6.0 TRENDS IN OZONE AND OZONE-PRECURSOR AMBIENT CONCENTRATIONS

6.1 Basinwide Ambient Trends in NO_2, NO_x, and NO_2/NO_x

Following the acquisition of ambient data for the 1996 smog season, we examined Basinwide ozone-precursor trends over the eleven-year period 1986-96. Figure 6-1 shows a generally decreasing trend in 0600-0900 PDT Basinwide ambient NO_x concentration from 1986 to 1996, with a particularly dramatic decrease in 1996. Similarly, average 0600-0900 PDT Basinwide ambient NO_2 concentrations also decreased over the 11-yr study period (Figure 6-2). Figure 6-3 shows a consistent day-of-the-week effect for morning NO_x concentration as well as a general decrease in NO_x concentration between 1986 and 1996.

We also examined 2100-0000 PDT NO_x and NO_2 concentrations by day-of-the-week over the 11-yr study period. A downward trend in NO_x concentration is evident, as is a fairly consistent day-of-the-week difference in ambient NO_x levels (Figure 6-4). Figure 6-5 shows a similar decreases in NO_2 concentrations over the eleven-year period, with an approximate 25% reduction for the 1996 smog season over the average for the 1992-95 smog seasons. This reduction may be responsible, in part, for the corresponding decrease in the number of first stage ($[O_3]$ = 20 pphm) episodes in the Basin from 13 in 1995 to 7 in 1996. In addition, the early evening (1800-2100 PDT) NO_2/NO_x ratio decreased significantly in 1996 (Figure 6-6).

6.2 Hydrocarbon Trends: 1986-95

To determine NMHC trends over the ten-year period 1986-95, we used the method of Fujita et al. (1992) to convert ambient total hydrocarbon data (THC) from the West Los Angeles, LA North-Main, Azusa, Lynwood, Long Beach, and Riverside monitoring stations to NMHC in parts-per-billion carbon (Figure 6-7). These results show a general decrease in 0600-0900 PDT NMHC over the ten-year period for all days

of the week. Unfortunately, we could not include the 1996 smog season since THC monitoring was discontinued after the 1995 smog season.

6.3 Ozone Trends: 1986-96

6.3.1 Examination of Incidence and Distribution of Various Ozone Concentrations

Table 6-1 shows the number of days (D) and hours (H) of ozone concentration at or above 9, 12, 15, and 20 parts-per-hundred million (pphm) during smog season daytime hours, where "daytime" is defined as the period extending from 1100 to 2100 PDT. (Note that M represents the number of missing hourly observations during the daytime for each smog season; M generally has a value of 50 or less, but is sometimes much larger due to significant gaps in the ozone data set (which in some cases extend through the length of an entire smog season.)

The smallest number of exceedences occurred at sites in the coastal portion of the Basin, including Hawthorne, Lynwood, and Long Beach. Interestingly, West Los Angeles reported a considerably larger number of hours of ozone concentration at or above 9 pphm than these other three coastal sites.

The general trend during the 1986-96 period was toward an increasingly lower number of hours and days of exceedance, at all concentration levels. Although this trend was usually not in the form of a steady decrease (by the metrics used in this analysis), it is clear that substantial reduction in ambient ozone concentration in the Basin has occurred during the past decade. In particular, there has been substantial reduction in number of hours of *peak* ozone levels (i.e., hours with ozone concentrations at or above 20 pphm). The magnitudes of the percent decrease in number of ozone exceedances are generally much smaller (both hourly and daily) at the lower level of 9 pphm.

It is interesting to examine the H9 trend at Crestline, where slight decreases (from about 1300 hours of exceedance per year for 1986-89 to about 1200 hours of exceedance per year for 1990-94) are followed by a sudden discontinuous drop to a much lower value

(751) in 1995. This suggests an important change in 1995 may have occurred in the chemical composition of the air transported to Crestline from the Basin.

For comparison, Figure 6-8 shows the 20-year trend in stage 1 episodes in the SoCAB. When using this metric a steady decrease in unhealthful ozone levels can be easily observed over this period.

6.3.2 Frequency of Occurrence of Ozone Exceedances

The percent change (from year-to-year) in number of smog season hours equal or exceeding the ozone NAAQS was computed for three groups of four sites each within the SoCAB for the period 1986-96 (Figures 6-9, 6-10, and 6-11). Only sites located in the central or eastern part of the Basin were used in this analysis, since year-to-year variation in the small number of ozone NAAQS exceedances which occur in less polluted areas (e.g., Coastal subregion) is likely to be strongly influenced by anomalous meteorological conditions, whereas the variation at the more polluted sites farther inland is likely to be dominated by the effects of non-meteorological factors such as reductions in emissions. Pasadena data are not available for this analysis during the 1992-94 period due to low data completeness.

At each of the 12 sites, the percent change was generally, from one year to the next, less than 50% (the large 1993-94 value at Central Los Angeles reflects the small total number of exceedances during those years, and thus does not actually represent a large increase in the number of exceedances). For the San Gabriel Valley sites in Figure 6-10, the largest year-to-year percent change occurred between the 1995 and 1996 smog seasons. Less dramatic decreases were found at both the sites located farther inland (Figure 6-11), and those closer to the coast (Figure 6-9). The introduction of RFG with lower mass emissions of VOC and lower VOC reactivity throughout the Basin may be largely responsible for the significant reduction in ozone in the San Gabriel Valley (Figure 6-10).

6.4 Recent Air Quality Changes

6.4.1 1994-96 Smog Season Ambient Air Quality

Figures 6-12 and 6-13 show the average changes in ambient NO_x and NO_2 ambient concentrations over the 1994-96 smog seasons during the morning commute period (0600-0900 PDT). There was a substantial decrease in both NO_x and NO_2 in 1996 vs. 1994-95 for all days of the week, with weekend days having lower average ambient NO_x and NO_2 concentrations than weekdays. Also, Figure 6-13 shows that Saturday morning NO_2 concentrations were comparable to Monday morning NO_2 concentrations for the 1994-96 period. Figure 6-14 shows the variation by day-of-the-week in NO_2/NO_x ratios during the morning (0600-0900 PDT) hours for the 1994-96 period. These weekend/weekday differences in NO_2/NO_x ratio were not seen for either 1800-2100 PDT or 2100-0000 PDT, the two evening time intervals evaluated (Figure 6-15).

6.4.2 1995-96 Smog Season Meteorological Conditions vs. Climatology

The monthly-mean daily-maximum and daily-minimum temperatures were determined for the 1995-1996 smog season months of May through October for four sites (Figures 6-16 to 6-19): Los Angeles International Airport (LAX), Los Angeles Civic Center (LACC), San Gabriel Fire Department (SGFD), and San Bernardino County Hospital (SBCH). Also shown for these sites is the corresponding 1961-90 climatological average values. At LAX (Figure 6-16), the 1995 smog season was slightly cooler than the 1961-90 mean, while 1996 was slightly warmer than the long-term average (especially during May and August). At LACC, SGFD, and SBCH, the 1995 smog season was either near or above normal, except during the months of May and June which were cooler than normal; the 1996 smog season at these sites was clearly warmer than normal.

With the exception of May and June of 1995, the 1995-96 smog seasons appear to have recorded near or above normal surface temperatures in the central and eastern

portions of the SoCAB. These conditions would seem to favor normal to above normal photochemical smog production rates [warmer SoCAB surface temperatures are associated with higher ozone concentrations (Blier and Winer 1996)]. This conclusion also follows from analysis of gridded 850 mb temperatures at a grid point near the SoCAB (see Figure 6-20) which showed near or above normal temperatures for the 1995-96 smog seasons (except during May-June 1995 and September-October 1996, which were cooler than the 1985-96 mean climatological values). Since a substantial *decrease* in the number of ozone exceedances was reported in the San Gabriel Valley (SGV) from 1995 to 1996 (see Table 6-1), and since this decrease was not likely due to meteorological variability, there appears to be evidence of a significant reduction in SGV ozone during the 1995-96 smog seasons resulting from non-meteorological factors.