CHAPTER 3

Air Quality Setting

FIGURES

Following Page

TABLES

Page or Following Page

CHAPTER 3

Air Quality Setting

3.1 WEATHER AND CLIMATE

The Owens Valley Planning Area (OVPA) is located in the southern end of the Owens Valley in Inyo County, California. Owens Lake is bounded by the Inyo Mountains to the east, and the Sierra Nevada to the west, which rise over 10,000 feet above the lake bed surface. Because it is in the rain shadow of the Sierra Nevada, annual rainfall is very low in the project area. Owens Lake averages approximately 4 inches of rainfall per year with the majority of that falling from November through April. Temperatures range from around 18ºF to 70ºF during winter, and 45ºF to 112ºF during summer. Hourly average wind speeds in the area can exceed 40 mph as measured at a 33-foot height. These winds are generally associated with the passage of low-pressure systems during winter and spring months. The leading edges of these low-pressure systems are usually cold fronts that initially produce winds from the south as the colder air mass approaches, under-running and displacing the warmer air in its path. As the leading edge of the front passes, the wind direction shifts, often resulting in converging winds from the south along the east side of the valley and from the north along the west side. Cold winds from the north typically follow the passage of the low-pressure system as high pressure begins to build back over the area.

3.2 AIR QUALITY AND AREA DESIGNATIONS

Air quality is regulated through federal, state and local requirements and standards in the project area. Under the Federal Clean Air Act, the U.S. Environmental Protection Agency (USEPA) has set ambient air quality standards to protect public health and welfare. National ambient air quality standards (NAAQS) have been set for the following criteria pollutants; particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), ozone, carbon monoxide, oxides of nitrogen, sulfur dioxide, and lead. In addition, California has set air quality standards for these pollutants, which are usually more stringent, and has added to this list standards for vinyl chloride, hydrogen sulfide, sulfates and visibility-reducing particles. Table 3.1 shows the current California and national ambient air quality standards.

The OVPA has been designated by the state and the USEPA as non-attainment for the state and federal 24-hour average PM_{10} standards. The boundaries of the federal PM_{10} nonattainment area are shown in Figure 3.1. The area is designated as “attainment” or “unclassified” for all other federal ambient air quality standards. Monitoring and research conducted for more than 20 years, as well as three previous State Implementation Plans (SIPs), has determined that wind-blown dust from the dry bed of Owens Lake is the dominant cause of NAAQS violations for PM_{10} in the non-attainment area.

The USEPA designated the Owens Valley as a “serious” non-attainment area due to the frequent violations of the NAAQS for PM_{10} and the inability of the area to attain the standard by December 31, 1995. For serious PM_{10} non-attainment areas, the federal Clean Air Act Amendments of 1990 (CAAA) required the submittal of a SIP by February 8, 1997 that would bring the area into attainment with the NAAQS by December 31, 2001, if practicable. In November 1998, the District adopted the 1998 SIP, which was approved by the USEPA on August 19, 1999 (Federal Register, 1999). That 1998 SIP required the City of Los Angeles (City), the entity responsible for diverting the Lake's water and exposing the emissive lake bed, to use Best Available Control Measures (BACM), which consisted of Shallow Flooding, Managed Vegetation, and Gravel Blanket, to reduce PM_{10} emissions on 16.5 square miles of the Owens Lake bed by 2003. The 1998 SIP also provided a five-year extension of the deadline for attainment, and committed to a SIP Revision in 2003 that would determine the final control strategy to attain the NAAQS by December 31, 2006 (GBUAPCD, 1998a).

On November 13, 2003, the District approved the 2003 Revised State Implementation Plan for the Owens Valley Planning Area (2003 SIP), which was approved by the CARB in February 2004. The 2003 SIP is currently implemented under Board Order #031113-01. The 2003 SIP control strategy required the City to continue to use BACM to control emissions on a total of 29.8 square miles of the lake bed. The 2003 SIP also required the District to continue to monitor PM_{10} emissions and to require the City to implement additional controls beyond the 29.8 square miles, if necessary. (GBUAPCD, 2003)

In December 2005, a dispute arose between the District and the City regarding requirements to control dust from additional areas at Owens Lake beyond the 29.8 square miles identified in the 2003 SIP (Schade, 2005 and Schade, 2006). On December 4, 2006 a Settlement Agreement was approved by both parties to resolve this dispute (GBUAPCD, 2006b). Under the provisions of this agreement, the City agreed to implement dust control measures on an additional 13.2 square miles of the lake bed by April 1, 2010 and the District agreed to revise the 2003 SIP before March 1, 2008 to incorporate the provisions of the Settlement Agreement.

On March 23, 2007, the USEPA published a finding that the Owens Valley Planning Area did not attain the 24-hour NAAQS for PM_{10} by December 31, 2006 as mandated by the CAAA (USEPA, 2007a). As a result of this finding, the Owens Valley SIP must be revised to include a control strategy that will provide for attainment in the Owens Valley Planning Area as soon as practicable, by achieving at least a 5 percent reduction in PM_{10} emissions per year. The 2008 SIP must demonstrate that the NAAQS can be attained by March 23, 2012, unless the USEPA grants an extension which could extend the deadline up to March 23, 2017 (CAAA §179(d)(3)). The USEPA may consider the severity of nonattainment and the feasibility of applying available control measures in deciding if an extension should be granted. In accordance with CAAA §189(d), the revised SIP must be submitted to the USEPA by December 31, 2007.

At the time the 2003 SIP was approved by the District and the CARB in November 2003, the USEPA policy direction on PM_{10} attainment demonstrations was that the control measures that were needed to demonstrate attainment must be implemented by December 31, 2006. After the 2003 SIP was adopted, the USEPA policy direction changed to require three continuous years of air quality data without violations prior to December 31, 2006 to demonstrate attainment. This change in policy direction effectively made the 2003 SIP attainment demonstration deficient, since all the control measures should have been implemented before the end of 2003 to meet the attainment deadline. Because it takes two to three years to implement the Shallow Flooding and Managed Vegetation control measures, the construction of the 2003 SIP dust control measures were not completed until the end of 2006. Numerous NAAQS violations occurred during the

Table 3.1 - California and National Ambient Air Quality Standards

Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1]		Federal Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Ozone (O_3)	1 Hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 $\mu g/m^3$)		0.08 ppm (157 $\mu g/m^3$)		
Respirable Particulate Matter (PM10)	24 Hour	50 $\mu g/m^3$	Gravimetric or Beta Attenuation	150 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 $\mu g/m^3$		—		
Fine Particulate Matter (PM2.5)	24 Hour	No Separate State Standard		35 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 $\mu g/m^3$	Gravimetric or Beta Attenuation	15 $\mu g/m^3$		
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	9 ppm (10 mg/m^3)	None	Non-Dispersive Infrared Photometry (NDIR)
	1 Hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	—
Nitrogen Dioxide (NO_2) *	Annual Arithmetic Mean	0.030 ppm (56 μg/m3)	Gas Phase Chemiluminescence	0.053 ppm (100 $\mu g/m^3$)	Same as Primary Standard	Gas Phase Chemiluminescence
	1 Hour	0.18 ppm (338 $\mu g/m^3$)		—		
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	—	Ultraviolet Fluorescence	0.030 ppm (80 $\mu g/m^3$)	—	Spectrophotometry (Pararosaniline Method)
	24 Hour	0.04 ppm (105 $\mu g/m^3$)		0.14 ppm (365 $\mu g/m^3$)	—	
	3 Hour	—		—	0.5 ppm (1300 $\mu g/m^3$)	
	1 Hour	0.25 ppm (655 $\mu g/m^3$)		—	—	—
Lead [8]	30 Day Average	1.5 $\mu g/m^3$	Atomic Absorption	—	—	—
	Calendar Quarter	—		1.5 $\mu g/m^3$	Same as Primary Standard	High Volume Sampler and Atomic Absorption
Visibility Reducing Particles	8 Hour	Extinction coefficient of 0.23 per kilometer — visibility of ten miles or more (0.07 — 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent. Method: Beta Attenuation and Transmittance through Filter Tape.		No Federal Standards		
Sulfates	24 Hour	25 $\mu g/m^3$	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)	Ultraviolet Fluorescence			
Vinyl Chloride [8]	24 Hour	0.01 ppm (26 $\mu g/m^3$)	Gas Chromatography			

* The Nitrogen Dioxide ambient air quality standard was amended on February 22, 2007, to lower the 1-hr standard to 0.18 ppm and establish a new annual standard of 0.030 ppm. These changes become effective after regulatory changes are submitted and approved by the Office of Administrative Law, expected later this year.

See footnotes on next page …

Table 3.1 Continued

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, suspended particulate matter—PM10, PM2.5, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

2. National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM10, the 24 hour standard is attained when the expected number of days per calender year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For PM2.5, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact U.S. EPA for further clarification and current federal policies.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent procedure which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

7. Reference method as described by the EPA. An “equivalent method” of measurement may be used but must have a “consistent relationship to the reference method” and must be approved by the EPA.

8. The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

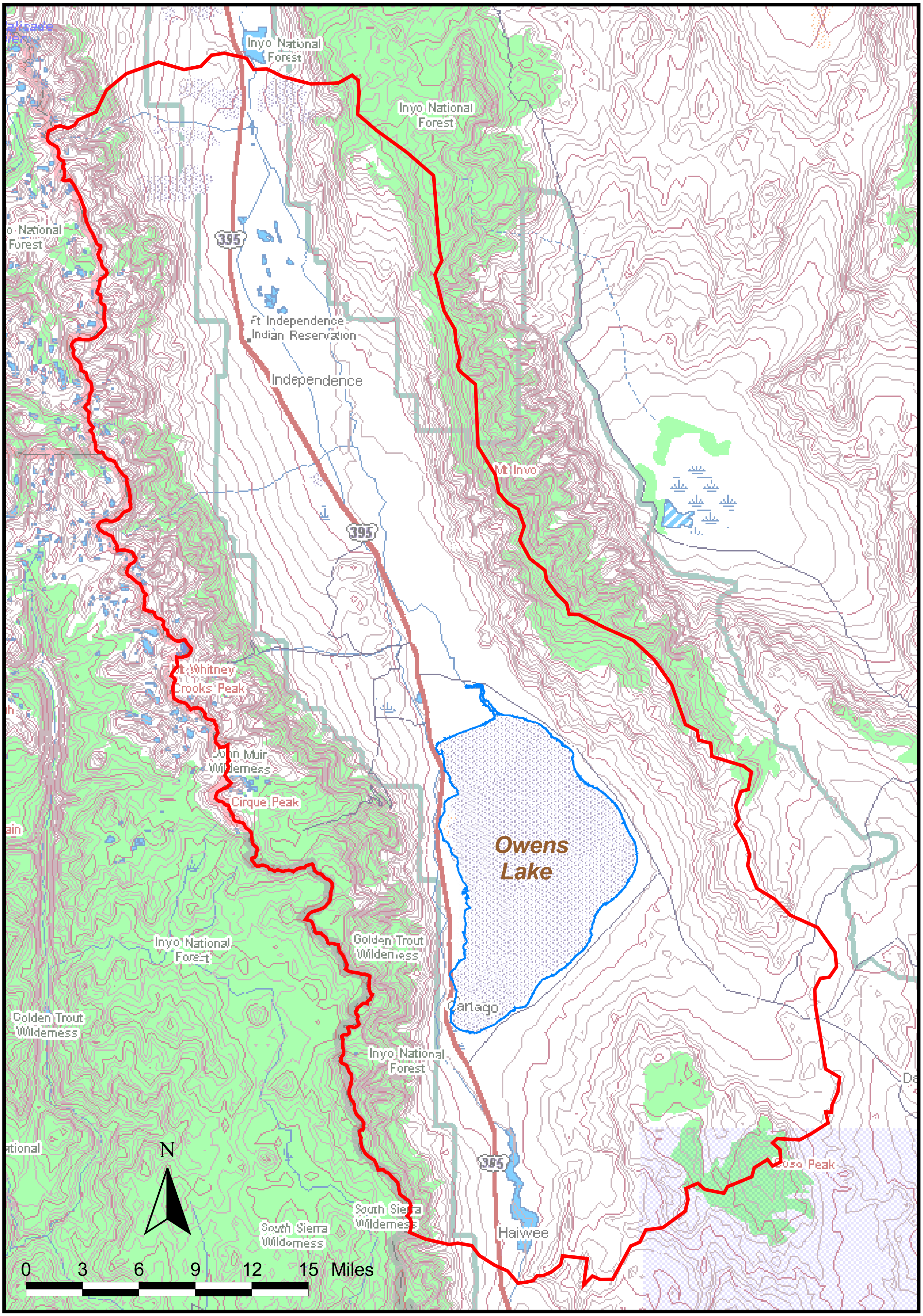

Figure 3.1 - Boundaries of the federal PM-10 nonattainment area

BLANK PAGE

3-year attainment demonstration period. As a result, the USEPA made the finding that the Owens Valley failed to attain the standard as required under CAAA §189(d).

The USEPA did not take action on the approval or disapproval of the 2003 SIP, but it has been approved by both the District and the state and is currently enforced by the District. By December 31, 2006, the City had implemented dust control measures on all 29.8 square miles of the lake bed as required in the 2003 SIP.

This 2008 SIP revises the 2003 SIP and includes an updated analysis of the particulate matter air pollution problem in the Owens Valley and a revised control strategy to bring the area into attainment with the federal air quality standard for particulate matter as soon as practicable. This 2008 SIP also incorporates provisions of the Settlement Agreement between the District and the City to expand dust control measures to additional areas at Owens Lake in order to attain the NAAQS as soon as practicable (GBUAPCD, 2006b).

3.3 PM_{10} AIR QUALITY

3.3.1 Health Impacts of PM_{10}

Particulate pollution is generally associated with dust, smoke and haze and can be measured as PM_{10}, which indicates particulate matter less than 10 microns in average aerodynamic diameter. These particles are extremely small, one-seventh the diameter of a human hair or 400 times smaller than the period at the end of this sentence. Because of their small size, the particles can easily penetrate into the lungs. Breathing PM_{10} can cause a variety of health problems. It can increase the number and severity of asthma and bronchitis attacks. It can cause breathing difficulties in people with heart or lung disease, and it can increase the risk for, or complicate, existing respiratory infections. Children, the elderly and people with existing heart and lung problems are especially sensitive to elevated levels of PM_{10}. Even healthy people can be adversely affected by dust at extremely high concentrations. The USEPA has set an episode level of 600 $\mu g/m^3$ (averaged over 24 hours) as the level that can pose a significant risk of harm to the health of the general public (40 CFR 51.151).

3.3.2 Owens Lake Health Advisory Program

The NAAQS for PM_{10} is frequently violated in the Owens Valley Planning Area because of wind-blown dust from Owens Lake. Wind speeds greater than about 17 mph have the potential to cause significant wind erosion from the barren lake bed. Ambient PM_{10} readings are the highest measured in the country (USEPA, 2007a). Prior to implementing dust control measures on the lake bed, twenty-four-hour average PM_{10} concentrations measured at the Dirty Socks monitor site at times exceeded 12,000 $\mu g/m^3$—more than 80 times higher than the 24-hour NAAQS of 150 $\mu g/m^3$.

In 1995, the District instituted a program to advise the public when unhealthful levels of particulate pollution occur in the Owens Valley area. Under this program, the District issues Air Pollution Health Advisories when dust storms from Owens Lake cause PM_{10} concentrations that exceed selected trigger levels. Health Advisory notices are faxed to schools and doctor’s offices in the area and to local news media.

- Stage 1 Air Pollution Health Advisories are issued when hourly PM_{10} levels exceed 400 $\mu g/m^3$. The Stage 1 Health Advisory recommends children, the elderly, and people with heart or lung problems refrain from strenuous outdoor activities in dust-impacted areas.
- Stage 2 Air Pollution Health Advisories are issued when hourly PM_{10} levels exceed 800 $\mu g/m^3$, and recommends that everyone refrain from strenuous outdoor activities in dust-impacted areas.

From fall of 1995 through spring of 2007, over 150 advisories were issued as part of the Owens Lake Air Pollution Health Advisory program. This program is not intended to replace the need to control the dust problem at Owens Lake, but is intended to help reduce adverse health effects until dust control measures are in place. The health advisory program will remain in effect until dust control measures are fully implemented at Owens Lake and PM_{10} levels no longer violate the NAAQS.

3.3.3 Monitoring Sites and Data Collection

3.3.3.1 PM_{10} Monitoring Network

Ambient PM_{10} measurements to determine compliance with the federal PM_{10} standard have been taken at Keeler, Olancha and Lone Pine for over 20 years (Figure 3.2). Meteorological data are also collected at each of these permanent monitoring sites to provide wind speed, wind direction, and temperature information. An upper air profiler was operated from March to May 2000 and January to September 2001 at Dirty Socks and from October 2001 to June 2003 at the Mill Site to measure upper level wind speeds and temperature profiles. Precipitation data are collected at the Keeler site and humidity and barometric pressure are recorded at the Olancha site. Four additional PM_{10} sites were set up on the shoreline of Owens Lake as part of the Owens Lake Dust Identification Program. These are Dirty Socks (Summer 1999), Shell Cut and Flat Rock (both set up in January 2001) and the Bill Stanley site (March 2002). Other sites that were or still are monitored for PM_{10} from Owens Lake include the Navy 1 site at the Coso Known Geothermal Resource Area and the Coso Junction site. These sites are about 10 miles south of the Owens Valley planning area. The Coso Junction PM_{10} monitor is currently providing hourly PM_{10} measurements and the Navy 1 monitor was discontinued in 1998.

The Lone Pine Paiute-Shoshone Tribe installed a PM_{10} monitor on the Lone Pine reservation in 2002 and a $PM_{2.5}$ monitor in 2006. Both monitors are Tapered Element Oscillating Microbalance (TEOM) monitors that provide hourly concentration data. They are operated in accordance with federal monitoring guidelines (40 CFR, Part 58). The monitor site is located southeast of the District’s Lone Pine monitor site. Data from the Lone Pine Tribe’s PM_{10} TEOM have closely paralleled the values recorded by the District’s Lone Pine TEOM, although specific dust plumes may cause high values at one of these TEOMs and yet miss the other.

Currently, all the PM_{10} monitor sites in the planning area are equipped with TEOM continuous PM_{10} samplers (*EPA Manual Reference Method:* EQPM-1090-079) that provide hourly and daily PM_{10} concentrations. TEOMs are USEPA equivalent method particulate monitors. Some of the monitoring sites began collecting PM_{10} data with High-Volume (Hi-Vol) samplers (Wedding [RFPS-1087-062] or Graseby [RFPS-1287-063]). Changes in primary sampler type, from Hi-Vols to TEOMs, are indicated in Table 3.2. All Owens Lake monitoring sites, except the Bill Stanley site were also equipped with Partisol PM_{10} samplers (RFPS-1298-126 and RFPS-1298-127), which are filter-based USEPA-approved reference method samplers that were operated to

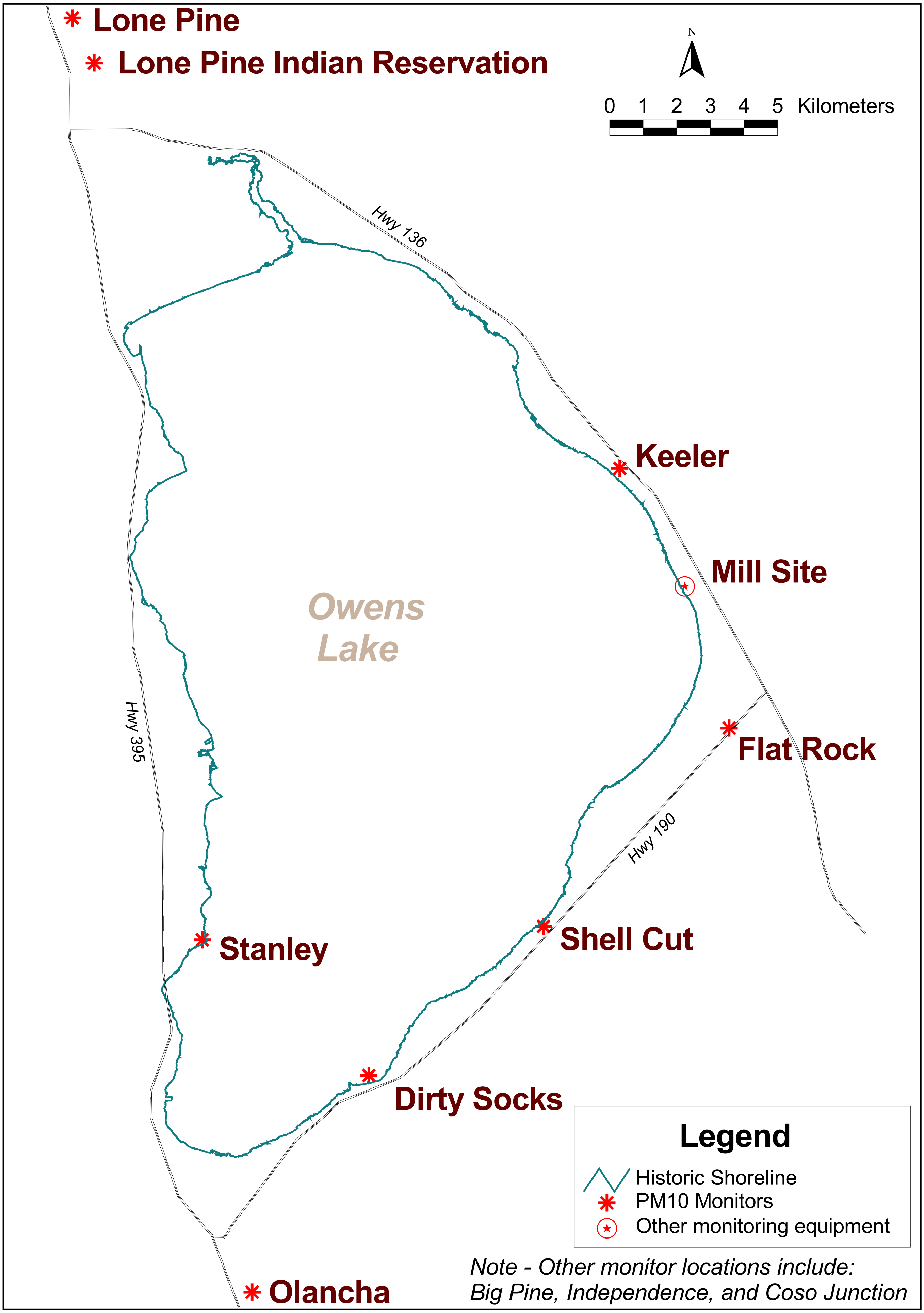

Figure 3.2 - Location of PM-10 monitor sites near Owens Lake

provide 24-hour average PM_{10} concentrations. The Partisol samplers confirm the 24-hour averages of the TEOM samplers (Parker, 2003). Table 3.2 summarizes the particulate matter monitoring history at each site in the Planning Area.

The District performed a detailed study of different types of PM_{10} monitors and found significant differences in the concentrations measured by collocated monitors of different types. The District's analysis showed that TEOM and Partisol samplers provide the most consistent measurements at Owens Lake, and that they are the most suitable monitors for measuring PM_{10} caused by wind-blown dust (Ono, *et al*., 2000).

3.3.3.2 Dust Transport Study

Historically, the permanent PM_{10} monitoring stations were operated on a one-in-six day schedule to sample PM_{10}, and did not sample on the other five off-schedule days. This was changed for a period from March 1993 to June 1995 to collect data to assess the PM_{10} impacts downwind from Owens Lake toward the City of Ridgecrest. A special-purpose monitoring network was set up adding the southern communities of Pearsonville, Inyokern and Ridgecrest. During the special-purpose monitoring period, samplers at both Owens Lake and the southern sites were operated on days when Owens Lake dust events were forecast to have impacts toward the south. The results of this study showed that Owens Lake dust plumes caused exceedances of the PM_{10} NAAQS as far as Ridgecrest, 60 miles south of the lake. The 1998 SIP (GBUAPCD, 1998a) includes the monitoring data from this episode-monitoring program.

About 40,000 permanent residents from Ridgecrest to Bishop are affected by the dust from Owens Lake. In addition, many visitors spend time in this dust-impacted area, to enjoy the many recreational opportunities the Eastern Sierra and high desert have to offer. Lone Pine annually hosts the Lone Pine film festival, which draws thousands of visitors from outside the area. The National Park Service is concerned about the health hazard posed to the 86,000 people that annually visit the Manzanar National Historic Site, 15 miles north of Owens Lake. The Park Service is concerned because a high percentage of the visitors to Manzanar are older visitors who are more prone to airborne respiratory threats, and that they will spend 3 to 4 hours outdoors in a potentially harmful environment (Hopkins, 1997).

3.3.3.3 $PM_{2.5}$ Monitoring at Keeler

Monitoring of fine particulate matter ($PM_{2.5}$) on a 1-in-3-day schedule was initiated in 1999 at Keeler. Eight years of $PM_{2.5}$ data show a rough correspondence between $PM_{2.5}$ levels and PM_{10} levels at the Keeler site. A high value of 193 $\mu g/m^3$, recorded on December 28, 2006, indicates that a serious fine particulate pollution problem may exist at this site. However, the current $PM_{2.5}$ NAAQS is 35 $\mu g/m^3$ for the 98^{th} percentile value at a monitor in a calendar year. This allows seven exceedances of the 35 $\mu g/m^3$ standard per year without violating the standard. Therefore, there was not a violation of the $PM_{2.5}$ NAAQS at Keeler for 2006 because the 98^{th} percentile (eighth highest) value was below 35 $\mu g/m^3$, despite this one high value. To date, no violations of the $PM_{2.5}$ NAAQS have been documented in Keeler.

In the near future, the District is planning to upgrade to daily $PM_{2.5}$ monitoring at Keeler in an effort to better characterize fine particulate levels there.

3.3.4 PM_{10} Data Summary

3.3.4.1 Number of 24-hour Exceedances

From 1993 through 2006, almost daily PM_{10} sampling recorded 208 PM_{10} exceedances at Keeler. This averages about 15 exceedances of the PM_{10} NAAQS per year. The Dirty Socks monitor recorded 205 PM_{10} exceedance days over a seven year period from January 2000 to December 2006. Dirty Socks averaged over 29 exceedances per year and had the highest concentrations of the seven sites monitored. Figure 3.3 shows the number of exceedances from 1994 through 2006 at each site. All six monitor sites were in violation of the 24-hour average PM_{10} NAAQS, which allows no more than one exceedance per year over a three year period.

3.3.4.2 Annual Average PM_{10} Concentrations

Figure 3.4 shows the annual PM_{10} concentration trend for six Owens Lake sites from 1994 through 2002. Although the USEPA eliminated an annual PM_{10} NAAQS in 2006, it is instructive to track annual PM_{10} averages in order to observe trends (Prior to its elimination, the annual PM_{10} NAAQS was 50 $\mu g/m^3$). Since the installation of a PM_{10} monitor at Dirty Socks in 1999, this monitor site has consistently registered the highest concentrations measured at Owens Lake. The three-year annual average for Dirty Socks was estimated at 157 $\mu g/m^3$ for the years 2000-2002. Only once (2005) in seven years of operation has the annual average PM_{10} concentration in Dirty Socks monitoring site dropped below 50 $\mu g/m^3$. The Shell Cut monitoring site has produced an annual average above 50 $\mu g/m^3$ for the years 2002 through 2006, as well.

3.3.4.3 Peak PM_{10} Concentrations

The 24-hour average PM_{10} measurements from Owens Lake sites are consistently listed as the highest concentrations in the United States on the USEPA's AIRData website (USEPA, 2007c). PM_{10} concentrations exceeding 20,000 $\mu g/m^3$ have been measured at the Dirty Socks monitor site using a partisol PM_{10} monitor. This is more than 133 times higher than the 24-hour NAAQS of 150 $\mu g/m^3$. Partisols are Federal Reference Method monitors that collect samples on a filter that are weighed in the lab and are operated once every third day. However, note that most of the PM_{10} data shown in Table 3.2 are based on automated TEOM PM_{10} measurements which provide hourly and daily concentrations and are another federally approved PM_{10} monitor. Table 3.3 compares Owens Lake values with the rest of the United States.

In the data available on the USEPA's AIRData website, Owens Lake has produced the highest PM_{10} reading in the nation in all but one of the past eleven years. As shown graphically in Figure 3.5, Owens Lake concentrations have consistently dwarfed values reported from the rest of the nation since 2000. Table 3.3 also contains PM_{10} values measured at Mono Lake, which is in the District to the north of the Owens Valley PM_{10} Planning Area. Mono Lake has also consistently exceeded all PM_{10} readings in the rest of the nation since 2000. Mono Lake PM_{10} exceedances are also caused by the City of Los Angeles' Eastern Sierra water diversions (GBUAPCD, 1995).

The highest PM_{10} concentration for any of the PM_{10} monitor sites at Owens Lake on each date for a six-year period is shown in Figure 3.6. PM_{10} concentrations are shown on a logarithmic scale due to the extreme concentration range. The seasonal nature of the dust events can also be seen in this figure. Most dust events occur during winter and spring. There are few violations recorded during summer and fall months.

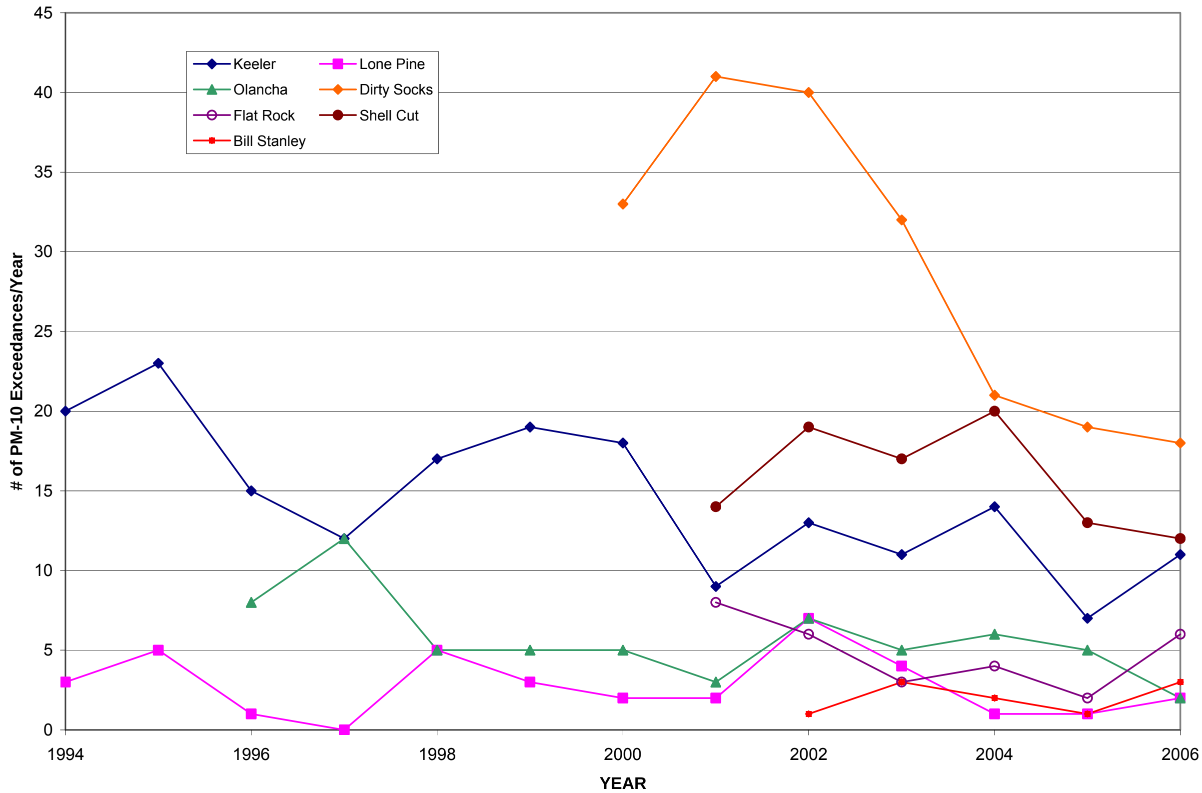

Figure 3.3 - All seven Owens Lake monitoring sites have violated the NAAQS (150 µg/m^3) by averaging more than one exceedance per year of the 24-hour standard.

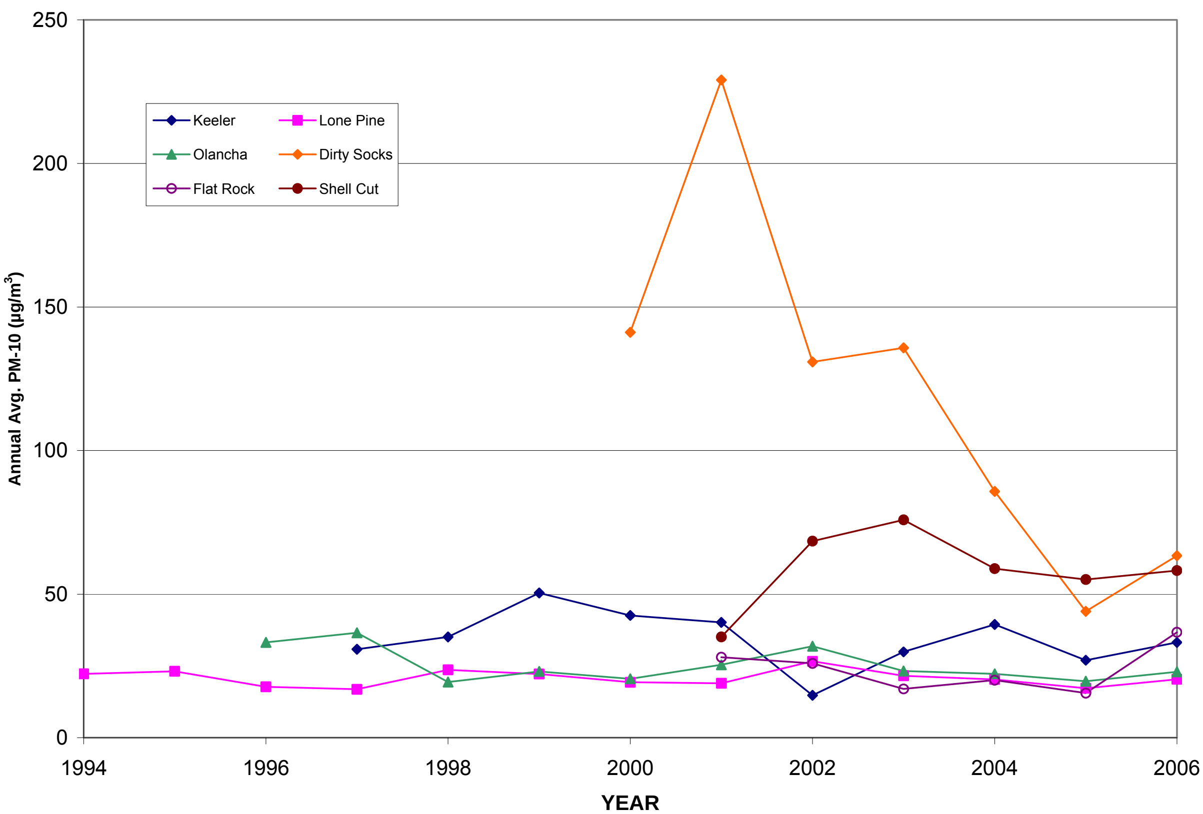

Figure 3.4 - The 3-year annual average PM_{10} concentrattions measured at Dirty Socks and Shell Cut both violated the PM_{10} annual NAAQS of 50 µg/m^3.

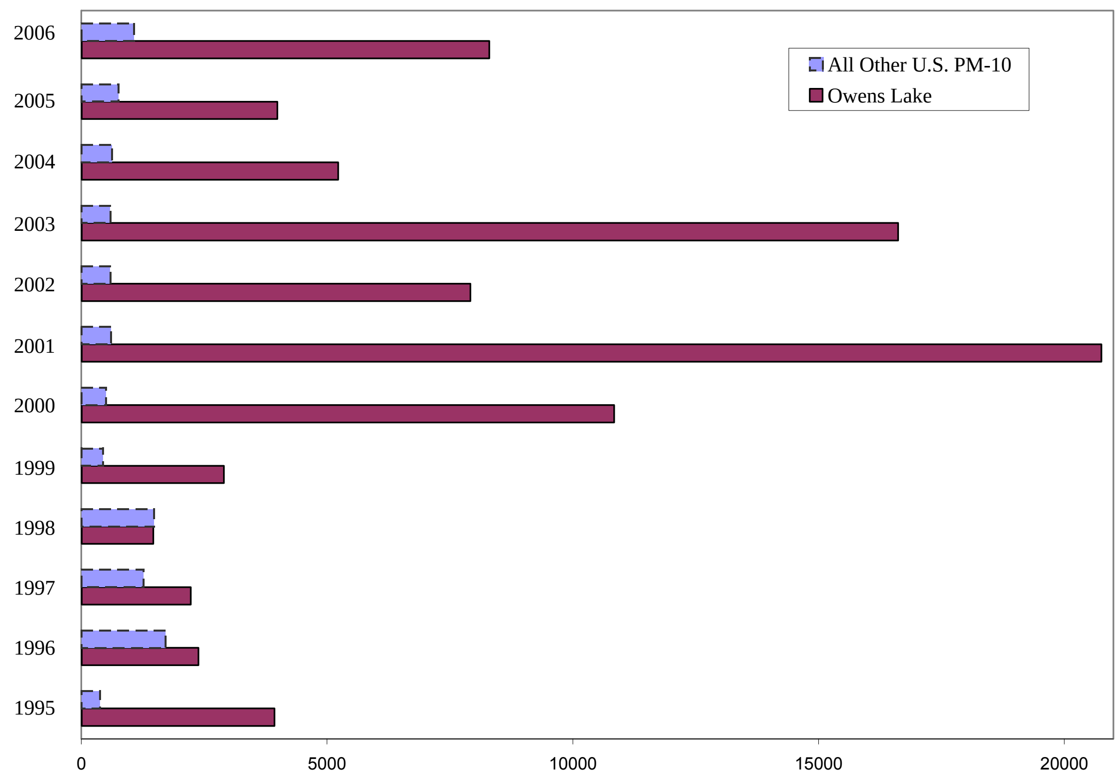

Figure 3.5 - Yearly comparison of highest Owens Lake PM_{10} concentrations with highest concentrations at all U.S. PM_{10} monitoring sites outside the GBUAPCD

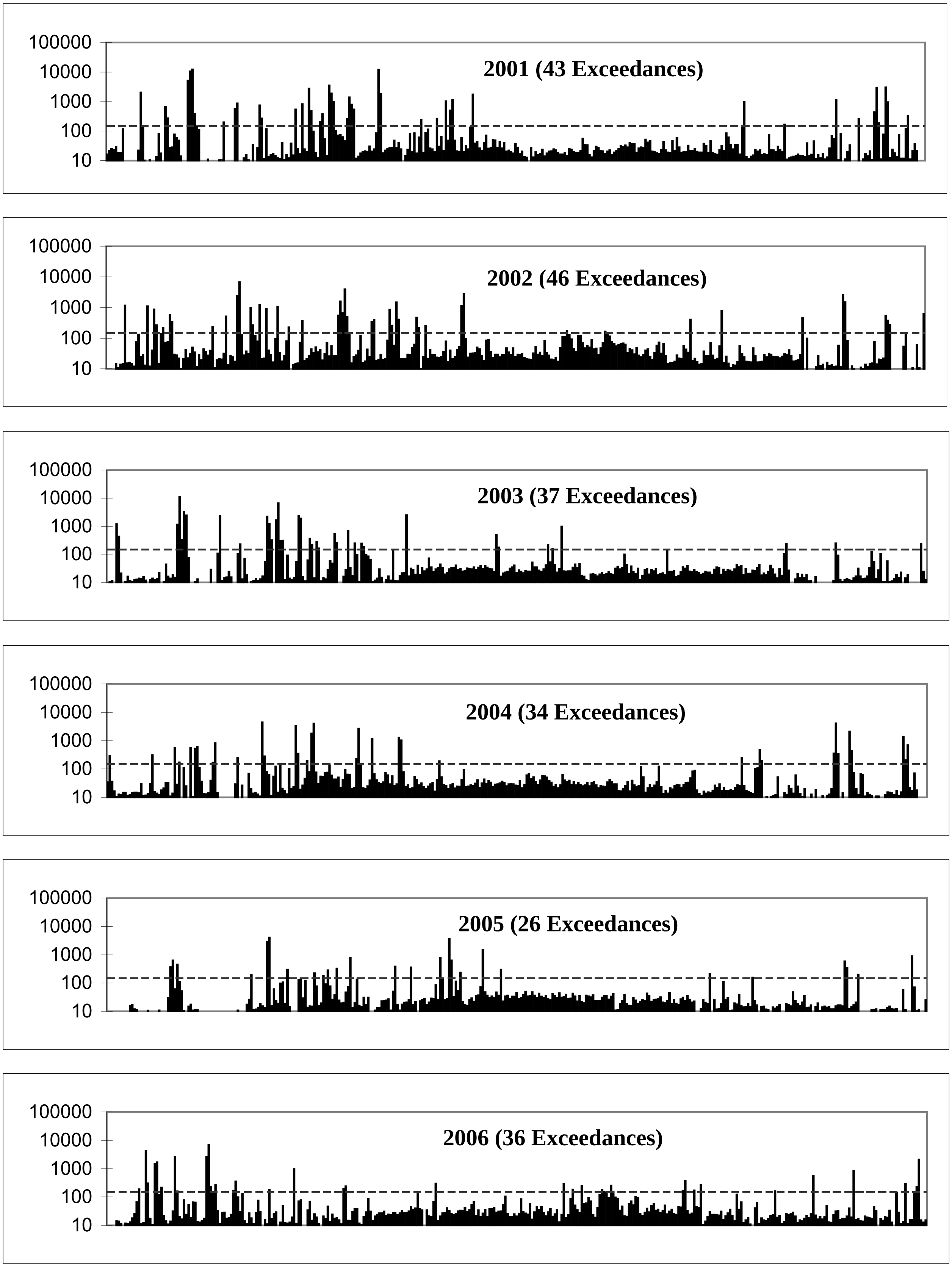

Figure 3.6 - Daily 24-hour maximum PM-10 values at Owens Lake monitoring sites, 2001 - 2006

Table 3.2 Summary of the particulate matter monitoring history for each site

Site	Year	Peak 24-Hour Value	Number of Exceeds	Adjusted # of Exceeds	Annual Average	3-Year Average	Number Sample Days	Primary Monitor
KEELER	1987	672	4	24	46.70		60	Hi Vol
KEELER	1988	394	2	12	31.75		58	Hi Vol
KEELER	1989	1861	4		**Invalid**		55	Hi Vol
KEELER	1990	858	2		**Invalid**		20	Hi Vol
KEELER	1991	181	1		**Invalid**		47	Hi Vol
KEELER	1992	526	3	18	37.34		59	Hi Vol
KEELER	1993	781	1	6	43.16		58	Hi Vol
KEELER	1994	1381	20		**Invalid**		297	TEOM
KEELER	1995	3929	23		**Invalid**		311	TEOM
KEELER	1996	862	15	15	**Invalid**		309	TEOM
KEELER	1997	835	12	12	30.81		341	TEOM
KEELER	1998	1464	17	17	35.08		353	TEOM
KEELER	1999	2569	19	19	50.41	38.76	364	TEOM
KEELER	2000	1101	18	18	42.56	42.68	365	TEOM
KEELER	2001	1400	9	9	40.16	44.38	353	TEOM
KEELER	2002	1077	13	13	14.75	39.86	365	TEOM
KEELER	2003	1209	11	11	29.87	35.63	364	TEOM
KEELER	2004	3322	14	14	39.46	35.40	363	TEOM
KEELER	2005	1441	7	7	26.99	32.11	364	TEOM
KEELER	2006	2101	11	11	33.18	33.21	365	TEOM
LONE PINE	1987	178	1	6	23.27		58	Hi Vol
LONE PINE	1988	172	1	6	21.60		60	Hi Vol
LONE PINE	1989	126	0	0	22.73	22.53	61	Hi Vol
LONE PINE	1990	68	0	0	17.15	20.49	61	Hi Vol
LONE PINE	1991	82	0	0	17.90	19.26	59	Hi Vol
LONE PINE	1992	63	0	0	17.15	17.40	57	Hi Vol
LONE PINE	1993	170	1	5	17.02	17.36	117	Hi Vol
LONE PINE	1994	499	3	3	22.23	18.80	352	TEOM
LONE PINE	1995	392	5	5	23.12	20.79	363	TEOM
LONE PINE	1996	166	1	1	17.71	21.02	336	TEOM
LONE PINE	1997	123	0	0	16.86	19.23	360	TEOM
LONE PINE	1998	472	5	5	23.62	19.40	346	TEOM
LONE PINE	1999	325	3	3	22.18	20.89	350	TEOM
LONE PINE	2000	180	2	2	19.30	21.70	360	TEOM
LONE PINE	2001	260	2		18.94	20.14	332	TEOM
LONE PINE	2002	315	7	7	26.59	21.61	365	TEOM
LONE PINE	2003	724	4	4	21.57	22.37	365	TEOM
LONE PINE	2004	349	1	1	20.27	22.81	355	TEOM
LONE PINE	2005	262	1	1	17.20	19.68	364	TEOM
LONE PINE	2006	293	2	2	20.33	19.26	361	TEOM

Table 3.2 Continued

Site	Year	Peak 24-Hour Value	Number of Exceeds	Adjusted # of Exceeds	Annual Average	3-Year Average	Number Sample Days	Primary Monitor
OLANCHA	1987	31	0		**Invalid**		31	Hi Vol
OLANCHA	1988	55	0	0	19.00		57	Hi Vol
OLANCHA	1989	109	0		**Invalid**		52	Hi Vol
OLANCHA	1990	200	2	12	23.19		61	Hi Vol
OLANCHA	1991	181	1	6	18.04		59	Hi Vol
OLANCHA	1992	366	2	6	19.66	20.30	60	Hi Vol
OLANCHA	1993	346	3		**Invalid**		36	Hi Vol
OLANCHA	1994	362	2		**Invalid**		94	Hi Vol
OLANCHA	1995	2252	4		**Invalid**		207	TEOM
OLANCHA	1996	2383	8	8	33.22		354	TEOM
OLANCHA	1997	2229	12	12	36.52		350	TEOM
OLANCHA	1998	327	5	5	19.38	29.71	358	TEOM
OLANCHA	1999	353	5	5	23.07	26.32	356	TEOM
OLANCHA	2000	417	5	5	20.54	21.00	365	TEOM
OLANCHA	2001	1545	3	3	25.37	22.99	352	TEOM
OLANCHA	2002	905	7	7	31.86	25.92	365	TEOM
OLANCHA	2003	1062	5	5	23.23	26.82	359	TEOM
OLANCHA	2004	408	6	6	22.24	25.78	365	TEOM
OLANCHA	2005	288	5	5	19.64	21.71	363	TEOM
OLANCHA	2006	428	2	2	22.94	21.61	364	TEOM
DIRTY SOCKS	1999	2182	10		**Invalid**		185	TEOM
DIRTY SOCKS	2000	10549	33	33	141.21		365	TEOM
DIRTY SOCKS	2001	12153	41	41	229.11		339	TEOM
DIRTY SOCKS	2002	6702	40	40	130.90	167.07	365	TEOM
DIRTY SOCKS	2003	10933	32	32	135.77	165.26	365	TEOM
DIRTY SOCKS	2004	4472	21	21	85.77	117.48	365	TEOM
DIRTY SOCKS	2005	3087	19	19	43.99	88.51	365	TEOM
DIRTY SOCKS	2006	4169	18	18	63.39	64.38	364	TEOM
FLAT ROCK	2001	1779	8	8	28.00		354	TEOM
FLAT ROCK	2002	759	6	6	25.89		359	TEOM
FLAT ROCK	2003	395	3	3	16.98	23.62	363	TEOM
FLAT ROCK	2004	626	4	4	20.04	20.97	348	TEOM
FLAT ROCK	2005	346	2	2	15.52	17.51	365	TEOM
FLAT ROCK	2006	6171	6	6	36.73	24.10	364	TEOM
SHELL CUT	2001	2660	14	14	35.08		351	TEOM
SHELL CUT	2002	2840	19	19	68.44		361	TEOM
SHELL CUT	2003	9162	17	17	75.87	59.80	342	TEOM
SHELL CUT	2004	2990	20	20	58.89	67.73	366	TEOM
SHELL CUT	2005	3989	13	13	55.08	63.28	359	TEOM
SHELL CUT	2006	6847	12	12	58.20	57.39	365	TEOM

Table 3.2 Continued

Site	Year	Peak 24-Hour Value	Number of Exceeds	Adjusted # of Exceeds	Annual Average	3-Year Average	Number Sample Days	Primary Monitor
COSO JUNCTION	1987	196	1	6	33.53		59	Hi Vol
COSO JUNCTION	1988	92	0	0	33.53		59	Hi Vol
COSO JUNCTION	1989	227	1	6	27.13	27.43	61	Hi Vol
COSO JUNCTION	1990	866	1	6	29.38	26.05	60	Hi Vol
COSO JUNCTION	1991	93	0	0	18.80	25.10	60	Hi Vol
COSO JUNCTION	1992	38	0		**Invalid**		36	Hi Vol
COSO JUNCTION	1993	254	2		**Invalid**		51	Hi Vol
COSO JUNCTION	1994	388	1		**Invalid**		49	Hi Vol
COSO JUNCTION	1995	692	2	12	18.60		55	Hi Vol
COSO JUNCTION	1996	309	1		**Invalid**		47	Hi Vol
COSO JUNCTION	1997	92	0		**Invalid**		54	Hi Vol
COSO JUNCTION	1998	409	1	6	22.81		59	Hi Vol
COSO JUNCTION	1999	46	0	0	13.96		114	Hi Vol
COSO JUNCTION	2000	74	0	0	14.56	17.11	110	Hi Vol
COSO JUNCTION	2001	100	0	0	11.42	13.31	122	Hi Vol
COSO JUNCTION	2002	175	1	3	17.63	14.53	112	Hi Vol
COSO JUNCTION	2003	484	1	3	20.10	16.38	110	Hi Vol
COSO JUNCTION	2004	66	0	0	14.40	17.37	121	Hi Vol
COSO JUNCTION	2005	97	0	0	17.89	17.46	119	Hi Vol
COSO JUNCTION	2006	296	1	1	19.09	17.12	273	TEOM
BILL STANLEY	2002	539	1		**Invalid**		154	TEOM
BILL STANLEY	2003	2196	3		**Invalid**		92	TEOM
BILL STANLEY	2004	191	2		**Invalid**		166	TEOM
BILL STANLEY	2005	880	1		**Invalid**		261	TEOM
BILL STANLEY	2006	322	3	3	17.69		356	TEOM

Notes:

(1) Number of samples 150 µg/m^{3} or more.

(2) If not daily sampling, number of exceeds is divided by sampling frequency (e.g., divide by 1/6 for 1-in-six-day sampling).

(3) Annual average is invalid if less than 75% of scheduled samples are collected in each of four quarters.

(4) One quarter (3rd) at 73% data capture. District views data as valid.

Table 3.3 – Annual Ranking of Owens Lake PM_{10} in U.S.

YEAR	Owens Lake Highest in U.S.?	Highest Owens Lake Value	Highest Mono Lake Value	Highest non-GBUAPCD Value
1995	Yes	3,929	-	384
1996	Yes	2,383	-	1,715
1997	Yes	2,229	-	1,264
1998	No	1,464	-	1,477
1999	Yes	2,901	-	442
2000	Yes	10,842	10,466	508
2001	Yes	20,754	4,482	610
2002	Yes	7,915	6,505	590
2003	Yes	16,619	5,745	590
2004	Yes	5,225	987	625
2005	Yes	3,989	2,108	760
2006	Yes	8,299	4,300	1,079

BLANK PAGE

For days when the 24-hour PM_{10} standard is violated, peak hourly wind speeds at the Owens Lake monitoring sites have been measured up to 50 mph. However, violations have also been recorded when the hourly wind speed peaked at a more modest 20 mph. The daily average wind speed when the 24-hour PM_{10} standard is violated ranges from 5 to 33 mph, since many violations occur with winds that last only a few hours.

3.3.4.4 PM_{10} Trends

Although dust control measures were in place on 29.8 square miles of lake bed by the end of 2006, PM_{10} levels at Owens Lake have remained high at the monitoring sites. Monitoring of PM_{10} levels beginning in 2007 will be necessary to establish the overall air quality improvements resulting from the first phases of dust control measure implementation. Some improvement in exceedances per year (Figure 3.3) and in annual average PM_{10} concentration (Figure 3.4) at Keeler and Dirty Socks may indicate signs of improvement, but are yet to show that the NAAQS are being met. At Keeler, the average TEOM value for the years 1993 through 2000 was 45 $\mu g/m^3$. This was prior to the construction of dust control measures on the nearby North Sand Sheet. The average TEOM value for the years 2002 through 2006, after dust control measures on the North Sand Sheet were operational, was 34 $\mu g/m^3$. The inter-year comparisons in Figure 3.6 indicate an overall reduction in exceedances per year and a reduction in daily peak values at Owens Lake monitors. Keeler and Dirty Socks appear to be trending toward significant reductions in PM_{10} levels, but the other sites have yet to show significant improvements.

3.4 CANCER RISK DUE TO OWENS LAKE DUST STORMS

In addition to the high levels of fine particulate matter, Owens Lake dust also contains cadmium, arsenic and other toxic metals that are at levels above those in soils in the Owens Valley due to natural concentration in the terminal lake. These metals pose a significant risk for additional cancer cases in the areas of greatest dust impact. Table 3.4 shows that the cancer risk at Keeler, associated with cadmium and arsenic in the Owens Lake dust, is estimated at 23 additional cases in a million. This is based on an annual concentration average of 45 $\mu g/m^3$ from the dust storms, breathed over a 70-year period. The value of 45 $\mu g/m^3$ is taken from the seven-year average of PM_{10} concentrations measured using a TEOM at Keeler (1993-2000). This average represents the annual average prior to the implementation of controls.

Under the District's adopted air toxics policy, a toxic risk greater than one in a million additional cancer cases is considered to be significant. This policy requires implementation of controls on sources that pose a risk greater than one in a million in order to reduce the risk, and it prohibits the issuance of a permit to sources that exceed a risk of 10 in a million (GBUAPCD, 1987). A revised cancer risk from arsenic and cadmium, using the reduced average dust concentration of 34 $\mu g/m^3$ at Keeler, would result in 17 cases per million, a significant reduction in cancer risk. Model calculations project an average Keeler PM_{10} concentration of 21 $\mu g/m^3$ after all dust control measures are operational. This would result in even greater reduction in cancer risk. Since this residual dust would contain a smaller fraction of lake bed-derived material than under pre-dust-control conditions, the benefits for reduction in cancer risk would be compounded.

Table 3.4 Inhalation cancer risk at Keeler due to Owens Lake dust storms			
Toxic Metal	Cancer Potency $(\mu g/m^3)^{-1}$	Toxic Metal Concentration (parts per million)	Inhalation Cancer Risk
Cadmium	4.2×10^{-3}	29	5 per million
Arsenic	3.3×10^{-3}	118	18 per million
Lifetime Cancer Risk =23 per million			

- *Cancer potency from the Air Toxics Hot Spots Program (OEHHA, 2002).*
- *Dust samples are taken from Keeler PM_{10} filters, with concentrations measured by x-ray fluorescence (Chester LabNet, 1996).*
- *70-year cancer risk at PM_{10} = 45 $\mu g/m^3$ (Keeler annual average from 1993-2000).*

3.5 VISIBILITY AND SENSITIVE AIRSHEDS

Under normal conditions, visibility in the Owens Valley generally ranges from 37 to 93 miles, with the best visibility occurring during winter. Visibility is most limited from May through September and during days when Owens Lake dust storms occur. Owens Lake dust storms can reduce visibility to near zero at Owens Lake and obscure visibility 150 miles away from the lake bed. The main cause of visibility degradation in the Owens Valley is fine particles in the atmosphere. In addition to dust from Owens Lake, visibility degradation results from transport of air pollutants from the San Joaquin Valley and South Coast air basins, and from forest fires. Most of the visibility degradation can be attributed to inter-basin transport of air pollutants. On days when Owens Lake dust storms do not occur, emissions of fine particulate matter from gasoline and diesel fueled vehicles and equipment within the Owens Valley are local man-made contributors to visibility degradation. However, these local sources have an insignificant impact on the area’s visibility. Nitrogen dioxide, a light-absorbing gas formed during local fuel combustion, contributes less than five percent to the overall visibility degradation. Other local man-made sources of visibility degrading emissions represent less than five percent of the overall reduction in visibility (Trijonis, *et al*., 1988).

There are 11 sensitive airsheds in the region, including wilderness areas, national parks, national forests, a national historic site, and the R-2508 military airspace. Figure 3.7 shows the locations of these sensitive airsheds. Four of these airsheds are designated as Class I PSD (Prevention of Significant Deterioration) areas, which are afforded more stringent protection from visibility degradation and for impacts from air pollutants: John Muir and Domeland Wilderness Areas, Kings Canyon and Sequoia National Parks. These sensitive areas and their classifications are shown in Table 3.5.

The R-2508 military air space, which includes the China Lake Naval Air Weapons Station, is a sensitive site for visibility impacts from Owens Lake dust events. Good visibility is needed for some military operations, such as an air-to-air test (an air-launched target whose target is also in

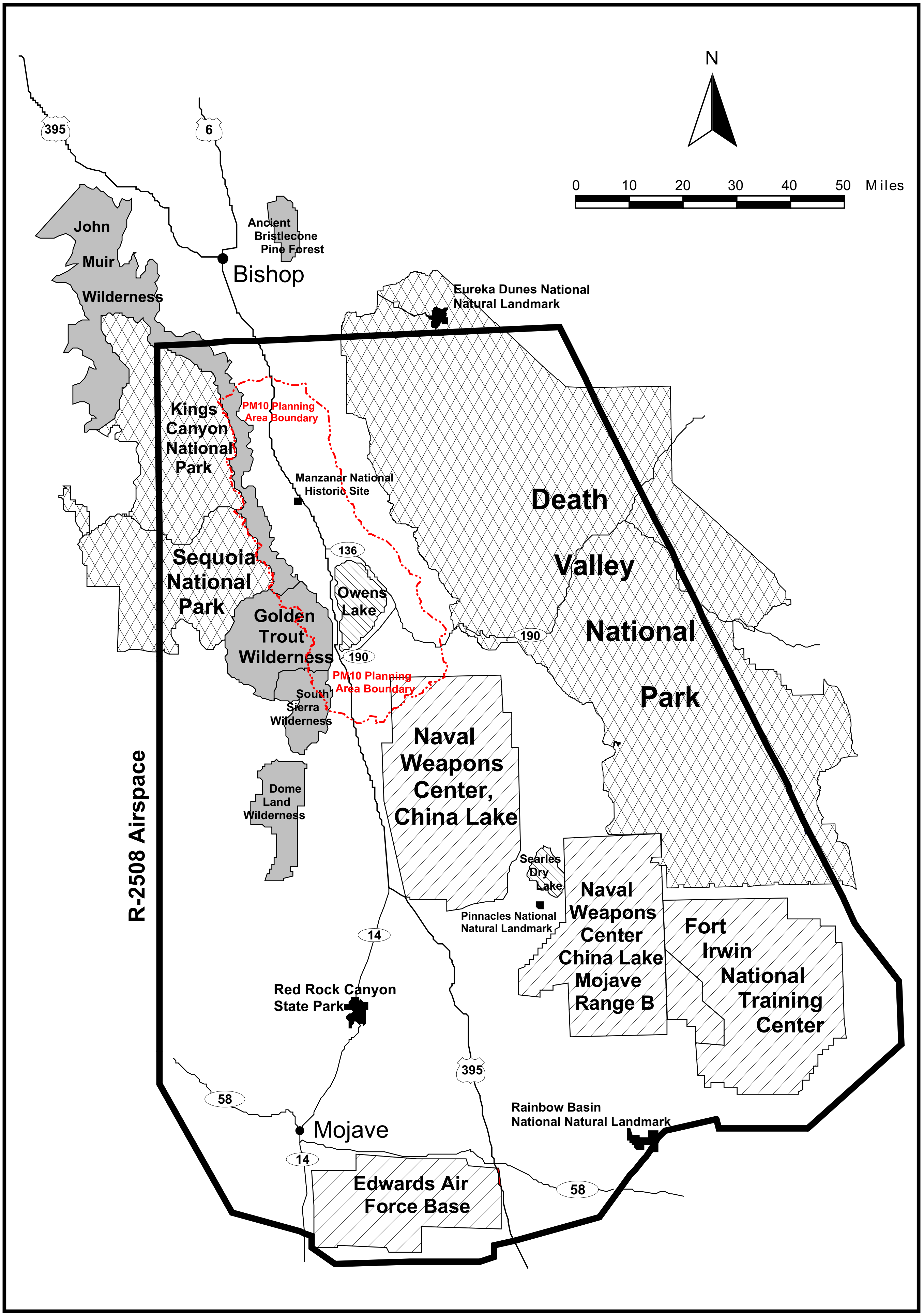

Figure 3.7 - Locations of sensitive airsheds near the Owens Valley Planning Area

Table 3.5 – Sensitive airsheds and their PSD classifications.

	Sensitive Airshed	PSD Airshed Classification
*	Wilderness Areas in National Forests:	
	Domeland	Class I
	Golden Trout	Class II
	John Muir	Class I
	South Sierra	Class II
*	National Parks:	
	Death Valley	Class II
	Kings Canyon	Class I
	Sequoia	Class I
*	National Historic Site:	
	Manzanar	Class II
*	National Forests:	
	Inyo	Class I&II
	Sequoia	Class I&II
*	Military Base:	
	China Lake NAWS	Class II

Source: MHA Environmental Consulting, Inc., 1994.

the air), which relies on high-speed cameras to record time and position information. Owens Lake events can reduce the visibility to less than one to two miles at China Lake. The Department of the Navy has stated that cancellation of a test costs the Range and/or its customer approximately $10,000 to $50,000. Owens Lake dust events can lead to cancellations of several tests per day and can last for one to two days, or occasionally longer (Stevenson, 1996).

3.6 OFF-LAKE PM_{10} VIOLATIONS

Analysis of exceedances of the PM_{10} NAAQS at Owens Lake shoreline monitors indicates that some of the high PM_{10} days would have resulted in exceedances, even if emissions from the lake bed were reduced to zero (Kiddoo, *et al.*, 2007). Winds from off-lake directions carry wind-blown dust from the Keeler dunes, northeast of the lake bed, and from the Olancha dunes, south of the lake bed, toward shoreline monitors. In the period from January 2000 through December 2006, the Keeler dunes are estimated to have caused five violations of the PM_{10} NAAQS at Keeler per year. In the same period, the Olancha dunes are estimated to have caused one violation of the PM_{10} NAAQS per year at each of the Shell Cut and Flat Rock monitors. At the Dirty Socks monitor, 30 violations can be attributed to southerly wind directions, but it appears that many of these violations may have resulted from erosion of emissive areas on the lake bed, but south of the Dirty Socks monitor. Dust controls in this area immediately south of the Dirty Socks monitor were completed at the end of 2006, and it is expected that violations there due to southerly wind directions will be reduced to levels similar to those observed at Flat Rock and Shell Cut (see Kiddoo, et al., 2007, for details of this analysis).

After all the lake bed sources in the 2003 and 2008 dust control areas are controlled, the Keeler dunes area is expected to be the only remaining dust source that is causing exceedances of the standard in the planning area. The Olancha dunes are natural dunes that were present prior to the City’s water gathering activities in the Owens Valley. If PM_{10} violations are attributed to the Olancha dunes, these violations will be treated as natural events and a Natural Events Action Plan will be developed and implemented in accordance with the USEPA rule on Exceptional Events (see Section 2.2.3.3).

3.7 REFERENCES

Chester LabNet, 1996. Chester LabNet - Portland, report on chemical analysis of ambient filters, Report #95-085, prepared for Great Basin Unified Air Pollution Control District, Tigard, Oregon, June 18, 1996.

Federal Register, 1999. Approval and Promulgation of Implementation Plans: California – Owens Valley Nonattainment Area; PM_{10}, Federal Register, Volume 64, No. 171, pp. 48305-48307, September 3, 1999.

GBUAPCD, 1987. Great Basin Unified Air Pollution Control District, Adopted Toxic Risk Policy, GBUAPCD, Bishop, California, 1987.

GBUAPCD, 1995. Great Basin Unified Air Pollution Control District, Mono Basin Planning Area PM_{10} State Implementation Plan (Final), GBUAPCD, Bishop, California, May, 1995.

GBUAPCD, 1998a. Great Basin Unified Air Pollution Control District, Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan, GBUAPCD, Bishop, California, November 16, 1998.

GBUAPCD, 2003. Great Basin Unified Air Pollution Control District, Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan - 2003 Revision, GBUAPCD, Bishop, California, November 13, 2003.

GBUAPCD, 2006b. Great Basin Unified Air Pollution Control District, Settlement Agreement between the District and the City to resolve the City's challenge to the District's Supplemental Control Requirement determination issued on December 21, 2005 and modified on April 4, 2006, GBUAPCD, Bishop, California, December 4, 2006.

Hopkins, 1997. Hopkins, Ross, letter from National Park Service, Manzanar National Historic Site, Superintendent, to Ellen Hardebeck, Great Basin Unified Air Pollution Control District, regarding the Owens Lake air pollution problem, January 3, 1997.

Kiddoo, *et al.*, 2007. Kidoo, Phill, Jim Parker, Duane Ono, Off-Lake PM_{10} Exceedances at Owens Lake, January 1, 2000 – June 30, 2007.

OEHHA, 2002. Office of Environmental Health Hazard Assessment, Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors, Sacramento, California, December 2002.

Ono, *et al*., 2000. Ono, Duane, Ellen Hardebeck, Jim Parker, B.G. Cox, *Systematic Biases in Measured PM_{10} Values with U.S. Environmental Protection Agency-Approved Samplers at Owens Lake, California,* J.Air & Waste Manage. Assoc., Pittsburgh, PA, 50:1144-1156, July 2000.

Parker, 2003. Parker, James, Comparison of TEOM and Partisol Monitors at Owens Lake, California, Great Basin Unified Air Pollution Control District, June 2003.

Schade, 2005. Great Basin Unified Air Pollution Control District, Owens Lake Dust Control: Air Pollution Control Officer's 2004-2005 Determination Requiring the City of Los Angeles to Implement, Operate and Maintain Air Pollution Control Measures on Additional Areas of the Owens Lake Bed, Letter from Theodore D. Schade, Air Pollution Control Officer, GBUAPCD, Bishop, California to Ronald Deaton, General Manager, Los Angeles Department of Water and Power, Los Angeles, California, December 21, 2005.

Schade, 2006. Great Basin Unified Air Pollution Control District, Modified Determination and Response to the City of Los Angeles' Alternative Analysis of the Air Pollution Control Officer's 2004-2005 Supplemental Control Requirements Determination, Letter from Theodore D. Schade, Air Pollution Control Officer, GBUAPCD, Bishop, California to Ronald Deaton, General Manager, Los Angeles Department of Water and Power, Los Angeles, California, April 2, 2006.

Stevenson, 1996. Stevenson, C.A., letter from U.S. Department of the Navy, Naval Air Weapons Station, Commanding Officer, to Ellen Hardebeck, Great Basin Unified Air Pollution Control District, regarding impact of Owens Lake dust on China Lake, May 9, 1996.

Trijonis, J. *et al.*, 1988. Trijonis, John, Michael McGown, Marc Pitchford, Donald Blumenthal, Paul Roberts, Warren White, Edward Macias, Raymond Weiss, Alan Waggoner, John Watson, Judith Chow, Robert Flocchini, RESOLVE Project Final Report - Visibility Conditions and Causes of Visibility Degradation in the Mojave Desert of California, Naval Weapons Center, China Lake, California, July 1988.

USEPA, 2007a. United States Environmental Protection Agency, Proposed Finding of Failure to Attain; State of California, Owens Valley Nonattainment Area; Particulate Matter of 10 Microns or Less, EPA-R09-OAR-2007-0091, FRL-8291-1, Federal Register, Volume 72, No. 56, March 23, 2007, pp 13723-13726.

USEPA, 2007c. United States Environmental Protection Agency, AirData website, http://www.epa.gov/air/data/monvals.html, August, 2007.

BLANK PAGE