SECTION 3 - AIR QUALITY SETTING

3.1 Health Impacts of PM-10

Both the EPA and the State of California have established ambient air quality standards for PM-10. The California 24-hour and annual average standards, which are considerably more stringent than the federal standards, have been set with the intention of:

> "Prevention of excess deaths from short-term exposures and of exacerbation of symptoms in sensitive patients with respiratory disease. Prevention of excess seasonal declines in pulmonary function, especially in children." (CAC, Title 17, Section 70200)[8]

In developing these standards, many sources of health effects data were considered, including: epidemiology studies, clinical studies of controlled human exposures, animal toxicology, short-term bioassays, and biochemical studies. The development of the final standards focused primarily on epidemiological studies.

In developing the short-term (24-hour) health-based PM-10 Standard, EPA considered health effects reported in the literature, including mortality and various morbidity indicators such as reduced lung function. Examples are:

- As early as 1952, particulate pollution was blamed for contributing to an estimated 4,000 deaths in London when a thick fog laden with coal dust enveloped the city. Illnesses included pneumonia, heart disease, and chronic obstructive lung disease. Deaths among children under age five increased.

- In the Utah Valley, the death rate rose 16% after particulate pollution levels from a nearby steel mill exceeded 100 $\mu g/m^3$. Further, when the steel mill was open, twice as many children were in the hospital for bronchitis and asthma as when the mill was closed. On high pollution days, school absences rose 40%.[9]

- In Saskatchewan, Canada, Old Wives Lake evaporated in the 1980's leaving 180 km2 of dry lake bed. Exposure to airborne alkali dust has caused: increased nasal, throat, and eye irritation, respiratory problems in residents, and weight loss and nasal and eye irritation in livestock.[10]

- The diversion of water from the Aral Sea on the border of Kazakistan and Uzbekistan has resulted in a 40% reduction in the lake surface. It is calculated that 43 million tons of salty grit are whipped up from the dry sea-bed each year. In 1959, there were 74 cases of throat cancer treated compared to 366 in 1989--a five-fold increase and twice the rate of population growth in the region.[11]

- According to the EPA, as many as 60,000 people die in the United States each year from breathing particulates at or below legally allowed levels.

Mortality effects were considered in the development of a short-term standard, although they were not used to derive a specific threshold for effects. Morbidity studies, which were most important in the development of the 24-hour standard for PM-10, were conducted by Dockery et al.[12] and Dassen et al.[13] These studies show a decrease in lung function following episodes of particulate pollution. The changes are small, but significant, and persist for two-to- three weeks. In the Dockery study, there is a higher response in some children indicating that there may be sensitive subgroups in the population.

Several studies have noted a correlation between mortality rates and long-term exposure to particulate pollution levels.[14] These studies raise concerns for possible premature mortality due to particulate pollution and were taken into consideration in the evaluation of the margin of safety for the Standard.

The data that were most influential in the development of the annual average PM-10 Standard were published by Ware et al.[15], involving about 10,000 children, ages six-to-nine, in six U.S. cities. The study reports an association between particulate pollutant levels and occurrences of coughing, bronchitis, and respiratory illness.

The federal PM-10 Standard is based on total particle mass without consideration of the chemical components. However, studies indicate that heavy exposure to desert dust may be harmful to human health. A syndrome referred to as "desert lung syndrome" [nonoccupational pneumoconiosis] has been described in the literature. Cases have been reported from the Sahara, Arabian, and Negev deserts. The syndrome is characterized by deposits of sandy dust in the lungs. Desert dust also contains crystalline silica. Exposure to this compound has been associated with adverse health effects in occupational settings (i.e., fibrosis, silicosis).[16]

In the Mono Basin, monitoring data from Simis Ranch show a statistical average of about 3.3 exceedances per year of the federal PM-10 Standard for the period 1988 to 1992. The Standard allows for one exceedance or less per year without regard to how much the level is above 150 $\mu g/m^3$. While the air quality of the Mono Basin is generally good, dust events have occurred at a frequency and concentration to be in violation of the health-based PM-10 Standard.

In a physical setting similar to Mono Lake, Owens Lake lies 120 miles to the south. There are a number of reports that windblown lake shore dust from Owens Lake has aggravated medical problems in individuals who suffer from respiratory diseases. Saint-Amand quotes personal communications with three physicians in the Owens Valley and states that "patients . . . who suffer from emphysema, asthma, and chronic bronchitis are subject to increased morbidity. Hospitalization of these patients with bronchial spasm and related pulmonary problems increases during dust episodes. The populace complains of coughing, sneezing, and irritation of the eyes. Psychological problems emerge as some people become apprehensive because of difficulty in breathing."[17]

Beyond impacts to human populations, the Mono Basin Planning Area contains significant plant and animal resources that are adversely affected by elevated levels of fugitive dust. Two Class 1 Wilderness Areas in the Inyo and Toiyabe National Forests are within the Planning Area and are less than 10 miles from the emissive lake shore: the Ansel Adams Wilderness and Hoover Wilderness. These are pristine natural areas designated "to preserve the unique wild and scenic areas of America's public lands." Visibility and excellent air quality are high priorities in a wilderness experience. Also within the Planning Area are the Mono Basin National Forest Scenic Area and Bodie State Historic Park. The U.S. Forest Service has expressed concern that exposure to dust events poses a potential health risk to visitors to the Mono Basin, and prepared a video documenting such events as seen from the Mono Lake Visitor Center in the spring of 1993. Another invaluable natural resource, Yosemite National Park, is immediately adjacent to the western boundary of the Planning Area.

3.2 Planning Area Prediversion Environment

No ambient air quality monitoring was conducted in Mono Basin prior to 1979, however prediversion air quality conditions can be obtained from historical accounts. A reprint of a 1889 report by Israel C. Russell gives a detailed description of topographic features and visual conditions, as well as extensive geologic interpretations in the Mono Basin.[18] Russell noted that on windy days Mono Lake was streaked with alkaline froth, but his report makes no mention of windblown dust, sand, or salt.

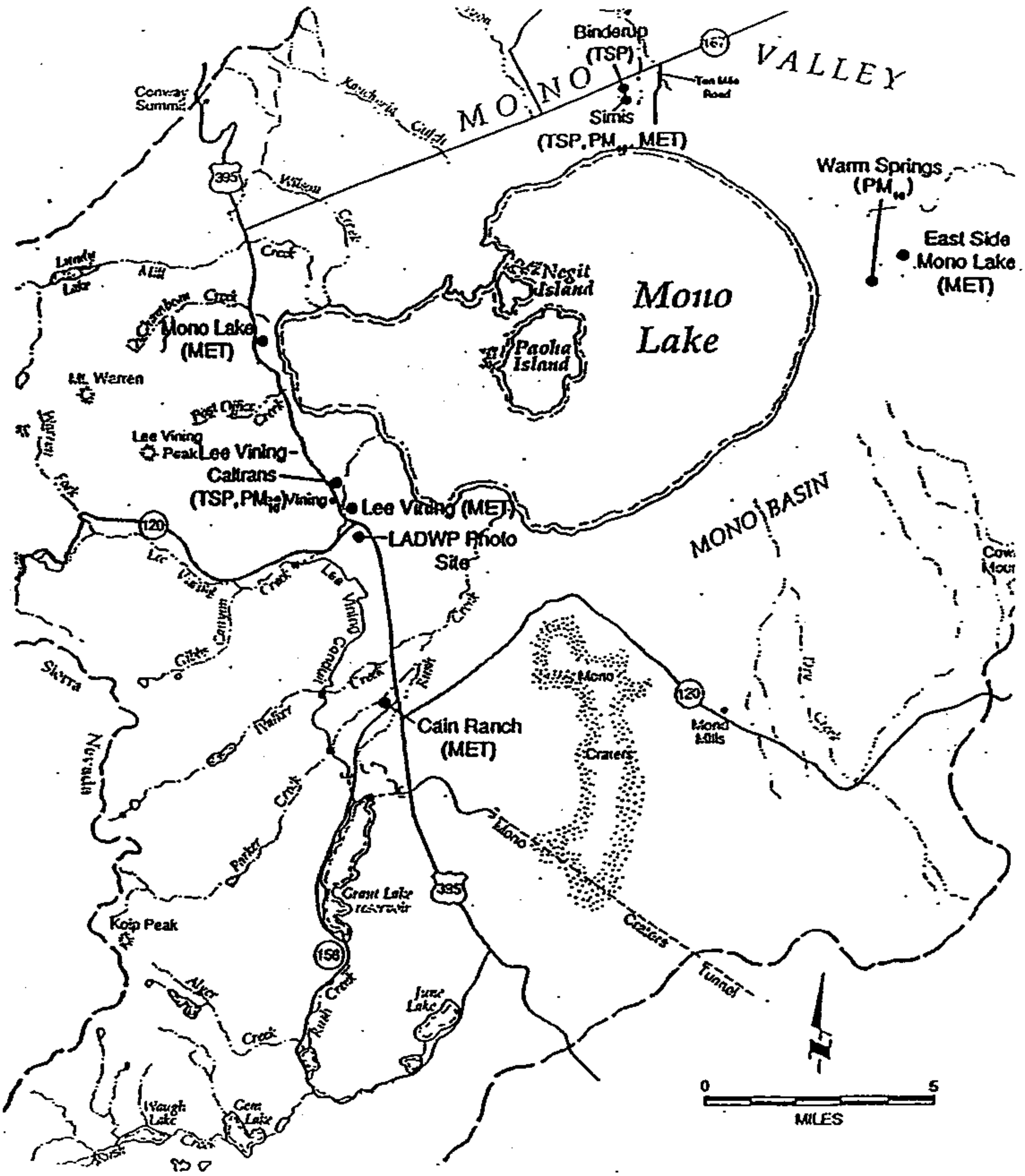
Historical aerial photographs of Mono Lake from 1930 (lake elevation approximately 6,420') and 1940 (lake elevation approximately 6,417') provide additional evidence that efflorescent salt deposits were limited under prediversion conditions. The photographs show very narrow fringes of efflorescent salts along the edges of lagoons near the lake shore, scattered small patches of salt among some sand dunes, and no efflorescent salt visible on the narrow strip of barren sand bordering the north or east shores of the lake. The EIR states that the best available evidence suggests that major dust storm events were probably rare under prediversion conditions and that any dust storms that did occur would have been dominated by silt, clay, and sand particles with only small quantities of salt particles from interstitial salts and water spray from off the lake.[19]

3.3 Monitoring Sites and Data Collection

The District has established air quality and meteorological monitoring sites in the Mono Basin at Simis Ranch-Binderup, Lee Vining, Warm Springs, and Cedar Hill (Figure 3-1). Simis Ranch is located on the northern shore of Mono Lake, approximately one mile north of the shore line. The Lee Vining site is in the town of Lee Vining, on the west side of Mono Lake. The Warm Springs site is on the east side of Mono Lake, one mile east of the lake shore. The monitoring site at Cedar Hill is located about five miles northeast of the lake.

Prior to June 1989, both the Simis Ranch and Lee Vining monitoring sites operated on a one-in-six day schedule for PM-10 data collection. For the period June through September 1989, the Simis Ranch site operated on a five-in-six day schedule. From October 1989 to present, the Simis Ranch site has obtained data on a three-consecutive days in-six schedule. Meteorological data was also collected at the Simis Ranch site on a daily basis. The Warm Springs and Cedar Hill sites were added to the PM-10 monitoring network in 1989 and operated during periods of expected exceedances.

Detailed sampling data from all monitoring sites is contained in Appendix 4. The six-day samples are noted with an asterisk (*). Background PM-10 levels are obtained from Lee Vining, due to its location upwind of the dust source area and the other monitoring sites. Total Suspended Particulate (TSP) data from the Simis site for the period 1979 through 1982 is also provided.



Notes: Parameters monitored at each site are shown in parentheses; see text for definitions.
MET refers to temperature, precipitation, or wind speed data.

Figure 3-1 Monitoring Sites

3.4 PM-10 Violations/Exceedances

Air quality in the area can generally be characterized as good, attributable to the small population, the remoteness of the area from major urban centers, and the relative lack of industrial development. Violations of the 150 μg/m^3 24-hour PM-10 Standard have been measured for the period January 1988 through May 1993, as observed at Simis Ranch and Warm Springs. These exceedances are summarized in Table 3-1. It should be noted that the Warm Springs monitoring site did not operate during 1989 for reasons unrelated to air quality and was discontinued in December 1992. Consequently, there is no data from Warm Springs for the 1993 dust episodes that were recorded at Simis Ranch. Due to equipment problems, Simis Ranch did not operate during the first part of 1993 through May 2, 1993, and from February 26, 1994 through August 17, 1994. No violations were recorded at the Lee Vining site, probably due to its location upwind of the lake shore dust source area.

Table 3-1

EXCEEDANCES OF THE 24-HOUR PM-10 NATIONAL AMBIENT AIR QUALITY STANDARD (NAAQS)

	WARM SPRINGS	SIMIS RANCH
Date	PM-10 Concentration (μg/m^3)	
5/16/88	404	
4/21/89		272
5/23/90	157	
5/8/91	389	
5/16/91	218	
4/12/92		493
6/12/92	362	
12/2/92	265	225
5/3/93	Discontinued	402
5/11/93	Discontinued	981
5/12/93	Discontinued	658

3.5 Expected Number of Exceedances

Sampling at the Simis Ranch site occurred once every sixth day and during predicted episode periods. Because PM-10 sampling did not occur every day, it is uncertain how many times or by how much the 24-hour PM-10 Standard has been exceeded at the Simis Ranch site. To account for the days that were not sampled, the expected number of exceedances can be determined by examining Figure 3-2. This figure shows a frequency distribution of the PM-10 concentration at the Simis Ranch monitoring site. The graph has been developed from the six-day data only and for the years 1988 through 1992. This sampling schedule provides the statistical random sampling convention necessary for the development of this frequency distribution.

As can be determined from Figure 3-2, exceedances can be expected 0.9% of the time. This is equivalent to an average of 3.3 episode days per year that would be expected to exceed the 150 $\mu g/m^3$ 24-hour PM-10 Standard (NAAQS) threshold at the Simis Ranch site. This is shown in Figure 3-3 by converting the frequency of occurrence to the number of days per year. The graph yields the number of expected days per year that various concentrations can be predicted to occur.

During the period from 1988 to 1992, the lake level ranged from 6,373.4 feet elevation to 6,379.6 feet elevation with an annual average elevation of 6,376 feet. As the lake level rises, the expected number of exceedances should decrease.

Figure 3-2

1988 - 1992 SIMIS RANCH PM-10 CONCENTRATION FREQUENCY DISTRIBUTION (6-Day Sampling, 305 Dates, 262 Runs)

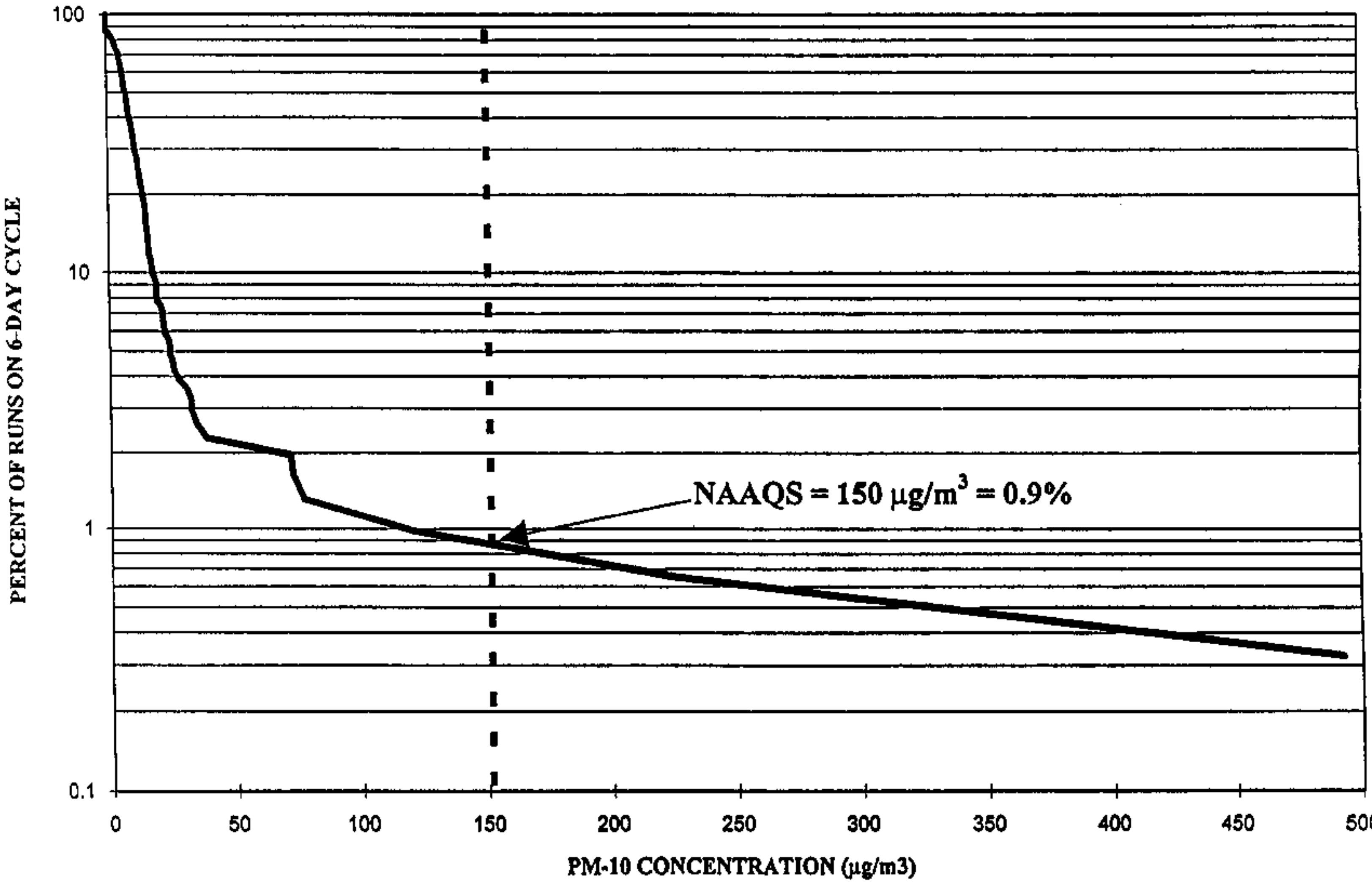
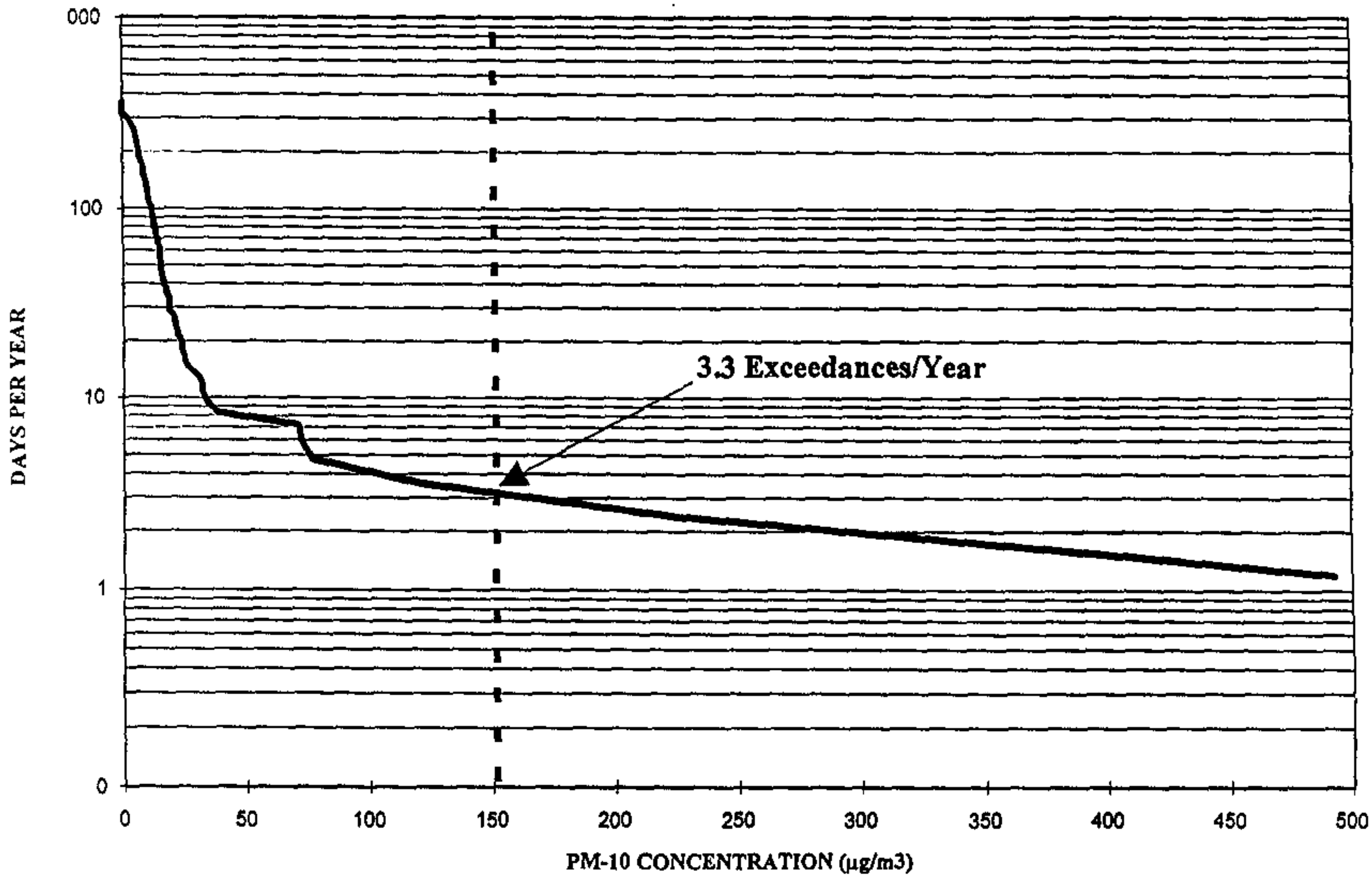


Figure 3-3

1988 - 1992 SIMIS RANCH PM-10 CONCENTRATION
DAYS PER YEAR (6-Day Sampling, 305 Dates, 262 Runs)



3.6 Annual Average PM-10 Concentrations

Mono Basin has not violated the 50 μg/m³ concentration annual average PM-10 Standard. The annual average is calculated by averaging the quarterly average PM-10 for each year and then averaging the averages for the last three years (1990-1992). This is shown in Table 3-2, which indicates that the annual average for the Mono Basin is 12.34 μg/m³.

Table 3-2

SIMIS RANCH
ANNUAL AVERAGE PM-10 CONCENTRATIONS
(μg/m³)

YEAR	QUARTER				AVERAGE
	1st	2nd	3rd	4th	
1988	6.50	10.52	16.14	7.33	10.12
1989	4.77*	11.26	13.43*	6.47	8.98*
1990	4.00	13.71	12.13	10.07	9.98
1991	8.95	18.72	10.37	5.77	10.95
1992	4.87	14.75	13.60*	31.10	16.08*
1993	NO DATA*	NO DATA*	15.83	11.14	INVALID
1994	6.09*	NO DATA*	5.21*	4.71	INVALID
ANNUAL AVERAGE FOR NAAQS = 12.34 μg/m³ (1988-1992)					

* Invalid--fewer than 75% of data available for a quarter

The trends show seasonal fluctuations with a general increase in the maximum quarterly values as seen in Figure 3-4. The figure indicates that the emission episodes at Mono Lake occur more frequently during late spring and early winter. This same observation is described in detail in the *Final Mono Lake Air Quality Modeling Study* (Appendix 5).

Figure 3-4

EMISSION EPISODES
QUARTERLY AVERAGE PM-10 CONCENTRATION