Chapter 1

Progress and Current Air Quality

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Chapter 1: Progress and Current Air Quality

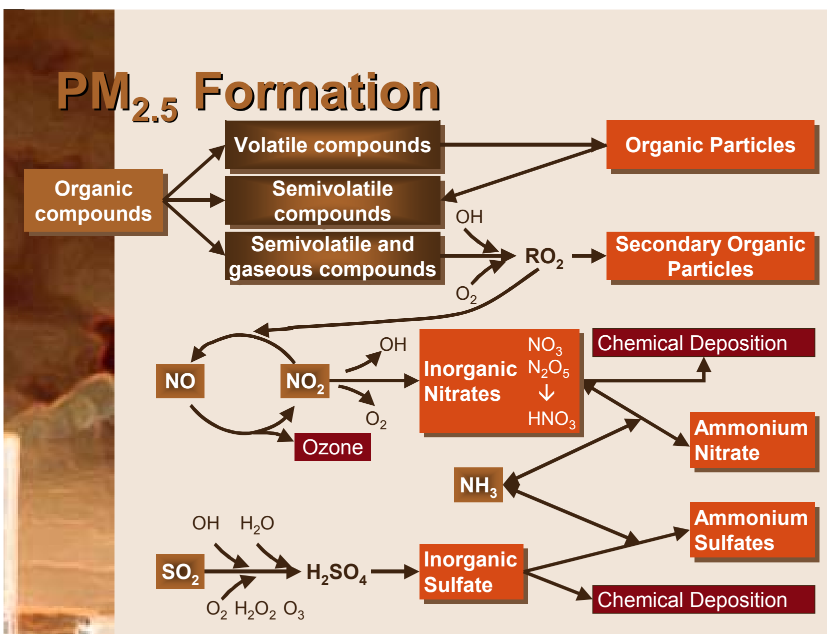
1.1 INTRODUCTION

This chapter presents an overview of the progress that has been made and the current state of the San Joaquin Valley's air quality. Over the past 20 years, the hard work and financial and personal investments made by industries, individuals, and agencies are producing real and tangible results that yield an improvement in air quality.

1.2 WHAT IS PM2.5?

Particulate matter (PM) is any material except pure water that exists in the solid or liquid state in the atmosphere. Under current regulations, particulate matter (PM) is differentiated by particle size as opposed to composition. PM can be emitted directly as primary PM, and it can form in the atmosphere through the reactions of precursors to form secondary PM (see Figure 1-1). Since PM occurs as a wide range of compounds, PM planning requires an evaluation of emissions inventories for several pollutants: direct PM, nitrogen oxides (NOx), volatile organic compounds (VOCs), sulfur dioxide (SO_2), and ammonia (NH_3). Some of these precursors also form other air pollutants, such as ozone. Control measures that reduce PM precursor emissions tend to have a beneficial impact on ambient PM levels. Air quality modeling and other forms of analyses are used to evaluate the benefit of precursor controls on PM levels in individual regions (see Chapter 3).

Figure 1-1 PM2.5 Formation



The resulting ambient PM mixture includes aerosols (fine airborne solid particles and liquid droplets, except pure water) consisting of components of nitrates, sulfates, elemental carbons, organic carbon compounds, acid aerosols, trace metals, geological materials, etc. Primary PM can be emitted either naturally (windblown dust and wildfires) or from human (anthropogenic) activity: agricultural operations, industrial processes, combustion of wood and fossil fuels, construction and demolition activities, and entrainment of road dust.

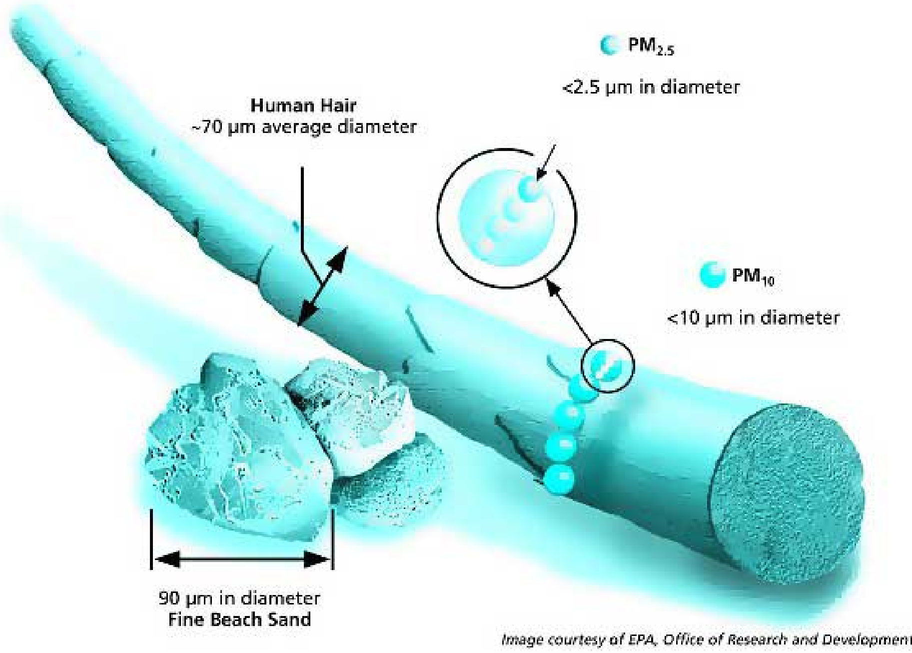
PM in the air may eventually be removed from the atmosphere by gravitational settling, rainout (attaching to water droplets as they fall to the ground), and washout (being absorbed by water molecules in clouds and later falling to the ground with rain). However, particles can condense or re-enter the gas phase under different environmental conditions. All of these processes contribute to the complexity of predicting PM levels in the atmosphere using computer simulation models.

State and federal air quality standards differentiate two size fractions of PM (see Figure 1-2): PM that is 10 microns or less in diameter (PM10) and the smaller subset that is 2.5 microns or less in diameter (PM2.5). The District's previous PM planning efforts focused on PM10, also referred to as "inhalable coarse particles." Under the control strategy put forth in the *2003 PM10 Plan* and its amendments, and reaffirmed in the *2006 PM10 Plan,* the Valley has reached attainment of the federal PM10 standards. The SB656 report prepared and adopted to meet state requirements in 2006 confirmed that the District's PM10 and precursor strategy is a benchmark for other air districts in California. In September 2007, the District Governing Board adopted the *2007 PM10 Maintenance Plan and Request for Redesignation*, which included meteorological analysis, a contingency plan, and modeling. This plan demonstrated continued attainment through 2020, which is necessary to allow the U.S. Environmental Protection Agency (EPA) to officially redesignate the San Joaquin Valley to attainment of the PM10 standards. The California Air Resources Board (ARB) approved the PM10 Maintenance Plan on October 25, 2007. The *2008 PM2.5 Plan* is the District's first plan focused specifically on PM2.5 (also referred to as "fine particles"), although the control strategies of the PM10 plans and *2007 Ozone Plan* have already improved the Valley's ambient PM2.5 levels.

1.3 ADOPTED RULES

Since its formation in 1992, the San Joaquin Valley Unified Air Pollution Control District (District) has adopted about 500 rules and rule amendments. The District was the nation's first air district to adopt a progressive Indirect Source Review (ISR) program, which reduces emissions from new indirect sources Valley-wide, such as commercial, industrial, and residential developments. The District was also the first air district in the nation to adopt a rule to control emissions of volatile organic compound (VOC) from wine production and storage. This rule contains groundbreaking compliance options that offer flexibility to operators without sacrificing emission reductions.

Figure 1-2 Diameter Comparison: Human Hair, Sand, PM10, and PM2.5



The District was the first air district in the state to regulate emissions from on-field agricultural operations. To date, through the Conservation Management Practices (CMP) rule, the District has received 6,400 CMP plans from Valley farmers that reduce particulate matter emissions from 3.2 million acres of productive agricultural land. The District was also the first major air district in the state to regulate the use of residential fireplaces. Other major air districts in the state are now using the District's regulation as the benchmark for their regulatory efforts. In addition, the District leads the nation with its stringent emission limits on engines, boilers, turbines, and glass-melting furnaces. Air quality improvements evidence the success of the District's innovative rules, as discussed in the next section.

As noted in the ARB staff report on *Accelerating San Joaquin Valley Air Quality Progress* (2007)*:*

> "A snapshot of rule stringency taken ten years ago would have shown the South Coast District with the State's most stringent rules, setting the benchmark for stationary source control. The San Joaquin Valley District would have been seen lagging behind. The picture today looks very different. While the South Coast is still pushing the limits of stringency, the San Joaquin Valley District has caught up. Since early this decade, the District has set aggressive rulemaking targets in its SIPs for ozone and particulate matter."[1]

[1] California Air Resources Board (ARB) (November 6, 2007). *ARB Staff Report to the Air Resources Board: Accelerating San Joaquin Valley Air Quality Progress*. Page 12.

1.4 EMISSIONS AND CURRENT AIR QUALITY

The two major indicators of air quality improvement are emissions inventories and ambient air quality data. Emissions inventories are estimates indicating how much direct pollution is going into the air as a result of various activities. Ambient air quality data, which is measured by monitors, tells us how much pollution is in the air we breathe. Together, these data illustrate progress made in improving air quality as well as the great challenge we face in meeting future standards.

1.4.1 Emissions

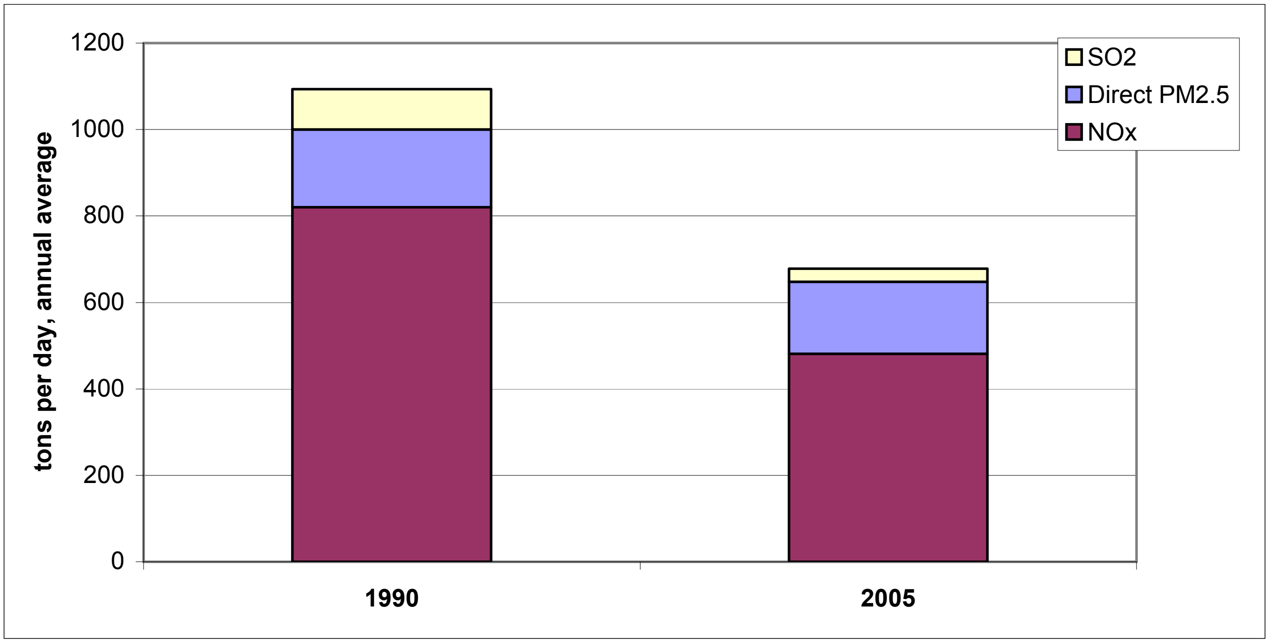
An emissions inventory is a tabulation of pollutant emissions into the atmosphere. The District uses comprehensive emissions inventories to develop control strategies; determine the effectiveness of permitting and control programs; provide input into ambient receptor, aerosol, photochemical, and statistical models; fulfill reasonable further progress requirements; and screen sources for compliance investigations. Emissions inventory data, like ambient monitoring data, are also used as indicators for trends in air pollution.

To reduce the Valley's PM2.5 levels further, the *2008 PM2.5 Plan* presents a control strategy that is based on an exhaustive evaluation of the emissions inventories of directly emitted PM2.5 as well as relevant PM2.5 precursors. Typically, an emissions inventory is organized by emission source category. Source categories consist of several broad groups:

- **Mobile sources** – motorized vehicles
  - On-road sources include automobiles, motorcycles, buses, and trucks
  - Other or off-road sources include farm and construction equipment, lawn and garden equipment, forklifts, locomotives, boats, aircraft, and recreational vehicles
- **Stationary sources** – fixed sources of air pollution
  - Power plants, refineries, and manufacturing facilities
  - Aggregated point sources - facilities (such as gas stations and dry cleaners) that are not typically inventoried individually but are estimated as a group and reported as a single source category.
- **Area sources** –human activity that takes place over a wide geographic area
  - Includes consumer products, fireplaces, tilling, and unpaved road dust
- **Natural sources** – non-anthropogenic, naturally occurring emissions
  - Geogenic sources, such as petroleum seeps
  - Biogenic sources, such as emissions from plants
  - Wildfire sources

The District has made significant progress in reducing PM2.5 precursor emissions (see Figure 1-3). These reductions are a result of the many rules and programs put in place by the District and the California Air Resources Board (ARB). These reductions represent an impressive accomplishment, especially in light of the 37% increase in population in the San Joaquin Valley over the same time period.

Figure 1-3 PM2.5 and Precursor Emissions Reductions, 1990-2005
(Annual Averages, 2006 Almanac, base year 2005)

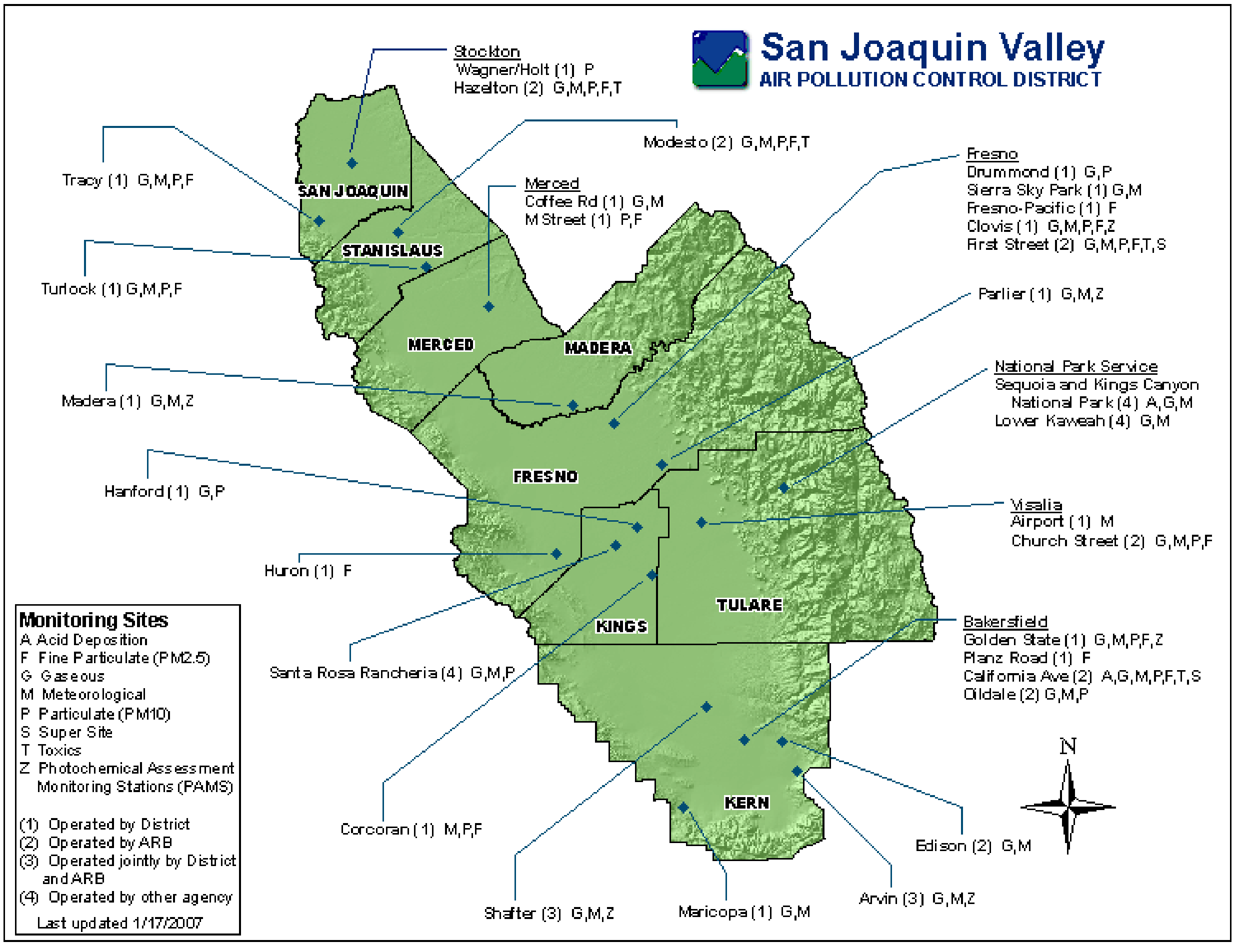


Appendix B contains detailed tables showing the emissions inventories for directly emitted PM2.5, NOx, VOC, SO_2, and ammonia. This appendix also contains information on emissions inventory maintenance. Motor vehicle transportation conformity budgets, which are required in state implementation plans (SIPs) and are based on motor vehicle emissions inventories, will be available in Appendix C in the next version of the plan. Emission reduction credits (ERCs) are in Appendix D.

1.4.2 Air Monitoring Data and Analysis

The District operates an extensive air monitoring network to measure progress toward compliance with the National Ambient Air Quality Standards (NAAQS). Air quality monitoring networks are designed to monitor areas with high population densities, areas with high pollutant concentrations, areas impacted by major pollutant sources, and areas representative of background concentrations. Together, the District and ARB operate 11 filter-based PM2.5 monitoring sites throughout the San Joaquin Valley. Figure 1-4 shows the Valley's air quality monitoring sites.

Figure 1-4 Atmospheric Monitoring Sites within the San Joaquin Valley Air Basin



PM is measured and expressed as the mass of particles contained in a cubic meter of air (micrograms per cubic meter, or $\mu g/m^3$). The data collected from the District's network of filter-based PM2.5 monitors is used to calculate design values for the 24-hour and annual PM2.5 standards, as outlined in EPA guidance[2] and regulations.

To calculate the 24-hour average design values (three-year 24-hour average 98th percentile):

1. Determine the 98th percentile PM2.5 concentration value for each year of three consecutive years,
2. Average these three values
3. Round to the nearest 1.0 $\mu g/m^3$

To calculate annual design values (three-year annual mean values):

1. Average the data by quarter,
2. Average the four quarters in a calendar year to determine that year's average
3. Average three consecutive years
4. Round to the nearest 0.1 $\mu g/m^3$

[2] EPA, *Guideline on Data Handling Conventions for the PM NAAQS*, April 1999; Appendix N of 40 CFR Part 50

The three-year 24-hour average 98th percentile and three-year annual mean values are then compared to their respective National Ambient Air Quality Standard. Rounding convention guidelines are also incorporated into the annual and 24-hour calculations. Data substitution guidelines are only used in the 24-hour average calculation.

EPA promulgated the 1997 PM2.5 NAAQS designations based on 2001-2003 data in the *Federal Register* on January 5, 2005, effective April 5, 2005 (70 *FR* 944-1019). Figure 1-5 shows 24-hour and annual PM2.5 design values for each of the District's PM2.5 monitoring sites based on 2004-2006. To meet the attainment test for the 1997 PM2.5 NAAQS, a site must attain both the 24-hour NAAQS (with a design value less than or equal to 65.49 $\mu g/m^3$) and the annual NAAQS (with a design value less than or equal to 15.0 $\mu g/m^3$). For the San Joaquin Valley Air Basin to be in attainment, all sites in the Valley must attain the PM2.5 NAAQS. Because several monitoring sites do not pass the attainment test for the annual PM2.5 standard, the Valley is nonattainment for the 1997 PM2.5 NAAQS.

Figure 1-5 PM2.5 Design Values and Attainment Test
(based on 2004-2006 monitoring data)

Monitoring Site	Attainment Tests (Sites must pass both tests)				Attainment?
	24-hour PM2.5 NAAQS		Annual PM2.5 NAAQS		
	Design Value ($\mu g / m^3$)	Within the NAAQS?	Design Value ($\mu g / m^3$)	Within the NAAQS?	
Stockton	41	Yes	12.9	Yes	Yes
Modesto	51	Yes	14.1	Yes	Yes
Merced	45	Yes	14.7	Yes	Yes
Fresno-1st	58	Yes	**16.7**	**No**	**No**
Fresno-Winery	59	Yes	**17.2**	**No**	**No**
Clovis	57	Yes	**16.2**	**No**	**No**
Corcoran	58	Yes	**17.2**	**No**	**No**
Visalia	56	Yes	**18.2**	**No**	**No**
Bakersfield-Golden	64	Yes	**18.5**	**No**	**No**
Bakersfield-California	62	Yes	**18.5**	**No**	**No**
Bakersfield-Planz	65	Yes	**18.9**	**No**	**No**
San Joaquin Valley Air Basin					**No**

PM2.5 data review for trend analysis is limited since PM2.5 monitoring has been in progress for less than a decade. Figures 1-6 and 1-7 provide 24-hour and annual design values by site for 2004, 2005, and 2006:

- The 2006 24-hour PM2.5 design value is the 3-year average of the 98th percentile values of 2004, 2005, and 2006.
- The 2005 24-hour PM2.5 design value is the 3-year average of the 98th percentile values of 2003, 2004, and 2005.

- The 2004 24-hour PM2.5 design value is the 3-year average of the 98th percentile values of 2002, 2003 and 2004.

Figure 1-6 shows that although the Bakersfield-California site's data yielded 24-hour design values above the standard in 2004 and 2005, all Valley sites showed design values below the 24-hour standard in 2006. Figure 1-7 shows that although several Valley sites still had design values over the annual standard in 2006, annual design values are improving overall. More PM2.5 data analysis is available in Appendix A.

Figure 1-6 24-hour Design Values at Valley Sites, 2004, 2005, and 2006

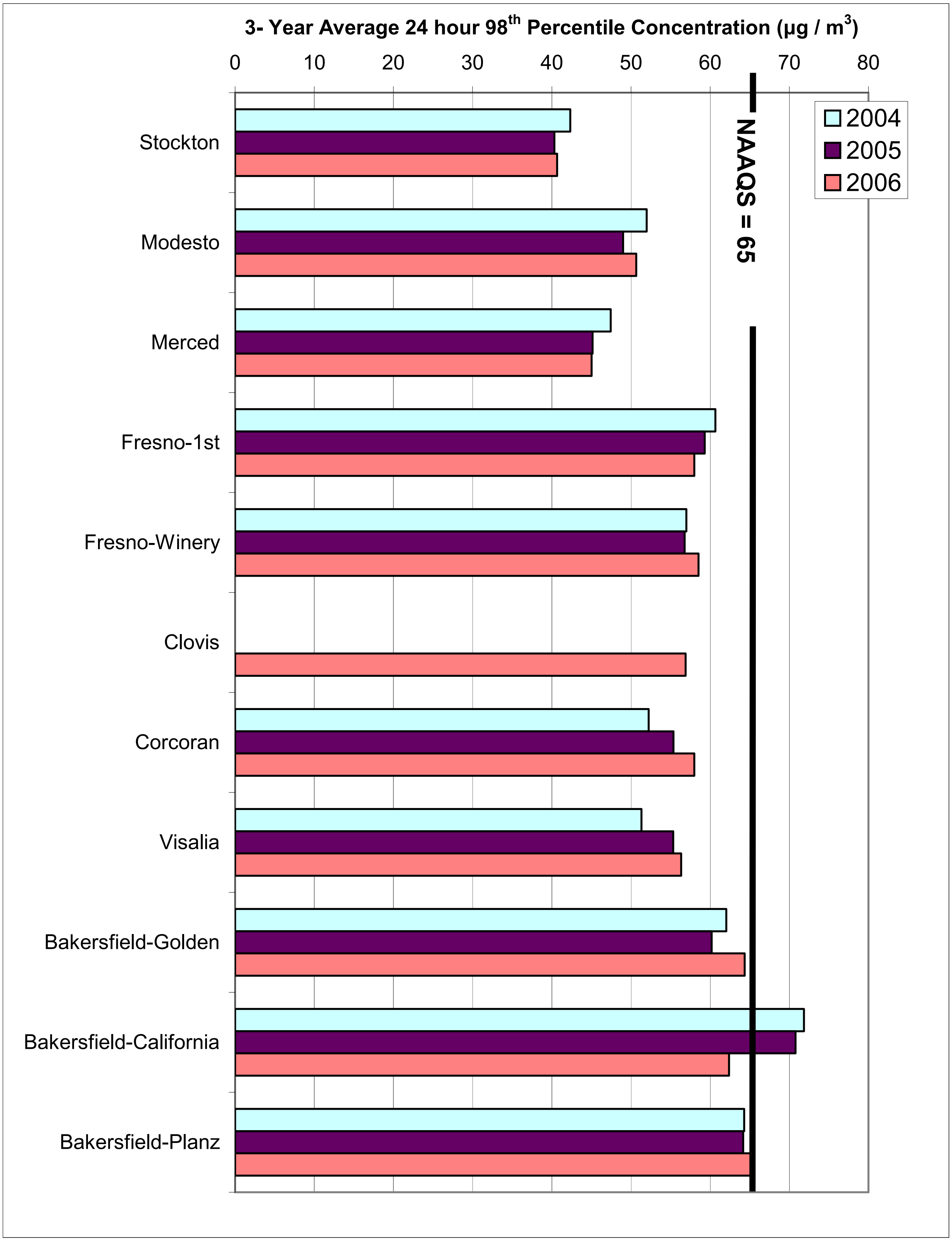


Figure 1-7 Annual Design Values at Valley Sites, 2004, 2005, and 2006