



Appendix C  
**AIR QUALITY**



## PRINCIPAL POLLUTANTS OF THE AIR BASIN

A substance in the air that can cause harm to humans and the environment is known as an air pollutant. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made. Pollutants can be classified as primary or secondary. Usually, primary pollutants are directly emitted from a process, such as ash from a volcanic eruption, carbon monoxide gas from a motor vehicle exhaust, or sulfur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact.

### Criteria Air Pollutants

Pollutants emitted into the ambient air by stationary and mobile sources are regulated by Federal and State law. Air pollutants are categorized as primary and/or secondary pollutants. Primary air pollutants are emitted directly from sources, and include carbon monoxide (CO), reactive organic gases (ROG), nitrogen oxides (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), coarse inhalable particulate matter (PM<sub>10</sub>), fine inhalable particulate matter (PM<sub>2.5</sub>), and lead (Pb). Of these, CO, SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> are "criteria air pollutants," which means that ambient air quality standards (AAQS) have been established for them. ROG and NO<sub>x</sub> are criteria pollutant precursors that form secondary criteria air pollutants through chemical and photochemical reactions in the atmosphere. Ozone (O<sub>3</sub>) and nitrogen dioxide (NO<sub>2</sub>) are the principal secondary pollutants.

The following is a description of each of the primary and secondary criteria air pollutants and their known health effects.

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C-1 Principal Pollutants of the Air Basin

**Carbon Monoxide**

Carbon Monoxide (CO) is a colorless, odorless, toxic gas produced by incomplete combustion of carbon substances, such as gasoline or diesel fuel. CO concentrations tend to be the highest during winter mornings with little or no wind, when surface-based inversions trap the pollutant at ground levels. Because CO is emitted directly from internal combustion engines, motor vehicles operating at slow speeds are the primary source of CO in the Air Basin. Emissions are highest during cold starts, hard acceleration, stop-and-go driving, and when a vehicle is moving at low speeds. New findings indicate that CO emissions per mile are lowest at about 45 miles per hour (mph) for the average light-duty motor vehicle and begin to increase again at higher speeds. When inhaled at high concentrations, CO combines with hemoglobin in the blood and reduces its oxygen-carrying capacity. This results in reduced oxygen reaching the brain, heart, and other body tissues. This condition is especially critical for people with cardiovascular diseases, chronic lung disease, or anemia, as well as for fetuses. Even healthy people exposed to high CO concentrations can experience headaches, dizziness, fatigue, unconsciousness, and even death. The Air Basin is designated under the California and National AAQS as being in attainment of CO criteria levels.

**Reactive Organic Gases**

Reactive Organic Gases (ROGs) are compounds composed primarily of hydrogen and carbon atoms. Internal combustion associated with motor vehicle usage is the major source of ROGs. Other sources of ROGs include evaporative emissions from paints and solvents, the application of asphalt paving, and the use of household consumer

products such as aerosols. Adverse effects on human health are not caused directly by ROG<sub>s</sub>, but rather by reactions of ROG<sub>s</sub> to form secondary pollutants such as O<sub>3</sub>. There are no AAQS established for ROG<sub>s</sub>. However, because they contribute to the formation of O<sub>3</sub>, BAAQMD has established a significance threshold for this pollutant.

### **Nitrogen Oxides**

Nitrogen Oxides (NO<sub>x</sub>) are a by-product of fuel combustion and contribute to the formation of O<sub>3</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub>. The two major components of NO<sub>x</sub> are nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>). The principal component of NO<sub>x</sub> produced by combustion is NO, but NO reacts with oxygen to form NO<sub>2</sub>, creating the mixture of NO and NO<sub>2</sub> commonly called NO<sub>x</sub>. NO<sub>2</sub> acts as an acute irritant and in equal concentrations is more injurious than NO. At atmospheric concentrations, however, NO<sub>2</sub> is only potentially irritating. There is some indication of a relationship between NO<sub>2</sub> and chronic pulmonary fibrosis. Some increase in bronchitis in children (two and three years old) has also been observed at concentrations below 0.3 ppm. NO<sub>2</sub> absorbs blue light; the result is a brownish-red cast to the atmosphere and reduced visibility. NO is a colorless, odorless gas formed from atmospheric nitrogen and oxygen when combustion takes place under high temperature and/or high pressure. The Air Basin is designated an attainment area for NO<sub>2</sub> under the National AAQS and California AAQS.

### **Sulfur Dioxide**

Sulfur Dioxide (SO<sub>2</sub>) is a colorless, pungent, irritating gas formed by the combustion of sulfurous fossil fuels. It enters the atmosphere as a result of burning high-sulfur-content fuel oils and coal and from chemical processes at chemical plants and refineries. Gasoline and natural gas have very

low sulfur content and do not release significant quantities of  $\text{SO}_2$ . When  $\text{SO}_2$  forms sulfates ( $\text{SO}_4$ ) in the atmosphere, together these pollutants are referred to as sulfur oxides ( $\text{SO}_x$ ). As a result,  $\text{SO}_2$  is both a primary and secondary criteria air pollutant. At sufficiently high concentrations,  $\text{SO}_2$  may irritate the upper respiratory tract. At lower concentrations and when combined with particulates,  $\text{SO}_2$  may do greater harm by injuring lung tissue. The Air Basin is designated an attainment area for  $\text{SO}_2$  under the California and National AAQS

### **Suspended Particulate Matter**

Suspended Particulate Matter ( $\text{PM}_{10}$  and  $\text{PM}_{2.5}$ ) consists of finely divided solids or liquids such as soot, dust, aerosols, fumes, and mists. Two forms of fine particulates are now recognized and regulated. Inhalable coarse particles, or  $\text{PM}_{10}$ , include the particulate matter with an aerodynamic diameter of 10 microns (i.e., 10 millionths of a meter or 0.0004-inch) or less. Inhalable fine particles, or  $\text{PM}_{2.5}$ , have an aerodynamic diameter of 2.5 microns or less (i.e., 2.5 millionths of a meter or 0.0001 inch).

Some particulate matter, such as pollen, occurs naturally. In the Air Basin most particulate matter is caused by combustion, factories, construction, grading, demolition, agricultural activities, and motor vehicles. Extended exposure to particulate matter can increase the risk of chronic respiratory disease.

$\text{PM}_{10}$  bypasses the body's natural filtration system more easily than larger particles and can lodge deep in the lungs. The U.S. Environmental Protection Agency (USEPA) scientific review concluded that  $\text{PM}_{2.5}$  penetrates even more deeply into the lungs, and this is more likely to contribute to health effects—at concentrations well below current  $\text{PM}_{10}$  standards. These health effects include premature death in people

with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, increased respiratory symptoms (e.g., irritation of the airways, coughing, or difficulty breathing). Motor vehicles are currently responsible for about half of particulates in the Air Basin. Wood burning in fireplaces and stoves is another large source of fine particulates.

Both  $PM_{10}$  and  $PM_{2.5}$  may adversely affect the human respiratory system, especially in people who are naturally sensitive or susceptible to breathing problems. These health effects include premature death and increased hospital admissions and emergency room visits (primarily the elderly and individuals with cardiopulmonary disease); increased respiratory symptoms and disease (children and individual with asthma); and alterations in lung tissue and structure and in respiratory tract defense mechanisms.

Diesel particulate matter (DPM) is classified a carcinogen by the California Air Resources Board (CARB). The Air Basin is designated nonattainment under the California AAQS for  $PM_{10}$  and nonattainment under both the California and National AAQS for  $PM_{2.5}$ .

### **Ozone**

Ozone ( $O_3$ ) is commonly referred to as “smog” and is a gas that is formed when ROGs and  $NO_x$ , both by-products of internal combustion engine exhaust, undergo photochemical reactions in the presence of sunlight.  $O_3$  is a secondary criteria air pollutant.  $O_3$  concentrations are generally highest during the summer months when direct sunlight, light winds, and warm temperatures create favorable conditions to the formation of this pollutant.  $O_3$  poses a health threat to those who already suffer from respiratory diseases as well as to healthy people.  $O_3$  levels usually build up during the day and peak in the afternoon hours. Short-term exposure can irritate the eyes and cause constriction of the airways.

Besides causing shortness of breath, it can aggravate existing respiratory diseases such as asthma, bronchitis, and emphysema. Chronic exposure to high ozone levels can permanently damage lung tissue. O<sub>3</sub> can also damage plants and trees and materials such as rubber and fabrics. The Air Basin is designated nonattainment of the 1-hour California AAQS and 8-hour California and National AAQS for O<sub>3</sub>.

## **Lead**

Lead (Pb) is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been mobile and industrial sources. As a result of the phase-out of leaded gasoline, metal processing is currently the primary source of lead emissions. The highest levels of lead in air are generally found near lead smelters. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers.

Twenty years ago, mobile sources were the main contributor to ambient lead concentrations in the air. In the early 1970s, the EPA set national regulations to gradually reduce the lead content in gasoline. In 1975, unleaded gasoline was introduced for motor vehicles equipped with catalytic converters. The EPA banned the use of leaded gasoline in highway vehicles in December 1995. As a result of the EPA's regulatory efforts to remove lead from gasoline, emissions of lead from the transportation sector and levels of lead in the air decreased dramatically. The Air Basin is designated in attainment of the California and National AAQS for lead.

## **Toxic Air Contaminants**

Public exposure to TACs is a significant environmental health issue in California. In 1983, the California Legislature enacted a program to identify the health effects of TACs and to reduce exposure to these contaminants to protect the public health. The California Health and Safety Code define a TAC

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.” A substance that is listed as a hazardous air pollutant pursuant to Section 112(b) of the Federal Clean Air Act (42 U.S. Code Section 7412[b]) is a toxic air contaminant. Under State law, the California Environmental Protection Agency (Cal/EPA), acting through CARB, is authorized to identify a substance as a TAC if it is an air pollutant that may cause or contribute to an increase in mortality or serious illness, or may pose a present or potential hazard to human health.

California regulates TACs primarily through AB 1807 (Tanner Air Toxics Act) and AB 2588 (Air Toxics “Hot Spot” Information and Assessment Act of 1987). The Tanner Air Toxics Act sets up a formal procedure for CARB to designate substances as TACs. Once a TAC is identified, CARB adopts an “airborne toxics control measure” for sources that emit designated TACs. If there is a safe threshold for a substance (i.e. a point below which there is no toxic effect), the control measure must reduce exposure to below that threshold. If there is no safe threshold, the measure must incorporate toxics best available control technology to minimize emissions. To date, CARB has established formal control measures for 11 TACs that are identified as having no safe threshold.

Air toxics from stationary sources are also regulated in California under the Air Toxics “Hot Spot” Information and Assessment Act of 1987. Under AB 2588, TAC emissions from individual facilities are quantified and prioritized by the air quality management district or air pollution control district. High priority facilities are required to perform a health risk assessment (HRA), and if specific thresholds are exceeded, are required to communicate the results to the public through notices and public meetings.

At the time of the last update to the TAC list in December 1999, CARB had designated 244 compounds as TACs. Additionally, CARB has implemented control measures for a number of compounds that pose high risks and show potential for effective control. The majority of the estimated health risks from TACs can be attributed to relatively few compounds, the most important being particulate matter from diesel-fueled engines.

In 1998, CARB identified diesel particulate matter (DPM) as a TAC. Previously, the individual chemical compounds in diesel exhaust were considered TACs. Almost all diesel exhaust particles are 10 microns or less in diameter. Because of their extremely small size, these particles can be inhaled and eventually trapped in the bronchial and alveolar regions of the lungs.