Chapter 2

Air Quality Monitoring, Data, and Analysis

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2 AIR QUALITY MONITORING, DATA, AND ANALYSIS

2.1 INTRODUCTION

This chapter briefly explains the PM10 air quality monitoring network requirements for the District, presents recent air quality monitoring data for PM10, and discusses the meaning of the data. The network and the data determine the Basin's attainment status.

2.2 MONITORING NETWORK

The EPA requires states to measure the ambient levels of air pollution to determine compliance with the NAAQS. The District and the state work together to fulfill EPA's mandate. In 2004, ARB and the District operated 15 PM10 monitoring sites throughout the SJVAB. A few of these 15 sites have multiple monitors to allow for assessment of the precision and accuracy of data.

Federal regulations require PM10 monitoring networks to meet four basic monitoring objectives:

- Monitoring the highest concentration of a pollutant
- Monitoring representative concentrations in areas of high population density
- Monitoring the impact of major pollutant sources
- Monitoring pollutant background concentrations

Thirteen of the 15 currently operating monitors are located to measure representative concentrations in areas of high population density. Typically, these sites measure representative concentrations within a radius of four kilometers or less. The other two monitoring sites are located to measure PM10 from local sources within half a kilometer of a site.

One additional siting consideration is that the monitoring station be placed in an area where it can remain for an extended period of time (ideally at least 15 years). Having sites located at the same locations over an extended time allows for the examination of trends, the demonstration of attainment, and characterization of changes around the site over time.

2.3 AMBIENT AIR QUALITY DATA

The current NAAQS for PM10 are 50 $\mu g/m^3$ for an annual arithmetic mean and 150 $\mu g/m^3$ for a maximum 24-hour concentration (Section 1.6).[1] Monitoring for PM10 started in 1987; however, only recent data are included in the following tables. Table 2-1 summarizes the average 24-hour maximum values of PM10 data for the years 1998-2004 by SJVAB monitoring station. Additional air quality data can be found at ARB's website (http://www.arb.ca.gov). Dashes mean that the site was not running for that year because either it had not been opened yet or the site was closed. Values above the federal standard should not be interpreted directly as an indication that the site does not comply with the air quality standard. A limited number of such values are permitted to occur over a three-year period (see Section 2.4 for more information). Tables 2-1 and 2-2 are used together to determine the air quality status for each site for the 24-hour standard.

Table 2-1 PM10 24-Hour Maximum Concentrations
(Micrograms per cubic meter)

Monitoring Station	1998	1999	2000	2001	2002	2003	2004
Bakersfield-California Ave	148	143	140	190	100	110	83
Bakersfield-Golden State	159	183	145	205	189	136	85
Clovis-Villa	113	151	114	155	92	79	63
Corcoran-Patterson	165	174	128	165	168	150	139 [a]
Fresno-Drummond	132	162	130	186	106	92	79
Fresno-First Street	141	154	138	193	96	74	54
Hanford-Irwin	146	143	119	185	161	140	123
Merced-2334 M Street	---	134	104	113	85	74	56
Modesto-14th Street	125	132	112	158	83	70	80
Oildale-Manor	103	156	122	158	93	106	82
Stockton-Hazelton	106	150	91	140	87	88	60
Stockton-Wagner/Holt	99	118	104	119	80	52	48
Taft-College	84	101	99	128	80	92	61
Turlock-Minaret	108	157	104	148	93	87	59
Visalia-Church Street	160	152	130	143	110	100	82

[a] On September 3, 2004, there was a wind event with a measured value of 217 $\mu g/m^3$. On July 8, 2005, EPA determined that this was indeed a "natural event." The 217 $\mu g/m^3$ will not be used for attainment or modeling purposes. The next high for the site, 139 $\mu g/m^3$, will be used for all official purposes.

[1] On December 20, 2005, EPA announced its intent to revoke the PM10 NAAQS, revise the PM2.5 NAAQS, and establish a new 24-hour NAAQS for the PM2.5-10 fraction (urban areas only). These proposed changes are driven by new evidence on health effects from specific size fractions, federal CAA requirements, and case law affecting the PM10 and PM2.5 standards.

Table 2-2 presents estimated exceedance days[2] of the 24-hour PM10 NAAQS. The District follows a federal schedule for PM10 monitoring that requires collecting a sample once every six days. At some sites, the District has increased monitoring frequency to once every three days. Since the District only monitors PM10 once every six days for most sites, the actual number of days that exceed the 24-hour standard cannot be determined; therefore, the number of exceedances is estimated by following the procedures in CFR Title 40, Chapter I, Subchapter C, Part 50, Appendix K. In general, one measured violation is calculated as representing a potential for six exceedance days when sampling on a one-in-six schedule and three exceedance days when the site is monitored on a one-in-three day schedule.

Table 2-2 Estimated Exceedance Days of 24-Hour PM10 NAAQS

Monitoring Station	Estimated 2002 Exceedances	Estimated 2003 Exceedances	Estimated 2004 Exceedances	Average Number of Exceedances per year 2002-2004
Bakersfield-California Ave	0.0	0.0	0.0	0.0
Bakersfield-Golden State	6.1	0.0	0.0	2.0
Clovis-Villa	0.0	0.0	0.0	0.0
Corcoran-Patterson	3.0	0.0	0.0	1.0
Fresno-Drummond	0.0	0.0	0.0	0.0
Fresno-First Street	0.0	0.0	0.0	0.0
Hanford-Irwin	6.1	0.0	0.0	2.0
Merced-2334 M Street	0.0	0.0	0.0	0.0
Modesto-14th Street	0.0	0.0	0.0	0.0
Oildale-Manor	0.0	0.0	0.0	0.0
Stockton-Hazelton	0.0	0.0	0.0	0.0
Stockton-Wagner/Holt	0.0	0.0	0.0	0.0
Taft-College	0.0	0.0	0.0	0.0
Turlock-Minaret	0.0	0.0	0.0	0.0
Visalia-Church Street	0.0	0.0	0.0	0.0
District-wide [a]	**7.8** [a]	**0.0** [a]	**0.0** [a]	**2.6** [a]

[a] The District-wide totals are based on averages of quarterly maximum values and not sums or averages of the above exceedances alone.

Interpretation of Tables 2-1 and 2-2 provides the following findings:

- As of 2005, the District is nonattainment of the 24-hour standard because at least one site has a three year average of more than one estimated exceedance per year
- Two sites (Hanford and Bakersfield at Golden State) establish the non-attainment status. The Corcoran site actually shows attainment with only one estimated exceedance.

[2] An exceedance day occurs when local ambient air quality exceeds the NAAQS.

Note that both sites that fail the attainment test have experienced no violations for the last two years. If air quality continues to meet the standard this year, both of these sites will also show attainment for the federal 24-hour PM10 standard. Table 2-3 presents specific dates when exceedances of the 24-hour PM10 standard were observed and reflects that no values above the federal 24-hour standard have been detected in the last two years.

Table 2-4 shows the annual average for each site for 1998-2004. EPA guidance documents, as well as the procedures found in Appendix K, were used to calculate these averages. This table also provides data that should not be used directly in comparison to the established standard (see Section 2.4 for more information). The federal requirement is that a three-year average of the annual averages should not exceed annual PM10 standard.

Table 2-3 Site Concentrations of Days Exceeding the 24-Hour PM10 NAAQS (Observed)

Date	Monitoring Site	Concentration (μg/m³)
May 20, 2002	Bakersfield-Golden State	189
October 29, 2002	Corcoran - Patterson Ave.	168
November 4, 2002	Hanford-Irwin	161
All of 2003	None	None
All of 2004 [a]	None	None

[a] See footnote for Corcoran 2004 in Table 2-1.

Table 2-4 PM10 Annual Average Concentrations
(micrograms per cubic meter)

Monitoring Station	1998	1999	2000	2001	2002	2003	2004
Bakersfield-California Ave	37.7	47.8	45.1	50.6	49.0	47.3	42.8
Bakersfield-Golden State	58.5	59.5	53.1	59.6	59.2	52.1	42.7
Clovis-Villa	33.5	46.2	39.4	44.4	42.8	36.3	31.8
Corcoran-Patterson	41.2	52.5	45.7	48.7	52.8	47.0	45.1
Fresno-Drummond	39.3	56.2	46.8	52.3	52.2 [a]	43.4	39.9
Fresno-First Street	33.7	44.3	40.3	42.5	39.0	34.7	30.9
Hanford-Irwin	48.3	53.2	48.5	56.7	53.5	46.7	43.1
Merced-2334 M Street	---	47.3	34.9	38.6	38.7	32.0	28.0
Modesto-I Street	24.2						
Modesto-14th Street	---	41.1	34.2	36.7	33.2	25.1	27.2
Oildale-Manor	36.9	50.3	40.5	47.4	46.5	43.2	40.7
Stockton-Hazelton	29.1	36.4	32.5	35.5	35.1	27.6	28.6
Stockton-Wagner/Holt	25.5	37.4	29.3	31.2	29.7	22.3	21.8
Taft-College	29.0	34.9	34.9	41.9	38.0	33.9	31.8
Turlock-Minaret	31.0	47.1	33.9	39.5	36.2	30.7	30.0
Visalia-Church Street	40.0	54.9	52.7	51.9	51.9	42.8	41.2

[a] The Fresno-Drummond site had the 1st and 2nd calendar quarters of 2002 data invalidated. The District substituted the highest measured same-quarter average from 1990-2001 to calculate the average. This creates a conservatively high annual average. The District believes that the yearly peak value was captured in one of the other two quarters because most of the sites in the District recorded their peaks in these same quarters.

2.4 INTERPETATION OF AIR QUALITY DATA

Using data from the most recent time period[3], 2002 through 2004, we can determine each site's attainment status. If any monitoring site exceeds either the Annual PM10 standard or the 24-Hour PM10 standard, then the entire air basin is nonattainment.

For the 24-hour standard, the number of days over the three most recent years of data whose measured PM10 levels are estimated to exceed the 150 micrograms per cubic meter NAAQS, based on the monitoring data, needs to be 1.0 or less. For the annual standard, the final average needs to be 50.4 micrograms per cubic meter or less. The calculations for the annual standard involve several steps:

- Determine averages for each of the four quarters in the year
- Average together the four quarters to get an annual average for the year
- The annual averages (as calculated in the above steps) for the three most recent, complete years of official data are averaged together
- This three-year average is compared to the NAAQS to determine whether or not attainment is met

Table 2-5 summarizes the current values on a site-by-site basis. Bold values indicate that one of the attainment tests is over the standard. The 24-hour peak value for 2002-2004 is included for information only. Table 2-5 reveals that Hanford fails to comply with the 24-hour PM10 standard with an estimated average of two days per year that would experience levels above the standard. Bakersfield at Golden Avenue fails both the 24-hour and annual tests. However, as reflected in the tables, both of these sites have not exceeded the standard in 2003 or 2004. The SJVAB could achieve attainment for PM10 if 2005 annual and 24-hr measurements support attainment. This would require that the three-year annual average is less than or equal to 50 and the expected 24-hour exceedance days is less than or equal to 1.0 for each station. Figures 2-1 and 2-2 show the data from Table 2-5 in graph form. In Figure 2-1, the gray columns need to be at or below the gray line, and the black columns need to be at or below the black line for attainment.

2.4.1 Trend and Spatial Variations

The monitoring data indicates that PM10 air quality has improved significantly since 1998. Table 2-5 shows that only two out of 15 sites are nonattainment for the PM10 standards for the 2002-2004 time period. For the period of 1990-1992, 19 out of 23 sites were nonattainment, and for the time period of 1998-2000, six out of 15 sites were nonattainment. The estimated numbers of exceedance days in the SJVAB have also decreased: 33.0 days for 1990-1992, 5.9 for 1998-2000, and 2.9 days for 2002-2004. More air quality trend data can be found at <http://www.arb.ca.gov>.

[3] 40 CFR (Code of Federal Regulations) Part 50, Appendix K, Sections 2.2 and 2.3, require that attainment calculations be based on at least the most recent three years of data, provided that at least 75% of the scheduled PM10 samples per quarter be available.

Table 2-5 Summary of 2002-2004 Attainment Statistics

Monitoring Station	Attainment Tests		Attainment Status [c]	Observed Three-Year 24-Hour Maximum (µg/m³)
	Three-Year Annual Average (µg/m³) [a]	Estimated 24-Hour Exceedance Days [b]		
Bakersfield-California Ave	46	0.0	Yes	110
Bakersfield-Golden State	**51**	**2.0**	No	189
Clovis-Villa	37	0.0	Yes	92
Corcoran-Patterson	48	1.0	Yes	168
Fresno-Drummond	35	0.0	Yes	106
Fresno-First Street	45	0.0	Yes	96
Hanford-Irwin	48	**2.0**	No	161
Merced-2334 M Street	33	0.0	Yes	85
Modesto-I Street	29	0.0	Yes	83
Oildale-Manor	43	0.0	Yes	106
Stockton-Hazelton	30	0.0	Yes	88
Stockton-Wagner/Holt	25	0.0	Yes	80
Taft-College	35	0.0	Yes	92
Turlock-Minaret	32	0.0	Yes	93
Visalia-Church Street	45	0.0	Yes	110

[a] Average the 4 quarterly averages for each of three years, then average those three values.
[b] Since PM samples are measured once every six days, the ratio of the number of measured exceedances to the number of samples in the quarter is applied to the total number of days in the quarter to yield a number of expected exceedance days for that quarter. The sum of the four quarters yields an annual total, and then 3 years of totals are averaged.
[c] A station is considered in attainment if the three-year annual average PM10 concentration is less than or equal to 50 ug/m^3 and the expected 24-hour exceedance days is less than or equal to 1.0.

Meteorological influences can have a dramatic effect on PM10 levels. The high PM10 values measured in 1990 and 1991 occurred at the end of an extended drought period. Measured PM10 values were much lower in 1992 when the rains returned. PM10 levels would be expected to rise should another long-term drought period occur. The timing of rainfall in 2002-2004 has helped lower the PM10 levels. For instance, Fresno received 2.5 inches of rain in October of 2004; this prevented high levels of geologic PM10 from developing. Although complex meteorological phenomena and emissions activities make it challenging to determine the extent of PM10 air quality improvements that are highlighted by favorable weather, longer term analysis and modeling comparing similar weather regimes indicate that recent recurring air quality improvements are the result of regulatory actions to reduce emissions.

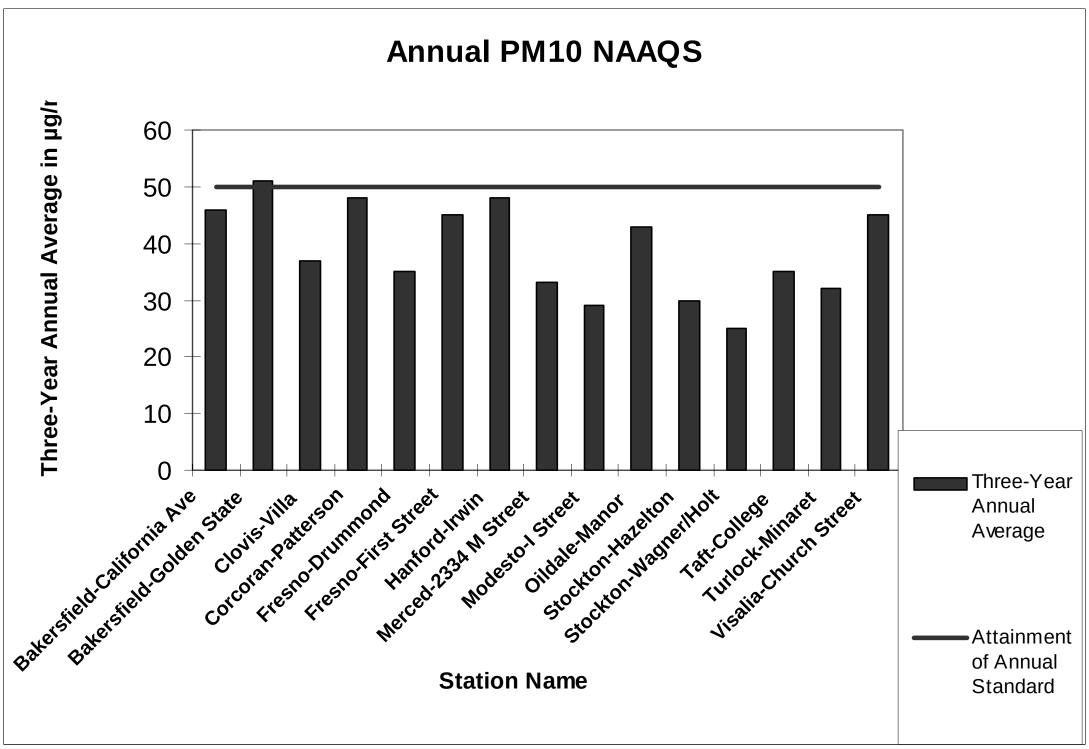
Reductions in PM2.5, which is a subset of PM10, have helped to reduce measured PM10 levels. In 2000-2001, peak PM2.5 values of 155-160 µg/m³ were measured. In 2003-2004, peak PM2.5 values were around 68-70 µg/m³. Reductions in the PM2.5

subset are reflected in PM10 measurements. The District will prepare a separate PM2.5 Plan in 2008, as required the EPA.[4]

2.4.2 Seasonal Variations

Variations of source operations and activity levels affect emissions rates, and seasonal differences in atmospheric processes affect particle formation and retention. As a result, there is extensive seasonal variation of PM10 concentrations. During the October to January period, the PM10 concentrations undergo a shift from dominance by primary particles to dominance by secondary particles. Secondary particles are a major fraction in colder, wetter periods, but are present in smaller amounts before mid-November. The October through January period is discernable as dividing into two overlapping periods that develop high particulate concentrations from different sources and atmospheric processes. Both seasonal periods commonly experience stagnant conditions. During a stagnant period, primary geologic or secondary particulates accumulate, resulting in concentrations that eventually exceed the PM10 standard.

Figure 2-1 2002-2004 Attainment Statistics for SJVAB Air Monitoring Sites – Annual NAAQS



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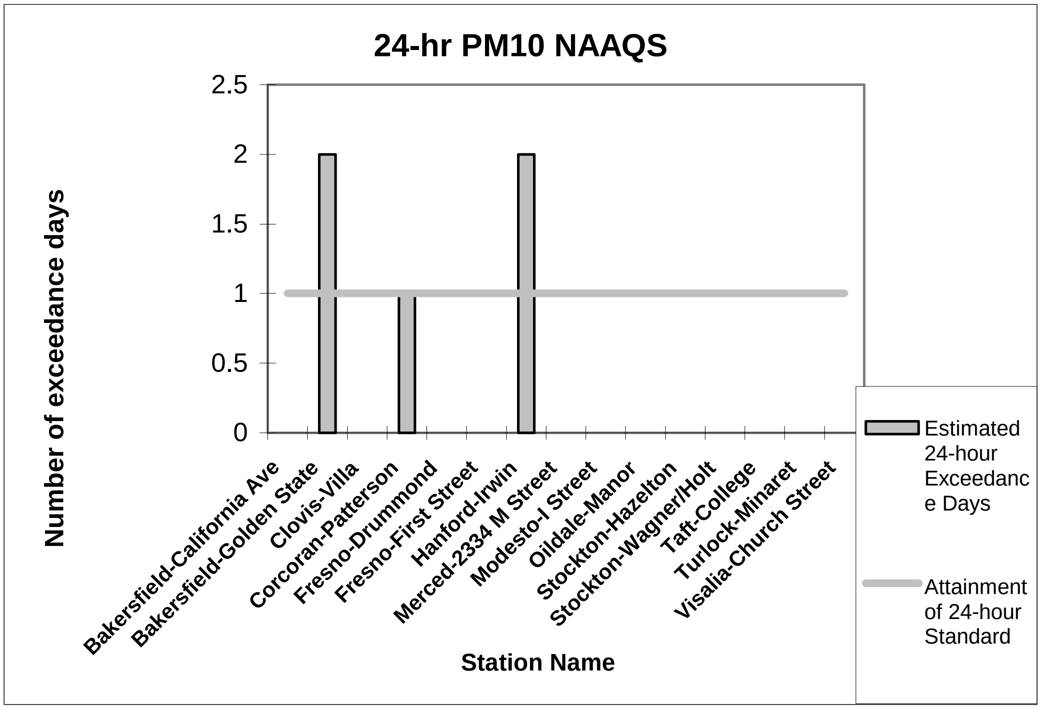
[4] On December 20, 2005, EPA announced its intent to revoke the PM10 NAAQS, revise the PM2.5 NAAQS, and establish a new 24-hour NAAQS for the PM2.5-10 fraction (urban areas only). These proposed changes are driven by new evidence on health effects from specific size fractions, federal CAA requirements, and case law affecting the PM10 and PM2.5 standards.

Figure 2-2 2002-2004 Attainment Statistics for SJVAB Air Monitoring Sites- 24hr NAAQS



The October and November episodes that have occurred in the last several years were low wind speed events. High wind PM10 events are not typical within the SJVAB, but they have occurred and have contributed to high PM10 concentrations in the past. The October-November low wind speed events tend to be localized stagnation events with wind speeds that are insufficient to disperse high PM10 concentrations. The episodes affected only a few urban areas in the SJVAB. Air quality field programs identified the highest concentrations of PM10 in urban areas. In these episodes, anthropogenic (human) activities entrain PM10 in fugitive geological dust, adding to emissions dispersing from surrounding agricultural operations. The emissions inventory for the SJVAB indicates that most of the directly emitted PM10 is due to open area fugitive geological dust sources. Anthropogenic sources (paved and unpaved road dust, farming operations, and construction/demolition) account for most of the fugitive geological PM10 emissions, and wind erosion of exposed surfaces of geological material accounts for the balance as represented in the emissions inventory. However, downwind ambient PM10 concentrations are not proportional to the emission estimates of fugitive geological PM10 emissions. Most of the large geologic particles settle to the ground within a few kilometers of their source when wind velocities are low; therefore, significant contribution to the urban area exceedances involve only the emissions of large PM10 particles that occur in the urban area and within a few kilometers of the urban area. Implementing control measures for fugitive emissions of geological origin is especially valuable during these months when the contributions from geological sources are highest.

The second elevated PM10 period of the year begins mid November to mid December and extends through February. This season is characterized by extended periods of stagnant air interspersed with cold, damp, foggy conditions conducive to the formation of particulate nitrate in amounts that are frequently the dominant component of PM10 (often 70 percent or more of the material found on a filter). During the last several years episodes dominated by increased levels of nitrate particulates and primary and secondary carbon occurred in December and January. These episodes occurred during long stagnation periods in cold weather and affected one or more urban areas. The District prohibited agricultural burning (no-burn status) during these events based on meteorology with poor dispersion to limit emissions. Residential wood combustion, particles formed from exhaust gases and poor dispersion of emissions contribute to PM10 buildup in these events. Air monitoring data indicates that when meteorological conditions produce little or no air movement with cold air temperature, secondary particulate levels (largely ammonium nitrate) are elevated in the entire SJVAB.

2.4.3 Diurnal Variations

During the Integrated Monitoring Study of 1995 (IMS95), a study within the California Regional PM10/PM2.5 Air Quality Study (CRPAQS), special monitors were operated on a daily basis with the filters being changed every three hours for approximately one month. The results of that study showed that in urban areas, the greatest concentrations of PM10 during December and January are measured in the evening hours, after most people return home from work. This suggests that PM10 could be emitted and formed at increased rates during the evening hours (6:00 PM through midnight), probably due to cooking and the use of fireplaces. These increasing emissions in the evenings can elevate PM10 levels under certain, concurrent meteorological conditions. Other findings from CRPAQS have already been incorporated in these discussions regarding seasons and episodic development and patterns.

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