
CHAPTER 1

Introduction



Organization

This almanac contains information about current and historical emissions and air quality in California. In addition, forecasts of projected emissions for the years 2005 and 2010 are presented. The document provides a reference for anyone interested in air quality as it relates to State and national ambient air quality standards (State standards and national standards) and to toxic air contaminants (TACs). When using this information, please remember that the emission and air quality values represent a snapshot of the data at a particular point in time. This edition of the almanac is a year 2002 snapshot of the emission inventory and air quality databases. Historical and projected emission and air quality data can change over time. For example, emission data may be revised to reflect improved estimation methods, and air quality data may be changed because of corrections or additions.

The Air Resources Board's (ARB's) emission and air quality data are available on the World Wide Web, and they can be viewed directly from the ARB's emission inventory and air quality databases. The emission inventory data can be found at www.arb.ca.gov/emisinv/emsmain/emsmain.htm. The emission

database contains data for more than 17,000 individual facilities, such as power plants and refineries. It also includes over 400 area-wide source categories (such as consumer products and architectural coatings), and it provides data for on-road and off-road vehicles, including cars, trucks, trains, ships, aircraft, and farm equipment. In addition, data are available for natural emissions which include wildfires and petroleum seeps.

Emission inventory trends make use of historical emission inventory data and projections based on expectations of future economic and population growth and emission controls. The historical emission inventory data in this almanac were updated to reflect improvements in emission inventory methodologies. The future year projections for stationary sources are developed using the California Emission Forecasting System (CEFS) model. The future year projections are based on the 2002 emission inventory, California economic projections prepared by the air pollution control and air quality management districts and E.H. Pechan and Associates, stationary source emission control measures reported to September 2002, the EMFAC 2002 version 2.2 of the mobile source emission model,

and the ARB OFFROAD model. State Implementation Plan (SIP) and conformity inventory forecasts may differ from the forecasts presented in this almanac. For more information on these forecasts, please see the ARB SIP web page at www.arb.ca.gov/sip/siprev1.htm.

Historical air quality data can be accessed on the web at www.arb.ca.gov/aqd/aqd.htm. The most current air quality data can be accessed directly from the ARB's air quality database using the "Air Quality Data Summaries & Statistics" option. Using this option, the user may select the desired information, knowing that it reflects what is currently in the database. Because of the time required for sample collection, analysis, and subsequent review of the data for general use, the air quality data on the web lags behind the current date. However, the database is updated periodically, as information becomes available.

In addition to the air quality data on the web, a compact disk (CD) containing air quality data is available from the Air Resources Board. The CD contains multiple years of California air quality data: 1980 through 2001 criteria pollutant data and 1990 through 2001 toxic air contaminant data. The data are stored in ASCII files and other forms that analysts can use. The

CD is available free upon request from the ARB's Planning and Technical Support Division by calling (916) 322-6076.

The emission and air quality information in the remainder of this document are based on data maintained in the ARB's emission and air quality databases. The document is divided into five chapters and four appendices, described below, which include descriptive information, graphics, and tabular data. In addition to this information, Appendix E provides lists of the Figures and Tables included in Chapters 1 through 5.

Chapter 1 contains introductory material that describes the information necessary to understand the remaining chapters. It includes information about data interpretation, emission estimating, air quality monitoring, the State and national standards, area designations for the State and national standards, and toxic air contaminants. It also includes a discussion of air quality regulation in California, a list of air pollution contacts, and a timeline of important milestones in California's emissions control programs.

Chapters 2 through 4 and Appendices A and B provide information on several of the criteria pollutants. Criteria pollutants are those pollutants for which the State and federal governments

have established health-based ambient air quality standards. The pollutants described are ozone, particulate matter (PM₁₀ and PM_{2.5}), carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), and lead.

Chapter 2 contains information about current criteria pollutant emissions and air quality at the statewide level, including lists of the State's highest emitting facilities. It is organized by pollutant for the three criteria pollutants that still pose major air quality problems: ozone, particulate matter, and carbon monoxide. In addition to data for 2001, the most current year with complete data, preliminary ozone data for the year 2002 are also included. Chapter 2 also contains information about how air quality in California compares to other parts of the nation.

Chapters 3 and 4 include information about historical criteria pollutant emission trends and forecasts and air quality trends. Chapter 3 provides statewide information for ozone, PM₁₀, PM_{2.5}, CO, lead, NO₂, and SO₂. Chapter 4 gives similar information for the State's five most populated air basins: the South Coast, San Francisco Bay Area, San Joaquin Valley, San Diego, and Sacramento Valley Air Basins. The chapter focuses on ozone, PM, and CO. However, Chapter 4 also includes information on NO₂ for the South Coast and San Diego Air Basins since these two areas had NO₂ problems in the past.

Appendix A includes more detailed emission and air quality data for the criteria pollutants: ozone, PM, CO, NO₂, and SO₂. The emission trends and forecasts are given at 5-year increments from 1975 through 2010, while the air quality data cover the period 1982 through 2001 (1988 through 2001 for PM₁₀). Data are provided for all of California's 15 air basins and all counties (or county portions) within these air basins. The data are summarized in tabular format and are organized alphabetically, by air basin. (PM_{2.5} air quality data are not included in Appendix A because the data are limited and not yet adequate for developing trends. However, available PM_{2.5} air quality data are summarized by air basin in Chapter 2.) Appendix A also includes lists of the highest emitting facilities in each air basin. Appendix B provides air quality information similar to that found in Appendix A, but arranged by pollutant.

Chapter 5 and Appendix C provide information on toxic air contaminants (TACs). In contrast to the criteria pollutants, the control of TACs is based on a risk assessment and risk management approach. The State and federal governments have identified close to 200 TACs. This document includes information on the ten TACs that pose the greatest risk in California: acetaldehyde, benzene, 1,3-butadiene, carbon tetrachloride, chromium (hexavalent), formaldehyde, methylene chloride, *para*-dichlorobenzene, perchloroethylene, and diesel particulate

matter (diesel PM). The determination of risk for the first nine TACs was based on ambient monitoring data while risk for diesel PM was based on estimates of ambient concentrations.

Chapter 5 provides historical TAC emission, air quality, and health risk information for the State as a whole, and for each of California's five most populated air basins. The emission data reflect the year 2002. In contrast, the air quality and health risk trends are based on ambient data collected during 1990 through 2001. Appendix C provides more detailed information on the ten TACs, including information on the emissions in each county and the air quality and health risk information for the individual sites where TAC concentrations are routinely measured.

It is important to note that the TAC information presented in this almanac reflects only those compounds for which data are available. There may be other compounds that pose a substantial risk, but have not been identified as a concern, or do not have data available. One example is dioxins, which may pose a substantial risk, but for which ambient air quality data are not available. Furthermore, the air quality and health risk information represents general population exposures. Therefore, the data may not provide information on localized impacts, often referred to as near-source exposures. The ARB is currently participating in several studies to address localized impacts and

community health issues. Information from these studies may be included in subsequent editions of this almanac.

Finally, Appendix D provides tabulated information on surface area, population, and vehicle miles traveled (VMT) for the State, for each air basin, and for each county (or county portion) within the air basins. The population and VMT trend data reflect estimates for the years 1982 through 2001.

This almanac focuses on air emissions and air quality. In April 2002, the California Environmental Protection Agency (Cal/EPA) released a set of indicators to measure California's overall environmental health. The indicators cover all media, not just air, and help us understand the causes of environmental problems, the status of the environment, and the effectiveness of our environmental strategies. The data in this almanac are good detailed indicators of the State's air quality health, and in conjunction with Cal/EPA's indicators, provide a continuum of information from detailed air quality trends to California's overall environmental health.

Interpreting the Emission and Air Quality Statistics

Interpreting the Criteria Pollutant Statistics. A number of air quality statistics or indicators are used in this document, representing both measured values and statistically derived values. In general, the 1-hour, 8-hour, and 24-hour average concentrations and the number of days above the State and national standards are measured values. In contrast, the peak indicator values and the annual averages, as well as the calculated number of days above the State and national PM₁₀ standards, are statistically derived from the measured data.

The peak indicator represents the maximum concentration expected to occur once per year, on average. This site-specific indicator is based on a statistical calculation using three years of ambient data collected at a particular monitoring site. Because it is based on a robust statistical calculation, it is relatively stable, thereby providing a trend indicator that is not highly influenced by year-to-year changes in meteorology.

The annual averages are also calculated values and are based on all the data collected during a single year. In several cases, the annual average may be missing, even though other statistics, such as the maximum concentration, are listed. Because the annual average reflects concentrations measured over an entire

year, the data used to calculate this average must be complete and representative for the entire *year*. In contrast, a maximum concentration is valid if the data are complete and representative for the *season* during which the highest concentrations occur. Finally, the calculated number of days above the State and national PM₁₀ standards are also derived values. PM₁₀ concentrations are generally measured only once every six days. Using a simple count of days above the standard tends to underestimate the actual number of exceedance days. The method for determining "calculated days" accounts for the limited data, giving a more reliable estimate of the actual number of exceedance days.

Compared with last year's almanac, this edition contains several changes to the air quality statistics for ozone and PM₁₀. For PM₁₀, the calculated number of days above the State and national PM₁₀ standards in the air basin tables (Chapter 4 and Appendix B) now represent composite basinwide values. Last year these values were simply one worst-case site. In the county tables (Appendix A), the two "calculated days" statistics represent the value for the worst-case site rather than a composite countywide value, this is unchanged from last year. The PM₁₀ statistics also reflect changes made to the PM₁₀ standard by

the Board in 2003 that require data be reported in “local” rather than “standard” conditions. For sites located at elevations above 1,000 feet, this change can result in PM₁₀ concentrations that are lower than would be reported under standard conditions. This may potentially impact PM₁₀ trends, which will reflect a combination of standard conditions in earlier years, and local conditions in more recent years.

In addition, the National 1-Hour Design Value and National 8-Hour Design Value ozone statistics have been renamed as the 4th High 1-Hour in 3-Years and the Average of the 4th High 8-Hour in 3 Years, respectively. These names more accurately reflect the basis for the statistics. In some cases, they may be the same as the national design value, but because they do not consider missing data, the new names are more appropriate. In addition, the maximum average of quarters for PM₁₀ replaces the maximum annual geometric mean statistic. The average of quarters statistic is consistent with the revised State annual PM₁₀ standard the ARB adopted in June 2002.

In general, the criteria pollutant air quality trends in this almanac represent data that have been summarized from a network of monitoring sites to characterize the air quality in a particular region (for example, a county or air basin). Whenever data are summarized, the resulting statistics may be influenced by a number of factors, including the number of monitoring sites in operation and the completeness of the data. To help in

interpreting the air quality trends, the ARB has included information on the time periods for which air quality data are available for different pollutants at sites in California and Baja, Mexico in its publication titled: “*California State and Local Air Monitoring Network Plan - 2002*” (June 2002). This report is available on the web: www.arb.ca.gov/aqd/namlams/namlams.htm, or from the ARB’s Planning and Technical Support Division by calling (916) 322-6076.

Interpreting the Criteria Pollutant Emission and Air Quality Trends. A number of criteria pollutant trends are presented in this almanac. Emission and air quality trends for the same pollutant are usually highly correlated. In some cases, however, the two trends may differ, at least in terms of the rate of increase or decrease. The comparison of emission trends to air quality trends is complex, and a number of confounding factors can affect the resulting trends, such as the impacts of transported ozone and particulate matter from one area to another. An area can show a stable (or flat) emission trend because local emission growth offsets the reductions achieved through technology, but this same area may show an improvement in air quality because ambient concentrations reflect the impact of transport from a region that has improved. Other factors that can affect air quality are meteorology and changes in monitoring sites (both site closures and the establishment of new sites). In addition, the emission data and some air quality statistics are based

on estimates. These estimates use the best available methods, however, they embody some degree of uncertainty. All of these factors should be kept in mind when using and interpreting the trends.

The air quality trends in this almanac are for the period 1982 to 2001 for all the criteria pollutants except PM₁₀ which is shown from 1988 to 2001. In addition, preliminary air quality data for the year 2002 are included for ozone. The emission estimates are presented at five year intervals from 1975 to 2010, the period for which we have the greatest confidence in the estimates. Generally, air quality trends are based on data which have been consistently measured over the period presented. Because of these factors, care should be taken in the use of these data either absolutely or in trend analyses.

Interpreting the Toxic Air Contaminant Statistics. This almanac includes a number of statistics for ten toxic air contaminants. These statistics are based on data collected by the ARB. (TAC air quality data are also collected by the local air districts and for special studies. However, for consistency, only data collected by the ARB are included here.) In general, TAC concentrations are sampled once every twelve days, for an average of two to three samples per month. Currently, the TAC sampling network comprises 18 sites located throughout California. The ARB originally established the network to

measure the presence of TACs in the ambient air. The measured concentrations are generally used to represent average statewide concentrations and health risk. It is important to remember that concentrations can vary from one location to another. As a result, local concentrations and risks may be either higher or lower than the average values.

Chapter 5 and Appendix C contain air quality data for the ten TACs that pose the greatest health risk, based on the available ambient air quality data. The data are summarized for the State as a whole, for each of the five major air basins, and for each individual site within these air basins. As mentioned earlier, historically, the ARB staff used data from the TAC sampling network to characterize statewide average concentrations and health risks. However, this document also presents summary information for air basins and for individual sites. This information should be used with caution because the summary statistics are based on limited data. The ARB is currently involved in efforts to better characterize local or communitywide exposures, and more refined data will be included in future editions of this almanac.

Interpreting the Toxic Air Contaminant Emission and Air Quality Trends. A number of TAC emission and air quality trends are presented in this almanac. Numerous factors influence the ambient measurements, and a number of assumptions

are embodied in the summary statistics. Therefore, the resulting trends should be used with caution. The most important factors are summarized below. Chapter 5 and Appendix C include both emission data and ambient concentrations and health risk estimates for the ten TACs that pose the greatest risk statewide.

The toxics emission inventory for 2002 is the most current inventory compiled by the ARB staff. The toxics emissions for stationary sources include emissions data associated with the air toxics "Hot Spots" program. For all source categories associated with diesel fuel combustion, all particulate matter or "PM" emitted from these sources was considered "diesel PM." The area-wide source emission estimates were made by either the local air pollution control districts or the ARB staff. These estimates have been speciated for toxics. Emission estimates for the other mobile source category are primarily from ARB's OFFROAD model, speciated for toxics. For the categories not currently included in the model, the emission estimates have been developed by either local districts or ARB staff. Districts may also provide estimates for categories usually developed by ARB staff. Finally, the on-road mobile source emission estimates are based on the current model, EMFAC 2002, version 2.2. Again, the emission estimates have been speciated for toxics.

With respect to the air quality and health risk estimates, there are varying degrees of uncertainty in both the concentrations

and the health risk estimates. Bear in mind that the health risk estimates reflect the estimated number of excess cancer cases per million people exposed over a 70-year period only for the ten compounds considered. In addition, the risk estimates are uncertain and actual health risk may be higher or lower than reported here. A number of factors add to the uncertainty, including the assumptions of the underlying risk factors, the assumption of a constant 70-year exposure, measurement biases and uncertainties, and the absence of ambient air quality data for diesel particulate matter, dioxins, and other TACs that may pose a substantial health risk. However, the data are very useful for comparing relative health risks (e.g., comparing the level of health risk for one compound or area relative to another).

The downward concentration trends for the TACs are real, as there have been many control measures implemented to reduce emissions. However, the overall downward trend for some compounds may be different than shown here, for several reasons. First, low concentrations are under-reported for some compounds using the U.S. EPA-approved calibration method. For example, prior to 1996, ambient formaldehyde and acetaldehyde concentrations were under-reported. A method change in 1996 corrected the bias. Because the earlier data as reported in this almanac have not been corrected, the trends appear discontinuous. This may hold true for other gaseous compounds, as well. In contrast, benzene and 1,3-butadiene concentrations

during previous years were also likely under-reported, especially at low concentrations. The ARB staff resolved this problem beginning in 1999. Furthermore, the ARB staff developed correction factors for these two TACs, and the pre-1999 data presented in this almanac reflect the correction. Finally, the TAC data lack any meteorological adjustment, and variations in meteorology may affect the trends. For example, the latter years of the trend period tend to have more rain than the earlier drought years (1990-1992), and the presence of rainfall tends to lower the ambient concentrations. This may further affect the downward trends.

While most of the TACs have some missing data during the trend period caused by sampling or analysis problems, several TACs show substantial gaps in their data record. Furthermore, because of the limited sampling schedule, only two or three samples are collected at each site during any particular month. In order to calculate a valid annual average (a mean of the monthly means), data must be available for at least seventy-five percent of the potential sampling days during all twelve months of the year. As a result, only a few missing data points may determine whether a valid annual average can be calculated. If a valid annual average cannot be calculated, data for the year will appear to be missing, even though some data are available.

In addition to missing data, there have been several site changes since the TAC network began operating. In several cases, the site change occurred during the middle of a year. Because the site-by-site statistics presented in this almanac do not combine concentrations measured at different sites, an annual average for the year during which the site change occurred will be missing. Furthermore, sites with incomplete annual data are not included in either the air basin or statewide annual average for that year. This may lead to some variation in the year-to-year statistics. In particular, the average health risk estimates may include a varying number of compounds and therefore, may not be directly comparable from one year to the next. Site changes in each of the five major air basins are described in Chapter 5. A summary of the data record for all the monitoring sites and toxic air contaminants is available on the ARB's web site at: www.arb.ca.gov/aqd/toxics/toxics.html. In addition, information about specific gaps in the TAC data is available from the ARB Monitoring and Laboratory Division at (916) 445-3742.

Finally, it is important to note that the concentrations and health risk estimates presented in this almanac are based on ambient outdoor measurements. They do not account for any indoor exposure to TACs. However, the indoor exposures can contribute significantly to individual health risk.

California Facts and Figures

California is truly a “Land of Contrasts.” The State offers a variety of physical features, including mountains, valleys, oceans, and deserts. In terms of size, California ranks third in the United States, after Alaska and Texas. California covers a total area of close to 160,000 square miles and is larger than many nations in the world today, including Great Britain, Japan, Italy, and Norway. Of California’s total area, about 152,000 square miles are land, and almost 8,000 square miles are water. The Pacific Ocean forms the western boundary of California, with a coastline more than 1,200 miles long. This is nearly equal to the combined Atlantic coastlines of Maine, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, and New Jersey.

California is blessed with a wide range of scenery and climates. The southern coastal areas enjoy a Mediterranean climate with the oak-studded hills and sunny beaches for which the State is famous. The northern coast is covered by fog-shrouded redwood forests. Inland lies the vast Central Valley with its millions of acres of cropland. The Sierra Nevada in the eastern half

of California runs nearly two-thirds the length of the State. The Sierra includes the highest mountain in the continental United States, Mount Whitney, as well as the southernmost glacier in North America. Most of the southeastern portion of the State is desert, with sun-baked Death Valley, the lowest point in North America, lying only 60 miles from Mount Whitney. Further south are the scenic mountain ranges of the Mojave Desert.

To a large degree, California’s pleasant climate and abundance of relatively level land are the major features that have drawn people to the State. Since 1975, California’s population has increased about 61 percent, from about 21.5 million to nearly 34.8 million in the year 2001. The increase in the average number of vehicle miles traveled (VMT) each day on our roadways has been even more dramatic. VMT has increased 118 percent, from about 372 million miles per day in 1975 to over 810 million miles per day in 2001. With these dramatic increases in population and VMT have come tremendous challenges in controlling emissions to improve air quality.

Sources of Emissions in California

California is a diverse state with many sources of air pollution. To estimate the sources and quantities of pollution, the Air Resources Board, in cooperation with local air pollution control districts and industry, maintains an inventory of California emission sources. Sources are subdivided into four major emission categories: stationary sources, area-wide sources, mobile sources, and natural sources. The tables in Chapter 2 provide some examples of the types of emission sources included in each of these categories.

Stationary source emissions are based on estimates made by facility operators and local air pollution control districts. Emissions from specific facilities can be identified by name and location. Area-wide emissions are estimated by ARB and district staffs. Emissions from area-wide sources may be either from small individual sources, such as residential fireplaces, or from widely distributed sources that cannot be tied to a single location, such as consumer products and dust from unpaved roads. Mobile source emissions are estimated by ARB staff with assistance from districts and other government agencies.

Mobile sources include on-road cars, trucks, and buses and other sources such as boats, off-road recreational vehicles, aircraft, and trains. Natural sources are also estimated by the ARB staff and the air districts. These sources include geogenic hydrocarbons, natural wind-blown dust, and wildfires. Biogenic hydrocarbon emission estimates are not included in this document.

For the inventoried emission sources, the ARB compiles emission estimates for both the criteria pollutants and toxic air contaminants. Chapters 2 through 4 and Appendices A and B focus on five criteria pollutants: ozone, particulate matter, carbon monoxide, nitrogen dioxide, and sulfur dioxide. Emissions related to these criteria pollutants include total organic gases (TOG), reactive organic gases (ROG), oxides of nitrogen (NO_x), carbon monoxide (CO), oxides of sulfur (SO_x), particulate matter with an aerodynamic diameter of 10 microns or smaller (PM_{10}), and particulate matter with an aerodynamic diameter of 2.5 microns or smaller ($\text{PM}_{2.5}$).

While some pollutants, such as CO, are directly emitted, others are formed in the atmosphere from *precursor emissions*. Such is the case with ozone, which is formed in the atmosphere when hydrocarbon and NO_x precursor emissions react in the presence of sunlight. Particulate matter (PM), which includes PM₁₀ and PM_{2.5}, is a complex pollutant that can either be directly emitted or formed in the atmosphere from precursor emissions. PM can form in the atmosphere from the reaction of gaseous precursors such as NO_x, ROG, SO_x, and ammonia. Examples of directly emitted PM include dust and soot.

Hydrocarbon is a general term used to describe compounds comprised of hydrogen and carbon atoms. Hydrocarbons are classified as to how photochemically reactive they are: relatively reactive or relatively non-reactive. Non-reactive hydrocarbons consist mostly of methane, which in turn consists of a single carbon atom and four hydrogen atoms. Emissions of *Total Organic Gases* and *Reactive Organic Gases* are two classes of hydrocarbons measured for California's emissions inventory. TOG includes all hydrocarbons, both reactive and non-reactive. In contrast, ROG includes only the reactive hydrocarbons. For emissions inventory purposes, TOG is measured because non-reactive hydrocarbons, although relatively non-reactive,

nonetheless have enough reactivity to play an important role in photochemistry that needs to be quantified for modeling purposes.

In addition to the information about the criteria pollutants, Chapter 5 and Appendix C focus on the ten toxic air contaminants that pose the greatest potential health risk, primarily based on statewide ambient air quality data. These ten TACs are: acetaldehyde, benzene, 1,3-butadiene, carbon tetrachloride, chromium (hexavalent), *para*-dichlorobenzene, formaldehyde, methylene chloride, perchloroethylene, and diesel particulate matter. Excluding diesel particulate matter, the remaining nine TACs represent over 95 percent of the potential health risk as measured through the statewide TAC air monitoring network. Although diesel particulate matter is not currently monitored, emissions and modeled ambient concentrations indicate that diesel particulate matter has a higher health risk than the other nine compounds combined.

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Air Quality Monitoring

Meteorology acts on the emissions released into the atmosphere to produce pollutant concentrations. These airborne pollutant concentrations are measured throughout California at air quality monitoring sites. The Air Resources Board operates a statewide network of monitors. Data from this network are supplemented with data collected by local air districts, other public agencies, and private contractors. As shown in Figure 1-1, there are more than 250 criteria pollutant monitoring sites in California. Currently, the ARB also monitors ambient concentrations of toxic air contaminants (TACs) at 18 of these sites. In addition to the California sites, a few monitoring sites are located in Baja California, Mexico. These sites were established in cooperation with the United States Environmental Protection Agency (U.S. EPA) and the Mexican government to monitor the cross-border transport of pollutants and pollutant precursors. Each year, more than ten million air quality measurements from all of these sites are collected and stored in a comprehensive air quality database maintained by the ARB. To ensure the integrity of the data, the ARB routinely conducts audits and reviews of the monitoring instruments and the resulting data.

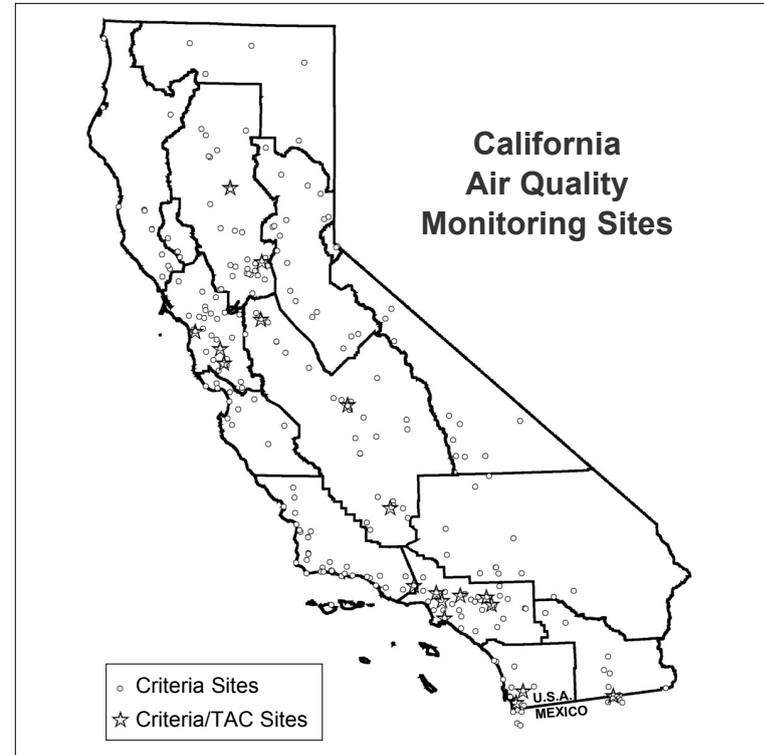


Figure 1-1

California Air Basins

California contains a wide variety of climates, physical features, and emission sources. This variety makes the task of improving air quality complex, because what works in one area may not be effective in another area. To better manage common air quality problems, California is divided into 15 air basins, as shown in Figure 1-2 and Table 1-1. The Air Resources Board established the initial air basin boundaries during 1968.

An air basin generally has similar meteorological and geographical conditions throughout. To the extent possible, the air basin boundaries follow along political boundary lines and are defined to include both the source area and the receptor area. However, air masses can move freely from basin to basin. As a result, pollutants such as ozone and particulate matter can be transported across air basin boundaries, and interbasin transport is a reality that must be dealt with in air quality programs. Although established in 1968, the air basin boundaries have been changed several times over the years, to provide for better air quality management.



Figure 1-2

List of Counties in Each Air Basin

Great Basin Valleys Air Basin

- Alpine County
- Inyo County
- Mono County

Lake County Air Basin

- Lake County

Lake Tahoe Air Basin

- El Dorado County (portion)
- Placer County (portion)

Mojave Desert Air Basin

- Kern County (portion)
- Los Angeles County (portion)
- Riverside County (portion)
- San Bernardino County (portion)

Mountain Counties Air Basin

- Amador County
- Calaveras County
- El Dorado County (portion)
- Mariposa County
- Nevada County
- Placer County (portion)
- Plumas County
- Sierra County
- Tuolumne County

Table 1-1

List of Counties in Each Air Basin

North Central Coast Air Basin

- Monterey County
- San Benito County
- Santa Cruz County

North Coast Air Basin

- Del Norte County
- Humboldt County
- Mendocino County
- Sonoma County (portion)
- Trinity County

Northeast Plateau Air Basin

- Lassen County
- Modoc County
- Siskiyou County

Sacramento Valley Air Basin

- Butte County
- Colusa County
- Glenn County
- Placer County (portion)
- Sacramento County
- Shasta County
- Solano County (portion)
- Sutter County
- Tehama County
- Yolo County
- Yuba County

List of Counties in Each Air Basin

Salton Sea Air Basin

- Imperial County
- Riverside County (portion)

San Diego Air Basin

- San Diego County

San Francisco Bay Area Air Basin

- Alameda County
- Contra Costa County
- Marin County
- Napa County
- San Francisco County
- San Mateo County
- Santa Clara County
- Solano County (portion)
- Sonoma County (portion)

San Joaquin Valley Air Basin

- Fresno County
- Kern County (portion)
- Kings County
- Madera County
- Merced County
- San Joaquin County
- Stanislaus County
- Tulare County

South Central Coast Air Basin

- San Luis Obispo County
- Santa Barbara County
- Ventura County

Table 1-1 (continued)

List of Counties in Each Air Basin

South Coast Air Basin

- Los Angeles County (portion)
- Orange County
- Riverside County (portion)
- San Bernardino County (portion)

Table 1-1 (continued)

Criteria Air Pollutants

California and National Ambient Air Quality Standards

Very simply, an ambient air quality standard is the definition of “clean air.” More specifically, a standard establishes the concentration above which the pollutant is known to cause adverse health effects to sensitive groups within the population, such as children and the elderly. Both the California and federal governments have adopted health-based standards for the *criteria pollutants*, which include but are not limited to ozone, particulate matter (PM₁₀ and PM_{2.5}), and carbon monoxide. For some pollutants, the California (State standards) and national standards are very similar. For other pollutants, the State standards are more stringent. The differences in the standards are generally explained by the different health effects studies considered during the standard-setting process and the interpretation of the studies. In addition, the State standards incorporate a margin of safety to protect sensitive individuals (a complete list of the State and national ambient air quality standards can be found on the ARB website at www.arb.ca.gov/aqs/aqs.htm). In general, the air quality standards are expressed as a measure of the amount of pollutant per unit of air. For example, the particulate matter standards are expressed as micrograms of particulate matter per cubic meter of air ($\mu\text{g}/\text{m}^3$).

Ozone

Ozone, a colorless gas which is odorless at ambient levels, is the chief component of urban smog. Ozone is not directly emitted as a pollutant, but is formed in the atmosphere when hydrocarbon and NO_x precursor emissions react in the presence of sunlight. Meteorology and terrain play major roles in ozone formation. Generally, low wind speeds or stagnant air coupled with warm temperatures and cloudless skies provide the optimum conditions for ozone formation. As a result, summer is generally the peak ozone season. Because of the reaction time involved, peak ozone concentrations often occur far downwind of the precursor emissions. Therefore, ozone is a regional pollutant that often impacts a large area.

Ozone impacts lung function by irritating and damaging the respiratory system. In addition, ozone causes damage to vegetation, buildings, rubber, and some plastics. Recognizing the impacts of day-long exposure, the U.S. EPA promulgated a new 8-hour standard for ozone in 1997. Because of delays due to legal activity, the transition to the national 8-hour standard is just beginning. At this time, the national 1-hour standard continues to apply in all areas.

In 2000, the Air Resources Board transmitted recommendations for nonattainment area designations for the national 8-hour ozone standard to U.S. EPA. We plan to revisit those recommendations to reflect expected changes to federal implementation policies and more current air quality data.

State Ozone Standard:

0.09 ppm for 1 hour,
not to be exceeded.

National Ozone Standards:

0.12 ppm for 1 hour,
not to be exceeded more
than once per year *and*
0.08 ppm for 8 hours,
not to be exceeded,
based on the fourth highest
concentration averaged
over three years.

Table 1-2

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Particulate Matter (PM₁₀ and PM_{2.5})

Exposure to particulate matter aggravates a number of respiratory illnesses and may even cause early death in people with existing heart and lung disease. Both long-term and short-term exposure can have adverse health impacts. All particles with a diameter of 10 microns or smaller (PM₁₀) are harmful. For comparison, the diameter of a human hair is about 50 to 100 microns. PM₁₀ includes the subgroup of finer particles with an aerodynamic diameter of 2.5 microns or smaller (PM_{2.5}). These finer particles pose an increased health risk because they can deposit deep in the lung and contain substances that are particularly harmful to human health.

PM₁₀ is a mixture of substances that includes elements such as carbon and metals; compounds such as nitrates, organic compounds, and sulfates; and complex mixtures such as diesel exhaust and soil. These substances may occur as solid particles or liquid droplets. Some particles are emitted directly into the atmosphere. Others, referred to as secondary particles, result from gases that are transformed into particles through physical and chemical processes in the atmosphere.

In 1982, the Air Resources Board adopted 24-hour average and annual average PM₁₀ standards. National ambient air quality standards for PM₁₀ have been in place since 1987. However, California's PM₁₀ standards are more health-protective.

In June 2002, the ARB adopted recommendations to lower the level of the PM₁₀ annual standard from 30 $\mu\text{g}/\text{m}^3$ to 20 $\mu\text{g}/\text{m}^3$ and establish a new annual PM_{2.5} standard of 12 $\mu\text{g}/\text{m}^3$. The ARB will proceed with recommendations for State 24-hour PM standards when results of the reanalysis of short-term PM exposure studies become available. Additional information on the State PM standards is available on the ARB's website at the following address: www.arb.ca.gov/research/aaqs/std-rs/std-rs.htm.

The United States Environmental Protection Agency (U.S. EPA) promulgated new national ambient air quality standards for PM_{2.5} to complement the national PM₁₀ standards. Implementation is now beginning.

State PM₁₀ Standards:

50 µg/m³ for 24 hours

not to be exceeded *and*

20 µg/m³ annual arithmetic mean,

not to be exceeded.

State PM_{2.5} Standard:

12 µg/m³ annual arithmetic mean,

not to be exceeded.

National PM₁₀ Standards:

150 µg/m³ for 24 hours, not to be exceeded,
more than once per year *and*

50 µg/m³ annual arithmetic mean
averaged over 3 years.

National PM_{2.5} Standards:

65 µg/m³ for 24 hours, not to be exceeded,
based on the 98th percentile concentration
averaged over three years *and*

15 µg/m³ annual arithmetic mean
averaged over 3 years.

Table 1-3

Carbon Monoxide

Carbon monoxide is a colorless and odorless gas that is directly emitted as a by-product of combustion. The highest concentrations are generally associated with cold stagnant weather conditions that occur during winter. In contrast to ozone, which tends to be a regional pollutant, CO problems tend to be localized.

Carbon monoxide is harmful because it is readily absorbed through the lungs into the blood, where it binds with hemoglobin and reduces the ability of the blood to carry oxygen. As a result, insufficient oxygen reaches the heart, brain, and other tissues. The harm caused by CO can be critical for people with heart disease (angina), chronic lung disease, or anemia, as well as for unborn children. Even healthy people exposed to high levels of CO can experience headaches, fatigue, slow reflexes, and dizziness. Health damage caused by CO is of greater concern at high elevations where the air is less dense, aggravating the consequences of reduced oxygen supply. As a result, California has a more stringent CO standard for the Lake Tahoe Air Basin.

State CO Standards:

20 ppm for 1 hour *and*
9.0 ppm for 8 hours,
neither to be exceeded.

6 ppm for 8 hours
(Lake Tahoe Air Basin only),
not to be equaled or exceeded.

National CO Standards:

35 ppm for 1 hour *and*
9 ppm for 8 hours,
neither to be exceeded more
than once per year.

Table 1-4

California and National Area Designations

Both the California and federal governments use monitoring data to designate areas according to their attainment status for most of the pollutants with ambient air quality standards. The purpose of the designations is to identify those areas with air quality problems and thereby initiate planning efforts to make the air more healthful. There are three basic designation categories: nonattainment, attainment, and unclassified. In addition, the California (State) designations include a subcategory of the nonattainment designation, called nonattainment-transitional. The nonattainment-transitional designation is given to nonattainment areas that are making progress and nearing attainment.

A *nonattainment designation* indicates that the air quality violates an ambient air quality standard. Although a number of areas may be designated as nonattainment for a particular pollutant, the severity of the problem can vary greatly. For example, in two ozone nonattainment areas, the first area has a measured maximum concentration of 0.13 parts per million (ppm), while the second area has a measured maximum concentration of

0.23 ppm. While both areas are designated as nonattainment, it is obvious that the second area has a more severe ozone problem and will need a more stringent emission control strategy. To identify the severity of the problem and the extent of planning required, nonattainment areas are assigned a classification that is commensurate with the severity of their air quality problem (e.g., moderate, serious, severe).

In contrast to nonattainment, an *attainment designation* indicates that the air quality does not violate the established standard. Under the federal Clean Air Act, nonattainment areas that are redesignated as attainment must develop and implement maintenance plans designed to assure continued compliance with the standard. Finally, an *unclassified designation* indicates that there are insufficient data for determining attainment or nonattainment. More detailed information on the area designation categories can be found on the ARB's website at the following address: www.arb.ca.gov/desig/desig.htm.

Ozone - National 1-Hour Area Designations

Similar to the State designations, most of the major urban areas in California are designated as nonattainment for the national 1-hour ozone standard. Ozone air quality in Butte, northern Sutter, Yuba, Santa Barbara, San Diego, and eastern Kern counties now meets the national 1-hour ozone standard, but these areas have not yet been officially redesignated as attainment. All the remaining areas of California are designated as unclassified/attainment. Ambient ozone concentrations in these areas do not violate the national 1-hour standard. However, a number of these areas violate the new 8-hour national ozone standard.

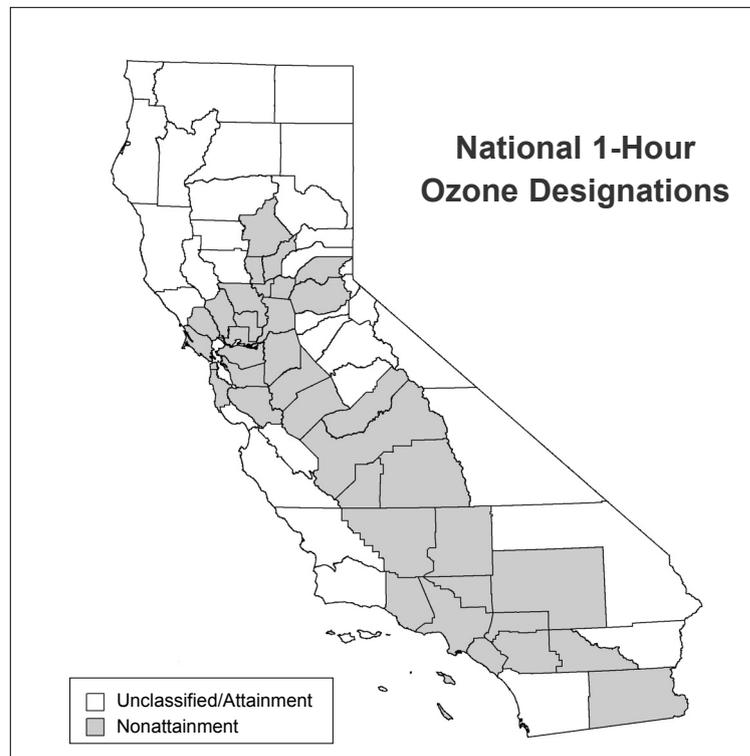


Figure 1-4

PM₁₀ - State Area Designations

The majority of California is designated as nonattainment for the State PM₁₀ standards. Three counties in the northern half of the State remain unclassified, and only one area, the Lake County Air Basin, is designated as attainment.

PM₁₀ remains a widespread problem, and its causes are very diverse. Because of the variety of sources and the size and chemical make-up of the particles, the PM₁₀ problem can vary considerably from one area to the next. In addition, high PM₁₀ concentrations are seasonal, and the high season varies from area to area. For example, in some areas, windblown dust may contribute to high PM₁₀ concentrations in the summer and fall, while in other areas, high concentrations due to secondary particles may occur during the winter. As a result, two areas with similar PM₁₀ concentrations may have very different PM₁₀ problems, and multiple control strategies are needed to effectively deal with these problems.

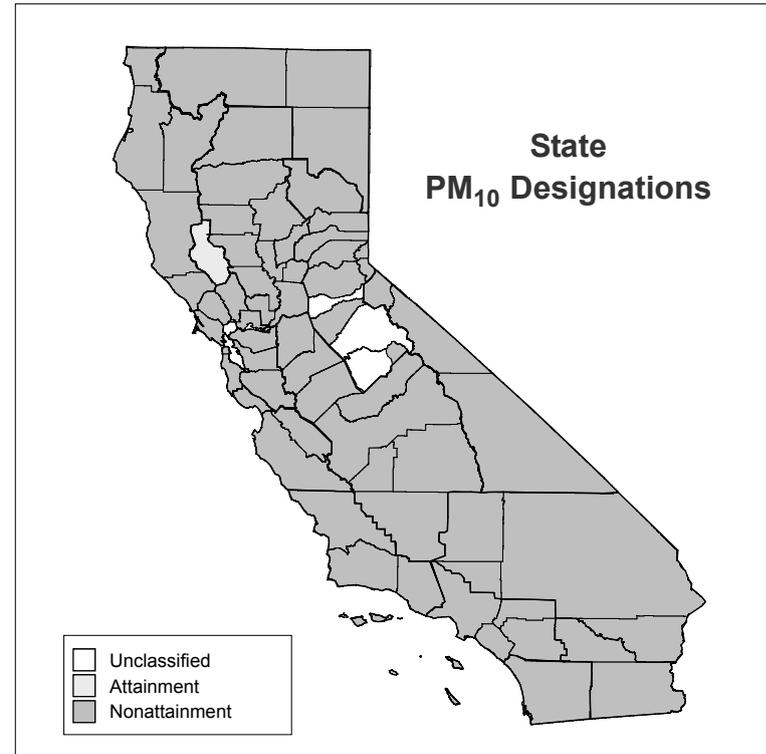


Figure 1-5

PM₁₀ - National Area Designations

In contrast to the State PM₁₀ designations, there are only two designation categories for the national PM₁₀ standards: nonattainment and unclassified. Areas designated as nonattainment for the national PM₁₀ standards are required to develop and implement plans designed to meet the standards. Although they are designated as nonattainment, Sacramento, Indian Wells (northeastern Kern County), and Trona (northwestern San Bernardino County) now meet the national PM₁₀ standards.

Recognizing the health impacts of fine particles (those equal to or less than 2.5 microns in diameter), the U.S. EPA promulgated national PM_{2.5} standards in 1997. California began deploying a PM_{2.5} monitoring network in late 1998. After three complete years of PM_{2.5} data are available, California will recommend, and the U.S. EPA will promulgate, nonattainment designations for PM_{2.5}. Until then, the actions taken to reduce ozone and PM₁₀ should also help in reducing PM_{2.5}.



Figure 1-6

Carbon Monoxide - State Area Designations

Currently, there are only two nonattainment areas for the State CO standards: Los Angeles County and the city of Calexico, in Imperial County. California has made tremendous progress in reducing CO concentrations in the last ten years, during which a number of areas have been redesignated as attainment. Much of the progress in reducing ambient CO is attributable to motor vehicle controls and the introduction of cleaner fuels.

With respect to the nonattainment areas, the outlook for further reducing CO concentrations in Los Angeles County is good, and continued emission reductions should assure attainment sometime in the future. In contrast, the problem in Calexico is unique in that this area is probably impacted by emissions from Mexico. Additional studies are needed to determine the most effective control strategy for the Calexico area.



Figure 1-7

Carbon Monoxide - National Area Designations

The U.S. EPA uses only two designation categories for CO: unclassified/attainment and nonattainment. All areas of California except the South Coast Air Basin are currently designated as unclassified/attainment for the national CO standards. Furthermore, the CO problem in the South Coast area is limited to only a small portion of Los Angeles County. Most CO is directly emitted by cars and trucks, and the Air Resources Board's motor vehicle controls should be sufficient to overcome the problem in the coming years. In addition to Los Angeles County, the city of Calexico, in Imperial County, also has carbon monoxide concentrations that violate the national standards. However, the U.S. EPA has not acted to change this area's designation from unclassified/attainment to nonattainment.



Figure 1-8

Toxic Air Contaminants

A toxic air contaminant or TAC is defined as an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health. TACs are usually present in minute quantities in the ambient air. However, their high toxicity or health risk poses a threat to public health even at these very low concentrations. In general, there is no concentration at which a TAC is considered safe. In other words, there is no threshold below which adverse health impacts do not occur. This contrasts with the criteria pollutants for which acceptable levels of exposure can be determined and for which the State and federal governments have set ambient air quality standards.

The Air Resources Board's TAC program traces its beginning to the criteria pollutants program in the 1960s. For many years, the criteria pollutant control program has been effective at reducing TACs because many volatile organic compounds and particulate matter constituents are also TACs. During the 1980s, the public's concern over toxic chemicals heightened. As a result, citizens demanded protection and control over the release of toxic chemicals into the air. In response to public

concerns, the California legislature enacted a 1983 law governing the release of TACs. This law charges the Air Resources Board with the responsibility of identifying substances as TACs, setting priorities for control, adopting control strategies, and promoting alternative processes. To date, the ARB has designated nearly 200 compounds as TACs. Additionally, the ARB has implemented control strategies for a number of compounds that pose high risk and show potential for effective control.

The majority of the estimated health risk from TACs can be attributed to a relatively few compounds, the most important being particulate matter from diesel-fueled engines (diesel particulate matter or diesel PM). Diesel particulate matter differs from other TACs in that it is not a single substance but rather, a complex mixture of hundreds of substances. Although diesel particulate matter is emitted by diesel-fueled internal combustion engines, the composition of the emissions will vary depending on engine type, operating conditions, fuel composition, lubricating oil, and whether an emission control system is present. Unlike the other toxic air contaminants, no ambient monitoring data are available for diesel particulate matter

because no routine measurement method currently exists. However, the ARB made preliminary estimations of concentrations for the State and its fifteen air basins using a particulate matter-based exposure method. The method uses the ARB emission inventory's PM₁₀ database, ambient PM₁₀ monitoring data, and the results from several studies with chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel particulate matter. Details on the method and the resulting estimates for individual air basins can be found in the ARB report entitled: *“Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant -- Appendix III Part A Exposure Assessment,”* (April 1998). Since that report was published, the ARB has updated the estimated statewide concentrations for diesel PM. These updated statewide concentrations are used in this almanac and are described in Appendix VI of the ARB report titled: *“Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles,”* (October 2000). In addition to diesel particulate matter, benzene and 1,3-butadiene are also significant contributors to overall public health risk in California.

This almanac (Chapter 5 and Appendix C) includes information for ten TACs: acetaldehyde, benzene, 1,3-butadiene, carbon

tetrachloride, chromium (hexavalent), *para*-dichlorobenzene, formaldehyde, methylene chloride, perchloroethylene, and diesel PM. These ten compounds pose the greatest risk, statewide, based primarily on air quality data. (Note that other TACs, for example dioxins, may also pose a significant health risk. However, sufficient air quality data are not yet available.)

The TAC data in this almanac were obtained from monitors operated by the ARB. The majority of the information is presented on a pollutant-by-pollutant basis, with a focus on cancer risk. The data represent general, average population exposures and may not represent the health risk near local sources. Localized impacts may involve exposure to different toxic air contaminants or to higher concentrations than those represented by the ambient monitoring data. One future challenge is to better characterize community health risks by focusing on localized or near-source impacts. Future editions of this almanac may include this type of information, as it becomes available. In addition to the focus on general, average population exposure, this almanac includes only cancer risk. Future editions may include data for non-cancer risks, which may be more significant on a local basis than on a general, average basis.

The ARB has substantially increased its knowledge about TACs in the last fifteen years, and control efforts have been effective

in reducing public exposures and associated health risks. The future gradual phase-in of control strategies will likely continue to result in lower exposures for California's citizens. In the interim, work continues on identifying toxic substances and developing a better understanding of the risks they pose. Health experts still have only a limited knowledge of the mechanisms by which many toxic substances harm the body, and there is still much work to be done in researching health effects and quantifying cancer risks. Cooperative strategies between the ARB, businesses, and other State, local, and federal agencies will be a major focus of future control efforts. Furthermore, we must look at community health issues and cumulative exposures to learn which communities are the most impacted and who in those communities are the most vulnerable. The ARB is currently participating in several studies to address localized impacts and community health issues. More information on these studies is available on the web at www.arb.ca.gov/ch/ch.htm.

Additional information on TACs may be found on the ARB website at www.arb.ca.gov/toxics/toxics.htm. Detailed information on the health effects of these pollutants, as well as many other toxic air contaminants, can be found in a report entitled: "*Toxic Air Contaminant Identification List-Summaries*." This report, dated September 1997, is available from the ARB Public Information Office and on the web at www.arb.ca.gov/toxics/tac/intro.htm.



Figure 1-9

California Air Quality Regulation

The responsibility for controlling air pollution in California is shared between 35 local air pollution control and air quality management districts (districts), the Air Resources Board, and the United States Environmental Protection Agency. The basic responsibilities of each of these entities are outlined below.

District Responsibilities:

- Control and permit industrial pollution sources (such as power plants, refineries, and manufacturing operations) and widespread area-wide sources (such as bakeries, dry cleaners, service stations, and commercial paint applicators).
- Adopt local air quality plans and rules.

Air Resources Board Responsibilities:

- Establish State ambient air quality standards.
- Adopt and enforce emission standards for mobile sources (except where federal law preempts ARB's authority), fuels, consumer products, and toxic air contaminants.

- Provide technical support to the local districts.
- Oversee local district compliance with State and federal law.
- Approve local air quality plans and submit State Implementation Plans to U.S. EPA.

United States Environmental Protection Agency Responsibilities:

- Establish national ambient air quality standards.
- Set emission standards for mobile sources, including those sources under exclusive federal jurisdiction (like interstate trucks, aircraft, marine vessels, locomotives, and farm/construction equipment).
- Oversee State air programs as they relate to the Federal Clean Air Act.
- Approve State Implementation Plans.

List of Air Pollution Contacts

Amador County Air Pollution Control District

All of Amador County

(209) 257-0112

www.air-amador.org

Antelope Valley Air Pollution Control District

Northeast portion of Los Angeles County

(661) 723-8070

www.avaqmd.ca.gov

Bay Area Air Quality Management District

All of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, and Santa Clara counties, western portion of Solano County, and southern portion of Sonoma County

(415) 771-6000

www.baaqmd.gov

Butte County Air Quality Management District

All of Butte County

(530) 891-2882

www.bcaqmd.org

Calaveras County Air Pollution Control District

All of Calaveras County

(209) 754-6504

lgrewal@co.calaveras.ca.us

Colusa County Air Pollution Control District

All of Colusa County

(530) 458-0590

www.colusanet.com/apcd

El Dorado County Air Pollution Control District

All of El Dorado County

(530) 621-6662

www.co.el-dorado.ca.us/emd/apcd

Feather River Air Quality Management District

All of Sutter and Yuba counties

(530) 634-7659

www.fraqmd.org

Glenn County Air Pollution Control District

All of Glenn County

(530) 934-6500

www.countyofglenn.net/Air_Pollution_Control/home_page.asp

Great Basin Unified Air Pollution Control District

All of Alpine, Inyo, and Mono counties

(760) 872-8211

greatbasin@qnet.com

Imperial County Air Pollution Control District

All of Imperial County

(760) 482-4606

jeannettemonroy@imperialcounty.net

Kern County Air Pollution Control District

Eastern portion of Kern County

(661) 862-5250

www.kernair.org

Lake County Air Quality Management District

All of Lake County

(707) 263-7000

bohr@pacific.net

Lassen County Air Pollution Control District

All of Lassen County

(530) 251-8110

lassenag@psln.com

Mariposa County Air Pollution Control District

All of Mariposa County

(209) 966-2220

air@yosemite.net

Mendocino County Air Quality Management District

All of Mendocino County

(707) 463-4354

www.co.mendocino.ca.us/aqmd

Modoc County Air Pollution Control District

All of Modoc County

(530) 233-6419

modocag@hdo.net

Mojave Desert Air Quality Management District

Northern portion of San Bernardino County and eastern portion of Riverside County

(760) 245-1661

www.mdaqmd.ca.gov

Monterey Bay Unified Air Pollution Control District

All of Monterey, San Benito and Santa Cruz counties
(831) 647-9411
www.mbuapcd.org

North Coast Unified Air Quality Management District

All of Del Norte, Humboldt, and Trinity counties
(707) 443-3093
www.northcoast.com/~ncuaqmd

Northern Sierra Air Quality Management District

All of Nevada, Plumas, and Sierra counties
(530) 274-9360
www.nccn.net/~nsaqmd

No. Sonoma County Air Pollution Control District

Northern portion of Sonoma County
(707) 433-5911
nsc@sonic.net

Placer County Air Pollution Control District

All of Placer County
(530) 889-7130
www.placer.ca.gov/airpollution/airpolut.htm

Sacramento Metro Air Quality Management District

All of Sacramento County
(916) 874-4800
www.airquality.org or www.sparetheair.com

San Diego County Air Pollution Control District

All of San Diego County
(858) 650-4700
www.sdapcd.co.san-diego.ca.us

San Joaquin Valley Unified Air Pollution Control District

All of Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare counties and western portion of Kern County
(559) 230-6000
www.valleyair.org

San Luis Obispo County Air Pollution Control District

All of San Luis Obispo County
(805) 781-4AIR
www.slocleanair.org

Santa Barbara County Air Pollution Control District

All of Santa Barbara County

(805) 961-8800

www.sbcapcd.org

Shasta County Air Quality Management District

All of Shasta County

(530) 225-5674

www.co.shasta.ca.us/Departments/Resourcemgmt/drm/aqmain.htm

Siskiyou County Air Pollution Control District

All of Siskiyou County

(530) 841-4029

rakana@co.siskiyou.ca.us

South Coast Air Quality Management District

Los Angeles County except for portion covered by Antelope Valley APCD, all of Orange County, western portion of San Bernardino County, and western portion of Riverside County

(909) 396-2000

www.aqmd.gov

Tehama County Air Pollution Control District

All of Tehama County

(530) 527-3717

www.tehcoapcd.net

Tuolumne County Air Pollution Control District

All of Tuolumne County

(209) 533-5693

bsandman@co.tuolumne.ca.us

Ventura County Air Pollution Control District

All of Ventura County

(805) 645-1400

www.vcapcd.org

Yolo-Solano Air Quality Management District

All of Yolo County and eastern portion of Solano County

(530) 757-3650

www.ysaqmd.org

Milestones in California's Emission Control Programs

Historical Milestones:

1963: First vehicle emission control in the country – positive crankcase ventilation required to reduce evaporative emissions.

1966: First tailpipe emission standards for hydrocarbons (HC) and carbon monoxide (CO).

1971: First oxides of nitrogen (NO_x) standards for cars and light trucks.

1973: First heavy-duty diesel truck standards.

1975: Two-way catalytic converters first used to control HC and CO emissions from cars.

1976: "Unleaded" gasoline first offered for sale, with reduced lead levels.

Three-way catalyst first used to control NO_x, HC, and CO emissions from cars.

1984: California Smog Check program implemented to identify and repair ineffective emission control systems on cars and light-trucks.

1988: California Clean Air Act is enacted, setting forth the framework for meeting State ambient air quality standards.

1992: California's reformulated gasoline introduced – reducing evaporative emissions, phasing out lead in gasoline, and requiring wintertime oxygenates to reduce CO formation.

First consumer product regulations take effect, regulating HC emissions from aerosol antiperspirants and deodorants.

1993: Cleaner diesel fuel launched, reducing emissions of diesel particulate matter, sulfur dioxide, and NO_x.

Regulations to limit HC emissions from consumer products such as hairspray, windshield washer fluid, and air fresheners take effect.

1994: Low emission vehicle regulations to further reduce emissions from cars and light trucks take effect.

1996: Cleaner burning gasoline debuts with emission benefits equivalent to removing 3.5 million cars from California roads.

Regulations reducing HC emissions from spray paint take effect.

1998: Tighter standards for California diesel trucks and buses take effect.

Revamped Smog Check II program implemented.

1999: ARB acted to phaseout MTBE in gasoline.

2000: First standards for large spark ignition off-road engines such as forklifts and pumps take effect nationwide.

More stringent California standards for the small engines used in lawn and garden equipment take effect.

Diesel Risk Reduction Plan adopted.

2001: Tighter emission standards for off-road diesel equipment, such as tractors and generators, take effect nationwide.

More stringent standards for pleasure boats and personal watercraft sold in California begin.

Limits on HC emissions from products such as carpet and upholstery cleaners take effect.

2002: Emission standards for new heavy-duty diesel trucks are cut in half, nationwide.

Upcoming Milestones:

2003: New emission standards for inboard marine engines sold in California take effect.

2004: Regulations to further reduce emissions from cars (and require light-trucks and sport-utility vehicles to meet the same emission standards as cars) take effect in California.

MTBE in California gasoline is fully phased out.

Tighter standards for on-road motorcycles begin.

2005: Limits on HC emissions from paint removers take effect.

2006: Low sulfur diesel fuel required nationwide.

2007: Tighter emission standards for heavy-duty diesel trucks take effect nationwide.

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