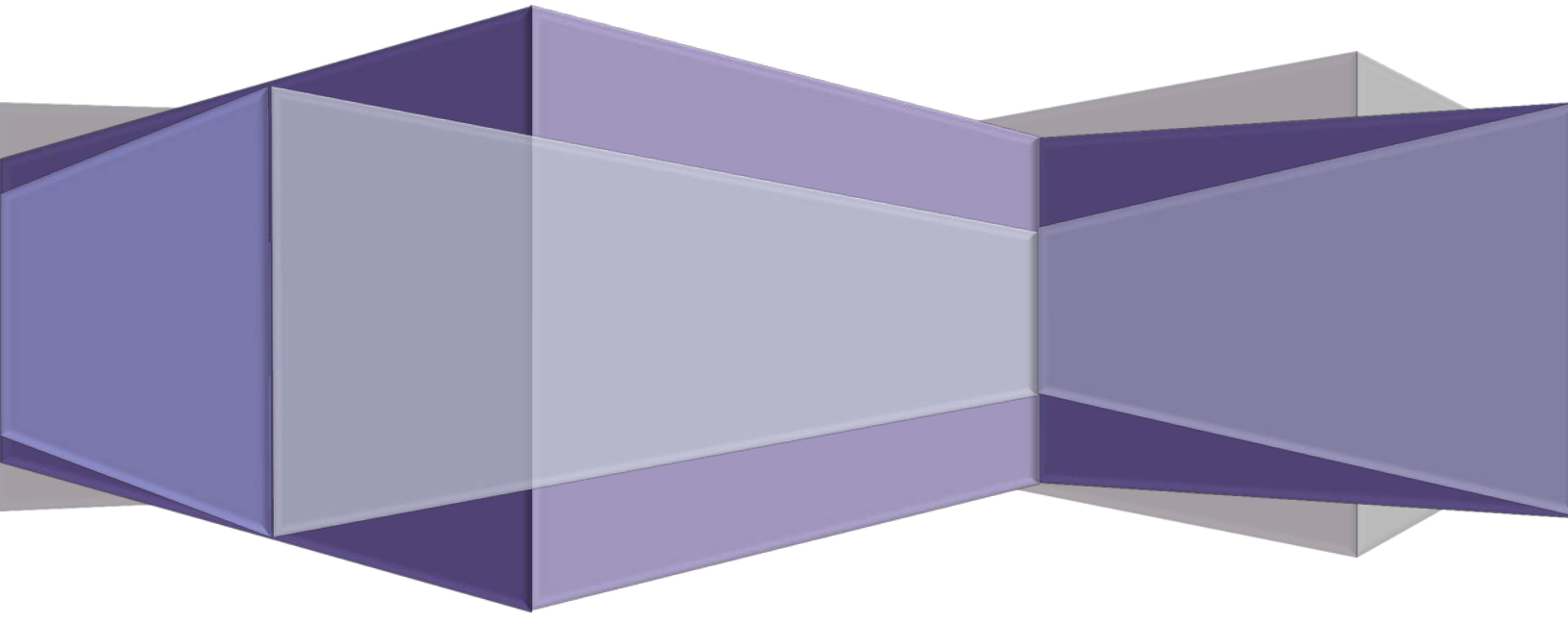
CHAPTER 1

Introduction

2016 Moderate Area Plan for the 2012 PM2.5 Standard



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Chapter 1: Introduction

The U.S. Environmental Protection Agency (EPA) periodically reviews and establishes health-based air quality standards (often referred to as National Ambient Air Quality Standards, or NAAQS) for ozone, particulates, and other pollutants. Although the San Joaquin Valley's (Valley) air quality is steadily improving, the Valley experiences unique and significant difficulties in achieving these increasingly stringent standards. Over the past couple of decades, the San Joaquin Valley Air Pollution Control District (District) has implemented several generations of emissions control measures for those stationary and area sources under its jurisdiction. Similarly, the California Air Resources Board (ARB) has adopted regulations for mobile sources. Together, these efforts represent the nation's toughest air pollution emissions controls and have greatly contributed to reduced ozone and particulate matter concentrations in the Valley. Despite the significant progress under these regulations, greatly aided by the efforts of Valley businesses and residents, many air quality challenges remain, including attainment of the 2012 PM2.5 standard, EPA's most recent standard for particulate matter that is 2.5 microns or less in diameter. Significant additional emissions reductions will be needed, particularly with respect to mobile sources under ARB and EPA jurisdiction that make up over 85% of remaining Valley emissions.

The District is developing this *2016 Moderate Area Plan for the 2012 PM2.5 Standard (2016 PM2.5 Plan)* to satisfy federal Clean Air Act (CAA) requirements under EPA's 2012 PM2.5 standard. This *2016 PM2.5 Plan* demonstrates the impracticability of the Valley to attain the federal 2012 PM2.5 standard by the Moderate nonattainment area deadline of 2021, and includes a request for reclassification from Moderate to Serious as provided for under CAA §188(b).

1.1 NATIONAL AMBIENT AIR QUALITY STANDARDS

1.1.1 EPA's Standard Setting Process

CAA §108 and §109 require EPA to set health-based standards for six criteria pollutants, including PM2.5. EPA periodically reviews existing standards to consider the most recent health studies. These reviews are to be conducted every five years, though in the past, some standard revisions did not meet the 5-year deadline. The review process starts as the Clean Air Scientific Advisory Committee (CASAC) analyzes available science and then, if supported by research, suggests to EPA a range of revised standards that would protect public health from the adverse effects of air pollution. The EPA Administrator appoints CASAC members, who are non-EPA experts in the fields of science, engineering, or the social sciences. The committee is to provide objective, independent advice to EPA on the technical basis for the standard. Thousands of peer-reviewed scientific studies are considered as EPA formulates its proposed standard, which is made available for scientific peer review and public comment. EPA then sets the standard. Setting new standards every five years results in confusing, overlapping standards, and duplicative requirements.

In evaluating and setting new standards, federal law prohibits EPA from taking into account economic feasibility. However, economic feasibility issues can be considered as EPA promulgates the implementation rules that establish the deadlines for meeting the standards and in devising individual control measures aimed at attaining the standards.

Once a standard is set, EPA designates an area as attainment or nonattainment based on the most recent three years of air quality data available. For particulate matter standards, EPA automatically classifies nonattainment areas as Moderate by order of law pursuant to CAA Subpart 4 requirements.

EPA also adopts implementation rules to guide states and local air districts as they prepare state implementation plans[1] (SIPs) to bring areas into attainment with the standard. While EPA cannot consider costs or difficulty in setting the standards, costs and difficulty are inescapable for local air districts as they determine the best way to bring areas into attainment. That being said, local air districts must meet planning and attainment requirements to avoid federal sanctions and to improve public health.

There are a number of serious penalties and risks associated with any failure to submit approvable attainment strategies for meeting federal standards. Upon development of an attainment strategy, an area submits the plan to EPA for approval. If EPA finds that an area fails to submit an approvable plan on time or fails to implement plan commitments after the plan has been approved, then the following sanctions may be applied:

- Two-to-one offset requirement for major sources, leading to a de facto ban on new and expanding business
- Loss of federal highway funds
- A federal implementation plan (FIP), which would result in a loss of local control

Once EPA approves a SIP, that plan becomes federally enforceable.

[1] Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements; Final Rule. 81 Fed. Reg. 164, pp. 58010-58162. (2016, August 24). (to be codified at 40 CFR Parts 50, 51, and 93). https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf

1.1.2 Federal PM2.5 Standards and Implementation

Table 1-1 summarizes EPA's 2012 PM2.5 national ambient air quality standard and the timing of District actions under the standard consistent with CAA requirements.

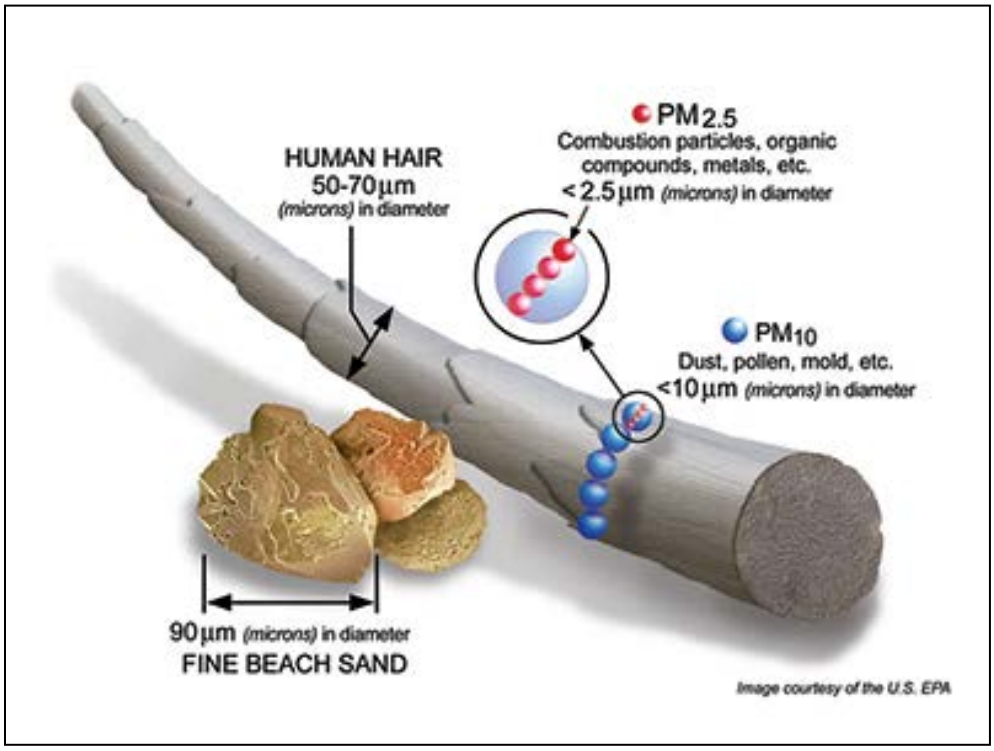
Table 1-1 2012 PM2.5 National Ambient Air Quality Standard

Year	Milestone
2012	EPA sets NAAQS: Annual: 12 µg/m³
2013	D.C. Circuit Court makes Subpart 4 finding
2014	-
2015	EPA designates Valley as a Moderate nonattainment area (effective 4/15/2015) EPA proposes an implementation rule for Subpart 4
2016	EPA finalizes implementation rule for Subpart 4 (August 2016) Attainment plan due to EPA October 15, 2016
2017-2025	(2021) Attainment deadline for Moderate nonattainment areas (not later than 6 years after designation) (2025) Attainment deadline for Serious nonattainment areas (not later than 10 years after designation)

1.2 PM2.5 POLLUTION DEFINED

Particulate matter (PM) is a mixture of solid particles and liquid droplets in the air. PM can be emitted directly into the atmosphere (primary PM), or can form as secondary particulates in the atmosphere through the photochemical reactions of precursors (when precursors are energized by sunlight). Thus, PM is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals and soil or dust particles. PM10 is PM that is 10 microns or less in diameter, and the PM2.5 subset includes smaller particles that are 2.5 microns or less in diameter (see Figure 1-1).

Figure 1-1 PM10, PM2.5, Human Hair, and Fine Beach Sand



1.2.1 Nature and Formation of PM2.5

The nature of PM2.5 formation in the Valley is highly complex, and attainment of the 2012 PM2.5 standard is not a one-size-fits-all effort. Significant differences in regional natural environments and the relative contribution of precursor emissions requires regionally specific modeling and regionally specific control strategies. Also, differences within PM2.5 itself, directly-emitted PM2.5 versus secondary PM2.5 forming in the atmosphere through series of chemical reactions, adds to the complexity inherent in modeling and planning efforts.

This complexity is accounted for in the modeling and other scientific analyses conducted for this plan. The District, ARB, and researchers have developed and refined these analytical tools, including regional modeling, over many years. The District's regional modeling protocol notes that the Valley is one of the most studied airsheds in the world in terms of the number of publications in peer-reviewed scientific journals and other major reports. Such scientific analyses, and the field studies providing data for these analyses, are the foundation of the modeling efforts for this plan. Public and private sector partnership through the San Joaquin Valleywide Air Pollution Study Agency (Study Agency) provided funding and coordination for many of these studies.

Unlike ozone, which is a fairly simple molecule of three oxygen atoms, PM2.5 can be composed of any material that has a diameter of 2.5 microns or less. Among the chemical precursors that can form secondary PM2.5 are nitrogen oxides (NOx), volatile organic compounds (VOCs), sulfur dioxide (SO_2), and ammonia (NH_3). In addition,

naturally occurring emissions from biogenic sources, such as plants, can also add to the formation of PM2.5.

The resulting ambient PM2.5 mixture can include aerosols (fine airborne solid particles and liquid droplets) consisting of components of nitrates, sulfates, elemental carbon, organic carbon compounds, acid aerosols, trace metals, geological materials, and more.

The complex formation and composition of PM2.5 requires a robust planning effort, where various components of the mass can be targeted for reduction. A control strategy that targets reductions among the precursors of PM2.5 has been shown to have a positive impact in reducing the total formed mass. Both direct PM2.5 and its precursors are tracked and projected within the emissions inventory.

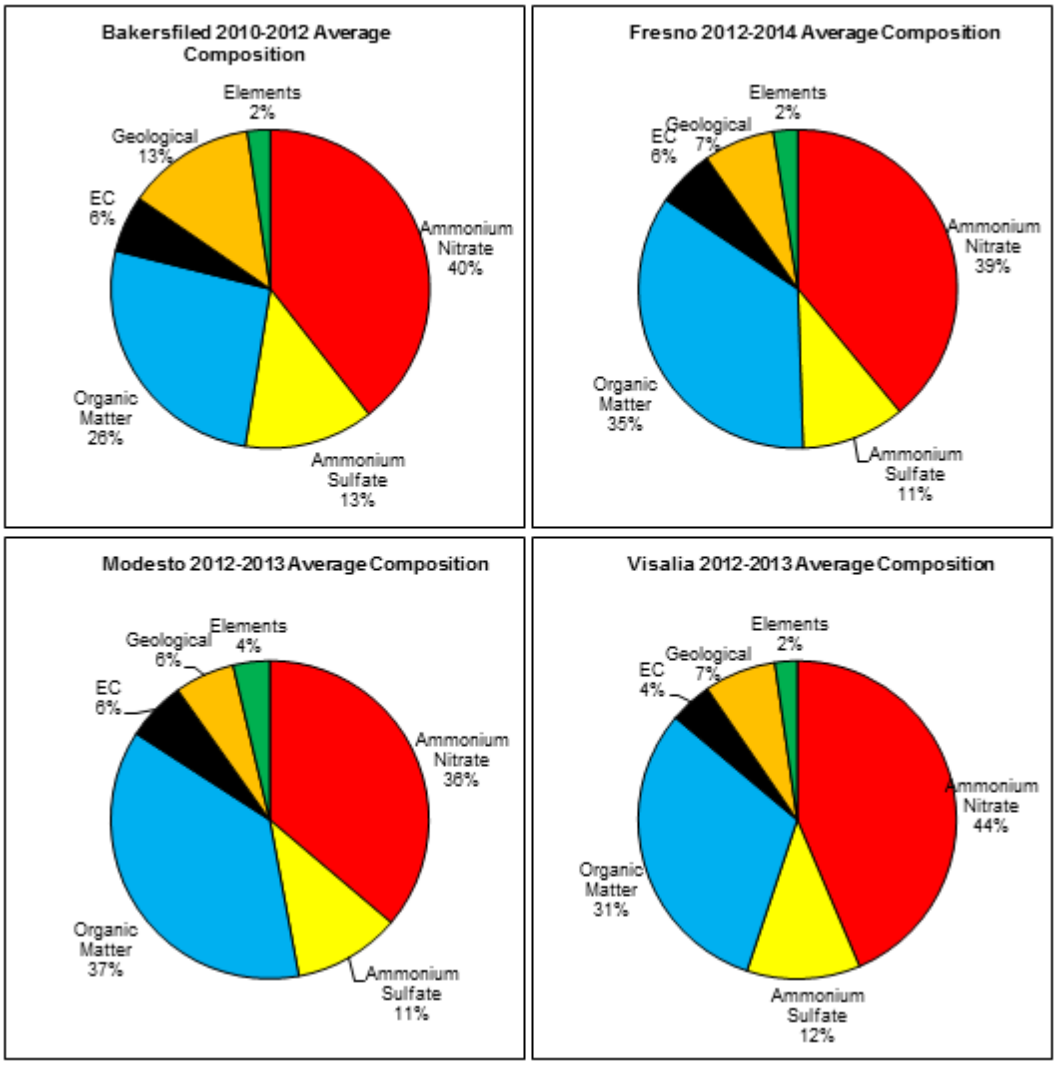
1.2.2 PM2.5 Species in the Valley

PM2.5 in the Valley is comprised of many species that contribute to the total PM2.5 mass, as summarized in Table 1-2 and Figure 1-2 below. This complex mixture is attributable to stationary, mobile, and area-wide sources, as well as naturally occurring emissions. Although the list of species contributing to PM2.5 in the Valley is lengthy, it can be grouped into larger representative categories. The following is a brief description of how each of these larger species categories are formed and emitted into the atmosphere.

Table 1-2 Summaries of PM2.5 Species

PM2.5 Species	Description
Organic carbon	Directly emitted, primarily from combustion sources (e.g. residential wood combustion). Also, smaller amounts attached to geologic material and road dusts. May also be emitted directly by natural/biogenic sources.
Elemental carbon	Also called soot or black carbon; formed during incomplete combustion of fuels (e.g. diesel engines).
Geologic material	Road dust and soil dust that are entrained in the air from activity, such as soil disturbance or airflow from traffic.
Trace metals	Identified as components from soil emissions or found in other particulates having been emitted in connection with combustion from engine wear, brake wear, and similar processes. Can also be emitted from fireworks.
Sea salt	Sodium chloride in sea spray where sea air is transported into the Valley.
Secondary organic aerosol	Secondary particulates formed from photochemical reactions of organic carbon.
Ammonium nitrate	Reaction of ammonia and nitric acid, where the nitric acid is formed from nitrogen oxide emissions, creating nitric acid in photochemical processes or nighttime reactions with ozone.
Ammonium sulfate	Reaction of ammonia and sulfuric acid, where the sulfuric acid is formed primarily from sulfur oxide emissions in photochemical processes, with smaller amounts forming from direct emissions of sulfur.
Combined water	A water molecule attached to one of the above molecules.

Figure 1-2 Annual PM2.5 Chemical Composition in the San Joaquin Valley[2]



1.2.3 PM2.5 and Associated Health Impacts

Any particles 10 microns or less are considered respirable, meaning they can be inhaled into the body through the mouth or nose. PM10 can generally pass through the nose and throat and enter the lungs. PM2.5 can be inhaled more deeply into the gas exchange tissues of the lungs, where it can be absorbed into the bloodstream and carried to other parts of the body.

The potential health impacts of particle pollution are linked to the size of the particles, with the smaller particles having larger impacts. Numerous studies link PM2.5 to a variety of health problems, including aggravated asthma, increased respiratory symptoms (irritation of the airways, coughing, difficulty breathing), decreased lung function in children, development of chronic bronchitis, irregular heartbeat, non-fatal

[2] Source: California Air Resources Board

heart attacks, increased respiratory and cardiovascular hospitalizations, lung cancer, and premature death. Children, older adults, and individuals with heart or lung diseases are the most likely to be affected by PM2.5. Many studies have quantified and documented the health benefits of attaining the air quality standards for PM.

Understanding various PM2.5 species, including how each species is formed, how much each contributes to the Valley's total PM2.5 concentrations, and how each is linked to different public health impacts, is of the utmost importance for the development of an effective, health-protecting control strategy. For example, ammonium nitrate is estimated to comprise about 40% of the Valley's annual average PM2.5 concentrations, but it is generally regarded as having relatively low toxicity compared to other PM2.5 species, such as organic or elemental carbon.

In addition to affecting human health, air pollution also affects the health of the natural environment. PM2.5 can be transported from sources hundreds of miles away to contribute to visibility problems at remote locations, such as the Sierra Nevada mountain range and associated national parks. As PM settles out of the air, it can make lakes and streams acidic, change an ecosystem's nutrient balance, and affect ecosystem diversity. PM can affect vegetation by damaging foliage, disrupting the chemical processes within plants, reducing light adsorption, and disrupting photosynthesis. As the Valley progresses toward attainment of EPA's human-health-based PM2.5 standards, there will also be less harmful impacts to the surrounding natural environment.

1.2.4 Health Risk Reduction Strategy

EPA NAAQS are the primary driving force for new emissions controls that result in air quality improvements and health benefits to Valley residents. In the conventional planning process for attaining these standards, success in protecting public health is defined by whether the standards are met at all air monitors. In effect, the reduction in PM2.5 mass, which shows progress toward attainment of the standard, serves as the surrogate for population exposure and risk.

NAAQS, as currently established, are essentially *mass-based* standards. In the case of PM2.5, the current standards do not account for particle size distribution, chemical species composition, surface area, and other factors of health risk. In contrast, recent health-science research has substantially deepened our knowledge of air pollutant health risk beyond the CAA framework and EPA standards. There is a growing recognition within the scientific community that the NAAQS alone can be incomplete measures of public exposure to air pollution. Thus, while the CAA NAAQS and SIP process is motivated by public health, the process alone does not fully address public health impacts of ambient air pollution. To fully address potential public health benefits, the District's attainment strategy uses a more comprehensive, multidimensional

population exposure assessment approach that goes beyond ambient mass measurements.[3]

The District Governing Board adopted a research-driven Risk-based Strategy (RBS) designed to maximize public health improvements resulting from the District's attainment strategies and related initiatives. The overall goal of the RBS was to minimize cumulative population exposure to air pollution and corresponding health risks in the region. In May 2013, the District Governing Board rebranded this strategy as the Health Risk Reduction Strategy (HRRS) in response to criticisms and skepticism by a number of air quality advocates. The District has integrated the HRRS into the development of air quality attainment plans.

A number of the District programs have been influenced by the underlying principles and goals of the HRRS and provide a model of the success and added potential benefits possible under this strategy. The following are a few examples.

- **District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters) and the District's corresponding Check-Before-You-Burn program** have both been reducing harmful species of PM2.5 where and when those reductions are most needed—in impacted urbanized areas when the local weather is forecast to hamper PM dispersion. In 2008, the Central Valley Health Policy Institute found that District wood burning curtailments on days with high PM concentrations reduced annual PM exposure by about 13% in Bakersfield and Fresno, resulting in an estimated 59 to 121 avoided cases of annual premature mortality.[4]

  The District's *2012 PM2.5 Plan* committed to amend the Rule 4901 in 2016 with compliance beginning the winter season of 2016-2017. When the District Board adopted the *2012 PM2.5 Plan,* guided by the HRRS, they directed the District to amend Rule 4901 in 2014. As a result, the rule was amended and implemented two years ahead of the SIP commitment. The significant increase in curtailment days resulting from the lowered threshold has resulted in a reduction in nighttime neighborhood exposure to PM 0.1. The District's prioritization of Rule 4901 is one of the best examples of a District policy aimed at maximizing public health benefits based on a rigorous assessment of population exposure and risk.

- **District grant programs** reach beyond the current CAA NAAQS-SIP process to reduce emissions in advance of or beyond regulations.

[3] Lippman, M. (2012, April 16). Presentation: Results from National Particle Component Toxicity (NPACT) Program and NYU: Toxicology Findings, Integration, and implications. Presented at the Annual Meeting of the Health Effects Institute (HEI) in Chicago, IL, April 15–17, 2012. Presentation retrieved from http://www.healtheffects.org/Slides/AnnConf2012/Lippmann-MonPM.pdf

[4] Lighthall, D., Nunes, D., & Tyner, T.R. (2009). Environmental Health Evaluation of Rule 4901: Domestic Wood Burning. Fresno, CA: Central Valley Health Policy Institute for the San Joaquin Valley Air Pollution Control District. Retrieved from http://www.fresnostate.edu/chhs/cvhpi/documents/wood-burning-report.pdf

- **The District's information and educational programs, such as the Real-Time Air Quality Advisory Network (RAAN),** also contribute to the HRRS. RAAN uses real-time data from air monitoring stations throughout the Valley to provide hour-by-hour air quality updates to schools and other subscribers. Subscribers can use this information to make informed decisions and plan outdoor activities for times with the best air quality, reducing potential air quality health risks.

- **District-supported health research.** As part of the District's HRRS, the District is playing an active role in funding leading edge health research focusing on the Valley population. The District will continue to seek out and fund research opportunities that further the understanding of PM-related impacts on public health.

1.3 CHALLENGES TO ATTAINMENT

1.3.1 Challenges of the Natural Environment

The Valley's natural environment supports one of the most productive agricultural regions in the country. However, these same natural factors present significant challenges for air quality, the surrounding mountains trap pollution and block air flow, and the mild climate keeps pollutant-scouring winds at bay most of the year.

The Valley, as seen in Figure 1-3, is an inter-mountain valley encompassing nearly 25,000 square miles. Surrounded by mountain ranges to the west, east, and south, the air flow through the Valley can be blocked, leading to severely constrained dispersion. During the winter, high-pressure systems can cause the atmosphere to become stagnant for longer periods of time, where wind flow is calm and air movement is minimal. These stagnant weather systems can also cause severe nighttime temperature inversions, which exacerbate the build-up of PM2.5 and related precursors both beneath and above the evening inversion layer.

Figure 1-3 San Joaquin Valley Air Basin

Under normal conditions, temperature decreases with increasing altitude, but during temperature inversions the temperature gradient is reversed, with temperatures *increasing* with altitude, causing warmer air to be above cooler air. Temperature inversions are common in the Valley throughout the year. Since the inversion is often lower than the height of the surrounding mountain ranges, the Valley effectively becomes a bowl capped with a lid that traps emissions near the surface. When horizontal dispersion (transport flow) and vertical dispersion (rising air) are minimized, PM2.5 concentrations can build quickly, especially in the winter. These naturally occurring meteorological conditions have the net effect of spatially concentrating direct PM2.5 concentrations near their sources; promoting the formation and regional buildup of secondary species; and chemically aged organic carbon species, resulting in an increase in their relative toxicity.

Given these challenges, the Valley needs even more effective emissions reductions to attain the federal PM2.5 standard; and the District continues to pursue these reductions through its numerous air quality attainment plans, prohibitory regulatory control strategy

and innovative non-regulatory emission reduction strategy. However, given the enormity of the reductions needed for attainment, mobile sources, particularly in the goods movement sector, must transition to near-zero emission levels through the implementation of transformative measures. The District does not have the authority to implement regulations requiring tailpipe emissions standards on mobile sources. New state and federal regulations coupled with a robust incentive-based emission reduction strategy are necessary to have any chance to achieve the enormous reductions that are necessary to attain the federal standards. EPA must take responsibility for implementing regulatory and incentive-based measures for sources under their jurisdiction.

1.3.2 Population Growth in the San Joaquin Valley

To further exacerbate current air quality challenges, the Valley is one of the fastest growing regions in the state. The Population Research Unit of the California Department of Finance (DOF) released revised population growth projections in December 2014 that demonstrate how significantly the Valley's population is expected to grow in the coming years.

Based on the revised 2015 to 2030 DOF data, the Valley's population is expected to increase by 25.3% (Table 1-3). In contrast, the total population for the State of California is projected to increase by only 13.3% over the same time period. Increasing population generally means increases in air pollutant emissions as a result of increased consumer product use and more automobile and truck vehicle miles traveled (VMT). In addition to increased VMT resulting from increased Valley population, the Valley will also see increased vehicular traffic along the State's major goods and people movement arteries, both of which run the length of the Valley.

Table 1-3 Estimated Valley Population by County, 2015-2030[5]

County	Projected 2015	Projected 2020	Projected 2025	Projected 2030
Fresno	981,681	1,055,106	1,130,406	1,200,666
Kern*	894,492	989,815	1,088,711	1,189,004
Kings	155,122	167,465	180,355	192,562
Madera	157,722	173,146	189,267	204,993
Merced	269,572	288,991	313,082	337,798
San Joaquin	723,506	766,644	822,755	893,354
Stanislaus	538,689	573,794	611,376	648,076
Tulare	467,170	498,559	537,015	578,858
Total	***4,187,954***	***4,513,520***	***4,872,967***	***5,245,311***

** Includes entire Kern County population*

[5] California Department of Finance. Retrieved on June 29, 2015 from: http://www.dof.ca.gov/research/demographic/reports/projections/view.php

While the bulk of the Valley's remaining emissions come from mobile sources outside of the District's regulatory authority, under the federal Clean Air Act, the responsibility to bring the region into attainment with the federal standards rests with the local air district. Additionally, the region will be subject to sanctions that would be devastating to the Valley's economy if mobile sources under federal regulatory authority are not adequately controlled. As such, given the enormity of the reductions needed for attainment, mobile sources, particularly in the goods movement sector, must transition to near-zero emission levels through the implementation of transformative measures. The District does not have the authority to implement regulations requiring ultra-low tailpipe emissions standards on mobile sources. New state and federal regulations coupled with a robust incentive-based emission reduction strategy are necessary to have any chance to achieve the enormous reductions that are necessary to attain the federal standards. EPA must take responsibility for implementing regulatory and incentive-based measures for sources under their jurisdiction.

1.4 PUBLIC PROCESS

To ensure that the public has the opportunity for meaningful participation in the development of this *2016 PM2.5 Plan* the District has provided multiple opportunities for the public to learn more about this plan and to provide the District with comments or to request more information. The District has presented regular updates on the *2016 PM2.5 Plan* at public meetings, such as meetings of District Governing Board, Citizens Advisory Committee (CAC), and Environmental Justice Advisory Group (EJAG).

Table 1-4 *2016 PM2.5 Plan* Development Timeline

Date	Meeting Summary
Ongoing	Continuous updates on plan development process at public meetings of the Governing Board, Citizen's Advisory Committee, and Environmental Justice Advisory Group. Each update is followed by an opportunity for the public to provide comments and ask questions.
August 2016	Proposed plan published for public review and comment
September 2016	Present proposed plan to the District Governing Board for consideration at a public hearing
October 2016	ARB hearing to adopt the District Governing Board approved plan