CHAPTER 2

Impracticability Demonstration and Request for Reclassification

2016 Moderate Area Plan for the 2012 PM2.5 Standard

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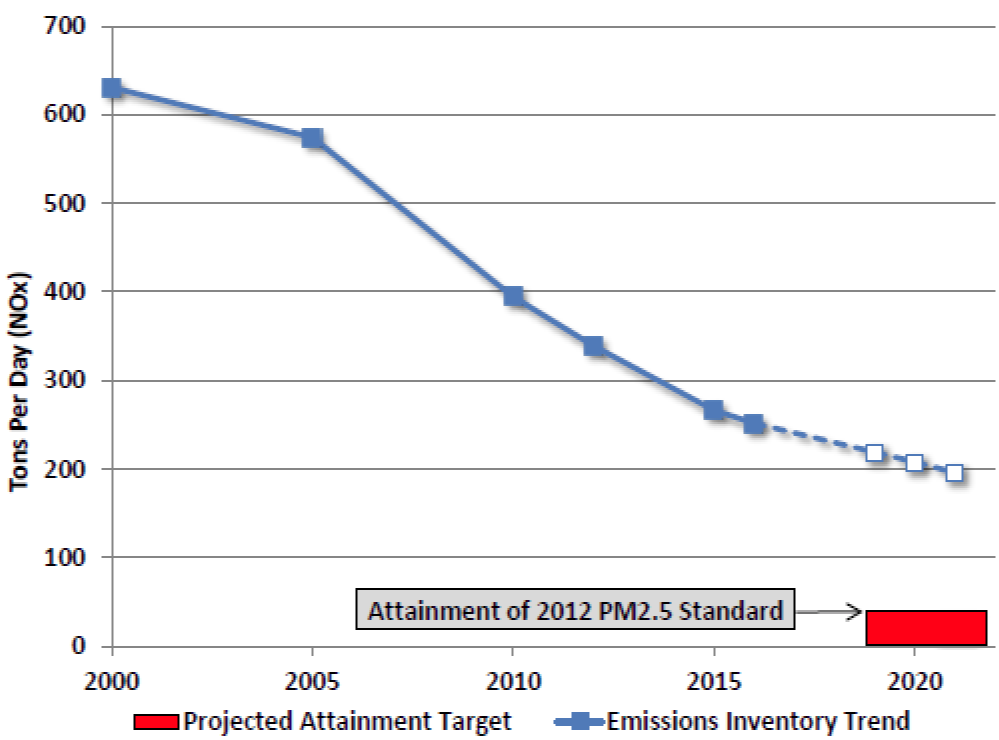
Chapter 2: Impracticability Demonstration and Request for Reclassification

This chapter demonstrates that attainment by the Moderate area deadline date of December 31, 2021 for the 2012 PM2.5 standard is not practicable and as such provides the supporting documentation necessary for the U.S. Environmental Protection Agency (EPA) to reclassify the San Joaquin Valley air basin (Valley) as a Serious nonattainment area.

2.1 VALLEY ATTAINMENT OF THE 2012 STANDARD BY MODERATE AREA ATTAINMENT DEADLINE OF 2021 IS NOT PRACTICABLE

Although the Valley has some of the most stringent regulations in the nation (see Chapter 3) that will continue to bring about significant reductions into the future, the Valley will need enormous additional emission reductions, specifically from sources that are under the state and federal jurisdiction, in order to meet this standard. As shown below, attainment is not possible by the mandated Moderate area deadline of 2021.

Figure 2-1 San Joaquin Valley NOx Emissions Inventory and Target for Attainment of 2012 PM2.5 Standard



Under the Clean Air Act, demonstrating attainment requires a clean data finding for three consecutive years from 2019 through 2021. This means that the needed reductions must be achieved by 2019 or extra reductions must be made in 2020 or 2021 for the three-year average concentration to be below the standard. As illustrated in Figure 2-1, this is physically impossible given that the ARB truck and bus regulation and off-road engine regulation will not be fully implemented until 2023.

Furthermore, modeling for this plan, as summarized in Section 2.3 – Summary of Modeling Results, confirms that attainment of the 2012 PM2.5 standard by 2021 is not practicable.

2.2 REQUEST FOR RECLASSIFICATION FROM MODERATE AREA TO SERIOUS AREA

Pursuant to CAA subpart 4 §188(b) a Moderate area may be reclassified for one of the following two circumstances:

1. Before the Attainment Date: Any Moderate area that EPA determines cannot practicably attain the NAAQS by the attainment date.

2. Upon Failure to Attain: Any Moderate area that EPA finds is not in attainment after the applicable attainment date shall be reclassified by operation of law as a Serious area.

Given the impracticability of meeting the Moderate attainment deadline date for this standard, the Valley should be reclassified as a Serious nonattainment area. This reclassification will provide the Valley the time needed to develop an attainment plan aimed at achieving expeditious attainment of the standard.

For a Serious area, the attainment date will be as expeditiously as practicable no later than 2025. The District will demonstrate an appropriate attainment year in a new attainment plan satisfying Serious nonattainment area federal mandates. As required by the Clean Air Act, the new attainment plan will be submitted to EPA no later than four years after EPA reclassification of the Valley to Serious nonattainment.

2.3 SUMMARY OF MODELING RESULTS

[*This section provided by the California Air Resources Board*]

Photochemical modeling plays a crucial rule in demonstrating attainment of the national ambient air quality standards based on projected future year emissions. Currently, San Joaquin Valley (SJV or Valley) is designated as a Moderate nonattainment area for the 2012 U.S. EPA annual $PM_{2.5}$ standard (i.e., 12 µg/m^3) with an attainment date of 2021. However, recent $PM_{2.5}$ trends in the Valley brought on by a sustained drought, and supported by the modeling assessment described below, illustrate the impracticability of attaining the standard by 2021. This would lead to a reclassification of the Valley from a Moderate to Serious nonattainment area, as well as a new State Implementation Plan[1] (SIP) timeline and attainment date of 2025.

The findings from the modeling assessment are summarized below. Additional descriptions of the model inputs, modeling procedures, and results can be found in Appendix A.

The current modeling approach draws on the products of large-scale, scientific studies as well as past $PM_{2.5}$ SIPs in the region, collaboration among technical staff of state and local regulatory agencies, and from participation in technical and policy groups in the region. In this work, the Weather Research and Forecasting (WRF) model version 3.6 was utilized to generate the annual meteorological fields. The Community Multiscale Air Quality (CMAQ) Model version 5.0.2 with state-of-the-science aerosol treatment was used for modeling annual $PM_{2.5}$ in the Valley. Other model inputs and configuration, including the modeling domain definition, chemical mechanisms, initial and boundary conditions, and emission processing can be found in the Modeling Protocol and Modeling Emissions Inventory Appendices.

The U.S. EPA modeling guidance[2] recommends using modeling in a “relative” rather than “absolute” sense. Based on analysis of recent years’ ambient $PM_{2.5}$ levels and meteorological conditions leading to elevated $PM_{2.5}$ concentrations, the year 2013 was selected for baseline modeling calculations.

Specifying the baseline design value (DV) is a key consideration in the model attainment test, because this value is projected forward to the future and used to test for future attainment of the standard at each monitor. To minimize the influence of year-to- year variability in demonstrating attainment, the U.S. EPA optionally allows the averaging of three DVs, where one of the DV years is the same as the baseline emissions inventory and modeling year. This average DV is referred to as the baseline (or reference) DV. For a baseline modeling year of 2013, this would typically mean that the average of the

[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

[2] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM- RH_Modeling_Guidance-2014.pdf

2013, 2014, and 2015 DVs would be used. However, at the time of this work the 2015 DVs were still preliminary (i.e., 2015 measurements had not been finalized), so the average DV instead includes 2012, 2013, and 2014 (see the Table 2-2 for the baseline DV utilized in the modeling assessment).

In order to use the modeling in a relative sense, three simulations were conducted: 1) base year simulation for 2013, which demonstrated that the model reasonably reproduced the observed $PM_{2.5}$ concentrations in the Valley; 2) reference (or baseline) year simulation for 2013, which was the same as the base year simulation, but excluded exceptional event emissions such as wildfires; 3) future year simulation for 2021, which was the same as the reference year simulation, except projected emissions for 2021 were used in lieu of the 2013 emissions.

Table 2-1 shows the 2013 and 2021 SJV annual anthropogenic emissions for the five $PM_{2.5}$ precursors. From 2013 to 2021, anthropogenic emissions in the SJV are estimated to drop approximately 38%, 8%, 7%, 2%, and 1% for nitrogen oxides (NO_x), reactive organic gases (ROG), primary $PM_{2.5}$, sulfur oxides (SO_x), and ammonia (NH_3), respectively. Among these five precursors, anthropogenic NO_x emissions show the largest relative reduction, dropping from 318.2 tons/day in 2013 to 196.1 tons/day in 2021. Anthropogenic ROG emissions will drop from 319.2 tons/day to 292.8 tons/day, reflecting an 8% reduction from 2013 to 2021.

Table 2-1 SJV Annual Planning Emissions for 2013 and 2021

Category	NO_x	ROG	$PM_{2.5}$	SO_x	NH_3
			2013 (tons/day)		
Stationary	38.6	85.1	8.9	7.2	13.8
Area	8.1	150.3	42.3	0.3	310.7
On-road Mobile	183.2	49.9	6.4	0.6	4.5
Other Mobile	88.3	33.9	5.8	0.2	0.0
Total	318.2	319.2	63.5	8.4	329.1
			2021 (tons/day)		
Stationary	29.8	90.5	9.1	6.9	15.3
Area	8.1	152.4	41.9	0.3	306.4
On-road Mobile	88.0	23.3	3.3	0.6	4.2
Other Mobile	70.2	26.7	5.0	0.3	0.0
Total	196.1	292.8	59.3	8.2	325.9
Change in total emissions in 2021 compared to 2013	-38%	-8%	-7%	-2%	-1%

In this relative approach, the fractional change (or ratio) in $PM_{2.5}$ concentration between the model future year (2021) and model baseline year (or reference year, 2013) are calculated. These ratios are called RRFs. Since $PM_{2.5}$ is comprised of different chemical species, which respond differently to changes in emissions of various pollutants, separate RRFs were calculated for individual $PM_{2.5}$ specie. In addition, because of potential seasonality in $PM_{2.5}$ formation mechanisms, RRFs for each specie were also calculated separately for each quarter.

The RRF for a specific $PM_{2.5}$ component *j* for each quarter is calculated using the following expression:

$$RRF_j = \frac{[C]_{j,\,future}}{[C]_{j,\,reference}} \quad (1)$$

Where $[C]_{j,\,future}$ is the modeled quarterly mean concentration for component *j* predicted for the future year averaged over the 3x3 array of grid cells surrounding the monitor, and $[C]_{j,reference}$ is the same, but for the reference year simulation.

The measured FRM/FEM (i.e., Federal Reference Method/Federal Equivalent Method) $PM_{2.5}$ must be separated into its various chemical components. Species concentrations were obtained from the four $PM_{2.5}$ chemical speciation sites in the Valley. These four speciation sites are located at: Bakersfield – California Avenue, Fresno – Garland, Visalia – North Church, and Modesto – 14th Street. Since not all of the 16 FRM/FEM $PM_{2.5}$ sites in the Valley have collocated speciation monitors, the speciated $PM_{2.5}$ measurements at one of the four speciation sites were utilized to represent the speciation profile at each of the FRM/FEM sites based on geographic proximity, analysis of local emission sources, and measurements from previous field studies.

Since the FRM $PM_{2.5}$ monitors do not retain all of the $PM_{2.5}$ mass that is measured by the speciation samplers, the U.S. EPA modeling guidance recommends using the SANDWICH approach (Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbon Hybrid material balance)" described by Frank[3] to apportion the FRM $PM_{2.5}$ mass to individual $PM_{2.5}$ species based on nearby chemical speciation measurements. Based on completeness of the data, $PM_{2.5}$ speciation data from 2010 – 2013 were utilized. For each quarter, percent contributions from individual chemical species to FRM/FEM $PM_{2.5}$ mass were calculated as the average of the corresponding quarter from 2010-2013.

Future DVs for each site are given in Table 2-2. Corresponding RRFs, as well as base and projected future year annual $PM_{2.5}$ composition at each monitor are given in Tables 2-3, 2-4, and 2-5 (Note that the annual RRFs and composition are for reference only and that in the actual future year DV calculation, separate calculations were performed for each quarter and not on the annual average). The Bakersfield-Planz site has the highest projected future year DV at 14.8 $\mu g/m^3$, which is well above the 2012 annual $PM_{2.5}$ standard of 12 $\mu g/m^3$, but below the 2006 annual $PM_{2.5}$ standard of 15 $\mu g/m^3$. From the base to future year, there are significant reductions projected for ammonium nitrate and elemental carbon (EC), modest reduction in organic matter (OM), almost no change in sulfate, and a slight increase in crustal material (i.e., other primary $PM_{2.5}$ such as fugitive dust emissions).

[3] Frank, N.H., 2006, Retained nitrate, hydrated sulfates, and carbonaceous mass in federal reference method fine particulate matter for six eastern U.S. cities, Journal of Air & Waste Management Association, 56, 500-511

To further evaluate the impact of reducing emissions of different $PM_{2.5}$ precursors (i.e., primary $PM_{2.5}$, NO_x, SO_x, ammonia, and volatile organic compounds (VOC)) on the projected future $PM_{2.5}$ DVs, a series of model sensitivity simulations were conducted, where emissions of the precursor species were scaled by ±15% from the future year baseline emissions (in this case, emissions representing year 2025 were used as opposed to year 2021 emissions). Comparing the difference in $PM_{2.5}$ DVs from the ±15% perturbations essentially produces the sensitivity of the future year $PM_{2.5}$DVs to a 30% change in future year baseline precursor emissions. For each precursor, only anthropogenic emissions in California were perturbed. Natural emissions and emissions outside of California (e.g., Mexico) were not perturbed.

A threshold of 0.2 µg/m3 for the annual $PM_{2.5}$ DV as well as the DV portion of a precursor-specific component (see Appendix A for detail about the precursor- specific component) was used to determine the significance of a precursor to $PM_{2.5}$ formation (e.g., if a 30% change in precursor emissions leads to a change in component DV less than or equal to 0.2 µg/m^3 then the precursor is deemed not significant). Based on the sensitivity analysis, in the SJV, primary $PM_{2.5}$ and NO_x were determined to be significant precursors, while ammonia, VOC, and SO_x all are shown to be not significant.

Table 2-2 Base and projected future year $PM_{2.5}$ DVs at each monitor

Site AQS ID	Site Name	Base DV (µg/m^3)	Future 2021 DV (µg/m^3)
60290016	Bakersfield - Planz	17.3	14.8
60392010	Madera	16.9	14.4
60311004	Hanford	16.5	13.4
60310004	Corcoran	16.3	14.4
61072002	Visalia	16.2	13.7
60195001	Clovis	16.1	14.1
60290014	Bakersfield - California	16.0	13.6
60190011	Fresno-Garland	15.0	12.9
60990006	Turlock	14.9	12.8
60195025	Fresno - Hamilton & Winery (H&W)	14.2	12.2
60771002	Stockton	13.1	11.7
60470003	Merced - S Coffee	13.1	11.2
60990005	Modesto	13.0	11.2
60472510	Merced - Main Street	11.0	9.7
60772010	Manteca	10.1	8.8
60192009	Tranquility	7.7	6.5

Table 2-3 Annual RRFs for $PM_{2.5}$ components

Site Name	RRF for $PM_{2.5}$	RRF for NH_4	RRF for NO_3	RRF for SO_4	RRF for OM	RRF for EC	RRF for Crustal
Bakersfield - Planz	0.85	0.68	0.69	0.97	0.90	0.51	1.02
Madera	0.85	0.74	0.70	1.00	0.93	0.69	1.01
Hanford	0.81	0.71	0.67	1.02	0.94	0.70	0.92
Corcoran	0.88	0.70	0.68	1.04	0.97	0.76	0.95
Visalia	0.85	0.69	0.70	1.01	0.89	0.63	1.02
Clovis	0.87	0.70	0.70	1.00	0.91	0.66	1.07
Bakersfield - California	0.85	0.67	0.67	0.97	0.90	0.52	1.03
Fresno-Garland	0.86	0.72	0.72	0.99	0.89	0.59	1.05
Turlock	0.86	0.77	0.75	1.00	0.92	0.67	1.05
Fresno - H&W	0.86	0.74	0.74	0.99	0.89	0.58	1.05
Stockton	0.89	0.80	0.76	1.02	0.95	0.70	1.05
Merced - S Coffee	0.85	0.73	0.71	1.01	0.93	0.68	1.04
Modesto	0.86	0.77	0.74	1.01	0.92	0.67	1.05
Merced - Main Street	0.88	0.72	0.71	1.01	0.93	0.69	1.04
Manteca	0.87	0.81	0.77	1.02	0.92	0.68	1.04
Tranquility	0.84	0.69	0.63	1.00	0.96	0.73	1.02

Table 2-4 Base year $PM_{2.5}$ compositions*

Site	Base $PM_{2.5}$ (µg/m^3)	Base NH_4 (µg/m^3)	Base NO_3 (µg/m^3)	Base SO_4 (µg/m^3)	Base OM (µg/m^3)	Base EC (µg/m^3)	Base Crustal (µg/m^3)
Bakersfield - Planz	17.3	1.1	2.6	1.7	7.0	1.0	2.5
Madera	16.9	1.4	4.1	1.5	6.4	0.9	1.2
Hanford	16.5	1.9	5.5	1.5	4.1	0.7	1.2
Corcoran	16.3	1.2	2.9	1.5	7.4	0.7	1.2
Visalia	16.2	1.2	3.0	1.4	7.3	0.7	1.2
Clovis	16.1	0.9	2.1	1.3	8.7	0.9	1.1
Bakersfield – California	16.0	1.1	2.6	1.5	6.4	0.9	2.2
Fresno - Garland	15.0	0.9	2.2	1.1	8.0	0.8	0.9
Turlock	14.9	1.4	3.9	1.2	5.4	0.8	0.9
Fresno - H&W	14.2	0.8	2.1	1.0	7.6	0.8	0.8
Stockton	13.1	1.1	3.3	1.1	4.9	0.7	0.8
Merced - S Coffee	13.1	1.1	3.3	1.1	4.8	0.7	0.8
Modesto	13.0	1.2	3.4	1.1	4.7	0.7	0.8
Merced – Main Street	11.0	0.7	1.7	0.9	5.6	0.6	0.6
Manteca	10.1	0.9	2.6	0.8	3.6	0.5	0.6
Tranquility	7.7	0.6	1.9	0.6	2.8	0.4	0.5

* Base year PM2.5 compositions were based on PM2.5 chemical speciation measurement adjusted by the U.S. EPA SANDWICH method. Base year water and blank are not shown since they are not projected in the calculation.

Table 2-5 Projected future year $PM_{2.5}$ compositions

Site	Future $PM_{2.5}$ ($\mu g/m^3$)	Future NH_4 ($\mu g/m^3$)	Future NO_3 ($\mu g/m^3$)	Future SO_4 ($\mu g/m^3$)	Future OM ($\mu g/m^3$)	Future EC ($\mu g/m^3$)	Future Crustal ($\mu g/m^3$)	Future Water ($\mu g/m^3$)	Blank ($\mu g/m^3$)
Bakersfield - Planz	14.8	0.8	1.8	1.6	6.2	0.5	2.6	0.7	0.5
Madera	14.4	1.1	2.8	1.5	5.9	0.6	1.2	0.8	0.5
Hanford	13.4	1.4	3.6	1.5	3.8	0.5	1.1	0.9	0.5
Corcoran	14.4	0.8	2.0	1.5	7.1	0.5	1.1	0.7	0.5
Visalia	13.7	0.8	2.1	1.5	6.5	0.4	1.2	0.7	0.5
Clovis	14.1	0.6	1.5	1.3	7.9	0.6	1.1	0.6	0.5
Bakersfield - California	13.6	0.7	1.7	1.4	5.8	0.5	2.3	0.6	0.5
Fresno - Garland	12.9	0.6	1.6	1.1	7.1	0.5	0.9	0.5	0.5
Turlock	12.8	1.0	3.0	1.2	4.9	0.5	0.9	0.7	0.5
Fresno - H&W	12.2	0.6	1.5	1.0	6.7	0.4	0.9	0.5	0.5
Stockton	11.7	0.9	2.5	1.2	4.6	0.5	0.9	0.6	0.5
Merced - S Coffee	11.2	0.8	2.3	1.1	4.5	0.5	0.8	0.6	0.5
Modesto	11.2	0.9	2.5	1.1	4.3	0.4	0.8	0.6	0.5
Merced – Main Street	9.7	0.5	1.2	0.9	5.2	0.4	0.6	0.4	0.5
Manteca	8.8	0.7	2.0	0.8	3.3	0.3	0.6	0.5	0.5
Tranquility	6.5	0.4	1.2	0.6	2.7	0.3	0.5	0.3	0.5

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