed use projects rather than encourage them.

**3. Other Topics**

None.

**4. Next Steps**

A question was asked regarding when staff expected to bring the current GHG proposals to the Governing Board for consideration. Staff responded that the hope was to bring the proposals to the Board by December 2010. However, this schedule will depend on any feedback from the working group and necessary changes to the current proposals. In addition, the guidance document prepared for the numerical industrial GHG significance threshold needs to be revised and updated to reflect the current proposals.

**5. Closing Remarks**

The meeting ended at approximately 11:00 a.m. The next meeting is scheduled for August 26, 2009 in meeting room GB at 10:00 AM.

**6. Other Business**

None.

**MEMBERS PRESENT (11)**

Greg Adams – City of Los Angeles Bureau of Sanitation
James Arnone – Latham & Watkins
Doug Feremenga – San Bernardino County Land Use Planning Department
Michael Hendrix – Association of Environmental Professionals (AEP)
Shari Libicki, Green Developers Coalition (*on conference call)*
Debbie Stevens – Refineries
Cindy Thielman – Riverside County Planning Department
Jocelyn Thompson - Alston
Matt Vespa – Center for Biological Diversity (CBD) (*on conference call)*
Carla Walecka – Realtors Committee on Air Quality (RCAQ)
Lee Wallace – Sempra Energy Utilities

**OTHERS PRESENT (7)**

Lilia Barker – LADWP (*on conference call)*

Patrick Griffith – County Sanitation Districts of Los Angeles County
Mark Hagmann – Matrix (*on conference call)*
Sung Key Ma – Riverside County Waste Management Department
Vince Mirabella – Michael Brandman Associates
Molly Pearson – Santa Barbara County APCD (*on conference call*)
Haseeb Qureshi – Urban Crossroads

**AQMD STAFF PRESENT (8)**

Elaine Chang – Deputy Executive Officer
Steve Smith – Program Supervisor
Daniel Garcia – Air Quality Specialist
Jeff Inabinet – Air Quality Specialist
James Koizumi – Air Quality Specialist
Mike Krause – Program Supervisor
Gordon Mize – Air Quality Specialist
Barbara Radlein – Air Quality Specialist

# Appendix A
# Calculation Details for CalEEMod

Prepared for:
**California Air Pollution Control Officers Association (CAPCOA)**

Prepared by:
**BREEZE Software, A Division of Trinity Consultants**
**Dallas, Texas**
**in collaboration with**
**South Coast Air Quality Management District and the California Air Districts**

**October 2017**
**CalEEMod2016.3.2**

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# 1 Overview of Program

California Emissions Estimator Model (CalEEMod) calculates both the criteria air pollutant emissions and greenhouse gas (GHG) emissions associated with construction and operational sources as part of development projects. In addition it calculates GHG emissions associated with one-time changes in vegetation land use. These emission estimates can be used for quantification and reporting as part of the California Environmental Quality Act (CEQA) environmental impact reports and other environmental documentation.

This Appendix A serves as the basis for all methods and assumptions and data source references that are used for calculating all emission categories. These category modules include construction, operational energy use, operational mobile sources, operational landscape maintenance, operational consumer product use, operational architectural coating use, operational hearth use, operational stationary sources, indirect emissions from water and wastewater use, vegetation carbon sequestration, and emissions associated with solid waste disposal.

## 1.1 Structure of this Document

This Appendix will discuss each major module in detail with appropriate subdivisions. These major modules include the following:

- Project Characteristics
- Land Use
- Construction
- Operational Mobile
- Operational Area Sources
- Energy Use
- Water and Wastewater
- Solid Waste
- Stationary Sources
- Vegetation
- Mitigation
- Results

# 2 Project Characteristics

The Project Characteristics screen has no calculations associated with it. It is used to provide information on appropriate default values in subsequent screens. A detailed description of this screen and the areas requiring user input is given in the User's Guide main text. Some further information regarding some of the inputs are below.

- Mendocino County requested county subdivisions as follows:
    - Inland
    - Coastal
    - Rural Inland North
    - Rural Inland South
- Santa Barbara County requested county subdivisions as follows:
    - North Santa Barbara County: North of Santa Ynez range
    - South Santa Barbara County: South of Santa Ynez range
- Wind speeds are from District supplied information, nearby weather stations if easily identifiable[1], or a default of 2.2 m/s.
- Precipitation Frequency was based on data from the Western Regional Climate Center (WRCC)[2] which is an average of all of the stations found in that county, air basin, or district.

## 2.1 Utility Information

Several of the modules require an estimation of the indirect GHG emissions associated with supplying electricity to the Project site. The user will need to specify the utility company that will be providing electricity to the Project. The default carbon intensities for the major utility companies as well as a state-wide default are based on Table G6 of the California Air Resources Board (CARB) Local Government Operation Protocol version 1.1 or the latest public utilities inventory reports. This is consistent with recommendations in the California Air Pollution Control Officer Association (CAPCOA) Quantifying Greenhouse Gas Mitigation Measures document. The complete list of the utilities powering California and the reporting year from which the $CO_2$ intensity factor currently used in CalEEMod can be found in Table 1.2 in Appendix D. The $CH_4$ and $N_2O$ values are based on E-grid values for the region since more refined data is not readily available. The user will also be able to provide an alternative value that is recommended by the local agency, if applicable.

[1] http://www.wrcc.dri.edu/htmlfiles/westwind.final.html

[2] http://www.wrcc.dri.edu/htmlfiles/ca/ca.01.html

## 2.2 Criteria Pollutants

The criteria pollutants are those pollutants or precursor pollutants to the chemicals that have National Ambient Air Quality Standards (NAAQS) or California Ambient Air Quality Standards (CAAQS). These pollutants are listed below:

- Particulate Matter: The program will define both Particulate Matter with aerodynamic radius less than 10 microns ($PM_{10}$) and Particulate Matter with aerodynamic radius less than 2.5 microns ($PM_{2.5}$). Since emission factors for $PM_{2.5}$ have not been fully defined, the conversion assumption for each generating source will be described in more detail with the specific modules. Particulate matter will be tracked by subtype which will include fugitive dust and equipment exhaust.
- Carbon Monoxide: The emissions from carbon monoxide (CO) will be calculated for all direct combustion sources associated with the project.
- Lead: The emissions from lead (Pb) will be calculated for all direct combustion sources associated with the project.
- Sulfur Dioxide: The emissions associated with sulfur dioxide ($SO_2$) will be calculated for all direct combustion sources associated with the project.
- Nitrogen Oxides: The emissions associated with nitrogen oxides (NOx) will be calculated for all direct combustion sources associated with the project or direct emissions associated with area sources. Note that there may be some nitrous oxide ($N_2O$) emissions that are calculated under the GHG module indirect sources that will not be incorporated into the nitrogen oxide emission tally for criteria pollutants since these emissions may be out of basin.
- Ozone: The ozone ($O_3$) emissions are not calculated directly in this program. Instead the emissions associated with ozone precursors are calculated.
- Ozone Precursors: Ozone precursors will be quantified as reactive organic gases (ROG). ROGs when released will interact in the atmosphere and produce ozone.

By definition, a Volatile Organic Compound (VOC) is an organic compound that can evaporate into an organic gas. VOCs can be either reactive or non-reactive. Over the years, non-reactive VOCs have been exempt from regulation. CalEEMod calculates the VOC emissions from the application of architectural coatings based on the locally required VOC content limit of the coatings. ROG is an organic gas that undergoes a photochemical reaction, thus, is reactive. ROG emissions are generated from the exhaust of mobile sources and these combustion emissions are calculated in CalEEMod based on CARB's ROG emission factors. Both VOC and ROGs are precursors to ozone so they are summed in the CalEEMod report under the header ROG. For the purposes of comparing the ROG value to a VOC significance threshold, the terms can be used interchangeably.

## 2.3 Greenhouse Gas Pollutants

The greenhouse gas (GHG) pollutants are those recognized by the state of California under Assembly Bill 32 (AB32). The most common GHGs emitted in association with land use developments include carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$). All GHGs will be reported on a common currency of carbon dioxide equivalent ($CO_2e$). In order to obtain the $CO_2e$, an individual GHG is multiplied by its global warming potential (GWP). The GWP designates on a pound for pound basis the potency of the GHG compared to $CO_2$. The program will use GWP from the 2007 IPCC Fourth Assessment Report (SAR)[3], and are consistent with 2014 CARB's Scoping Plan Update[4].

[3] Available at: https://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_full_report.pdf

[4] Available at: http://www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm

# 3 Land Use

The primary project description data that needs to be entered by the user is a listing of all land use types and size of the land use types that make up the project. CalEEMod contains several land use categories that are mainly based on ITE land use classifications. Some further division of some land uses (mainly warehouses) has been added. The land use subtype is the basis to define several default values used by the modules. The user-defined land use does not have any default information and the user is required to enter all of the necessary information. The program currently places a value of 0 for all areas where user defined values would be required for a blank land use.

The land use size has several different size metrics that the user can choose from. In order for the information to be cross-compatible, the user can enter all of the metrics for a given land use or default conversions between the metrics will be used. The cross-comparison data generally came from the following sources:

- The value for average dwelling unit square footage is rounded based on the average square footage reported in the Residential Appliance Saturation Survey (RASS). Retirement communities and congregate care facilities are assumed to be similar in size to multifamily units.
- The conversion value is based on taking the ratios of different metrics reported in the Institute of Transportation Engineers (ITE) trip rate manual.
- Equivalent commercial building metrics as noted in Table B1 of the Energy Information Administration (EIA) Commercial Building Energy Consumption Survey (CBECS).
- South Coast Air Basin land use statistics (see Appendix E for this reference data).

Unlike other programs, CalEEMod does not account for additional acreage associated with commercial buildings. This was deemed unnecessary since parking lots have been separated out as a separate land use and multi-story buildings should have their lot acreage known.

## 3.1 Population

The population is used to estimate some metrics. The population per dwelling unit is based on the statewide default or information supplied by individual air districts. Population data can be found in Appendix D, Table 2.2.

# 4 Construction

The construction module is used to calculate the emissions associated with the construction of the project. Construction has several different types of sources which contribute to emissions of pollutants. These source types include off-road equipment usage, on-road vehicle travel, fugitive dust, architectural coating, and paving off-gassing. Each of these source types is discussed in more detail in the subsequent sections. These emission sources are associated with various types of construction phases. Typical construction phases include demolition, site preparation, grading, trenching, building construction, paving, and architectural coating. The extent to which these phases occur depends on the specific project. For instance, a demolition phase would only occur if demolition of existing structures was required. Similarly, trenching only occurs if the project requires trenching generally associated with underground utilities. Unique aspects and default assumptions associated with these phases is discussed below in the context of the different emission source calculations.

## 4.1 Construction Phase

No emission calculations are associated with this sub-screen. The SCAQMD construction survey is used to estimate default phase lengths based on total project acreage as calculated from the acreage entered on the land use screen. If the acreage is in between the acreages in the survey, the next highest acreage tier is used. If the project size defined by the user is between the sizes of two surveyed projects, CalEEMod conservatively uses the phase duration for the larger project. For instance, if the given project is 7 acres, the program will use the phase duration for the 10-acre project rather than that for the 5-acre project. For large acreage sites, the survey was extrapolated by adding additional phase time equivalent to adding phase time from two acreage ranges in the survey. This occurs for sites with acreage larger than 34 acres. In these situations, the user should consider the accuracy of the equipment and phase duration estimations or using site-specific construction schedules and equipment lists.

The date range, work days per week and total days are dynamically linked to each other and will influence one another if the user changes these values.

## 4.2 Off-road Equipment

Construction consists of several types of off-road equipment. Since the majority of the off-road construction equipment used for construction projects are diesel fueled, CalEEMod assumes all of the equipment operates on diesel fuel. However, there are mitigation measures that can be implemented that will allow for use of alternative fueled equipment.

The SCAQMD construction survey is used to estimate default equipment lists based on total project acreage as calculated from the acreage entered on the land use screen. If the acreage is in between the acreages in the survey, the next highest acreage tier is used. For large acreage sites, the survey was extrapolated by adding additional phase time equivalent to adding phase time from two acreage ranges in the survey. This occurs for sites with acreage larger than 34 acres. In these situations, the user should consider the accuracy of the equipment and phase duration estimations or using site-specific construction schedules and equipment lists.

The calculations associated with this screen include the running exhaust emissions from off-road equipment. Since the equipment is assumed to be diesel, there are no starting or evaporative emissions associated with the equipment as these are *de minimis* for diesel-fueled equipment[5]. The software program calculates the exhaust emissions based on California Air Resources Board (CARB) OFFROAD2011 methodology using the equation presented below.[5]

$$\text{Emission}_{\text{DieselEx}} = \sum_{i} (\text{EF}_i \times \text{Pop}_i \times \text{AvgHp}_i \times \text{Load}_i \times \text{Activity}_i)$$

Where:

*EF* = Emission factor in grams per horsepower-hour (g/bhp-hr) as processed from OFFROAD2011

*Pop* = Population, or the number of pieces of equipment

*AvgHp* = Maximum rated average horsepower

*Load* = Load factor

*Activity* = Hours of operation

*i* = equipment type

The program allows the user to enter the number of pieces of equipment, horsepower, load factor, and daily hours of operation for each selected equipment type. CalEEMod assigns default parameters for the construction equipment as explained below:

***Emission Factor***

OFFROAD2011 was run for statewide with averaging days of MON-SUN for 22 scenario years each. All scenarios were run for three seasons – Annual, Summer, and Winter. The exhaust emission factors for each equipment at each horsepower range were back calculated from total daily emissions reported in the model output files using the following formula:

$$\text{Emission Factor [g/hp-hr]} = \frac{\text{Total Daily Exhaust x } 907{,}184.74}{\text{Activity} \times \text{AvgHP} \times \text{LF}}$$

Where:

| | |
|---|---|
| Total Daily Exhaust | = Total pollutant emissions [tons/day] |
| Activity | = Total daily statewide usage of equipment [hours/day] |
| AvgHP | = Average HP of equipment within the horsepower range [HP] |
| LF | = Load Factor of equipment [unitless] |
| 907,185 | = Conversion factor tons to grams (2,000 lbs/ton x 453.6 g/lb) |

Total Daily Exhaust and Activity were obtained from OFFROAD2011 model output, while AvgHP and LF were obtained from input files to the model.

[5] CARB, 2006. Program Structure of the OFFROAD2007. Available at: http://www.arb.ca.gov/msei/offroad/pubs/offroad_overview.pdf

***AvgHP***

The default average equipment horsepower is from OFFROAD2011. OFFROAD2011 has an average horsepower for each engine tier which was used in developing the emission factor (from equip.csv). This is different than the default horsepower used for default data which is based on the average horsepower of the mode of populations for the various engine horsepower tiers in OFFROAD.

***Load***

The load factor is the ratio of the actual output to the maximum output of a piece of equipment. The program uses the OFFROAD2011 load factor as default. Based on OFFROAD2011, the load factor is equipment type-specific and does not vary with horsepower (hp) (e.g., the load factors of a 125-hp dozer and a 500-hp dozer are the same).

***Activity***

The default hours of operation are 8 hours a day and 5 days a week over the construction phase duration unless specified otherwise in the equipment list. The construction phase length is used from the construction phase screen.

***i (Equipment Type) and Pop***

The default equipment list and number of pieces of equipment for each equipment type is determined based on the size (i.e., acreage) of the construction project based on the construction activity survey performed by the SCAQMD (Appendix E). If the project size defined by the user is between the sizes of two surveyed projects, the program will use the equipment list and number for the larger project. All equipment in the construction category of OFFROAD2011 is included in CalEEMod.

### Trenching Emissions

There is no default equipment list associated with trenching emissions at this time. The user can enter site-specific equipment lists for these situations.

## 4.3 Dust From Material Movement

Fugitive dust is generated by the various source activities occurring at a construction site. This dust contributes $PM_{10}$ and $PM_{2.5}$ emissions and for detailed emission breakdowns are distinguished from exhaust particulate matter emissions. The program calculates fugitive dust associated with the site preparation and grading phases from three major activities: haul road grading, earth bulldozing, and truck loading. As recommended by SCAQMD, the fugitive dust emissions from the grading phase are calculated using the methodology described in USEPA AP-42.

### Grading Equipment Passes

Fugitive dust emissions from grading equipment passes are estimated using the methodology described in Section 11.9, Western Surface Coal Mining, of the USEPA AP-42[6]. AP-42 estimates the emission factor of $PM_{10}$ applying a scaling factor to that of $PM_{15}$. Similarly, the

[6] Available at: http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s09.pdf

emission factor of $PM_{2.5}$ is scaled from that of total suspended particulates (TSP). The equations used to calculate the emission factors for $PM_{15}$ and TSP and the scaling factor for those of $PM_{10}$ and $PM_{2.5}$ are presented below:

$$EF_{PM15} = 0.051 \times (S)^{2.0}, \text{ and } EF_{PM10} = EF_{PM15} \times F_{PM10}$$
$$EF_{TSP} = 0.04 \times (S)^{2.5}, \text{ and } EF_{PM2.5} = EF_{TSP} \times F_{PM2.5}$$

Where:

*EF* = emission factor (lb/VMT)
*S* = mean vehicle speed (mph). The AP-42 default value is 7.1 mph.
$F_{PM2.5}$ = $PM_{2.5}$ scaling factor. The AP-42 default value is 0.031.
$F_{PM10}$ = $PM_{10}$ scaling factor. The AP-42 default value is 0.6.

The grading dust emissions are calculated by multiplying the emission factors with the total vehicle miles traveled (VMT) for the grading equipment (i.e., grader). The VMT are estimated based on the dimensions of the grading area and the blade width of the grading equipment.

$$E = EF \times VMT \text{ , and}$$

$$VMT = As / Wb \times 43{,}560(sqft / acre) / 5{,}280(ft / mile)$$

Where:

E: emissions (lb)
EF: emission factor (lb/VMT)
VMT: vehicle miles traveled (mile)
$A_S$: the acreage of the grading site (acre)
$W_b$: Blade width of the grading equipment. The program uses a default blade width of 12 ft. based on Caterpillar's 140 Motor Grader[7].

Note that the dimensions (e.g., length and width) of the grading site have no impact on the calculation, only the total area to be graded. In order to properly grade a piece of land multiple passes with equipment may be required. The acres is based on the equipment list and days in grading or site preparation phase according to the anticipated maximum number of acres a given piece of equipment can pass over in an 8-hour workday. The equipment-specific grading rates are given in the following table as determined by SCAQMD in consultation with building estimator references.

| Equipment Type | Acres/8hr-day |
|---|---|
| Crawler Tractors | 0.5 |
| Graders | 0.5 |
| Rubber Tired Dozers | 0.5 |
| Scrapers | 1 |

[7] http://www.cat.com/cmms/16897760?x=7

## Bulldozing

Similar to the grading equipment passes emission estimation, the bulldozing emission factors for $PM_{10}$ and $PM_{2.5}$ are scaled from those of $PM_{15}$ and TSP. Based on Section 11.9 of AP-42, the dust emission factor for bulldozing is calculated using the following equations:

$$EF_{TSP} = \frac{C_{TSP} \times s^{1.2}}{M^{1.3}}, \text{ and } EF_{PM\,2.5} = EF_{TSP} \times F_{PM\,2.5}$$

$$EF_{PM15} = \frac{C_{PM15} \times s^{1.5}}{M^{1.4}}, \text{ and } EF_{PM\,10} = EF_{PM\,15} \times F_{PM\,10}$$

Where:

*EF* = emission factor (lb/hr)
*C* = arbitrary coefficient used by AP-42
*M* = material moisture content (%)
*S* = material silt content (%)
*F* = scaling factor

C, M, s, and F vary depending on the bulldozed material. The following table summarizes the constants for overburden[8] presented in AP-42[9].

**Bulldozing Fugitive Emission Factors**

| Constant | Overburden |
|---|---|
| $C_{TSP}$ | 5.7 |
| $C_{PM15}$ | 1.0 |
| M | 7.9% |
| s | 6.9% |
| $F_{PM10}$ | 0.75 |
| $F_{PM2.5}$ | 0.105 |

The program uses the constants associated with overburden as default for calculation of bulldozing dust emissions since overburden more closely models the bulldozed materials during the development construction. The dust emissions are calculated by multiplying the emission factor with the hours of operation for the dozers listed in the equipment list using the formula below:

$$E = EF \times Hr$$

Where:

*E* = emissions (lb)
*EF* = emission factor (lb/hr)
*Hr* = hours of operation

[8] The earth that is between the topsoil and the coal seam (USEPA AP-42).

[9] Tables 11.9-1 and 11.9-3 of USEPA AP-42.

## Truck Loading

Processes such as truck dumping on the pile or loading out from the pile to a truck with a front-end loader also cause fugitive dust emissions. The program calculates these emissions using the methodology described in Section 13.2, Introduction to Fugitive Dust Sources, of USEPA AP-42. The emission factor that is based on the material moisture content and mean wind speed is calculated using the following formula:

$$EF_D = k \times (0.0032) \times \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where:

*EF* = emission factor (lb/ton)

*K* = particle size multiplier. The AP-42 default value for $PM_{10}$ is 0.35 and that for $PM_{2.5}$ is 0.053

*U* = mean wind speed. The program selects wind speed based on the value listed on the Project Characteristics screen. It has been converted internally to miles per hour.

*M* = material moisture content (%). The moisture contents of different materials are listed in Table 13.2.4-1 of AP-42. The program uses the moisture content of cover (12%) as default.

The fugitive dust emissions are calculated by multiplying the emission factor with the throughput of loaded and unloaded material that is entered by the user.

$$E = EF \times TP$$

Where:

*E* = emissions (lb)

*EF* = emission factor (lb/ton)

*TP* = throughput of loaded and unloaded materials (ton)

CalEEMod assumes that 1.2641662 tons per cubic yard based on a bulk density of 1.5 grams per cubic centimeter. Typical soil densities range from about 1.25 to about 1.6 and 1.5 is the approximate density of a silty loam soil which is relatively common in most other parts of the state. The density reported above does not account for watering to suppress dust, it only accounts for natural moisture.

## 4.4 Demolition

The program calculates the demolition dust emissions using the methodology described in the report prepared for the USEPA by Midwest Research Institute (MRI)[10]. The three primary operations that generate dust emission during the demolition phase are mechanical or explosive dismemberment, site removal of debris, and on-site truck traffic on paved and unpaved road. The truck traffic on roads in described with the trips and VMT information.

### Mechanical or Explosive Dismemberment

Based on the MRI report, there is no AP-42 emission factor data available for this mechanical or explosive dismemberment. Thus, the emission factor for dismemberment and collapse of a structure is calculated using the following AP-42 equation for batch drop operations:

$$EF_D = k \times (0.0032) \times \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where:

*$EF_D$* = emission factor (lb PM/ton of debris)

*$EF_{D\text{-}PM10}$* = 0.0011 lb $PM_{10}$/ton of debris

*$EF_{D\text{-}PM2.5}$* = 0.00017 lb $PM_{2.5}$/ton of debris

*k* = particle size multiplier. The AP-42 default value for $PM_{10}$ is 0.35 and that for $PM_{2.5}$ is 0.053.

*U* = mean wind speed. The program selects the default mean wind speed based on the wind speed (m/s) provided on the project characteristics screen.

*M* = material moisture content. The program uses 2% as the default based on the MRI report.

The dust emissions are calculated by multiplying the above emission factors with the total weight of building waste using the following equation:

$$E_D = EF_D \times W$$

Where:

*$E_D$* = emissions (lb of PM)

*$EF_D$* = emission factor (lb of PM/ton of debris)

*W* = building waste (ton of debris)

[10] Midwest Research Institute. 1988. Gap Filling PM10 Emission Factors for Selected Open Area Dust Sources.

If the total building waste weight is not known, the program will estimate the tonnage using the *building waste tonnage – structural floor space* relationship determined from a 1976 analysis by Murphy and Chatterjee of the demolition of 12 commercial brick, concrete, and steel buildings. The following data are cited directly from the MRI report:

1 $ft^2$ floor space = 10 $ft^3$ original building volume,
1 $ft^3$ building volume = 0.25 $ft^3$ waste volume,
1 $yd^3$ building waste = 0.5 ton weight,
Mean truck capacity = 20 $yd^3$ haulage volume, and therefore
1 $ft^2$ represents 0.046 ton of waste material.

The total building waste is then calculated using the following equation:

$$E_D = EF_D \times SF \times 0.046(ton / ft^2)$$

Where:

$E_D$ = emissions (lb of PM)

$EF_D$ = emission factor (lb of PM/ton of debris)

$SF$ = building square footage ($ft^2$)

## Debris Loading

The dust emission factor of $PM_{10}$ and $PM_{2.5}$ in pounds per ton building waste is estimated based on the measured total suspended particulates (TSP) emission factor using the following equation:

$$EF_L = k \times EF_{L-TSP}$$

Where:

$EF_L$ = emission factor (lb/ton)

$k$ = particle size multiplier. The AP-42 default value for $PM_{10}$ is 0.35 and that for $PM_{2.5}$ is 0.053.

The default value for $EF_{L\text{-}TSP}$ is 0.058 lb/ton, the average of the two TSP factor (i.e. 0.053 and 0.063 lb/ton) measured from two tests of the filling of trucks with crushed limestone using a front-end loader.

The dust emissions from debris loading are then calculated following the same methodology used for mechanical and or explosive dismemberment:

$$E_L = EF_L \times SF \times 0.046(ton / ft^2)$$

Where:

$E_L$ = emissions (lb)
$EF_L$ = emission factor (lb/ton)
$SF$ = building square footage ($ft^2$)

## 4.5 Trips and VMT

The number of worker, vendor, and hauling trips and associated vehicle miles traveled (VMT) are used to determine both the exhaust emissions associated with on-road vehicle use and fugitive dust emissions.

### Trips

Worker trips for all construction phases except building construction and architectural coating is based on 1.25 workers per equipment in that phase resulting in one roundtrip per worker. For building construction workers, the trip number is estimated using the trip generation rate from a survey conducted by SMAQMD. This has been reanalyzed and results in slightly different numbers than used by other programs and that was previously reported in some agency documents. The analysis and data supporting these values can be found in Appendix E. The land types selected for the project are grouped into four categories presented in the following table which also presents the associated SMAQMD trip generation rates.

**Building Construction Worker and Vendor Trip Rates**

| Land Use SubType | Rate Metric | Worker Trip Rate | Vendor Trip Rate |
|---|---|---|---|
| Single Family | Daily Trips per DU* | 0.36 | 0.1069 |
| Multi-Family | Daily Trips per DU* | 0.72 | 0.1069 |
| Commercial/Retail | Daily Trips per 1000 sq. ft. | 0.32 | 0.1639 |
| Office/Industrial | Daily Trips per 1000 sq. ft. | 0.42 | 0.1639 |
| Source: SCAQMD's analysis of SMAQMD Building Construction Worker and Vendor trip rates found in Appendix E. | | | |

*DU = dwelling unit

Architectural coating worker trips are 20% of building construction phase trips. Vendor trips are only associated with building construction and is based on the land uses and trip rate indicated in the table above.

Haul trips are based on the amount of material that is demolished, imported or exported assuming a truck can handle 16 cubic yards of material. For phased trips, the truck is assumed to be full both ways. For non-phased trips, the truck is assumed to be empty one direction and thus results in more haul trips calculated.

### VMT

The VMT is estimated from the trip lengths input in this screen. The default trip length for workers is based on the location H-W trip length. The default trip length for vendors is the C-NW trip length. The hauling trip length default is set at 20 miles.

### On-Road Vehicle Emissions

Construction generates on-road vehicle exhaust, evaporative, and dust emissions from personal vehicles for worker and vendor commuting, and trucks for soil and material hauling. These emissions are based on the number of trips and VMT along with emission factors from

EMFAC2014. The detailed methodology for converting EMFAC2014 emission rates into CalEEMod vehicle emission factors is provided in section 5.2.

Emission rates of all vehicle categories were obtained from EMFAC2014 Web Database based on aggregated model year and aggregated speed for all counties, air basins, air districts and statewide average for 31 scenario years that each includes three seasons – Annual, Summer, and Winter[11]. Emission rates of methane (CH4) were provide by CARB directly because they are not included in web database.

Running emissions for all pollutants, PM emissions from tire and brake wear, and running loss emissions of TOG and ROG were divided by the VMT of each respective vehicle class from each scenario year and adjusted for unit conversions to derive emission factors in units of grams per VMT. All other emissions (including evaporative) were divided by the number of trips to derive emission factors in units of grams per trip.

VMT fractions, calculated as the ratio of VMT for each vehicle class to total VMT for all vehicles were also derived for each scenario year. The emissions from mobile sources were calculated with the trip rates, trip lengths and emission factors for running from EMFAC2014 as follows:

$$Emissions_{pollutant} = VMT * EF_{running,pollutant}$$

Where:

$Emissions_{pollutant}$ = emissions from vehicle running for each pollutant

VMT = vehicle miles traveled

$EF_{running,pollutant}$ = emission factor for running emissions

Evaporative emissions, starting and idling emissions are multiplied by the number of trips times the respective emission factor for each pollutant.

### Brake Wear and Tire Wear Emissions

As vehicles are driven, particulate matter is generated from degradation of brakes and tires. This is calculated based on the EMFAC emission factors for each vehicle class and the total VMT traveled by that vehicle class according to the following equation:

$$Emission_{brakewearortirewear} = \sum_{class} (E.F._{brakewearortirewear,class} \times VMT_{class})$$

### Vehicle Mix

The user can select the type of vehicle mix. The EMFAC mix is the total mix of all vehicles provided by EMFAC. The program can also assume that the workers' personal vehicles consist of 50% light-duty auto (or passenger car), 25% light-duty truck type 1 (LDT1), and 25% light-

[11] 2000, 2005, 2010 to 2035 inclusive, 2040, 2045, and 2050

duty truck type 2 (LDT2). The equivalent test weight (ETW) from EMFAC2014 for each type of vehicle is presented below[12]:

**Gross Vehicle Weights**

| Vehicle Type | ETW (lb) |
|---|---|
| LDA | All |
| LDT1 | <= 3,750 |
| LDT2 | 3,751 - 5,750 |

For vendor trips, CalEEMod has the option to choose the EMFAC mix or also choose all HHDT or all MHDT vehicles. The program default assumes that all vendors' vehicles are heavy heavy-duty trucks (HHDT).

For hauling trips, CalEEMod has the option to choose the EMFAC mix, all MHDT, all HHDT or a 50% mix of MHDT and HHDT vehicles.

## 4.6 On-Road Fugitive Dust

CalEEMod calculates all on-road fugitive dust associated with paved and unpaved roads consistent with the method discussed in the traffic section. All vehicle miles traveled from worker commuting, vendor commutes, soil hauling, and demolition hauling are accounted for. The same equations described in section 5.3 are used here with the variables coming from this screen.

## 4.7 Architectural Coatings

Volatile organic compounds[13] (VOC) off-gassing emissions result from evaporation of solvents contained in surface coatings. The program calculates the VOC evaporative emissions from application of residential and non-residential surface coatings using the following equation:

$$E_{AC} = EF_{AC} \times F \cdot A_{paint}$$

Where:

*E* = emissions (lb VOC)

*EF* = emission factor (lb/sq. ft.)

*A* = building surface area (sq. ft.).

The program assumes the total surface for painting equals 2.7 times the floor square footage for residential and 2 times that for nonresidential square footage defined by the user[14]. All of the land use information provided by a metric other than square footage will be converted to square footage using the default conversions or user defined equivalence. Green area square footage of City Parks and Golf Courses, pool surface area square footage of Recreational Swimming Pools, and parking surface area square

[12] CARB. EMFAC2007 version 2.30 User's Guide. Available at: http://www.arb.ca.gov/msei/downloads/emfac2014/emfac2014-vol1-users-guide-052015.pdf

[13] This program will assume that all VOCs are represented by reactive organic gases (ROGs).

[14] The factors 2.7 and 2 are based on page A9-124 of SCAQMD's 1993 CEQA Guide.

footage are excluded from the floor square footage in calculating VOC emission due to architectural coatings.

*F* = fraction of surface area. The default values based on SCAQMD methods used in their coating rules are 75% for the interior surfaces and 25% for the exterior shell.

The emission factor (EF) is based on the VOC content of the surface coatings and is calculated estimated using the equation below:

$$EF_{AC} = C_{VOC} / 454(g/lb) \times 3.785(L/Gal) / 180(sqft)$$

Where:

*EF* = emission factor (lb/sq. ft.)

*C* = VOC content (g/L). This varies by location and year.

The emission factors for coating categories are calculated using the equation above based on default VOC content provided by the air districts or ARB's statewide limits if an air district did not provide VOC content[15].

CalEEMod also calculates the VOC emissions from the painting of stripes, handicap symbols, directional arrows and car space descriptions in parking lots. Please refer to Appendix E for the studies conducted to determine a default percent of parking lot square footage that is painted. The equation for striping emission is the same as that for $E_{AC}$ above, but $A_{paint}$ is:

$$A_{paint} = A_{PL} \times P\%$$

Where:

$A_{PL}$ = Parking lot area (sq. ft.)

*P%* = Default percent of parking lot area that is painted (6%)

The VOC content limit for parking lot area is either provided by local air districts or based on the exterior coating VOC limit of the region where the project is located. If the user has more specific VOC content limit on the coating being applied the default can be overridden but the user is expected to explain and justify the change in the "Remarks" box at the bottom of the screen.

## 4.8 Asphalt Paving Off-Gassing Emissions

While there is no specific screen associated with asphalt paving emissions, CalEEMod estimates VOC off-gassing emissions associated with asphalt paving of parking lots using the following equation:

$$E_{AP} = EF_{AP} \times A_{Parking}$$

[15] Received via email from James Koizumi dated April 27, 2010.

Where:

*E* = emissions (lb)

*EF* = emission factor (lb/acre). The SMAQMD default emission factor is 2.62 lb/acre[16].

*A* = area of the parking lot (acre)

The size (acre) of the parking lot is calculated by multiplying the paved area associated with each parking stall with the capacity of the parking lot, or the number of parking stalls.

$$A_{Parking_lot} = A_{Parking_Stall} \times Capacity$$

Where the paved area associated with parking stall includes the area of the parking stall and that of the immediate access road, or aisle.

$$A_{Parking_Stall} = W_{Stall} \times D_{Stall} + W_{Stall} \times W_{Aisle}$$

Where:

*A* = area (sq. ft.)

*W* = width (ft)

*D* = depth (ft)

The dimensions (e.g., width and depth) of a parking stall and the aisle width vary depending on the local government planning guidance. The program conservatively assumes 400 square feet (0.009 acre) of paved area per parking stall as default based on the city guidance or municipal code of the following cities in the State of California and a one-way aisle:

**Parking Stall Size Estimate**

| Location | Dimensions | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Compact | | | | | Full Size | | | | |
| | Width (ft) | Depth (ft) | Aisle Width (ft) | Area (two-way) (sq. ft.) | Area (one-way) (sq. ft.) | Width | Depth | Aisle | Area (two-way) (sq. ft.) | Area (one-way) (sq. ft.) |
| City of San Jose | 8 | 16 | 20 | 208 | 288 | 9 | 18 | 26 | 279 | 396 |
| Menlo Park | 8 | 16.5 | 23 | 224 | 316 | 9 | 18 | 23 | 265.5 | 369 |
| Escondido Municipal Code[17] | 8.5 | 16 | 24 | 238 | 340 | 8.5 | 18 | 24 | 255 | 357 |
| Davis | 8 | 16 | 20 | 208 | 288 | 9 | 18 | 20 | 252 | 342 |

The program allows the user to override the total acres assumed in the land use screen.

[16] Sacramento Metropolitan Air Quality Management District. 1994. Air quality thresholds of significance, first edition. Sacramento, CA.

[17] Available at: http://www.qcode.us/codes/escondido/view.php?topic=33-39-33_768&frames=on

## 4.9 Maximum Daily Construction Emissions

Since construction phases may or may not overlap in time, the maximum daily construction emissions will not necessarily be the sum of all possible daily emissions. CalEEMod therefore calculates the maximum daily emissions for each construction phase. The program will then add together the maximum daily emissions for each construction phase that overlaps in time. Finally the program will report the highest of these combined overlapping phases as a daily maximum. For fugitive dust calculations during grading, the maximum amount of acres graded in a day is determined by the number of grading equipment which is assumed to operate for 8 hours.

# 5 Operational Mobile

CalEEMod calculates the emissions associated with on-road mobile sources. These are associated with residents, workers, customers, and delivery vehicles visiting the land use types in the project. The emissions associated with on-road mobile sources includes running and starting exhaust emissions, evaporative emissions, brake and tire wear, and fugitive dust from paved and unpaved roads. Starting and evaporative emissions are associated with the number of starts or time between vehicle uses and the assumptions used in determining these values are described below. All of the other emissions are dependent on vehicle miles traveled (VMT). The methods and assumptions used by the program are described in the following sections.

## 5.1 Vehicle Trips

The first step in determining the number of starts and vehicle miles traveled is to determine the number of trips associated with the various project land uses. These trips are calculated based on either an average daily or a peak daily. The average daily is used when calculating annual emissions from a project, and peak daily is used when calculating peak daily summer or winter emissions. Since CalEEMod has different trip rates for different days of the week, the daily maximum will be determined based on the highest total of either weekday, Saturday, or Sunday trip emissions. To calculate average daily trips, the weekday trips are multiplied by five and added to the Saturday and Sunday trips, then divided by 7. The average daily trip rates for the individual land uses being modeled are used by CalEEMod in the calculation of a project's annual vehicle miles traveled and as just described are determined from the following equation:

$$\text{Average Daily Trip Rate}_i =$$

$$(Triprate_{Weekday} \times 5 + Triprate_{Sat} + Triprate_{Sun})_i / 7 \times LandUse_i$$

Where

Trip Rate = Weekday, Saturday, or Sunday daily trip generation rate

Land Use = Size metric for a land use type (e.g., number of dwelling units)

i = Land use type

For peak daily trips, CalEEMod chooses the highest trip rate amongst weekday, Saturday and Sunday data, and multiplies by the size metric to get total peak daily trips.

Trip rate describes the amount of trips generated by each land use. Multiplying trip rate per unit size of land use (e.g., per dwelling unit, per 1,000 sq. ft., etc.) by land use size yields total daily trips generated by each land use. The Institute of Transportation Engineers (ITE) trip generation rate[18] are used as default in the program. Like all standard references, it should be noted that ITE has guidance about how their trip rates should be used. For example, some land uses (e.g., electronic superstore, fast food without drive-thru, general heavy industrial, government (civic center), hardware/paint store, movie theater without a matinee) are based on

[18] ITE. 2012, ITE Trip Generation 9th edition.

a limited number of survey samples so the user might consider gaining more refined trip rate information for their project. If the user needs more specific information than the default trip rates provided by CalEEMod, they are encouraged to consult with licensed traffic engineers. If more accurate trip rate information is available, the user has the ability to override the default Trip Rate. The user will be required to provide justification from alternative sources of data (e.g., project-specific traffic study) that demonstrate that a different trip rate is appropriate for their project. Metropolitan Planning Organizations (MPOs) may be another source of trip generation rates specific for the given region.

## Trip Type

Once the total number of trips for a land use type is determined, the next step is to determine the trip type. The trip type breakdown describes the purpose of the trip generated at each land use. For example, the trip type breakdown indicates the percentage of trips generated at single family home for work, for shopping, and for other purposes. Multiplying the total trips for a land use by trip type breakdown percentage yields trips of a given trip type. Two sets of trip type breakdown are used in CalEEMod – residential breakdown and commercial breakdown.

**Residential trip type**: These include home-work (H-W), home-shop (H-S), or home-other (H-O). A home-work trip represents the trip from the home to the workplace. A home-shop trip represents the trip from the home to a land use where shopping takes place (generally retail). A home-other represents all other types of trips generated from the resident such as school, entertainment, etc. The default trip type breakdown is either from air district supplied information or the 1999 Caltrans Statewide Travel Survey. It is recommended that the District or Project Applicant go to accredited sources such as the regional Metropolitan Planning Organization (MPO) to obtain trip type breakdown specific for the given region. The trip type breakdown can be overwritten if users can provide sufficient justification for alternative sources of data (e.g., project-specific traffic study) that demonstrate a different breakdown.

**Commercial trip type**: These include commercial-customer (C-C), commercial-work (C-W) and commercial-nonwork (C-NW). A commercial-customer trip represents a trip made by someone who is visiting the commercial land use to partake in the services offered by the site. The commercial-work trip represents a trip made by someone who is employed by the commercial land use sector. The commercial-nonwork trip represents a trip associated with the commercial land use other than by customers or workers. An example of C-NW trips includes trips made by delivery vehicles of goods associated with the land use. The trip type breakdown from the number or workers and or truck trips from ITE and an analysis of information provided for the SCAB was used as default to assign the trip type breakdowns for all land uses. If an exact match to a land use was not available, data from a similar land use was used as a surrogate. Trip type breakdown can be overwritten if users can provide justification for alternative sources of data (e.g., project-specific traffic study) that demonstrates different breakdown.

## Primary Trip Lengths

Each trip type has a primary trip length associated with it. These trip lengths are based on the location and urbanization selected on the project characteristic screen. These values were supplied by the air districts or use a default average for the state. Each district (or county) also assigns trip lengths for urban and rural settings. For residential projects, average primary trip

lengths of all trip types are determined with the below equation. Commercial and industrial land use types use a similar equation based on their trip types.

$$\text{Average Primary Trip Length}_{i} =$$

$$H-W_{miles} \times H-W_{trip\%} + H-S_{miles} \times H-S_{trip\%} + H-O_{miles} \times H-O_{trip\%}$$

Where

| | |
|---|---|
| $H\text{-}W_{miles}$ | = Home to Work trip length |
| $H\text{-}W_{trip\%}$ | = % of the total primary trips that are Home to Work trips |
| $H\text{-}S_{miles}$ | = Home to Shopping trip length |
| $H\text{-}S_{trip\%}$ | = % of the total primary trips that are Home to Shopping trips |
| $H\text{-}O_{miles}$ | = Home to Other trip length |
| $H\text{-}O_{trip\%}$ | = % of the total primary trips that are Home to Other trips |
| i | = land use type. |

### Primary, Pass-by and Diverted Trip Links

Trip link types further describe the characteristics of the trip attracted to each land use, whether it's a primary trip, a diverted link trip, or a pass-by trip. For example, a commercial customer pass-by trip could be a person going from home to shop on his/her way to work. In addition, a commercial customer diverted-link trip could be a person going from home to work, and on its way making a diversion to shop. Pass-by trips generate virtually no additional running emissions but could generate additional resting and startup emissions. Diverted trips generate less running emissions compared to primary trips, and can also generate additional resting and startup emissions. The average VMT associated with a trip is adjusted by modifying the primary trip length to account for reductions from pass-by and diverted trips. The trip lengths mentioned above are for primary trip links. For pass-by trip links the trip length will be 0.1 miles and diverted trip links the trip length will be 25% of the primary trip length. An average overall trip length can be calculated as follows:

$$\text{Average Overall Trip Length}_{i} =$$

$$Link\%_{primary} \times TripLength_{Avg\,Primary} + Link\%_{diverted} \times 0.25 \times TripLength_{Avg\,Primary} + Link\%_{passby} \times 0.1mile$$

Where

| | |
|---|---|
| Link % | = percentage of link types |
| $\text{Trip Length}_{AvgPrimary}$ | = Average primary trip length for each trip type |
| i | = land use type |

The trip link percentages from the ITE Generation book and SANDAG are used as defaults. The trip link percentages can be overwritten if users can provide justification for alternative sources of data (e.g., project-specific traffic study) that demonstrate different breakdowns. If diverted or pass-by trips are not desired, the user can change the default percentages to zero for these and have primary equal 100%.

## Vehicle Miles Traveled

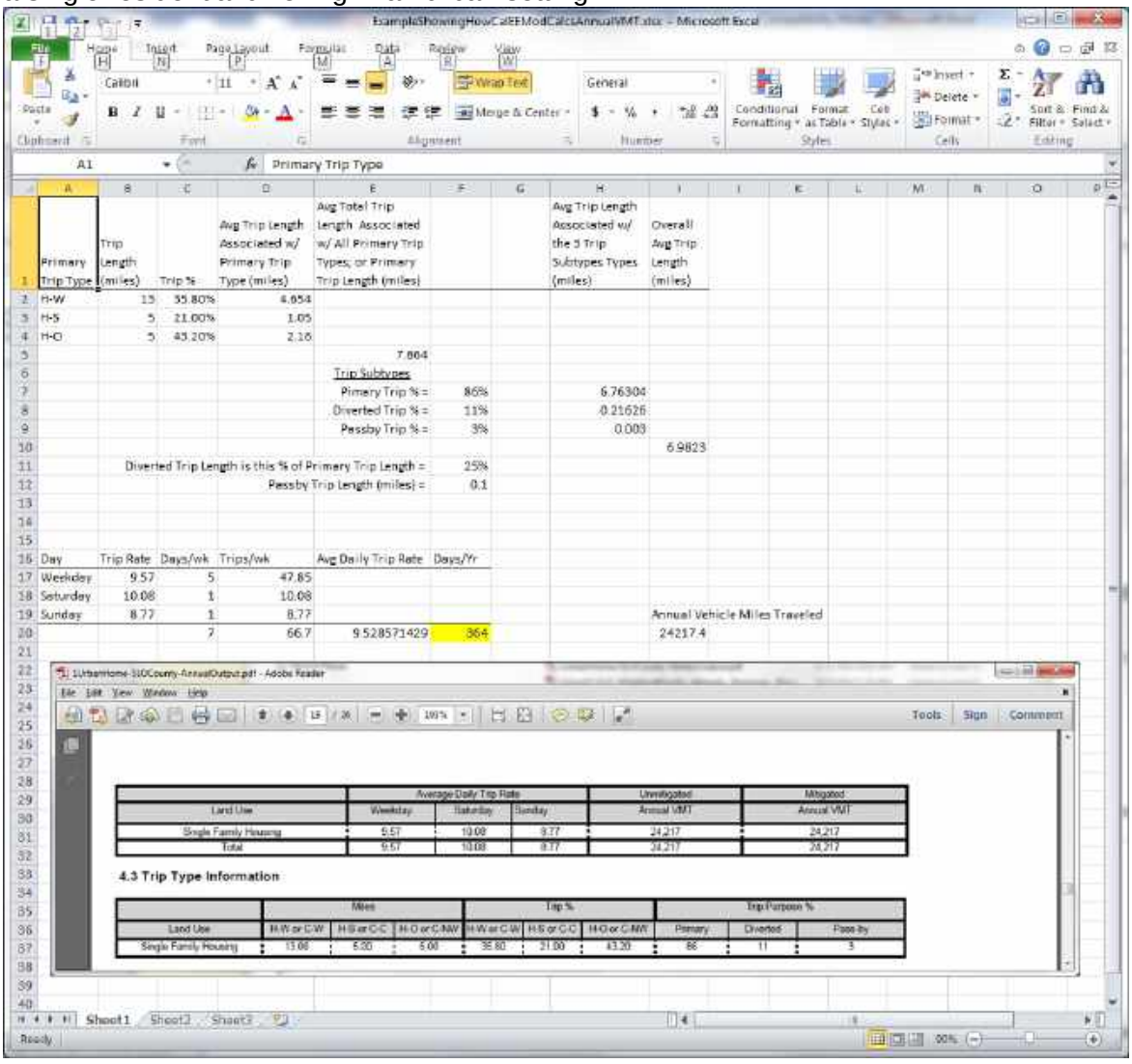
The daily vehicle miles traveled ($VMT_d$) for a modeled project is calculated with the below equation using average daily trip rates and lengths calculated from equations above. CalEEMod calculates Annual VMT by multiplying $VMT_d$ by 365 days/year.

$$VMT_d = \Sigma(\text{Average Daily Trip Rate}_i * \text{Average Overall Trip Length}_i)_n$$

Where:

n = Number of land uses being modeled.

The following screen shot shows an example of how CalEEMod calculated the Annual VMT for a single residential dwelling in an urban setting.



## 5.2 Methodology for Converting EMFAC2014 Emission Rates into CalEEMod Vehicle Emission Factors

The vehicle emission factors in CalEEMod are extracted from EMFAC2014 emission rate data (www.arb.ca.gov/msei/categories.htm; www.arb.ca.gov/emfac/2014). The EMFAC2014 emission rate data for each vehicle class includes multiple types of emissions that are presented with varying units. For example, running emissions are presented in units of grams per mile (g/mile), while starting emissions are presented in units of grams per trip (g/trip) and idling emissions are presented in units of grams per vehicle per day (g/vehicle/day), etc. However, not all of the emission rate data in EMFAC2014 is in a format that is compatible to the formats of CalEEMod vehicle emission factors. In addition, EMFAC2014 emission rate data is presented by both vehicle classes and fuel types while CalEEMod vehicle emission factors are an aggregation of all fuel types for each vehicle class. Thus, in order for all of the EMFAC2014 vehicle emission types to be processed in CalEEMod to yield emission factors for a particular vehicle and land use in the CalEEMod report, EMFAC2014 emission rate data is converted to obtain CalEEMod vehicle emission factors. After this conversion occurs, all of the emission types are then calculated by CalEEMod vehicle emission factors and vehicle activities, and summed to yield one uniform data point with consistent units (e.g., in terms of pounds per day or tons per year). The following describes the methodology for how the EMFAC2014 emission rates are converted for incorporation into CalEEMod.

### 5.2.1 EMFAC2014 Emission Rate Raw Data

For each vehicle model year and type, the raw emission rate data were obtained from the EMFAC2014 web database for all counties, air basins, air districts and statewide average for all fuel types (e.g., gasoline, diesel, and electric). The emission rate values selected were from EMFAC2014's aggregated speed option.

### 5.2.2 EMFAC2014 Emission Rate Units versus CalEEMod Emission Factor Units

In CalEEMod, emission factors of running emissions for all pollutants and PM emissions from tire and brake wear are in units of grams per vehicle miles traveled (g/VMT). For all other emission types, the emission factors are in units of g/trip and these emission factors were derived as total emissions divided by the total number of trips.

The following table summarizes the acronyms, descriptions, and units of each vehicle emission type in EMFAC2014 and the corresponding units of the emission factor for each vehicle emission type as it is presented in CalEEMod:

| EMFAC2014 Acronyms For Each Vehicle Emission Type | EMFAC2014 Description of Each Vehicle Emission Type | EMFAC2014 Emission Rate Unit | CalEEMod Emission Factor Unit |
|---|---|---|---|
| RUNEX | Running Exhaust | grams/mile | grams/mile |
| PMBW | PM Brakewear | grams/mile | grams/mile |
| PMTW | PM Tirewear | grams/mile | grams/mile |
| STREX | Start Exhaust | grams/trip | grams/trip |
| HTSK | Hot Soak Evaporative | grams/trip | grams/trip |
| RUNLS | Running Loss Evaporative | grams/trip | grams/trip |
| IDLEX | Idle Exhaust | grams/vehicle/day | grams/trip |
| RESTL | Resting Loss Evaporative | grams/vehicle/day | grams/trip |
| DIURN | Diurnal Loss Evaporative | grams/vehicle/day | grams/trip |
| VMT | Vehicle Miles Traveled | miles/day | miles (per day, per season, or per year) |
| Trip | Total trips per day of a vehicle class | trips/day | trips (per day, per season, or per year) |
| Population | Vehicle Population | vehicle | vehicle |

### 5.2.3 Conversion from EMFAC2014 to CalEEMod

Because the EMFAC2014 emission rates are associated with vehicle fuel types while CalEEMod vehicle emission factors are aggregated to include all fuel types for each individual vehicle class, the EMFAC2014 emission rates for different fuel types of a vehicle class are averaged by activity or by population and activity to derive CalEEMod emission factors. The equations applied to obtain CalEEMod vehicle emission factors for each emission type are detailed below.

CalEEMod emission factors of all vehicle classes are calculated using data from EMFAC2014 according to the following equations:

$$RUNEX_{CalEEMod} = \sum_{fueltype}(RUNEX_EmissionRate_i \times VMT_i) / \sum_{fueltype} VMT_i$$

$$PMBW_{CalEEMod} = \sum_{fueltype}(PMBW_EmissionRate_i \times VMT_i) / \sum_{fueltype} VMT_i$$

$$PMTW_{CalEEMod} = \sum_{fueltype}(PMTW_EmissionRate_i \times VMT_i) / \sum_{fueltype} VMT_i$$

$$STREX_{CalEEMod} = \sum_{fueltype}(STREX_EmissionRate_i \times Trip_i) / \sum_{fueltype} Trip_i$$

$$HTSK_{CalEEMod} = \sum_{fueltype}(HTSK_EmissionRate_i \times Trip_i) / \sum_{fueltype} Trip_i$$

$$RUNLS_{CalEEMod} = \sum_{fueltype}(RUNLS_EmissionRate_i \times Trip_i) / \sum_{fueltype} Trip_i$$

$$IDLEX_{CalEEMod} = \sum_{fueltype}(IDLEX_EmissionRate_i \times Population_i) / \sum_{fueltype} Trip_i$$

$$RESTL_{CalEEMod} = \sum_{fueltype}(RESTL_EmissionRate_i \times Population_i) / \sum_{fueltype} Trip_i$$

$$DIURN_{CalEEMod} = \sum_{fueltype}(DIURN_EmissionRate_i \times Population_i) / \sum_{fueltype} Trip_i$$

At the left side of the equations, $RUNEX_{CalEEMod}$, $PMBW_{CalEEMod}$, $PMTW_{CalEEMod}$, $STREX_{CalEEMod}$, $HTSK_{CalEEMod}$, $HTSK_{CalEEMod}$, $RUNLS_{CalEEMod}$, $IDLEX_{CalEEMod}$, $RESTL_{CalEEMod}$, and $DIURN_{CalEEMod}$ are CalEEMod vehicle emission factors while the right side of the equations refer to EMFAC2014 data of emission rates, VMT, vehicle population, and vehicle trips per day.

For example, the following equations illustrate how CalEEMod emission factors of RUNEX, STREX, and IDLEX emissions for LDA vehicles are derived from EMFAC2014 data:

$$RUNEX_{CalEEMod} = \frac{(RUNEX_{gas} \times VMT_{gas} + RUNEX_{DSL} \times VMT_{DSL} + RUNEX_{ELEC} \times VMT_{ELEC})}{(VMT_{gas} + VMT_{DSL} + VMT_{ELEC})}$$

$$STREX_{CalEEMod} = \frac{(STREX_{gas} \times Trip_{gas} + STREX_{DSL} \times Trip_{DSL} + STREX_{ELEC} \times Trip_{ELEC})}{(Trip_{gas} + Trip_{DSL} + Trip_{ELEC})}$$

$$IDLEX_{CalEEMod} = \frac{(IDLEX_{gas} \times Population_{gas} + IDLEX_{DSL} \times Population_{DSL} + IDLEX_{ELEC} \times Population_{ELEC})}{(Trip_{gas} + Trip_{DSL} + Trip_{ELEC})}$$

### 5.2.4 Special Handling in CalEEMod for Diesel Fueled Heavy-Heavy Duty and Medium-Heavy Duty Truck Emission Factors

The EMFAC2014 database includes population data for the vehicle classes of heavy-heavy duty trucks (HHDT) and medium-heavy duty trucks (MHDT), but it does not provide trips per day data for diesel fueled HHDTs and MHDTs. As the equations in section 5.2.3 demonstrate, trips per day data are required for processing the following six emission types: STREX, HTSK, RUNLS, IDLEX, RESTL, and DIURN. As such, trips per day data for diesel heavy duty truck vehicle classes need to be obtained from other sources.

The EMFAC2014 database also lacks $NO_x$ STREX emission rates data for the diesel HHDT and MHDT vehicles, so that the estimate of $NO_x$ STREX emissions in CalEEMod cannot be calculated for these vehicle categories. In the absence of the $NO_x$ STREX emission rates and trips per day data from EMFAC2014, the following describes the process used by CalEEMod to estimate the trips per day and $NO_x$ STREX emissions for HHDT and MHDTs.

***Diesel Fueled HHDT and MHDT Trips per Day Estimate***

Table 3.2-49 from the California Air Resources Board (CARB)'s EMFAC2014 Volume III – Technical Documentation (2015) provides Heavy Duty Truck (HDT) start frequency estimates. In particular, this table provides the number of starts per weekday of HDTs using a 30-minute soak time as the cutoff.

**Table 3.2-49**
**Number of Estimated Starts per Weekday by Truck Service Type**

| Truck Service Type | Starts/Day/Vehicle |
|---|---|
| Long-Haul | 2.53 |
| Short-Haul | 2.04 |
| Drayage | 2.76 |

Without knowing the number of trucks that are used for each truck service type within the total HDT population, by averaging the starts/day/vehicle for the three truck service types (e.g., long-haul, short-haul, and drayage), the average start frequency is 2.44 starts/day/vehicle and this value is assumed to be a surrogate for representing the average start frequency for the entire HDT population that includes both HHDTs and MHDTs. This average start frequency is also assumed to be equivalent to the trip frequency and is therefore used to estimate the total trips per day for diesel fueled HHDT and MHDT vehicle classes, as shown in the following equation:

$$Vehicle\ Class\ Trips\ per\ Day = 2.44\ starts\ per\ Day\ \times\ Population\ of\ the\ Vehicle\ Class$$

***Diesel Fueled HHDT and MHDT $NO_x$ STREX Emission Rate Estimate***

Table 3.2-48 from CARB's EMFAC2014 Volume III – Technical Documentation provides diesel fueled HDT STREX emission rates for several pollutants, including $NO_x$.

**Table 3.2-48**
**Start Emission Rates of Diesel HHD Trucks (in grams/start)**

| Vehicle MY | HC | CO | NOx | | PM | $CO_2$ |
|---|---|---|---|---|---|---|
| | Cold/ Warm | Cold/ Warm | Cold | Warm | Cold/ War | Cold/ Warm |
| Pre-2010 | 0.0 | 0.0 | 0.00 | 0.00 | 0.0 | 0.0 |
| 2010 | 0.0 | 0.0 | 4.162 | 2.053 | 0.0 | 0.0 |
| 2011 | 0.0 | 0.0 | 23.28 | 11.48 | 0.0 | 0.0 |
| 2012 | 0.0 | 0.0 | 28.62 | 14.12 | 0.0 | 0.0 |
| 2013 | 0.0 | 0.0 | 28.71 | 14.16 | 0.0 | 0.0 |
| 2014 | 0.0 | 0.0 | 29.59 | 14.60 | 0.0 | 0.0 |
| 2015+ | 0.0 | 0.0 | 29.80 | 14.70 | 0.0 | 0.0 |

Lastly, Table 3.2-50 from CARB's EMFAC2014 Volume III – Technical Documentation provides cold start and warm start frequencies for all three service types of diesel fueled HDTs.

**Table 3.2-50**
**Number of HD Diesel Truck Starts**

| Truck Service Type | Type of Start | Starts/Vehicle/Day |
|---|---|---|
| Long-Haul | Cold Start | 1.00 |
| | Warm Start | 1.53 |
| Short-Haul | Cold Start | 1.00 |
| | Warm Start | 1.04 |
| Drayage | Cold Start | 1.00 |
| | Warm Start | 1.76 |

CalEEMod utilizes STREX emission factors that are averages and the model does not take into account that STREX emission rates for trucks are different for cold and warm starts. For CalEEMod purposes, the $NO_x$ cold and warm start emission rates in Table 3.2-48 and the numbers of cold and warm starts/vehicle/day in Table 3.2-50 are used in combination to derive average $NO_x$ STREX emission rates of diesel fueled HDTs.

By assuming that there are an equal number of trucks for each service type and averaging the number of cold starts and warm starts in Table 3.2-50, then the ratio of cold starts to warm starts for the entire HDT population is 1:1.44. Then, the average $NO_x$ STREX emission rates of cold and warm start can be calculated according to the following equation:

$$NOx\ STREX = \frac{(NOx\ Cold\ Start + NOx\ Warm\ Start\ \times 1.44)}{(1 + 1.44)}$$

For example, for year 2014, NOx STREX emission rate for diesel HDT population can be calculated as follows: (29.59 + 14.60 x 1.44)/2.44 = 20.74 grams/trip. This average $NO_x$ STREX emission rate is treated as the rates of diesel HHDT and MHDT, and used in the conversion of CalEEMod $NO_x$ STREX emission factors by the equations presented in section 5.2.3.

### 5.2.5 CalEEMod Vehicle Emissions

The CalEEMod emissions from mobile sources are calculated with the CalEEMod emission factors described in the previous sections and user input trip rates and trip lengths.

For running emissions (RUNEX) and brake wear and tire wear emissions (PMBW and PMTW), pollutant emissions are calculated from VMT as follows:

$$Emissions_{pollutant} = VMT * EF_{pollutant}$$

Where:

| | |
|---|---|
| $Emissions_{pollutant}$ | = emissions for each pollutant |
| VMT | = vehicle miles traveled (per day, per season, or per year) |
| $EF_{pollutant}$ | = CalEEMod emission factor for each pollutant |

For all other emission types, pollutant emissions are calculated from vehicle trip rates as follows:

$$Emissions_{pollutant} = Trip * EF_{pollutant}$$

Where:

| | |
|---|---|
| $Emissions_{pollutant}$ | = emissions for each pollutant |
| Trip | = vehicle trips (per day, per season, or per year) |
| $EF_{pollutant}$ | = CalEEMod emission factor for each pollutant |

## 5.3 Road Dust

Vehicles that drive on both paved and unpaved roads generate fugitive dust by dispersing the silt from the roads. The following equation is used to calculate the fugitive dust emissions associated with paved roads:

$$E_{ext} = [\, k\,(sL)^{0.91} \times (W)^{1.02} \,]\,(1 - P/4N)$$

Where:

$E_{ext}$ = annual or other long-term average emission factor in the same units as k

*k* = particle size multiplier for particle size range and units of interest (see below)

*sL* = road surface silt loading (grams per square meter) ($g/m^2$)

*W* = average weight (tons) of *all the vehicles* traveling the road (2.4 tons)

*P* = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period

*N* = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

The above is the average emission factor by land use for paved roads. The default values for the required parameters are based on recommendations in AP-42. For daily emissions it is assumed to have no precipitation.

The following equation is used to calculate the fugitive dust emissions associated with unpaved roads (if the user does not check the box to select CARB's 2.0 lbs $PM_{10}$/VMT option, which is only for San Luis Obispo County APCD and Sacramento Metropolitan AQMD):

$$E.F._{dust,i} = \left( \frac{k(s/12)^1 (S/30)^{0.5}}{(M/0.5)^{0.2}} - C \right) (1 - \frac{P}{365})$$

Where:

*k* = particle size multiplier for particle size range and units of interest (see below)

s = surface material silt content (%)

M = surface material moisture content (%)

S = mean vehicle speed (mph)

*C* = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear, and

P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

The above is the average emission factor by land use for unpaved roads. For daily emissions it is assumed to have no precipitation.

By default, CalEEMod assumes the percentage of paved and unpaved roads for each district as provided by the district. The user is allowed to modify the percentage of unpaved roads if specific information is available.

Once emission factors are determined, dust emissions can be calculated by

$$Emissions_{dust} = \sum_i (E.F._{dust,i} \times VMT)$$

The VMT is the same used in vehicle trips.

## 5.4 Operational Off-Road Equipment

CalEEMod also calculates emissions from off-road equipment (e.g., forklifts, cranes, loaders, generator sets, etc.) used during the operation of the land use being analyzed. This is an optional calculation so the user would need to provide the type and number of off-road equipment being used during operation. From that information, CalEEMod provides horsepower, load factor, hours of operation and fuel type. The user has the ability to override the defaults.

The emission factors are from OFFROAD2011. Please refer to section 4.2 for the equations used for calculating emissions from off-road equipment.

# 6 Area Sources

The area source module is used to calculate direct sources of air emissions located at the project site. This includes hearths, consumer product use, architectural coatings, and landscape maintenance equipment. This does not include the emissions associated with natural gas usage in space heating, water heating, and stoves as these are calculated in the building energy use module.

## 6.1 Hearths

GHG emissions from the combustion of wood or biomass are calculated and are considered biogenic emissions of $CO_2$. Some protocols do not consider these emissions to be a part of the emission inventory. Therefore, these $CO_2$ emissions will be kept distinct from the anthropogenic GHG emissions. The method to calculate the criteria and biogenic GHG emissions associated with wood stoves is shown. Emissions from wood stoves are calculated using the formula below for each wood stove type:

$$\textit{Wood hearth emissions (MT/year)} = \textit{Emission Rate (g } CO_2 \textit{ per kg wood burned)} \times \textit{Wood Burned (tons per year)} \times \textit{907,185 g/ton} \times \textit{number of stoves} \times \textit{1 MT CO2 / } 1x10^6 \textit{ g CO2}$$

where:

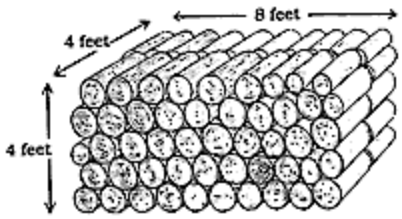
Emission Rate = Based on AP-42[19]

Wood Burned = Weight of wood burned per year per residential unit

Number of stoves = Number of this type of stove in the project

Using the formula above and the number of residential units with wood stoves, it is possible to estimate the GHG emissions from wood stoves. Default values for the emission factors and the amount of wood burned by different hearth types and the percentage of different hearths in various areas of California are based on CARB, USEPA, and air district supplied emission factor values for hearths and woodstoves. The number of wood stoves or hearths is based on percentages supplied by districts or state defaults. If applicable, CalEEMod incorporates the restrictions on the number of wood burning fireplaces and stoves from SJVUAPCD Rule 4901 Amended 10/16/2008. For projects in the San Luis Obispo region, the wood burned per year is 2,016.5 lbs/year (3,081 lbs/cord X 0.6545 cords/year). For visual clarification, a standard cord of wood is defined as a stack of wood with a volume of 128 cubic feet (4 ft. x 4 ft. x 8 ft.)

[19] US EPA AP-42, Chapter 1.9 (http://www.epa.gov/ttnchie1/ap42/ch01/bgdocs/b01s09.pdf) and Chapter 1.10 (http://www.epa.gov/ttnchie1/ap42/ch01/bgdocs/b01s10.pdf)




Criteria pollutant emissions from wood stoves or hearths are computed by CalEEMod in a similar manner with emission factors also coming from AP-42[20].

**Natural Gas Fireplaces/Stoves**

GHG emissions associated with natural gas fired fireplaces are calculated using emission factors from the California Climate Action Registry (CCAR). The criteria pollutant emission factors are based on AP-42. The average heating rate in British Thermal Units (BTU) per hour for fireplaces in homes is 60,000 BTU/hr[21]. Default values for annual fireplace usage needs to be determined for each county. Natural gas is assumed to have 1,020 BTU per standard cubic foot[22]. Criteria pollutant emissions from natural gas fireplaces/stoves are computed by CalEEMod in a similar manner with emission factors also coming from AP-42[20].

## 6.2 Consumer Products

Consumer products are chemically formulated products used by household and institutional consumers, including, but not limited to, degreasers, fertilizers/pesticides, detergents; cleaning compounds; polishes; floor finishes; cosmetics; personal care products; home, lawn, and garden products; disinfectants; sanitizers; aerosol paints; and automotive specialty products; but does not include other paint products, furniture coatings, or architectural coatings. SCAQMD did an evaluation of consumer product use compared to the total square footage of buildings using data from CARB consumer product Emission Inventory. Trinity and SCAQMD performed an evaluation of degreaser use for parking lots and pesticide/fertilizer use for City Parks/Golf Courses. These analyses can be found in Appendix E. To calculate the ROG emissions from consumer product use, the following equation is used:

$$Emissions = EF \times Building\ Area$$

Where:

EF = pounds of VOC per building square foot per day

The factor is $2.14 \times 10^{-5}$ lbs/sq. ft./day for everyplace except SCAQMD.

The factor is $2.04 \times 10^{-5}$ lbs/sq. ft./day for SCAQMD areas.

[20] US EPA AP-42, Chapter 1.9. Page 3, Table 1.9-1 (http://www.epa.gov/ttnchie1/ap42/ch01/bgdocs/b01s09.pdf) and Chapter 1.10 (http://www.epa.gov/ttnchie1/ap42/ch01/bgdocs/b01s10.pdf)

[21] SCAQMD Final Environmental Assessment for Proposed Rule 445 – Wood Burning Devices, March 2008. Available at: http://www.aqmd.gov/docs/default-source/ceqa/documents/aqmd-projects/2008/final-environmental-assessment-for-proposed-rule-445.pdf.

[22] USEPA. 1998. AP-42 Emission Factors. Chapter 1.4 Natural Gas Combustion, Pages 5-6, Tables 1.4-1 and 1.4-2, http://www.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf.

Building Area = The total square footage of all buildings including residential square footage.

## 6.3 Architectural Coatings

VOC off-gassing emissions result from evaporation of solvents contained in surface coatings such as in paints and primers. The program calculates the VOC evaporative emissions from application of residential and non-residential surface coatings using the following equation:

$$E_{AC} = EF_{AC} \times F \cdot A_{paint} \times Reapplication$$

Where:

*E* = emissions (lb)

*EF* = emission factor (lb/sq. ft.)

*F* = fraction of surface area. The default values based on SCAQMD are 25% for the exterior surface and 75% for the interior.

*A* = building surface area (sq. ft.). The program assumes the total surface area for painting equals 2.7 times the floor square footage for residential land use and 2 times the floor square footage for nonresidential land use[23]. All land use information provided by a metric other than square footage will be converted to square footage using the default conversions or user-defined equivalence. Green area of City Parks/Golf Courses, pool surface area of Recreational Swimming Pools, and Parking surface area square footage are excluded from building floor square footage.

Reapplication = Rate at which surfaces are repainted.

The emission factor is based on the VOC content of the surface coatings and is calculated estimated using the equation below:

$$EF_{AC} = C_{VOC} / 454(g/lb) \times 3.785(L/Gal) / 180(sqft)$$

Where:

*EF* = emission factor (lb/sq. ft.)

*C* = VOC content (g/L). This typically varies by air district and year.

CalEEMod also calculates the VOC emissions from the painting of stripes, handicap symbols, directional arrows, and car space descriptions in parking lots. Please refer to Appendix E for the studies conducted to determine a default percent of parking lot square footage that is painted. The equation for striping emission is the same as that for $E_{AC}$ above, but $A_{paint}$ is:

$$A_{paint} = A_{PL} \times P\%$$

[23] The factors 2.7 and 2 are from Table A9-13-C on page A9-124 of SCAQMD's 1993 CEQA Air Quality Handbook.

Where:

$A_{PL}$ = Parking lot area (sq. ft.)

*P%* = Default percent of parking lot area that is painted (6%)

The VOC content limit for parking area coatings is either provided by local air districts or based on the exterior coating VOC limit of the area where the project is located. If the user has more specific VOC content limit on the coating being applied, the default can be overridden but the user is expected to explain and justify the change in the "Remarks" box at the bottom of the screen.

### Reapplication rate

All land use buildings are assumed to be repainted at a rate of 10% of area per year. This is based on the assumptions used by SCAQMD.

## 6.4 Landscape Equipment

Landscape maintenance includes fuel combustion emissions from equipment such as lawn mowers, roto tillers, shredders/grinders, blowers, trimmers, chain saws, and hedge trimmers, as well as air compressors, generators, and pumps. The emissions associated from landscape equipment use were processed using OFFROAD 2011 and CARB's Technical Memo: Change in Population and Activity Factors for Lawn and Garden Equipment (6/13/2003[24]). The information was used along with the total building square footage and dwelling units in California to determine two emission factors. The first is for the commercial landscape equipment which is in terms of grams per square foot of non-residential building space per day. The second is the for the residential landscape equipment which is in terms of grams per dwelling unit per day. These emission factors are multiplied by the number of summer days or winter days that represent the number of operational days. For example, pieces of equipment that would typically be used in snow conditions were used with winter days this includes equipment such as snow blowers while all others were used with summer days. For those regions with 365 or 330 summer days (South Coast, Sacramento, San Joaquin Valley), it is assumed non-residential (e.g., commercial land uses) landscaping equipment would likely only operate during the week (not weekends) so operational days are 250 days per year.

[24] http://www.arb.ca.gov/msei/offroad/techmemo/Lawn_and_Garden_Activity.doc

# 7 Energy Use

Criteria pollutants and GHGs are emitted as a result of activities in buildings that consume energy in the form of natural gas and electricity.

Combustion of any type of fuel, including natural gas, emits criteria pollutants and GHGs directly into the atmosphere. When this occurs within buildings, it is considered a direct emission source[25] associated with that building, and the program will calculate emissions of all of criteria pollutants and GHGs accordingly. Fuel oil, kerosene, and liquefied petroleum gas can also be used as fuels in buildings, but are not widely used in California compared to natural gas. As such, CalEEMod does not calculate emissions from combustion of these fuels within buildings. Emissions from wood combustion in wood burning stoves and fireplaces is calculated under the Area Source category of Hearths (See Section 6.1).

Criteria pollutants and GHGs are also emitted during the generation of electricity at fossil fuel power plants. When electricity is used in buildings, the electricity generation typically takes place offsite power plants, the majority of which burn fossil fuels. Because power plants are existing stationary sources permitted by air districts and/or the USEPA, criteria pollutant emissions are generally associated with the power plants themselves, and not individual buildings or electricity users. Additionally, criteria pollutant emissions from power plants are subject to local, state, and federal control measures, which can be considered to be the maximum feasible level of mitigation for stack emissions.

In contrast, GHG emissions from power plants are not subject to stationary source permitting requirements to the same degree as criteria pollutants. Likewise, it is difficult to mitigate GHG emissions emitted at power plants using exhaust after treatment control technologies. The most effective way to control GHGs from power plants is to reduce electricity demand. As such, GHGs emitted by power plants may be indirectly attributed to individual buildings and electricity users, who have the greatest ability to decrease usage by applying mitigation measures to individual electricity "end uses." The program therefore calculates GHG emissions (but not criteria pollutant emissions) from regional power plants associated with building electricity use.

Since 1978, the CEC has established building energy efficiency standards with the aim of conserving the state's electricity and natural gas resources. The standards are contained Title 24 of the California Code of Regulations (The Building Standards Code), which are updated periodically. The 2005 standards were relied upon during the formation of CARB's initial AB 32 Scoping Plan and were subsequently revised in 2008,[26] 2013[27], and 2016[28].

CalEEMod 2016.3.2 has the capability of calculating building energy use incorporating only the 2005 Title 24 standards and the capability of calculating building energy use incorporating the 2005, 2008, 2013 and 2016 Title 24 standards. The option of calculating energy use up to the 2005 Title 24 standards would be used in some air districts that have adopted CEQA thresholds

[25] California Climate Action Registry (CCAR) General Reporting Protocol (GRP), Version 3.1 (January). Available at: http://sfenvironment.org/sites/default/files/fliers/files/ccar_grp_3-1_january2009_sfe-web.pdf Chapter 8
[26] http://www.energy.ca.gov/title24/2008standards/
[27] http://www.energy.ca.gov/title24/2013standards/
[28] http://www.energy.ca.gov/title24/2016standards/

and/or guidance linked to values from CARB's initial AB 32 Scoping Plan. To use this option, users must check the "using historical data" box. Once the box is clicked, the user then must click the "Default" button to download the historical (2005) data. If the "using historical data" box is NOT checked, CalEEMod 2016.3.2 estimates the building energy use based on the application of the 2005, 2008, 2013, and 2016 standards.

Energy use in buildings (both natural gas and electricity) is divided by the program into end use categories subject to Title 24 requirements (end uses associated with the building envelope, such as the HVAC system, water heating system, and integrated lighting) and those not subject to Title 24 requirements (such as appliances, electronics, and miscellaneous "plug-in" uses).

The program will calculate the emissions associated with buildings by multiplying by the natural gas use by appropriate emission factors and by multiplying electricity use by the GHG intensity factors of the utility selected on the Project Characteristics screen. The following sections describe the methodologies used to estimate building energy use and emissions.

## 7.1 Estimating Non-residential Building Energy Use

The program uses the California Commercial End Use Survey (CEUS)[29] database to develop energy intensity values (electricity and natural gas usage per square foot per year) for non-residential buildings.

The CEUS data[30] lists energy use intensity by building type, "end-use," and CEC forecasting climate zone[31]. Each nonresidential land use in CalEEMod is matched to the appropriate CEUS building type. The CEUS end uses are grouped according to whether the end use is subject to Title 24 building requirements or not.

Appendix E describes in detail the method used to analyze the CEUS data.

## 7.2 Estimating Residential Building Energy Use

The program uses data collected during the Residential Appliance Saturation Survey (RASS) to develop energy intensity values (electricity and natural gas usage per square foot per year) for residential buildings.

Similar to CEUS, the RASS data[32] lists energy use intensity by building type, "end-use," and CEC forecasting climate zone[33]. Each residential land use in CalEEMod is matched to the appropriate RASS residence type. The RASS end uses are grouped according to whether the end use is subject to Title 24 building requirements or not.

Appendix E describes in detail the method used to analyze the RASS data.

[29] California Energy Commission (CEC). California Commercial End-Use Survey Results. Data available from Itron Inc. at http://capabilities.itron.com/CeusWeb/Chart.aspx
[30] Workbooks downloaded from http://capabilities.itron.com/CeusWeb/Chart.aspx for all building categories
[31] A few climate zones were not included in the CEUS data. These climate zones will be mapped to another related climate zone that was included in the data.
[32] Workbooks downloaded from https://webtools.dnvgl.com/rass2009/ for all building categories
[33] A few climate zones were not included in the RASS data. These climate zones will be mapped to another related climate zone that was included in the data.

## 7.3 Estimating Energy Use from Other Land Uses

There are a few remaining land use categories that are not included in the CEUS or RASS data. These include golf courses, parks, and recreational pools. These currently do not have associated default energy use values within the program; however, users may enter non-default values estimated apart from the program.

For parking lots, several studies have been published regarding the energy use from lighting, ventilation and elevators in parking lots and structures. This data has been incorporated into the program to calculate electricity use, based on the type of parking lot selected by the user: Open Parking Lot, Unenclosed Parking Structure, Unenclosed Parking Structure with Elevators, Enclosed Parking Structure, or Enclosed Parking Structure with Elevators.

Appendix E contains further information regarding the assessment of the electricity usage by parking lots and structures, as well as guidance for overriding the default values (e.g., if the number of elevators is known).

The following table provides a summary of the energy use factors included in CalEEMod for parking lots and structures, depending on the type selected by the user.

| Type of Parking Lot | Electricity Use | Annual Energy Use (kWh/sq ft) |
|---|---|---|
| Open parking lot | Lighting | 0.345 |
| Unenclosed parking structure | Lighting | 1.75 |
| Enclosed parking structure | Lighting, ventilation | 5.67 |
| Parking structure with elevators | Elevators | 0.19 |

## 7.4 Calculating Emissions from Energy Use

As previously discussed, natural gas use will contribute to both criteria and GHG emissions. The emission factors for natural gas combustion are from AP-42 and the CCAR. Electricity use will contribute to GHG emissions only.

Emissions from natural gas and electricity use are calculated by the program for each land use using the following equations. (See section 8.2 for further information about electricity carbon intensity).

$$\text{Natural Gas Emissions}_i = \Sigma_j (EF_i \times \text{Energy Intensity} \times \text{Size})$$

Where:

| | |
|---|---|
| EF | = emission factor based on AP-42 or CCAR (lbs/kBTU) |
| Energy Intensity | = natural gas energy intensity for a land use (kBTU/sq.ft. or kBTU/DU) |
| Size | = size metric (square feet or dwelling units) |
| i | = each criteria and GHG pollutant |
| j | = land use type |

$$\text{Electricity Emissions} = \Sigma_i (\text{Utility} \times \text{Energy Intensity} \times \text{Size})$$

Where:

| | |
|---|---|
| Utility | = Carbon intensity of Local Utility ($CO_2e$/kWh) |
| Energy Intensity | = electricity energy intensity for a land use (kWh/sq.ft. or kWh/DU) |
| Size | = size metric Dwelling units (square feet or dwelling units) |
| i | = land use type |

# 8 Water and Wastewater

The amount of water used and wastewater generated by a project has indirect GHG emissions associated with it. These emissions are a result of the energy used to supply, distribute, and treat the water and wastewater. It will often be the case that the water treatment and wastewater treatment occur outside of the project area. In this case, it is still important to quantify the energy and associated GHG emissions attributable to the water use. In addition to the indirect GHG emissions associated with energy use, wastewater treatment can directly emit both methane and nitrous oxide.

## 8.1 Annual Indoor and Outdoor Water Use by Land Use Category

Total residential indoor and outdoor water use for all of California for the year 2000 is reported in Table ES-1 of the Pacific Institute "Waste Not Want Not" report[34]. These values were divided by the total number of occupied households in California in the year 2000[35] to give water demand per dwelling unit. It is assumed that these water use values are representative of all residential dwelling unit types (single-family, apartment, condo, etc.) and will be used unless alternate values are supplied by the air districts or the user.

Data for most commercial and industrial land uses was obtained from Appendices E and F of the Pacific Institute's "Waste Not Want Not" report[36]. Total gallons of water used per day per metric were reported, where the metric is employee, student, room, acre, or square foot, depending on the land use. For example, water use at office and retail land uses was reported in a metric of gallons per employee per day, while water use at hotels and motels was reported in a metric of gallons per room per day. The total daily water use was converted to annual water use based on the number of days of operation for that land use. For example, it was assumed that schools operate for 180 days per year while offices operate for 225 days per year (excluding weekends and holidays). The figures in Appendices E and F of the Pacific Institute report shows the percent of water use dedicated to landscape irrigation; this percent was multiplied by the total water use to obtain the outdoor water use. The remainder was assigned to indoor water use.

For a few land uses (library, place of worship, movie theater, arena, and civic center), The Pacific Institute report did not provide sufficient data and so the American Water Works Association Research Foundation's Commercial and Institutional End Uses of Water report[37] was used. This data is specific to Southern California and was obtained from sample sizes ranging from 1 to 26. In all cases, the total gallons of water used per employee per day was reported.

[34] Gleick, P.H.; Haasz, D.; Henges-Jeck, C.; Srinivasan, V.; Cushing, K.K.; Mann, A. 2003. Waste Not, Want Not: The Potential for Urban Water Conservation in California. Published by the Pacific Institute for Studies in Development, Environment, and Security. Full report available online at: http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf. Appendices available online at: http://pacinst.org/publication/waste-not-want-not/

[35] US Census Bureau. 2000 Census. Table QT-H1: General Housing Characteristics 2000.

[36] Gleick et al. 2003. Appendices E and F.

[37] Dziegielewski; B.; Kiefer, J.C.; Optiz, E.M.; Porter, G.A.; Lantz, G.L.; DeOreo, W.B.; Mayer, P.W.; Nelson, J.O. 2000. Commercial and Institutional End Uses of Water. Published by the American Water Works Association Research Foundation.

Specifically for industrial land use categories, the default indoor water use rate is 231,250 gallons/work-year/ thousand square feet. This value was computed by dividing the annual water use in California industry (Table ES-6 in Gleick et al. 2002; 963,071,916 gallons/industrial work day) by the industrial work area in California (Dun & Bradstreet, Business Population Report aggregated by Standard Industrial Classification (SIC) and Census Block, May 2002; 1,041,386 thousand square feet). This yields 925 gallons/work-day/thousand square feet and the annual value is derived using 250 workdays in a year. For those industrial projects where the anticipated water use rate is known or can be estimated from similar projects, the project specific indoor water use rate should overwrite the default value and specific rationale needs to be entered in the Remarks section of the Water and Wastewater CalEEMod input page.

Indoor water end-use intensities were also obtained from the Pacific Institute report[38]. End-use categories include toilets, showerheads, bathroom faucets, kitchen faucets, dishwashers, clothes washers, and leaks. End-use intensity is given in terms of percent of total indoor water use. For example, The Pacific Institute estimates that toilets contribute to 33% of indoor residential water use. Water end-use intensity must be known in order to calculate the expected water and GHG savings from installing low-flow or high-efficiency water fixtures.

## 8.2 Electricity Intensity Factors

Electricity intensity factors were obtained from the 2006 CEC report, "Refining Estimates of Water-Related Energy Use in California." The electricity intensity factors are reported in units of kWh per million gallons (MG) of water used, and represent the amount of electricity needed to: 1) supply and convey the water from the source; 2) treat the water to usable standards; and 3) distribute the water to individual users. The sum of these factors gives the total electricity required to supply, treat, and distribute water for outdoor uses. For indoor uses, the electricity needed to process the resulting wastewater is also included. The program will allow the user to specify project specific electricity intensity factors if they are available for the project.

$CO_2e$ emissions associated with *indoor water use* are calculated according to the following equation:

$$\text{GHG emissions} = \text{Water}_{\text{indoor}} \times \text{Electricity}_{\text{indoor}} \times \text{Utility}$$

Where:

GHG emissions = Tonnes $CO_2e$

$\text{Water}_{\text{indoor}}$ = Total volume of water used indoors (million gallons)

$\text{Electricity}_{\text{indoor}}$ = Electricity required to supply, treat, and distribute water and the resulting wastewater (kWh/million gallons). This is assigned for each location.

Utility = Carbon intensity of Local Utility ($CO_2e$/kWh)

$CO_2e$ emissions associated with *outdoor water use* are calculated according to the following equation:

$$\text{GHG emissions} = \text{Water}_{\text{outdoor}} \times \text{Electricity}_{\text{outdoor}} \times \text{Utility}$$

[38] Gleick et al. 2003. Residential end-use intensities found in Figure 2-4c of main report. Commercial end-use intensities found in Appendix E.

Where:

GHG emissions = Tonnes $CO_2e$

$Water_{outdoor}$ = Total volume of water used outdoors (million gallons)

$Electricity_{outdoor}$ = Electricity required to supply, treat, and distribute water (kWh/million gallons). This is assigned for each location.

Utility = Carbon intensity of Local Utility ($CO_2e$/kWh)

The sum of emissions from indoor and outdoor water use for each land use category gives the total $CO_2e$ emissions associated with water use at the project.

## 8.3 Wastewater Treatment Methods by County and Air District

Depending on the method, the treatment of wastewater can produce methane ($CH_4$), nitrous oxide ($N_2O$), and carbon dioxide ($CO_2$) emissions, which are all greenhouse gases. Methane and nitrous oxide emissions are converted to carbon dioxide equivalent ($CO_2e$) emissions based on their GWP. When a development generates waste and wastewater, the waste is typically either treated on-site in septic tanks or sent to a centralized wastewater treatment plant to be treated by one of several possible methods. The various wastewater treatment methods employed by each county or air district and the percent of total wastewater treated by each method was used if provided, otherwise the default percentage used in ARB's GHG emission inventories was used. Wastewater treatment methods include on-site septic tanks and centralized wastewater treatment plants which may be composed of aerobic processes, or facultative lagoons. The solids from the latter two treatments could be digested anaerobically to produce digester gas. In some cases, the combusted digester gas may be part of a cogeneration system which recovers the heat generated from combustion and generates electricity which is used for on-site processes. Thus, for aerobic and facultative lagoons wastewater treatment, digestion (*listed in the last two column on the wastewater screen*) should equal 100% percent. For septic systems, the digestion could be zero percent or 100 percent.

The majority of nitrous oxide emissions are generated when treated wastewater is discharged to water bodies as effluent. The default assumption is for non-recycled water. The program calculates total GHG emissions from wastewater treatment based on the region-specific distribution of wastewater treatment methods which the user can modify with project specific data.

## 8.4 Wastewater Treatment Methods – Calculation of Greenhouse Gas Emissions

The GHGs emitted from each type of wastewater treatment are based on the CARB's Local Government Operations Protocol (LGOP)[39], which are in turn based on USEPA methodologies[40]. The methodologies are summarized below.

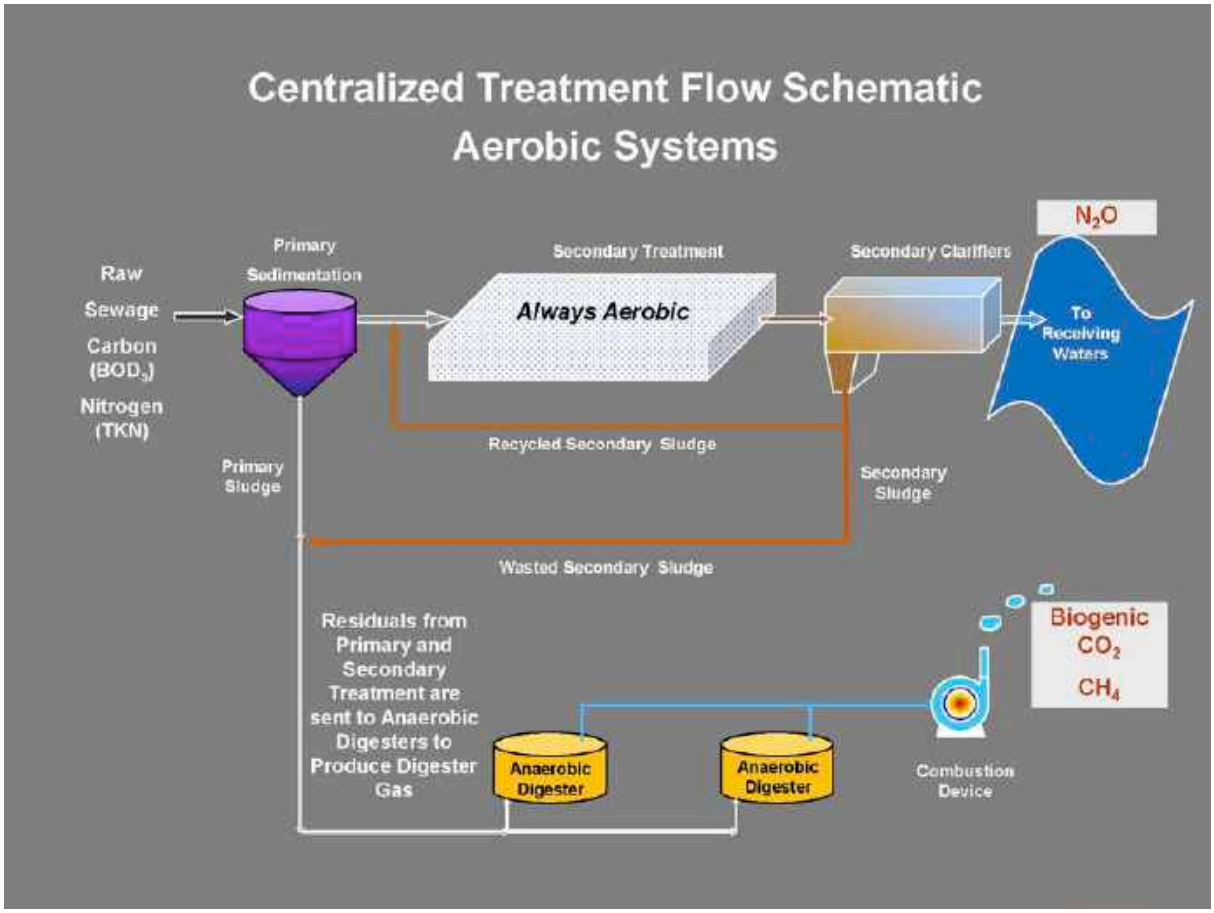
Wastewater (or sewage) treatment can occur one of three ways - aerobically, in septic tanks or in facultative lagoons, specifically described below. In CalEEMod, the following defaults for sewage treatment options were used unless an air district provided an alternative percentage of treatment appropriate to the particular project region. The user has the ability to override the defaults but the total percentage must equal 100% and must justify the reason for the change in the "Remarks" box at the bottom of the screen.

| Statewide Default Treatment Distribution | | |
|---|---|---|
| **Septic Tank (%)** | **Aerobic (%)** | **Facultative Lagoons (%)** |
| 10.33 | 87.46 | 2.21 |

Solids produced from primary treatment, aerobic processes, or facultative lagoons are typically digested in anaerobic digesters. The gas produced by these digesters may be flared or burned in some other simple device, or sent to a cogeneration process for heat recovery and/or electrical generation. The default condition is to assume no cogeneration; however, the user has the ability to input an estimate of the percentage of the digester gas combusted in such systems ranging from 0% to 100%.

Anaerobic decomposition in septic tanks and facultative lagoons can produce fugitive emissions of methane. The following figure provides an example of the process flow for a centralized wastewater treatment facility that treats the sewage aerobically, produces digester gas in anaerobic digesters and combusts the gas. The figure also shows where the GHG emissions are occurring in the process.

[39] https://www.arb.ca.gov/cc/protocols/localgov/localgov.htm
[40] https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-report-archive




As depicted in the figure above, nitrous oxide is produced when treated wastewater is released as effluent into aquatic environments such as rivers and estuaries. Although the nitrification/denitrification processes within the wastewater treatment plant may also produce nitrous oxide, the USEPA estimated that this contributed to less than 3% of national $N_2O$ emissions associated with wastewater in 2005[41]. Therefore, the program assumes that all $N_2O$ emissions are generated from effluent discharged into aquatic environments.

$CO_2$ emissions are generated from both aerobic and anaerobic processes, as well as from the combustion of digester gas, but CalEEMod only calculates combustion emissions because there are currently no authoritative emission factors for process $CO_2$ emissions. When digester gas is combusted to generate electricity, fossil fuel emissions are offset by this renewable power generation. CalEEMod allows the user to provide an estimate of how much renewable power is expected from the project and will debit the biogenic combustion $CO_2$ with the $CO_2$ that would otherwise have been sourced from fossil fuel combustion.

[41] USEPA. 2008. Page 8-7.

**Septic Systems**

Developments may use *septic systems* to treat wastewater on-site. These systems utilize microbes to decompose wastewater anaerobically. A by-product of this anaerobic decomposition is methane, which is quantified using Equation 10.5 from LGOP:

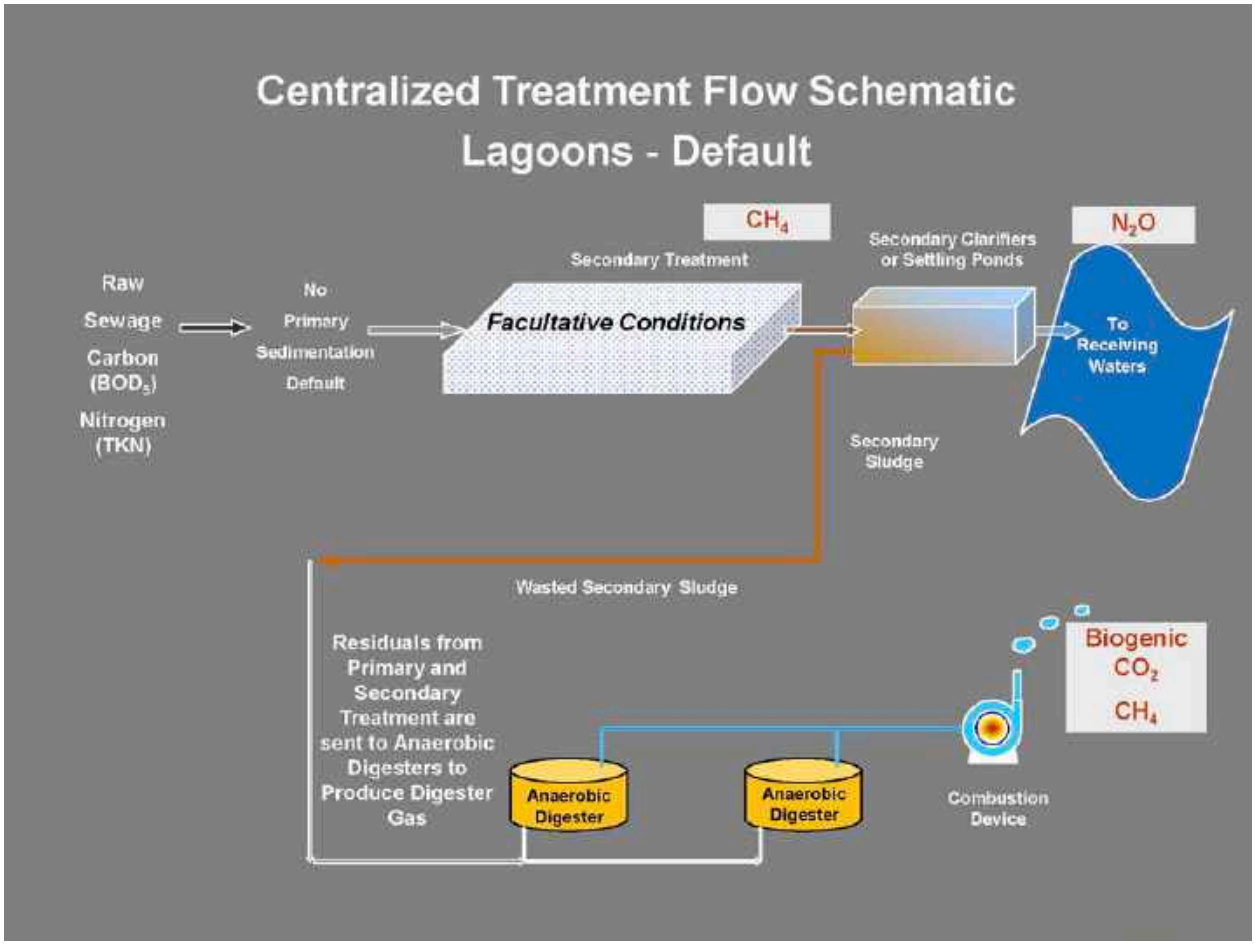
$$CH_4 \text{ emissions (MT)} = \text{Wastewater} \times BOD_5 \text{ load} \times 10^{-6} \times Bo \times MCF_{septic} \times 10^{-3}$$

| Term | | Description | Value | Unit | Reference |
|---|---|---|---|---|---|
| Wastewater | = | volume of wastewater | INPUT | liters | User |
| $BOD_5$ load | = | concentration of $BOD_5$ in wastewater | 200 | mg / liter wastewater | |
| $10^{-6}$ | = | conversion factor | -- | kg / mg | -- |
| Bo | = | maximum CH4-producing capacity for domestic wastewater | 0.6 | kg $CH_4$ / kg $BOD_5$ removed | LGOP default |
| $MCF_{septic}$ | = | $CH_4$ correction factor for septic systems | 0.5 | -- | LGOP default |
| $10^{-3}$ | = | conversion factor | -- | MT / kg | -- |

The LGOP provides default values for all terms in the equation except $BOD_5$ load, which is the amount of $BOD_5$ sent to these decentralized systems per day. BOD, or Biochemical Oxygen Demand, measures the degradable organic component of the wastewater that could deplete dissolved oxygen in receiving waters if left untreated ($BOD_5$ is the measurement of dissolved oxygen depletion from a liquid sample held for a 5-day test). The program assumes a default $BOD_5$ load value of 200 mg per liter of wastewater. This value is typical for residential and commercial wastewater. A higher value is typically associated with certain types of industrial wastewater.

**Facultative Lagoons**

Centralized wastewater treatment facilities may use *facultative lagoons* to treat wastewater. The following figure is an example of the treatment process if facultative lagoons provide the secondary treatment assuming process solids are sent to anaerobic digesters and the digester gas is combusted. In addition, the following figure shows where the GHG emissions are occurring in the process.




The methane emissions expected from facultative lagoons are calculated using Equation 10.3 from LGOP:

$$CH_4 \text{ emissions (MT)} = \text{Wastewater} \times BOD_5 \text{ load} \times 10^{-6} \times (1-F_P) \times Bo \times MCF_{anaerobic} \times F_{removed} \times 10^{-3}$$

| Term | | Description | Value | Unit | Reference |
|---|---|---|---|---|---|
| Wastewater | = | volume of wastewater | INPUT | liters | User |
| $BOD_5$ load | = | concentration of $BOD_5$ in wastewater | 200 | mg / liter wastewater | |
| $10^{-6}$ | = | conversion factor | -- | kg / mg | -- |
| $F_P$ | = | fraction of $BOD_5$ removed in primary treatment | 0 | -- | no primary treatment |
| Bo | = | maximum $CH_4$-producing capacity for domestic wastewater | 0.6 | kg $CH_4$ / kg $BOD_5$ removed | LGOP default |
| $MCF_{anaerobic}$ | = | $CH_4$ correction factor for anaerobic systems | 0.8 | -- | LGOP default |

| | | | | | |
|---|---|---|---|---|---|
| $F_{removed}$ | = | fraction of overall lagoon $BOD_5$ removal performance | 1 | -- | LGOP default (see Eq. 10.4) |
| $10^{-3}$ | = | conversion factor | -- | MT / kg | -- |

The LGOP provides default values for all terms in the equation except $BOD_5$ load and $F_P$, the fraction of $BOD_5$ removed in primary treatment, if present. As before, the program assumes a default $BOD_5$ load value of 200 mg per liter of wastewater. The program assumes $F_P = 0$, indicating no primary treatment.

**Anaerobic Digestion**

*Anaerobic digesters* produce methane-rich biogas which is typically combusted on-site. In some cases the biogas is combusted simply for the purpose of converting methane to $CO_2$, which has a lower global warming potential than methane. In many cases, a cogeneration system is used to harvest the heat from combustion and use it to generate electricity for on-site energy needs. In both cases, inherent inefficiencies in the system result in incomplete combustion of the biogas, which results in remaining methane emissions. The methane emissions from incomplete combustion of digester gas are quantified using Equation 10.1 from LGOP:

$$CH_4 \text{ emissions (MT)} = \text{Wastewater} \times \text{Digester Gas} \times F_{CH4} \times \rho_{CH4} \times (1\text{-DE}) \times 0.0283 \times 10^{-3} \times 10^{-3}$$

| Term | | Description | Value | Unit | Reference |
|---|---|---|---|---|---|
| Wastewater | = | volume of wastewater | INPUT | gallons | User |
| Digester Gas | = | volume of biogas generated per volume of wastewater treated | 0.01 | $ft^3$ biogas / gallon wastewater | USEPA 2008 |
| $F_{CH4}$ | = | fraction of $CH_4$ in biogas | 0.65 | -- | USEPA 2008 |
| $\rho_{CH4}$ | = | density of $CH_4$ at standard conditions | 662.00 | g / $m^3$ | LGOP default |
| DE | = | $CH_4$ destruction efficiency | 0.99 | -- | LGOP default |
| 0.0283 | = | conversion factor | -- | $m^3$ / $ft^3$ | LGOP default |
| $10^{-3}$ | = | conversion factor | -- | MT / kg | -- |
| $10^{-3}$ | = | conversion factor | -- | kg / g | -- |

The LGOP provides default values for all terms in the equation except the volume of digester gas produced per day (Digester Gas), and the fraction of methane in the biogas ($F_{CH4}$). The program assumes a digester gas production of 0.01 cubic feet of biogas per gallon of

wastewater treated based on USEPA methodology[42,43]. The program assumes $F_{CH4}$= 0.65 based on the USEPA methodology[44].

The amount of biogenic $CO_2$ produced from the combustion of biogas is calculated using the following equation based on flow sent to centralized systems (i.e., not sent to septic tanks):

Biogenic $CO_2$ emissions (MT $CO_2$) = Wastewater x Digester Gas x $F_{CH4}$ x EF / 2204.623

Where:

| | | |
|---|---|---|
| Wastewater | = | Volume of Wastewater sent to centralized systems (gallons) |
| Digester Gas | = | Volume of biogas produced from wastewater treatment<br>0.01 $ft^3$ biogas / gallon wastewater treated |
| $F_{CH4}$ | = | Fraction of $CH_4$ in biogas<br>0.65 |
| EF | = | Emission factor for methane combustion[45]<br>0.120 lb $CO_2$ / $ft^3$ $CH_4$ |
| 2204.623 | = | Conversion factor from lb $CO_2$ to MT $CO_2$ |

If a *cogeneration system* is used to generate electricity from the combusted biogas, the following equation derived from USEPA's Solid Waste Management and Greenhouse Gases report[46] is used to calculate the amount of electricity generated based on flow sent to centralized systems.

Electricity Generated (kWh) = Wastewater x Digester Gas x $F_{CH4}$ x $HHV_{CH4}$ x ECF x EFF

Where:

| | | |
|---|---|---|
| Wastewater | = | Volume of Wastewater sent to centralized systems (gallons) |
| Digester Gas | = | Volume of biogas produced from wastewater treatment<br>0.01 $ft^3$ biogas / gallon wastewater treated |

[42] USEPA 2008. Page 8-9. USEPA estimates 1.0 cubic feet of digester gas per person per day and 100 gallons of wastewater per person per day.

[43] USEPA reports 1.0 cubic feet of digester gas per person per day based on Metcalf & Eddy, Inc., 1991, "Wastewater Engineering: Treatment, Disposal, and Reuse," 3rd Ed. McGraw Hill Publishing. USEPA reports 100 gallons of wastewater per person per day based on Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2004, "Recommended Standards for Wastewater Facilities (Ten-State Standards)." USEPA also reports 100 gallons of wastewater per person per day on the USEPA Water & Wastewater Pricing website, based on the U.S. Geological Survey Circular 1200, 1995, "Estimated Use of Water in the United States in 1995."

[44] USEPA. 2008. Page 8-9. USEPA cites Metcalf & Eddy, Inc., 1991, "Wastewater Engineering: Treatment, Disposal, and Reuse," 3rd Ed. McGraw Hill Publishing.

[45] USDOE. 2005. Form EIA-1605: Long Form for Voluntary Reporting of Greenhouse Gases. Available online at: ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/FormEIA-1605_2004_Instructions.pdf

[46] USEPA. 2006. Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, 3rd Ed. Sections 6.2-6.5. Available online at: http://www.epa.gov/climatechange/wycd/waste/downloads/fullreport.pdf

$F_{CH4}$ = Fraction of $CH_4$ in biogas
0.65

HHV = Heating value of methane
1,012 BTU / $ft^3$ $CH_4$

ECF = Energy conversion factor
0.00009 kWh/BTU

EFF = Efficiency Factor[47]
0.85

Since this amount of electricity is generated on-site and no longer needs to be supplied by the local electricity utility, the indirect $CO_2e$ emissions associated with that utility electricity generation are also avoided. The avoided $CO_2e$ emissions are calculated by multiplying the amount of electricity generated (in kWh) by the local utility carbon-intensity factor from Table 2.8.

Net $CO_2$ emissions are then the difference between the $CO_2$ produced from the combustion of digester gas and the $CO_2$ avoided by generating renewable energy, thus:

$$\text{Net } CO_2 \text{ Emissions} = CO_{2\,(\text{digester gas combustion})} - CO_{2\,(\text{avoided emissions})}$$

Nitrous oxide is produced when treated wastewater is discharged to aquatic environments such as rivers or estuaries. The nitrogen which remains in treated wastewater effluent is converted to nitrous oxide in a multi-step process accomplished by bacteria which is present in soil and aquatic environments. The nitrous oxide emissions are quantified using Equation 10.9 from the LGOP:

$$N_2O \text{ emissions (MT)} = \text{Wastewater} \times 10^{-6} \times \text{N Load} \times 44/28 \times \text{EF effluent} \times 10^{-3}$$

| Term | | Description | Value | Unit | Reference |
|---|---|---|---|---|---|
| Wastewater | = | volume of wastewater | INPUT | liters | User |
| $10^{-6}$ | = | conversion factor | -- | kg / mg | -- |
| N Load | = | mass of nitrogen discharged per volume of wastewater | 26 | mg / liter of wastewater | USEPA 2013 *(CA Statewide Average)* |
| 44/28 | = | Ratio of molecular weights for $N_2O$ and $N_2$ | | | USEPA 2008 |
| EF effluent | = | $N_2O$ effluent emission factor | 0.005 | kg $N_2O$ / kg N | LGOP default |
| $10^{-3}$ | = | conversion factor | -- | MT / kg | -- |

[47] Ibid. USEPA assumes a 15% system efficiency loss, to account for system down-time. USEPA assumes that methane is flared during down-time.

The LGOP provides default values for all terms in the equation except N Load, the total mass of nitrogen discharged in the wastewater effluent per day. CalEEMod assumes N Load = 26 mg N per liter of wastewater effluent based on the USEPA methodology.[48] This value is appropriate for residential and commercial wastewater. A higher value may be more appropriate for certain types of industrial wastewater.

Methane and nitrous oxide emissions are converted to carbon dioxide equivalent emissions by multiplying by their GWPs. The GWPs for methane and nitrous oxide are 25 and 298, respectively[49].

[48] USEPA. 2013. California Statewide average. USEPA Database at http://cfpub.epa.gov/dmr/ez_search.cfm

[49] Provided in Appendix E, Table E.1 of CARB's LGOP. As specified in Appendix E, Second Assessment Report (SAR) GWPs are still used by international convention and the United States.

# 9 Solid Waste

Municipal solid waste (MSW) is the amount of material that is disposed of by land filling, recycling, or composting. CalEEMod calculates the indirect GHG emissions associated with waste that is disposed of at a landfill. The program uses annual waste disposal rates from the California Department of Resources Recycling and Recovery (CalRecycle) data for individual land uses. If waste disposal information was not available, waste generation data was used. CalEEMod uses the overall California Waste Stream composition to generate the necessary types of different waste disposed into landfills. The program quantifies the GHG emissions associated with the decomposition of the waste which generates methane based on the total amount of degradable organic carbon[50]. The program will also quantify the $CO_2$ emissions associated with the combustion of methane, if applicable. Default landfill gas concentrations were used as reported in Section 2.4 of AP-42. The IPCC has a similar method to calculate GHG emissions from MSW in its 2006 Guidelines for National Greenhouse Gas Inventories.

The amount of methane and $CO_2$ generated is calculated as:

$$Gen = DOC \cdot DANF \cdot 0.5$$

Where:

Gen = Amount of $CO_2$ or methane generated

DOC = Degradable organic carbon

DANF = Degradable anaerobic fraction (0.5)

0.5 = Assumes half anaerobic carbon is methane and other half is $CO_2$.

IPCC lists default values for the DOC in its 2006 Guidelines in Table 2.4.

The amount of methane and $CO_2$ emitted is calculated by assuming collection and destruction efficiencies. The user will be able to select if the landfill the waste is sent to has a landfill gas collection system. The collection efficiency will be assumed to be 75% if this is selected otherwise it will be 0%. The destruction efficiency is assumed to be 98%. The calculations take into account the oxidation of methane to $CO_2$ as it rises through the landfill. The methane and $CO_2$ emitted are described as:

$$Emit_{methane} = Gen \cdot [Collect \cdot (1 - destruct) + (1 - Collect) \cdot (1 - ox)]$$

$$Emit_{CO2} = Gen \cdot [Collect \cdot destruct + (1 - Collect) \cdot (ox) + 1]$$

[50] Landfill gas generation is dependent upon the amount, type, age and moisture content of the disposed waste. The United States Environmental Protection Agency (USEPA) has developed emission factors for landfill gas as specified in Section 2.4 of AP-42 which are incorporated in the LANDGEM model. This model uses a first order decay equation that will vary with time. However, there is no need to use a time-varying emissions model, as we are interested in total emissions of gases that could be emitted from a ton of waste. Therefore, instead of using the LANDGEM model, the volume of landfill gas from solid waste will be based on the total amount of degradable organic carbon.

Where:

$Emit_{methane}$ = Methane emitted per ton of green waste

$Emit_{CO2}$ = Carbon dioxide emitted per ton of green waste

Gen = Amount of $CO_2$ or methane generated

Collect = Collection efficiency of landfill gas (75%)

Destruct = Destruction efficiency of landfill gas (98%)

Ox = Oxidation efficiency of methane (10%)

The $CO_2$ emissions will be classified as biogenic emissions. The amount of methane emitted will be multiplied by its GWP to convert to $CO_2e$.

# 10 Stationary Sources

CalEEMod version 2016.3.1 was the first version that integrated criteria pollutant emissions and GHG emissions from stationary sources into the project emission totals. The user can either enter stationary sources and their operation conditions, then let the program calculate the emissions, or the user can enter stationary source emissions to the program directly. The second option is provided for stationary equipment that is not included in the program.

## 10.1 Emergency Generators and Fire Pumps

Emissions for emergency generators and fire pumps are calculated as:

$$\text{Emission} = EF * HP * LF * \text{Operation Hours}$$

Where:

EF = Emission factor

HP = Horsepower

LF = Load factor

In emission calculations, a default emission factor may be adjusted for unit conversion to grams/horsepower-hour.

The following table summarizes source references and assumptions to obtain default emission factors of diesel emergency generators.

| Pollutant | Emission Factor Source and Assumptions for Diesel Emergency Generators |
|---|---|
| TOG | AP42 Table 3.3-1 |
| ROG | AP42 Table 3.3-1 and assumes ROG accounts for 91% of TOG |
| CO | CCR 2423 for engines < 50 hp, CARB ATCM Final Regulation for engines >= 50 hp |
| NOx | CCR 2423 for engines < 50 hp, CARB ATCM Final Regulation for engines >= 50 hp assumes NOx accounts for 95% of (NMHC+NOx) |
| SO2 | Based on diesel fuel sulfur content 15 ppmw, diesel heat value 19300 BTU/lb, Brake specific fuel consumption (BSFC) of 7000 BTU/hp-hr |
| PM10 | CCR 2423 for engines < 50 hp, CARB ATCM Final Regulation for engines >= 50 hp |
| PM2.5 | CCR 2423 for engines < 50 hp, CARB ATCM Final Regulation for engines >= 50 hp, assumes all PM10 is PM2.5 |
| CO2 | AP42 Table 3.3-1 |
| CH4 | Based on 0.0014 kg/gallon diesel (California Climate Action Registry General Reporting Protocol), diesel density 6.943 lb/gallon, diesel heat value 19,300 BTU/lb, BSFC of 7,000 BTU/hp-hr |

The following table summarizes sources references and assumptions to obtain default emission factors of diesel fire pumps.

| Pollutant | Emission Factor Source and Assumptions for Diesel Fire Pumps |
|---|---|
| TOG | AP42 Table 3.3-1 |
| ROG | AP42 Table 3.3-1 and assumes ROG accounts for 91% of TOG |
| CO | 40 CFR 60.4202 for engines < 50 hp, CARB ATCM Final Regulation for engines >= 50 hp |
| NOx | 40 CFR 60.4202 for engines < 50 hp, CARB ATCM Final Regulation for engines >= 50 hp, assumes NOx accounts for 95% of (NMHC+NOx) |
| SO2 | Based on diesel fuel sulfer content 15 ppmw, diesel heat value 19,300 BTU/lb, Brake specific fuel consumption (BSFC) of 7,000 BTU/hp-hr |
| PM10 | 40 CFR 60.4202 for engines < 50 hp, CARB ATCM Final Regulation for engines >= 50 hp |
| PM2.5 | 40 CFR 60.4202 for engines < 50 hp, CARB ATCM Final Regulation for engines >= 50 hp, assumes all PM10 is PM2.5 |
| CO2 | AP42 Table 3.3-1 |
| CH4 | Based on 0.0014 kg/gallon diesel (California Climate Action Registry General Reporting Protocol), diesel density 6.943 lb/gallon, diesel heat value 19,300 BTU/lb, BSFC of 7,000 BTU/hp-hr |

The following table summarizes source references and assumptions to obtain default emission factors of natural gas emergency generators.

| Pollutant | Emission Factor Source and Assumptions for Natural Gas Emergency Generators |
|---|---|
| TOG | AP42 Table 3.2-3 |
| ROG | SCAQMD Rule 1110.2 |
| CO | SCAQMD Rule 1110.2 |
| NOx | SCAQMD Rule 1110.2 |
| SO2 | AP42 Table 3.2-3, assumes 100% conversion of fuel sulfur to SO2 and sulfur content of 2,000 gr/$10^6$ scf |
| PM10 | AP42 Table 3.2-3 |
| PM2.5 | AP42 Table 3.2-3 |
| CO2 | AP42 Table 3.3-1 |
| CH4 | AP42 Table 3.3-1 |

For natural gas emergency generators, conversion from emission factor in pound per MMBTU of fuel input (lb/MMBTU) to emission factor in grams per brake horsepower hour is derived as:

$$\frac{1\ \text{lb}}{\text{MMBTU}} * \frac{1\ \text{MMBTU}}{1{,}000{,}000\ \text{BTU}} * \frac{7{,}000\ \text{BTU}}{1\ \text{hp} - \text{hr}} * \frac{453.6\ \text{grams}}{1\ \text{lb}} = 3.1752\ \text{gram/hp} - \text{hr}$$

Where a BSFC of 7,000 BTU/hp-hr is used.

For natural gas emergency generators, conversion from emission limit of parts per million by volume (ppmv) to emission factor in pound per MMBTU of fuel input (lb/MMBTU) is performed as:

$$\frac{\text{Pollutant lb}}{\text{MMBTU}} = \text{ppmv} * \frac{1}{\text{molar volume}} * \text{MW} * \text{Fd} * 20.9/(20.9 - \%\text{O2})$$

Where:

Molar Volume = 379.5 dscf/lbmol @ 14.696 psia, 60 deg. F

Fd = 8,579 dscf/MMBTU for 1020 BTU/scf Natural Gas @60 deg F

%O2 = Oxygen percentage in emission (SCAQMD Rule 1110.2 limits are based on 15% oxygen)

MW = molecular weight, lb/lb-mol.

Molecular weight for ROG is set at 86 lb/lb-mol based on Hexane.

**Process Boilers**

Emissions for process boilers are calculated as:

Emission = Emission Factor * Total Fuel MMBTU input

For this emission calculation, a default emission factor may be adjusted to convert the units to lb/MMBTU.

The following table summarizes source references and assumptions to obtain default emission factors of diesel boilers.

| Pollutant | Emission Factor Source and Assumptions for Diesel Boilers |
|---|---|
| TOG | AP42 Table 1.3-3, Commercial/institutional/residential combustors, Distillate oil |
| ROG | AP42 Table 1.3-3, assumes ROG = TOG – CH4 |
| CO | AP42 Table 1.3-3, No. 4 oil |
| NOx | SJVAPCD Rule 4306 |
| SO2 | AP42 Table 1.3-3, No. 4 oil, diesel fuel sulfur content 15 ppmw |
| PM10 | AP42 Table 1.3-6 |
| PM2.5 | AP42 Table 1.3-6 |
| CO2 | AP42 Table 1.3-12 |
| CH4 | AP42 Table 1.3-3, Commercial/institutional/residential combustors, Distillate oil |

A diesel heat value of 140 MMBTU/$10^3$ gallon is used to convert emission factor in lb/$10^3$ gal to emission factor in lb/MMBTU.

The following table summarizes source references and assumptions to obtain default emission factors of natural gas boilers.

| Pollutant | Emission Factor Source and Assumptions for Natural Gas Boilers |
|---|---|
| TOG | AP42 Table 1.4-2 |
| ROG | AP42 Table 1.4-2 |
| CO | AP42 Table 1.4-1 |
| NOx | SCAQMD Rule 1146, 1146.1, 1146.2, |
| SO2 | AP42 Table 1.4-2, assumes 100% conversion of fuel sulfur and sulfur content of 2,000 gr/$10^6$ scf |
| PM10 | AP42 Table 1.4-2 |
| PM2.5 | AP42 Table 1.4-2 |
| CO2 | AP42 Table 1.4-2 |
| CH4 | AP42 Table 1.4-2 |

A natural gas heat value of 1,020 BTU/scf is used to convert emission factor in lb/$10^6$ scf to emission factor in lb/MMBTU.

# 11 Vegetation

The program calculates GHG emissions associated with the vegetation activities of land use change and the planting of new trees.

The program calculates GHG emissions from vegetation activities according to the IPCC protocol for vegetation since it has default values that work well with the information typically available for development projects. This method is similar to the CAR Forest Protocol[51] and the Center for Urban Forest Research Tree Carbon Calculator[52], but it has more general default values available that will generally apply to all areas of California without requiring detailed site-specific information[53].

## 11.1 Land Use Change

A development which changes land use type results in changes in $CO_2$ sequestration from the atmosphere which would not have been captured had there been no land-type change.

Overall Change in Sequestered $CO_2$ [MT $CO_2$]

$$= \sum_i (SeqCO_2)_i \times (area)_i - \sum_j (SeqCO_2)_j \times (area)_j$$

Where:

| | | |
|---|---|---|
| $SeqCO_2$ | = | mass of sequestered $CO_2$ per unit area [MT $CO_2$/acre] |
| area | = | area of land for specific land use type [acre] |
| i | = | index for final land use type |
| j | = | index for initial land use type |

Overall change in sequestered $CO_2$ is the summation of sequestered $CO_2$ from initial land use type multiplied by area of land for initial land use type subtracted by the summation of sequestered $CO_2$ from final land use type multiplied by area of land for final land use type. There is no reduction in GHG emissions associated with preservation of a land.

[51] CCAR. 2007. Forest Sector Protocol Version 2.1. September. Available at: https://www.arb.ca.gov/cc/ccei/forestry/forestry_protocols/ccar_forest_protocols.pdf

[52] Available at: http://cares.ucdavis.edu/resource/center-urban-forest-research-tree-carbon-calculator-ctcc

[53] The CAR Forest Protocol and Urban Forest Research Tree Carbon Calculator are not used since their main focus is annual emissions for carbon offset considerations. As such they are designed to work with very specific details of the vegetation that is not available at a CEQA level of analysis.

*SeqCO$_2$*

The mass of sequestered $CO_2$ per unit area [MT $CO_2$/acre] is dependent on the specific land use type. The program uses default $CO_2$ sequestration values from CCAR for each land use that will be preserved or created:

| Land Use | Sub-Category | Default $CO_2$ accumulation per acre (MT $CO_2$/ acre) |
|---|---|---|
| Forest Land | Scrub | 14.3 |
| | Trees | 111 |
| Cropland | -- | 6.20 |
| Grassland | -- | 4.31 |
| Wetlands | -- | 0 |

The default annual $CO_2$ is calculated by multiplying total biomass (MT dry matter/acre) from IPCC data by the carbon fraction in plant material (0.47), then using the ratio of molecular weights (44/12) to convert from MT of carbon (C) to MT of carbon dioxide ($CO_2$).

*Vegetation Type*

Vegetation types are defined by IPCC as follows:

**(i) Forest Land**

This category includes all land with woody vegetation consistent with thresholds used to define Forest Land in the national greenhouse gas inventory. It also includes systems with a vegetation structure that currently fall below, but *in situ* could potentially reach the threshold values used by a country to define the Forest Land category.

**(ii) Cropland**

This category includes cropped land, including rice fields, and agro-forestry systems where the vegetation structure falls below the thresholds used for the Forest Land category.

**(iii) Grassland**

This category includes rangelands and pasture land that are not considered Cropland. It also includes systems with woody vegetation and other non-grass vegetation such as herbs and brushes that fall below the threshold values used in the Forest Land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastural systems, consistent with national definitions.

**(iv) Wetlands**

This category includes areas of peat extraction and land that is covered or saturated by water for all or part of the year (e.g., peatlands) and that does not fall into the Forest Land, Cropland, Grassland or Settlements categories. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.

*Area*

The user must specify area of land in acres for specific final and initial land use types. These area changes include not only the area of land that will be converted to buildings, but also areas disrupted by the construction of utility corridors, water tank sites, and associated borrow and grading areas. Areas temporarily disturbed that will eventually recover to become vegetated will not be counted as vegetation removed as there is no net change in vegetation or land use.[54]

## 11.2 Sequestration

Planting trees will sequester $CO_2$ and is considered to result in a one-time carbon-stock change. Trees sequester $CO_2$ while they are actively growing. The amount of $CO_2$ sequestered depends on the type of tree.

$$\text{Total Sequestered } CO_2 = (\text{Growing Period} \times \sum_{i=1}^{n} [\text{ Sequestration } i \times \text{Trees } i \text{ }])$$

Where:

Growing Period = Growing period for all trees, expressed in years (20).

*n* = Number of broad species classes.

Sequestration *i* = Default annual $CO_2$ accumulation per tree for broad species class *i.*

Trees *i* = Number of net new trees of broad species class *i.*

Total Sequestered $CO_2$ is the growing period for all trees multiplied by the summation of annual $CO_2$ accumulation multiplied by the number of new trees per broad species class.

*Growing Period*

The program assumes the IPCC active growing period of 20 years. Thereafter, the accumulation of carbon in biomass slows with age, and will be completely offset by losses from clipping, pruning, and occasional death. Actual active growing periods are subject to, among other things, species, climate regime, and planting density. Note that trees may also be replaced at the end of the 20-year cycle, which would result in additional years of carbon sequestration. However, this would be offset by the potential net release of carbon from the removal of the replaced tree.

[54] This assumption facilitates the calculation as a yearly growth rate and $CO_2$ removal rate does not have to be calculated. As long as the disturbed land will indeed return to its original state, this assumption is valid for time periods over 20 years.

*Sequestration*

The program uses default annual $CO_2$ accumulation per tree for broad species class as follows:

| Broad species class | Default annual $CO_2$ accumulation per tree[1] (MT $CO_2$/ year) |
|---|---|
| Aspen | 0.0352 |
| Soft maple | 0.0433 |
| Mixed hardwood | 0.0367 |
| Hardwood maple | 0.0521 |
| Juniper | 0.0121 |
| Cedar/larch | 0.0264 |
| Douglas fir | 0.0447 |
| True fir/Hemlock | 0.0381 |
| Pine | 0.0319 |
| Spruce | 0.0337 |
| Miscellaneous[2] | 0.0354 |

1. IPCC's carbon (C) values converted to carbon dioxide ($CO_2$) using ratio of molecular weights (44/12).
2. Average of all other broad species classes. To be assumed if tree type is not known.

# 12 Mitigation

## 12.1 Construction Mitigation Measures and Regulatory Adjustments

The section below describes the types of reduction in emissions that CalEEMod incorporates. All information required in this section will require the user to supply a source to support the parameter they select. This source will be displayed in the result output to enhance the communication of the assumptions used in determining the final mitigated emissions reported.

### Mitigation Measures for Onsite Off-Road Construction Diesel Equipment

The emissions mitigation measures for onsite off-road construction diesel equipment include use of alternative fuel, electric equipment, diesel particulate filters (DPF), oxidation catalysts, newer tier engines, and dust suppression. The program has options allowing the user to apply mitigation measures to single pieces of equipment or the entire fleet.

**Exhaust Emissions Reduction**

**Alternative Fuel**: The use of alternative fuels (i.e., biodiesel, compressed natural gas, propane, etc.) can change both criteria and GHG emissions. Alternative fuels can change emissions (increase or decrease) for each pollutant. These values are based on values for alternative fuels in OFFROAD2011. Therefore they may not be available for all pieces of equipment. The biodiesel emissions are based on a report from NREL[55]. Biodiesel emissions are separated into both biogenic and non-biogenic $CO_2$ emissions. These values may be a slight under estimation since no starting or evaporative emissions are calculated in the program.

**Electric Equipment**: The use of electric equipment reduces emissions by 100% for all criteria pollutants. However, there are indirect GHG emissions associated with the electricity use. This is calculated by converting the horsepower to kilowatts and multiplying by the electricity carbon intensity factor. This is only available for those pieces of equipment where values have been identified as listed in the CAPCOA's Quantification of Greenhouse Gas Mitigation Measures.

**DPF**: The use of DPFs reduces the emissions of $PM_{10}$ and $PM_{2.5}$. The program allows the user to choose filters that meet different CARB standardized abatement and certification levels as needed[56]. The program also allows the user to enter filter specification in case a filter with higher abatement level becomes available.

**Diesel Oxidation Catalyst**: The use of an oxidation catalyst assumes the combination operation of a selective catalytic reduction (SCR) that reduces NOx emissions by 0 to 40% percent. Minor PM emission reductions are also achieved.

**Newer Tier Engines**: The program allows the user to choose newer engines that meet more stringent USEPA tier emissions standards than is anticipated from the statewide fleet mix. If this option is checked, user will be required to enter the expected tier level, and CalEEMod will use the emission standard of the selected tier for the emissions calculation[57].

[55] http://www.nrel.gov/docs/fy06osti/37508.pdf (see Table 2)
[56] http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm
[57] CARB and USEPA Off-Road Compression-Ignition (Diesel) Engine Standard is available here: http://www.arb.ca.gov/msprog/ordiesel/documents/Off-Road_Diesel_Stds.xls

The mitigation measure-pollutant applicability matrix is presented in the following table:

| Mitigation Measure | Applicability | | | | | | |
|---|---|---|---|---|---|---|---|
| | VOC | SOx | NOx | $PM_{10}$ | $PM_{2.5}$ | GHG Anthropogenic | GHG Biogenic |
| Alternative Fuel | | x | x | x | x | X | x |
| Electric Equipment | x | x | x | x | x | X | x |
| DPF | | | | x | x | | |
| Diesel Oxidation Catalyst/SCR | | | x | x | x | | |
| Newer Tier Engines | x | x | x | x | x | | |
| User Input | x | x | x | x | x | X | x |

### Fugitive Dust Emissions Reduction

The mitigation measures in this section apply the specified percent reduction in $PM_{10}$ or $PM_{2.5}$ to the applicable fugitive dust calculations. Watering of unpaved roads recalculates the unpaved road equations using the updated values supplied by the user in this section. These are based on mitigation measures described by SCAQMD.

## 12.2 Mobile Mitigation

All mitigation associated with mobile sources is consistent with the methods described in CAPCOA's Quantification of GHG Mitigation Measures.

## 12.3 Hearths Mitigation Measures

The user will be able to change the default percentage of hearths including no hearths or all natural gas hearths. This will recalculate the number of hearths and the corresponding emissions.

## 12.4 Architectural Coating Mitigation

The user can select lower VOC content in paints than required by regulation. This value will be used instead of the usual emission factor.

## 12.5 Landscape Equipment Mitigation

The user will be able to specify the percentage of landscape equipment that will be electric. This will be incorporated consistent with CAPCOA Mitigation Measures methodology.

## 12.6 Improve Building Envelope Beyond Title 24 part 6

The user will enter their commitment to improve building envelope related systems (space heating, space cooling, water heating, and ventilation) beyond current (2013) Title 24 regulations. The user will enter the percentage improvement.

## 12.7 Install Energy Efficient Appliances

The user can designate the appliances that they will install that meet USEPAs Energy Star criteria. In order to meet CEQA enforceability criteria, these appliances need to be supplied by

the builder. The program will use the average savings for an Energy Star appliance as reported in the Energy Star's most recent annual report. The following appliances will be available: refrigerators, dish washers, fans, and clothes washers. The reduction will only apply to these end uses.

## 12.8 Install Renewable or Alternative Energy systems

The user will be able to specify the percentage of the electricity use that will be supplied from renewable or alternative energy systems. This includes energy from sources such as photovoltaic cells, wind turbines, geothermal sources, and fuel cells. The user will enter the total annual kilowatt-hours anticipated to be generated or the percentage of the annual building energy that will be supplied by the alternative energy systems. Information on how to calculate these can be found in CAPCOA's Quantification of Greenhouse Gas Mitigation Measures.

## 12.9 Water Mitigation

All water mitigation methods are consistent with those described in the CAPCOA Quantifying GHG Mitigation Measures document.

## 12.10 Waste Mitigation

The amount of waste disposed will be reduced by the percentage entered by the user. There is no reallocation of the type of material disposed.

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# South Coast AQMD Air Quality Significance Thresholds

| Mass Daily Thresholds [a] | | |
|---|---|---|
| **Pollutant** | **Construction [b]** | **Operation [c]** |
| **$NO_x$** | 100 lbs/day | 55 lbs/day |
| **VOC** | 75 lbs/day | 55 lbs/day |
| **$PM_{10}$** | 150 lbs/day | 150 lbs/day |
| **$PM_{2.5}$** | 55 lbs/day | 55 lbs/day |
| **$SO_x$** | 150 lbs/day | 150 lbs/day |
| **CO** | 550 lbs/day | 550 lbs/day |
| **Lead** | 3 lbs/day | 3 lbs/day |
| **Toxic Air Contaminants (TACs), Odor, and GHG Thresholds** | | |
| **TACs** (including carcinogens and non-carcinogens) | Maximum Incremental Cancer Risk ≥ 10 in 1 million<br>Cancer Burden > 0.5 excess cancer cases (in areas ≥ 1 in 1 million)<br>Chronic & Acute Hazard Index ≥ 1.0 (project increment) | |
| **Odor** | Project creates an odor nuisance pursuant to South Coast AQMD Rule 402 | |
| **GHG** | 10,000 MT/yr $CO_2$eq for industrial facilities | |
| **Ambient Air Quality Standards for Criteria Pollutants [d]** | | |
| **$NO_2$**<br>1-hour average<br>annual arithmetic mean | South Coast AQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards:<br>0.18 ppm (state)<br>0.03 ppm (state) and 0.0534 ppm (federal) | |
| **$PM_{10}$**<br>24-hour average<br>annual average | 10.4 μg/m$^3$ (construction)[e] & 2.5 μg/m$^3$ (operation)<br>1.0 μg/m$^3$ | |
| **$PM_{2.5}$**<br>24-hour average | 10.4 μg/m$^3$ (construction)[e] & 2.5 μg/m$^3$ (operation) | |
| **$SO_2$**<br>1-hour average<br>24-hour average | 0.25 ppm (state) & 0.075 ppm (federal – 99$^{th}$ percentile)<br>0.04 ppm (state) | |
| **Sulfate**<br>24-hour average | 25 μg/m$^3$ (state) | |
| **CO**<br>1-hour average<br>8-hour average | South Coast AQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards:<br>20 ppm (state) and 35 ppm (federal)<br>9.0 ppm (state/federal) | |
| **Lead**<br>30-day Average<br>Rolling 3-month average | 1.5 μg/m$^3$ (state)<br>0.15 μg/m$^3$ (federal) | |

[a] Source: South Coast AQMD CEQA Handbook (South Coast AQMD, 1993)
[b] Construction thresholds apply to both the South Coast Air Basin and Coachella Valley (Salton Sea and Mojave Desert Air Basins).
[c] For Coachella Valley, the mass daily thresholds for operation are the same as the construction thresholds.
[d] Ambient air quality thresholds for criteria pollutants based on South Coast AQMD Rule 1303, Table A-2 unless otherwise stated.
[e] Ambient air quality threshold based on South Coast AQMD Rule 403.

KEY: lbs/day = pounds per day ppm = parts per million μg/m$^3$ = microgram per cubic meter ≥ = greater than or equal to
MT/yr $CO_2$eq = metric tons per year of $CO_2$ equivalents > = greater than