

## **CHAPTER 2**

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# **AIR QUALITY AND HEALTH EFFECTS**

**Introduction**

**Ambient Air Quality Standards**

**Comparison to Other U.S. Areas**

**Current Air Quality Summary**

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## INTRODUCTION

In this chapter, 1995 air quality in the South Coast Air Basin (Basin), and in the portions of the Mojave Desert and Salton Sea Air Basins (MDAB/SSAB) monitored by the South Coast Air Quality Management District (District), is compared to state and federal ambient air quality standards. (The MDAB and SSAB were part of the Southeast Desert Air Basin or SEDAB until May 30, 1996, when the California Air Resources Board adopted the boundaries and names of the two new air basins.) For those pollutants which exceeded federal standards, maps which compare 1995 air quality in different areas of the Basin have been included.

Nationwide air quality for 1994 is also briefly summarized in this chapter. A comparison of air quality in the Basin to other U.S. and California urban areas is presented in the following pages.

## AMBIENT AIR QUALITY STANDARDS

Ambient air quality standards for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter (PM<sub>10</sub>), and lead have been set by both the California state and federal governments. The state has also set standards for sulfate and visibility. The ambient air quality standards for each of these pollutants and their effects on health are summarized in [Table 2-1](#).

In 1995 the Basin exceeded the federal standards for ozone, carbon monoxide, and PM<sub>10</sub> on a total of 116 days. In recent years the Basin has recorded many more days exceeding the federal standards than any other area of the U.S.

## COMPARISON TO OTHER U.S. AREAS

The Basin's severe air pollution problem is a consequence of the combination of emissions from the nation's second largest urban area and especially adverse meteorological conditions. The average wind speed for Los Angeles is the lowest of the nation's ten largest urban areas. In addition, the summertime maximum mixing height (an index of how well pollutants can be dispersed vertically in the atmosphere) in Southern California averages the lowest in the U.S. The Southern California area is also an area with abundant sunshine, which drives the photochemical reactions which form pollutants such as ozone.

**TABLE 2-1**  
Ambient Air Quality Standards

| AIR POLLUTANT                                    | STATE STANDARD  | FEDERAL PRIMARY STANDARD  | MOST RELEVANT EFFECTS  |
|--|---|---|--|
|  | CONCENTRATION/<br>AVERAGING TIME  | CONCENTRATION/<br>AVERAGING TIME  |  |
| Ozone  | 0.09 ppm, 1-hr. avg. >  | 0.12 ppm, 1-hr avg.>  | (a) Short-term exposures: (1) Pulmonary function decrements and localized lung edema in humans and animals. (2) Risk to public health implied by alterations in pulmonary morphology and host defense in animals; (b) Long-term exposures: Risk to public health implied by altered connective tissue metabolism and altered pulmonary morphology in animals after long-term exposures and pulmonary function decrements in chronically exposed humans; (c) Vegetation damage; (d) Property damage |
| Carbon Monoxide                                  | 9.0 ppm, 8-hr avg. ><br>20 ppm, 1-hr avg. >   | 9 ppm, 8-hr avg.><br>35 ppm, 1-hr avg.>   | (a) Aggravation of angina pectoris and other aspects of coronary heart disease; (b) Decreased exercise tolerance in persons with peripheral vascular disease and lung disease; (c) Impairment of central nervous system functions; (d) Possible increased risk to fetuses  |
| Nitrogen Dioxide                                 | 0.25 ppm, 1-hr avg. >   | 0.053 ppm, ann. avg.>   | (a) Potential to aggravate chronic respiratory disease and respiratory symptoms in sensitive groups; (b) Risk to public health implied by pulmonary and extra-pulmonary biochemical and cellular changes and pulmonary structural changes; (c) Contribution to atmospheric discoloration   |
| Sulfur Dioxide                                   | 0.04 ppm, 24-hr avg.><br>0.25 ppm, 1-hr. avg. >   | 0.03 ppm, ann. avg.><br>0.14 ppm, 24-hr avg.>   | (a) Bronchoconstriction accompanied by symptoms which may include wheezing, shortness of breath and chest tightness, during exercise or physical activity in persons with asthma   |
| Suspended Particulate Matter (PM <sub>10</sub> ) | 30 µg/m <sup>3</sup> , ann. geometric mean ><br>50 µg/m <sup>3</sup> , 24-hr average>   | 50 µg/m <sup>3</sup> , annual arithmetic mean ><br>150µg/m <sup>3</sup> , 24-hr avg.> | (a) Excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease; (b) Excess seasonal declines in pulmonary function, especially in children  |
| Sulfates   | 25 µg/m <sup>3</sup> , 24-hr avg. >=  |   | (a) Decrease in ventilatory function; (b) Aggravation of asthmatic symptoms; (c) Aggravation of cardio-pulmonary disease; (d) Vegetation damage; (e) Degradation of visibility; (f) Property damage  |
| Lead   | 1.5 µg/m <sup>3</sup> , 30-day avg. >=  | 1.5 µg/m <sup>3</sup> , calendar quarter>   | (a) Increased body burden; (b) Impairment of blood formation and nerve conduction  |
| Visibility-Reducing Particles                    | In sufficient amount such that the extinction coefficient is greater than 0.23 inverse kilometers (to reduce the visual range to less than 10 miles) at relative humidity less than 70 percent, 8-hour average (10am - 6pm) |   | Visibility impairment on days when relative humidity is less than 70 percent   |

In the Basin, exceedances of the federal ozone standard are recorded largely during the spring to early fall months. By contrast, exceedances of the federal carbon monoxide standard occur in late fall and winter. Exceedances of the federal 24-hour PM<sub>10</sub> standard can occur throughout the year, but occur most frequently in fall and winter. Although there are changes in emissions by season, the observed variations in pollutant concentrations are largely a result of seasonal differences in weather conditions.

In 1995, the federal standard for ozone was exceeded at one or more Basin locations on 27 percent of days and the federal carbon monoxide standard was exceeded on 4 percent of days. The federal PM<sub>10</sub> standard was exceeded on 10 percent of the days sampled.<sup>1</sup>

Figure 2-1 shows maximum pollutant concentrations in 1994 for the South Coast Air Basin compared to other urban areas in the U.S. and California. Maximum concentrations in these other large U.S. urban areas exceeded the federal ozone and PM<sub>10</sub> standards in some instances, and did not exceed the carbon monoxide standard. However several other areas in the country did report exceedances of the carbon monoxide standard. In California, some of the other large urban areas also exceeded the PM<sub>10</sub> and ozone standards, but did not exceed the carbon monoxide standard.

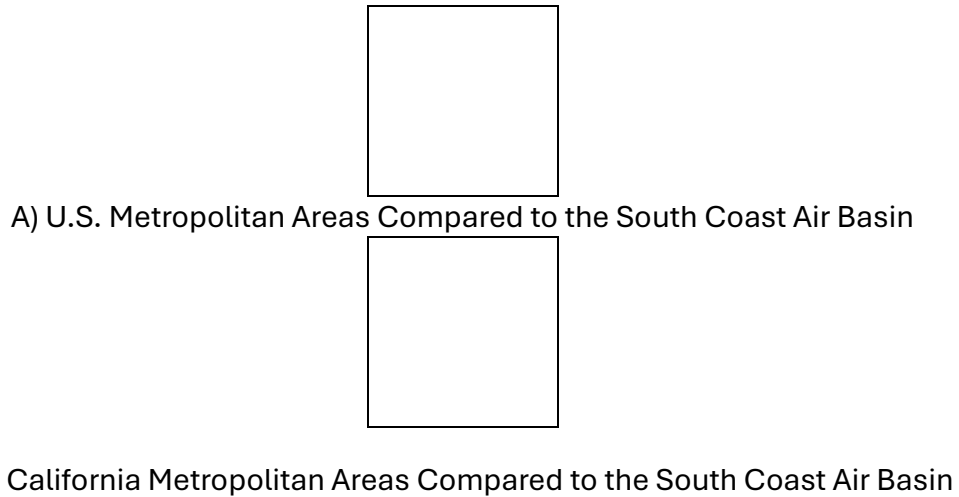
The maximum second highest 1-hour average ozone concentration in the Basin was nearly twice the federal standard. New York and Houston exceeded by much less of a margin, and Philadelphia and Washington barely exceeded, while Chicago did not exceed the standard. Though New York is a much larger urban area than Houston, the maximum ozone concentration for Houston equaled that of New York. Houston, like Los Angeles, is an area with abundant sunshine which creates favorable conditions for the photochemical reactions that yield ozone and other photochemical pollutants. In California, San Francisco did not exceed the ozone standard, while the San Diego, Sacramento and Oxnard-Ventura metropolitan areas each exceeded the standard. Both the San Diego and Oxnard-Ventura metropolitan areas are subject to higher ozone levels due to transport from the South Coast Air Basin.

The maximum 8-hour average carbon monoxide concentration in the Basin was over one and a half times the federal standard. The standard was not exceeded in the other major urban areas depicted in Figure 2-1 in this comparison.

Maximum annual average PM<sub>10</sub> concentrations recorded in the Basin, New York, and Philadelphia exceeded the federal PM<sub>10</sub> standard, and San Diego exceeded very narrowly. Only Philadelphia recorded a higher PM<sub>10</sub> than the Basin, as a consequence of nearby stationary source emissions.

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<sup>1</sup> PM<sub>10</sub> is sampled every sixth day, unlike the gaseous pollutants such as ozone and carbon monoxide which are sampled continuously.



**FIGURE 2-1**

1994 Air Quality

Maximum Pollutant Concentrations as Percentages of the Federal Standard

In 1994, no location in the Basin or any other area of the U.S. exceeded the nitrogen dioxide standard. The Los Angeles County portion of the Basin was the last area of the U.S. to exceed the standard, but has remained in compliance since 1991. Sulfur dioxide concentrations in the Basin continued to remain well below federal standards, and were lower than those in the urban areas of the Eastern U.S. Concentrations of sulfur dioxide in urban areas in the Eastern U.S. have generally been higher than those in the Basin due to the use of fuels such as coal which have relatively high sulfur content.

**CURRENT AIR QUALITY SUMMARY**

Figure 2-2 shows the maximum pollutant concentrations for 1995 as percentages of the state and federal standards. The maximum ozone concentration exceeded the federal standard by the widest margin, with a maximum 1-hour average (0.26 ppm recorded in the Central San Bernardino Mountain area) that was 200 percent of the federal standard. The highest 8-hour average carbon monoxide concentration recorded (13.86 ppm in the South Central Los Angeles County area) was 146 percent of the federal carbon monoxide standard. The maximum 24-hour average PM<sub>10</sub> (219 µg/m<sup>3</sup> in the Metropolitan Riverside County area) was 145 percent of the federal 24-hour standard, and the maximum annual average PM<sub>10</sub> (69 µg/m<sup>3</sup> recorded in Metropolitan Riverside County) was 138 percent of the federal annual PM<sub>10</sub> standard. The maximum sulfate concentration (26.3 µg/m<sup>3</sup> in Metropolitan Riverside County) was 105 percent of the state sulfate standard.

Concentrations of other pollutants remained below the standards. The maximum annual average nitrogen dioxide concentration (0.0464 ppm in the East San Gabriel Valley and Northwest San Bernardino Valley areas) was 87 percent of the federal standard, while the

maximum annual average sulfur dioxide concentration (0.0030 ppm in South Central Los Angeles County) was 10 percent of the federal standard. The maximum quarterly average lead concentration recorded at any District air monitoring station was 4 percent of the federal standard. However, higher concentrations of lead (40 percent of the standard) were recorded at special monitoring locations immediately adjacent to stationary sources.

Figure 2-3 shows the percent of days on which the federal and state standards were exceeded in 1995 at the Basin locations which exceeded most frequently. The federal ozone standard was exceeded on a maximum of 20 percent of days (in the East San Gabriel Valley area of Los Angeles County), and the federal carbon monoxide standard was exceeded on a maximum of 4 percent of days (in South Central Los Angeles County). Exceedances of the federal 24-hour PM<sub>10</sub> standard were recorded on a maximum of 7 percent of days sampled (Metropolitan Riverside County), while the state sulfate standard was exceeded on a maximum of 2 percent of days sampled (Metropolitan Riverside County).

**FIGURE 2-2**

1995 Maximum Pollutant Concentrations as Percent of Federal and State Standards

**FIGURE 2-3**

**1995 Percent of Days/Months/Quarters Exceeding Federal and State Standards at Most Affected Locations**

Detailed analyses of current air quality and statistics for all monitoring areas are contained in [Appendix II](#). The following sections present summary information on health effects and how frequently, and by how much of a margin, different areas of the Basin and MDAB/SSAB exceeded the federal and state ambient air quality standards in 1995.

**Ozone (O<sub>3</sub>) Specific Information**

**Health Effects**

Individuals exercising outdoors, children and people with preexisting lung disease such as asthma and chronic pulmonary lung disease are considered to be the most susceptible sub-groups for ozone effects. Short-term exposures (lasting for a few hours) to ozone at levels typically observed in Southern California can result in breathing pattern changes, reduction of breathing capacity, increased susceptibility to infections, inflammation of the lung tissue, and some immunological changes. In recent years, a correlation between elevated ambient ozone levels and increases in daily hospital admission rates, as well as mortality, has also been reported.

Ozone exposure under exercising conditions is known to increase the severity of the above mentioned observed responses. Similarly, animal studies suggest that exposures to a combination of pollutants which include ozone is more toxic than exposure to ozone alone. Although lung volume and resistance changes observed after a single exposure diminish with repeated exposures, biochemical and cellular changes appear to persist,

which can lead to subsequent lung structural changes. The cancer causing potential of ozone exposure identified in some studies needs further evaluation to draw any definitive conclusions.

### **Air Quality**

In 1995, the South Coast Air Quality Management District monitored ozone concentrations at 33 locations in the Basin and MDAB/SSAB. In the Basin, the maximum ozone concentration (0.26 ppm recorded in the central San Bernardino Mountain area) was 200 percent of the federal standard and 260 percent of the state standard. Los Angeles, Riverside and San Bernardino Counties had maxima above the stage I episode level (0.20 ppm). Ozone concentrations at Orange County locations remained below the episode level, but the maximum exceeded the health advisory level (0.15 ppm). [Table 2-2](#) shows maximum ozone concentrations by Basin and County.

Maximum ozone concentrations in the MDAB/SSAB areas monitored by the District were lower than in the Basin. However, the maximum concentration in the Riverside County SSAB (0.16 ppm in the Coachella Valley area) still exceeded the health advisory level.

**TABLE 2-2**

1995 Maximum Ozone Concentrations by Basin and County

| Basin/County                         | Maximum<br>1-Hr Avg.<br>ppm | Percent of<br>Federal<br>Standard | Area                       |
|--------------------------------------|-----------------------------|-----------------------------------|----------------------------|
| South Coast Air Basin                |                             |                                   |                            |
| Los Angeles Co.                      | 0.22                        | 169                               | East San Gabriel Valley    |
| Orange Co.                           | 0.16                        | 123                               | North Orange County        |
| Riverside Co.                        | 0.21                        | 162                               | Metropolitan Riverside Co. |
| San Bernardino Co.                   | 0.26                        | 200                               | Cent San Bernardino Mtn    |
| Mojave Desert/Salton Sea Area Basins |                             |                                   |                            |
| Los Angeles Co.                      | 0.14                        | 108                               | Antelope Valley            |
| Riverside Co.                        | 0.16                        | 123                               | Coachella Valley           |

The number of days exceeding the federal standard varied widely by area ([Figure 2-4](#)). Areas along the immediate coast did not exceed the federal standard, due in large part to the prevailing sea breeze which transports polluted air inland before high ozone concentrations can be reached. In addition, some inland areas which are remote from urban areas of the Basin did not exceed the standard. The standard was exceeded most frequently in the inland valleys extending from East San Fernando Valley through the San Gabriel Valley into the Riverside-San Bernardino area, and in the adjacent mountains. The East San Gabriel Valley recorded the greatest number of exceedances of the federal



standard (73 days), health advisory level (48 days) and Stage I episode level (9 days). The greatest number of state standard exceedances (123 days) was recorded in the East San Bernardino Valley area.

**FIGURE 2-4**

Ozone -1995  
Number of Days Exceeding the Federal Standard  
(1-hour average ozone > 0.12 ppm)

**Carbon Monoxide (CO) Specific Information**

**Health Effects**

A consistent association between increasing ambient CO levels and excess admissions for heart diseases, such as congestive heart failure, is observed in many cities across the United States. Individuals with a deficient blood supply to the heart are more susceptible to the adverse effects of CO exposure. The effects observed include earlier onset of chest pain with exercise, and electrocardiograph changes indicative of worsening oxygen supply to the heart.

Inhaled CO has no direct toxic effect on the lungs, but exerts its effect on tissues by interfering with oxygen transport by competing with oxygen to combine with hemoglobin

present in the blood to form carboxyhemoglobin (COHb). Hence, conditions with an increased demand for oxygen supply can be adversely affected by exposure to CO. Examples include fetal development, chronic hypoxemia (oxygen deficiency) as seen in high altitudes, anemia, and diseases involving heart and blood vessels.

Reduction in birth weight and impaired neurobehavioral development have been observed in animals chronically exposed to CO resulting in COHb levels similar to those observed in smokers.

### **Air Quality**

Carbon monoxide concentrations were measured at 22 locations in the Basin and neighboring MDAB/SSAB areas in 1995. [Table 2-3](#) shows the 1995 maximum 8-hour average concentrations of carbon monoxide by air basin and county. The highest concentration recorded in the Basin (13.86 ppm in South Central Los Angeles County) was 146 percent of the federal standard and 152 percent of the state standard. Maximum carbon monoxide concentrations in Orange, Riverside, and San Bernardino County areas of the Basin did not exceed the standards.

Maxima for the MDAB/SSAB were much lower. Carbon monoxide levels in both Los Angeles and Riverside County MDAB/SSAB areas remained well below the federal standard.

[Figure 2-5](#) shows the number of days exceeding the federal standard in 1995. Exceedances were limited to the areas of Los Angeles County where vehicular traffic is most dense, with the maximum number of exceedances (13 days exceeding the federal standard and 15 days exceeding the state standard) recorded in the South Central Los Angeles County area.

**TABLE 2-3**

1995 Maximum Carbon Monoxide Concentrations by Basin and County

| Basin/County                                | Maximum 8-Hr Avg. ppm | Percent of Federal Standard | Area                       |
|---|-----------------------|-----------------------------|----------------------------|
| <b>South Coast Air Basin</b>                |                       |                             |                            |
| Los Angeles                                 | 13.86                 | 146                         | South Central L.A. Co.     |
| Orange                                      | 8.00                  | 84                          | Central Orange Co.         |
| Riverside                                   | 6.50                  | 68                          | Metropolitan Riverside Co. |
| San Bernardino                              | 6.25                  | 66                          | Cent San Bernardino V.     |
| <b>Mojave Desert/Salton Sea Area Basins</b> |                       |                             |                            |
| Los Angeles                                 | 4.87                  | 51                          | Antelope Valley            |

|           |      |    |                  |
|-----------|------|----|------------------|
| Riverside | 1.50 | 16 | Coachella Valley |
|-----------|------|----|------------------|

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**FIGURE 2-5**

Carbon Monoxide - 1995  
Number of Days Exceeding the Federal Standard  
(8-hour average CO  $\geq$  9.5 ppm)

**Particulate Matter (PM<sub>10</sub>) Specific Information**

**Health Effects**

A consistent correlation between elevated ambient PM<sub>10</sub> levels and an increase in mortality rates, respiratory infections, number and severity of asthma attacks and the number of hospital admissions has been observed in different parts of the United States and various areas around the world. Although the concentrations and/or combinations of pollutants are significantly different in these studies, most of the PM<sub>10</sub> levels recorded in these studies are lower than those observed in the South Coast Air Basin.

In recent years, some studies have reported an association between long-term exposure to air pollution dominated by fine particles and increased mortality, reduction in life-span, and the possibility of an increased incidence of cancer.

Daily fluctuations in PM<sub>10</sub> levels have also been related to hospital admissions for acute respiratory conditions in children, to school and kindergarten absences, to a decrease in respiratory lung volumes in normal children and to increased medication use in children and adults with asthma.

The elderly, people with pre-existing respiratory and/or cardiovascular disease and children appear to be susceptible to the effects of PM<sub>10</sub>. There is a growing consensus among the scientific community that the fine fraction of PM<sub>10</sub> is relatively more toxic than the coarse fraction and is responsible for the majority of effects observed.

### **Air Quality**

PM<sub>10</sub> concentrations were monitored at 21 locations by the South Coast Air Quality Management District in 1995. Maximum 24-hour and annual average concentrations are shown in [Tables 2-4](#) and [2-5](#). The maximum 24-hour PM<sub>10</sub> concentration recorded in the Basin (219 µg/m<sup>3</sup> in the Metropolitan Riverside County area) was 145 percent of the federal standard and 429 percent of the state standard. The maximum was associated with high winds, but other exceedances of the federal standard not associated with high winds were recorded. Maximum concentrations in all four of the Basin counties exceeded the federal 24-hour standard. The maximum annual average PM<sub>10</sub> (69 µg/m<sup>3</sup> in Metropolitan Riverside County) was 138 percent of the federal annual standard. The federal annual standard was exceeded in Riverside and San Bernardino Counties but not in Los Angeles or Orange Counties. The much more stringent state annual standard was exceeded in all areas of the Basin.

In 1995, both annual and 24-hour maximum concentrations of PM<sub>10</sub> in the Los Angeles County portion of the MDAB were below the federal standards. However in the Riverside County area of the SSAB, both standards were exceeded. The maximum 24-hour PM<sub>10</sub> concentration (199 µg/m<sup>3</sup> in the Coachella Valley) was 132 percent of the federal 24-hour standard, and was associated with high winds in the desert areas. The maximum annual average PM<sub>10</sub> concentration (52.0 µg/m<sup>3</sup> in the Coachella Valley) was 104 percent of the federal annual standard. It should be noted that the exclusion of the high wind event day reduces the annual average to 49.5 µg/m<sup>3</sup>, or 99 percent of the standard.

**TABLE 2-4**

1995 Maximum 24-hour Average PM<sub>10</sub> Concentrations by Basin and County

| Basin/County                                | Maximum 24-Hr Avg. $\mu\text{g}/\text{m}^3$ | Percent of Federal Standard | Area                       |
|---|---|-----------------------------|----------------------------|
| <b>South Coast Air Basin</b>                |   |                             |                            |
| Los Angeles                                 | 177   | 104                         | Pomona/Walnut Valley       |
| Orange                                      | 172   | 114                         | Central Orange Co.         |
| Riverside                                   | 219   | 145                         | Metropolitan Riverside Co. |
| San Bernardino                              | 178   | 118                         | Cent San Bernardino V.     |
| <b>Mojave Desert/Salton Sea Area Basins</b> |   |                             |                            |
| Los Angeles                                 | 61  | 40                          | Antelope Valley            |
| Riverside                                   | 199   | 132                         | Coachella Valley           |
| Riverside, corrected*                       | 133*  | 88*                         | Coachella Valley           |

\*Adjusted for one high-wind natural event day.

**TABLE 2-5**

1995 Maximum Annual Average PM<sub>10</sub> Concentrations by Basin and County

| Basin/County                                | Annual Average $\mu\text{g}/\text{m}^3$ | Percent of Federal Standard | Area                       |
|---|---|-----------------------------|----------------------------|
| <b>South Coast Air Basin</b>                |   |                             |                            |
| Los Angeles                                 | 49.1                                    | 98                          | East San Gabriel Valley    |
| Orange                                      | 43.5                                    | 86                          | Central Orange Co.         |
| Riverside                                   | 69.0                                    | 138                         | Metropolitan Riverside Co. |
| San Bernardino                              | 61.0                                    | 122                         | Cent. San Bernardino V.    |
| <b>Mojave Desert/Salton Sea Area Basins</b> |   |                             |                            |
| Los Angeles                                 | 25.6                                    | 52                          | Antelope Valley            |
| Riverside                                   | 52.0                                    | 104                         | Coachella Valley           |
| Riverside, corrected*                       | 49.5*                                   | 99*                         | Coachella Valley           |

\*Adjusted for one high-wind natural event day.

Figure 2-6 shows the percent of days exceeding the federal 24-hour average PM<sub>10</sub> standard in 1995. (PM<sub>10</sub> is normally sampled every sixth day, and for this reason is reported in terms of the percent of days sampled which exceeded the standard.) The federal standard was exceeded in parts of all four Basin counties, with the greatest percent of days exceeding recorded in the vicinity of the Metropolitan Riverside County area. No exceedances were

recorded in the coastal Los Angeles and Orange County areas, or in the inland areas of the Basin most removed from urban areas. However, still further inland (east of the area on the map) the SSAB's Coachella Valley area did record an exceedance of the standard, which was associated with high winds. The more stringent state 24-hour PM<sub>10</sub> standard was exceeded at all District monitoring locations in the Basin and MDAB/SSAB.

**FIGURE 2-6**

PM<sub>10</sub> - 1995

Percent of Days Exceeding the Federal Standard  
(24-hour average PM<sub>10</sub> > 150 µg/m<sup>3</sup>)

[Figure 2-7](#) shows the 1995 annual average PM<sub>10</sub> concentration. The federal standard was exceeded in the areas of Riverside and San Bernardino Counties in and around the Metropolitan Riverside County area. Most areas of the Basin did not exceed the federal annual PM<sub>10</sub> standard. However the more stringent state annual PM<sub>10</sub> standard was exceeded throughout most of the Basin and in part of the SSAB (Riverside County's Coachella Valley area).

**FIGURE 2-7**

PM<sub>10</sub> - 1995

Annual Average Concentration Compared to Federal Standard  
(Federal standard = 50 µg/m<sup>3</sup>, annual arithmetic mean)

**Nitrogen Dioxide (NO<sub>2</sub>) Specific Information**

**Health Effects**

Population-based studies suggest that an increase in acute respiratory illness, including infections and respiratory symptoms in children (not infants), is associated with long-term exposures to NO<sub>2</sub> at levels found in homes with gas stoves, which are higher than ambient levels found in Southern California. Increase in resistance to air flow and airway contraction without any effect on lung volumes (breathing capacity) is observed after short-term exposure to NO<sub>2</sub> in healthy subjects. Larger decreases in lung volumes are observed in individuals with asthma and/or chronic obstructive pulmonary disease (e.g., chronic bronchitis, emphysema) than in healthy individuals, following exposure to lower levels of NO<sub>2</sub>, indicating the greater susceptibility of these sub-groups.

In animals, exposure to levels of NO<sub>2</sub> considerably higher than ambient concentrations results in increased susceptibility to infections, possibly due to the observed changes in cells involved in maintaining immune functions. The severity of lung tissue damage

associated with high levels of ozone exposure increases when animals are exposed to a combination of ozone and NO<sub>2</sub>.

### **Air Quality**

In 1995, nitrogen dioxide concentrations were monitored at 24 locations. No area of the Basin, MDAB or SSAB exceeded the federal or state standards for nitrogen dioxide. Maximum annual average concentrations for 1995 are shown in [Table 2-6](#). The highest annual average concentrations recorded in the Basin (0.0464 ppm in the East San Gabriel Valley and Northwest San Bernardino Valley areas) were 87 percent of the federal standard, while the highest concentration recorded in the MDAB/SSAB was 42 percent of the standard. The Basin has not exceeded the federal standard for nitrogen dioxide since 1991, when the Los Angeles County portion of the Basin recorded the last exceedance of the standard in any U.S. county.

The state standard was not exceeded at any District monitoring location in 1995. The highest 1-hour average concentration recorded (0.24 ppm in Central Los Angeles) was 92 percent of the state standard.

**TABLE 2-6**

1995 Maximum Nitrogen Dioxide Concentrations by Basin and County

| Basin/County                                | Maximum Annual Avg. ppm | Percent of Federal Standard | Area                        |
|---|-------------------------|-----------------------------|-----------------------------|
| <b>South Coast Air Basin</b>                |                         |                             |                             |
| Los Angeles                                 | 0.0464                  | 87                          | East San Gabriel Valley     |
| Orange                                      | 0.0391                  | 73                          | North Orange Co.            |
| Riverside                                   | 0.0306                  | 57                          | Metropolitan Riverside Co.  |
| San Bernardino                              | 0.0464                  | 87                          | Northwest San Bernardino V. |
| <b>Mojave Desert/Salton Sea Area Basins</b> |                         |                             |                             |
| Los Angeles                                 | 0.0193                  | 36                          | Antelope Valley             |
| Riverside                                   | 0.0223                  | 42                          | Coachella Valley            |

## **Sulfur Dioxide (SO<sub>2</sub>) Specific Information**

### **Health Effects**

Even an exposure of a few minutes to low levels of SO<sub>2</sub> can result in airway constriction in some asthmatics. All asthmatics are sensitive to the effects of SO<sub>2</sub>. In asthmatics, increase in resistance to air flow, as well as reduction in breathing capacity leading to severe breathing difficulties, are observed after acute exposure to SO<sub>2</sub>. In contrast,



healthy individuals do not exhibit similar acute responses even after exposure to higher concentrations of SO<sub>2</sub>.

Animal studies suggest that despite SO<sub>2</sub> being a respiratory irritant, it does not cause substantial acute or chronic toxicity at ambient concentrations. However, very high levels of exposure can cause lung edema (fluid accumulation), lung tissue damage, and sloughing off of cells lining the respiratory tract.

Some population-based studies indicate that the mortality and morbidity effects associated with fine particles show a similar association with ambient SO<sub>2</sub> levels. In these studies, efforts to separate the effects of SO<sub>2</sub> from fine particles have not been successful. It is not clear whether the two pollutants act synergistically or whether one pollutant alone is the predominant factor.

### **Air Quality**

No exceedances of federal or state standards for sulfur dioxide occurred in 1995 at any of the nine District locations monitored. Though sulfur dioxide concentrations remain well below the standards, sulfur dioxide is a precursor to sulfate, which is a component of PM<sub>10</sub>. Standards for both sulfate and PM<sub>10</sub> were exceeded in 1995.

Maximum concentrations of sulfur dioxide for 1995 are shown in [Table 2-7](#). The maximum 24-hour average sulfur dioxide (0.018 ppm, recorded in South Coastal Los Angeles County) was 13 percent of the federal 24-hour standard. The maximum annual average concentration (0.0030 ppm in the South Central Los Angeles County area) was 10 percent of the federal annual standard.

Sulfur dioxide was not measured at MDAB/SSAB sites in 1995. Historical measurements showed concentrations to be well below standards and monitoring has been discontinued.

The more stringent state 1-hour standard was last exceeded in 1990, due to a breakdown at a Basin refinery (the first such exceedance since 1984). In 1995, the maximum 1-hour average sulfur dioxide concentration (0.14 ppm in the South Coastal Los Angeles County area) recorded was 54 percent of the state standard.

**TABLE 2-7**

1995 Maximum Sulfur Dioxide Concentrations by Basin and County

| Basin/County                         | Maximum<br>24-hr Avg.<br>ppm | Percent of<br>Federal<br>Standard | Area                       |
|--------------------------------------|------------------------------|-----------------------------------|----------------------------|
| South Coast Air Basin                |                              |                                   |                            |
| Los Angeles                          | 0.018                        | 13                                | South Coastal L.A. Co.     |
| Orange                               | 0.010                        | 7                                 | North Orange Co.           |
| Riverside                            | 0.006                        | 4                                 | Metropolitan Riverside Co. |
| San Bernardino                       | 0.010                        | 7                                 | Central San Bernardino V.  |
| Mojave Desert/Salton Sea Area Basins |                              |                                   |                            |
| Los Angeles                          | N.D.                         |                                   |                            |
| Riverside                            | N.D.                         |                                   |                            |

N.D. = No Data. Historical measurements indicate concentrations are below standard

## Sulfates (SO<sub>4</sub><sup>2-</sup>) Specific Information

### Health Effects

Most of the health effects associated with fine particles and sulfur dioxide at ambient levels are also attributable to sulfates. Thus, both mortality and morbidity effects are observable with an increase in ambient sulfate concentrations. However, efforts to separate the effects of sulfates from the effects of other pollutants, including ozone, have not been successful.

Clinical studies of asthmatics exposed to sulfuric acid suggest that adolescent asthmatics are probably a subgroup susceptible to acid aerosol exposure. Animal studies suggest that acidic particles such as sulfuric acid aerosol and ammonium bisulfate are probably more toxic than non-acidic particles like ammonium sulfate. Whether the effects are attributable to acidity or to particles remains unresolved. However, the severity of effects observed appears to be greater in population studies from the eastern United States and Canada, where sulfate concentrations are higher, than in the western United States.

### Air Quality

In 1995, the state sulfate standard was exceeded in one area of the Basin (the Metropolitan Riverside County area) on 2 percent of days sampled. The maximum concentration recorded (26.3 µg/m<sup>3</sup>) was 105 percent of the state standard. Maximum concentrations by air basin and county are shown in [Table 2-8](#). No exceedances were recorded in Los Angeles, Orange, or San Bernardino Counties in 1995.

No sulfate data were obtained at MDAB/SSAB stations in 1995. Historical sulfate data showed concentrations in the MDAB/SSAB areas to be well below the standard, and measurements have been discontinued.

**TABLE 2-8**  
1995 Maximum Sulfate Concentrations by Basin and County

| Basin/County                         | Maximum<br>24-hr Avg.<br>µg/m <sup>3</sup> | Percent of<br>Federal<br>Standard | Area                       |
|--------------------------------------|--|-----------------------------------|----------------------------|
| South Coast Air Basin                |  |                                   |                            |
| Los Angeles                          | 20.4                                       | 82                                | South Coastal L.A. Co.     |
| Orange                               | 12.8                                       | 51                                | Central Orange Co.         |
| Riverside                            | 26.3                                       | 105                               | Metropolitan Riverside Co. |
| San Bernardino                       | 13.4                                       | 54                                | Central San Bernardino V.  |
| Mojave Desert/Salton Sea Area Basins |  |                                   |                            |
| Los Angeles                          | N.D.                                       |                                   |                            |
| Riverside                            | N.D.                                       |                                   |                            |

N.D. = No Data. Historical measurements indicate concentrations are below standard

## Lead (Pb) Specific Information

### Health Effects

Fetuses, infants, and children are more sensitive than others to the adverse effects of lead exposure. Exposure to low levels of lead can adversely affect the development and function of the central nervous system, leading to learning disorders, distractibility, inability to follow simple commands, and lower intelligence quotient. In adults, increased lead levels are associated with increased blood pressure.

Lead poisoning can cause anemia, lethargy, seizures and death. It appears that there are no direct effects of lead on the respiratory system. Lead can be stored in the bone from early-age environmental exposure, and elevated blood lead levels can occur due to breakdown of bone tissue during pregnancy, hyperthyroidism (increased secretion of hormones from the thyroid gland) and osteoporosis (breakdown of bony tissue). Fetuses and breast-fed babies can be exposed to higher levels of lead because of previous environmental lead exposure of their mothers.

### Air Quality

The federal and state standards for lead were not exceeded in any area of the District in 1995. There have been no violations of the standards at the District's regular air

monitoring stations since 1982 as a result of removal of lead from gasolines. However, special monitoring stations immediately adjacent to stationary sources of lead have recorded exceedances of the standards in very localized areas of the Basin as recently as 1991 for the federal standard and 1994 for the state standard. [Table 2-9](#) shows the maximum concentrations recorded in 1995.

The maximum quarterly average lead concentration ( $0.06 \mu\text{g}/\text{m}^3$  at several Los Angeles County sites) recorded at District air monitoring stations was 4 percent of the federal standard. The highest quarterly average lead concentration ( $0.60 \mu\text{g}/\text{m}^3$  in Southeast Los Angeles County) measured at special monitoring locations immediately adjacent to stationary sources of lead was 40 percent of the federal standard.

The maximum monthly average lead concentration at the regular monitoring stations ( $.07 \mu\text{g}/\text{m}^3$  at several Los Angeles County locations) was 5 percent of the state standard, and the maximum at the special monitoring sites immediately adjacent to sources ( $0.62 \mu\text{g}/\text{m}^3$  in Southeast Los Angeles County) was 41 percent of the standard.

**TABLE 2-9**

1995 Maximum Lead Concentrations\* by Basin and County

| Basin/County                                | Maximum Quarterly Average. $\mu\text{g}/\text{m}^3$ | Percent of Federal Standard | Area                       |
|---|---|-----------------------------|----------------------------|
| <b>South Coast Air Basin</b>                |   |                             |                            |
| Los Angeles                                 | 0.06  | 4                           | Multiple Sites             |
| Orange                                      | 0.04  | 3                           | Central Orange Co.         |
| Riverside                                   | 0.04  | 3                           | Metropolitan Riverside Co. |
| San Bernardino                              | 0.04  | 3                           | Central San Bernardino V.  |
| <b>Mojave Desert/Salton Sea Area Basins</b> |   |                             |                            |
| Los Angeles                                 | N.D.  |                             |                            |
| Riverside                                   | N.D.  |                             |                            |

N.D. = No Data. Historical measurements indicate concentrations are below standard

## Visibility Specific Information

Air pollution induced visibility degradation in the Basin is due primarily to particulate matter. On some days, the presence of water droplets may contribute significantly to

\* Higher concentrations of lead were recorded at special monitoring stations in the immediate vicinity of stationary sources of lead. The maximum concentration (quarterly average lead concentration  $0.60 \mu\text{g}/\text{m}^3$  in the Southeast Los Angeles County area) at the special monitoring sites was 40 percent of the federal standard.

visibility reduction. Days for which this is true are removed by excluding days on which the relative humidity was greater than 70 percent from consideration when determining compliance with the standard

In 1995, visual range data were collected at two locations in the Basin. Both sites exceeded the state standard by a significant margin. The standard was exceeded on a maximum of 35 percent of days in the only area (East San Gabriel Valley area of Los Angeles County) for which complete data were available.

## **Summary**

In 1995, the Basin continued to exceed federal and state standards for ozone, PM<sub>10</sub>, and carbon monoxide, and the state standards for sulfate and visibility. The MDAB/SSAB areas continued to exceed standards for ozone and PM<sub>10</sub>. However for PM<sub>10</sub>, the removal of one high wind natural event in the Coachella Valley results in MDAB/SSAB meeting the federal PM<sub>10</sub> standards, but not the state PM<sub>10</sub> standards.

The Basin exceeded one or more federal standards on nearly one third of the days of the year. Maximum concentrations of PM<sub>10</sub> and carbon monoxide were nearly one and one-half times the federal standards, and the maximum ozone concentration was twice the federal standard.